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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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1851.

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

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

No. 43. JULY 1851.

I.—*Report upon the Researches of* Prof. Müller *into the Anatomy and Development of the* Echinoderms. By Thomas H. Huxley, F.R.S.

[With a Plate.]

1. Müller, Johann. Ueber die Larven und die Metamorphose der Ophiuren. *Transactions of the Berlin Academy*, 1846.
2. Müller, Johann. Ueber die Larven und die Metamorphose der Echinodermen. *Ibid.* 1848.
3. Müller, Johann. Ueber die Larven und die Metamorphose der Holothurien und Asterien. *Ibid.* 1849–50.
4. Müller, Johann. Anatomische Studien über die Echinodermen. *Müller's Archiv*, 1850, Heft ii.
5. Müller, Johann. Berichtigung und Nachtrag zu den anatomischen Studien über die Echinodermen. *Ibid.* Heft iii.
6. Müller, Johann. Fortsetzung der Untersuchungen über die Metamorphose der Echinodermen. *Ibid.* Heft v.
7. Müller, Johann. Ueber die Ophiuren-larven des Adriatischen Meeres. *Ibid.* 1851. Heft i.

We purpose in the present article to give some account of the results at which the illustrious author of the works whose titles are prefixed has arrived, in the course of a series of elaborate and patiently conducted researches in one of the most remarkable and most obscure provinces of zoological and physiological science. It is a province too in which Professor Müller is at once Columbus and Cortez. The discoverer—he has gleaned all its riches. For it so happens that Sars, the only investigator who preceded him in the study of the development of the Echinoderms, had not the good fortune to meet with instances of the ordinary course of development, but only with a case, exceptional among the Echinoderms, but differing less from the embryogenic phænomena of other animals.

Nor are we indebted to the Professor for a widening of our embryological knowledge alone. A more exact knowledge of development involved the necessity for, and at the same time furnished the key to, a more accurate idea of the adult structure of the Echinoderms.

The ordinary Echinoderms sufficiently try the patience of the anatomist; and any one who has ever endeavoured to dissect a Holothuria, must recollect the feeling of despair with which he regarded the knotted, glairy, eviscerated mass, which was too often the reward of all his care and caution. Undaunted by the great practical difficulties, however, Prof. Müller has entered into these complementary investigations (which are contained in the fourth and fifth treatises of the foregoing list); the errors, difficulties, and contradictions which formerly infested the subject have been cleared up and rectified, and the structure of the Ophiuridæ, Asteridæ, Echinidæ, and Holothuriadæ is now capable of being reduced to broad general propositions. Without by any means claiming for the celebrated Berlin physiologist the merit of discovering facts of organization, due to Tiedemann, to Valentin, to Krohn and others, it yet cannot be denied, that under his hands these facts have first assumed their due importance, and become moulded into a consistent whole. Under his authority, then, without always caring to indicate the original sources of information, we shall give the following summary of some points of the organization of the Ophiuridæ, Asteridæ, Echinidæ and Holothuriadæ, as preliminary, and indeed necessary, to a proper comprehension of their genetic phænomena.

It is not, however, necessary for our present purpose to enter upon the anatomy of any other systems of organs than the water-vascular system, the blood-vascular system, and the nervous system.

In all the families cited, the fundamental part of these three systems consists of three distinct rings, surrounding the œsophagus; the blood-vascular ring lies innermost, the water-vascular ring next, the nervous ring outermost.

The *blood-vascular* ring, besides the branches which it gives off, is always connected with two vessels which run along opposite sides of the intestine (*Holothuria*); and in Asteridæ and Echinidæ there is a distinct tubular heart which connects the vascular ring round the œsophagus with another vascular ring surrounding the anus, from which branches pass to the ovaria, &c.

Branches are given off from the principal blood-vascular ring towards the ambulacra, and in the Holothuriadæ it appears very probable that these branches accompany and indeed inclose the nerves.

The blood-vascular system is everywhere totally unconnected with the water-vascular system.

The *water-vascular* system, whose real disposition it is of great importance to understand, with reference to embryonic states, lies, it has been said, superficial to the blood-vascular system. It forms a ring, which lies close to the integument of the mouth in the Ophiuridæ and Asteridæ, surrounds the œsophagus at the base of the lantern in Echinidæ, and encircles it beneath and at some distance from the calcareous ring in the Holothuriadæ.

From this ring a series of vesicles, varying in number from four (*Ophiura*) to a hundred (*Cladolabes peruanus*), depend. These are the Polian vesicles; they open into the water-vascular ring, and appear to be in some way connected with the distribution of fluid through the water-vascular system.

Connected also with the circular water-vascular ring is the famous sand-canal, of which one or more are found in all the families enumerated. In most there is only one sand-canal, but in some Asteridæ there are several, and in *Synapta serpentina* there are a great number.

The sand-canal is a membranous tube having calcareous particles imbedded in its parietes, which are sometimes (Holothuriadæ) pierced by distinct apertures.

Now the extremity of the sand-canal may be either adherent to some part of the parietes of the animal, as in Ophiuridæ, Asteridæ, Echinidæ, or it may hang loose in the abdominal cavity, as in the Holothuriadæ. In the former case the spot to which it adheres is either entire (*Ophiura*), or perforated by many apertures which communicate with the interior of the canal (Asteridæ, Echinidæ), in which case it forms the "madreporic plate."

But in all cases it is important to recollect that the sand-canal is nothing more than a part of the water-vascular system in which a calcareous deposit has taken place.

Besides all these appendages the circular water-vessel is connected with five vessels, the water-canals, which supply the tentacles and feet and run down the sides of the body in the ambulacral spaces.

The *nervous ring* is formed by a simple cord without ganglionic enlargements, encircling the œsophagus superficial to the water-vascular ring, and giving off five cords which run with, but superficial to, the water-vascular canals in the ambulacral spaces.

The position of the water-vascular canals and of the nervous cords is apparently different in the Asteridæ from what it is in the Echinidæ, inasmuch as in the former these organs are *outside* the bony skeleton, in the latter *inside* it; but this apparent difference arises only from a difference in the mode of development of the ambulacral plates.

The ambulacral plates in the Asteridæ, *between* which the canals lead from the ampullæ to the feet, are homologous with the ambulacral plates in the Echinidæ *through* which they pass.

But in the Asteridæ the ambulacral plates develope internal processes which unite *above*, or internal to, the water-vascular canals and nerves, while in the Echinidæ the ambulacral plates unite *below* or external to the water-vascular canals and nerves.

In the Echinidæ, the only parts that represent the internal processes of the Asteridæ are the "auriculæ"—arched processes which give attachment to the suspensor muscles of the lantern, and under which the vessels and nerves pass.

In the Ophiuridæ both internal and external processes of the ambulacral plates exist, and the vessels and nerves are contained in a complete bony canal.

In the Holothuriadæ the arrangement of parts is as in the Echinidæ. The ring, composed of ten to fifteen bony pieces, encircling the œsophagus, is not homologous with any part of the skeleton of the Echinidæ, but with the lantern or masticatory apparatus.

Five of these pieces are always either notched (as in the Holothuriadæ) or pierced (as in the Synaptæ) for the passage of the water-vessels and nerves, and these pieces correspond homologically with an equal number of calcareous pieces of the lantern of the Echinidæ (falces of Valentin) which cover in the terminations of the radial water-canals in the circular canal.

Every Echinoderm commences its existence as an oval ciliated body like an infusory animalcule, without organs or distinction of parts.

In some genera, such as *Asteracanthion* and *Echinaster*, it appears from the observations of Sars, Agassiz and Desor, that such a germ as this developes at one part one, three, or four short processes or peduncles, by which it is enabled to adhere to other bodies; among these Prof. Müller thinks he has discovered an aperture. The remainder of the germ gradually enlarges and assumes the form of a starfish. The feet appear on its under side whence the peduncle or peduncles proceed. The latter become smaller, and eventually appear as mere processes on one side of the mouth of the young starfish, finally vanishing altogether.

Now in these larvæ, their inner structure and the mode in which the disc of the starfish is developed do not appear to have been clearly made out, so that points of comparison with the embryological phænomena to be described subsequently are wanting. One thing however appears evident, viz. that, as in the other forms, the axis of the starfish is oblique to the axis of the larva from which it proceeds.

The larvæ whose development has been observed by Prof. Müller are widely different.

These larvæ may be reduced to two kinds: 1st, those of the Ophiuridæ and Echinidæ (fig. 1, 2, 3); 2nd, those of the Asteridæ and Holothuriadæ (fig. 4, 5, 6, 7).

1. The larvæ of the Ophiuridæ and Echinidæ are somewhat hemispherical bodies, having one edge of their truncated side prolonged into a single flat and wide process, which carries the mouth and œsophagus.

On the hemispherical portion—not at the extremity, but on the side opposite to that which is prolonged into the wide process—is a circular anus. The œsophagus leads from the mouth, which looks in the same direction as the anus, and opens into a globular stomach placed in the hemispherical portion of the larva; a short intestine runs from this at right angles with the direction of the œsophagus to the anus.

The extremity to which the mouth is turned may be considered anterior, the anal side inferior, and it is this position which the animal has in swimming*.

In this general description of the form of the larvæ, however, some most important and characteristic features have been omitted. These are, the calcareous rods which form a sort of internal skeleton or framework, and the ciliated fringe which is the organ of locomotion.

The rods are four, eight or more in number; they run forwards, diverging from the most convex or posterior portion of the hemispherical part of the larva, and still clothed by the substance of the larva, form processes of a considerable length: some of them pass through the margins of the hemispherical part of the larva, some run through and support the buccal prolongation†.

The *ciliated fringe* is a sort of ridge, thickly covered with large cilia (which however do not exhibit the wheel motion), which forms the edge of the flat anterior side of the hemispherical part of the larva and of the buccal prolongation. It therefore passes *above* the mouth and before the anus, completely encircling the

* These determinations of anterior and posterior, &c. are altogether different from those of Prof. Müller. The mode of description adopted by the latter is quite accidental, and we have changed it to make the general homologies more clear.

† See the figure given in the 'Annals,' *ante*, vol. xix.

body in an oblique manner. It is continued forwards on one side and back on the other, upon the processes of the calcareous rods, and thereby attains a great length and complicated appearance, but fundamentally its relations are such as have been described. In some of these larvæ Prof. Müller considers that he has detected, in front of and above the mouth, a rudimentary nervous system, consisting of two little ganglia connected by a commissure, whence branches proceed*.

We have described the structure common to all the larvæ of this division; there are certain peculiarities in some, however, which are deserving of notice. Thus in some Echinus-larvæ three long processes containing calcareous rods are developed from the convex posterior extremity of the larva (fig. 3).

In other Echinus-larvæ (fig. 2) these do not exist, but four little prominences, richly ciliated, are developed on the hemispherical portion just where the long processes leave it. These are the "epaulettes" of Müller.

In Ophiurid-larvæ the convex side of the larva bears a circlet of cilia (fig. 1).

2. The second form of larvæ has no internal calcareous skeleton. It falls into two subdivisions: (*a.*) the form of the Holothuriadæ, and (*b.*) the form of the Asteridæ.

a. These larvæ, the *Auricularia* of Müller (fig. 6 & 7), are at first bean-shaped, convex on the dorsal side, concave on the ventral side. An irregular transverse fissure answers to the hilum of the bean, and in this the mouth is placed. The margins of the fissure are edged by a ciliated fringe exactly similar to that of the former kind of larvæ. The anus opens on the ventral surface of the larva, behind the fringe, the posterior portion of which runs between it and the mouth. The fringe forms a continuous circle, the anterior part of which is bent back to form the anterior margin of the fissure in which the mouth lies.

In the course of its growth the margins of the larva and the corresponding parts of the fringe are thrown into numerous lateral processes which give it a scolloped appearance.

The disposition of the intestine, stomach, &c. is as in the first kind of larvæ.

As the larva increases in size and becomes more elongated in form, the primary fringe becomes replaced by a number of ciliated rings which encircle the now cylindrical body of the larva (fig. 7).

b. The Asterid-larvæ.—The *Bipinnaria* (fig. 4), which is the commoner form of Asterid-larva, closely resembles *Auricularia* in its young condition, except that there is a distinct ciliated circle developed upon the surface of the larva in front of the mouth.

* In the Pluteus from Heligoland, but not in other larvæ.

Instead therefore of the anterior boundary of the fissure of the mouth being formed as in *Auricularia* by the recurved anterior part of the "ciliated fringe," it is formed by the posterior part of a distinct band of cilia.

It is particularly to be observed that this "band," like the extra band in the Ophiura-larva, does not encircle the body—it is altogether in front of and above the mouth.

The position of the anus is as in *Auricularia*. A variety of the Asterid-larva, described by Prof. Müller under the name of *Tornaria,* resembles this condition of *Bipinnaria,* but subsequently adds a ciliated ring like one of those of *Auricularia,* which encircles the body near the anal end* (fig. 5).

Bipinnaria increases greatly in size, attaining the length of an inch or more, chiefly by the increase of the anterior part of the body. This assumes a very extraordinary form, both the "band" and the "fringe" throwing out long processes on each side to the number of half a dozen, and at the anterior extremity they form two fin-like expansions placed one above the other.

Another Asterid-larva, *Brachiolaria* (Diag. V.), resembles *Bipinnaria* in general form, but developes three processes anteriorly between the anterior part of the ciliated "fringe" and the anterior ciliated "band."

These are all the forms of Echinoderm-larvæ enumerated by Prof. Müller. Complicated as they seem to be at first sight, it seems to us that they may all be readily reduced to one very simple hypothetical type; having an elongated form, traversed by a straight intestine, with the mouth at one extremity and the anus at the other, and girded by a circular ciliated fringe; just like the larvæ of some Annelids (fig. 9).

Supposing such to be the typical form of the Echinoderm-larva, the specific variations are readily derived from it by simple laws of growth. Let the region before the ciliated fringe be called the *pre-trochal* region, the region behind the fringe be called the *post-trochal* region.

Then the Echinoderm-larvæ would appear to be characterized by a disproportionate development of the dorsal post-trochal region (Diag. I^{a}.) whereby the anus is thrust downwards, and the dorsal part of the ciliated fringe downwards and forwards; processes are then developed from the ciliated fringe as previously described.

As in the Annelid-larvæ patches of cilia are frequently developed elsewhere than in the principal circle, *e. g.* on the sides of the

* If Prof. Müller's conjecture, that his "wurmförmige Larve" (Larven und Metamorphose der Holothurien und Asterien, p. 27) is a further stage of development of *Tornaria,* be correct, it ultimately assumes a still more worm-like shape, and more closely resembles a Holothurid-larva.

body, at the bases of the feet, &c., so in the Echinoderms, ciliated elevations and circles (not encircling the body), and even long processes (*Echinus, Brachiolaria*), are developed upon other parts of the body of the larva than the "ciliated fringe."

In the Echini and Ophiuridæ these additional parts are developed in the post-trochal region (Diag. I. II. III.); in the Asteridæ they are as invariably developed in the pre-trochal region (Diag. IV. V. VI.).

The ciliated circle of the Ophiurid-larva on the dorsal side of the post-trochal region answers precisely to the ciliated "band" on the dorsal side of the pre-trochal region of the Asterid-larva.

We have ventured here to give a general view of the Echinoderm-larvæ different from that put forth by Professor Müller himself, who, we would with all deference suggest, loses sight of the real position of the ciliated fringe in its apparent bilaterality. Speaking of the ciliated fringe he says, "We may name this circular ciliated fringe (Wimper-schnur), to *distinguish it from such as encircle the body transversely*, the *bilateral ciliated fringe*" (Metam. d. Holothurien u. Asterien, p. 35).

We maintain that this "bilateral" fringe itself does, in truth, encircle the body transversely, however distorted it may have become, and the reader is referred to the diagrams for a demonstration of the truth of this position.

A strong confirmation of this opinion is afforded by the structure of the larva of *Sipunculus* described by Max. Müller (Müll. Archiv, 1850, v.). (Fig. 8.)

In this remarkable larva there is a single even band of strong cilia which encircles the anterior part of the animal, and evidently represents the "ciliated fringe" of the other Echinoderm-larvæ. Except that the intestine is bent upon itself, it agrees precisely with our hypothetical type of the Echinoderm-larva.

The Echinoderm larva, we repeat, may be considered as an Annelid-larva, which has become distorted by the excessive development of the dorsal part of its post-trochal region*.

Out of these larvæ, all of which have a strictly bilateral symmetry, the more or less radiate adult Echinoderms are developed by a process which is a sort of internal gemmation.

Now the result of this process is twofold; either the new

* The only other animals which possess a larva at all resembling that of the Echinoderms and Annelids are certain Trematoda (see Müller, Ueber eine eigenthumliche Wurmlarve aus der Classe d. Turbellarien, Müll. Arch. 1850). Here it would appear that by an excessive development of the pre-trochal region, the ciliated fringe has the concavity of its bend posterior; but the difficulty, from the absence of an anus, of determining the real axis of the body, renders this determination doubtful.

structure ultimately throws off more or less of the larva in which it was developed, or it unites with the larva to form the adult animal, no part being thrown off.

The former is the case in the Ophiuridæ, Echinidæ and Asteridæ, for the most part—the latter in the Holothuriadæ.

The latter process, as the simpler, shall be described first.

A portion of the dorsal integument of the larva becomes as it were thrust inwards (fig. 10.) towards one or other side of the stomach, as a tube terminated by an enlarged globular extremity, whose cavity communicates with the exterior and is ciliated internally.

The vesicle which terminates this "internal bud" now sends forth processes so as to form a sort of "rosette," which lies close to and above the stomach.

The "rosette" becomes a circular canal (the circular canal of the water-vascular system), from which cæca are given off anteriorly to form the tentacles, posteriorly to the parietes, in which they become the water-canals.

The former mouth of the larva is obliterated, and a new one is formed in the centre of the circular canal and its tentacular appendages. This is the permanent mouth of the Holothuria, which is therefore *a new structure formed upon the dorsum of the larva.*

In the meanwhile, vesicles, the Vesiculæ Polianæ, are developed from the circular canal, and a deposit of calcareous matter takes place round a portion of the tubular canal, from whose spherical extremity the water-vascular system has been formed. That portion of the tubular canal which lies between the dorsal parietes and the calcareous deposition dies away, and the remainder hangs freely from the circular canal of the water-vascular system as the "sand-canal."

The process in the Echinidæ, Asteridæ, and Ophiuridæ is essentially the same; only, as in these the old body is to be more or less completely discarded, the development of the water-vascular system is attended, *pari passu*, by that of a mass of cells from which the new body is to be formed.

We cannot do better than adduce in illustration Prof. Müller's description of the development of the Echinoderm in the Asterid-larva *Bipinnaria* (Fortsetzung der Untersuchungen über die Metamorphose d. Echinodermen, Müll. Archiv, 1850).

In larvæ which are not 0·15 of a line in length, the dorsal pore and the tube which proceeds from it are perceptible. It passes into a longish sac, in which, as in the tube, there is a ciliary motion. The sac lies behind, at the side of the œsophagus (Diag. IX.).

Soon after the appearance of these parts, a hyaline mass, in which very small cells are imbedded, is seen lying like a mantle upon the dorsal side of the stomach.

The sac becomes developed into a rosette of five cæca, the first foundation of the water-vascular system.

The mantle-like mass curves over and covers in the stomach and foundation of the tentacles like a cap, widely open below. The dorsal pore becomes invested by it, and it extends round the anus; but the œsophagus remains outside it (Diag. XI.).

A crest or elevation now appears on the mantle-like mass, and runs obliquely over it in a curved line, whose ends become eventually united. It then forms the margin of the starfish.

What lies beneath this thickened margin belongs to the dorsum of the starfish, what lies above it to its ventral surface.

The young starfish now attains a diameter of $\frac{1}{7}$th of a line, becomes slightly pentagonal, and retains only a narrow connexion with the *Bipinnaria*.

The digestive canal, and with it the rosette-like rudiment of the water-vascular system, becomes turned so as to present the latter towards the ventral surface of the starfish, at that point where its mouth is subsequently formed. The tube which connected the rosette with the pore, which is now imbedded in the dorsal surface of the starfish, receives a calcareous deposit and becomes the sand-canal, while the "pore" is converted into the madreporic plate.

The œsophagus of the larva is obliterated, whilst its rectum projects as an anal tube subcentrally from the dorsal surface of the starfish (Diag. XIII.).

The slightest touch now separates the starfish from the larva in which it was developed; the former sinks to the bottom and creeps by the aid of its newly-developed feet; the latter swims about as before for some time, but eventually perishes.

In the Echinidæ the process is essentially the same. An internal diverticulum of the integument of the larva is formed, but from a somewhat different spot*, namely in front of the ciliated fringe and on one side. It is connected with a vesicle which lies close against the œsophagus, and from which the water-vascular system is developed.

At this place the shell of the *Echinus* subsequently makes its

* It is remarkable that in the Asterid-larvæ, while the development of accessory ciliary processes, &c. takes place in the pre-trochal dorsal region, the bud of the Echinoderm is developed from the post-trochal region. In the Echinus-larvæ we have just the reverse—the bud is developed from the pre-trochal region ("below the lateral arch of the ciliated band," Müller), while the processes, &c., as we have seen, are developed from the post-trochal region. The Ophiuræ appear to present the same relations as the Echinidæ, though Prof. Müller has not been able to make out the point with certainty.

appearance as a circular disc, which gradually envelopes the stomach, and developes tentacles and spines. A new anus is formed as well as a new œsophagus, in the young sea-urchin.

The development of the Ophiuridæ has not been traced so far back as that of the other groups. The dorsal pore and tube have not been observed; but the development of the "rosette" and its accompanying mass of cells into the Echinoderm takes place as in the Asteridæ.

The observations of Dr. Busch (Müll. Arch. 1849) have shown that the larva of *Comatula* very early assumes the form of the Holothurid-larva with ciliated rings, but its internal structure and the development of the Echinoderm are not understood.

To sum up, in Prof. Müller's words, the variations of the metamorphosis of Echinoderms:—

"1. The change of the bilateral larva into the Echinoderm takes place when the larva yet remains an embryo, and is universally covered with cilia, without a ciliated fringe. A part of the body of the larva takes on the form of the Echinoderm; the rest is absorbed by the latter. (A part of the Asteridæ, *Echinaster, Asteracanthion*, Sars.)

"2. The change of the bilateral larva into the Echinoderm takes place when the larva is perfectly organized; that is, possesses digestive organs and a special ciliated fringe. The Echinoderm is constructed within the Pluteus like a picture upon its canvass, a piece of embroidery in its frame, and then takes up into itself the digestive organs of the larva. Hereupon the rest of the larva vanishes* (*Ophiura, Echinus*), or is thrown off (*Bipinnaria*).

"3. The larva changes twice. The first time it passes out of the bilateral type with lateral ciliated fringe into the radial type, and receives instead of the previous ciliated fringe, new locomotive larval organs, the ciliated rings. Out of this pupa-condition the Echinoderm is developed without any part being cast off (*Holothuria*, some Asteridæ).

"If we call embryonic type the condition in which the animal leaves the egg, and when the internal organs are not yet developed, we have four stages or types—the embryonic type, the larval type, the pupa type, and the Echinoderm type. The animal may pass from either of the first three forms into the Echinoderm, or may run through them all." (Larven u. Metam. d. Holoth. u. Asterien, p. 33.)

Furthermore it may be stated that the nature of the change

* It seems questionable how far the integument of the larva over the Echinoderm can be said to vanish, when it is remembered that the pedicellariæ are developed thereon while the Echinoderm is still quite rudimentary.

here called development of the Echinoderm, is, that a process of the integument of the larva grows inwards and lays the foundation of the future water-vascular system, on which the other organs of the Echinoderm, whether nervous, vascular or tegumentary, are in a manner modelled*.

It is of very great importance to remember this fact in considering the homologies of the parts of the Echinoderms.

If the larva of the Echinoderm pursued its normal course of development, it is obvious that its nervous system, for instance, would be homologous in form and position with that of other Annulose forms. There would be a ring with cerebral ganglia round the œsophagus and a chain of ganglia proceeding therefrom, if the nervous system were of the type of the Annelids. Or if it resembled that of the Trematoda, there would be an œsophageal ring with two opposite ganglia, from which a cord would proceed on each side of the body. But the nervous system of the adult Echinoderm can be reduced to neither of these types; it consists invariably in the Ophiuridæ, Asteridæ, Echinidæ, and Holothuriadæ, of a circular or pentagonal cord surrounding the œsophagus (*of the Echinoderm*) without distinct ganglia. From this five cords proceed, in a perfectly radiate manner, following the course of the water-canals.

The study of development renders the reason of this discrepancy obvious. The œsophagus of the Echinoderm is not homologous with the œsophagus of the larva, nor with the œsophagus of an Annelid, and therefore the nervous ring of the Echinoderm is not homologous with the nervous ring of the Annelid. Indeed, since the mouth of the Echinoderm answers homologically to an aperture in the dorsal wall of the stomach of the larva, and since the nervous system of the Echinoderm follows exactly in its form the form of the water-vascular system of the Echinoderm, which is essentially a process of the dorsal integument of the larva, we might be tempted to conclude that the nervous system of the Echinoderm is homologous, not with the ordinary ganglionic chain of an Annelid, but with that elaborate system of dorsal-proboscidean nerves which M. Quatrefages has detected and described in the latter.

The fact that these nerves supply eye-spots would indeed present some difficulties in the way of this hypothesis, if this system of nerves in the Annelida is truly stomatogastric. But in the first place it has not been shown so to be; and in the second place, the existence of well-organized eyes supplied by nerves from the ordinary ventral ganglia in each segment of *Poly-*

* Hitherto we have chiefly quoted Prof. Müller, but for what follows we must be considered alone responsible, unless direct mention be made to the contrary.

ophthalmus, would lead us to hesitate in drawing any very strict conclusions from position and structure to function, in the nervous system of these animals *.

Yet one word upon the bearing of the facts of development now made known, on the affinities of the various groups of Echinoderms.

If we were to arrange the Echinoderms according to the nature of their larvæ, we should have one group formed by the Asteridæ, Holothuriadæ and Crinoideæ (*Comatula*); and another composed of the Ophiuridæ and Echinidæ. And if the acute speculation of Prof. E. Forbes, that the pectinated rhombs of the Cystideæ answer to the "epaulettes" of the Echinus-larva, be correct, then the Cystideæ would, as a sort of permanent form of Echinus-larva, fall into the latter group, in which they would represent the Crinoideæ.

Interesting as are the phænomena presented by the larvæ of the Echinoderms, taken in themselves, as mere facts, they are far more important in their bearing upon one of the most comprehensive and interesting zoological theories of modern times—we refer to the theory of "the alternation of generations." Founded by Chamisso and Eschscholz, extended to a great number of new cases by Steenstrup, and finally reduced to a fixed and definite scientific form under the name of "Parthenogenesis" by the celebrated Hunterian Professor of Comparative Anatomy, this theory has bid fair to unite all the aberrant generative processes of the Invertebrata (those of the Echinoderms among the rest) under its conditions, and to express them in its terms.

The theory may be generally expressed thus: 1. The ovum produces an individual A^1, whose offspring is another individual B dissimilar to A^1. This again may in the same way produce an individual C, and so on. The last of the series only contains generative organs from which ova are formed, and these reproduce an individual A^2 precisely resembling A^1. The species therefore is said to be represented by a number of generations of individuals which regularly alternate with one another.

To this Professor Owen adds—

2. That the individuals B, C, D, &c. which intervene between the sexual individuals A^1 and A^2 are always developed from masses of cells which are the immediate and unchanged descendants of the embryo cells of the ovum, and which as such, retain a portion of the original "spermatic force," whence they are enabled to attain a certain independent development without a renewal of the spermatic influence.

* Again, the eyes of the Acephala are as much supplied from the palleal or visceral ganglion as from the cerebral ganglion.

Now the questions to be decided before the alternation theory can be said to apply to the Echinoderms or any other animals, are different as regards the two portions of the theory. The problem as regards the first question is a matter of naming—as regards the second it is a matter of fact.

We have said that the question involved in the first part of the theory is a question of naming. It is, whether we can apply to A, B, C, &c. in the foregoing instance, the name "individual." For it is quite clear that if they cannot with propriety be called "individuals," their succession cannot be called an "alternation of generations," inasmuch as generations are composed of individuals.

We must carefully bear in mind that this inquiry has nothing to do with the thorny problem of psychical individuality. With that the zoologist has no concern; his science investigates the laws of animal form, and in psychological questions he has no more *direct* interest than the astronomer has in the zoology of the planet Saturn.

Leaving psychological considerations aside, then, and inquiring into the *zoological* meaning of the term "individual," we find that anything to which it is applied among the higher and the greater part of the lower animals, has two principal characters: first, it has an independent existence; and secondly, it is the total result of the independent development of a single ovum.

Now the forms A, B, C, described as "individuals" by Steenstrup, have only one of these characters (in the most strongly marked cases of "alternation"), that of independent existence; for each of them is only *part* of "the total result of the development of a single ovum."

But in predicating "individuality" of any animal which does not "alternate," we predicate both these characters of it.

Hence, unless the meaning of the term "individual" be altered, the advocates of the alternation theory commit the capital error of using the same term in two very different senses, according as they speak of a Hydra or a Campanularia, a Salpa or a Cynthia.

It is only by narrowing the meaning of the word "individual" to mere "independent existence," that it can possibly become applicable in Steenstrup's sense. But in this case spermatozoa, spermatophora, and even cancer cells, would equally be "individuals." So that the new meaning would be not only entirely arbitrary, but opposed to the general sense of zoologists.

We propose on the other hand not to alter the ordinary zoological meaning of the word "individuality," but merely to define it more strictly, and give to the relative value of the attributes which it connotes, and which are conversely a mark of it.

Individuality has so long and so obviously, among the higher animals, been observed to be accompanied by independent existence, that the latter attribute has come to be considered as, conversely, an indication of individuality—to the neglect of the really characteristic attribute, which is—the circumstance of being the total result of the development of a single ovum.

According to our view, then, the zoological individual = the total result of the development of a single ovum, whether this total result consist of one or many independent existences. The individual is the zoological unit, and its value is the same, whether we have it as (1) or as $(\frac{1}{3}+\frac{1}{3}+\frac{1}{3})$. A fraction does not become equal to the unit by standing alone. The Cyanæa and the Polype from which it proceeds, the two forms of Salpæ, the parent nurses, nurses, and Cercariæ, of the Distomata, are not distinct individuals—are not separately equivalent to an individual beetle or dog.

It is their sum only, which is equivalent to the individual among the higher animals.

They are not the individual, but are successive forms by which the individual is manifested; standing in the same relation to the individual, as the incarnations of Vishnu to Vishnu, in the Hindoo theology.

What then may these independently existing "parts of individuals" be properly termed? They can hardly be called organs, without doing violence to our ordinary acceptation of the nature of an organ, in which a certain subserviency and dependence is understood. The term "*zooid*" has been devised; and as it has no theoretical meaning, but is merely intended to suggest two indisputable facts with regard to the creatures to which it is applied—namely that they are like individuals, and yet are not individuals, in the sense that one of the higher animals is an individual—its use does not appear to be open to any serious objection.

Instead of saying then, that in a given species, there is an alternation of so many generations, we should say that the individual consists of so many zooids.

Again, where no "alternation" takes place, the individual = the sum of its organs; where there is alternation, the individual = the sum of its "zooids."

If the view we have taken be correct, the whole doctrine of the so-called "compound animals" must be revised, and their terminology altered. A whole tree of Sertularia, a Pennatula, a Pyrosoma, a mass of Botrylli, must no longer be considered as an aggregation of individuals, but as an individual developed into many zooids.

And if the term "compound animal" is to be retained in its old meaning, we know of only one creature which is entitled to the name, viz. the *Diplozoon paradoxum,* which Von Siebold has just shown to be really formed by the fusion of two previously distinct individuals.

We hope that the reader will pardon this long digression into the regions of abstract thought. Whether he adopt our view or not, we trust that at any rate, we have pointed out where the real battle of the alternation theory lies.

The onus of giving a new meaning to the word "individuality" must rest with the advocates of the alternation theory; we have endeavoured merely to make a consistent extension of the old meaning to embrace new facts.

The Echinoderms have been included under the "Alternation theory;" but, if the reasoning above be correct, unjustly, as is indeed plainly pointed out on other grounds by Prof. Müller in his second memoir. He justly observes that the process of development of the Echinoderm partakes as much of the nature of metamorphosis as of "alternation." The larva and the Echinoderm cannot be said to be two individuals, when they possess the same intestine.

Nor, as to the question of fact, does the development of the Echinoderm appear to be a case of "Parthenogenesis."

The structure of the integument of the larva, at the place where the tubular rudiment of the Echinoderm is subsequently formed, is quite undistinguishable from that of any other spot. There are here no descendants of the embryo-cells specially set aside to become developed into the new structure*.

The development of the Echinoderm is then neither a process of "alternation of generations" nor of "Parthenogenesis," but the individual consists of two zooids—a larva-zooid and an Echinoderm-zooid, the latter of which is developed from the former by a process of internal gemmation†.

* The elongated cellular masses which exist on each side of the digestive canal in the larvæ, are very possibly the immediate descendants of the embryo-cells. But Prof. Müller leaves it very doubtful, whether these masses have anything to do with the development of the Echinoderm. Certainly they are not concerned in the development of one most important part of it—the water-vascular system. See Müll. Arch. 1850, p. 466. *Ibid.* 1851, p. 4.

† According to Prof. Müller (Archiv, 1851, p. 18) the development of the Echinoderm can only "figuratively" (bildlich) be compared to gemmation, inasmuch as the "formative mass" arises independently.

But since he says immediately afterwards that "the rudiment of the water-vascular system, in general, arises before the rudiment of the parietes of the Echinoderm," and since he shows elsewhere that the origin of the water-vascular system is by the development of a bud-like process inwards—the process may, we think, be called gemmation in much more than a figurative sense.

The development of the Echinoderms is, as Prof. Müller observes, exactly intermediate between the ordinary process of metamorphosis by ecdysis in insects and the so-called "alternation" of the Trematoda and Aphides.

The phænomena of alternation, or as we have called it, "zooid development," take place in two ways—by external gemmation and by internal gemmation.

The former process is confined to the Polypes and Ascidians, which form a series leading from the lowest Radiate to the Molluscous types. The latter process on the other hand is restricted to the Worms and Echinoderms, which form a series leading from the lowest Radiate to the Annulose types.

Now in each series three modifications may be detected. The deutero-zooid is developed either—1. from a complete segment of the protozooid, when it is difficult to say whether the process is one of internal or external gemmation; or 2. from a small portion of a segment, including a portion of the digestive canal; or 3. from a small portion of a segment, an entirely new digestive canal being formed.

The following table will illustrate the relations of these modifications to one another:—

Zooid Development by

	External Gemmation.	*Internal Gemmation.*
3.	Salpa	Aphides. Trematoda.
2.	Campanularia, Corynidæ, &c.	Echinodermata.
1.	Cyanæa.	Tænia. Nais.

We have hitherto considered the various zooids of each form to be complementary to one another, and all necessary to the perfect manifestation of the individual.

But the law of "irrelative repetition" long since established elsewhere by Prof. Owen, is illustrated here in the development of zooid forms where they are not necessary to the manifestation of the individual.

In the Echinoderm there is one larval-zooid and one Echinoderm-zooid—the "individual" would be incomplete without either.

But in the Cyanæa the single Scyphistoma-zooid developes perhaps twenty Cyanæa-zooids, any one of which would have been sufficient to complete the individual.

The development of the hundreds of polypes of a Sertularian appear to be referable to a similar law. Nay, the "generation by gemmation" of a Hydra or a simple Ascidian, and the fission of a Microstomum, seem, strictly speaking, to be phænomena of the same kind.

As in these cases, however, it is impossible when once the gemma is separated from the parent stock to distinguish it from a true individual, it may seem pedantic and unnecessary to insist upon the distinction.

In concluding, we cannot refrain from remarking upon one character of Professor Müller's researches, of which our imperfect notice can give no idea,—it is the singular candour and philosophic impartiality of the writer. In the course of five years, much that seemed probable at first, had, later, to be rejected—much that seemed certain, to be overthrown. It was often necessary to make pretty hypotheses give way before stubborn facts—to re-examine conclusions that had seemed unquestionable.

If any one be curious to know how this has been done, and desire at the same time to learn in what spirit scientific investigation should be conducted, we cannot do better than refer him to the works whose titles head this Report—they are models.

EXPLANATION OF PLATE I.

The figures numbered with the Arabic numerals all represent really existing forms, and are taken, with the exception of figures 8 and 9, from Professor Müller's memoirs. The "calcareous rods" are omitted for the sake of clearness.

The figures numbered with the Roman numerals on the other hand are all to be considered merely as diagrams. They represent what the Echinoderm-larvæ would be if they were, as it were, straightened out and reduced to their simplest elements.

Fig. I.[a] is given in order to show how a symmetrical Annelid-like larva, fig. I., may by development of some of its parts at the expense of others become converted into the Ophiura-larva, fig. 1.

Fig. 1.	Ophiura-larva	I.	The corresponding diagram.
Fig. 2.	Echinus-larva with "epaulettes"	II.	Ditto.
Fig. 3.	Echinus-larva with spines viewed from behind.	III.	Ditto.
Fig. 4.	Asterias-larva (*Bipinnaria*), very young.	IV.	Ditto.
	Brachiolaria, an Asterias-larva...	V.	The diagram only is given.
Fig. 5.	*Tornaria*, probably an Asterias-larva.	VI.	The corresponding diagram.
Fig. 6.	*Auricularia*, the Holothuria-	VII.	Ditto.
Fig. 7.	larva in its two forms	VIII.	Ditto.

In all the figures of larvæ the mouth and anus are indicated by the letters *m* and *a*, and the cilia are disproportionately large so as to render the "fringes" and "bands" evident.

The Diagram No. I. is similarly lettered, and all the other diagrams have their anterior and posterior extremities in a position corresponding to it.

Fig. 8. is the larva of *Sipunculus* after Max. Müller.

Fig. 9. The larva of an Annelid after Milne-Edwards.

Fig. 10. *Auricularia.* The larva of Holothuria, after Müller; to show the mode of development of the water-vascular system, &c. from the internal bud, *d*: *e*, the oval masses of cells.

Fig. 11. One of the epauletted Echinus-larvæ, in which the Echinoderm, *d*, has already begun to envelope the stomach of the larva.

IX. X. XI. XII. XIII. are diagrams intended to represent the mode of development of an Asterias within its larva the *Bipinnaria*.

The form of the latter is not given; its relation being indicated only by the dotted line.

IX. *m*, the mouth of the larva; *a*, its anus; *d*, the bud-like commencement of the Echinoderm.

X. XI. The latter has developed the water-canals, and with its accompanying blastema has begun to invest the stomach of the larva.

XII. The investment nearly complete. The position of the mouth of the Asterias indicated by (*o*).

XIII. The Echinoderm has become free and separate from the body of the larva with its primitive œsophagus.

It is to be understood that these diagrams do not pretend to be strictly accurate. They are intended only to render the process of development more easily comprehensible.

II.—*Report on* MM. L. R. *and* C. Tulasne's "*Memoir on the History of the Hypogæous Fungi.*" By MM. Jussieu and Ad. Brongniart*.

The mode of vegetation and reproduction of the Fungi had long been one of the most obscure portions of the vegetable kingdom, and, in spite of the progress of this department of botany during the last fifty years, many points yet remain to be cleared up; but in this vast class, the anomalous organization of which has caused some naturalists to regard them as a kind of peculiar kingdom, nothing perhaps is more singular than the development of the subterranean Fungi, the whole life of which, the growth and reproduction, goes on in the bosom of the earth, without any portion of their structure coming to the surface.

This existence, entirely removed from the action of light, is an anomaly even among the plants of the Fungous class, which, generally speaking, prefer weakly illuminated situations; for ordinary Fungi cannot live in complete obscurity without becoming profoundly altered in form and structure, and being kept imperfect and sterile. Light therefore, although in less degree necessary to Fungi than to ordinary vegetables, is almost always indispensable to their regular development at least at the period of reproduction.

For a long period the common Truffle, and a few other equally

* Comptes Rendus, Dec. 30, 1850.

edible species, were the only Fungi in which this unusual mode of existence had been recognized. Thus, at the beginning of this century, Persoon, in his 'Synopsis Fungorum,' described only four species, and in 1822 M. Fries enumerated only twelve species, distributed into four genera.

In 1831 however, the study of the numerous edible species of northern Italy led M. Vittadini of Milan to a more minute examination of these Fungi, and to the investigation of those species of this group which are not available for food; through this, the total number was raised to sixty-three species, arranged in thirty different genera, eight of which were established by this author.

The microscopic examination of these very diversified forms led that able botanist to the recognition of an exceedingly varied organization, the modifications of which threw light, reciprocally, on the obscure and often difficultly comprehensible structure of these Fungi.

But since the anatomical organization, and above all the reproduction of Fungi in general, were at this period enveloped in so much obscurity, the good optical instruments and modes of preparation adapted to microscopic observations of this kind were still confined to so limited a circle, and so far removed from that degree of perfection they have since attained, it is not wonderful that Vittadini, notwithstanding the progress which he caused in this branch of science, left many points to be cleared up and more completely studied.

The important discoveries made a few years later in the different modes of formation of the spores or reproductive bodies of the Fungi with external and superficial fructification, such as the Agarics, the Boleti, the Morels and Pezizas, soon led several botanists to the recognition of these same diverse modes of formation of the spores in the Fungi with internal fructification, the reproductive bodies of which are developed in the cavities of a peridium or common envelope.

Those observations on the common Lycoperdaceæ, which we owe to Messrs. Berkeley, Klotsch, Corda, and in part to Messrs. Tulasne themselves, at once threw light upon the often rather obscure descriptions of M. Vittadini; new examinations demonstrated in fact that the subterraneous Fungi, analogous in their mode of growth to the Truffle, are referable, in accordance with the structure of their reproductive organs, and as Vittadini had already detected, to two essentially different types.

In one type, the *Hymenogastreæ*, the interior of the fleshy mass of which they consist, presents a number of sinuous cavities lined by a membrane analogous to that which clothes the gills of the Agarics, and the superficial cells of which each produce at their free extremity three or four spores, becoming successively detached, and finally filling the cavities.

The other type, comprising the true Truffles and forming the groups *Tuberaceæ* and *Elaphomyceæ,* also present a fleshy mass, the outer surface of which constitutes the common envelope or peridium, while the numerous narrow, sinuous, not very distinct cavities are lined and in part filled up by a special tissue, mingled with cells of a peculiar form, producing in their interior three or four or from six to eight spores, like the thecæ of the *Pezizeæ.*

Thus in the hypogæous as in the ordinary Fungi, there are two different modes of formation of the spores; in the one class these reproductive bodies are developed upon the external surface of special cells called *basidia* or sporophores; in the other they are formed in the interior of particular cells named *thecæ* or *sporangia.*

This difference in the mode of production of the spores had already been shown by M. Vittadini's observations and figures, although he sought to explain it by an accessory modification of a single kind of organization. It was established in a much more positive manner in different groups of Fungi by various authors of more recent date, by Messrs. Leveillé, Klotsch, Berkeley, and Messrs. Tulasne themselves in various memoirs. It now forms the basis of the divisions both of the hypogæous and of the ordinary Fungi.

But many essential points in the very obscure life of these strange plants still remained to be elucidated.

The discovery of numerous species, the comparison of their form, of their organization, their distribution into well-defined genera, in a word, the natural history properly so called of this curious subterranean flora, has not only resulted in increasing the catalogue of organisms of this kind; these discoveries have, in addition, allowed of a better appreciation being arrived at of their mode of existence, development and reproduction; for this diversity of organization has yielded the solution of questions which would have been very difficult to answer from the study of a small number of species. How many physiological questions have been cleared up in this way by the examination of varied forms of the inferior members of the scale of organization!

The well-directed investigations of Messrs. Tulasne, in the neighbourhood of Paris and in different parts of France, have, in the first place, enabled them to extend the list of these plants greatly; thus, while M. Vittadini, in 1831, indicated only sixty-three species, distributed into thirteen genera, Messrs. Tulasne have carried the number to a hundred and forty-four species comprehended in twenty-five genera, and have added seventy-one of these species to the French flora.

The repeated examination of the structure of many of these plants in different stages of growth, has conducted them to very interesting results, throwing much light upon the life of subterranean Fungi.

It has long been known that in the ordinary Fungi, the fleshy body, of such varied form, commonly considered as forming the whole of the fungus, is only an external development, a temporary product, analogous to certain compound fruits, originating from a filamentous, byssoid, irregular mass extending beneath the surface of the soil or in the interior of the bodies supporting these vegetables, comparable to the subterraneous stems of various plants; this mass, called the *mycelium* or *thallus*, is what, under the name of *Mushroom spawn*, is commonly used for the reproduction of the Mushroom in beds.

All Fungi when carefully examined presented this filamentous mycelium, concealed before the formation and what may be called the expansion of the Fungus; the Truffles however seemed to be devoid of it, and several authors, whose opinions had been hastily received, had supposed that the Truffles were produced directly from the spores of these plants, called by them *truffinelles*, which became increased and dilated in all directions.

Facts observed by Messrs. Tulasne in genera closely allied to the Truffles had already rendered this view, altogether hypothetical, inadmissible. Thus, in *Balsamia*, a genus very close to the true Truffles, Messrs. Tulasne had observed the spores during germination, emitting, like those of other Fungi, delicate ramified filaments, which, by their interlacement, would form the mycelium, destined to reproduce, subsequently, new fleshy bodies, the true fructification of these vegetables. In *Delastria* and *Terfezia*, other genera of this tribe, and better still in the *Elaphomyces*, which are a little removed, this mycelium reproducing the fleshy body which constitutes the Fungus properly so-called, persists for a long time around it, and by its presence proves that these subterraneous Fungi, so near to the Truffles, do not differ in this respect from ordinary Fungi.

It might therefore have been assumed with nearly perfect certainty, that the Truffles proper also possessed a mycelium, producing these fleshy and fungous bodies, but quickly decaying and allowing them to continue to grow in an isolated condition. This has been actually demonstrated, in observations carefully made by M. L. R. Tulasne in the Truffle grounds of Poitou, who has seen the soil in which they grow traversed, in the course of September, by numerous white, cylindrical filaments, much finer than common sowing thread, yet themselves composed of articulated microscopic filaments three to five thousandths of a millimetre in diameter. These white threads are continuous with a byssoid, flocculent mycelium of the same nature, which envelopes the young Truffles and forms immediately around them a sort of white felt several millimetres thick, the filaments of which are directly continuous with the external layer of the young Truffle, scarcely so large as a nut at this epoch. In a short time the gradual destruction of this byssoid envelope commences; at first a part, then the whole is lost, and the Truffle appears completely isolated in the soil.

Thus, that which was indicated by analogy is confirmed by direct observation, and it is seen that the Truffles, like the other Fungi, are reproduced by spores which give origin to a filamentous mycelium, the source of new Truffles. These facts, important in a scientific point of view, from the uniformity they establish in the mode of existence of the whole of a large class of vegetables, may, like many other scientific discoveries, one day become a source of useful applications.

These singular plants, thus isolated in the midst of the soil at the epoch of their reproduction, without apparent external organs, nevertheless exhibit internally a structure much more complicated than was at first supposed. The observations of M. Vittadini had already indicated the curious arrangement of the black and white veins which traverse the tissue of the Truffles, and these had been mentioned by the earliest observers; but the more varied and more precise investigations of Messrs. Tulasne have shown much more clearly their relations and destination. When young, the Truffles exhibit very irregular sinuous cavities, partly communicating with each other and terminating, sometimes at a single orifice corresponding to a depression or umbilicus on the outside, sometimes at several points of the surface which present no distinguishable character externally. As they advance in age, the partitions which separate the cavities become thickened, the tissue composing their surface is developed into a kind of white tomentum which obliterates them; hence result two systems of veins; one set coloured, corresponding to the partitions which separated the primitive cavities, the other white, formed by the filamentous tissue which finally fills these cavities.

The former are continuous with the external tissue which composes the envelope of the Fungus, or peridium; in their middle portion they are formed of a network of filaments or elongated cells, running in the direction of the cavities; from this arise shorter filaments, almost perpendicular to the first, and the inflated extremities of these become the sporangia, or sporigenous cells; the deep colour is due to the black or brown colour of the spores. The other veins, the white ones, appear to be formed of the prolongations of sterile filaments, intermingled with sporigenous cells, and originate like them from the primitive partitions.

The veins composed of these filaments and the air interposed, owe to this structure their dull white appearance, and opacity when their tissue is examined in thin slices by transparent light, under which circumstance they appear darker than the tissue filled with liquid forming the coloured veins. These aëriferous white veins terminate at the external surface, either at a single point to which all converge, or at several distinct points.

In these plants, therefore, so shapeless and simple in appearance, is formed a double system of veins, or rather of irregular filamentous lamellæ; one set arising from the cortical tissue, absorbing the surrounding moisture and serving to transmit this humidity to the cells in which the spores are formed, being therefore the organs of nutrition; the others, remarkable for their white colour and opacity, terminating externally, introducing air into all parts of the Fungi and bringing it into contact with the sporigenous cells themselves. This communication of the external air with the internal lacunæ of the Fungus is much more evident in the Truffles and in certain other *Tuberaceæ,* than in the other hypogæous Fungi, where the lacunæ analogous to those of the Truffles, although filled with air, do not appear to communicate with the exterior.

The formation and structure of the spores have also been the objects of very interesting researches by Messrs. Tulasne. In all the true *Tuberaceæ,* the spores are developed freely in the cavities of the sporangia, or vesicular cells destined to produce them. They are limited in number, and not very variable, in each of these sporangia; more than eight are never formed in one vesicle, and in many species the maximum number is four.

These spores exhibit very varied forms, according to the genera and species in which they are observed, but are perfectly constant in the same species. This diversity however depends almost solely upon the structure of the external membrane or *epispore,* sometimes smooth, sometimes with points all over, or variously reticulated. Beneath this external, coloured and rather resisting membrane, is found a second integument, smooth, transparent, more or less thick, but strongly resisting chemical agents, and not only colourless in its natural state, but not coloured by the action of iodine, and easily separable from the external integument by various reagents. The simple cavity of this internal utricle of the spore is filled with oleaginous globules suspended in a liquid which is probably albuminous, and is coloured yellow or brown by iodine.

These reproductive bodies, although less simple in their structure than has been sometimes supposed, are still far from representing on a small scale the organization of the Truffle itself, as Turpin supposed; their structure is not more complicated than that of the spores of many other Fungi, and particularly of the *Uredineæ,* already very well examined in this respect by Messrs. Tulasne several years ago.

This idea of a kind of identity between the structure of the spores of the Truffles and the Truffle itself which they are to reproduce, was founded on an analogy of form and colour which exists only in few species, and on the hypothesis that the spores increased in all directions to form the fungous mass of the Truffle; but as we have seen, this very improbable hypothesis is completely subverted by observation of the germination of the spores of *Balsamia,* and by that of the existence of a mycelium around the Truffles themselves while they are young.

The precise knowledge of the varied and complicated structure of these subterranean Fungi, the observation of the different phases of their life, if not in the same species, at least in plants sufficiently allied to admit of analogy guiding us with safety, enable us now therefore to appreciate the manner of the nourishment, growth, and reproduction of these plants, so imperfect in appearance that their mode of existence was long concealed from the observations of naturalists, and of which, a quarter of a century ago, there was but a distant idea of the variety of organization and the considerable number of species.

Thanks to the extensive and profound researches of Messrs. Louis René and Charles Tulasne, this group of Fungi, which so many causes rendered it particularly difficult to study, may now be considered one of the best known; for to the general anatomy and the physiological facts, of which a brief analysis is above given, are adjoined a detailed monograph of all the species of subterranean Fungi known at this time, and excellent figures representing most of those species and the most minute details of their organization.

III.—*On the Anatomy of* Antiopa Spinolæ, *a Nudibranchiate Mollusk.* By Albany Hancock, Esq.

[With two Plates.]

This paper treats of the anatomy of an animal which was discovered by M. Verany on the shores of Italy, and was described by that naturalist in 1846 under the name of *Janus Spinolæ.* Shortly afterwards it was taken by Dr. Battersby on the Devonshire, and by Mr. Alder on the Cornish coast; and the latter gentleman and I published an account of it in the 'Annals of Natural History' for 1848, where it was named *Antiopa splendida.* At that time we had seen neither the original description nor specimens from the Mediterranean; but have since been favoured with some from thence through the kindness of M. Verany; and having made careful dissections of them, and of others from the coast of Cornwall, we have satisfied ourselves that no character exists to distinguish the Italian from the English specimens. The anatomy is the same in both, and all the external parts agree.

In 1849 M. Emile Blanchard gave a full account of the anatomy of *Janus Spinolæ* in the 'Annales des Sciences Naturelles,' 3e série, t. 10. My dissections, however, have brought to light numerous and important details which do not coincide with those given by that anatomist, otherwise I should not have deemed it necessary to draw up the present memoir. These differences will be noticed after the description of each organ; therefore it is only necessary to state here, that the most important of them relate to the digestive system and to the reproductive organs.

*Antiopa Spinolæ** (the name by which our animal must be now designated, the generic appellation of M. Verany having been previously used) belongs undoubtedly to the family Eolididæ, as defined in the 'Monograph of the British Nudibranchiate Mollusca,' now being published by the Ray Society, though it exhibits some characters approximating it to *Doris* and *Tritonia*. *Antiopa* differs in many respects from *Eolis*, both externally and internally. The body is upwards of an inch long; it is ovate, a little depressed, and tapers to a point behind, with the sides of the back carinated, indicating the presence of a cloak. The branchial papillæ are arranged along the carinæ and pass round in front of the head; extending posteriorly a little behind the anus, which is placed in the median line of the back, near to the termination of the body. The generative organs open on the right side. The dorsal tentacles are laminated and united at the base by a fleshy crest.

Digestive System.—The oral opening is rather large, and is placed on the inferior surface of the head; it is guarded by a fleshy lip divided behind, and leads by a short canal to the buccal mass (Pls. II. and III. fig. 1 *a*), which is very large, of a lozenge-form when viewed from above, and somewhat depressed. It is very compact and firm, having the jaws exposed at the sides (Pl. II. fig. 2 *c*), and is provided with numerous powerful muscles for their motion, and for advancing and retracting the whole apparatus. The jaws (fig. 3) are of great power, being equal in size to the buccal mass, and give to it its proper form. They are not mere thin plates as in *Eolis*, but are of considerable thick-

* As this paper was passing through the press, I have learnt that M. Delle Chiaje was the first to discover this animal, and that he had described it under the name of *Eolidia cristata*. His specific denomination will therefore have to be adopted.

ness, of a peculiar horny texture, apparently porous within, admitting readily the point of a needle; their form is subtriangular when seen in front, each having attached to the anterior angle a plate or cap (*a*), which is provided with two parallel cutting edges, the outer one (*b*) being denticulated, the inner (*c*) smooth. The denticulations are about twelve in number, very large, compressed and lancet-formed, with their points tipped abruptly with black: their bases being pale have not a little the appearance of forming a second row of teeth. This appearance probably deceived M. Blanchard, who describes two denticulated plates. The inner edge is quite smooth, and separated from the outer one by a deep groove: the function of this edge is rather problematical. The jaws are strongly articulated above in front, at a point (fig. 5 *d*) which is furnished with a projecting process or fulcrum.

The tongue is large, and stands up from the floor of the buccal cavity in front of the œsophagus; it is formed as in *Doris*, being tubular behind (Pl. II. fig. 6, and Pl. III. fig. 2 *b*), with the frontal portion (*a*) turned over, as it were expanded like the mouth of a trumpet. This is the only portion of the organ that can act as a prehensile instrument, the spines being exposed and turned with their points towards the gullet. The spines behind line the tubular portion, and are covered by a soft, delicate membrane. Here they are generated, and retained until gradually pushed forward to make up the deficiency occasioned by the loss of those in front.

The spines are firmly attached to a stiffish membrane, which rests upon a muscular support capable of moving backwards and forwards, and of giving to them the necessary prehensile action. When the tongue is removed from this muscular support and spread out, it (Pl. II. fig. 7) is found to be about twice as long as it is broad, slightly narrowed behind (*a*), and a little rounded at both extremities, with the whole surface covered with transverse rows of plain, stout, recurved spines (figs. 8 & 9) of a deep amber colour, giving to the rows when seen with a low magnifying power a dark purple-brown hue. There are thirty of these rows, each containing eighty spines, one spine being central (fig. 8 *a*), of the same size, plain and recurved like the rest. From this the lateral portions of the rows, on either side, slope forward, giving to the tongue a bipartite appearance.

The œsophagus (Pls. II. & III. fig. 1 *b*) is rather wide, very short and internally plicated; it passes from about the middle of the upper aspect of the buccal mass, and opens into the lower portion of the stomach in front. This latter organ (*c*) is placed far forward in the visceral cavity, a little on the left side. It is transversely elongated, of considerable size, exhibiting through its upper wall, which is very delicate, internal, longitudinal plicæ. The lower portion of the stomach, towards the left side (Pl. III. fig. 1 *d*), is covered with a thin coating of a folliculated, glandular substance. Here the intestine (Pl. II. fig. 1 *d* & Pl. III. fig. 1 *e*) leaves the gastric pouch, and doubling back upon it passes across to the right side of the body, down which it runs for some distance, and then turning inward dips under the ovary, and shortly reaches the large, tubular anal nipple (Pl. II. fig. 1 *e* & Pl. III. fig. 1 *f*), placed on the median line of the back, not far from the posterior extremity of the animal. The intestine is wide, diminishing slightly in caliber towards its termination; the inner surface being longitudinally plicated throughout.

The hepatic apparatus is extensively diffused in this species, as it is in all the other Eolididæ. Two large anterior hepatic canals open into the upper surface of the stomach, one on each side. These canals on leaving the gastric organ almost immediately divide into two branches (Pl. II. fig. 1 *f*, *f*), one of which curves forward (Pl. III. fig. 1 *g*, *g*), the other backward (*h*, *h*). The two that pass forward stretch along the sides of the back, and turning round in front of the head, are apparently united on the median line. These branches give off from their outward margin numerous ramuscules (k'), which divide and subdivide, forming dendritic tufts, some of the twigs of which pass into the anterior branchial papillæ. The two posterior branches (*h*, *h*) of these hepatic canals, turning backward, run down the sides of the back, and communicate, by similar dendritic tufts, with the papillæ on the sides for more than half-way down the body. Here these two latter branches terminate. There is, however, another trunk canal belonging to the hepatic apparatus. This is the great, posterior or central duct (Pl. II. fig. 1 *h* & Pl. III. fig. 1 *i*, *i*); it is a little larger in caliber than the anterior canals, and opens into the lower, glandular portion of the stomach a short way in advance of the pylorus, and passing backward, beneath the anterior ovarian mass, sends a branch which ascends between the lobes of the ovary, to communicate with the papillæ on the left side in front of the anus. The trunk canal then turning upward between the anterior and posterior masses of the ovary on the same side, gives off another branch, which crossing the median line in advance of the anal nipple, subdivides into two portions, one of which bends forward, the other backward; these go to supply the papillæ along the right side near to the anal region. The posterior canal then passes backward above the posterior ovarian mass, and on the left side of the anus. It now assumes a more central position, and after sending two or three branches to either side, terminates in a blind sac a little behind the papillæ.

All the branches of the great posterior canal give off dendritic ramuscules, which communicate with the papillæ in the same manner as those from the anterior canals. The whole of the ramuscules, branches and trunk canals are of a dark chocolate colour when the animal is alive, resembling in this respect the gland of the papillæ. It is therefore likely that all these parts assist in the production of the biliary fluid. The walls of the canals and branches are very firm, retaining their cylindrical form even when completely isolated.

The great posterior canal has entirely escaped the notice of M. Blanchard, who after describing the posterior branches of the anterior trunks to be united by a transverse communication in front of the anus, states that they pass down to the extremity of the body*. This we have seen to be erroneous, the transverse communication (Pl. III. fig. 1 *j*) being, in fact, a branch from the posterior canal. He has committed this error, probably, from having relied too much on the examination of living specimens, in which many of the branches and most of the ramuscules are distinctly seen through the dorsal skin. In spirit specimens there is no difficulty in isolating all the principal canals, their branches, and most of the ramuscules. In this way I have on more than one occasion demonstrated the existence of the posterior canal, and the various other ramifications of the hepatic organ. I have therefore no hesitation in asserting the accuracy of the above description and of the accompanying illustrations. I may state, that only the terminal portion of the posterior canal can be traced through the dorsal skin, the rest being concealed beneath the ovary; and that this portion of it is pretty correctly represented in M. Blanchard's figure, but is erroneously connected with the branches of the anterior canals of each side.

The hepatic gland (Pl. III. fig. 1 *k* & fig. 3) of the papillæ is very simple, being contained within an inner sheath, and extending almost to the apex of the papilla; it is tubular with the extremity bifid (fig. 3 *a*), the portions being folliculated and a little branched. The inner surface is lined with a brown-coloured, glandular matter.

The whole of these glands, together with the numerous dendritic branches and canals, form an exceedingly beautiful example of an unravelled liver, exhibiting as it were, at a glance, the complicated mechanism of this highly organized viscus. These parts, however, do not appear to be the only representative of the biliary organ in this animal. On each side of the lower portion of the body, immediately below the skin and in contact with it, there is a peculiar glandular structure composed chiefly

* M. Delle Chiaje, who has given an account of the anatomy of *Antiopa*, appears also to have overlooked the great posterior canal.

of anastomosing tubes, which form a network (Pl. II. fig. 1 *i* & Pl. III. fig. 4 *d*) across the dorsal aspect in front of the anus. This network inosculates with the minute twigs of the hepatic organ leading to the papillæ, and is apparently connected with a dense gland-like body (Pl. II. fig. 1 *j* & Pl. III. fig. 4 *c*) surrounding the termination of the intestine. There can be little doubt that this network of tubes, which is unnoticed by M. Blanchard, is part of the hepatic apparatus; and from its internal position points out *Antiopa* as one of the intermediate forms connecting the Eolididæ with the other families of the Nudibranchs.

The digestive system of this animal thus becomes of great interest, while it is evident that the hepatic canals are arranged after the type of those of *Eolis*, in which the anterior ones always enter the sides of the stomach from above, and the posterior or central one from behind and below the pylorus:—the stomach being, in fact, perforated by three hepatic ducts in the same manner as it is in *Antiopa*. The chief differences being that in this latter animal the anterior branches are excessively developed, and the central one is below the ovary.

Vascular System.—From deficiency of specimens, I have not been able to investigate the circulatory apparatus to any great extent. The heart is placed about the middle of the back immediately below the skin, having the intestine in front, and the ovary beneath exactly as in *Eolis*. The pericardium is of excessive tenuity, and is of a pretty regular oval form. The ventricle (Pl. II. fig. 1 *k*) lies in front, and when contracted is irregularly elliptical; it is rather large and muscular. The auricle (*l*) is delicate, membranous, and is connected to the posterior margin of the ventricle: at this point the two chambers of the heart communicate. The aorta passes from the front of the ventricle, and dipping almost directly beneath the intestine, gives off branches to the generative organs, to the stomach and to the buccal mass, in the same manner as in *Eolis*. I did not observe the pedial artery, though there can be no doubt of its existence as described by M. Blanchard. The auricle receives in front, on either side, a large trunk vein which communicates with numerous small branches from the skin, and is apparently joined behind, on the median line, by two other large trunks, that on the right side being considerably the smaller. There are several other small vessels, but whether they entered the posterior margin or belonged to the lateral trunks, I could not determine. This is so different from what is observed in the other Eolididæ, that I should have doubted the accuracy of my observations, had not M. Blanchard described numerous vessels entering the posterior margin of the auricle. It would therefore appear that the efferent or branchio-cardiac vessels are arranged in a peculiar manner in *Antiopa*—differing alike from those in *Eolis*, in *Doris*, and in *Tritonia*.

The capillary portion of the vascular system is undoubtedly as deficient in our animal as it is in the other Nudibranchiata; but I cannot speak from observation on this point; neither have I ascertained how the blood passes to the aërating surface, on its return to the heart, though from analogy we cannot hesitate to believe that it escapes from the arterial twigs into the tissues of the various organs, thence filters as it were into the visceral cavity, and then passing through orifices in the walls of that cavity, it reaches the skin and branchial papillæ on its way to the auricle through the branchio-cardiac vessels.

A small oval vesicle (Pl. II. fig. 1 *m*) lies immediately below the pericardium, and opens into it, through its floor, rather in front and on the right side of the median line. This vesicle is the representative of that described by Cuvier, in *Doris*, as communicating with the liver, and opening externally by a minute orifice at the side of the anus; and is the same which Dr. Embleton and I have designated a portal heart in our communication on the anatomy of *Doris* *. In *Antiopa Spinolæ* this vesicle opens into the pericardium in the same manner as it does in that genus, and in like manner is internally plicated. I have not been able to examine it further in this species; but from analogy suppose that it may throw venous blood into the hepatic network of tubes, and perhaps also within the sheaths that surround the papillary glands. This is, I believe, the first time that this vesicle or portal heart has been observed in the Eolididæ †; and it proves in a striking manner the connexion of *Antiopa* with the other two families of the order.

Respiratory System.—The specialized breathing organ is composed of the papillæ arranged along the sides of the back, and in front of the head. These in *Antiopa* are very large and numerous, their external skin being exceedingly delicate. A portion of the deteriorated blood, on its way to the auricle, will be made to traverse the surface of the papillæ; but doubtless much of the blood will pass at once through the skin to the heart, and on its way be there partially aërated, as is the case in *Eolis*, in *Doris*, and probably in all the Nudibranchs.

No ovate vesicle was detected in the terminal portion of the papilla, similar to that observed in *Eolis*; though Mr. Alder informs me that when the animal was alive, a distinct orifice was visible at the apex, opening and closing at intervals.

* Read at the meeting of the British Association held in Edinburgh, 1850.

† A similar vesicle also exists in *Tritonia Hombergii*; and since writing the above I have likewise found it in *Eolis papillosa*.

Nervous System.—The cephalic or cerebral ganglions are arranged round the œsophagus in the same manner as in *Eolis*; there are five pairs, three supra-œsophageal, two infra-œsophageal; the former are very much the larger and nearly of equal dimensions. Of these the two central pairs, the cerebroid (Pl. III. fig. 5 *a, a*) and branchial (*b, b*), the latter the "cervicaux" of Blanchard, are almost completely fused, forming two elongated, bilobed masses, one on each side of the median line,—the branchial lying behind the cerebroid, which latter is united by a very short commissure to its fellow on the opposite side of the œsophagus. This is exactly similar to what is observed in *Eolis*; but in this latter genus the masses being less distinctly bilobed, the constituent parts are not so readily made out. External to these masses, and in close contact with them, are two rounded ganglions, the third or pedial pair (*c, c*). These lie in a plane a little below the central masses, and are united to them on the under surface.

The first and largest pair of nerves are given off from the upper surface of the cerebroid ganglions in front, next the median line; these are the olfactory nerves. Each immediately divides into two portions,—the inner, generally the larger, of which converge, and go to the crest between the dorsal tentacles, where they divide into numerous twigs; the outer portions diverge a little and enter the bases of the dorsal tentacles, and are there enlarged to form the olfactory ganglions (*d, d*), which are quite distinct and round, and very little inferior in size to the buccal. The second, third and fourth pairs come from the under side of the front margin of the same ganglions, and supply the lip and channel of the mouth, and probably the oral tentacles. The fourth pair give off at their roots a nervous trunk; these trunks curve round, one on either side of the œsophagus, and are united to the buccal ganglions; thus forming the commissure (*g*) between the supra- and infra-œsophageal nervous centres. The fifth pair issue from the upper surface of the cerebroid ganglions near to their junction with the branchial; these are the optic nerves; they are very delicate, and are long enough to allow the eye, which is as well developed as in any of the Nudibranchs, to pass a little in front of the ganglions. M. Blanchard represents the eye as almost sessile on the cerebroid ganglion. The sixth, the auditory, I did not detect; they will undoubtedly be found behind the optic, as described by M. Blanchard. The seventh pair of nerves emerge apparently from the pedial ganglions at their union with the central masses, and supply the skin on the sides of the body in front. The eighth and ninth pairs pass from the outer margin of the pedial ganglions, and go to supply the foot. From the posterior margin of these ganglions emerges a stout nervous trunk (*h*), which curving under the gullet, completes the great œsophageal collar. Another nervous trunk (*i*), but very inferior in size, passes below the œsophagus, and has its extremities attached, at either side, to the under surface of the ganglions near to the point where the pedial are united to the cerebroid and branchial. This is the middle or slender collar, and, as in *Eolis*, it gives off on the right side a nerve, the tenth, which, passing to the generative organs, is I believe united to a ganglion (Pl. III. fig. 6 *l*) which lies on the sheath of the penis. Of this, however, there may be some doubt, as I was unable to verify the observation from the want of specimens. Several nervous twigs radiate from this ganglion, representing pretty accurately the principal parts of the nervous plexus on the same organ in *Doris*, and which has been described, as a portion of the sympathetic system, by Dr. Embleton and myself in the communication before alluded to.

This collar, its nerves, and the ganglion situated on the sheath of the penis have escaped the notice of M. Blanchard, who points out a branch from a small ganglion, which he calls "branchio-cardiaque" in connexion with the right branchial nerve, the "cervico-cardiaque" of this naturalist, as that which supplies the reproductive organs. I have not observed this ganglion and its branch. The eleventh or last pair of nerves, from the supra-œsophageal ganglions, come out of the posterior margin of the branchial, and pass to the dorsal skin, one on each side, and apparently supply the papillæ; these are the branchial nerves.

The two pairs of infra-œsophageal ganglions rest upon the upper surface of the buccal mass below the gullet, and are connected, as before stated, to the supra-œsophageal by a wide, slender commissure. The buccal ganglions (fig. 5 *e, e*) are well developed, though very much smaller than the principal cerebral; they are elliptical, and are connected across the median line by a commissure much longer than usual; the commissure from the supra-œsophageal being attached to their outer margin. The twelfth and thirteenth pairs of nerves come from these ganglions; the former issue from their outer margin in connexion with the commissure, and pass into the buccal mass; these are the buccal nerves; the latter come from the posterior margin and dip immediately into the buccal mass behind, and are the same which in *Doris* supply the tongue.

The gastro-œsophageal ganglions (*f, f*), though of sufficient magnitude to be readily distinguished, are much inferior in size to the buccal, to which they are united in front by a longish pedicle. The fourteenth, fifteenth and sixteenth pairs of nerves belong to these ganglions; the two former are applied to the upper portion of the gullet, one probably going to supply some minute salivary gland at present undiscovered. The nerves of the sixteenth pair are larger than those of the other two, and pass down the under surface of the œsophagus, parallel to each other, on their way to the stomach.

The gastro-œsophageal ganglions are undescribed by M. Blanchard, who states that they are not isolated in *Janus* from the buccal ganglions. In my specimens, however, they were as distinct as in any of the Nudibranchs, and further removed from the buccal ganglions than usual. The gastro-œsophageal are named by this naturalist the "ganglions aortiques,"—evidently a false appellation, as all their nerves are distributed to the alimentary organs.

The Reproductive Organs resemble those of *Eolis* and *Doris*, and are of vast volume and complication; they (Pl. II. fig. 1 *n, o, p*) lie on the right side of the visceral cavity immediately behind the buccal mass. The sheath of the intromittent organ, female channel, and vagina in communication with the spermatheca open into one common vestibule, the lips of which, when the organs are fully retracted, form a nipple-like swelling on the right side, less than half-way down the body. The intromittent organ (Pl. III. fig. 6 *a*) lies in front of the other parts, and in its retracted state appears to be of considerable dimensions, of a clavate form, with the smaller extremity leading to the external opening. The testis (*b*) is a rather short, stout tube forming two or three convolutions, with one end united to the thick or inner termination of the penis, and the other, which tapers a little, to the oviduct.

The ovary is very ample, filling the greater portion of the visceral cavity from the stomach backwards. It is composed of two masses, one (Pl. II. fig. 1 *p*) lying in front and a little to the left of the other (p'). They are both made up of large irregular lobules composed almost entirely of eggs. The oviduct (Pl. III. fig. 6 *c*) leaves the ovary as a very delicate, slender tube, and is soon abruptly dilated (fig. 6 *d* & fig. 7 *c*) into at least five or six times its original diameter; and is so continued on, in a tortuous course, to the front of the mucus-gland; then, bending back upon itself, it again becomes excessively contracted, and shortly afterwards receives the duct-like extremity of the testis at a point (fig. 6 *e* & fig. 7 *d*) where the oviduct is once more suddenly bent upon itself. After this it (fig. 6 *f* & fig. 7 *e*) is slightly enlarged just before it unites with a very short duct (fig. 7 *h*) from the spermatheca; then, passing forward, it divides into two portions or branches, one (*j*) of which sinks into the mucus-gland near to the place of its union with the female channel (fig. 6 *i* & fig. 7 *f*) leading to the external outlet close behind the penis. It is by this branch that the mature ova pass on being evacuated. The other branch (fig. 6 *k* & fig. 7 *i*), which must be considered the vagina, is continued on to the orifice opening externally between and above the male and female outlets. This vagina, or copulatory passage, we thus see, communicates with the oviduct as well as with the spermatheca very much in the same manner as in *Eolis*.

The spermatheca (fig. 6 *j* & fig. 7 *g*), a rather small membranous sac of a globular form, lies half-buried in a fissure which divides the two portions of the mucus-gland, and gives off from its anterior margin the duct above alluded to. The mucus-gland is a large, pyriform mass, a little flattened, lying against the wall of the visceral cavity immediately behind the penis. It is composed of two parts, one (fig. 6 *g*) semi-pellucid and without colour, the other (*h*) of an opake fleshy hue. These parts are formed of a convoluted tube, very large and not much folded in the former, in the latter minute and intricately rolled up. They both open directly into the female channel (*i*). This gland secretes the substance forming the gelatinous mucus-like envelope that covers the eggs.

Thus it is evident that the generative apparatus of *Antiopa* is very complete, exhibiting the same union of male, female and androgynous parts as observed in *Eolis*. Here, as in that genus, the spermatheca will receive the semen of another individual shed during coitus, and will discharge it, when required, into the oviduct; and as the latter is in connexion with the testis, it would appear probable that, in failure of copulation, the ova may be also fertilized by a species of self-impregnation. In *Antiopa Spinolæ* there is only one spermatheca, though perhaps the second dilated portion of the oviduct may act as an accessory receptacle. From this deficiency and from the general arrangement of the androgynous apparatus, the generative organs of this animal more closely resemble those of *Eolis* than of *Doris*; though the form of the mucus-gland approximates nearer to that of the latter.

M. Blanchard has entirely misunderstood these organs; his figure of them is most imperfect, and proves that he has failed to make out the various parts. He has never seen the spermatheca, nor the junction of the testis with the oviduct, and of course knows nothing of the union of the latter with the spermatheca; he calls the mucus-gland, in connexion with the female channel, the testis, and the testis the vas deferens.

After this account of the anatomy of *Antiopa Spinolæ*, there can be little hesitation about its true position in the classification. It must undoubtedly be placed with the Eolididæ, as proved by its digestive apparatus, the hepatic canals being arranged after the type of those of *Eolis*; while the internal network of hepatic tubes, the backward and dorsal position of the anus, the character of the tongue, the presence of a portal heart, and the form of the mucus-gland, in connexion with the genitalia, show its relationship to the Dorididæ. It seems likewise to have some affinity with the Tritoniadæ, as evinced by the great size and character of the jaws, by the imperfect development of the cloak, and by the arrangement of the branchial papillæ, which do not extend over the sides of the back as in *Eolis*, but are confined to the ridges representing the mantle.

In this animal, then, we see blended the characters of the three great divisions of the order Nudibranchiata.

EXPLANATION OF PLATES II. AND III.

Plate II.

Fig. 1. General view of the viscera of *Antiopa Spinolæ*, the dorsal skin having been removed: *a*, buccal organ; *b*, œsophagus; *c*, stomach; *d*, intestine; *e*, anus; *f*, *f*, *f*, *f*, branches from the anterior hepatic canals; *g*, *g*, branches from the posterior hepatic canal; *h*, a portion of the posterior hepatic canal; *i*, internal network of tubes connected with the hepatic apparatus; *j*, a gland-like body apparently in connexion with the network of tubes; *k*, ventricle of the heart; *l*, auricle; the oval boundary represents the extent of the pericardium; *m*, portal heart or vesicle opening into the pericardium; *n*, portions of male organs; *o*, portion of mucus-gland attached to the female channel; *p*, *p'*, anterior and posterior ovarian masses; *q*, supra-œsophageal ganglions.

Fig. 2. Side view of buccal organ: *a*, channel of mouth; *b*, œsophagus; *c*, jaw.

Fig. 3. Front view of jaws: *a*, anterior cap or plate; *b*, denticulated cutting edge; *c*, inner or plain cutting edge.

Fig. 4. Side view of jaw: *a*, anterior cap or plate; *b*, denticulated cutting edge.

Fig. 5. View of jaw with the cutting edges seen in front: *a*, anterior plate or cap; *b*, denticulated edge; *c*, plain edge; *d*, point of attachment or fulcrum.

Fig. 6. Tongue removed from the muscular support: *a*, anterior portion exhibiting rows of spines; *b*, posterior tubular portion.

Fig. 7. Tongue spread out, exhibiting the rows of spines apparently interrupted in the centre.

Fig. 8. Central portion of a single row of spines from the tongue: *a*, central spine.

Fig. 9. A single lateral spine more highly magnified.

Plate III.

Fig. 1. Digestive apparatus: *a*, buccal organ; *b*, œsophagus; *c*, stomach; *d*, glandular portion of the same; *e*, intestine; *f*, anus; *g*, *g*, anterior branches of the anterior hepatic canals; *h*, *h*, posterior branches of the same; *i*, *i*, posterior hepatic canal, giving branches to the posterior portion of the body; *j*, branch from the posterior hepatic canal crossing the back in front of the anus; *k'*, ramuscules leading to glands of papillæ; *k*, three glands of the papillæ in connexion with the ramuscules, the rest of the glands having been removed.

Fig. 2. Tongue seen from above: *a*, anterior portion; *b*, posterior portion; *c*, membrane dividing the two portions.

Fig. 3. A gland removed from the papilla, much enlarged: *a*, terminal bifid portion; *b*, lower portion or duct, curtailed.

Fig. 4. A portion of the network of tubes in connexion with the hepatic apparatus: *a*, anus; *b*, intestine; *c*, gland-like body surrounding the termination of the same; *d*, network of tubes.

Fig. 5. Nervous system: *a, a*, cerebroid ganglions; *b, b*, branchial ditto; *c, c*, pedial ditto; *d, d*, olfactory ditto; *e, e*, buccal ditto; *f, f*, gastro-œsophageal ditto; *g*, commissure between the supra- and infra-œsophageal ganglions; *h*, great œsophageal collar; *i*, middle ditto; No. 1, olfactory nerve; 2, 3 and 4, nerves supplying channel of the mouth; 5, optic nerve; 6, auditory ditto; 7, nerve to side of body; 8 and 9, nerves to foot; 10, nerve to generative organs; 11, ditto to skin of the back and branchial papillæ; 12, ditto to buccal mass; 13, ditto to tongue; 14 and 15, nerves to œsophagus; 16, nerve to œsophagus and stomach.

Fig. 6. Generative organs: *a*, sac or sheath of penis; *b*, testis; *c*, oviduct as it leaves the ovary; *d*, dilated portion of the oviduct; *e*, the point where the testis is united to the oviduct; *f*, second dilated portion of oviduct; *g*, semi-pellucid portion of mucus-gland in connexion with the female channel; *h*, opake portion of the same; *i*, female channel leading to external orifice; *j*, spermatheca; *k*, vagina, or copulatory channel leading from external orifice to spermatheca; *l*, visceral ganglion in connexion with nerve No. 10.

Fig. 7. A portion of the generative organs spread out, exhibiting the connexion of the various parts: *a*, penis; *b*, testis; *c*, dilated portion of oviduct; *d*, point where the oviduct is connected with the testis; *e*, second dilated portion of oviduct; *f*, female channel leading to external opening; *g*, spermatheca; *h*, duct of the same; *i*, vagina leading to external orifice; *j*, branch from the vagina leading into mucus-gland.

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

[Continued from vol. vii. p. 452.]

44. *Philodromus Clarkii.*

Philodromus Clarkii, Blackw. Ann. and Mag. of Nat. Hist. Second Series, vol. vi. p. 338.

A male of *Philodromus Clarkii*, having the palpal organs completely developed, was taken at Southgate in June 1849, and is preserved in Mr. Walker's cabinet.

45. *Philodromus variatus.*

Philodromus variatus, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. x. p. 102.

In summer, when the sun shines brightly, this species may be seen on rails and gates in the neighbourhood of Llanrwst. Early in June the female constructs a lenticular cocoon of white silk of a slight texture, measuring $\frac{1}{3}$rd of an inch in diameter, in which she deposits about 64 spherical eggs of a pale yellow colour, not agglutinated together.

46. *Philodromus mistus.*

Philodromus mistus, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. x. p. 103.

Affecting the same localities as *Philodromus variatus,* this spider pairs in May; and in June the female spins a cell of white silk in which she constructs a lenticular cocoon of a slight texture, measuring $\frac{1}{4}$th of an inch in diameter, and deposits in it between 60 and 70 spherical eggs of a pale yellow colour, not agglutinated together. A near resemblance may be traced between *Philodromus mistus* and *Philodromus cespiticolis,* Walck. (Hist. Nat. des Insect. Apt. t. i. p. 555).

47. *Philodromus aureolus.*

Philodromus aureolus, Walck. Hist. Nat. des Insect. Apt. t. i. p. 556; Sund. Vet. Acad. Handl. 1832, p. 223.
Thomisus aureolus, Hahn, Die Arachn. B. ii. p. 57. t. 62. f. 144, 145.

Both sexes of this species, which were captured at Southgate in July 1849, are in Mr. Walker's cabinet.

48. *Philodromus oblongus.*

Philodromus oblongus, Walck. Hist. Nat. des Insect. Apt. t. i. p. 558; Blackw. Linn. Trans. vol. xix. p. 123.
—— *trilineatus,* Sund. Vet. Acad. Handl. 1832, p. 227.
Thomisus oblongus, Latr. Gen. Crust. et Insect. tom. i. p. 112; Hahn, Die Arachn. B. i. p. 110. tab. 28. fig. 82.
Thanatus trilineatus, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 28.

I have received living specimens of *Philodromus oblongus* which had been taken in the north of Lancashire and in Cheshire.

Genus Sparassus, Walck.

49. *Sparassus smaragdulus.*

Sparassus smaragdulus, Walck. Hist. Nat. des Insect. Apt. t. i. p. 582; Blackw. Linn. Trans. vol. xix. p. 123.
—— *smaragdinus,* Sund. Vet. Acad. Handl. 1831, p. 147, and 1832, p. 271.
—— *virescens,* Koch, Uebers. des Arachn. Syst. erstes Heft, p. 28; Die Arachn. B. xii. p. 87. tab. 416. fig. 1019.
Micrommata smaragdina, Latr. Gen. Crust. et Insect. tom. i. p. 115; Hahn, Die Arachn. B. i. p. 119. tab. 33. fig. 89.

This handsome spider has the tarsi provided with scopulæ constituting a climbing apparatus; it is not uncommon in the south of England, and has been captured, in an immature state, in the woods at Tan y Bwlch, in Merionethshire, by Thomas Glover, Esq., of Smedley Hill, near Manchester. The sexes, when they have acquired their full development, are very dissimilar, and have been mistaken for distinct species.

Family *Drassidæ*.

Genus Drassus, Walck.

50. *Drassus lucifugus*.

Drassus lucifugus, Walck. Hist. Nat. des Insect. Apt. t. i. p. 613; Sund. Vet. Acad. Handl. 1831, p. 138; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 18.
—— *melanogaster*, Latr. Gen. Crust. et Insect. tom. i. p. 87; Hahn, Die Arachn. B. ii. p. 11. tab. 41. fig. 102.
Filistata femoralis, Wider, Mus. Senck. B. i. p. 206. taf. 14. fig. 5.
Pythonissa lucifuga, Koch, Die Arachn. B. vi. p. 54. tab. 194. fig. 468–470.

According to Dr. Leach (Supplement to the 4th, 5th and 6th editions of the 'Encyclopædia Britannica,' article Annulosa) the *Drassus melanogaster* of Latreille (*Drassus lucifugus*, Walck.) has been found in England, under stones; and on his authority I introduce it here as a British spider, never having seen a native specimen myself.

Among the new genera proposed by M. Koch, for the reception of certain groups into which he has separated the *Drassi*, are several including British species which I am not prepared to adopt.

51. *Drassus ater*.

Drassus ater, Latr. Gen. Crust. et Insect. tom. i. p. 87; Walck. Hist. Nat. des Insect. Apt. t. i. p. 618; Hahn, Die Arachn. B. ii. p. 54. tab. 61. fig. 142; Blackw. Linn. Trans. vol. xix. p. 114.
Melanophora subterranea, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 17; Die Arachn. B. vi. p. 85. tab. 201. fig. 491, 492.
—— *pusilla*, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 17; Die Arachn. B. vi. p. 90. tab. 202. fig. 496.
—— *atra*, Koch, Die Arachn. B. vi. p. 88. tab. 201. fig. 493.
Filistata atra, Wider, Museum Senckenb. B. i. p. 202. taf. 14. fig. 2.

In the mountainous parts of Denbighshire and Caernarvonshire this species is of frequent occurrence under detached pieces of rock. When adult, the terminal joint of each intermediate spinner is directed downwards at right angles to its base, and the full complement of papillæ or spinning tubes connected with the short terminal joint of each inferior spinner is eight. Six of these papillæ, which are of large dimensions, are probably used by *Drassus ater* chiefly in constructing its cocoon, the remarkably compact texture of which is best explained on the supposition that a copious supply of viscous matter in a state of fluidity is employed in its fabrication; and the other two, situated on the inferior surface of the spinner, at a greater distance from its extremity than the rest, are minute and almost contiguous. The large papillæ vary in number with the age of the animal; and it is a fact deserving of notice that they are not always developed simultaneously on both spinners, four, five, or six being sometimes observed on one, when three, four, or five only are to be seen on the other; but the two minute ones are present invariably.

In May the female deposits 40 or 50 white spherical eggs, not agglutinated together, in a cocoon of a plano-convex figure, attached to the under side of stones by its plane surface; it is of a fine but very compact texture, and measures $\frac{2}{5}$ths of an inch in diameter: when newly constructed it is white, but becomes reddish before it is abandoned by the young, which, at that early period of their existence, have each inferior spinner provided with two large and two small papillæ. The female usually remains upon or near the cocoon, to which she is strongly attached.

52. *Drassus sericeus.*

Drassus sericeus, Sund. Vet. Acad. Handl. 1831, p. 136; Walck. Hist. Nat. des Insect. Apt. t. i. p. 619; Koch, Die Arachn. B. vi. p. 37. tab. 190. fig. 457, 458; Blackw. Linn. Trans. vol. xix. p. 113.

Filistata sericea, Wider, Mus. Senck. B. i. p. 204. taf. 14. fig. 3.

I have met with *Drassus sericeus* in several of the northern counties of England and Wales. It frequents the interior of houses, especially such as are old, and is decidedly nocturnal in its habits. Having, like other species of the genus, a climbing apparatus consisting of numerous hair-like papillæ distributed over the inferior surface of the tarsi, from which an adhesive secretion is emitted, it can run with facility on the perpendicular surfaces of dry smooth bodies. The papillæ connected with the terminal joint of each inferior spinner not only vary in number with the age of the spider, the full complement being nine large and two small ones, but a like number does not constantly occur on both spinners of the same individual.

53. *Drassus sylvestris.*

Drassus sylvestris, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 440; Research. in Zool. p. 342.

—— *signifer*, Koch, Die Arachn. B. vi. p. 31. tab. 188. fig. 452.

M. Walckenaer has placed the *Drassus signifer* of M. Koch, which is specifically identical with *Drassus sylvestris*, among the synonyma of *Clubiona lapidicolens*, supposing it to be that species in an immature state (Hist. Nat. des Insect. Apt. t. ii. p. 479). Now as I have taken adults of both sexes in the woods about Llanrwst, I am prepared to affirm that they are invariably much smaller than *Clubiona lapidicolens*, and that they also differ from it materially in structure, having the maxillæ curved towards the lip, and all the essential characters of a *Drassus*. For these reasons the name given to it by me is retained.

In July the female constructs a lenticular cocoon of white silk of a fine but compact texture, measuring $\frac{3}{10}$ths of an inch in diameter, which she places in a cavity formed in the ground beneath stones and lined with silk, depositing in it about 123 whitish eggs of a spherical form, not agglutinated together. She is greatly attached to her cocoon, and is with difficulty compelled to abandon it.

A specimen of this spider was transmitted to me from Berwickshire in the spring of 1849 by Mr. Hardy.

54. *Drassus cupreus.*

Drassus cupreus, Blackw. Research. in Zool. p. 345.
—— *rufus*, Koch, Die Arachn. B. vi. p. 33. tab. 189. fig. 453, 454.

Though the *Drassus rufus* of M. Koch, identical with *Drassus cupreus*, is regarded by M. Walckenaer as a variety of *Clubiona livida* (Hist. Nat. des Insect. Apt. t. ii. p. 479), yet I have ascertained by the inspection of numerous specimens, in every stage of growth, that it possesses all the characteristics of a *Drassus* in so marked a degree that it might be selected as a type of the genus; consequently, the name I have conferred upon it is retained.

As regards the papillæ connected with the inferior spinners of this species, which occurs under stones in various parts of Great Britain, the same law of development holds good to which attention has been directed in treating upon *Drassus ater* and *Drassus sericeus*; moreover, I may remark that the number of the papillæ is not uniformly the same even in adults of any of these spiders, but that the two minute ones belonging to each spinner are always present.

In June the female constructs a lenticular cocoon of white silk of a fine but compact texture, measuring $\frac{2}{5}$ths of an inch in diameter, in which she deposits about 118 spherical eggs of a pale yellow colour, not agglutinated together. The cocoon is enveloped in a large sac of very fine white silk, usually placed in a cavity of the earth underneath a stone, and this sac generally comprises the female.

55. *Drassus nitens.*

Drassus nitens, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 439 ; Research. in Zool. p. 328.
—— *formosus,* Walck. Hist. Nat. des Insect. Apt. t. ii. p. 488.
Macaria formosa, Koch, Die Arachn. B. vi. p. 97. tab. 203. fig. 501.

In warm sunny weather in spring and summer this small but brilliant spider may be seen running on the ground in the woods of Denbighshire and Caernarvonshire. Like many other species of *Araneidea* it is partial to moisture and drinks water freely. A pair confined in a phial having become feeble and greatly emaciated, I introduced to them a few drops of water, which they drank with avidity, and speedily resumed their strength and former plump appearance. In the month of May 1833, females, in a state of captivity, constructed cocoons of a hemispherical form, measuring about $\frac{1}{6}$th of an inch in diameter, in each of which they deposited 9 or 10 spherical eggs of a pale yellow colour, not agglutinated together. The cocoons were composed of delicately white silk of a very fine but compact texture, and connected with the upper part of each was a tube of the same material, usually occupied by the female.

Genus Clubiona, Latr.

56. *Clubiona holosericea.*

Clubiona holosericea, Walck. Hist. Nat. des Insect. Apt. t. i. p. 590 ; Latr. Gen. Crust. et Insect. tom. i. p. 91 ; Sund. Vet. Acad. Handl. 1831, p. 142 ; Hahn, Die Arachn. B. i. p. 112. tab. 29. fig. 84 ; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 19.

Clubiona holosericea, in common with other species of the genus, has a small climbing apparatus situated below the tarsal claws, by means of which it runs securely on the perpendicular surfaces of dry smooth bodies. It is most abundant in well-wooded districts, constructing a cell of white silk, which serves it for a domicile, on the under side of leaves or behind the exfoliating bark of old trees. In June the female spins in this cell a lenticular cocoon of fine white silk, measuring $\frac{1}{4}$th of an inch in diameter, and deposits in it about 109 spherical eggs of a yellowish white colour, not agglutinated together. From this period she appears to direct her attention exclusively to her progeny, constantly remaining on or near the cocoon.

57. *Clubiona amarantha.*

Clubiona amarantha, Walck. Hist. Nat. des Insect. Apt. t. i. p. 591 ; Hahn, Die Arachn. B. i. p. 113. tab. 29. fig. 85.

The haunts, habits and œconomy of this species are similar to those of *Clubiona holosericea.* The female deposits about 145 spherical eggs of a yellowish white colour, not agglutinated together, in a lenticular cocoon of white silk of a fine texture, measuring $\frac{3}{10}$ths of an inch in diameter. This cocoon, for which she manifests much solicitude, is inclosed in a cell of white silk fabricated on the inferior surface of a leaf, the sides of which are curved upon it and are retained in that position by silken lines. Towards the end of June or the beginning of July the eggs are hatched; but the young, like those of all other spiders whose œconomy is known, do not quit the cocoon till they have completed their first change of integument.

58. *Clubiona epimelas.*

Clubiona epimelas, Walck. Hist. Nat. des Insect. Apt. t. i. p. 592; Blackw. Linn. Trans. vol. xix. p. 115.

Crevices in stone walls and the under side of fallen leaves are the usual haunts of *Clubiona epimelas,* which is found, though rarely, in the wooded parts of Denbighshire and Caernarvonshire. The male has the palpal organs completely developed in May, and in June the female constructs a plano-convex cocoon of white silk of a very fine texture, measuring $\frac{3}{10}$ths of an inch in diameter, in which she deposits about 154 spherical eggs of a pale yellow colour, not agglutinated together. The cocoon is attached by its plane surface to the under side of a stone or leaf, and is inclosed in a sac of white silk, which also comprises the female.

59. *Clubiona corticalis.*

Clubiona corticalis, Walck. Hist. Nat. des Insect. Apt. t. i. p. 593.
—— *domestica,* Wider, Mus. Senck. B. i. p. 214. taf. 14. fig. 9.
Philoica notata, Koch, Die Arachn. B. viii. p. 55. t. 268. f. 631, 632.
Titulus 22, Lister, Hist. Animal. Angl. De Aran. p. 70.

In the wooded parts of Denbighshire this spider is found among ivy and lichens growing on trees. It spins a large sac of white silk on the under side of leaves or behind exfoliating bark, in which the female constructs a cocoon of a lenticular form in the month of July; it is composed of white silk of a very fine texture, is $\frac{3}{10}$ths of an inch in diameter, and contains between 30 and 40 spherical eggs of a pale yellow colour, not agglutinated together.

60. *Clubiona brevipes.*

Clubiona brevipes, Blackw. Linn. Trans. vol. xviii. p. 603.

M. Walckenaer has confounded this species with *Clubiona amarantha* (Hist. Nat. des Insect. Apt. t. iv. p. 439), from which it differs in magnitude, in colour, in the relative size of its eyes, and, as regards the male, in the structure of its palpi and palpal organs. It commonly occupies a cell of compact white silk, constructed on the inferior surface of leaves and of lichens growing on the trunks of trees in the woods of North Wales. Though not particularly active in its general movements, yet it can leap with agility.

61. *Clubiona comta.*

Clubiona comta, Koch, Die Arachn. B. vi. p. 16. tab. 185. fig. 440; and B. x. p. 129. tab. 358. fig. 841.
—— *compta,* Walck. Hist. Nat. des Insect. Apt. t. ii. p. 478.
—— *fucata,* Blackw. Linn. Trans. vol. xviii. p. 605.

Clubiona fucata, Blackw., which is identical with the *Clubiona comta* of M. Koch, is placed by M. Walckenaer among the synonyma of *Clubiona corticalis* (Hist. Nat. des Insect. Apt. t. iv. p. 439); yet it is not only very much smaller than that species, from which it differs decidedly in colour and in the relative size of its eyes, but the structure of the palpi and of the palpal organs also is widely dissimilar in the male.

I have taken this rare spider in the woods of Denbighshire and Caernarvonshire. It conceals itself among the foliage in summer, constructing a cell of white silk on the inferior surface of a leaf, the sides of which are curved towards it and retained in that position by fine lines of silk. The male has the palpal organs completely developed in June, and in that month females may be seen having the abdomen greatly distended with eggs.

A specimen of *Clubiona comta,* captured by Miss Ellen Clayton at Church Town, in the north of Lancashire, was transmitted to me, with some other spiders, in the summer of 1843.

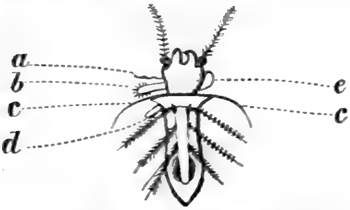
V.—*On the* Skeneadæ. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Exmouth, June 3, 1851.

I present an account of a highly important unrecorded animal, that has long been sought for, not only by the simple malacologist, but by the professors of the science, to settle the apocryphal family of the Skeneadæ. To show that its acquisition is very desirable, I need only mention that Professor Forbes did me the honour to request that I would include this minute creature in my researches, as he thought it would in all probability resolve a malacological problem. I subjoin a rude sketch of the animal.

Lower surface of the animal, without the shell, magnified 25–35 times.



EXPLANATION.

a. Genitale.
b. Semi-serrated neck-lobe.
c, c. Curved auricles of the foot.
e. Shorter plain neck-lobe.
d. Anus.

The other organs shown are the eyes and ciliated tentacula. The vibracula, springing from tubercles of the operculigerous lobe, which carries an orbicular spiral corneous operculum of 6–8 gyrations, and the sole of the foot.

Trochus serpuloides, Mont. (certe).

Skenea divisa, Fleming et auct.

Animal inhabiting a discoid white shell of three spiral turns, striated around the umbilicus of the body-volution with fine capillary lines, the upper part of the whorl being plain; it is pure hyaline white, except the eyes and head-disk. The head is a rather long, broad, finely wrinkled proboscidal muzzle, with a vertical fissure, having a pale red or pink disk, from whence the corneous jaws and lingual riband may sometimes be seen in action, but not so conspicuously as in the *Rissoæ*; the tentacula are long, flattish, frosted on the central line of the stamens, not irregularly setose at the edges, but most elegantly clothed, each on both sides, with 12–14 long hyaline cilia, arranged in symmetrical series, inclining obliquely from base to point, and diminishing in length in like manner. I have never seen tentacula so elaborately adorned: the eyes are very large, black, and lateral, attached nearly at the external bases on round inflations to the main stems, there being no distinct pedicles: no head-lobes were detected. There are two neck-lappets of different form, the one on the right side being narrowish, flat and semiserrated; that of the columellar range is shorter, more suboval, and plain. The foot is subtruncate or subrotund in front, superficially labiated, forming at the angles long curved linear auricles somewhat of the shape of the *Murex varicosus* (*Nassa*, nonnull.), but longer in proportion, thin at the edges of the sole, which is not fringed; it is moderately long and rather obtusely pointed; the operculigerous lobe is also plain, the prototype of the sole, though diminished to be well within its margins; it carries near the extremity the circular corneous moderately close-set spiral operculum of 6–8 turns, and on each side, at equal distances, three not very long nor slender flattish tentacular filaments issuing from tubercles of the same elegant structure as the capitular ones; these are not vibrated with the usual activity of the tribe, but the curved auricles of the foot may be said to be "læte vibrantes." The genitale springs under the right tentaculum; it is flat pointed and lies horizontally, nearly extending to outside the aperture, not reflected in the branchial vault. The canal of depuration is visible at the right side just above the first vibraculum; it is a short pendent shoot or cylinder. This animal inhabits the coralline zone in fifteen fathoms water, five miles off Budleigh Salterton; it is active, marches with quickness, not at all shy, and gave me good opportunities of observing its points.

It thus appears that the principal differences between this species and its congeners are the mere specialties of the want of distinct eye-pedicles, and the long linear curved auricles of the foot. Axis $\frac{1}{35}$, diameter $\frac{1}{20}$ unciæ.

This very important discovery of a desideratum that has hitherto escaped detection proves that the animal is nearly a strict *Trochus*, which does not in the specialties show a greater departure from the trochidian type than is often seen amongst the most classic species. This fact determines the fate of the genus *Skenea*: its provisional members, the *S. Cutleriana* and *S. nitens* of Philippi, called by some authors "*Trochus pusillus*," are in all probability *Trochi*; but I will not venture to say as much of *S. nitidissima*. The *S. lævis* is scarcely a variety of our present species. The *S. costulata* is apocryphal.

Professor Forbes, when he deposited these species provisionally in *Skenea*, with infinite sagacity predicted that they would probably prove *Trochi*; he is right, at all events, as to the one he considered would when discovered determine the position of the others. I did not concur in this opinion, as I thought the entirety of the aperture and its want of angularity did not harmonize with the typical Trochidæ; my conjectures have not been confirmed; but I feel pleasure in having the good fortune to discover my own error, and verify the acuter perceptions of this profound naturalist.

Can the genus *Skenea* be maintained even for the so-called "*planorbis*"? which I have for the second time just examined; it appears to be absolutely a discoid *Rissoa*, allowing the necessary margin for specialties of the shape of the foot, operculigerous lobe, tentacula and opercula: these organs greatly vary in the *Rissoæ*, and often differ more with each other, and the type, than even the discoidal "*planorbis*." Ought there not to be two sections in *Rissoa*,—one for the elongated *Cerithium reticulatum*, which repeated examinations tell me does not exhibit a difference from it in any material point, and might as respects the animal be the type, instead of *R. parva,* and the other for the "*planorbis,*" which is equally a *Rissoa* of another form?

I have scarcely a doubt that the *Adeorbis subcarinatus,* from the aperture being of the same character as the *Trochus serpuloides, T. Cutlerianus* and *T. nitens,* will, when discovered, turn out a *Trochus* in all essential characters, even if it has a testaceous operculum like its near relative *Phasianella pullus.* Surely the British list may with advantage be relieved from the superfluous genera *Cerithium* and *Skenea,* and ultimately probably from *Adeorbis.* Is it to be contended, that because an animal has an elongated shell of twelve volutions, and another a discoidal one of three, it cannot be a *Rissoa,* and that such a departure from the type demands that the genus *Cerithium* be constituted for the one and *Skenea* for the other? I would ask, what is the classic number of volutions which stamp the Rissoidean animal? It may be said that the so-called *C. reticulatum* has a canal at the base of the aperture; this is scarcely so; it is a mere contraction and attenuation at that part, giving an effuse aspect; the mantle is even with the shell, without a canaliculation: many of the *Rissoæ* have these parts quite as much developed. Again, it is said that its operculum and that of the so-called *Skenea planorbis* are suborbicular: I say, not more so than some of the *Rissoæ*; and both these animals have very much the same paucispiral rapidly increasing character of the opercular increment as in the *Littorinæ.* I think that the *C. reticulatum* and *S. planorbis* differ less from the Rissoidean type, the *parva,* than any other of the *Rissoæ* admitted by authors into that genus. If these positions are not admitted, we ought, to be consistent, to manufacture a separate genus for every petty variation of each *Rissoa,* and expunge the term 'species' from the molluscan vocabulary.

I am, Gentlemen, your most obedient servant,

William Clark.

Exmouth, 3 P.M., June 3, 1851.

P.S.—I have great satisfaction to say that whilst I am writing, I have under examination the so-called *Skenea Cutleriana,* discovered alive within the last half-hour. The animal at first view exhibits the general characters of *Trochus serpuloides*; the only differences between the two are, that in the now *Trochus Cutlerianus* the cilia of the tentacula and vibracula are less close-set, the curved auricles of the foot much flatter and broader, the foot both anteally and posteally more rounded, and the eye-prominences may almost be called very short pedicles. The animal is infinitely more active, exhibiting a three or four times greater rapidity of locomotion. I fully expect to examine the *Skenea nitens,* and perhaps the *Adeorbis subcarinatus.*—W. C.

Since the above was written, my expectation respecting the *S. nitens* has been verified by the occurrence of three live specimens. I have thus had the singular satisfaction of contemporaneously examining three rare unrecorded creatures;—I almost think a similar concatenation will scarcely again occur to any naturalist:—

Skenea? now *Trochus, nitens,* nobis; *Trochus pusillus,* auct.

The same difficulty in distinguishing the specialties of this species from those of the two preceding ones exist. I can only say, that the tentacula and vibracula may be less long in proportion, the foot shorter, broader, and more rounded in front and behind, with the curved auricles more free or less attached to the anterior line of the foot, being only amalgamated with it by a broadish central lobe of union, than in either of the others; the eye-pedicles may also be more pronounced than in *T. serpuloides,* but less so in *T. Cutlerianus.* I never saw three animals so similar, malacologically, with the hard parts so decidedly differing in most respects. I may say that this species has four lateral vibracula, and it is possible the other two may have the same number. In these very minute beings, from the continual change of position, we cannot always arrive at facts with certainty. My own impression is that all of them have four vibracula; but however this may be, in a generic point of view it is of no moment. This is the minutest animal of the three, and by far the most active; thus again showing, as I formerly observed in the 'Annals,' on *Cæcum glabrum,* that nature, as she diminishes in volume, usually accompanies that condition with an equivalent of increased energy and activity.

And finally, in addition to the three species just noticed, I give a list of others I have examined, the animals of which I believe are all unrecorded ones, and will be communicated when the minutes are reduced to order.

Chem. Sandvicensis.
C. decussata.
C. elegantissima.
C. pusilla: very distinct; not a var. of *C. elegantissima.*
Rissoa costata.
R. soluta.
R. reticulata; *Beanii,* nonnull.

The two following may have been mentioned, but perhaps fuller accounts will be acceptable.

Rissoa inconspicua, Alder.
Conovulus bidentatus?

Addendum to the Paper on the Classification of the British Marine Testaceous Mollusca, 'Annals,' vol. vii. p. 469.

Exmouth, June 19, 1851.

In the postscript to this paper, I stated that the foot of the *Conovulus denticulatus* was entire, and beyond doubt it breathed free air, and that the species usually called the *C. bidentatus* or *albus* had the foot divided transversely, and I considered it a *Pedipes,* and probably a pulmonifer. Since the above was written, I have decisively verified the last condition, and for the third time, the transverse scission of the foot. The *Conovuli* may therefore be regarded as established pulmonifers, and probably hermaphrodites with mutual congression: perhaps the better term for the respiratory qualities of this family and the Limneadæ would be pulmonibranchiates. Their position in my classification remains the same. I beg that *Carychium* may be added to the Conovulidan family, and, for the *present at least,* be regarded as a diœcious pulmonifer. Its position in the diagram of genera requires no change—it is only to be deemed a Conovulidan. With respect to *Acme* I have greater difficulty; the animal requires further investigation. I would be greatly obliged for some examples, sent in a half-pint bottle, in fine moss, *well saturated,* guarded by a wooden case, *per post*—moss in such a sized bottle would for a sufficient period escape exsiccation.

As to *Cyclostoma,* though much more allied in structure to the *Paludinæ* and *Littorinæ* than to the free air-breathing animals, it may be more correct to term it a pulmonifer terrestris.—W. C.

[Errata *in my paper on the Classification of the Mollusca,* 'Annals,' vol. vii. p. 472, 1st column,

Fifth Division.

For * Oculi ad basin externam tentaculorum, *read* Oculi ad basin externam tentaculorum, *Assiminia* excepta.

And in the 2nd column of the same page, 472, **** proboscidifera et canalifera, *for* Oculi ad *basin externam* tentaculorum, *read* Oculi ad *latus externum* tentaculorum.]

VI.—*Descriptions of new species of Coleopterous Insects.* By T. Tatum, Esq., M.E.S.

Iresia smaragdina.

Of a brilliant green above; all the joints of the antennæ black; first joint of palpi fulvous, the two last black; two deep curved lines between the antennæ, the concavities directed outwards and connected in the centre by a transverse impression. Clypeus gray, base dark; mandibles with the tip dark, the base fulvous. Head and thorax smooth and of a brilliant green. Elytra with deep sinuous transverse grooves, at the bottom of some of which are faint reddish reflections. Under part of body green, last divisions of abdomen with a slight golden tinge. Trochanters and femora fulvous. Tibiæ and tarsi black. Length $5\frac{1}{4}$ lines; breadth $1\frac{1}{2}$ line.

Hab. Brazil.

This species is larger than the *Iresia Lacordairei,* its thorax is wider behind, and the elytra are wider than in that species.

Odontocheila DeGandii.

Brilliant copper colour with slight bluish reflections. Head large, covered with fine waved lines; eyes prominent; palpi and antennæ fulvous; clypeus fulvous with black tip; mandibles fulvous with black tips. Thorax narrow, shortish, sides slightly rounded, central furrow well marked; anterior and posterior furrows indistinct; surface marked by numerous waved and irregular striæ. Elytra parallel, posterior angles well defined; posterior margins having a central prominence; the surface covered with irregular and waved striæ; two well-defined white marks on each elytron, one a little below the middle, a sinuous line beginning a little within the margin and ending before reaching the suture in a hook directed forward; the second mark nearly round, situated just beyond the posterior angle and just within the margin. Under part of the body bright copper, except last divisions of abdomen which are reddish, and not metallic. Trochanters and upper part of femora fulvous, lower part of femora and tibiæ darker, tarsi nearly black. Length 4 lines; breadth 1 line.

Hab. Minas Geraes, Brazil.

In form like *O. nodicornis,* but less than half its size, and with the thorax neither so long nor so cylindrical as in that species.

Tetracha viridis.

Of a brilliant green. Head with two deep irregular indentations between the eyes, surface smooth and polished, with a few slightly marked striæ near the eyes; clypeus black; antennæ brown, the two first joints black, the two next black, with small brown points at the root. Palpi reddish brown, with the tips of the last joints black; mandibles reddish brown at the base, black at the extremity. Scutellum black. Under part of body black with green reflections. Femora black. Trochanters, tibiæ and tarsi pitchy. Length 8 lines; breadth $2\frac{1}{2}$ lines.

Hab. Minas Geraes (Brazil); M. DeGand.

This species resembles *T. elongata,* but differs in colour, in the head being smaller and the eyes less prominent, in the thorax being more cylindrical, less cordiform, and with the central depression less marked; the elytra are narrower, less deeply and less numerously punctured, and the surface more smooth and polished.

Myrmecoptera læta.

Elytra with a single white mark on each, beginning just below the shoulder, extending along the middle of the elytron to the centre, where it gets narrower and inclines to the outer margin, which it accompanies but does not quite include; again becoming broader it terminates at the angle of the suture; puncta very numerous and metallic. Also a row of larger impressions likewise metallic near to, and parallel with, the suture. Trochanters, femora, &c., black. Length 6 lines.

Hab. Abyssinia.

This species resembles *M. egregia,* Germar, but is much larger, the head is smaller, and the thorax is longer, narrower, and more cylindrical.

Carabus Boysii.

Dull black. Head rather large and finely punctured; mandibles large; last joints of palpi strongly securiform. Thorax cordiform and finely punctate, with a well-defined central furrow; anterior margin slightly concave and raised into a border; posterior margin also slightly concave, sides sinuous with elevated borders, posterior angles considerably prolonged backwards. Elytra elongate, oval, narrower before than behind, strongly striated, each stria finely punctated and each interval punctated, but more coarsely; each elytron with three rows of deep and regular indentations. Length 14 lines; breadth 4½ lines.

Hab. India.

This species comes near to the *Carabus sylvestris.*

VII.—*Some Remarks on Mosses, with a proposed new Arrangement of the Genera.* By William Mitten, A.L.S.

The author has been induced to offer to the consideration of bryologists the arrangement proposed below, from an impression that it may engage the attention of others more competent than himself to grapple with the difficulties which continually arise in endeavouring to strike out new arrangements, and whose more extensive knowledge of the vegetable kingdom may enable them at a glance to come to a proper appreciation of the conclusions he has arrived at.

It was in 1847, whilst examining *Phascum multicapsulare* of

Smith, that the author's attention was first arrested by the fact that all the Cleistocarpous Mosses might be distributed among the Stegocarpous genera; since which the subject has been neglected; and he now publishes his ideas from seeing in the most recent works on bryology the continued adhesion to the old plan of keeping up a class of Cleistocarpous genera and species.

In all arrangements of plants, Mosses, *Musci,* and Liverworts, *Hepaticæ,* are placed after Equiseta, Lycopodia, and Ferns, as though these tribes were possessed of a higher degree of development; and even in the last systematic work on Mosses, by M. C. Müller, the definition of the order commences with "Plantæ Agamæ," a term altogether inapplicable to *Musci* and *Hepaticæ,* however well it may agree with the tribes above mentioned, which, so far as seems known, are truly agamous.

The Musci may be defined as follows:—

Plants with stems bearing horizontal leaves which are mostly composed of one layer of cells and furnished with thickened nerves. Inflorescence surrounded by proper involucral leaves. Male flowers composed of anthers, *antheridia*: female of pistils, *archegonia,* which, as well as the antheridia, are mixed with slender threads, *paraphyses.* Fruit an unilocular capsule bursting at the sides or operculate, surmounted by a calyptra.

From this definition it is apparent that the Musci are neither agamous nor cryptogamous, but are the highest order of Acotyledons, forming the next link to Monocotyledons, and, with Hepaticæ, are entitled to take precedence of the Filices, Lycopodia and Equiseta, in which inflorescence is unknown. On one side the Musci, with their horizontal nerved leaves and the presence of stomata in their capsules, approach to Monocotyledons; on the other side the Hepaticæ, which, with their nerveless semi-vertical or vertical leaves, and the form of their perianths, especially in *Jungermannia, Plagiochila* and *Radula,* resembling very closely the involucra of *Hymenophyllum* and *Trichomanes,* come near to the Filices.

The inflorescence of Mosses is dioicous, monoicous, or hermaphrodite. In the growth of the species that are usually termed acrocarpous, the first flower produced appears to be always male; and it is upon an innovation from beneath, or rarely through this, that the female flower and fruit are borne. In some species the antheridia are found in the axils of the comal without proper involucral leaves; not springing out as a secondary growth, but appearing to be left there by the elongation of the axis, which has passed as it were through the first and male flower to form the female, as seen in *Bryum nutans.* In *Polytrichum undulatum* after the production of a male flower the growth is resumed by the axis through the centre of the flower, and a female flower produced at a considerable distance. It is only such mosses as these that are strictly acrocarpous. In *Funaria hygrometrica,* which in its mode of growth represents most of the so-called acrocarpous mosses, the plant first forms a male flower, then bears female flowers on innovations arising below it: but if the female flower had been produced at the point whence the innovation proceeded, without the innovation, it must have been considered pleurocarpous, as in *Zygodon compactus* (*Hedwigia æstiva,* Eng. Fl.); although it would in that case be as much acrocarpous as it actually is. In *Fissidens* the flowers are all terminal, or only the female terminal, or both sexes lateral; both of which last cases occur at times in *F. bryoides.* In the Hypnoid Mosses the mode of growth appears more complicated; the principal axis being in many respects like a rhizoma growing at one end and decaying at the other, producing roots at the side and not having the lower end of the axis divided into roots.

The capsules of Mosses are either without a regular opening and bursting at the sides, *astomate*; or furnished with a persistent or deciduous lid, *operculum,* which on its removal leaves the capsules closed by a membrane, *stomate*: the mouth of the capsule naked, *gymnostomate*; or with highly hygroscopic teeth arising from its inner walls, *peristomate*; or with the sporular sac also divided above into processes and cilia, *diploperistomate.*

In some well-marked genera, as *Encalypta, Orthotrichum* and *Zygodon,* there exist gymnostomate, peristomate and diploperistomate species, too closely allied in all other respects to be separated generically in any natural arrangement. In *Weissia,* including as of one genus, *Astomum Mittenii, Phascum crispum, P. rostellatum,* and all the *Hymenostoma, Gymnostoma,* and *Weissiæ* of 'Bryologia Europæa,' are seen species astomate, stomate, gymnostomate, and peristomate; and most of these mosses without the presence of fruit would be difficult enough to distinguish as species, to say nothing of genera;—from which the conclusion seems evident, that as a more or less perfect series of progressive development from astomate to diploperistomate capsules may occur in a single genus, so any degree of development less perfect than the diploperistomate may be considered but an imperfect state of that degree, and of no importance in generic distinctions whenever it is possible to trace a higher.

The calyptra consists of the enlarged upper part of the archegonium, and is dimidiate, mitriform, or calymperoid, the last form being as it were a large mitriform calyptra split on one side; but it well marks the few genera in which it is found.

In the following arrangement, the plan of dividing the genera into groups dependent on the form of the cells of the leaves, as employed by M. C. Müller in his Synopsis, has been used, with however some considerable modifications, and, unless otherwise stated, the genera correspond with those adopted in that valuable work.

Tribe I. Andreæaceæ.

Cells of the leaves parenchymatous, but very minute and remote. Capsule astomate, bursting regularly at the sides near the apex. Sporular sac adhering throughout to the external wall of the capsule. Calyptra mitriform. Small mosses, mostly of a deep brown or blackish colour: growing on rocks.

Genus 1. Andreæa, *Ehrh.*

Tribe II. Dicranaceæ.

Cells of the leaves partly prosenchymatous and partly parenchymatous, lax or more or less incrassated. Capsules mostly inclining to a cylindrical form, and sometimes arcuate, astomate, gymnostomate and peristomate. Teeth sixteen, each more or less forked or divided down the middle. Calyptra mitriform or dimidiate. Small or very large mosses, having mostly narrow leaves, which are attenuated from a complicate or clasping base, and with broad flattened nerves: growing on the earth, on rocks, or on trees.

Sect. 1. *Leptotrichoideæ.*

Leaves without enlarged cells at the base.

Genus 1. Archidium, *Brid.*

2. Bruchia, *Schw.*, including Phascum exiguum, *Hook. et Wils.*, Eccremidium, *eorund.*, and Garckea phascoides, *C. Müller* (Dicranum, *Hook.*).

3. Angstrœmia, *B. et S.*, *C. Müller,* including Astomum, *Hampe.*

4. Trematodon, *Rich.*

5. Brachyodus, *Furnr.*

6. Campylostelium, *B. et S.*

7. Seligeria, *B. et S.*

8. Symblepharis, *Mont.*

9. Leptotrichum, *Hampe,* including Lophiodon, *Hook. et Wils.*

10. Distichium, *B. et S.*

11. Eustichia, *Brid.*

12. Drepanophyllum, *Rich.*

Sect. 2. *Dicranoideæ.*

Leaves with enlarged and mostly coloured cells at the base.

13. Blindia, *B. et S.*

14. Eucamptodon, *Mont.*

15. Holomitrium, *Brid.*

16. Dicnemon, *Schw.*
17. Pilopogon, *Brid.*
18. Dicranum, *Hedw.*

Tribe III. Pottiaceæ.

Cells of the leaves all parenchymatous, often minute, incrassated and papillose. Capsules astomate, stomate, gymnostomate, peristomate, and diploperistomate. Teeth sixteen or thirty-two, often cohering together: internal peristome of cilia. Calyptra mitriform, dimidiate, or calymperoid. Small or rather large mosses with chlorophyllose lanceolate or strap-shaped leaves, having terete nerves and smooth or striate capsules: growing on the earth, on rocks, and on trees.

Sect. 1. *Trichostomoideæ.*

Peristome of narrow slender teeth.

Genus 1. Schistidium, *Brid.*, including Acaulon, *C. Müller.*

2.? Gonomitrium, *Hook. et Wils.*

3. Pottia, *Ehrh.*, *C. Müller*, including Phascum bryoides, P. rectum, P. curvicollum, P. cuspidatum, P. subexsertum, P. splachnoides, P. tetragonum, P. cylindricum, and P. Drummondii; but scarcely distinguishable from the next genus.

4. Trichostomum, *Hedw.*

5. Barbula, *Hedw.*

6. Streptopogon, *Wils.*

7. Ceratodon, *Brid.*

8. Weissia, *Hedw.*, *C. Müller*, including Astomum crispum, A. Mittenii, A. multicapsulare, and A. rostellatum of *Bryol. Europ.*

9. Syrrhopodon, *Schw.*

10. Calymperes, *Sw.*

11. Tridontium, *Hook. fil.*

Sect. 2. *Zygodontoideæ.*

Peristome of broad teeth.

12. Coscinodon, *Spreng.*
13. Glyphomitrium, *Brid.*
14. Brachystelium, *Rchb.*
15. Gumbelia, *Hampe.*
16. Grimmia, *Ehrh.*
17. Cryptocarpus, *Dzy. et Molk.*
18. Drummondia, *Hook.*
19. Zygodon, *Hook. et Tayl.*
20. Orthotrichum, *Hedw.*
21. Macromitrium, *Brid.*
22. Schlotheimia, *Brid.*
23. Encalypta, *Schreb.*

Tribe IV. Funariaceæ.

Cells of the leaves parenchymatous, lax. Capsules more or less pyriform, apophysate, astomate, stomate, gymnostomate, peristomate, and diploperistomate. Teeth sixteen or thirty-two, sometimes cohering together: internal peristome of processes and cilia. Calyptra mitriform, dimidiate, or calymperoid. Mosses of great beauty, with chlorophyllose or pale pellucid leaves, and with capsules having sometimes remarkably large and coloured apophyses: growing on the earth or on decaying animal or vegetable matter.

Sect. 1. *Funaroideæ.*

Capsules not remarkably apophysate. Peristome of trabeculate teeth.

Genus 1. Ephemerum, *Hampe.*
2. Ephemerella, *C. Müller.*
3. Physcomitrium, *Brid.*, including Phascum patens, *Hedw.*, and Schistidium serratum, *Hook. et Wils.*
4. Pyramidium, *Brid.*
5. Entosthodon, *Schw.*
6. Discelium, *Brid.*
7. Funaria, *Schreb.*
8. Amblyodon, *Pal. de Beauv.*

Sect. 2. *Splachnoideæ.*

Capsules sometimes remarkably apophysate. Peristome of mostly geminate teeth, which are not trabeculate.

9. Œdipodium, *Schw.*
10. Tetraplodon, *B. et S.*
11. Tayloria, *Hook.*, including Voitia, *Hsch.*
12. Dissodon, *Grev. et Arnott.*
13. Splachnum, *Linn.*

Tribe V. Bryaceæ.

Cells of the leaves in the upper parts prosenchymatous, in the lower parallelogram. Capsules pyriform, clavate or cylindrical, stomate, gymnostomate, peristomate, and diploperistomate. Teeth sixteen: internal peristome of processes and cilia. Calyptra dimidiate. Small or rather large and graceful mosses, mostly with pendulous capsules: growing on the earth, on rocks, and on trees.

Genus 1. Schistostega, *Mohr.*
2. Meilichhoferia, *Hsch.*
3. Leptochlæna, *Mont.*
4. Orthodontium, *Schw.*
5. Bryum, *Dill.*

Tribe VI. BARTRAMIACEÆ.

Cells of the leaves parenchymatous. Capsules pyriform or globose, gymnostomate, peristomate, and diploperistomate. Peristome as in *Bryum*, but the processes splitting down the middle. Calyptra dimidiate. Small or very large mosses, mostly with rigid papillose leaves, and pyriform or globose capsules: growing on the earth or on rocks.

Genus 1. Oreas, *Brid.*
2. Catoscopium, *Brid.*
3. Plagiopus, *Brid.*
4. Meesia, *Hedw.*
5. Paludella, *Ehrh.*
6. Conostomum, *Sw.*
7. Bartramia, *Hedw.*

Tribe VII. MNIACEÆ.

Cells of the leaves parenchymatous, with cartilaginous walls. Capsules oval or cylindrical, gymnostomate, peristomate, and diploperistomate. Teeth four or sixteen: internal peristome of processes and cilia. Calyptra mitriform or dimidiate. Small or very large and beautiful mosses: growing on the earth, on rocks, or on trees.

Genus 1. Hymenodon, *Hook. et Wils.*
2. Fissidens, *Hedw.*
3. Octodiceras, *Brid.*
4. Mniadelphus, *C. Müller.*
5. Daltonia, *Hook. et Tayl.*
6. Cinclidotus, *Pal. de Beauv.*
7. Scouleria, *Hook.*
8. Georgia, *Ehrh.*
9. Leptostomum, *R. Brown.*
10. Leptotheca, *Schw.*
11. Timmia, *Hedw.*
12. Mnium, *Dill.*, including Cinclidium, *Sw.*

Tribe VIII. HYPOPTERYGIACEÆ.

Cells of the leaves prosenchymatous. Leaves dimorphous. Capsules gymnostomate? and diploperistomate. Teeth sixteen: internal peristome of processes and cilia. Calyptra mitriform and dimidiate. Very beautiful mosses, with simple or pinnate stems and tristichous leaves, one row of which are smaller and resemble stipules: growing on the earth or on trees.

Genus 1. Hypopterygium, *Brid.*
2. Cyathophorum, *Pal. de Beauv.*
3.? Helicophyllum, *Brid.*

Tribe IX. Hypnaceæ.

Cells of the leaves prosenchymatous, but mostly a few quadrate coloured ones at the base of the leaf. Capsules gymnostomate, peristomate, and diploperistomate. Teeth sixteen: internal peristome of processes and cilia. Calyptra mitriform, dimidiate, or calymperoid. Small or large mosses with simple or much branched stems, and nerveless or one or more nerved leaves: growing on the earth, on rocks, or on trees.

Genus 1. Rhegmatodon, *Brid.*
2. Fabronia, *Raddi.*
3. Neckera, *Hedw.*
4. Aulacopilum, *Wils.*
5.? Wardia, *Harvey.*
6. Phyllogonium, *Brid.*
7. Pilotrichum, *Pal. de Beauv.*
8. Hookeria, *Smith.*
9. Hypnum, *Dill.*

Tribe X. Polytrichaceæ.

Cells of the leaves parenchymatous, firm. Capsules stomate and peristomate. Peristome of numerous inarticulate cilia, free or combined together, and forming short tooth-like processes which are more or less adherent to the tympaniform expansion of the columella at the mouth of the capsule. Calyptra dimidiate. Small or very large mosses, mostly with rigid acute leaves, large, more or less angular, asymmetric capsules, and calyptras mostly covered with hair: growing on the earth.

Genus 1. Lyellia, *R. Brown.*
2. Polytrichum, *Dill.*
3. Dawsonia, *R. Brown.*

Tribe XI. Buxbaumiaceæ.

Cells of the leaves partly parenchymatous and partly prosenchymatous. Capsules asymmetric, peristomate and diploperistomate. Teeth beaded, free, or coherent together: internal peristome of a plicate membrane. Small but remarkable mosses, with very large asymmetric capsules: growing on the earth, on rocks, or on trees.

Genus 1. Diphyscium, *Web. et Mohr.*
2. Buxbaumia, *Haller.*

Tribe XII. Leucobryaceæ.

Cells of the leaves in one or more layers, dimorphous, external partly parenchymatous and partly prosenchymatous, foraminose on the internal walls, colourless; internal cells placed between the external layers, minute, chlorophyllose and duct-like. Capsules cylindrical, gymnostomate? and peristomate. Teeth eight or sixteen. Calyptra mitriform or dimidiate. Mosses remarkable for the pale colour, iridescence, and structure of the cells of their leaves: growing on the earth, on rocks, or on trees.

Genus 1. Octoblepharum, *Hedw.*
2. Arthrocormus, *Dzy. et Molk.*
3. Leucophanes, *Brid.*
4. Schistomitrium, *Dzy. et Molk.*
5. Leucobryum, *Hampe.*

Tribe XIII. SPHAGNACEÆ.

Cells of the leaves dimorphous, prosenchymatous, the larger colourless, perforate, often containing annular fibres; the smaller chlorophyllose, placed between the larger. Capsules gymnostomate. Calyptra covering the whole capsule. Large mosses, with erect stems, pale or rose-coloured leaves, and globose sessile capsules: growing in bogs.

Genus 1. Sphagnum, *Dill.*

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION.

Friday, February 7, 1851.

On Metamorphosis and Metagenesis. By Professor OWEN.

THE Lecturer commenced by passing under review the Linnæan characters of Minerals, Vegetables, and Animals, and the subsequent distinctions which had been proposed for the discrimination of the two latter kingdoms of nature. After discussing those founded on motion, the stomach, the respiratory products, the composition of the tissues, and the sources of nourishment, it was shown that none of these singly define absolutely the boundaries between plants and animals; it requires that a certain proportion of the supposed characteristics should be combined for that purpose.

The individuals in which such characters are combined are specially defined members of one great family of organized beings, and the supposed peculiarly animal and vegetable characters taken singly, interdigitate, as it were, and cross that debatable ground and low department of the common organic world from which the specialized plants and animals rise; and there are numerous living beings with the common organic characters that have not the distinctive combined superadditions of either group.

Between the organic and inorganic worlds the line of demarcation may be more definitely drawn. The term 'growth' cannot be used in the same sense to signify the increase of a mineral and of an organism. The mode of increase is different: there is a definite limit to it in the organic kingdom, and something more than mere growth takes place in the progress of an organism from its commencement to maturity. This was exemplified by reference to the human subject, to the lion which acquires its mane, to the stag which gets its horns, and to the change of plumage in birds during the course of growth. The changes of form and character are still more remarkable in the kangaroo; and in the frog they are such as to have received the name of '*metamorphosis.*'

The development of the frog was traced to its exclusion from the egg in the form of a fish, with external gills, a long caudal fin, and without legs.

The internal skeleton, like the external shape, is adapted for aquatic life.

Only those parts are ossified which are to be retained in the mature state. The vertebræ are at first biconcave, as in fishes, with invervening spherical elastic balls filled with fluid: they are converted into ball and socket joints by the ossification of the sphere, and its anchylosis to the back part of the vertebræ. The pelvis and hind legs are progressively developed; and, whilst this change is proceeding, the tail is undergoing proportional absorption. The chief change in the skull of the larva is operated in the lower or hæmal arches and their appendages. The maxillary arch is widened and provided with teeth, and the horny mandibles are shed. The mandibular arch retrogrades as well as expands. The hyoidean undergoes a remarkable change of size and shape, and the branchial arches are absorbed, excepting a small portion which is converted into the hinder 'horns' of the hyoid for supporting the larynx.

The scapular arch, which at first was connected with the occiput, whilst supporting the branchial heart—its primary function, begins, as soon as the fore legs bud out, to retrograde, and the sternum is developed to complete the 'point d'appui' for the fore limbs.

The food of the larva is chiefly the soft decaying parts of aquatic plants; it has a horny beak, a long alimentary canal disposed in a series of double spiral coils: but, as its frame undergoes the changes adapting it for life on land, and a purely animal diet, the mandibles are converted into jaws and teeth, and the long spiral intestine into a short and slightly convoluted one.

Soon after the external gills have reached their full development they begin to shrink and finally disappear; but the branchial circulation is maintained some time longer upon internal gills: by anastomoses between the principal branchial vessels these are converted into the aortic arches, carotids and subclavians; the internal gills with the cartilaginous hoops supporting them are absorbed, and lungs and glottis for breathing the air directly are developed.

Thus an animal formed for moving in water is changed into one adapted for moving and leaping on land; a water-breather is converted into an air-breather; a vegetable feeder into a carnivorous animal: yet the series of transmutations are limited to the nature of the species and produce no other. The frogs that croak in our marshes are as strictly batrachian as those that leapt in Pharaoh's chamber; their metamorphoses have led to nothing higher than their original condition, as far as history gives us any knowledge of it. With each successive generation the series of changes recommences from the old point, and ends in a condition of the animal adapted to set the same series again on foot.

Having traced the principal stages in the metamorphosis of an animal from a swimmer to a leaper, the Lecturer next took an instance where one begins life as a burrower or a crawler, and is converted into an animal of rapid and powerful flight.

Most insects quit the egg in the form of a worm, which masking, as it were, a different and higher form, is called the 'larva'; it is active and voracious—but usually falls into a kind of torpor, during which the changes take place which issue in the flying insect; during the passive stage of metamorphosis it is called a 'pupa'; the last volant stage is the 'imago.'

The chief steps in the metamorphosis were traced as they affect the outward form, the digestive organs, the circulatory, and respiratory, and nervous systems.

The main differences in the metamorphoses of insects relate to the place where, and the time during which they are undergone. The young cockroach and the little aphis, which were first acephalous and apodal, and then had thirteen equal segments, with soft unjointed legs, proceed to acquire a distinct head with antennæ, a thorax with three pairs of long jointed legs, and an abdomen, before they quit the egg; they thus enter upon active life under the guise of a crab, instead of a worm. With regard to the *Aphis*, that insect, instead of proceeding to perfect its individual development, may at once begin the great business of its existence by parthenogenetic procreation. Bonnet's experiments, which first brought to light this marvellous fact, have received uniform confirmation from all subsequent inquirers, and no natural phænomenon is now better determined.

From seven to eleven successive generations have been traced before the individual has finally metamorphosed itself into the winged male or winged oviparous female.

In autumn, when the nights grow chilly and long, the oviparous imago completes her duty by depositing the eggs in the axils of the leaves of the plant, where they are protected from the winter frost, and ready to be hatched at the return of spring. Then recommences the cycle of change, which being carried through a succession of individuals and not completed in a single life-time, is a 'metagenesis' rather than a 'metamorphosis.'

This phænomenon, which until very recently was deemed an exception, and a most marvellous one, in Nature, now proves to be an example of a condition of procreation to which the greater part of organized Nature is subject.

The Lecturer was inevitably limited in his choice of illustrations: and proceeded to an instance of metagenesis from the radiated subkingdom of animals.

The stages of this metagenesis have been best and most completely traced in the *Medusa aurita*, by Siebold, Dalyell, Sars, and others.

The first step was made by Siebold, who, in 1839, traced the development of the *Medusa aurita* from the egg to a stage resembling a ciliated monad, then to a lobed rotifer, and next to a long-armed polype.

This polype stage of the *Medusa* had been previously recognised in 1788, but without a suspicion of its true nature, by O. F. Müller, who called it *Hydra gelatinosa*.

It was next observed, and its habits more fully described, by Sir John Dalyell, in 1834, as *Hydra tuba*: and in 1836 he made known its singular metamorphoses into forms which Sars had previously described as *Scyphistoma* and *Strobila*; and Dalyell saw the spontaneous division of the latter into a pile or series of small Medusæ. All the stages of the metagenesis were independently noted by Sars, who described them in 1841.

The difficulty of accounting for the presence of Entozoa in the interior parts of animal bodies is rapidly disappearing as the knowledge of their course of development advances.

The principal stages of this development were described in a small worm (*Monostoma mutabile*), parasitic in the air-cells, intestines, and peritoneal cavity of many water-fowl.

The ovum is converted into a ciliated monadiform embryo, which escapes from the bird, and swims about freely in the water. A clear mass may be discerned in the interior which exhibits independent movements. This body is liberated, grows rapidly, and generates in its interior a number of independent organisms provided with a cephalic speculum and a caudal appendage, referable by their form to the genus *Cercaria*. They are very active and insinuating, could even bore through the skin by the sharp needle-like armature of the head, and somehow or other do, under the guise of the *Cercaria*, again get access to the interior of the water-fowl; fall into a state of torpor; become circular flattened pupæ; and are finally metamorphosed into Monostomes—a sluggish pendent parasite utterly deprived of the power of existing in water, or of gaining access, as a Monostome, to the interior of any animal.

Steenstrup, who has the merit of having first grouped together and pointed out the analogies of the different stages in the animals that undergo these successive changes, generalizes the facts under the phrase of 'Alternate Generation,' and he calls the procreant larvæ 'Amme,' or Nurses, and 'Gross-amme,' or Grand-nurses. There is no particular objection to these names; but we naturally desire to know on what power the metageneses depend.

Professor Owen thought the key to the power was afforded by the process which the germinal part of every egg undergoes before the embryo begins to be formed.

A principle, answering to the pollen, that fertilizes the seed of plants, is the efficient cause of these changes: its mode of operating is best seen in the transparent eggs of some minute worms; the principle manifests itself as a transparent, highly refractive globule in the centre of the egg; it then divides; and each division, attracting the vitelline matter of the egg about it, divides that matter into two parts. This division is repeated with the same result, until the principle has diffused itself by indefinite multiplication through the whole yelk which then constitutes the 'germ-mass.'

The next stage is the formation of the embryo: certain of the minute subdivisions called 'nuclei' or nucleated cells, combine and coalesce to constitute the tissues of the embryos: they are afterwards incapable of generating. If all be so metamorphosed, the organism cannot procreate of itself; but if a part only of the germ-mass be metamorphosed into tissues, the unchanged remnant may, if nutrition, heat, and other stimuli are present, repeat the same actions as those that formed the first germ-mass, and lay the foundation of future embryos.

In proportion to the amount of the substance of an organism which retains the primitive condition of cells, is the power of producing new individuals without receiving a fresh supply of the pollen-principle.

Thus in a plant, when the seed has received the matter of the pollen-filament, analogous changes take place to those that have been described in the animal egg, and the embryo plant appears in the form of the cotyledonal leaf with its radicle or rootlet. From this shoots forth another leaf with its stem: and the cellular substauce of the pith with its share of the pollen-principle goes on developing fresh leaves and leaf-stalks; until a provision for developing fresh pollen is made by transforming certain individual leaves into a higher form of the 'phyton' or elemental plant. Thus a generation or 'whorl' of leaves assumes the character of sepals, another that of petals, a third that of stamens, a fourth that of pistils: and in the two latter forms we recognise the analogues of the perfect male and female of the animal.

The development of the compound polype follows very closely the stages of the compound plant, which we call shrub or tree: the ovum, like the seed, having received the pollen-principle, is converted into countless cells and nuclei of cells by the process for diffusing that principle through, or of assimilating it with, the matter of the egg. Then certain germ-cells are metamorphosed into a ciliated integument, and the larva starts forth in a state answering to the cotyledonal leaf of the plant: the ciliated larva settles, subsides, and shoots up a stem from which a digestive polype is developed, answering to the leaf: but the pollen-force not being exhausted, a second branch and polype are developed, and so on until a preparation is made for a fresh supply of pollen-force, by metamorphosing the polype into a higher form of individual; and this, in many compound polypes, is set free in the shape of a minute medusa.

The true nature and relation of the individual polype to the compound whole is well illustrated by the propagations of the Aphides.

By comparing with the diagrams of the metagenesis of the plant and polype, that of the Aphis, in which was represented the corresponding stages intervening between the ovum and the perfect male and female individuals of the *Aphis*, the analogy between these stages in the plant, the polype, and the insect, was shown to be both true and close. The microscopic fertilizing filament of the male *Aphis* answers to the microscopic pollen-filament of the male leaf or 'stamen;' the ovum of the female *Aphis* to the ovule of the female leaf or pistil: by their combination the fertile ovum results. The same processes of cell-formation ensue, and the embryo *Aphis* is formed by the combination and metamorphoses of certain of these secondary germ-cells; but it retains the rest unchanged in its interior, which may be compared with the cells of the pith of the plant, and with the cells in the corresponding more fluid part of the pith of the polype. Under favourable circumstances of nutriment and warmth, certain of these cells repeat the process of embryonic formation, and a larval individual like that from the ovum is thus reproduced; which is only not retained in connection with its parent, because the integument is not coextended with it.

The generation of a larval Aphis may be repeated from seven to eleven times without any more accession to the primary pollen-force of the retained cells than in the case of the zoophyte or plant; one might call the generation, one by 'internal gemmation'; but this phrase would not explain the conditions essential to the process, unless we previously knew those conditions in regard to ordinary or external gemmation.

At length, however, the last apterous or larval Aphis, so developed, proceeds to be 'metamorphosed' into a winged individual, in which either only the fertilizing filaments are formed, as in the case of the stamens of the plant, or only the ovules, as in the case of the pistil. We have, in fact, at length 'male and female individuals,' preceded by procreative individuals of a lower or arrested grade of organization,—analogues to the gemmiparous polypes of the zoophyte and to the leaves of the plant.

The process was described for its better intelligibility in the Aphides as one of a simple succession of single individuals, but it is much more marvellous in nature. The first-formed larva of early spring procreates not one but eight larvæ like itself in successive broods, and each of these larvæ repeats the process; and it may be again repeated in the same geometrical ratio until a number which figures only can indicate and language almost fails to express, is the result. The Aphides produced by this internal gemmation are as countless as the leaves of a tree, to which they are so closely analogous.

It generally happens that the metamorphosis which has been described as occurring after the seventh or eleventh generation takes place much earlier in the case of some of the thousands of individuals so propagated; just as a leaf-bud near the root may develope a leaf-stem and a flower with much fewer antecedent generations of leaves from buds than have preceded the formation of the flower at the summit of the plant; or just as one of the lower and earlier-formed digestive polypes may push out a bud to be transformed into a procreative and locomotive polype. The same analogy is closely maintained throughout.

The wingless larval Aphides are not very locomotive; they might have been attached to one another by continuity of integument, and each have been fixed to suck the juices from the part of the plant where it was brought forth. The stem of the rose might have been incrusted with a chain of such connected larvæ as we see the stem of a fucus incrusted with a chain of connected polypes, and only the last developed winged males and oviparous females might have been set free. The connecting medium might even have permitted a common current of nutriment contributed to by each individual to circulate through the whole compound body. But how little of anything essential to the animal would be affected by cutting through this hypothetical connecting and vascular integument, and setting each individual free! If we perform this operation on the compound zoophyte, the detached polype may live and continue its gemmiparous reproduction. This is more certainly and constantly the result in detaching one of the monadiform individuals which assists in composing the seeming individual whole called 'Volvox globator'; and so likewise with the leaf-bud. And this liberation Nature has actually performed for us in the case of the Aphis, and she thereby plainly teaches us the true value or signification in morphology of the connecting links that remain to attach together the different gemmiparous individuals of the volvox, the zoophyte, and the plant.

The analogy between the procreating larvæ of the *Aphis*, the *Medusa*, and the *Coralline* is so true and so close, that if the larval Aphis be a distinct individual and not a part, so must be the strobila, the planula, and the gemmiparous leaf: if the succession of larval Aphides be truly described, as a succession of generations, so must that succession of planula, polype, and strobila which leads to the oviparous Medusa; and that succession of planulæ and nutritive polypes which precede the detachment of the free procreative medusoid polypes in the Coryne; and the like with the plant-generations preceding the flower.

It would have been easy, if time permitted, to multiply the illustrations of the essential condition of these phænomena. That condition is, the retention of certain of the progeny of the primary fertilized germ-cell, or in other words, of the germ-mass, unchanged in the body of the first individual developed from that germ-mass, with so much of the pollen-force inherited by the retained germ-cells from the parent-cell or germ-vesicle as suffices to set on foot and maintain the same series of formative actions as those which constituted the individual containing them.

How the retained pollen-force operates in the formation of a new germ-mass from a secondary, tertiary, or quaternary derivative germ-cell, the Lecturer did not profess to explain; neither was it known how it operates in developing the primary germ-mass.

The botanist and physiologist congratulates himself with justice when he has been able to pass from cause to cause, until he arrives at the union of the pollen-filament with the ovule as the essential condition of development—a cause ready to operate when necessary circumstances concur, and without which those circumstances would have no effect.

The chief aim of the present discourse was to point out the circumstances which bring about the presence of the same essential cause in the cases of the development of the successive generations completing the metagenetic cycle of the Aphis, the Medusa, the Polype, and the Entozoon. The cause is the same in kind though not in degree, and every successive generation, or series of spontaneous fissions, of the primary germ-cell must weaken the pollen-force transmitted to such successive generations of cells.

The force is exhausted in proportion to the complexity and living powers of the organism developed from the primary germ-cell and germ-mass. It is consequently longest retained and furthest transmitted in the vegetable kingdom; the zoophytes manifest it in the next degree of force; and the power of retained germ-cells to develope a germ-mass and embryo by the remnant of the pollen-force which they inherited, is finally lost, according to present knowledge, in the class of Insecta and in the lower Mollusca.

ZOOLOGICAL SOCIETY.

June 11, 1850.—W. Spence, Esq., F.R.S., in the Chair.

A Monograph of Scarabus, a genus of air-breathing Gasteropodous Mollusca. By Arthur Adams, R.N., F.L.S. etc.

Scarabus, Montfort.

Testa ovata, spira subobtusa, anfractibus compressis, varice utrinque instructis; apertura ovali intus utrinque dentata; peristomate non continuo, labro simplici, subexpanso.

The *Scarabi* have the eyes sessile on the inner bases of the tentacles, which are short and annulated; they live like most of the other genera of *Auriculidæ*, in the damp woods and mangrove marshes. None have been found in the African or American regions, but all the species at present known are from the East Indies.

Scarabus imbrium, Montfort, Conch. Syst. vol. i.; Férussac, Prodrome, p. 101; Chemnitz, Conch. vol. ix. pl. 136. fig. 1249 & 1250.

Helix scarabæus, *Linn.*—Helix pythia, *Müller.*—Bulimus scarabæus, *Bruguière.*—Auricula scarabæus, *Lamarck.*

S. testâ ovato-pyramidali, rufo-fusco variegatâ, longitudinaliter valdè striatâ; spirâ acuminatâ; aperturâ subrotundatâ, spiram æquante; labro posticè inflexo.

Hab. Island of Bohol, Philippines; in dry woods, under stones, and in earth; *H. C.* (Mus. Cuming.)

The large size, pyramidal form and strongly striated epidermis are peculiar to this species: the upper tooth on the inner lip is more triangular, and the posterior part of the outer lip is more inflexed than in *S. Lessoni*.

Scarabus Lessoni, Blainville, Dict. Sci. Nat. pl. 48. fig. 32; Lesson, Voy. de la Coquille, vol. ii. p. 334. pl. 10. fig. 4.

Auricula Petiveriana, *var. Deshayes.*

S. testâ ovatâ, longitudinaliter substriatâ, rufo-castaneo variegatâ; spirâ lateribus concavis; aperturâ oblongâ, spirâ longiore; labio subplano, labro posticè arcuato.

Hab. New Ireland; *Hinds.* (Mus. Cuming.)

The oval form and oblong mouth render this species easily distinguished from *S. imbrium*: the upper tooth on the inner lip is longer, and two of the five teeth in the outer lip are more prominent than the others.

Scarabus Petiverianus, Férussac, Prodrome, p. 101; Petiver, Gazophylacia Naturæ, pl. 4. fig. 10.

Cochlea Bengalensis, *Petiver.*—Auricula Peteveriana, *Desh.*

S. testâ ovato-oblongâ, læviusculâ, longitudinaliter tenuissimè striatâ, albidâ castaneo variegatâ; aperturâ spiram æquante; labro arcuato.

Hab. Borneo; Cagayan, province of Misamis; Mindanao; in damp woods, under decayed leaves; *H. C.* (Mus. Cuming.)

This species is characterized by its smaller size, more ovate form, smoother epidermis, the arcuated outer lip, and rotundate aperture.

Scarabus trigonus, Troschel, Wiegmann's Archiv, 1840.

S. testâ triangulari, rufo-fusco marmoratâ, anfractu ultimo transverso gibbo angulato, aperturâ angustatâ, labro valdè reflexo.

Hab. Sarsogon; Luzon; dense woods, damp places; *H. C.* (Mus. Cuming.)

The triangular form, approaching that of *Tomogerus,* at once distinguishes this species: the middle tooth on the inner lip is double, the upper tooth prominent: there are five teeth in the outer lip, two being more prominent than the others.

Scarabus plicatus, Férussac, Prodrome, p. 101; Chemn. Conch. vol. ix. pl. 136. fig. 1252, 1253.

Helix scarabæus, *var. Chemn.*—Auricula plicata, *Deshayes.*—Scarabus triangularis, *Benson.*

S. testâ subtriangulari, obliquâ, gibbosâ, spirâ brevi, acuminatâ, lateribus concavis, anfractu ultimo posticè gibboso anticè subangulato distorto, epidermide longitudinaliter obliquè striatâ, castaneâ, fasciis pallidis confusè ornatâ; aperturâ angustâ, labio anticè flexuoso, labro arcuato, unticè valdè dilatatâ, reflexâ, rimâ umbilicali longâ transversâ.

Hab. India; *Benson.* Jaffna, in saline marshes; *Dr. Gardner.* (Mus. Cuming.)

Scarabus striatus, Reeve, Ann. & Mag. Nat. Hist. 1842, vol. ix. p. 220. fig. 9.

Auricula scarabæus, *Quoy, Voy. de l'Astrolabe, Zool.* vol. ii. p. 162. pl. 13. f. 24.

S. testâ ovato-trigonali, fusco variegatâ, longitudinaliter valdè striatâ; spirâ acuminatâ; labio antico subflexuoso.

Hab. San Nicholas, island of Zebu; *H. C.* (Mus. Cuming.)

The sharp-pointed spire, striated epidermis and flexuous inner lip, distinguish this form: in the outer lip two of the teeth are more prominent than the others, the intermediate ones being more or less divided or bifid.

Scarabus Cecillii, Philippi, Zeitsch. für Malacol. 1847, August.

S. testâ ovato-oblongâ, læviusculâ, tenuissimè in longum rugatâ, corneâ; anfractu ultimo interdum castaneo, superius corneo bifasciato; epidermide lineis obscuris ziczac-formibus, punctisque, marmoratâ.

Hab. China. (Mus. Cuming.)

The reticulated epidermis, narrow ovoid form, and angulated outer lip are peculiar to this species; the aperture is oblong, equal to the spire; the outer lip below the angle is rectilinear, and but three teeth are visible in the outer lip.

Scarabus undatus, Lesson, Voy. de la Coquille, Zool. vol. ii. p. 336. pl. 10. f. 6.

Auricula scarabæus, *var. Desh.*

S. testâ ovatâ, fuscâ, longitudinaliter valdè striatâ; striis undulatis subdecussantibus; anfractu ultimo posticè gibboso; labio arcuato, valdè reflexo.

Hab. ——? (Mus. Cuming.)

The waved elevated lines which cross each other irregularly on the back, and the last whorl posteriorly tumid, will characterize this species: the upper tooth is large and elongated on the inner lip, and the lower tooth of the outer lip is rather lamelliform.

Scarabus pyramidatus, Reeve, Ann. & Mag. Nat. Hist. 1842, vol. ix. p. 221. fig. 12.

S. testâ ovato-pyramidali, pallidâ, aurantio-fusco variegatâ, longitudinaliter substriatâ; aperturâ aureâ, labio circulari.

Hab. New Ireland; *Hinds.* Solomon's Islands; *Capt. d'Orville.* (Mus. Cuming.)

The pyramidal form, golden aperture, and light yellow-brown markings distinguish this species, though some specimens are much more ovate than others: the peritreme is double and thickened, the middle tooth of the inner lip is simple and thickened, and in the outer lip two of the teeth are large and conspicuous.

Scarabus Cumingianus, Petit.

S. testâ ovato-trigonâ, fuscâ, longitudinaliter substriatâ; anfractu ultimo valdè varicoso; aperturâ aeratâ, labio calloso, labro valdè posticè sinuato.

Hab. Boljoon, island of Zebu, Philippines; in earth, among decayed coral in the woods. (Mus. Cuming.)

The upper tooth on the inner lip is thickened with a calcareous deposit; the middle tooth is prominent, with a callosity at the lower part: on the outer lip three of the teeth are very prominent, the others are obsolete; the varix on the last whorl is very prominent; the umbilical fissure is wide and deep.

SCARABUS LEKITHOSTOMA, Reeve, Ann. & Mag. Nat. Hist. 1842, vol. ix. p. 220. fig. 6.

S. testâ ovatâ, imperforatâ, solidâ, fusco variegatâ; aperturâ aurantiacâ, labio incrassato, labro duplicato, posticè subsinuato.

Hab. ——? (Mus. Cuming.)

The middle tooth of the inner lip is double; in the outer lip there are three prominent teeth, the two posterior being approximated; there is no umbilicus, and the spire is concave at the sides; the back, moreover, is strongly plicated near the sutures.

SCARABUS CASTANEUS, Lesson, Voy. de la Coquille, Zool. p. 336. pl. 10. fig. 7.

S. testâ oblongâ, ovato-pyramidali, læviusculâ, longitudinaliter substriatâ, castaneâ; spirâ elevatâ, acuminatâ; aperturâ oblongâ, spiram æquante, labro semicirculari.

Hab. Sibonga, island of Zebu, in the woods; *H. C.* (Mus. Cuming.)

This is a smooth, oblong shell, with a regularly arched outer lip with four teeth within it, two of which are much larger than the others.

SCARABUS POLLEX, Hinds, Zool. Voy. Sulphur, Moll. p. . pl. 16. fig. 9, 10.

S. testâ ovatâ, compressâ, fusco-castaneâ, longitrorsum valdè striatâ, anfractu ultimo confusè fasciato.

Hab. Feejee Islands; *Hinds.* (Mus. Cuming.)

Distinguished from *S. Lessoni* by its coarsely striated surface and different markings; and from *S. castaneus* by its larger size and darker colour, in being more striated, and by two dark yellowish bands on the upper part of the last whorl.

SCARABUS SEMISULCATUS, A. Adams. *S. testâ ovato-pyramidali, læviusculâ, rufo-castaneâ, longitudinaliter vix striatâ, anfractibus convexiusculis semisulcatis, fasciâ nigricante prope suturam; aperturâ subrotundatâ; labio crasso, anticè rotundatâ, dilatatâ; labro semicirculari, posticè subsinuato.*

Hab. ——? (Mus. Cuming.)

A pyramidal, smooth, dark-brown shell, with the whorls strongly sulcated longitudinally near the sutures; two of the teeth in the outer lip are much larger than the others, and the inner lip is rounded and thickened in front; the umbilicus is large and deep.

SCARABUS SINUOSUS, Adams. *S. testâ ovato-oblongâ, flavescenti nigro-fusco maculatâ; epidermide tenuissimè longitudinaliter substriatâ; spirâ obtusâ, lateribus convexis; aperturâ oblongâ; labio anticè rotundato, reflexo; labro posticè valdè sinuoso, in medio inflexo, peritremate incrassato.*

Hab. Island of Negros, Philippines. (Mus. Cuming.)

The posterior tooth of the inner lip is elongated, the middle tooth double; in the outer lip three of the teeth are prominent, the two posterior being approximated; the umbilicus is partly closed by the reflection of the inner lip.

SCARABUS IMPERFORATUS, A. Adams. *S. testâ ovatâ, compressâ, imperforatâ; spirâ brevi, acuminatâ, lateribus concavis, læviusculâ, longitudinaliter tenuissimè substriatâ, lutescenti fusco-castaneo variegatâ, anfractu ultimo posticè subangulato; aperturâ oblongâ; labio anticè excavato, reflexo, labro semicirculari.*

Hab. Borneo. (Mus. Cuming.)

The last whorl is posteriorly gibbous; the umbilicus is closed by the inner lip; three of the teeth in the outer lip are prominent, the two posterior approximated.

SCARABUS PANTHERINUS, A. Adams. *S. testâ ovato-pyramidali, tenui, læviusculâ, longitudinaliter substriatâ, lutescenti, maculis rufo-fuscis ornatâ; spirâ acuminatâ, lateribus convexis; aperturâ oblongâ, labio anticè rotundato, reflexo, labro semicirculari.*

Hab. Siquejor; Philippines, woods, under stones. (Mus. Cuming.)

The aperture is yellowish white; three of the teeth in the outer lip are more prominent than the others, the intermediate ones being sometimes double; the umbilicus is large and deep.

SCARABUS BORNEENSIS, A. Adams. *S. testâ ovato-pyramidali, luteo-fuscâ, castaneo confusè fasciatâ, læviusculâ; epidermide tenuissimè, longitudinaliter striatâ; aperturâ oblongâ, angustâ, spiram subæquante, anfractu ultimo infernè subangulato; foveâ umbilicali angustâ, transversâ.*

Hab. Borneo; *Lieut. Taylor.* (Mus. Cuming.)

This species is narrower and more ovate than *S. plicatus*, of a much smaller size; the outer lip is rectilinear in the middle; the teeth of the outer lip are connected by an elevated ridge, and three of the teeth are more prominent than the others.

SCARABUS CHALCOSTOMUS, A. Adams. *S. testâ ovato-pyramidali, spirâ elevatâ, acutâ, longitudinaliter substriatâ, pallide luteâ, rufo-fuscâ variegatâ; aperturâ ovali, æneâ; labio anticè subrecto; labro semicirculari; umbilico patulo.*

Hab. Solomon's Islands; *Capt. D'Orville.* (Mus. Cuming.)

In general appearance this species resembles *S. pyramidatus*, but it is more oval, larger, lighter, with the middle tooth on the inner lip double, and the lower tooth broad and ascending; two of the teeth in the outer lip are very large and tubercular.

A MONOGRAPH OF PHOS, A GENUS OF GASTEROPODOUS MOLLUSCA. BY ARTHUR ADAMS, F.L.S., R.N.

PHOS, Montfort.

Shell ovately fusiform, spire acuminated, whorls longitudinally ribbed and cancellated; columella with a single anterior plait; outer lip notched in front, striated within. The animal has a small head;

the tentacles connate at the base, with the eyes near their distal third; the foot is dilated in front, forming an elevated shield, acutely auriculate on each side, pointed behind, and ending in a single long filament. Operculum small, horny, and unguiform. In three species of this genus in which I have observed the animal, namely *Phos senticosus, roseatus,* and *Blainvillii,* the hind part of the foot terminated in a single median filament, and not, as in *Nassa,* in a bifurcate tail.

1. PHOS SENTICOSUS, Linn. sp.; List. Pl. 967. fig. 22.
Buccinum senticosum, *Linn.*
Phos senticosus, *Montfort.*
Hab. Philippine Islands; *H. C.*

2. PHOS BLAINVILLII, Desh. Chemn. pl. 125. f. 1201, 1202. Kiener, Mon. Buccinum, pl. 11. f. 38.
Buccinum pyrostoma, *Reeve.*
Hab. Philippine Islands; *H. C.*

3. PHOS CUMINGII, Reeve, Elements of Conchology, pl. 3. fig. 16.
Hab. ——?

4. PHOS CRASSUS, Hinds, Zool. Voy. Sulphur, Moll. p. 37. pl. 10. f. 1, 2.
Hab. Panama, Gulf of Fonseca.

5. PHOS VIRGATUS, Hinds, *l. c.* p. 37. pl. 10. fig. 11, 12.
Hab. Ceylon.

6. PHOS RETECOSUS, Hinds, *l. c.* p. 37. pl. 10. fig. 3, 4.
Hab. Ceylon.

7. PHOS VERAGUENSIS, Hinds, *l. c.* p. 37. pl. 10. fig. 13, 14.
Hab. Pueblo Nueva, west coast of Veragua.

8. PHOS ARTICULATUS, Hinds, *l. c.* p. 38. pl. 10. fig. 7, 8.
Hab. Panama.

9. PHOS ROSEATUS, Hinds, *l. c.* p. 38. pl. 10. fig. 9, 10.
Hab. North coast of Sumatra.

10. PHOS GAUDENS, Hinds, *l. c.* p. 38. pl. 10. fig. 5, 6.
Hab. Gulf of Tehuantepec, west coast of Mexico.

11. PHOS CANCELLATUS, A. Adams. *P. testâ ovato-fusiformi, albidâ, obsoletè fusco fasciatâ; anfractibus subrotundatis, lineis elevatis longitudinalibus et transversis, valdè cancellatis, cancellis ad angulos acutè nodosis; aperturâ intus fuscatâ, anticè tuberculatâ, plicâ validâ.*
Hab. ——?

This species resembles *P. veraguensis*; but the areas between the cancelli are simple, whereas in *P. veraguensis* there is an intermediate, elevated line, crossing them, a circumstance not mentioned in the description of Mr. Hinds.

12. PHOS TURRITUS, A. Adams. *P. testâ ovato-fusiformi, tenui, subpellucidâ, spirâ turritâ, acuminatâ, albido-fuscatâ; anfractibus rotundatis, costis longitudinalibus angustis numerosis,*

lineis elevatis, transversis, ad costas nodulosis, ornatis; columellâ plicâ anticâ subevanidâ.

Hab. Panama, coral sand, 6 to 10 fathoms; *H. C.*

13. Phos textilis, A. Adams. *P. testâ elongatè ovatâ, albidâ, spirâ acutâ, costis rotundatis, crassis, infra suturam nodoso-angulatis, lineis transversis, planis, subconfertis, elevatis, interstitiis longitudinaliter subtilissimè striatis; columellâ plicâ anticâ validâ.*

Hab. Dumaguete, Philippines; *H. C.*

In general form this species approximates *P. Blainvillii*, but the elaborate and distinct style of sculpture and white aperture at once distinguish it.

14. Phos rufocinctus, A. Adams. *P. testâ ovato-fusiformi; spirâ productâ, angustâ, albidâ, fasciâ rufâ ornatâ; anfractibus rotundatis, costis crassis, infra suturam rotundatis, lineis transversis, elevatis, nodulosis, confertis, ornatis; columellâ plicâ anticâ productâ.*

Hab. Dumaguete; *H. C.*

The nucleus of this species is large and papillary.

15. Phos scalarioides, A. Adams. *P. testâ ovatâ, acuminatâ, turritâ, albidâ, fusco variegatâ, obscurè fusco bifasciatâ; anfractibus rotundatis, costis longitudinalibus, distantibus, infra suturam rotundatis, lineis elevatis, transversis, ad suturas nodulosis, interstitiis subtilissimè longitudinaliter striatis; columellâ supernè callosâ, infernè plicâ productâ; labro intus lirato.*

Hab. —— ?

A beautiful species, with regular, strong ribs, giving it the appearance of a *Scalaria*.

16. Phos spinicostatus, A. Adams. *P. testâ ovatâ, spirâ acuminatâ, albidâ, sparsim fusco nebulosâ; anfractibus rotundatis, costatis, costis distinctis, subdistantibus, infra suturam angulatis et spinosis, lineis transversis elevatis ornatis; columellâ rufo-fusco maculatâ, plicâ anticâ productâ; labro intus rufescenti lirato.*

Hab. Batangas, in insulis Philippinis.

17. Phos nodicostatus, A. Adams. *P. testâ ovatâ, turritâ, acuminatâ, albidâ, rufo-fusco maculatâ; anfractibus rotundatis, costatis, costis distantibus, infra suturam angulatis et nodosis, lineis transversis, elevatis, ad costas nodulosis ornatis; columellâ plicis evanidis, plicâ anticâ validâ productâ.*

Hab. ad insulam Negros; *H. C.*

The two species, described above, are somewhat similar in form, but the peculiarity of the ribs and colour of the apertures readily distinguish them.

18. Phos cyllenoides, A. Adams. *P. testâ ovatâ, albido-fuscâ, spirâ acutâ, longitudinaliter plicato-costatâ, costis supernè nodosis, ad suturam evanidis, lineis impressis transver-*

sis sulcatâ; columellâ plicâ anticâ, valdè productâ; labro intus fusco lirato.

Hab. in insulis Philippinis.

19. Phos cyanostoma, A. Adams. *P. testâ elongatè ovatâ, acuminatâ, albidâ, anfractibus rotundatis, costatis, costis crassis, æqualibus, infra suturam plicato-nodosis, cingulis elevatis, transversis, subdistantibus, interstitiis longitudinaliter subtilissimè striatis; aperturâ cyaneo tinctâ; columellâ tuberculatâ, plicâ anticâ validâ.*

Hab. in insulis Philippinis.

The interstices between the transverse ridges in this species are very beautifully engraved with fine longitudinal lines, and the aperture is tinged with blue.

20. Phos lævigatus, A. Adams. *P. testâ elongatè ovatâ, lævigatâ, pallide fuscâ; anfractibus subrotundatis, costatis, costis crassis, distantibus, lævigatis, infra suturam valdè nodosis, lineis tenuibus transversis ornatis; columellâ plicâ anticâ productâ; labro extus plicato, plicis numerosis confertis, intus substriato.*

Hab. Promontorium Bonæ Spei.

A large, smooth shell, with thick, simple ribs.

MISCELLANEOUS.

Notices of one or two of the rarer Birds found in the South of Scotland. By John Alexander Smith, M.D.*

The following brief notes of several of our rarer birds, which have been met with principally in Roxburghshire and Selkirkshire, within the last few years, will I hope be considered as not altogether unworthy of notice. And the first which I shall mention is the

Great Grey or Cinereous Shrike, *Lanius excubitor*, Linn. —I need hardly allude to its well-known appearance, its bent and toothed bill, its ash-gray plumage, with black wings, and tail bordered with white; and the striking, large patch of black on its cheek. Several specimens of this rare bird have been shot in this district of Scotland. The first instance of its appearance occurred a good many years ago, near the village of Darnick, about a mile from the town of Melrose, Roxburghshire. The bird had been observed in the neighbourhood for several days, and at last was shot as it was flitting backwards and forwards on the top of a hedge, with a small bird which it had killed;—in all probability looking for some convenient thorn on which to impale its victim preparatory to making a meal of it. The second specimen was killed in the adjoining county, several years after this, near the town of Selkirk, and was in the possession of the late Mr. Anderson, Surgeon, there. And the third is the one which I now exhibit: its unusual appearance, and light-coloured plumage,

* Read before the Royal Physical Society of Edinburgh, 5th February, 1851.

attracted the notice of the individual, who, after watching it for some time, got near enough to shoot it, in the neighbourhood of Newtown, St. Boswell's Green, Roxburghshire. I was informed by his brother, that it flew in a peculiarly jerking and undulatory manner, rising and falling in its flight along the hedge side. This was in the end of the month of February, or beginning of March; the other individuals having been killed about the end of winter or beginning of spring. It seems to be a full-sized bird; but from the slightly mottled appearance of the breast and belly, instead of white, as it is described, it may be a young male, or perhaps a female. [I regret this was not ascertained by dissection.]

Cuvier says, "It is rather common in France, where it remains throughout the year." It is however only an occasional visitor in Britain, and has generally been observed between autumn and early spring. Yarrell, in his valuable and beautiful book on 'British Birds,' gives various localities in England, and even Ireland, in which it has been found, but does not allude to any instance of its occurrence in Scotland. MacGillivray mentions in his excellent and elaborate work on British Birds, that to his knowledge it has been shot in the counties of Peebles, Lanark, Midlothian and Eastlothian. And that at the time his book was published, 1840, there were four Scottish specimens in Edinburgh, including one in his own possession; and from having examined the bird in a fresh state, as well as stuffed, and in skin, he considers himself qualified to state, that when the wing is closed, as represented by Mr. Selby, and also by Mr. Gould, *two* contiguous patches of white are seen, one on the base of the primaries, the other on that of the secondaries, and of this he gives a figure (*vide* vol. iii. p. 191). He supposes these gentlemen, in representing this bird with only *one* patch on the primaries, have mistaken for it the *Lanius borealis*, or the *Lanius ludovicianus*. These birds however are distinguished from the *L. excubitor*, which they considerably resemble, by several characters, one of these being the different proportional lengths of the quill-feathers; the *Lanius borealis* according to Cuvier, having the third primary the longest, and the fourth equal to the second: the *L. ludovicianus* has the second primary the longest, and the first and fifth equal; while in the *L. excubitor* the first quill is only half as long as the second, the second shorter than the third, fourth, or fifth, which are nearly equal, and the longest in the wing, the sixth being but very little longer than the second. Yarrell, I may mention, describes this bird as having the wing primaries and secondaries black, with a white bar at their base, which when the wing is closed form *two* white spots. Now in the specimen exhibited, which corresponds exactly with all the characters given of the *L. excubitor*, there appears to be only *one* white spot, on the primaries, when the wing is closed; as figured in the splendid works of Selby's 'Ornithology,' and Gould's 'Birds of Europe,' already alluded to. The woodcut in Bewick's 'Birds' seems also to correspond in this respect with this specimen. Whether or not this may be an accidental variety, I am unable to determine; and may I suggest the possibility of its being a mark of a *young bird* (as in this specimen the point of the beak and the claws are exceedingly sharp, and the breast and abdomen slightly mottled with dusky or grayish lines), the white colour probably spreading more and more over the secondaries as the bird gets older?

The next bird to which I shall allude is also an accidental visitor or straggler; coming however from a totally different region from the last,—the frozen north, to spend a milder winter with us. It is the

WAX-WING OR BOHEMIAN CHATTERER, *Bombycilla garrula*, Flem. —This beautiful bird is, I doubt not, so well known as to require no description: I may only remind you that in adult birds, the points of the secondaries have attached to them the curious vermilion appendages to which it owes its name. Coming from the north, its distribution through our island is just the reverse of the last; being more common in Scotland than in England. About the end of January, or beginning of February, 1850, a small flock of these birds, some seven or eight in number, were seen in the neighbourhood of Melrose, and instead of being very shy, as they are generally described, they were so tame that one man shot no fewer than four of them, one after another, as they were hopping about in some trees, before the rest became so much alarmed as to take to flight: other two were shot in one of the cottage gardens of Melrose; and another was killed some ten days after in the Abbotsford plantations. From the singularly knobbed or distorted appearance of this bird about the crop, the person who shot it considered it as diseased, and therefore not worth preserving, and accordingly his curiosity being excited, he set to work with his knife to discover if possible the cause, and was astonished to find as many as three large-sized hips of the common dog-rose in its crop—sufficient fully to account for its peculiar shape.

Although this bird makes its appearance irregularly from time to time in this country, during the winter months, and often in considerable numbers, still it is only as an accidental visitor that it occurs, and it is undoubtedly to be considered as a very rare bird. I may mention that in the 'Courant' newspaper of Saturday last, I observed a notice of a Wax-wing having been killed the preceding day in a garden at Portobello, in this immediate neighbourhood.

About the same time that the Wax-wings made their appearance near Melrose, a gardener at Dryburgh Abbey, a few miles farther down the Tweed, shot in his orchard the next rare bird which I shall notice—

THE GREAT SPOTTED WOODPECKER, *Picus major*, Cuv.—This bird is one of our rare permanent residents; it is described as being extensively distributed over Britain, but in all parts is rare, and in Scotland is rarer than in England; it is said to occur in some of our extensive northern forests; but in the south of Scotland it is very rarely to be seen. This specimen is now in the possession of J. Meiklam, Esq., Torwoodlee.

In the beginning of May last, a very fine specimen of an eagle, described as being the

CINEREOUS EAGLE, OR ERNE, *Haliaëtus albicilla*, Cuv., was shot by a gamekeeper within a few hundred yards of Bowhill House, Selkirkshire, one of the residences of the Duke of Buccleuch. It was perched on some low alder bushes at the side of the river Ettrick, and was surrounded by flocks of crows and other birds, loudly complaining of his presence in that locality, their general feeling of innate enmity being in all probability increased by the fact of his having just lunched on one of them, as shown by the recent remains afterwards detected in his capacious stomach. This noble bird measured no less than 7 feet from tip to tip of his wings. I regret I have not been able to get a more particular description of it, so as to fix beyond a doubt the species; but the appearance of any eagle is by no means a usual occurrence in this part of the country. It is now, I understand, in the possession of the Duke of Buccleuch.

I may also notice in passing, that a few months ago a specimen of the

WOODPIGEON or CUSHAT, *Columba palumbus*, Linn., closely approximating to a *white variety*, was shot on the Gattonside hills, near Melrose, Roxburghshire; the head and neck being entirely pure white; and many white feathers were also scattered over different parts of its body. The bird was plump and in good condition, and when killed was feeding with a flock of wood-pigeons of the ordinary kind.

To the kindness of my friend Dr. Dumbreck I am indebted for being able to exhibit a specimen of the

QUAIL, *Coturnix vulgaris*, Flem., which is one of our very rare, or perhaps from its habits, one of our less seen summer visitors. It was shot in this county, near the Pentland hills, at Cockburn, about three or four miles above the village of Currie, by a gentleman whose dogs sprung it while in search of game, in the autumn of 1847. It is apparently an adult female, not having the dark semicircular marks on the sides of the neck which distinguish the male. In the following year two nests of the Quail were come upon by the mowers, in a field on Craiglockhart Farm, about three miles from Edinburgh, near the village of Slateford; and the poor hen birds were sitting so closely at the time, that the heads of both were actually struck off by the scythe. The nests contained respectively eight and twelve eggs, the usual range of the number being described as from six to fourteen; they are of a yellowish white, blotched and speckled with dark umber brown (some of which I now exhibit): and a friend informs me he has in his collection an egg of this bird, taken from a nest found in the neighbourhood of Musselburgh.

I may perhaps be allowed in conclusion to trespass on your patience a very little longer, with the brief details of a circumstance, and certainly I should think rather an unusual one, connected with the very peculiar instinct displayed by some birds, in preserving their eggs and young from threatened danger; for an account of which I am indebted to Mr. Whitecross, Gunmaker, Danwick. The subject is one which I am not qualified by any observations of my own to judge of; but the facts are stated to have occurred as follows:—A pair of the Common Sandpipers, *Totanus hypoleucos*, had a nest with its four eggs, among the grass of a thinly wooded plantation on the banks of the Tweed; and this establishment had been pretty frequently visited by some lads, who were anxious in their cruelty to capture the dam on the eggs, but she being on the watch escaped, and the four eggs were seen to be all in the nest; the lads then retired to a little distance within sight, where they waited patiently for her returning and settling quietly down again; she did soon return, but this time accompanied by her mate, and the two birds soon after flew across the river apparently fighting, as was supposed, with one another; they then, after an interval of a minute or two, returned singly to the nest, and left it again in company, struggling and fighting together as before; and this was repeated four different times, with the same short interval between each time; after which there was a wearisome pause, the birds not again making their appearance; when the lads having given up hope of catching either of them, went to take what they now supposed to be the forsaken eggs, but were astounded to find the nest empty, and the eggs gone!! Considering it as beyond a doubt that the birds had carried off their eggs, they immediately crossed the river to the other side, where they had seen them disappear; but after a diligent search, could find no traces of them whatever; so well did the sagacious birds appear to have hidden their safely transported eggs! The distance the birds were believed to have carried their eggs could not have been less than some 70 or 80 yards! Mr. Yarrell, in his well-known work on 'British Birds,' when describing the *Skylark*, alludes to the fact of two or three instances being recorded of this bird's moving its eggs under fear of impending danger; and he quotes from Jesse's 'Gleanings' an account of a clergyman in Sussex seeing a pair of larks rising out of a stubble-field, and crossing a road before him at a slow rate, one of them attempting to carry even a young bird in its claws, which however was unfortunately killed by its loosing its hold when the bird was some 30 feet from the ground. The instance I have just detailed of the Sandpiper is the only one of any other bird, as far as I am aware, described as following this extraordinary plan of removing its eggs to a place of safety. Perhaps some of the naturalists among your numerous readers may remember other instances of a somewhat similar kind; helping, it may be, to throw some light on this little-known, exceedingly curious, and very interesting subject.—J. A. S.

ACHÆUS CRANCHII.

To the Editors of the Annals of Natural History.

Weymouth, June 10, 1851.

Gentlemen,—I have the great pleasure of announcing the occurrence of the rare *Achæus Cranchii*, Cranch's Spider Crab of Leach and Bell, as an inhabitant of the Dorsetshire coast. I dredged it on the 27th of May last, in six fathom water, on a shingly and rocky bottom with weeds in Weymouth Bay, just off Belmont and the Nothe.

The fourth and fifth pair of legs are abruptly curved, falciform, and *strongly toothed* in their terminal joint. The hands and arms are much lighter than the body; the fingers are tinged with rose colour at the base and spotted and striped with a purplish brown, the terminal joints of the legs with rose-colour; the eyes are reddish brown; the carapace is brownish blotched with red. This is a male specimen. The abdomen is six-jointed, broad, and slightly hollowed out opposite the second, third and fourth joints. I do not notice the carinæ on the hands, as mentioned by Mr. Bell; but this may be occasioned either by my specimen being immature, or my lens not being perfect: the inner margin of the first and second joints of the arm strongly and acutely toothed. This individual I caught in company with *Stenorhynchus Phalangium, S. tenuirostris, Inachus Dorynchus, Pisa tetraodon,* and *Hyas coarctatus,* all of which nearly approach each other in their habits. *Achæus Cranchii,* like its congeners, was covered with weeds. This crab is, when first caught, one of the most handsome.

I am, Gentlemen, yours very obediently,

WILLIAM THOMPSON.

GYMNETRUS BANKSII.

Berwick, June 21.

A specimen of this extraordinary fish was captured this morning at the mouth of the river; its length is $8\frac{1}{2}$ feet long, and it weighs upwards of 10 stone.

CARCHARIAS VULPES.

To the Editors of the Annals of Natural History.

Weymouth, June 24, 1851.

GENTLEMEN,—On Saturday the 21st, a specimen of the Fox Shark, *Carcharias Vulpes,* was caught at Wyke in a mackerel seine; it measured 12 feet. I will try and get further particulars in time for the 'Annals' for July: this fish had been seen in the Bay some days before.

I am, Gentlemen, yours very obediently,

WILLIAM THOMPSON.

On the Chemnitziæ. By GEORGE BARLEE, Esq.

To the Editors of the Annals of Natural History.

Lerwick, June 20, 1851.

GENTLEMEN,—In the paper you did me the favour to publish in your last month's 'Annals,' there is an error at page 485, line 24, that makes my statement appear contradictory, and which I shall feel obliged by your correcting. Instead of the words, "as I have only seen three or four of them," I beg to substitute, "as there are three or four of them I have not seen." Those species are, *Chemnitziæ formosa, clathrata, striolata* and *notata.*

I have nothing to add to my former remarks, except that *Chemnitzia conspicua*, which Mr. Clark considers to be a variety of *C. insculpta* or *acuta*, is clearly not so, as neither of the two latter species possess the very conspicuous internal transverse ribs or folds upon the outer lip, so apparent in the former; which if it be not distinct, is undoubtedly a variety of *Chemnitzia conoidea*, the only British recent species, I believe, that has that very peculiar character.

I am, Gentlemen, yours very obediently,

GEORGE BARLEE.

METEOROLOGICAL OBSERVATIONS FOR MAY 1851.

Chiswick.—May 1. Very fine. 2. Clear: fine: slight frost at night. 3. Fine: rain at noon: cloudy. 4. Cloudy and fine: frosty at night. 5. Cloudy and cold. 6. Slight rain: cloudy and cold. 7. Fine, but cold. 8. Fine. 9. Fine: clear. 10, 11. Very fine. 12. Cloudy and fine. 13. Fine: clear. 14. Cloudy: clear and frosty. 15. Very clear: fine: frosty at night. 16. Very fine: densely clouded: rain. 17. Densely clouded. 18. Overcast: clear. 19. Cloudy: fine: clear. 20. Clear and cold: fine. 21. Overcast. 22. Cloudy and warm. 23. Hazy: fine: clear. 24. Very fine. 25. Cloudy: rain. 26—28. Fine. 29—31. Very fine.

Mean temperature of the month	51°·16
Mean temperature of May 1850	51 ·14
Mean temperature of May for the last twenty-five years	54 ·13
Average amount of rain in May	1·89 inch.

Boston.—May 1. Fine. 2. Cloudy: rain P.M. 3. Cloudy: rain A.M. and P.M. 4. Cloudy: rain and hail A.M. and P.M. 5. Cloudy: rain A.M. and P.M. 6. Cloudy: rain A.M. 7, 8. Cloudy. 9. Fine. 10. Cloudy. 11. Cloudy: rain A.M. 12, 13. Cloudy. 14—16. Fine. 17. Cloudy. 18. Cloudy: rain P.M. 19. Cloudy: rain A.M. 20—22. Cloudy. 23, 24. Fine. 25. Cloudy. 26. Cloudy: rain and hail A.M. 27—31. Fine.

Applegarth Manse, Dumfries-shire.—May 1. Frost keen: hail-shower: rain-shower. 2. No frost, but cold: fair all day. 3. Cold: hail-showers: wind keen. 4. Frost: hail: rain P.M. 5. Cold: dull: quiet. 6. Milder. 7. Mild and slight showers. 8. Dull and cloudy: rain P.M. 9. Heavy showers. 10. Dry and parching. 11. Wind high, but fair. 12. Fine: cloudy P.M. 13. Fine day. 14. Very fine all day. 15. Fine: cloudy P.M. 16. Dull: slight showers. 17. Fine: dull P.M. 18. Wet morning: cleared and fine. 19. Hail-showers frequent. 20. Dull and showery. 21. Dull, but fair. 22. Cloudy: cold wind. 23. Fine clear day and fair. 24, 25. Fine A.M.: slight shower P.M. 26. Fair and clear. 27. Fair, but chilly. 28. Fair and fine: wind strong. 29. Fair and fine: wind keen. 30. Fair and fine: very droughty. 31. Fair and fine: very warm.

Mean temperature of the month	48°·9
Mean temperature of May 1850	49 ·1
Mean temperature of May for the last twenty-nine years	50 ·9
Average rain in May for twenty-four years	1·89 inch.

Sandwick Manse, Orkney.—May 1. Damp: cloudy. 2. Damp: drizzle: showers. 3, 4. Snow-showers. 5. Bright: drops. 6. Damp: drops. 7. Clear: fine: clear. 8. Bright: cloudy: aurora. 9. Bright: clear. 10. Bright: fine. 11, 12. Cloudy: clear. 13. Fine: hazy. 14. Bright: hazy. 15. Clear: rain. 16. Fine: clear. 17. Cloudy. 18. Bright: clear. 19. Cloudy: showers. 20. Bright: drizzle. 21. Hazy. 22. Drizzle: showers. 23. Showers. 24. Fine: rain. 25. Showers: clear. 26. Bright: fine. 27. Damp: showers. 28. Hazy: drizzle. 29. Hazy: damp. 30. Showers: hazy. 31. Hazy.

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

Days of Month.	Barometer.							Thermometer.							Wind.				Rain.			
	Chiswick.		Boston. 8½ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. May.	Max.	Min.		9 a.m.	9 p.m.	9¾ a.m.	8½ p.m.	Max.	Min.		Max.	Min.	9¾ a.m.	8½ p.m.								
● 1.	29·760	29·672	29·40	29·58	29·52	29·67	29·81	58	32	43	52	31	46	43	sw.	w.	nw.	ne.	......	·03	......	·18
2.	29·835	29·659	29·33	29·69	29·73	29·86	29·89	57	29	49	50	40½	42½	37	n.	nnw.	e.	nnw.	......	......	......	·02
3.	29·826	29·732	29·45	29·72	29·74	29·90	29·95	54	32	45	47	39	41	36	nw.	nnw.	ne.	n.	·09	·04	......	·06
4.	29·702	29·665	29·33	29·70	29·72	29·95	29·97	50	30	41	48½	32½	42½	40	n.	nnw.	nne.	n.	·02	·06	......	·14
5.	29·709	29·677	29·27	29·71	29·73	29·95	29·97	54	38	46·5	47	36½	42½	40	n.	n.	n.	n.	·02	·03	......	·01
6.	29·846	29·775	29·36	29·78	29·71	29·91	29·83	52	36	45	52	36	43½	40	nw.	n.	nw.	nw.	·01	·06	......	·04
7.	29·868	29·830	29·44	29·62	29·58	29·71	29·65	58	38	45·5	53	40	48½	41½	w.	nw.	sw.	ese.	......	......	......	·02
☽ 8.	29·770	29·674	29·30	29·49	29·42	29·58	29·65	61	38	53	54	44	47½	47	s.	s.	se.	ese.	......	......	0·20	......
9.	29·676	29·639	29·26	29·50	29·52	29·72	29·80	59	43	55·5	47	45	49	46	s.	se.	se.	ese.	......	......	......	......
10.	29·613	29·598	29·26	29·61	29·62	29·82	30·01	70	37	58	55	40	51½	46½	s.	ese.	se.	se.	·03	......	......	......
11.	29·775	29·715	29·30	29·73	29·88	30·08	30·14	66	47	61	50	44	48	43	n.	ene.	e.	ne.	......	·08	......	......
12.	30·070	29·875	29·48	30·00	30·11	30·16	30·02	63	43	63	58	41	48	47	n.	e.	e.	se.	·29	......	......	......
13.	30·299	30·242	29·80	30·22	30·25	30·28	30·28	58	31	53	58	37	54	47½	ne.	ne.	se.	se.	......	......	......	......
14.	30·335	30·291	29·95	30·30	30·21	30·26	30·16	57	27	52	51	35	56½	54	ne.	ene.	s.	sw.	......	......	......	......
○ 15.	30·255	30·152	29·82	30·25	30·20	30·04	30·00	64	29	51	53	50	59½	51	ne.	e.	s.	......	......	......	0·17	......
16.	30·099	30·041	29·60	29·90	29·83	29·96	29·94	68	46	51	55	48	49½	47	sw.	wnw.	se.	sw.	·05	......	......	·35
17.	29·962	29·945	29·50	29·80	29·75	29·90	29·72	69	48	61	58	46	52	49	sw.	sw.	s.	s.	......	......	......	......
18.	29·881	29·849	29·34	29·60	29·65	29·50	29·54	63	40	61	52	47	48	44½	sw.	wsw.	sw.	w.	·10	......	......	·25
19.	30.071	29·834	29·38	29·58	29·80	29·50	29·76	63	37	51	51	39	45	45	sw.	w.	wsw.	nw.	·04	·06	......	·03
20.	30·238	30·016	29·73	29·98	30·02	29·94	29·96	63	48	52·5	55	46	48½	48½	nw.	nw.	sw.	se.	......	·04	......	·12
21.	30·216	30·238	29·75	30·07	30·11	30·00	29·98	65	44	59	57	48	51½	51½	sw.	wnw.	w.	w.	......	......	......	·05
22.	30·259	30·221	29·77	30·08	30·12	29·86	30·00	70	42	65·5	58	47	49½	47	sw.	wnw.	w.	nw.	......	......	0·23	......
☾ 23.	30·268	30·254	29·83	30·19	30·30	30·08	30·20	66	38	55	61	39	49	46½	nw.	nw.	nw.	w.	......	......	......	·19
24.	30·342	30·286	29·90	30·32	30·06	30·20	29·88	71	47	55	57	37½	51	51	se.	w.	wnw.	sw.	......	......	......	·02
25.	30·208	29·921	29·60	29·99	29·82	29·84	29·82	72	45	62	54	49	49	45	sw.	wnw.	wsw.	nw.	·08	......	......	·16
26.	29·965	29·902	29·49	29·87	29·93	30·00	30·04	62	34	53·5	58	46	47	44½	ne.	n.	wnw.	w.	·01	......	......	·07
27.	30·093	30·066	29·68	29·92	30·00	29·90	29·98	63	46	52·5	59	46½	48½	47	nw.	wnw.	nnw.	w.	......	·04	......	......
28.	30·254	30·203	29·74	30·10	30·18	30·02	30·14	68	39	54	54½	43	51½	49	ne.	wnw.	nw.	w.	......	......	......	·03
29.	30·367	30·349	29·90	30·29	30·31	30·26	30·22	75	47	58	63½	50	53	51	n.	wnw.	nw.	sw.	......	......	......	......
● 30.	30·411	30·402	29·94	30·35	30·38	30·32	30·42	74	45	63	64	50½	49½	47½	e.	nw.	w by n	w.	......	......	0·05	·02
31.	30·470	30·407	30·05	30·40	30·33	30·36	30·30	68	35	60	66	44	50	50	e.	n.	sw.-w.	w.	......	......	......	·01
Mean.	30·046	29·971	29·54	29·914	29·791	29·952	29·968	63·26	39·06	54·0	54·7	42·5	48·80	45·91					0·74	0·44	0·65	1·77

THE ANNALS

AND

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[SECOND SERIES.]

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VIII.—*On the Hinge of the Fossil Genus* Platymya, *Agassiz; with the description of a new species.* By J. Lycett, Esq.*

M. Agassiz proposed to constitute his genus *Platymya* with certain flattened and gaping bivalve shells whose figure differs sufficiently from that of other genera of fossil Myadæ, and he characterized with precision the external features of the group; but as the hinge remained unknown to him, the genus could not be considered as established. Subsequently M. D'Orbigny, from a consideration of several other species which he described in the 'Paléontologie Française,' believing that he had discovered in certain of their moulds impressions of an internal spoon-shaped process, and likewise of the rib which abuts against it, concluded that some of the species at least were true Anatinas, and therefore designated them as such. On the other hand, M. Agassiz†, whilst admitting the full importance of the characters noticed by M. D'Orbigny, and the possibility that in consequence *Platymya* may be reduced to the rank of a subgenus only, states his impression that nevertheless it may be a good genus, and directs attention to an important distinction between the two forms, viz. that in the Anatinas the anterior region is the most produced, but in *Platymya* it is the posterior which is most prominent. M. Agassiz therefore refused to abandon his genus *Platymya*, and reunited the six Anatinas of M. D'Orbigny to his own as additional species of *Platymya*. *Platymya* is exemplified in the 'Etudes Critiques' by six species only; the number of individuals in each species is stated to be but very few, and that the form altogether had not previously been noticed by palæontologists. All of the species pertain to the Cretaceous system of rocks with two exceptions, one belonging to the upper, and the

* Read to the Cotswold Naturalists' Club, June 24, 1851.

† Études Critiques sur les Mollusques fossiles, Myes, Introduction, p. xvi.

remaining one to the middle division of the Oolitic system. The present species has claims upon our notice beyond that of a new species merely, inasmuch as it is the first English recorded example of the genus,—the first which has been identified in the lower division of the Oolitic system; and lastly, it has the important and novel advantage of having its test preserved and the character of its hinge clearly exposed. Although six years have elapsed since the publication of the 'Etudes Critiques,' the state of uncertainty in which the hinges of several of the genera therein described were left by its distinguished author has not hitherto been removed; our own literature more especially is deficient in information relating to the extensive family of fossil Myadæ: these circumstances it is trusted will be deemed a sufficient excuse for presenting a brief description of the genus *Platymya* translated from the before-mentioned work of M. Agassiz.

"The Platymyas are near to the Arcomyas in their form and general physiognomy, but are distinguished by a general flatness of the valves, by the nearly median position of the umbones, which are very depressed, by the extremities being much developed and very large. The two extremities gape much, more especially the posterior one. The cardinal area is much less characterized than in the Arcomyas; the marginal keel which separates the area from the sides is not very distinct, and consequently is of little assistance in the determination of species. The ridges or folds of the sides are usually distinct, concentric and well marked upon the anterior side, but more indistinct and irregular upon the posterior. The lines of growth are not usually observed upon the exterior of the moulds, neither are they visible upon the internal moulds. Hinge unknown. The position of the umbones will always distinguish it from *Gresslya, Homomya* and *Myopsis*; *Mactromya* is usually more short and convex."

It will be perceived from the above extract, that a comparison of our new shell with the several species of *Platymya* must depend upon the external form only, inasmuch as no direct knowledge of the hinge has heretofore been obtained, and the remarks of M. D'Orbigny are based solely upon impressions in the moulds. Whatever value however may be attributed to impressions in moulds must yield to a disclosure of the hinge itself, and in the present instance this direct evidence is combined with a shell whose external characters agree with those of *Platymya,* and cannot with propriety be referred to any other known genus.

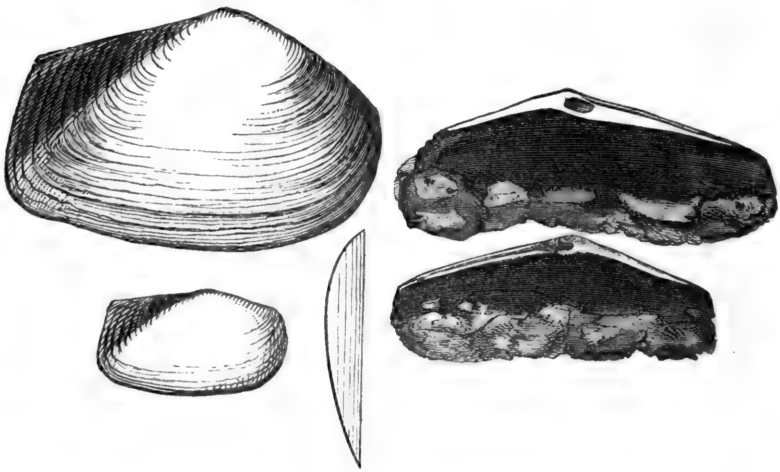
In two instances we have succeeded in exposing the hinge in each valve, and our definition of *Platymya,* derived from these examples, will be as follows:—

Shell thin, nearly equivalve, transverse, compressed; umbones small, depressed, contiguous, submesial; cardinal area indistinct, its superior border having in each valve a narrow elongated groove with an acute edge, as in *Mactromya*; both sides of the shell wide, more especially the posterior one, which is truncated; both extremities gape slightly, more especially the posterior extremity; ventral margin regular, curved moderately and elliptically. Hinge plate internally incrassated and lengthened posteriorly, having *a single small obtuse cardinal tooth in the left valve and a corresponding oval pit in the right valve*; lateral teeth none; muscular impressions unknown.

The hinge apparatus may be regarded as forming an exception to the usual characters of fossil Myadæ, which are for the most part edentulous; the present form however can only be considered as an aberrant modification of the same kind of hinge: the tooth is small; it is of an oval figure, its greater length being lateral; it projects but little, and the opposite corresponding pit consequently is but shallow. This kind of hinge, taken in connexion with the other characters of the shell, will be found to remove it from all other genera of the Myadæ, both recent and fossil: there is nothing resembling the projecting spoon-shaped process and accessory tricuspid osseous rib supporting an internal ligament, as in *Anatina*; on the contrary, there is every reason to believe that the ligament was external and supported upon the lengthened posterior grooves. The delicacy of the test and hardness of the matrix have foiled our attempts to expose the muscular impressions.

The tendency of these details then is to support the conclusion of M. Agassiz with regard to the generic value of *Platymya*, a conclusion at which he arrived from a consideration of certain external characters only; these however constitute a generic entireness upon which he relied with confidence even after a palæontologist of eminence had pronounced an adverse opinion, and he remained without the means of verifying his inductions by an examination of the hinge. The dental characters however of the several genera of fossil Myadæ would seem to be of much less relative importance than they acquire in certain other families of the Lamellibranchiate Mollusks. In the fossil Myadæ the teeth are for the most part absent altogether, the ligamental support being derived from a thickening internally of the posterior and superior border, forming a kind of lengthened posterior rib, and it is the only portion of the shell which is not thin and delicate. Without entering into details respecting the hinges of the several genera, it may suffice to mention that *Mactromya*, *Goniomya*, *Cercomya*, *Ceromya*, *Homomya*, *Myopsis* and *Arcomya* have all with certain modifications this description of hinge apparatus, which should be regarded as of coordinate rank only with other characters which are external and are connected with the general form and markings of the surface. *Platymya* has a similar kind of posterior elongated rib terminating anteriorly in a tooth and opposite corresponding fossa so small as not to form any projection beneath the hinge plate; the internal moulds consequently would exhibit little of the structure of the hinge, and supply no sufficient data whereby its real character could be inferred. The narrow lengthened posterior groove in each valve resembles those in *Mactromya,* in which however an hiatus remains between the grooves which does not exist in *Platymya. Arcomya* is destitute of these grooves.

Example. *Platymya Rodborensis.*



Shell compressed, subequilateral, with the posterior side wide, truncated, gaping moderately, the anterior extremity being nearly closed. The valves are equal, or with no apparent difference in their convexity. An obtuse and rather indistinct keel passes obliquely from the umbo to the infero-posterior extremity; folds or ridges concentric and irregular, distinct only upon the two extremities of the shell, and passing over the keel bent nearly at a right angle. Young specimens have their lateral diameter comparatively greater, but like the adult shell the middle portion is nearly smooth. The general outline has some resemblance to *P. tenuis* (Etud. Crit. t. 10 *a*, fig. 5–6), but in that species the hinge-line is more nearly horizontal, and the posterior border of the shell has a much larger hiatus. Our shell has likewise less convexity, and its posterior aperture is much smaller than in *P. hiantula* (Etud. Crit. t. 10 *a,* fig. 7–13); to other species the resemblance is more remote.

In common with other species of the genus, the general form has some resemblance to several of the shorter Arcomyas, and more especially to the figure of *A. ensis,* Etud. Crit. t. 9. fig. 4–6 (misprinted *A. brevis*), but the valves in that shell are less compressed and the umbones are more gibbose: our species however cannot be an *Arcomya,* for M. Agassiz has satisfied himself, from an examination of numerous moulds, that the hinge of that genus is without teeth; we have fortunately succeeded in clearing the hinge of the shell itself in more than one specimen of *Arcomya,* and are enabled to add our humble testimony to the same effect. There remains to be noticed a shell whose resemblance to our species is so considerable, that little doubt can exist that both belong to the same genus; this is the *Psammobia lævigata* of Phillips, figured at pl. 4. fig. 1. vol. i. of the 'Geology of Yorkshire.' The resemblance of the external form to *Psammobia* must be allowed, and the hinge characters, though distinct from the *Psammobiæ,* are more nearly allied to its subgenus *Psammotea,* which has no tooth in the right valve; but the figure of the tooth and pit in the recent shells will be found to be very different to our fossil; the *Psammobiæ* likewise have an elevated nymphal callosity supporting the ligament which is wanting in the fossil.

Though rare, our species was gregarious; several specimens occurred in near proximity. Height 13 lines, lateral diameter 17 lines.

Locality. Rodborough Hill near Stroud, where it occurs in the upper ragstone of the Inferior Oolite.

IX.—*Palæontological Notes.* By John Morris, F.G.S.

[With a Plate.]

The following notes relate to some new or little-known organisms of the chalk, and are chiefly contained in the collection of Mr. Wetherell of Highgate:—

Thecidea, Defrance. *Thecidium,* Sow.

The genus *Thecidea,* established by Defrance for certain Terebratuliform shells with a peculiar apophysary system, is very rare in a recent state, one species only having been obtained from the Mediterranean. The fossil species are not numerous: Bronn enumerates eight species, one from the Jurassic and seven from the Cretaceous formations. In this country the genus has only been recently noticed: Mr. Moore of Ilminster has discovered four in the Lias, and two others have been found in the Inferior Oolite, all of which are described and figured by Mr. Davidson*; to these, another is now added from the Chalk.

* Palæontographical Society, Article Brachiopoda.

Thecidea Wetherellii. Pl. IV. fig. 1–3.

T. testa parva, tenui, irregulari, sublævigata; valva inferiori triangulari vel pentagonali, interne striata; area brevissima, deltidio magno; valva superiori operculiformi planulata vel subconvexa.

A small, thin and smooth shell, nearly as wide as long, of a pentagonal form, and triangular towards the cardinal region, rounded laterally and straight on the anterior margin.

The inferior valve is attached by nearly the whole of its surface, the edges only being slightly elevated, and the beak depressed; the cardinal area is small, and chiefly occupied by a large triangular, rather elongated deltidium; besides the cardinal teeth, the interior beneath the deltidium is furnished with three laminar processes, of which the central one is generally the longest and most elevated; the inner surface of this valve is marked by longitudinal granular striæ (fig. 3). The smaller valve is flat or slightly convex, and has a large apophysary system, divided on each side in a deep, arched or reniform sinus; the cardinal process is large, and the margin of the valve is minutely granulated.

This species presents considerable resemblance in its general form to the recent *T. mediterranea,* and more to the *T. triangularis,* figured by Mr. Davidson, from the Inferior Oolite and Lias of England, and which is also found in the same formations as well as in the Great Oolite of Normandy. The apophysary system differs from that of the recent species in being more simple and less flexuous, and approaches that of *T. hippocrepis,* Goldf.; but the dissepiment is not so broad as in that species. It is frequently attached to the shells of *Ananchytes, Spatangus,* and *Inoceramus* from the Upper Chalk of Northfleet, Kent, and has been dedicated to N. T. Wetherell, Esq., who has succeeded in preserving this and many other minute and rare organisms from the same locality.

Talpina.

Under this name M. von Hagenow has arranged certain problematical branching bodies which traverse the spathose guard of the Belemnite, and whose position in the animal kingdom has not been defined, whether as belonging to the Annelides or to the boring Sponges. M. Hagenow remarks, that only the cylindric thread-like channels are left, by which the Belemnite has been perforated, most likely after the death of the animal, and perhaps only after the outer shelly substance was decayed, but evidently before the process of petrifaction commenced. These channels are close under the surface of the Belemnite, either simple or branched, and frequently show openings at the surface, and are filled with chalk, and therefore appear in the brownish and half-transparent Belemnite as fine yellowish threads, which are still more marked when it is wetted or oiled. M. Hagenow * describes two species from the chalk of Rugen, and Quenstedt † has subsequently added two more; all the forms are found in the Belemnites of the English Chalk; and it is somewhat remarkable that these parasitical bodies have been hitherto only detected in the section, *Belemnitella,* D'Orb.—no traces of them having been observed in the Belemnites of the Jurassic series.

Talpina solitaria, Hag. Pl. IV. fig. 6 *a.*

Simple, slender, rarely branched, cylindrical or little compressed channels, which either extend along the Belemnite in a straight or little-curved direction, or follow its cylindrical form in a spiral manner; they are about the size of a fine knitting-needle, and have only simple openings.

Talpina ramosa, Hag. Pl. IV. fig. 4.

Very fine thread-like channels which are variously branched or irregularly netted; the orifices, which are visible to the naked eye, always exist at the end of the tubes, as well as at those points where the lateral channels diverge from the main one or from each other.

The specimen figured is from the chalk at Norwich, and kindly lent me by Mr. S. Woodward.

Talpina dendrina, Quenstedt. Pl. IV. fig. 6 *b,* & 7.

This form has a very dendritic appearance; the branches are compressed, closely aggregated, generally arising from a common centre, and diverging in a somewhat radiating manner, variously dichotomous and rarely anastomosing.

This form is very common on the Belemnites from Gravesend and Norwich, and has been figured with a view of directing the attention of geologists to the subject, as it is doubtful whether it has really arisen from organic action.

CLIONA OR CLIONITES. *Vioa,* Nardo, Michelin.

The origin of those singular organic impressions which occur in the shells of Inocerami and the flinty nodules of the Chalk, long remained in obscurity, but are now referred to the operations of a sponge allied to or identical with *Cliona.*

The excellent monograph by Mr. Hancock on the characters

* Jahrbuch für Mineral. 1840, p. 671. † Die Cephalopoden, p. 470.

and habits of the recent species, in a late Number of the 'Annals,' is well known.

Fossil species have been noticed in the shells of the Crag, London clay, the Chalk, and the Gryphæa of the Lower Greensand; and Prof. M'Coy has lately described a species under the name of *Vioa prisca,* in an Avicula from the Silurian rocks.

Mr. Parkinson (1811) appears to have first noticed these bodies as occurring in the state of siliceous casts, and suggested that they may have been the work of some animals of a nature similar to the Polypes; and subsequently in 1814 the Rev. W. Conybeare * published a memoir on them, with some excellent illustrations of the common species, and asserting "that the origin of these bodies was widely different from that assigned by Parkinson, they being in fact siliceous casts moulded in little hollow cells excavated in the substance of certain marine shells; the work perhaps of animalcules preying on those shells and on the vermes inhabiting them." At the end of this paper is an interesting letter from Dr. Buckland which has been generally overlooked, as showing at that early period his suggestion that similar organisms which committed the ravages in the recent oyster, probably also effected the perforations in the shells of the extinct Inocerami:—

"The hollows that afforded a mould for the formation of these singular bodies appear to me to have been the work of some minute parasitical insect. The small aperture, the cast of which now forms the projecting axis of each globule, was probably perforated by this intruder as the entrance to his future habitation; having completed this passage, and excavated at its termination a cell suited to his shape and convenience, he appears by the aid of a delicate auger or proboscis to have drilled many minute and almost capillary perforations into the substance of the shell on every side around him, taking care to leave always partitions sufficient to support the roof of his apartment. Having exhausted all the nourishment which could in this manner be procured with safety from the vicinity of this first establishment, the insect appears to have emigrated, and after working for itself a lateral passage to a sufficient distance, to have formed a new settlement in the midst of fresh supplies. In the recent oyster shell which I have transmitted, you will perceive that this process has been carried on, to a great extent, in the intermedial matter between two or three sets of the pearly plates comprising it; and yet without effecting the destruction of the exterior crust, or in any degree injuring the inner surface of the shell, which remains un-

* "On the origin of a remarkable class of organic impressions occurring in nodules of flint" (Geol. Trans. 1 ser. vol. ii. p. 328. pl. 14).

touched, and, notwithstanding these attacks, still equally adapted to every purpose required by the œconomy of its inhabitant."

We have given some illustrations of the most abundant species, *Clionites Conybearei* *, one (fig. 8) in which the siliceous casts of the cavities cover almost entirely the surface of an Inoceramus—a specimen presented by Mr. R. A. Austen to the Museum of Practical Geology. Fig. 9 is a specimen filling a portion of the cast of a Belemnite from Norwich; fig. 10 shows simply the cavities left in the shell of an Inoceramus from Northfleet, Kent. Another species in a Norwich chalk-flint, *C. glomerata* (fig. 11), which appears to be distinct from the last, consists of one cell having an irregular globose form, obtusely tuberculated over the whole surface, and having two large canals diverging from it.

Pearl-like bodies.—Most persons are aware that some forms of the conchiferous mollusks are subject to certain abnormal secretions, assuming a more or less regular form, and composed of fibro-calcareous matter generally arranged in a concentric manner; sometimes it is solidly attached to the inner layer of the shell, of which it forms a portion; at others it is found perfectly free in the fleshy substance of the mollusk itself, of a symmetrical shape, as in the perfect pearl. Evidence of phænomena resulting from similar conditions has been detected in certain fossil genera, but few if any instances have been recorded†. The collection of Mr. Wetherell contains many illustrative specimens; in one, a Gryphæa (fig. 16) from the drift of Muswell Hill, and probably coming from the Oxford clay, is an irregular elongated body free at both ends, but attached by a considerable portion of its surface, the external lamina being continuous with the shell; the outer layers do not however show the regular fibrous arrangement of a pearlaceous body, but this may have been changed by subsequent mineralization. In another specimen (fig. 12) the pearly body is attached to the interior of an Inoceramus, and shows the concentric arrangement of the fibrous substance, and which is better exhibited in the specimen (fig. 14), showing a complete section of one of considerable size, quite unattached to any shell, from the Chalk of Kent, but from which Mr. Wetherell has obtained a few other specimens of similar structure, varying in their dimensions.

* *Clionites Conybearei*; cells irregular, somewhat polygonal, with one or more papillæ; surface finely tuberculated; connecting threads numerous. (References: Park. Org. Rem. pl. 8. f. 10; Dr. Mantell's Pictorial Atlas, pl. 40. f. 10.)

† There is an indistinct allusion to the occurrence of pearls in a fossil state, in Woodward's 'Essay towards a Natural History of the Earth,' 1695, p. 23.

EXPLANATION OF PLATE IV.

Fig. 1. *Thecidea Wetherellii*, magnified.
— 2. ——— ————, ventral valve magnified.
— 3. ——— ————, dorsal valve magnified.
— 4. *Talpina ramosa*, Hag.
— 5. Figure magnified.
— 6 *a*. *Talpina solitaria*, Hag.
— 6 *b*. ——— *dendrina*, Quenstedt.
— 7. ——— ————, figure magnified.
— 8. Siliceous cast of Inoceramus, with *Clionites Conybearei*.
— 8 *a*. *Clionites Conybearei*, cells magnified.
— 9. *Talpina solitaria* and *Clionites Conybearei* in cavity of *Belemnites mucronatus*.
— 10. Cells of Clionites in an Inoceramus shell.
— 11. *Clionites glomerata*, in cavity of *Bel. mucronatus*.
— 12. Pearl-like body attached to the inner shell of Inoceramus.
— 13. Pearl-like body unattached.
— 14. Section of ditto, showing concentric arrangement.
— 15. Section of a Belemnite, with cavities of Clionites.
— 16. Pearl-like body attached to a Gryphæa.

X.—*Notice of some new Footsteps in the Bunter Sandstone of Dumfries-shire.* By Robert Harkness, Esq.

The quarry which has hitherto furnished the most numerous and well-preserved impressions of footmarks from the Bunter sandstone is Corncockle, in the parish of Applegarth, Dumfries-shire. Some few have also been obtained from the Craigs quarry near Dumfries; and recently the quarries at Locherbriggs, in the same neighbourhood, have afforded tracks of animals. To these localities there may now be added the quarry of Green Mill, in the parish of Caerlaverock, which promises to rival Corncockle both in the number and perfection of its footsteps. The nature of the sandstone in these different localities is similar, consisting of strata, made up of laminæ of brownish and red-coloured sand, regularly bedded, dipping in the same direction and at nearly the same angle; the only variation being at the Craigs quarry, where the stone is of a coarser nature than at the other quarries.

With regard to the impressions which have been obtained from Corncockle, one of them is figured in Buckland's 'Bridgewater Treatise,' and referred to a Chelonian reptile; and others are now being figured and described by Sir William Jardine in his new work 'The Ichnology of Annandale,' a publication in which the footprints are illustrated by coloured lithographs of the size of the originals, and which will form a valuable addition to our knowledge of the Triassic fauna, and be the first work devoted exclusively to Ichnology published in this country. The footsteps to which this paper has immediate reference are procured from the quarries around Dumfries, and differ from those which Corncockle has hitherto afforded. Some of the impressions which are found in the latter locality are also common to the other quarries, but as these will be described in the work referred to, no further notice need here be taken of them.

Amongst the most common footmarks which are met with is one in which in general there is a perfect resemblance between all the impressions, so much so as to induce the spectator to arrive at the conclusion that the hind and fore feet were identical in form. On an examination of numerous specimens this opinion would be found to be incorrect; but, owing either to the nature of the substance receiving the impression, or from the structure of the animals which have produced them, it rarely happens that perfect tracks are found; the fore-feet having in general left no traces of their imprints, the hind feet only forming the impression. In a specimen in a good state of preservation from Locherbriggs quarry, in which both markings of the fore and hind feet are shown, the latter consist of a series of impressions about $\frac{3}{4}$ of an inch broad by about $\frac{5}{8}$ of an inch in length, curved gently in front, immediately within which there occur five impressions, of toes or rounded blunt claws; the two outer ones being comparatively indistinct, but the three inner ones being broad and well-marked. At the distance of less than $\frac{1}{8}$ of an inch in front of the impression of the hind-foot there is seen that of the fore one, which is less than $\frac{1}{4}$ of an inch in breadth, and commonly presents three claw-like markings running into each other at their sides. These toe or claw markings are like those of the hind impression, rounded and blunt, and afford no other characters. In the case of the hind impression, the front part of the foot is much more deeply marked than any other portion, and the sand has been thrown slightly backwards, forming an elevated curved ridge at the back part of the impression, after the manner of the tracks which are formed by walking on snow. The interval which separates the impressions of one hind-foot from the other is about an inch, and the space between each of the impressions of one foot is about 2 inches. The distance between the right and left fore-feet markings is greater than between the hind impressions; but this results from the comparatively small size of the former.

This track indicates an animal of small size, but broad in proportion to its length, having its anterior extremities small, and its posterior ones largely developed. On the whole the characters are such as bear relation to *Chelonia*, and the animal probably bore some relation to the *Chelichnus Duncani*, Owen, found at Corncockle, but was probably distinct in species. It is common at Locherbriggs, Craigs and Caerlaverock, and rarely exceeds the dimensions before given, and to distinguish it may be called the *Chelichnus plancus* from its broad hind-feet.

Another form of impression which has been only very recently obtained from the Green Mill quarry, Caerlaverock, is composed of a series of steps, consisting of markings of thick, rounded, blunt claws or toes. The steps, of which a slab in my possession affords eleven on each side, differ on the one side from those on the other. Those on the right side are formed of three indents, arranged almost in a line, but having the centre one slightly in advance of the other two. Behind the centre and the outer ones another marking similar to those in front occurs, and about the same distance from them as they are from each other. The diameter of each of these circular markings is about $\frac{1}{8}$ of an inch; and those on the left side differ from those on the right in having the hinder indents behind the inner one instead of between the outer and centre ones. The indents in all the impressions are marked in front by a slight elevation, which extends for a distance equal to about their diameter before them; and which appears to have arisen from the portion of the foot which caused the indents having been thrust obliquely forwards. The difference in the position of the hinder indent has probably been caused by one of the toes in each foot not having left its impress. No other portion of the foot has caused any marking, each step consisting solely of four claw-like impressions. The distance which separates the steps on each side from each other is less than the space occupied by the three front indents of each foot, being under an inch; and the interval between the prints on the right and the left side is about 2 inches, exceeding the space occurring between the steps on either side by more than double the distance.

From the impression as seen on the slab it would seem that the hind and fore foot were similar not only in form but also in size, both being large; and the evidence which the impressions afford is such as to show that the animal which formed them was of much greater breadth than length. Altogether the character of the footprint, and the great distance between the feet on the right and those on the left side, show resemblance to a Chelonian form; but this form was widely different from the one before alluded to, being apparently more nearly allied to *Testudinata* than the previous footsteps.

From the tortoise-like form of this step I propose to call it provisionally the *Chelaspodos Jardini*, the specific name being in honour of Sir William Jardine, Bart.

On a slab of sandstone from the same locality as the before-described impression there are seen two distinct kinds of steps;

one of these is of an elongated form, rounded at the anterior extremity, and immediately within this extremity there are seen impressions of either toes or claws. Two of these on the outer side are shallow and comparatively indistinct; the one in front is deeply impressed, and the inner one contiguous to it is also well marked. Traces of a fifth may also be seen, but owing to the nature of the sand, when the animal passed over it, not being in a condition to receive a perfect impression, these steps are not distinctly shown. From the raised margin in front of the claw-like markings gradually disappearing behind, it would seem that the animal in its progress had pushed the sand forwards by the sloping manner in which it set down its feet. The breadth of this form of step is about ½ an inch, and as only the front and a portion of the sides are seen, its length cannot be determined. There are only four impressions on the slab, and the interval between each of these about 8 inches. The position of the steps is slightly inclined outwards, but as these are in a line they seem to belong to one side only, and have probably been produced by the same foot; and as no other impressions of the same nature have been obtained, no conclusion can be arrived at concerning the form and size of the animal which produced this form of footprint.

The character of the step appears somewhat allied to the *Chelichnus,* and in order to distinguish this form it may be named the *Chelichnus obliquus,* from the oblique direction of the steps.

The other form of impression which is associated with that just described, shows characters which will remove it from *Chelonia,* and which seem to place the animal which caused it amongst Saurians.

This impression consists of a line of steps which are furnished with well-developed toes, three of which are very distinct, and two others can also be traced. The marks caused by the toes are much deeper and in a better state than the other parts of the foot; but in one case the impress of the posterior part of the foot is sufficiently perfect to show that it had a rounded form, and was less than an inch in length, including the toes, which are themselves about ½ an inch long; these being broad at their base and tapering rapidly towards the extremity, which is pointed. The nature of the impressions is such as to show that these toes were curved; and the step is devoid of the raised parts which are seen before the claws of the two preceding forms of footmarks, and appears to indicate that in progression the foot was put perpendicularly downwards. The direction of the steps is inclined to the path of the animal, and the interval which lies between them is about 6 inches. These steps, like the preceding form, occur in a line, and are those of one side only; they also seem to have been formed by the same foot, and therefore no inference can be drawn from them concerning the creature by which they were made: the elongated toes however seem to show some analogy to lizards, and therefore it is proposed to form a genus called *Saurichnis* for this form, and in consequence of its pointed toes to term it *S. acutus*.

There has been found at the Craigs quarry, not on the surfaces of the beds, but on the faces of the laminæ when the sandstone is divided, several indistinct impressions of various forms which the nature of the sandstone does not allow of being properly recognised. Along with these a form of footstep has been seen differing from those of the other localities, having an elongated form, about an inch in length, and broader at the anterior extremity than at the posterior. The space between the steps on one side is about 6 inches, and the interval between the corresponding impression on the right and on the left side is so small in comparison with the distance which occurs between the steps on the same side, as to show that the animal which formed them was of a long and narrow shape, and probably had a lacertian nature; and perhaps was allied to the genus *Herpetichnus* which is found at Corncockle. Owing to the imperfect state of this footprint it would be premature to assign to it any name, and perhaps other impressions may be found which will enable us to trace out its affinities.

About a month ago very perfect impressions of a batrachian foot were found at Green Mill, Caerlaverock, being the first which has been noticed in the quarries around Dumfries. In this instance both the hind and the fore feet have formed beautiful imprints. The former have the five toes distinctly visible, and the form of the sole of the foot is equally well seen. Its length is nearly an inch and a quarter, and its breadth about an inch. The hind part of the posterior impression has a curved form, resembling a segment of an ellipsis cut across the minor axis; and the toes spread outwards and are thick; the longest one being about twice the length of the sole.

Immediately in front of the hind footmark the impress of the small fore-foot is seen, consisting of five thick, short toe-marks, having a depression behind them. The length of the stride appears to have been about 3 inches, and the space which separates those on one side from those on the other is about 2 inches. The portion of the foot which has pressed most heavily on the sand is the hinder part, which has caused a deep indent and forced the sand forwards and upwards; so that while the heel is deeply impressed, the toes are above the level of the surface of the plane over which the animal traversed, showing that the hind part of the foot came in contact with the ground first.

This impression seems to belong to the *Labyrinthodon*, but differs somewhat from those of the Bunter sandstone of Cheshire, appertaining probably to another species. I propose therefore to call it the *L. Lyelli*.

Another impression which seems to partake of a batrachian character is common at Green Mill; but the animal which has caused it having been apparently of small size, the steps are rather indistinct. In this case the same difference obtains between the impress of the fore and hind step as marks the foregoing form. In the hind footmark three toes usually occur, two of which are longer than the sole of the foot, and the other about the same length. Traces of two other toes are in some instances visible; but these are small, and occur one on the inner side and the other on the outer side of the impression. The whole length of the foot is commonly less than an inch, and its breadth about $\frac{5}{8}$ of an inch. About $\frac{1}{4}$ of an inch in front of the larger impression are seen the marks of the fore-feet, which are in the form of indents; but in some cases they present a foot-like marking resembling the fore-step of the *Labyrinthodon*. The length of the stride is about 3 inches, and the space between the impressions on the right and those on the left side is about 2 inches, distances somewhat similar to those in the preceding batrachian; and the form of the step is such as to show some analogy between these two forms. The characters are however not such as to lead to the conclusion that the impression belongs to the *Labyrinthodon*; and I propose to term this form of step *Batrichnis*, giving to this impression the name of *B. Stricklandi*, after Mr. Strickland, who has at different times noticed the ichnolites of Dumfries-shire.

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

[Continued from p. 44.]

62. *Clubiona lapidicolens.*

Clubiona lapidicolens, Walck. Hist. Nat. des Insect. Apt. t. i. p. 598.
—— *lapidicola*, Latr. Gen. Crust. et Insect. tom. i. p. 91; Sund. Vet. Acad. Handl. 1831, p. 139; Hahn, Die Arachn. B. ii. p. 9. tab. 40. fig. 100.

The claim of *Clubiona lapidicolens* to a place among British spiders rests on the authority of Dr. Leach. See the Supplement to the 4th, 5th and 6th editions of the 'Encyclopædia Britannica,' article Annulosa.

63. *Clubiona accentuata.*

Clubiona accentuata, Walck. Hist. Nat. des Insect. Apt. t. i. p. 594; Sund. Vet. Acad. Handl. 1832, p. 268; Blackw. Linn. Trans. vol. xix. p. 115.
—— *punctata,* Hahn, Die Arachn. B. ii. p. 8. tab. 39. fig. 99.
Agelena obscura, Sund. Vet. Acad. Handl. 1831, p. 128.
Anyphæna accentuata, Sund. Consp. Arachn. p. 20, 21; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 18.

This active spider is of frequent occurrence in the woods of North Wales, running with great rapidity among the foliage of the trees, and sometimes concealing itself under the lichens which grow upon their trunks and branches. In June the female deposits about 157 spherical eggs of a pale yellowish white colour, not agglutinated together, in a lenticular cocoon of white silk of a very fine texture, measuring $\frac{7}{16}$ths of an inch in diameter; it is inclosed in a sac of the same material, attached to the inferior surface of a leaf, the sides of which are curved downwards and are held in that position by silken lines connecting them with the sac. The female generally places herself on or near the cocoon, but speedily abandons it on being disturbed.

64. *Clubiona nutrix.*

Clubiona nutrix, Walck. Hist. Nat. des Insect. Apt. t. i. p. 601; Latr. Gen. Crust. et Insect. tom. i. p. 92; Hahn, Die Arachn. B. ii. p. 7. tab. 39. fig. 98.
Drassus maxillosus, Wider, Mus. Senck. B. i. p. 209. taf. 14. fig. 8.
Anyphæna nutrix, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 18.
Chieracanthium nutrix, Koch, Die Arachn. B. vi. p. 9. tab. 182. fig. 434, 435.

According to Dr. Leach this spider has been taken once in England, near Cheltenham. See the Supplement to the 4th, 5th and 6th editions of the 'Encyclopædia Britannica,' article Annulosa.

65. *Clubiona erratica.*

Clubiona erratica, Walck. Hist. Nat. des Insect. Apt. t. i. p. 602; Blackw. Linn. Trans. vol. xix. p. 115.
Chieracanthium carnifex, Koch, Die Arachn. B. vi. p. 14. tab. 184. fig. 438, 439.

Specimens of this handsome species have frequently come under my observation when exploring the woods and commons of Denbighshire. In July the female constructs a cell of white silk of a compact texture among the stems of gorse, heath, or the leaves of plants, which she curves about it and secures in that position by means of silken lines. In this cell she deposits about 140 eggs of a deep yellow colour, not agglutinated together; they are contained in an exceedingly delicate tissue of white silk of a subglobose form, measuring $\frac{1}{4}$th of an inch in diameter, which is attached to the surface of the cell. The female, after the deposition of her eggs, does not appear to quit the cell even for the purpose of procuring food.

A collection of spiders made by the Rev. Hamlet Clark in the autumn of 1842, at Wappenham, in Northamptonshire, and obligingly placed by him at my disposal, comprised specimens of this species.

Genus ARGYRONETA, Latr.

66. *Argyroneta aquatica.*

Argyroneta aquatica, Latr. Gen. Crust. et Insect. tom. i. p. 94; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 378. pl. 22. fig. 4; Sund. Vet. Acad. Handl. 1831, p. 131; Hahn, Die Arachn. B. ii. p. 33. tab. 49. fig. 118; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 14; Die Arachn. B. viii. p. 60. tab. 269. fig. 636; Blackw. Linn. Trans. vol. xix. p. 116.

Argyroneta aquatica habitually passes the greater part of its life in the water, not only pursuing its prey in that liquid, but constructing beneath its surface a dome-shaped cell in which it places the cocoon containing its eggs; this cell is supported in a vertical position, the open part being directed downwards, by lines of silk connecting it with aquatic plants, and, as it comprises a considerable quantity of atmospheric air, the spider can at all times occupy it without experiencing the least inconvenience. In swimming and diving, the body of *Argyroneta aquatica* is more or less enveloped in air confined by the circumambient water among the hairs with which it is clothed, the supply being always more abundant on the under than on the upper part in consequence of the greater length and density of the hairs distributed over its surface.

This species is found in pools and ditches in various parts of England. It is of frequent occurrence in the fens of Cambridgeshire, from which locality I transported a pair to Crumpsall Hall, near Manchester, in the summer of 1833; each was inclosed in a small tin box, and did not appear to suffer materially from the confinement. After the lapse of ten days, during which period they were without water, I conveyed them to Oakland, in Denbighshire, where they arrived in perfect health. On placing one of them in a large goblet more than half filled with water, it speedily formed a dome-shaped cell beneath the surface, attaching it to the side of the glass by means of numerous silken lines; being well supplied with insects, it lived in this state of captivity till the commencement of winter, and on the temperature of the room in which it was kept becoming much reduced, it entered the cell and remained there in a state of torpidity, with its head downwards. A gentleman on a visit at the house, whose curiosity to examine the spider minutely in its hybernaculum was greater than his prudence, inclined the glass so much that the air escaped from the cell, the water flowed in, and before I was informed of the occurrence the dormant inmate had perished.

The aquatic habits of this species have induced M. Walckenaer to constitute with it a distinct family; but upon the same principle *Lycosa piratica* and *Dolomedes fimbriatus* might be separated from the *Lycosidæ*, as they descend spontaneously into water and perform the function of respiration in that situation precisely in the same manner as *Argyroneta aquatica* does; yet the position, which in conformity with their organization they so consistently occupy in the systematic arrangement of the *Araneidea*, has not been disturbed. Influenced by these considerations, and guided by the relations of affinity predominant in the structure of *Argyroneta aquatica*, I have included it among the *Drassidæ*.

Family *Ciniflonidæ*.

Genus Ciniflo, Blackw.

67. *Ciniflo atrox*.

Ciniflo atrox, Blackw. Linn. Trans. vol. xviii. p. 607.
Clubiona atrox, Walck. Hist. Nat. des Insect. Apt. t. i. p. 605; Latr. Gen. Crust. et Insect. tom. i. p. 93; Sund. Vet. Acad. Handl. 1831, p. 144; Hahn, Die Arachn. B. i. p. 115. tab. 30. fig. 87.
Amaurobius atrox, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 15; Die Arachn. B. x. p. 116. tab. 355. fig. 831.
Titulus 21, Lister, Hist. Animal. Angl. De Aran. p. 68. tab. 1. fig. 21.

Remarkable differences in structure, functions and œconomy effectually serve to distinguish the spiders belonging to the genus *Ciniflo* from those of the genera *Clubiona* and *Amaurobius* with which they have been associated by arachnologists; all have *eight* spinners, and have the metatarsus of each posterior leg provided with a *calamistrum*, consisting of two parallel rows of spines, which is employed in the fabrication of their extensive and curiously constructed webs; they are also sedentary in their habits, most frequently occupying crevices in rocks, walls, or the bark of old trees, between which and their snares a communication is effected through the medium of one or more slight silken tubes. Though the importance of these characters is admitted by M. Walckenaer, yet he still retains the species of *Ciniflo* among the *Clubionæ* (Hist. Nat. des Insect. Apt. t. iv. pp. 444, 445).

The female of this common spider in the month of June deposits about 70 spherical eggs of a pale yellow colour, not agglutinated together, in a cocoon of white silk of a loose texture, measuring $\frac{7}{24}$ths of an inch in diameter; it is nearly of a plano-convex figure, and is connected with the interior surface of an oval cell of white curled silk, on the outside of which bits of soil and other extraneous materials are distributed. This cell is generally constructed in or near the spider's retreat.

On the 14th September 1842 I captured an adult female of this species in which the left intermediate eye of the posterior row was entirely wanting.

68. *Ciniflo ferox.*

Ciniflo ferox, Blackw. Linn. Trans. vol. xix. p. 116.
Clubiona ferox, Walck. Hist. Nat. des Insect. Apt. t. i. p. 606.
Amaurobius ferox, Koch, Die Arachn. B. vi. p. 41. t. 191. f. 460, 461.

Notwithstanding the superior size of this spider, it is very commonly confounded with *Ciniflo atrox,* which it closely resembles in form, colour and œconomy; both species are found in the same localities, and are abundantly distributed throughout the kingdom.

Genus Ergatis, Blackw.

69. *Ergatis benigna.*

Ergatis benigna, Blackw. Linn. Trans. vol. xviii. p. 608.
Theridion benignum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 337; Sund. Vet. Acad. Handl. 1831, p. 122.
Dictyna benigna, Sund. Consp. Arachn. p. 16; Koch, Die Arachn. B. iii. p. 27. tab. 83. fig. 184, 185; Uebers. des Arachn. Syst. erstes Heft, p. 12.
Clubiona parvula, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 437.
Drassus parvulus, Blackw. Research. in Zool. p. 337.
Titulus 15, Lister, Hist. Animal. Angl. De Aran. p. 55.

The various places which arachnologists have assigned to the spiders constituting the genus *Ergatis,* in their attempts to arrange the *Araneidea* in accordance with the natural relations of affinity and analogy, afford a sufficient indication that the task of determining their true position, before the discovery of those marked characters which serve to connect them with the *Ciniflonidæ,* was attended by no ordinary difficulties. M. Walckenaer, in his 'Hist. Nat. des Insect. Apt.' t. iv. p. 500, has formed with the species belonging to the genus *Ergatis,* previously included by him in the genera *Drassus* and *Theridion,* a small group which he has placed at the head of his genus *Argus*; but so closely are they allied to the *Ciniflones* by their structure and functions, being provided with *eight* spinners and *calamistra* employed in the construction of their snares, that they cannot be removed from the family *Ciniflonidæ*, which I have founded upon those characters, without doing violence to the recognised principles of classification.

Ergatis benigna fabricates an irregular web of whitish silk at the extremity of the twigs of heath and gorse growing in various parts of England and Wales. It pairs in May, and in that and the succeeding month the female constructs two or three contiguous, lenticular, white cocoons of a compact texture, measuring about $\frac{1}{7}$th of an inch in diameter, on an average, which she attaches to the stems surrounded by her web, enveloping them with the refuse of her prey. Each cocoon contains from 10 to 30 spherical eggs of a pale yellow colour, which do not adhere together.

70. *Ergatis latens.*

Ergatis latens, Blackw. Linn. Trans. vol. xviii. p. 608; vol. xix. p. 117.
Dictyna latens, Koch, Die Arachn. B. iii. p. 29. tab. 83. fig. 186.
Theridion latens, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 340.
Titulus 16, Lister, Hist. Animal. Angl. De Aran. p. 56. tab. 1. fig. 16.

This species is found in the same localities as *Ergatis benigna*, which it resembles in habits and œconomy. The sexes pair in June, and in the following month the female constructs several contiguous lenticular cocoons of greenish white silk of a compact texture, measuring about $\frac{1}{8}$th of an inch in diameter, on an average; these she attaches to a stem of gorse or heath surrounded by her web, distributing about them the refuse of her prey; each contains from 10 to 16 spherical eggs of a yellow colour, which are not adherent among themselves.

The statement of M. Walckenaer that this spider has the fourth pair of legs longer than the second (Hist. Nat. des Insect. Apt. t. iv. p. 501) requires correction, as the relative length of its organs of locomotion does not differ from that of its congener *Ergatis benigna*.

Family *Agelenidæ*.

Genus Agelena, Walck.

71. *Agelena labyrinthica.*

Agelena labyrinthica, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 20; Sund. Vet. Acad. Handl. 1831, p. 129; Hahn, Die Arachn. B. ii. p. 61. tab. 65. fig. 150, 151; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 14.
Aranea labyrinthica, Latr. Gen. Crust. et Insect. tom. i. p. 95.
Titulus 18, Lister, Hist. Animal. Angl. De Aran. p. 60. t. 1. fig. 18.

In localities suited to its habits, this active spider is frequently very numerous, constructing among gorse, heath, and coarse herbage an extensive horizontal sheet of web, having a cylindrical tube connected with it which constitutes the abode of its possessor. The web is attached to surrounding objects by its margin, and derives additional support from fine lines, intersecting one another at various angles, whose extremities are in contact with its surface, and with such objects as are situated at a moderate elevation above it. The sexes pair in July, and in August the female fabricates a large sac of compact white silk, which comprises one or two lenticular cocoons composed of white silk of a fine texture, measuring about $\frac{7}{16}$ths of an inch in diameter, on an average. Each cocoon, according to its size, contains from 50 to 120 large spherical eggs of a pale yellow colour, not agglutinated together, and is enveloped in a lenticular covering of strong white silk, which is made secure to the inner surface of the sac by silken lines closely compacted in the form of short strong pillars, evidently alluded to by Lister in the following passage: "ipse autem folliculus *stellæ* in modum formatus est" (De Araneis, p. 62). The sac is firmly attached to stems of gorse, heath, or long grass, and has usually withered leaves, particles of soil, and other materials of various kinds distributed over its surface.

In the 'Report of the Third Meeting of the British Association for the Advancement of Science, held at Cambridge in 1833,' p. 445, I have shown that the superior spinners of *Agelena labyrinthica* and some other spiders have the spinning-tubes disposed along the inferior surface of the elongated terminal joint, and, consequently, that the opinion previously entertained, that the function exercised by these organs is simply that of touch, and that they are employed solely in regulating the application of the spinners to appropriate objects, is decidedly erroneous.

72. *Agelena elegans.*

Agelena elegans, Blackw. Linn. Trans. vol. xviii. p. 619; Walck. Hist. Nat. des Insect. Apt. t. iv. p. 463.
Hahnia pratensis, Koch, Die Arachn. B. viii. p. 64. t. 270. fig. 639.

Though M. Walckenaer has placed this species in the genus *Tegenaria,* yet he has omitted to change its generic name (Hist. Nat. des Insect. Apt. t. iv. p. 463); and, not perceiving that it is identical with the *Hahnia pratensis* of M. Koch, has also proposed to transfer it, together with the *Hahnia pusilla* (*Agelena montana,* Blackw.) of the latter naturalist, to the genus *Argus* (Hist. Nat. des Insect. Apt. t. iv. pp. 465, 466, 503); but, as the generic characters of both these spiders and those of the *Agelenæ* appear to coincide, I can neither adopt the proposition of M. Walckenaer nor the genus *Hahnia* of M. Koch.

Agelena elegans occurs in moist pastures near Llanrwst, and the males have the palpal organs fully developed in August.

73. *Agelena prompta.*

Agelena prompta, Blackw. Linn. Trans. vol. xviii. p. 621.

Agelena prompta is included by M. Walckenaer among the synonyma of *Tegenaria emaciata* (Hist. Nat. des Insect. Apt. t. iv. p. 462), from which species it differs in size, organization and colour. It conceals itself under stones in woods about Llanrwst, and the male has the palpal organs completely developed in October.

74. *Agelena montana.*

Agelena montana, Blackw. Linn. Trans. vol. xviii. p. 622.
Hahnia pusilla, Koch, Die Arachn. B. viii. p. 61. t. 270. f. 637, 638.
Argus montanus, Walck. Hist. Nat. des Insect. Apt. t. iv. p. 505.

In transferring this spider to the genus *Argus,* with which it has no relation of affinity, M. Walckenaer has not perceived that it is specifically identical with the *Hahnia pusilla* of M. Koch.

Females of this species were discovered in February 1837 under stones, on Gallt y Rhyg, a mountain in Denbighshire, near Llanrwst.

75. *Agelena nava.*

Agelena nava, Blackw. Linn. Trans. vol. xviii. p. 623.
Argus navus, Walck. Hist. Nat. des Insect. Apt. t. iv. p. 506.

About midsummer, this species, which, notwithstanding its close connexion with the *Agelenæ,* M. Walckenaer has placed in the genus *Argus* (see the synonyma), may be seen in considerable numbers running on the ground, and on rails and gates in pastures near Llanrwst. The palpal organs of the male are fully developed in May.

76. *Agelena brunnea.*

Agelena brunnea, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 351 ; Research. in Zool. p. 351.

Agelena brunnea is of rare occurrence in woods in the valley of the Conway. The sexes pair in May, and in the same month the female constructs an elegant vase-shaped cocoon of white silk of a fine compact texture, attached by a short foot-stalk to rushes, the stems of grass, heath, or gorse ; it measures about $\frac{1}{4}$th of an inch in diameter, and contains from 40 to 50 yellowish white spherical eggs enveloped in white silk connected with the interior surface of the cocoon contiguous to the foot-stalk. Greatly to the disadvantage of its appearance, the entire cocoon is smeared with moist soil, which drying serves to protect it from the weather, and, as an additional security, the extremity is closed and directed downwards.

XII.—*Contributions to the Botany of South America.*
By John Miers, Esq., F.R.S., F.L.S.

Liriosma.

This genus, proposed by Pöppig, and figured in his 'Nov. Gen.' tab. 239, for a species found by him near the Rio Negro, in Brazilian Guiana, is yet but imperfectly known: its characters there given are in many respects incorrect or incomplete. That botanist referred it to *Olacaceæ*, it having been at first placed in *Styraceæ* by Endlicher. Two other species were soon afterwards announced, for which another new genus, under the name of *Hypocarpus*, was proposed by Prof. A. DeCandolle, in his 'Prodr.' viii. 245, which he considered to be more related to *Styraceæ*; but he was soon undeceived, as in the addenda to the same volume, p. 673, he recognised its identity with *Liriosma*. From a plant which I found near Rio de Janeiro in 1830, and which I then examined, I am enabled to complete the generic character, as far as regards the details of the fruit and seed, and at the same time, I now add my analysis of the floral structure of *L. Gardneriana*. Both Pöppig and DeCandolle describe the ovarium in this genus to be half imbedded in the adhering calyx; I find on the contrary that although the lower moiety of the ovarium is glabrous, and closely invested by the fleshy cup of the calyx, it is yet perfectly free from it, even for a considerable period after the fall of the corolla; the ovarium now increases more than the calyx, but at length the latter assumes the greatest increment, and at last wholly incloses it, becoming agglutinated with it, and converted into an enveloping pulp, leaving a small umbilical hollow in the summit and showing there the remains of its epigynous gland. The presence of a fleshy epigynous gland upon an inferior ovarium is a circumstance of the most ordinary occurrence, where it is held to be an abortive whorl of stamens; its existence upon a perfectly superior ovarium was therefore considered to be an impossibility, or when noticed it was always described as a mere basal enlargement of the style; but I have shown that in *Hyoscyamus* this anomaly really exists, and have since met with the same occurrence in several other instances. In the present case, its development is most decidedly marked, under the form of a prominent, rounded, fleshy disk, distinct in colour and texture, and exterior to the true pericarpial membranes. It is still more prominent in *Schöpfia*, and is found with a greater or less degree of development in most of the genera of the *Olacaceæ* and *Santalaceæ*. The internal structure of the ovarium accords with the character pointed out by Mr. Bentham, as a prominent feature of one of his tribes of the *Olacaceæ*, where its central placentation divides at its base into pseudo-dissepiments, leaving the summit of the internal space always free and unilocular, and the ovules suspended in that free space from the common apex of these incomplete divisions. This structure is decidedly marked in *Liriosma,* where the ovarium is 3-locular at base, with one ovule in each half-cell, suspended from the internal angle of these incomplete divisions, and here the apices of the ovules, rising above the points of suspension, are seen connivent in the perfectly unilocular summit of the ovarium. Of these ovules, as in the *Olacaceæ* and *Santalaceæ,* only one is perfected in the fruit, which becomes an oval crimson-coloured drupe, containing a putamen covered by pulp and inclosing a single albuminous kernel that fills its cavity; this exhibits externally a distinct raphe-like thread, extending from the base to the summit, as if the seed were suspended by a funicular support; but it will be seen that this thread partakes in no degree of the character of a true raphe, but is merely the remains of the pseudo-dissepiments, extended with the growth of the seed, and forced into a groove formed by pressure along its sides, there being seen at its summit a small cruciform extremity, resulting from the abortive ovules, similar to the structure that forms so remarkable a character of the *Santalaceæ,* as first pointed out by Mr. Robert Brown. This same appearance is well defined, and a true explanation of its origin is given by Mr. Bentham, in his excellent memoir upon the *Olacaceæ,* in the 18th volume of the 'Linnæan Transactions': he had observed the same structure in the genera *Olax, Heisteria* and *Schöpfia,* but its true nature had been mistaken by other botanists. The development of the seed in *Liriosma* is therefore identical with that of *Schöpfia,* a genus referred by Mr. Brown to *Santalaceæ,* but which Mr. Bentham first placed among the *Olacaceæ* with great reason; and this proves that the views of the former, in regard to the close affinity existing betwen these families, are founded upon truth, and I will presently adduce other proofs of their validity. The stamens, both fertile and sterile, in *Liriosma,* in form and structure resemble those of *Olax*: and *L. Gardneriana* and the typical species have their three fertile stamens placed in an alternate position, between each second petal and their six sterile stamens, intermediate between them, which are of course placed opposite the six petals. With the exact number and position of the stamens in the other species we are not informed, but I believe that in this genus, as in *Olax,* the real normal number of petals is six, with six fertile and six sterile stamens, the former being always alternate with, the latter opposite to, the segments of the corolla.

The following is an amended generic character of *Liriosma,* drawn up from my own observations; and after the enumeration of its species, I purpose subjoining some remarks upon the affinities of the order to which it belongs:—

Liriosma, Pöpp. Hypocarpus, *A. DC.*—*Calyx* parvus, carnosus, cupuliformis, disco adnatus, margine libero, crenato, vel obsolete 5-dentato, augescens, et ad fructum demum coalitus, eum tegens. *Petala* 6, sæpe usque ad medium geminatim laxe connata, carnosa, æstivatione valvata, apice processubus totidem inflexa. *Stamina fertilia* 3, petalis alterna, dimidio breviora, et ante suturam cujusque paris sita, e margine disci cupuliformis orta; *filamenta* complanata, pilis longis cottoneis barbata, demum glabra, libera, vel ad petalas imo sæpius laxe agglutinata, connectivo crasso lato continua; *antheræ* introrsæ, ovatæ, cordatæ, 4-lobæ, 4-loculares, 4-valves, valvarum margine alterutro vicissim dextrorsum et sinistrorsum intrinsecus soluto, hinc longitudinaliter dehiscentes. *Stamina sterilia* 6, petalis opposita, et vix longiora, filamenta carnosula, longe barbata, demum glabra, apice appendiciformia et bifurcata, laciniis subulatis, acutis, tenuioribus. *Pollen* subglobosum, vesiculis 3 æquidistantibus notatum, integumentis tenuissimis. *Discus* hypogynus, cupuliformis, carnosus, calyce brevior et eo adnatus, ad marginem liberum inflexum petala et stamina suffulciens. *Ovarium* ovatum, per dimidium inferiorem disco circumdatum, et illic glabrum, primo omnino liberum, cito adnatum, superne conicum, glandula magna epigyna crassa carnosa pilosa undique tectum, imo dissepimentis incompletis 3-loculare, summo 1-loculare. *Ovula* 3, anatropa singulatim in loculis spurii sab axi placentifero centrali (cionospermio) suspensa, apicibus in loculi summo indiviso simul conniventia. *Stylus* simplex, inclusus. *Stigma* capitatum, sub-3-lobum. *Drupa* baccata, ovata, monosperma, calyce adnato tecta, apice umbilicata. *Putamen* subtenue, coriaceum. *Semen* loculum implens, sulco longitudinali pro receptione raphes spurii (e cionospermio in filum extenso) impressum. *Integumentum* tenuissimum. *Embryo* in *albumen* dense carnosum infra apicem inclusus, brevis, *cotyledonibus* minutis, ovatis, compressis, *radicula* ovata, umbilico proxima, supera.—Frutices *Brasilienses*; folia *alterna, breviter petiolata, ovata, integra* (*rarius subdentata* ?), *punctata*; racemi *axillares, breves, pauciflori*; flores *parvi, pedicellati*; pedicellis *ebracteatis, articulatis*; *florum partes præmolles interdum sese laxe agglutinantes.*

1. *Liriosma candida*, Pöpp. (Nov. Gen. iii. 33. tab. 239);—foliis ellipticis, utrinque acutis, obiter remoteque serratis, vel integerrimis, utrinque glaberrimis; racemis axillaribus, corym-

bosis, plurifloris, folio dimidio brevioribus, calyce petalisque lineari-lanceolatis, glabris, istis extus virenti-cinereis.—Prov. Rio Negro Braziliæ, circa fluv. Teffê, confluentem Amazonicum.

The leaves are described as being 5 inches long, 2 inches broad, the flowers supported by two bracts, the calyx obsoletely denticulate, the petals thickened at their summit, 3-nerved, and coriaceous.

2. *Liriosma pauciflora,* A. DC. Prodr. viii. 673; Deless. Icon. Sel. v. 18. tab. 41. Olax pauciflora, *Bth. Linn. Trans.* xviii. 678; *Lond. Journ. Bot.* ii. 375. Hypocarpus pauciflorus, *A. DC. Prodr.* viii. 246;—foliis ovatis, obtusis, junioribus cum ramulis pedicellisque pubescentibus; pedunculo axillari brevi, 1–3-floro, et pedicellis calycibusque molliter puberulis.—Prov. Bahia ad Serra d'Acuruà; *v. s. in herb. Hook.* (Blanchet, n. 2795).

The above characters are wholly taken from the description of Mr. Bentham, who also states that the ovarium is adnate to the calyx; the lower half is without doubt subsequently so, by the intervention of the cupular disk, but I suspect that at an earlier stage it is entirely free from the disk, as occurs in *L. Gardneriana*: the upper uncovered moiety, as in that species, is covered with short erect hairs. The only specimens known were collected by Blanchet in the Serra d'Acuruà or Açuà,—the rich diamond district discovered a few years ago in the province of Bahia.

3. *Liriosma Gardneriana,* A. DC. Prodr. viii. 679. Olax Gardnerianus, *Bth. Lond. Journ. Bot.* ii. 375. Hypocarpus Gardnerianus, *A. DC. loc. cit.* viii. 216;—foliis lanceolato-oblongis vel ovato-oblongis, acuminatis, apice obtusiusculo, imo subrotundatis, textura teneris, ramulisque glabris; racemulo brevi 4–12-floro, pedicello pedicellisque pulverulentis, calyce petalisque extus glabris, ovario pubescente.—Prov. Cearà, Serra de Araripe, prope Bomjardim (Gardn. n. 1957).

This is a small tree about 12 feet high, with odoriferous flowers, and with leaves mostly 3 inches long, $1\frac{1}{4}$ in. broad, on a petiole of 2 or 3 lines; the petals are of a sulphur-yellow colour, linear, 3 lines long, thick, fleshy, and quite glabrous. The six sterile stamens are two-thirds the length of the petals, and are always placed opposite to them; the three fertile stamens are shorter, and situated at points between each second petal, and are therefore alternate with them; all the filaments are free above, but adhere at their base to the petals for the length of a quarter of a line, by which agglutination these are formed into three distinct bifid petals, cleft nearly to the base; but the filaments are easily detached, and then the united petals separate of themselves, thus showing the corolla to be in no degree gamopetalous; the four anther-cells open by two longitudinal lines, as above described, and are filled with a number of pollen-grains, aggregated into a mass, by a quantity of loose yellowish grumous matter: the pollen-grains are roundish, with three globular equidistant, marginal vesicles, each terminated by a mammillary point; they are extremely thin in texture: all the filaments, both sterile and fertile, are covered with long white cottony hairs, which ultimately become glued to the petals. The ovarium is half immersed in the cupuliform disk; the exserted moiety is covered by the fleshy epigynous gland, which is hairy: before æstivation, the lower portion of the ovarium is quite free from the enveloping disk, but it soon becomes agglutinated to it, by the same mucilaginous exudation (probably evolved by the disk) that glues the base of the stamens to the petals: even after the ripening of the flower, the cupuliform disk is most easily separated from the ovarium, without the slightest rupture of the parts; but it cannot be torn away from the calyx without laceration.

4. *Liriosma Velloziana*, A. DC. Prodr. viii. 673. Olax Velloziana, *Bth. Lond. Journ. Bot.* ii. 375;—ramulis glabris, foliis obovatis, acuminatis, et mucronulatis, basi obtusiusculis, reticulato-venosis, nervis divaricatis, utrinque glaberrimis, petiolo brevi, canaliculato; racemo brevi, axillari, 3–5-floro; ovario pubescente; fructu ovali, incarnato, pulpa molli.—Rio de Janeiro.

The leaves are smaller than the last species, about 2 or 2½ inches long, 1¼ inch broad, on a petiole 3 lines in length; they are acuminated from the middle of the leaf, and are more fleshy and opake: the raceme is shorter; the drupe is oval, 9 lines long, 6 lines in diameter, polished, and of a light scarlet colour, with a circular brownish depression in the apex; it is soft and fleshy, inclosing a thin subosseous putamen; the details of the structure of its seed will be found in the following remarks on the affinities of the natural order to which it belongs*. This is a low growing tree, which I found in the wooded margins of the bay of Jurujuba; it is among Gardner's collection, no. 5380†.

* These will appear in the next Number of this Journal.

† A representation of this plant and an analysis of its fruit, together with the details of the floral structure of the preceding species, will be given in plate 3 of the 'Contributions to Botany,' &c.

XIII.—*Further Observations on the* Chemnitziæ. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Gentlemen, Exmouth, July 18, 1851.

After the many admissions to the 'Annals' I have lately been favoured with, I would gladly have withdrawn for a moment from the invasion of its pages, but an unexpected discovery, which was so forlorn a hope, that even the Gods would hardly have dared to promise the fulfilment of, having occurred, I am irresistibly led to present myself again to your notice, lest I should be guilty of a neglect to science, to the 'Annals,' and its readers. I announce the discovery of one of, perhaps, the rarest of the British Gasteropodan unrecorded molluscan animals, the shell of which I found near thirty years ago at this place; and my then specimens, I believe, passed into Mr. Jeffreys' hands, but by some strange omission this elegant object has until very lately remained without a name; the cause has perhaps been its anomalous aspect; as soon as I was aware of this circumstance I flew to the rescue of my own discovery, and in the 'Annals,' vol. vi. p. 459, N. S., I hazarded a conjecture of its position, and honoured my protégé with the name of a lady of distinguished science; I need scarcely say that the species I allude to is the *Chemnitzia Gulsonæ.* This rare creature was met with in the coralline zone of the South Devon coast, at Exmouth, in thirteen fathoms water; it remained alive three days, and furnished me with the minutes I now submit. It is necessary to say, that my friend Mr. Jeffreys did not concur with me in my opinion of the natural position of the animal, and announced his conflicting views in the 'Annals,' vol. vii. p. 27, N. S.

I also send descriptions of four other rare unrecorded *Chemnitziæ*; that on the *C. Sandvicensis* being a continuation of the paper in the 'Annals,' vol. vii. p. 388, N. S.

Chemnitzia Gulsonæ, Clark.

Animal inhabiting an elongated, slender, hyper-hyaline shell of six rounded volutions, the body occupying half the axis, with a large patulous, sinuated, and a little outwardly reflected aperture, the peristome of which is entire; the animal rarely protrudes the eyes and tentacula; the tip of the effete muzzle, the mentum of authors, is only seen, and also a part of the foot, which is so short as almost to allow of progression within the aperture. The shell is of such hyaline purity as to give a full view of the organs as if they were without that protection; the mantle is flake-white and even with the shell; the neck is very long, cylindrical, like that of the *Chem. spiralis,* and finely transversely corrugated, ending at the tentacula, which, though somewhat apart, are united by the usual membrane of the *Chemnitziæ*; they are thick, broad, short, not very membranous, rounded at the tips, which have the characteristic minute flake-white lobe or inflation. The black eyes are not very near together; they are immersed *exactly* and close to the base of each tentaculum on minute white circles; they do not in the least invade the area of the neck, but rather impinge on the stamens of the tentacula. The effete muzzle or mentum is undoubtedly the continuation of the neck, and has no connection with the foot, which position I propose to show in a separate work; it is long, slender, grooved at the margins anteally and on each side, the upper and lower surface being perfect and unbroken; the vertical fissure of the mouth is under the tentacular awning. The foot is of the palest frosted yellow, exceedingly short, narrow, deeply bifurcated in front, at rest rounded behind, and a little lengthened in action. The animal examined was an "*Alma Venus,*" and when fully retracted occupies the fourth volution; then the light green liver, and very pale red granular ovarium, occupy the three primary volutions; but when the animal is fully out in the body of the shell, the liver and ovarium are altogether withdrawn from the first whorls, leaving them perfectly hyaline, and they are then deposited in the lower part of the third and the whole of the fourth volution, the other parts of the body and organs being in the fifth and sixth. The narrow arcuated branchial plume of about 15–18 rather coarse, opake, pale drab strands, and with the auricle and heart, distinguished by their intense snow-white colour, is perfectly visible, under a powerful Coddington lens, at the smaller and posterior end of the branchial plume. I have been thus particular as to the site of the organs, because I never met with a shell so perfectly hyaline in which their position could be so well seen. The operculum is an almost invisible film, pear-shaped or suboval, with a narrow border of pale bistre with a pinkish hue; the striæ of increment radiate as in most of the other *Chemnitziæ*; it is fixed on a plain lobe near the posterior extremity. I saw no ornamental appendages to the head and neck. In this example the apex is subreflexed, and there is a rudimental denticle on the pillar lip. Axis $\frac{1}{12}$, diameter $\frac{1}{50}$ unciæ.

This very rare animal is an undoubted *Chemnitzia,* and probably the first of the species that has ever been seen alive. To add to the interest of this little narrative, I state, that Mrs. Gulson, who last year allowed me the honour of attaching her name to this elegant shell, examined and saw her namesake in a living state.

Chemnitzia Sandvicensis, Walker, Test. min. rariora.

Odostomia dolioliformis, nonnull.

Animal inhabiting a white spirally striated subglobose shell of four volutions, with a reflexed apex and strong fold on the pillar. The colour throughout is hyaline pale azure. Mantle even with the apertural margin, except a slight canaliculation at the upper angle of the right side. The proboscidal muzzle, which some call the mentum, is the exact characteristic essential shape of the tribe; in quietude it scarcely extends to the anterior margin of the foot, but on the march it considerably precedes that organ. The tentacula are proportionately longer than in its congeners, not so triangular, nor furnished with such broad lateral membranes, nor do they coalesce so decidedly as in some species to form a veil; nevertheless they are bevelled and subtriangular, with the eyes at the internal bases. The tip of each tentaculum has a point of flake-white, giving, I think, only the appearance of a slight inflation, or it may be real for a limited period, caused by the contraction of the muscle of the tentaculum.

The foot is a singular deviation from that organ in the typical species; it is short, broad and blunt, truncate anteriorly, there often twisting itself into acute angles, which, when they happen to fall in a line with the true tentacula, give the appearance of a pair on each side, but a change of position instantly makes that appearance disappear; the anterior third portion of the foot is somewhat contracted; at this point a transverse groove appears, from the centre of which another longitudinal one proceeds to the posterior end, dividing the foot below the transverse portion into two suboval lobes, each rounded at its termination and separated by an emargination: whether these grooves are only depressions or solutions of continuity, I could not in so minute a creature satisfactorily determine; but the appearance is a foot formed of three lobes, an anterior and two suboval lateral ones with rounded termini. This is the great singularity, and malacologists would constitute a genus for it, but in all the essential points it is a decided and typical *Chemnitzia.* The operculum is fixed on a plain, not extended lobe; it has the flap-process or apophysis of the tribe, not in the same plane, but inflexed at right angles; on each side the notch that receives the tooth it is cartilaginous and flexible in this species, and the striæ of increment range in elliptical curves, as in the typical *Chemnitzia pallida.*

The animal is not lively, at least the only one I have examined was not so, and it is possible more active creatures, which are exceedingly rare, may cause some modification of the points described. It inhabits the littoral zone, and is unrecorded. Axis

$\frac{1}{15}$, diameter $\frac{1}{18}$ unciæ. This description will be the sequence of my account of the shell in a former Number of the 'Annals of Natural History.'

A second example has shown, that the transverse groove in the foot does not exist, and that in the first specimen it was due to contraction, which when it is completely developed disappears; nevertheless the structure is peculiar: at rest it is suboval, but divided into two portions by an apparent superficial line due to colour; when fully deployed, the anterior one is constricted, slender, attenuated, capable of great extension, slightly auricled and emarginate, subhyaline white; the posterior portion is suboval, short, broad, fleshy, of an opake pale drab, divided by a deep medial longitudinal fissure, that seems almost to penetrate the integuments into two lobes, forming together a rounded termination with a narrow central emargination.

Chemnitzia decussata, Montagu.

Animal inhabiting a pale drab spiral decussated shell of 4–5 volutions; it is hyaline white, except the proboscidal muzzle, that passes for the mentum with some malacologists, which is pale pink or red. The mantle is even. The muzzle of this species is less lobed and more truncate than in its congeners, but it has at times varying phases; it is small, subcylindrical and narrow, and on the march, as is the invariable practice in all the species, it is in advance of the anterior portion of the foot, which, like the terminus of the rostrum, is truncate and without the auricular points at the angles; it is rather broad, and when extended reaches halfway on the antepenultimate volution, posteriorly becoming a little constricted, and has a very rounded termination. The tentacula are triangular, bevelled laterally, pointed, with the usual two minute flake-white lobes at the tips, which may be partly real, but principally simulations that depend on the will of the animal; the lateral membranes, which are not so extensive as in some species, coalesce and form a shallow veil; the eyes are very close together strictly at the internal bases, not immersed, but are a little elevated on minute prominences. We may remark, that in this tribe the membranes on both sides of each tentaculum simulate all kinds of shapes and foldings, which have been termed auriform or subtubular; these are deceptions, and due to the will of the animal, as on the march the tentacula are always carried in a regular, smooth, triangular, bevelled position; these changes from one form to another only occur when the animal is disquieted by position; then they are frequently and suddenly made, and as quickly assume a natural form. The operculum is of a narrow, rather elongated oval shape, carried on a simple lobe at some little distance from the posterior terminus of the foot; it has the usual characteristic right-angled semicartilaginous minute notched apophysis and oblique striæ of the tribe.

The animal is not at all shy, progresses rapidly, and inhabits the coralline zone at Budleigh Salterton, where we have taken it in twelve fathoms water, more than once, alive. The animal has not been described.

Chemnitzia elegantissima, Montagu.

Animal inhabiting a white spiral elongated glabrous shell of 12–16 costated volutions; it is, except the eyes, hyaline-white throughout. The produced rostrum, the mentum of some authors, is on the upper surface deeply medially grooved, and at the termination imperforate? there is at its clavate extremity a vertical, and a little below a linear transverse deeply impressed line, both having the appearance of a breach of continuity, though perhaps not really so. I mention these circumstances in this species to excite attention, as they are more developed than in such of its congeners as I have examined. The rostrum is conspicuously carried before the foot on the march, when it appears truncate, but at rest is rounded and sinuated as in *C. pallida*. The foot is also truncate, very slightly auricled; the upper flap-skin or real mentum does not reach to its margin; it is narrow, not very long, attenuates and tapers to a rounded broad extremity, carrying at a short distance therefrom, on an obsolete lobe, a narrowish pear-shaped obliquely striated corneous operculum that has a subelastic rectangular apophysis, not notched in the centre, as the fold or denticle in this species is not usually visible; but in those examples where it is more or less pronounced, the notch is proportionately marked. The tentacula are short, triangular and pointed, having large lateral membranes which coalesce to half their altitude, and are capable of assuming various shapes, as the auriform, the semitubular, and longitudinal folds on the stamens, and of again being, as if magically, returned to a smooth, pointed, correctly bevelled, unfolded, symmetrical condition, coalescing regularly at the bases; all these phases are effected by the will of the animal; in short, the tentacula in this creature have an arcuated, leaf-like, broadly subtriangular aspect, scarcely showing inflations at the obtuse tips; the eyes are at a little distance from the internal line of the bases.

This elongated animal of sixteen volutions differs in no essential point, and scarcely in specialties, from its pigmy congeners of three turns, whether they be smooth, costated, toothed, or edentular; emphatically pronouncing as impossible, on reasonable grounds, a generic division of the family: all the species must, I think, range as *Chemnitziæ*. I have omitted to say, that the mantle is even, plain, scarcely showing a trace of branchial canaliculation. This is the first year I have succeeded in obtaining live examples, which occurred in the littoral zone off Budleigh Salterton, where in former years I have taken abundance of fresh, excellent shells, but always without the inhabitant. The existing malacological notes on this animal are so meagre, that the present account may almost be considered as that of an unrecorded creature.

Chemnitzia pusilla, Philippi, tab. 28. fig. 21.

Chemnitzia var. *elegantissima*, Anglorum.

A single live specimen of this very distinct species has occurred, which enables me more decisively than in any of its congeners, to insist on the position, that the eyes and tentacula are planted across the rostrum (miscalled the mentum), which is an undoubted continuation of the neck. What has led to the idea that the so-called mentum belongs to the foot, is that the pedal union with the general body of the animal is in this tribe a little more anteally advanced than in the *Rissoæ* of similar proportions, thus giving the neck, and its sequence the rostrum, an apparent connection with the foot, which, if really organically viewed, it does not possess.

It will only be necessary to notice the variations of the *C. pusilla* from its more stately congener the *C. elegantissima* ; it is, as respects the shell, not half the size, much more tumid, and does not taper in the decided manner of an example of that species of similar size. The variations of the malacology are more pronounced : the foot is much longer, extending on the march to the third basal volution, and terminating in almost a needle point ; whilst in the other, in a similar condition, it is quite rounded, and does not reach beyond the body-whorl. In the "*pusilla*," the tentacula when spread have the membranes united almost to the extremities, which are minute and pointed, so that they appear in action a single united leaf ; in its congener they are more triangular, less, though greatly, membranous, and do not unite above half their length, and have very obtuse terminations. The *C. pusilla* has a palish purple streak on each tentaculum, and on each side the rostrum ; this little fact is not without its value, as it proves pretty clearly, that the rostrum, miscalled the mentum, belongs to the neck and tentacula, and not to the foot : in the *C. elegantissima* both the same parts are hyaline-white. The two inhabit together the same littoral levels at Littleham Cove. I now take leave of the *Chemnitziæ*, and will not again allude to them, unless I am compelled, as an "ultima ratio," or to communicate decidedly new facts.

I am, Gentlemen, your most obedient servant,

William Clark.

XIV.—*On the Reproductive Organs of the Lichens and Fungi* (First Part). By M. L. R. Tulasne*.

Among the various products originating on the thallus of the Lichens, the black points to which the attention of botanists has been recently directed by M. Itzigsohn, are not those least worthy of thorough examination. Long known to lichenographers, these points have been taken sometimes for parasitic Fungi of the order Pyrenomycetes, sometimes for anomalous fructifications, or even for peculiar species of Lichens. With regard to their organization, M. von Flotow, who seems to be the last who has spoken of them, appears to consider them as little utricles filled with a mucilage in which swim cylindrical corpuscles of extreme tenuity, animated with a molecular motion. In his eyes these corpuscles are spores in a rudimentary condition, destined however subsequently to become perfect reproductive organs. M. Itzigsohn, on the other hand, has been induced to regard the points in question as antheridia analogous to those of the Mosses and Hepaticæ, and the corpuscles they contain as animalcules endowed with a movement of translation. He affirms that these corpuscles become developed, like the spermatozoids already known, within lenticular cells seemingly imbedded in the green tissue of the Lichen. Like MM. Kützing and Von Flotow, I have not been able to witness the vital motion attributed to these corpuscles, even by employing the means recommended for the purpose; and far from seeing them originate in special cells like the spermatozoids of the Muscineæ, I have satisfied myself that they are developed on the surface of a basidigerous *hymenium*, and owe their origin to an acrogenous vegetation.

Whatever resemblance there may be, at first sight, between the black or brown points in question and the antheridia of the stemless Jungermanniæ for instance,—that a kind of mucilage, a white, gray, or brownish pulp is poured out by both,—the elements of this substance and the structure of the organ in which it is elaborated are unlike in the two cases. In the Lichens, the pulp effused from the thallus is composed solely of linear bodies which are very short and slightly curved, or more elongated and thin, either strongly curved into an arc or more or less flexuous; but these corpuscles never appear to present cilia or appendages of any kind, and their confused movements do not differ from the molecular trembling described by Mr. Brown; in a word, they do not possess the characters which distinguish those singular beings engendered in antheridia properly so-called.

They differ no less, as I have said, in their mode of develop-

* Translated from the Comptes Rendus for March 24, 1851.

ment. The globule or conceptacle which produces them is imbedded in the thallus of the Lichen, commonly beneath an obscure point or a prominence which reveals its presence. Sometimes it possesses special walls, and may be extricated entire from the tissue in which it seems to grow as a foreign and parasitic body (for example, in *Parmelia physodes*); more frequently it is intimately connected with the parenchyma of the Lichen, and its form only marked there by its peculiar colour. In other Lichens it is divided into a number of loculi, sinuous cavities, by various processes, or more or less perfect partitions. Whatever may be the internal organization, it opens on the surface by a rounded pore, little converging slits or irregular chinks.

The corpuscles which emerge through these orifices originate like acrogenous spores, isolated or twin, upon the cells which form the internal walls of the globule, or laterally from moniliform filaments, or various processes lining the cavity. Sometimes a long filament, which becomes divided into a variable number of corpuscles, becomes developed in place of one of these corpuscles. This genesis has nothing really in common with that of the spermatozoids, which all originate in the interior of special cells, from which they disentangle themselves soon after their exit from the antheridium. But the circumstance that approximates the corpuscles in question to true spermatozoids is their equal tenuity; for, with a thickness which appears scarcely equal to a thousandth of a millimetre, the majority measure not less than three thousandths of a millimetre in length; some are eight or ten times as long, but no thicker.

Taking into consideration the whole of the characters presented by these point-like conceptacles, which I propose to call *spermogoni*, one would be inclined to regard them as foreign bodies on the Lichen, as parasites upon its thallus, analogous to the *Septoria*, *Phyllosticta*, and other minute Fungi which live upon fading leaves, aware of course that these latter possess an organization almost identical with that just described. Yet there will be hesitation in deciding thus, when it is recollected how frequent these *spermogoni* are on the thallus of almost all Lichens, a frequency sometimes so great as to exclude all normal organs of fructification (I have seen examples in *Endocarpon fluviatile* and *E. hepaticum*); that is to say, if the ascigerous apothecia alone deserve this name. The examples furnished by *Verrucaria* and analogous genera have also much weight on the question. It may be ascertained in *V. atomaria*, that its apothecia, when observed at a certain age, inclose at the same time and in great numbers both corpuscles wholly resembling those contained in the *spermogoni* of other Lichens, and fertile spores of the well-known structure. It is further observable that the development of these corpuscles (which might be called *spermatia*) precedes that of the spore-bearing cells, for the young apothecia are densely filled with the first before the second have acquired a recognizable form. On the dissociated thallus of *V. epidermidis*, seminiferous perithecia and other smaller conceptacles containing only the linear corpuscles or *spermatia* occur scattered and intermingled, and it is impossible to avoid regarding those two kinds of perithecia as belonging to one and the same plant.

An examination, both of other crustaceous Lichens (e. gr. *Urceolaria scruposa, cinerea, Lecanora atra, circinata, Placodium murorum, radiosum, Squamaria lentigera,* &c.) and of foliaceous Lichens (e. g. *Parmelia tiliacea, aipolia, Acetabulum, Gyrophora hirsuta, pustulata, Loboria pulmonacea, Sticta glomulifera, herbacea,* &c.), will in like manner show that the Itzigsohnian corpuscles or *spermogoni* which occur in them must belong to them; and it is impossible to doubt that they are peculiar organs of these plants, unfairly neglected by lichenographers hitherto. This opinion may be expressed with the more assurance since it is by no means the case, as M. von Flotow imagines, that these organs occur only on certain Lichens, for they are found upon so great a number that the list of the species which appear to be devoid of them is probably very limited.

On the other hand, the extreme dissimilarity of form and size existing between the *spermatia* and true spores, the constancy of these differences, and above all, the mode of generation peculiar to each of these organs, render the idea that the *spermatian* corpuscles are imperfect or young spores, altogether improbable. If this be so, neither perhaps does their extreme tenuity allow us to suppose that they are organs of fissiparous or gongylary reproduction, the Lichens being moreover furnished very abundantly with organs of this nature in their gonidia and the gemmæ of various forms of which these are the principal elements. Thus these reflections tend to increase the probability of the opinion which regards, with M. Itzigsohn, the brown points observed by him as organs of the male sex in the Lichens. But it must not be concealed that their little analogy, in regard to structure, with the antheridia of the Algæ and Muscineæ, is unfavourable to their assimilation with these organs. So that just as the nature and true functions of the latter seem destined to be for a long time more or less problematical and questionable, this will doubtless also be the fate of the *spermogoni* in the history of the Lichens. At the same time it is doubtful whether their dissimilarity from the antheridia already known is a sufficient reason for denying the function attributed to them; for, if among those there are some which are similar, as the antheridia of the Mosses to those of the Ferns, others, such as the antheridia of the Algæ and those of the Salviniaceæ, have scarcely any parity of structure either between themselves or with the former.

Perhaps the study of the Lichens alone may not procure sufficient data for the solution of the question of the nature and physiological functions of the *spermatia*: this doubt has led me to make some researches in the class of Fungi, the results of which, joined to those previously obtained by observations exclusively devoted to the Lichens*, indicate, if I am not deceived, that the latter, in spite of the name *aërial Algæ* which has been applied to them, are connected with the Fungi by an affinity much closer than has been generally believed.

(Second Part.†)

The great resemblance between the spermogonia of the Lichens and the *Pyrenomycetes* of the genus *Septoria* or their allies, leads to the suspicion that these little Fungi are not, as is generally supposed, autonomous productions—that they do not represent, alone, an entire vegetable species; and since several of these have been described sometimes as *Sphæriæ*, sometimes as *Septoriæ*, it is probable that they have been observed at different epochs of their development, and that each of these ambiguous *Septoriæ* corresponds to a peculiar *Sphæria* or other thecasporous Pyrenomyces, which succeeds it and forms with it but a single species of Fungus. What would be true of the *Septoriæ*, should extend to a great number of other genera of Pyrenomycetes or of Coniomycetes, which in like manner would comprise only the dissociated members of species composed of several terms. This assertion is in fact now borne out by several proofs.

The *Cytisporæ*, which have so much analogy to the *Septoriæ*, were called by Tode *Sphæriæ cirrhiferæ*, and in the most recent classifications are placed near the *Sphæriæ* or confounded with them. The reason of this is not to be sought in their organization, which differs extremely from that of the *Sphæriæ*, but far rather in that remarkable correspondence, noted by M. Fries, between certain species of these two genera of Fungi. Patient research will show that this correspondence is a much more general fact than has been imagined, and it sufficiently authorizes the belief, that far from being the total expression of a species of Fungus, each of the *Cytispores* represents merely a particular state of a Fungus which subsequently presents itself under a more perfect form as a true *Sphæria*, or at least as a thecasporous Sphæriacean. It will be found that this is the real state of the

* Vide l'Institut, xviii. année, p. 16; or, Bull. de la Soc. Philomathique, 1850, p. 26.

† Comptes Rendus, March 31, 1851.

case in *Nemaspora, Micropera, Polystigma, Ascochyta,* and many other genera comprehended in the *Cytisporaceæ* or *Phyllosticteæ.* Thus, to cite only a few examples, *Nemaspora Ribis* belongs to *Sphæria Ehrenbergi,* N., *Polystigma rubrum* to *Polystigma fulvum,* a thecigerous Fungus, *Micropera Drupacearum* to *Sphæria Leveillei,* &c.

Any one attentively following this constant succession of the same fungous productions upon the same *mycelium* will naturally suppose that they are determined by a law, and that a necessary relation exists between these vegetable forms; but it will be found difficult to believe that they are so many different creations, parasitical upon one another, and it will be more readily supposed that they are connected by some other bond. A proof that this bond is that which exists between the members of the same body or the individuals of a single species, is furnished by the species of *Tympanis* and *Cenangium,* which are kinds of cespitose or coalescent Pezizas. The *stroma* of these Fungi, before giving birth to the thecigerous cupules or disks, produces abundantly upon its surface, borne upon *basidia* of various forms, not only naked spores, but also extremely slender cylindrical corpuscles, exactly like those emitted from the spermogoni of the Lichens, the *Septoriæ,* many of the *Cytisporæ,* and other analogous Fungi. The same corpuscles are observed also upon the edge of the cupule of various species of *Cenangium.*

In *Rhytisma,* a thecasporous genus, of the order *Discomycetes,* each species, so to speak, possesses a kind of precursor in a *Melasmia,* or Fungus with acrogenous spores, which plays towards it the same part as the *Cytisporæ* and their analogues do in relation to the *Sphæriæ.* According to what Mr. Berkeley says, *Asteroma Ulmi* should be a sort of *Melasmia* to *Dothidea Ulmi.* Several species of *Hysterium* and *Phacidium* are also joined to *Leptostroma,* which evidently belongs to them.

With reference to some genera of the *Coniomycetes,* it has long been suspected that the *Melanconia* and their allies are only *Sphæriæ* in a certain state of alteration (*Sphæriæ corruptæ*). M. Fries, following Link, has raised doubts as to their autonomy, but no one has yet shown, by a sufficient examination of their mode of increase, what they really are, that is to say (like *Stegonosporium, Didymosporium, Stilbospora* and analogous genera), the gonidia of various *Sphæriæ* (e. g. *Sphæria stilbostoma, favacea,* &c.). The majority of the *Tuberculariæ* also represent the *stroma* of certain *Sphæriæ* (v. g. *S. cinnabarina, S. coccinea,* &c.), and their spores must also be received as the gonidia of the latter. A very exact comparison can be made between the spores of the *Tuberculariæ* and the dissociated elements of the articulated filaments, which by their union constitute the pulvinules called by the name of *Dacrymyces Urticæ,* or the margin of the *Peziza fusarioides,* which is merely the perfect condition of the same fungus. *Tubercularia persicina,* Dittm. (*Æcidiolum exanthematum,* Ung.) and other analogous productions live intermingled with *Uredines* and *Æcidiæ* when the *sori* of these entophytes are scattered (e. gr. *Uredo Euphorbiæ, suaveolens, Æcidium Cichoracearum, Euphorbiæ*), or they occupy the centre of the area bounded by these *sori* when they are circular (e. c. *Uredo compransor, Mercurialis, concentrica, Æcidium Grossulariæ, crassum, Convallariæ, Paridis,* &c.); in like manner punctiform productions, which, like *Æcidiolum exanthematum,* might well represent the spermogoni of the *Uredineæ,* are constantly developed upon the opposite surface of the patch borne by *Ræstelia cancellata, Centridium Sorbi, Cydoniæ,* &c.

Among the Fungi most decisively proving the thesis now proposed, are the *Sphæriæ. S. Laburni,* Pers., is a very complete species; its ascophorous *perithecia* arise like those of a large number of *Sphæriæ,* around a cytispore with a whitish cirrhus, mixed, in addition, on the same *stroma* with conceptacles lined by a basidigerous *hymenium,* which would be referable to the genus *Sporocadus* or one of its analogues. Thus *Sphæria Laburni* possesses three kinds of reproductive organs, viz. normal endothecal spores, acrogenous spores very like the fruit, those of the *Sporocadus,* and lastly other spores equally acrogenous, but very different and exceedingly slender, namely those of the *Cytispora.* In *Sphæria hypoxylon* and other *Xylariæ,* I have as yet seen only two kinds of spores, namely the black endogenous spores which are known to belong to them, and in the second place the white seminules which cover the young branches of the *stroma* with a fine dust. These seminules arise singly from a naked *hymenium,* clothed with short, straight *basidia. Dothidea ribesia* is more complete; on the upper face of its pulviniform *stroma* it produces white seminules like those of the *Xylariæ,* and in the substance of its parenchyma little cavities become excavated here and there, producing upon their walls acrogenous corpuscles resembling the seminules of the *Septoriæ.* Finally, it is known that it also possesses an innumerable quantity of superficial conceptacles filled with eight-spored *thecæ.*

The multiplicity of reproductive organs in all these Fungi requires the invention of a few new words to distinguish them from each other. The term *spores* remaining attached to the most perfect, those developed in the *thecæ,* without relation of continuity with the parent plant; we may apply the name of *stylospores* to those which originate naked, that is to say, from linear stalk-like cells analogous to the *basidia* of the *Agaricineæ.* Then the more delicate seminules, the generation of which is also acrogenous, should receive, like the Itzigsohnian corpuscles which they wholly resemble, the name of *spermatia,* which merely conveys the idea of a body destined, in some manner or other, to the office of reproduction.

M. Fries applies the name of *conidia* to all the reproductive bodies which are not, as he thinks, normal spores, so that after the foregoing statements, this designation would embrace very dissimilar organs. I would propose to restrain the application of it to the *gemmæ* properly so-called, if it be agreed to regard as such the reproductive cells which arise directly from the *mycelium* (as in the *Erysiphes, Ascophoræ,* and other *Mucedineæ*) and appear to correspond especially to the *gongyli* of the Muscineæ and Hepaticæ. Leaving to it the general acceptation, the term *conidia* would be employed whenever it is impossible to determine the nature of a reproductive body which it is required to describe. The difficulty of this problem will appear when the fungus under examination does not present the different kinds of reproductive organs united; but then analogical reasoning will be usefully adopted. If, for example, *Melasmiæ,* the precursors of *Rhytisma,* are compared with the first condition of *Tympanis,* there will be an inclination to regard the seminules of these *Melasmiæ* as *spermatia,* rather than as *stylospores* of the future *Rhytismæ. Sphæria Laburni* furnishes the interpretation of all the *Sphæriæ* constructed upon the same plan; its *cytispore,* like that of its congeners, will represent the receptacle of the *spermatia,* and its *sporocadus* the stylosporous *perithecia.*

Another difficulty will be found in reuniting the elements of a single species of Fungus when they are not met with associated together in nature. If the Fungi above-named prove that these elements are often assembled together, so that there can be no doubt of their natural relations; there are others which would show in different degrees the dissociation of the different constituent terms of the species. For example, we find the yellow *stroma* of *Sphæria stilbostoma* sometimes fertile at the same time in ascophorous *perithecia* and in *Melanconium* (*conidia*); sometimes, on the contrary, devoid of one or other of these productions. The same is true of the *stroma* of *Sphæria favacea,* although, more frequently, it developes the *Sphæria* and their *conidia* isolated. In *Sphæria nivea,* we find on the same area, circumscribed by the black margin of the *mycelium, cytisporous* tubercles and tubercles producing *Sphæriæ*; we also find, but much more rarely, tubercles which are *cytisporous* only in part, one half giving birth to thecigerous *perithecia.* The *stroma* of *Sphæria castanea,* N., most frequently presents the *perithecia* and the *cytispora* united; yet it commonly produces the latter to the exclusion of the former, or *vice versâ,* and does not enter into the class of the *Sphæriæ*, among which the *cytispore* always accompanies the ascophorous conceptacles (e. g. *Sphæria leucostoma, ambiens, corticis, pulchella, Leveillei, profusa*, &c.).

It may be suspected that certain *Sphæriæ* do not exist at all, or are only met with commonly under the three principal forms which they may take on. In *Sphæria Laburni*, even, the stylosporous form (*Sphæropsis, Sporocadus*) is as frequent as, if not more common than, the perfect thecigerous state. *S. sapinea* appears to be known only with acrogenous spores, yet it is sometimes combined with its *cytispore*. *S. Oreades, atrovirens, Hederæ*, and a crowd of others, commonly present themselves with merely a gongylary reproductive apparatus. Hence it might be concluded with much probability, that the group of the *Sphæropsides* and that of the *Cytisporacei* (which claim a great number of *Phyllostictei*) include a number of *Pyrenomycetes*, the perfect states of which are to be sought among the *Sphæriaceæ* properly so-called, and which consequently must one day be united to them, when persevering investigations shall have clearly made known the constituent elements of each species.

Finally, there is a constant fact to which it is still desirable to call attention, namely the order of development of the different terms of which we believe the species of Fungus to be composed. It is such, that the *spermatia* which may be contemporaneous with the *stylospores* always precede the appearance of the perfect or thecigerous form. This anterior development may take place even several months before, as is seen in the *Rhytismæ* which only ripen their *spores* in spring, while their *spermatia* (*Melasmiæ*) are developed at the close of the preceding summer. Without in any way prejudging the nature and office of these *spermatia*, it is imposible to avoid remarking that they precede the *endothecal spores* in the same manner as the *antheridia* of the Ferns or *Equiseta* precede the origin of the seminiferous capsules of those plants.

BIBLIOGRAPHICAL NOTICES.

Manual of British Botany, containing the Flowering Plants and Ferns arranged according to the Natural Orders. By Charles Cardale Babington, M.A., F.L.S., F.G.S. &c. Third edition, with many additions and corrections. London: Van Voorst, 1851. Pp. 434.

Mr. Babington's 'Manual' has become so well known to all British botanists in the two previous editions through which it has passed, that a third can require of us no formal introduction. The features which distinguish it most strongly from other works of a similar nature are of such a kind as to afford no room for great organic changes. The book is emphatically a "Manual"; and most of the modifications and improvements introduced in the present edition tend to make it answer to its name even more thoroughly than before. We are aware that some persons would always have preferred to have had it more expanded and less concise; but in this view they forget the important distinction between a Manual or Synopsis and a complete descriptive Flora. We have no work on British botany of the latter class more recent than Smith's; and, excellent as that is in many respects, it is quite inadequate to our present wants: but it is delusive to expect that *any* mere enlargement of diagnoses with supplementary small-talk, however valuable or interesting, can really make up the deficiency. An author warmly devoted to his science exercises no small degree of self-control in forbearing to dilate on points which have specially engaged his attention: but the wisest plan for him is to make the sacrifice at once and confine himself to essentials, or at least to such conditions as are fully compatible with portability and salient clearness. A formidable difficulty however still remains: a book written in the vernacular and avowedly intended for the hand rather than the library must necessarily have somewhat of a popular character: whose interests then ought to be consulted, the botanist's or the botanophilist's? Should facility of discovery of names, or strict scientific truth, be the primary object? The question is not very easily answered: it is too much the fashion just now to lavish pharisaical contempt upon "mere collectors": surely their shallow knowledge of plants is better than none at all, and we have little chance of drawing out from among them recruits to the ranks of true botanists, if we scornfully leave them to the guidance of popular scribblers, scarcely better informed than themselves. On the other hand, it is manifestly wrong, though the occasional practice of illustrious authors may be pleaded in excuse, to sacrifice natural to definite and systematic but artificial arrangements, or to describe the facts of nature—not as they are, but—as they appear to the inexperienced eye, without giving warning of the illusion. Mr. Babington seems always to have had in view the benefit of both classes of readers, but more distinctly now than before: there is an increase of scientific rigour; confessedly natural genera are not fused together because each happens to have only one or two British representatives; but English terms are in several cases substituted for Latin ones, new subdivisions of genera introduced for the sake of convenience, and alphabetical indices of species appended to the accounts of *Rubus*, *Hieracium*, *Salix*, and *Carex*. All the descriptions have been carefully weeded of superfluous words or observations, and fewer synonyms, authorities, and localities are given; we observe also that the abbreviations are increased and some convenient terms borrowed from Mr. Woods: so that, notwithstanding the number of species discovered or discriminated in the last four years and the addition of an account of the Characeæ (occupying above four pages), there is an increase of only six pages upon the 2nd edition. It is almost superfluous to say that the descriptions are effectually revised throughout (several useful hints being taken from Hooker and Arnott), and show marks of constant labour in both the field and the study along with attention to the work of others up to the latest moment. Some persons may perhaps be annoyed at seeing the accounts of a few species, respecting which controversies have lately taken place or strong adverse opinions been expressed, left unchanged: but it is unwise, where grave doubts still exist, to make such alterations *as can scarcely lead the way to fuller knowledge.* Mr. Babington has advanced more than a step towards making our lists genuine summaries of British vegetation by including in brackets "a considerable number of plants which only occur in the Channel Islands, or there is reason to suppose have never been really detected in Britain; or have been added to our Flora by previous writers, but are not now to be found; or, although decidedly naturalized, have very slender claims to be considered as aboriginal natives." But the process of purgation must be carried further still and extended to nearly all the plants now marked with an asterisk. It is perhaps better not to banish these excluded species to the limbo of an appendix, but brackets are by no means sufficient to distinguish them from genuine natives: the use of small and insignificant type would probably be the best plan. There would then be room for an increased number of brief notes on plants likely to occur: we cannot think that Mr. Babington has done wisely in cutting them down in this edition.

It is now time to give a brief account of the principal individual changes, premising that neither we nor our readers can be competent to judge of the merits of many of them without having seen in Britain the plants in question. Two new *Thalictra* are introduced, *T. flexuosum* (Reich., Fries) and *T. saxatile* (D.C.) which is identical with *T. Kochii* (Fries). *Ranunculus aquatilis* adds *R. confusus* (Godr.) to its already large progeny. Submersed leaves are described for both the yellow Water-lilies: we suspect they are known to but few botanists, except those whose attention may have been attracted by their curious appearance, somewhat like lettuces, at the bottom of clear lakes or slow streams. The Fumitory lately described by Mr. Babington as *F. agraria* (Lag.) is referred as a variety to *F. capreolata* in accordance with Dr. Arnott's views: the account of the whole genus is remodelled. *Nasturtium anceps* of the last edition is wisely given up. The old arrangement of *Brassica* and *Sinapis* is restored. The stipulate species of *Alsine* are transferred, after Hooker and Arnott, to *Paronychiaceæ*: the genus so formed is not however called *Spergularia*, but *Lepigonum*; and reasonably enough, for the former name was originally affixed to a mere sectional division, and its *generic* use is quite recent. *Cerastium tetrandrum* is allowed to be a form, probably a young one, of *C. atrovirens*, but of course Curtis's name has the priority. Mr. Babington seems to abandon the characters drawn from the hypogynous ring in the *Gerania*; we certainly have found it very variable. *Ulex Gallii* (Planch.) is still kept under *U. nanus*, but noticed at some length as probably distinct. As no allusion is made to the supposed *Trifolium strictum* of Anglesea, mentioned in an early number of the 'Botanical Gazette,' we presume

Mr. Babington has discovered some error. *Orobus* is merged in *Lathyrus*. Of the *Rubi* it is enough to say that they have been evidently worked up fully anew, and that there are now forty-three species where four years ago thirty-six were given. Dandelion and the Hawkbits have nearly all recovered their old familiar names. Fries's Monograph has of course rendered necessary a thorough revision of the *Hieracia*, but much research is obviously still required: *H. Schmidtii* ("Tausch") vanishes, we know not whither: *H. Lawsoni* divides into *H. anglicum* (Fries) and *H. pallidum* (Biv.): Mr. Babington's *H. denticulatum* becomes *H. strictum* (Fr.), and Smith's is referred to *H. prenanthoides*: *H. inuloides* ("Tausch") is now *H. crocatum* (Fr.); and several new species are added. The four supposed *Armeriæ* are of course united: the wonder is how they ever came to be separated: it is evident that Mr. Babington followed in Boissier's steps far too blindly. The *Atriplices* are better described than before, but they are not yet in a satisfactory condition. The *Salices* are prodigiously reduced, chiefly according to Mr. Leefe's views: few things are wanted in British botany more than a really good monograph of this genus. Our hapless Blue-bell receives its fourth British generic name! it seems likely, however, that it really ought to be called *Endymion*, and so romantic an appellation is sure to be popular. *Sparganium natans* of our ditches becomes *S. minimum* (Fr.), the old name being retained for a long-leaved plant which would appear to be rare with us. The *Potamogeton* doubtfully referred to Fries's *P. zosteraceus* is apparently considered a new species, called *P. flabellatus*: Mr. Babington's words lead us to believe that it is common. We now come to the complicated question of the arrangement of the *Carices*: in the first twenty-eight species the transfer of *C. Boenninghauseniana* and *C. axillaris* to the Hypoarrhenæ and the change of position of *C. elongata* are the only alterations: may we take this opportunity of protesting against the received separation of Acroarrhenæ and Hypoarrhenæ? The discrepancy of statements about the two species above mentioned shows the uncertainty of the characters; nor is the grouping at all natural, however convenient: strictly speaking, we have in Britain but three series; the (more or less) rhizomatous group from *C. incurva* to *C. disticha* (including *C. brizoides, lagopina,* and *leporina*), the uncoloured group with fruit tending to be squarrose from *C. vulpina* to *C. Boenninghauseniana*, and the tawny panicled group (nearly parallel to the last) from *C. elongata* to *C. teretiuscula*: Mr. Babington describes sp. 16–21 as "glaucous," translated, we presume, from Andersson's "glaucescentia": but he ought to have seen that the word here means "*becoming* glaucous" (see Andersson himself, p. 56), for several of the species are bright green when fresh. The distigmatic section is treated in accordance with Fries's and Andersson's views, except that *C. pulla* and *C. Grahami* are unnaturally retained there: whether mere forms of *C. vesicaria* or not, they are at all events most closely allied to it, and except in size and colour scarcely differ from some of its not uncommon lowland states. The next division is considerably improved with Andersson's help, except that the fallacious and arbitrary distinction of erect or pendulous spikes is retained, and *C. glauca,* though intimately allied to *C. panicea,* is banished to a distance; nor should *C. strigosa* and *C. pendula* have been separated from *C. sylvatica* and *C. Pseudocyperus,* to which it might be well to add *C. lævigata* and *C. depauperata.* Objections will doubtless be made to *C. Œderi* being restored to specific rank, and perhaps rightly: but then they must not be founded on ordinary small or condensed specimens of *C. flava,* which are evidently by no means what Mr. Babington has in view. Some confusion may arise from several changes of nomenclature; yet they appear unavoidable, and it is quite time for British botanists to cease to ascribe oracular authority to the Linnæan Herbarium. *Lastræa uliginosa* (Newm.) is retained as a variety of *L. cristata,* but Mr. Babington is "very imperfectly acquainted" with it: is any one otherwise? *Cystopteris dentata* is again separated so far as the plants from the "Breadalbane Mountains and Cumberland" are concerned: they must therefore differ from the common dentate variety of *C. fragilis* of Wales and Teesdale. The account of the *Charæ* is a brief summary of the provisional monograph given in our pages a year and a half ago: it is to be hoped that the neglect with which they have hitherto been treated may now exist no longer.

This sketch gives a very imperfect idea of the volume: but, after all, it is in the field that the excellences of a Manual can best be tested. Still let no one suppose that all is done which requires to be done: even in the most familiar genera there is work for every one for some years to come: we know very little, for instance, of the different modes of growth collectively called "perennial" in the different species, and the imitation of them in annuals, particularly with reference to the relation of the vegetative and reproductive systems. But we are favourably placed at present for the progressive study of plants: the differences, which a few years back made wide schisms among British botanists, have latterly been greatly reduced; and if the reproach, that 'it is our custom to study exotics, but dogmatize on native plants,' has not altogether passed away, its just application is at least much narrowed.

We subjoin lists of the species introduced and suppressed in Mr. Babington's present edition.

Species Introduced.

Thalictrum flexuosum, *R.*
—— saxatile, *D.C.*
Ranunculus confusus, *Godr.*
—— tripartitus, *D.C.*
Thlaspi virens, *Jord.*
Viola stagnina, *Kit.*
Sagina ciliata, *Fr.*
Medicago sylvestris, *Fr.*
Melilotus arvensis, *Willd.*
Poterium muricatum, *Spach.*
Rubus Leesii, *Bab.*
—— fissus, *Lindl.*
—— affinis, *W. et N.*
—— latifolius, n. sp.
Rubus imbricatus, *Hort.*
—— incurvatus, *Bab.*
—— thyrsoideus, *Wimm.*
—— mucronatus, *Blox.*
—— calvatus, *Blox.*
—— fuscus, *Weihe.*
—— Hystrix, *Weihe.*
—— pallidus, *Weihe.*
—— pyramidalis, *Bab.*
—— scaber, *Weihe.*
Pyrus scandica (Sorbus, *Fr.*).
Epilobium lanceolatum, *Seb. & Mauri.*
Saxifraga Andrewsii, *Harv.*

Filago apiculata, *G. E. Sm.*
—— spathulata, *Presl.*
Gnaphalium norvegicum, *Gunn.*
Hieracium rupestre, *All.*
—— pallidum, *Biv.*
—— oreades, *Fr.*
—— saxifragum, *Fr.*
—— atratum, *Fr.*
—— cæsium, *Fr.*
—— dovrense, *Fr.*
—— gothicum, *Fr.*
—— corymbosum, *Fr.*
Orobanche Picridis, *F. W. Schultz.*
Teucrium Botrys, *L.*
Statice Dodartii, *Gir.*
Anacharis Alsinastrum, *Bab.*
Simethis bicolor, *Kunth.*
Luzula Borreri, *Bromf.*
Sparganium minimum, *Fr.*
Potamogeton trichodes, *Cham.*
Naias flexilis, *Rostk.*
Carex brizoides, *L.*
—— Œderi, *Ehrh.*
Apera interrupta, *Beauv.*
Triticum laxum, *Fr.*
Lolium linicola, *Sond.*
Cystopteris dentata, *Sm.*
And the Charæ.

Species Suppressed.

Nasturtium anceps.
Brassica Cheiranthus.
Viola lactea.
Cerastium atrovirens.
Hypericum maculatum.
Prunus insititia.
—— domestica.
Rubus fastigiatus.
—— tenuis.
—— Borreri.
—— Leightonianus.
—— Lingua.
—— humifusus.
—— Schleicheri.
Carduus Forsteri.
Hieracium Schmidtii.
Linaria italica.
Atriplex microsperma.
—— prostrata.
Urtica Dodartii.
Ulmus campestris.
—— major.
—— carpinifolia.
—— glabra.
—— stricta.
Salix decipiens.
—— Russelliana.
—— amygdalina.
—— rugosa.
—— ferruginea.
—— sphacelata.
—— cotinifolia*, &c.
—— propinqua, &c.
—— radicans, &c.
—— retusa.
Zostera angustifolia.
Poa montana.

Remarks on "Hymenopterologische Studien by Arnold Foerster, 1stes Heft, Formicariæ, Aachen, 1850." By William Nylander, M.D., of Helsingfors.

Having had an opportunity of seeing the above-named treatise by M. Foerster, on the species of Formicidæ inhabiting the German provinces on the Rhine, in which he has done me the honour of bestowing special attention on my essay on the natural history of this family †, I have thought that the expression of my opinion concerning the determination of some species in his work would not prove altogether unserviceable. As Mr. Walker has at the same time kindly

* The changes of nomenclature render it impossible to extricate singly the species suppressed in this and the two next groups.

† Adnotationes in Monographiam Formicarum borealium, 1846; Additamentum in Monogr. Form. bor. 1846; Additamentum alterum in Monogr. Form. bor. 1847.

submitted to me for examination typical specimens of the major portion of M. Foerster's species, transmitted to him by the author, it is on them chiefly that the following remarks are based. And I trust that the author will excuse me, if in some instances I entertain views differing from his; and I hope that he will not consider I have been, in penning them, prompted by any other motive than the advantage of our science. M. Foerster generally considers minute, and in my opinion too obscure characters, as sufficient ground upon which to found a species. With all deference to him, I must remark, that the same species of Ant does not always construct its nest of the same materials nor in the same manner, so that specific distinctions, taken from such circumstances, cannot be looked upon as very stable: the hill-making Ants gather the materials they find nearest at hand; if they inhabit pine-woods, they make use of the needles of those trees; if they inhabit meadows, of bits of grass, &c. Some species however (*F. pressilabris, exsecta*) prefer meadows or thickets; other, dry sterile heaths or fir-woods (*F. rufa, congerens*). The size is also very variable in every species, and the colour is frequently more or less pale or dark. I will now proceed to the remarks on the species:—

1. Under the name of "*Formica congerens*" (*l. c.* page 17. 5) is transmitted to Mr. Walker my *F. congerens* ☿ and *F. rufa* ♀ ♂.

2. Under the name of "*F. polyctena*" (*l. c.* 15. 4) I can see only a form of *F. rufa.*

3. Under the name of "*F. piniphila*" I see my *F. congerens.* To this may belong *F. truncicola,* Foerster, *l. c.* 21. 7, which is certainly not *F. truncicola* of my essay.

4. "*F. sanguinea*" (*l. c.* 20. 6) is my *F. dominula,* and perhaps Latreille's *F. sanguinea*; but his description agrees also with *F. truncicola,* whose geographical range is equally wide; for this reason I was unable to decide on the identity of either; but as his typical specimens are in all probability lost, the question will most likely remain for ever unsettled*. I believe however that M. Foerster's opinion is correct, and I can have no predilection for my own names. I may observe that my *F. dominula* occurs in all kinds of nests, and on this account I am induced to consider, that it takes up its residence in the deserted nests of other species. Thus I have found it living in trunks of trees, in nests probably previously inhabited by *F. truncicola, fusca* or *glebaria,* or more rarely in old hills of *F. exsecta,* but most frequently in burrows in the earth, belonging I think to *F. glebaria,* whose workers only it enslaves. The *F. truncicola* also sometimes makes its nest in the earth.

5. "*F. exsecta*" (*l. c.* 23. 8), "*F. flava*" (*l. c.* 38. 17), *F. fuliginosa* (*l. c.* 28. 11), *F. glebaria* (*l. c.* 31. 13, *F. fusca,* Latr.), are the insects which are described under the same names in my essay.

6. "*F. stenoptera*" (*l. c.* 26. 10) as far as I can judge does not differ from *F. cunicularia,* Latr.

* I may observe that in the magnified figure of the head given by Latreille, the clypeus is figured entire, whereas in my *F. dominula* it is constantly notched.

7. "*F. fusca,*" Foerster, *l. c.* 33. 11, is undoubtedly the same as *F. nigra,* L. This opinion is based not only on the traditional testimony of the northern collections, but also on the characters given by Linnæus himself: "Formica *minor* e fusco nigricans;" whilst on the contrary he says of his *F. fusca*: "Formica *media,* corpus certo modo ad lucem videtur nigrum, alias cinereum," which agrees perfectly with my *F. fusca* or *glebaria.* [On this subject as well as the synonomy of the other Linnæan species I have treated in the 'Sællskap. pro Fauna et Flora Fennica Notiser,' Heft 1. 239 *seqq.*] Unfortunately there are now no specimens of these two species with the Linnæan tickets in the collection preserved by the Linnæan Society. M. Foerster asserts somewhat too positively, that it is solely on the authority of Latreille, that I have founded my interpretation of the Linnæan *F. nigra.*

8. "*F. timida*" (*l. c.* 35. 15) and "*F. aliena*" (*l. c.* 36. 16) appear to me only different forms of one species distinguished principally by their size, the latter being the smaller. But whether both these species are not merely forms of *F. nigra,* L. (*F. fusca,* Foerster) is perhaps a question requiring further examination, for a paler colour, and the legs and antennæ a trifle more naked are, perhaps, characters too fugitive upon which to establish specific distinctions. I admit that I should have easily referred the individuals of these species, which I have seen, to *F. nigra,* L.

9. "*Tapinoma collina*" (*l. c.* 43. 21) is my *F. glabrella* (Addit. 2. 38); and I cannot understand why M. Foerster has established a distinct genus for it, only on the single character, that in this species the little scale of the petiole is inclined forwards and almost incumbent. My subdivisions of *Formica* and *Myrmica* had undoubtedly afforded more substantial generic characters. *Formica glabrella* appears to be a species widely distributed throughout the central and southern regions of Europe. At Paris it is of frequent occurrence, and inhabits all kinds of soil, sometimes dry sandy places, and sometimes humid mossy situations, often in very large and numerously tenanted nests, and is remarkable for its extreme agility and the sweet nectareous odour which it emits.

10. "*Myrmica ruginodis*" (*l. c.* 66. 36), "*M. lævinodis*" (*l. c.* 64. 35), "*M. scabrinodis*" (*l. c.* 67. 37), are absolutely identical with my species of the same names.

11. "*M. acervorum*" (*l. c.* 61. 32); the specimens sent to Mr. Walker are a pale form of my species bearing the same name.

12. "*M. fuscula*" (*l. c.* 56. 29) is likewise mine (i. e. *M. cespitum,* Latr.). In the male sent I can discover no tooth on the metathorax, but merely an obtuse angle.

13. "*M. impura*" (*l. c.* 48. 22) is in my opinion nothing more than a pale form of *M. fuscula,* which is very variable both in size and colour, and colonies are sometimes found consisting entirely of large individuals, while others are inhabited by small individuals only. I have observed the same circumstance in other species, more particularly in *F. nigra* and *F. herculeana* (cf. Addit. 2. p. 28). Perhaps *M. modesta,* Foerster, *l. c.* 49. 23, which I have not seen, is also a

form of my *M. fuscula*; and possibly by a typographical error its length has been indicated as $3\frac{1}{2}$ lin., since in the description it is compared with "*M. impura*," *fuscula* and *tuberum*, which species are little more than a line long.

14. "*M. læviuscula*" (*l. c.* 54. 27) is identical with my *M. nitidula*; very possibly I have erroneously described its antennæ as consisting of twelve joints; if so, I shall be happy to rectify my mistake as soon as I have an opportunity of re-examining my northern specimens. It may be remarked that the intermediate articulations of the flagellum are closely approximate.

In *M. muscorum*, Foerster, *l. c.* 59. 31, which I have not seen, I can scarcely recognise my *Myrmica* of the same name, for the antennæ entirely pale and the abdomen with a fuscous band, appear to indicate a different species. M. Foerster does not state whether his species has the thorax continuous above, or with a distinct transverse suture.

I trust shortly I shall have another opportunity of returning to this subject.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 11, 1850.—W. Spence, Esq., F.R.S., in the Chair.

The following paper was read:—

SYNOPSIS OF THE SPECIES OF ANTELOPES AND STREPSICERES, WITH DESCRIPTIONS OF SOME NEW SPECIES. BY J. E. GRAY, ESQ., F.R.S., P.B.S. ETC.

The genera in this Synopsis are arranged after the plan, first suggested in a paper on the genera of the Hollow-horned Ruminants (*Bovidæ*) in the 'Annals and Mag. of Nat. Hist.' xviii. 227.

ANTELOPES.

The Antelopes contain a large number of species separated into several genera, which may be arranged in the following sections:—

I. The ANTELOPES OF THE FIELDS have a tapering nose, with the nostrils bald within.

1. The *True Antelopes* are light-bodied and limbed, and small-hoofed, with a short or moderate tail covered with elongated hair to the base; horns lyrate or conical.

2. The *Cervine Antelopes* are large-sized, rather heavy-bodied and large-hoofed, and have an elongated tail with short hair at the base and tufted at the end; horns lyrate or conical.

3. The *Caprine Antelopes* are heavy-bodied and limbed, and large-

hoofed, with a very short, depressed tail covered with hair to the base; horns conical.

II. The Antelopes of the Sandy Deserts have a broad nose, and the nostrils lined with bristles within.

4. The *Equine Antelopes* have the nose very broad, soft, spongy, and bristly.

5. The *Bovine Antelopes* have the nose moderately broad, with a black, moist muffle.

I. The Antelopes of the Fields. Nose tapering, the nostrils bald within, close together in front and diverging behind.

1. The True Antelopes. Body moderate-sized, elegant; legs slender; tail moderately elongate, hairy; horns placed over the eyebrows.

A. *Horns lyrate (or rarely cylindrical, subspiral), strongly ringed at the base; nose ovine, without any naked muffle; deep inguinal pouches; and tear-bag generally well-developed.*

1. Saiga.

Horns short, strong, annulated, lyrate, white; nose very high, compressed, rounded; nostrils very close together; tear-bag distinct; fur soft.

1. Saiga Tatarica. The Colus or Saiga.

Pale yellowish, crown and back greyish washed; belly and anal region beneath the tail white; young, crown greyer.

Capra Tatarica, Linn. S. N. 97.—*Antilope Saiga,* Pallas.—*Ibex imberbis,* Gmelin.—*Antilope Colus,* H. Smith.—*Colus Strabonis,* Gesner.—*Colus Tartarica,* Wagner.—*Cervicapra,* sp. Blainv.—*Saiga tatarica,* Gray, Knowsley Menag. 3.

Inhabits Siberia. Cab. Brit. Mus.

2. Kemas.

Horns elongated, rather lyrate; nose with a dilated pouch on each side; tear-bag distinct? hair close, erect, spreading; nose-hole of skull very large; females hornless.

1. Kemas Hodgsonii. The Chiru.

Pale brown; chest, belly and inside of the limbs white; front of face and front of legs blackish.

Antilope Hodgsonii, Abel.—*A. Kemas,* H. Smith (not horns, t. 181. f. 6).—*A. Chiru,* Lesson.—*Kemas Hodgsonii,* Gray, Knowsley Menag. 3.

Inhabits Thibet. Cab. Brit. Mus.

3. Gazella, H. Smith.

Horns strong, lyrate, black; face tapering; nose simple; tear-bag distinct; fur short, close-pressed. Females with smaller horns; teats four.

** Knees with tufts; back and rump brown, vent white.*

† Lower part of side with a dark oblique streak; feet with a tuft of black hair beneath.

1. Gazella Dorcas. The Gazelle.

Fur rather elongate and harsh, grey brown; outside of fore legs, broad oblique streak along the side, edge of anal disc, front of face and face-streak, dark brown; face-streak, throat, chest, belly, inside of thigh and anal disc, white; tuft at under side of feet and end of tail black; knee-tufts blackish; young, back and side-streak rather paler.

Capra Dorcas, Linn.—*Antilope Dorcas*, Pallas; Licht. 3. t. 5.—*A. Gazella*, Pallas.—*Gazella Kevella*, H. Smith, ♀.—*G. Corinna*, H. Smith, ♀.—*Gazelle*, Buffon, H. N. xii. t. 22–25. ♂.—*Kevel*, Buffon, H. N. xii. t. 26. ♂. not F. Cuvier.—*Corinne*, Buffon, H. N. xii. t. 27. ♀. t. 30 (not F. Cuvier); Cuvier, Menag. Mus. t. .—*Kevel gris*, F. Cuvier, Mam. Lithog. t. 3.—*Antilope Cora*, H. Smith.—*A. Arabica*, Hemprich and Ehrenb. Symb. Phys. t. 5; Licht. Saugth. t. 6.—*A. Cuvieri*, Ogilby, Proc. Z. S. 1840, 35; Frazer, Zool. Typ. t.

Var. Nose with a dark spot or streak.

Var. Larger, legs thicker.

Gazella Dorcas, var. Gray, Knowsley Menag. t. 3.

Inhabits N. Africa; shore of Red Sea; Mogador (*Willshire*).

The Earl of Derby has specimens which he calls *Gazella vera*, figured *Knowsley Menag*. t. 3; they are rather larger, greyer, and the legs are much thicker and heavier than the specimens from the shore of the Red Sea. The fur is similar, but not quite so long on the under side of the neck. The *Kevel gris* (F. Cuvier, Mam. Lith.) well represents this variety.

The *A. Cuvieri* of Ogilby, from Morocco, is a much larger animal than the common *G. Dorcas*, but agrees with it in other characters, except, it is said, in having longer ears.

M. F. Cuvier (Mam. Lithog. vii. t. 8. ♀.) has figured and described an Antelope from Sennaar under the name *A. leptoceros*, which he says is very like *A. Dorcas*, but has larger horns, those of the males being twice and of the females half as long again as the head. The horns vary greatly in length in our specimens.

†† Upper part of sides with a pale streak.

2. Gazella Isabella. The Isabella Gazelle.

Fur short, very soft; pale yellowish brown, with a broad, rather paler oblique streak on the upper part of the side; knee-tufts, front of face and lower face-streak, darker yellow brown; upper face-streak, chest, back edge of tarsus, under side of feet, inside of limbs, belly and vent, white; tail black. Female, horns very slender, longer than the head. Young, paler, the lower part of the sides rather darker.

Gazella Isabella, Gray, Ann. and Mag. Nat. Hist. 1846.—*Antilope Iridis* (*Die Iris Antelope*), Licht.—*A. Dorcas*, Licht. Darstell. t. 5.—*A. Dorcas*, var. *a*. Sundevall.

Inhabits N. Africa; Egypt (*J. Burton, Esq.*), Kordofan (*Sundev.*).

This species is easily known from the foregoing by the softness and fineness of the fur, and the lower side-streak being of the same colour as the back, and from it and the following by having no dark edge to the anal disc.

3. Gazella subgutturosa. The Jairon.

Pale brown; upper part of sides with a broad, rather paler streak; crown and knee-tufts greyer; face-streak indistinct; nose, lower part of sides, belly, hinder side of fore and front side of hinder limbs and anal disc white; streak on haunches dark brown; end of tail blackish.

Antilope subgutturosa, Guldenst.; Pallas; H. Smith, Griff. A. K. t. 183. f. 5, horns.—*Capra Ahu*, Kœmp.—*A. Dorcas, var. persica*, Rüppell.—*Gazella subgutturosa*, Gray, K. Men. 4.

Inhabits Tartary, Armenia and North Persia. Cab. Brit. Mus.

Larger than the Chikara.

** *Knees with tufts; rump mark and throat-spots white: no dark side-streak; tail slender, compressed, only hairy above* (*Dama*, Bennett).

4. Gazella Soemmeringii. The Abyssinian Mohr.

Pale brown; nose, forehead and lower edge of face-streak and end of tail blackish; chest and belly, angular mark on rump above the tail, face-streak and spot on the throat white; limbs pale. Female, forehead paler in the centre.

Antilope Soemmeringii, Cretzchm. in Rüppell, Zool. Atlas, t. 19 ♂. —*Gazella Soemmeringii*, Gray, K. M. 5.

Inhabits Lower Abyssinia; Sennaar. Brit. Mus.

5. Gazella Mohr. The Mohr.

Bay; chin, spot on throat, chest, belly, edge and inside of limbs and angular spot on rump above the tail white; spot on side of face and end of tail black.

Antilope Mohr, Bennett, Trans. Z. S. i. t. 8; Knight, M. A. N. f. .—*A. Dama, var. occidentalis*, Sundevall.—*Gazella Mohr*, Gray, K. M. 5.

Inhabits Morocco. Mus. Zool. Soc. Portendic. There called *Seni-ci* (*Mr. Whitfield*). Mus. Brit.

The specimen in the Frankfort Museum, which was received from the Zoological Society, is one-third smaller than the *Andra*. It is brown, rump mark, lower part of the sides, belly, inside and edge of legs white, face iron-grey with longer hair at the base of the horns; horns large, thick, the face-streak indistinct from the pale colour of the head.

There is a fine specimen of this species living at Knowsley, and a female which died on the passage in the British Museum.

6. Gazella Dama. The Nangeur.

Bay; chin, spot on throat, belly, lower part of sides and hinder part of the back, inside of the limbs white; no spot on side of the face.

Antilope Dama, Pallas.—*Gazella Dama*, Gray, K. M. 5.—*A. rubra*, Afzelius.—*Nangeur*, Buffon, H. N. xii. t. 32. f. 3. t. 34.

Inhabits W. Africa; Senegal.

Not seen since Buffon's time; may be a bad figure of the former.

7. Gazella ruficollis. The Andra.

Whitish; neck and front part of the middle of the back reddish; no face-streak.

Antilope ruficollis, H. Smith, G. A. K. v. 205.—*A. Andra,* Bennett.—*A. Dama,* Licht. Saugth. t. 3, 4; Rüppell, Zool. Atlas, t. 14, 16; Ehrenberg, Symb. Phys. t. 6.—*A. Dama, var. orientalis,* Sundevall.—*Gazella ruficollis,* Gray, K. M. 5.

Var. Young? with an indistinct narrow brown streak across the outside of the thighs, and the forehead iron-grey, with longer hair at the base of the horns; horns small. Mus. Frankfort.

Inhabits North Africa; Kordofan. Brit. Mus. ♀.

These species differ in size as well as markings. The *Mohr* and *Andra* differ from *G. Soemmeringii* in being of much larger size, and in wanting the black face and streaks. Bennett's *Mohr* has only an angular white spot on the rump, like *G. Soemmeringii*; Buffon's *Nangeur* is smaller, and has more white on the rump, thighs and sides; and the *Andra,* which agrees with the figures cited, is almost all white, with a reddish neck and withers.

*** *Knees without tufts* (*but with rather longer hair, forming a linear keel in front*)*; back and rump brown; sides with dark streak.*

8. Gazella rufifrons. The Korin.

Bay brown; sides above paler, with broad dark streak below; tail black; chest, belly, inside of legs, back edge of tarsus, and under side of feet and anal disc white; face bright bay, side-streak broad white.

Gazella rufifrons, Gray, Ann. and Mag. Nat. Hist.—*Kevel,* male, F. Cuvier, Mam. Lithog. t. 3.—*Corine,* F. Cuvier, Mam. Lithog. t. . young ♀.—*A. lævipes,* Sundevall.—*Gazella rufifrons,* Gray, K. M. 5. t. 4.

Var. Nose blackish above (adult ♀).

Young; pale yellowish, side-streak brownish.

Inhabits W. Africa; Senegal. Mus. Paris. Gambia (*Mr. Whitfield*), called *Seni.* Brit. Mus. Sennaar (*Sundevall*).

Buffon mentions a *Corine* as coming from Senegal, but he says it is smaller than the *Kevel,* and Daubenton says that it has knee-tufts, so that it cannot be this species. Indeed the *Gazelle, Corine* and *Kevel* of Buffon are clearly all *A. Dorcas* of this memoir.

The *Kevel* figured by M. F. Cuvier well represents this species. He says it was sent from Senegal, and probably it has not knee-tufts, for they are not indicated in the figure or mentioned in the text; for, like other descriptions of this author, though it occupies more than two pages, all the peculiarities of the species are left out. The *Corine* of the same author, also from Senegal, well represents the young. M. F. Cuvier says the *Kevel* and *Corine* and *A. Dorcas* form one species, but afterwards, under *Kevel gris,* he thinks they may be two.

4. Procapra, Hodgson.

Horns strong, elongate, lyrate, black; face tapering, nose simple; tear-bag none; knee-tufts none; tail very short: female hornless; teats two. Asia; not gregarious.

1. Procapra gutturosa. The Dseren.

Pale yellowish; hair long, soft, of anal region short, white; tail black.

Antilope gutturosa, Pallas, Spic. xii. 45. t. 2; H. Smith.—*Gazella gutturosa,* Gray, Knows. Menag. 3.

Inhabits Mongolia, Siberia. Cab. Brit. Mus., male and female. Thibet. Mus. Ind. Comp.

2. Procapra picticauda. The Ragoa or Goa.

Hair sordid, brown with pale rufous tips; under side, inside of ears, limbs and anal disc, reddish white; tail black.

Procapra picticauda, Hodgson, J.A.S. Bengal, 1846, 173. 334. t.

Inhabits Thibet; in the plains. Brit. Mus., skulls. Perhaps same as former in summer fur.

5. Tragops, Hodgson.

Horns lyrate, short, black; face tapering, nose simple; "tear-bag none;" teats two: females with small horns. India; not gregarious.

1. Tragops Bennettii. The Chikara.

Bay brown; sides uniformly coloured; knee-tufts, end of nose and tail black; streak on haunches blackish; face-streak, chest, belly and inside of limbs white.

Antilope Bennettii, Sykes.—*A. Christii,* Gray.—*A. Bharatensis,* Hodgson.—*A. Hazenna,* I. Geoff., Voy. Jacq. Mam. t. 6, bad?—*A. Dorcas,* var. E., Sundevall.—*Tragops Bennettii,* Hodgson, 1847.

Inhabits India. Cab. Brit. Mus.

The feet are generally blackish, but sometimes brown like the back.

6. Antidorcas, Sundevall.

Horns lyrate, short, black; face tapering, nose simple; tear-bag not remarkably distinct; back with an expansile white streak or fold; hair close-pressed; knees not tufted: females with small horns.

1. Antidorcas Euchore. The Springboc or Tsebe.

Pale brown; face, throat, chest, belly, broad expansile streak on back to base of tail, edge and inner side of limbs white; face-streak and middle part of forehead pale brown, side-streak oblique, dark brown: young paler; side-streak paler, back-streak distinct.

Antilope Euchore, Forster, Licht. t. 7; H. Smith; Harris, W.A.A. t. 3.—*A. saltatrix,* Link.—*A. marsupialis,* Zimm.—*A. Pygarga,* Blumenb.—*A. dorsata* and *A. saliens,* Lacep.—*A. Ibex,* Afzelius, 1810.—*Gazella Euchore,* Gray, Know. Men. 6.

Inhabits S. Africa. Brit. Mus.

7. Æpyceros, Sundev. MSS.; *Antilope,* Gray.

Horns elongate, wide-spreading, lyrate, black; face tapering, nose simple; knees not tufted, feet with tuft of (black) hair near pastern; teats two; no trace of suborbital sinus (*Harris*).

1. Æpyceros Melampus. The Pallah or Rooye Boc.

Bay, sides paler beneath; belly, anal disc and lower side of tail white; crown, anal streak and tip of tail blackish; tuft above feet and back of feet black.

Antilope Melampus, Licht.; H. Smith, t. 181. f. 7; Harris, W. A. Africa, t. 15.

Inhabits S. Africa. Brit. Mus.

8. ANTILOPE, H. Smith; *Cervicapra,* Gray.

Horns elongate, subspiral, erect, diverging; face tapering, nose simple; tear-bag large. India; gregarious.

1. ANTILOPE BEZOARTICA. The ANTELOPE.

Grey brown; lips, orbits, chest, lower part of sides and belly, edge and inside of limbs white; nose, front of shoulder and outside of thigh, end of tail and front of feet blackish; neck redder.

Capra bezoartica, Aldrov.—*C. Cervicapra,* Linn., ? H. Smith.—*A. Cervicapra,* Pallas, Gray, Ill. Ind. Zool. t. .—*Antilope,* F. Cuv. Mam. Lith. t. . ♀.—*Cervicapra bezoartica,* Gray, Knowsley Men. 6.

Var. and young. A narrow pale streak on the upper part of each side.

Antilope bilineata, Temm., Gray, Illust. Ind. Zool. t. .

Inhabits India. Brit. Mus.

B. *Horns small, slender, straight, conical, tapering, more or less diverging and often bent forward at the tip; the muffle is generally large and moist.*

† *Tear-bag large; muffle generally large.*

9. TETRACERUS, Leach.

Muffle large; tear-bag large, longitudinal; horns, two pair very short, conical, straight; knee-tufts none: female hornless.

1. TETRACERUS QUADRICORNIS. The CHOUKA.

Front pair of horns conical, distinct.

T. quadricornis, H. Smith, G. A. K. t. 181. f. 3. t. 186.—*Antilope quadricornis,* Blainv.—*A. striaticornis,* Leach.—*A. tetracornis,* Hodgson.—*A. Chickara,* Hardw.; H. Smith.—*T. Chicara,* F. Cuv. Mam. t. . ♂.—*Cervus albipes,* F. Cuv. Mam. Lith. t. . female.

Inhabits India, Himalaya. Brit. Mus. Thibet. Mus. Ind. Comp.

M. De Blainville in describing this animal has read *Moorshadabad,* the habitat, for *Hoornadabad,* and thought it the name of the animal.

2. TETRACERUS SUBQUADRICORNUTUS. The JUNGLIBUKRA.

Front pair of horns rudimentary, tubercular; hinder horns conical, subcylindrical; pale brown; side rather paler; chest, belly, inside and front of legs whitish; feet paler, varied.

Var. Female, front of legs blackish.

Antilope subquadricornutus, Elliot, Madras Journ. 35. t. 4. f. 2.—*Brown Antelope,* Sykes.

Inhabits Madras. Brit. Mus. Larger than the former.

Mr. Hodgson, in MacClelland's Calcutta Journ. Nat. Hist. 1847, notices and figures five species of this genus: 1. *T. Iodes* (rusty-red), t. 4. f. 3, and 2. *T. paccerois* (full-horned), t. 4. f. 1, 2, from skull.

10. Calotragus, (part) Sundevall; *Oreotragus,* (part) Gray; *Redunca,* (part) H. Smith; *Tragulus,* H. Smith; *Cervicapra,* sp. Blainv.

Muffle large; tear-bag arched, transverse; horns subulate, elongate, erect; hoofs triangular, flattish beneath, acute in front; crown smooth; tail very short; groin and orbit nakedish: females hornless; teats four; the knees not tufted; inguinal pore none; ear elongate; false hoof small or none.

* *False hoofs none.*

1. Calotragus Tragulus. The Steinboc.

Fulvous, ashy; hair uniform; small spot on nose, and two diverging streaks on crown to nape blacker; upper part of throat, chest and abdomen white; ears three-fourths the length of the head; false hoofs none.

Antilope Tragulus, Forster, Licht. t. 14.—*A. rupestris,* H. Smith; Harris, W. A. A. t. 25. f. 2.—*A. campestris,* Thunb. 1811; Afzelius, 1815.—*A. pallida,* H. Smith.—*A. Pediotragus,* Afzelius.—*A. fulvo-rubescens,* Desmoul.—*A. rufescens,* H. Smith, G. A. K. t. 188.—*Calotragus tragulus,* Gray, Knowsley Menag. 7.

Var. Without the black crown-streaks, throat whiter.

Inhabits S. Africa. Brit. Mus.

This species varies much in colour, perhaps according to the season: sometimes the hairs are whitish at the tip, giving the fur a glaceous appearance; the black streaks are as distinct in the young as in the adult.

** *False hoofs small.*

2. Calotragus melanotis. The Grys Boc.

Red bay, with intermixed white hairs, crown with two dark streaks; ears two-thirds the length of head; false hoofs small.

Antilope Melanotis, Thunb. 1811; Afzelius; Licht. S. t. 12; Harris, W. A. A. t. 26.—*A. grisea,* Cuvier, D. S. N. ii. 244, 1816; H. Smith.—*A. rubro-albescens,* Desmoul.—*Calotragus melanotis,* Gray, Knowsley Menag. 7.

Var. *pallida.* Pale ashy white, hairs some white, others lead-coloured with grey tips. Brit. Mus.

Inhabits S. Africa. Brit. Mus.

11. Scopophorus, Gray; *Calotragus,* part Sundevall.

Muffle small, bald; tear-bag transverse; horns subulate, elongate, acute, slightly recurved at the tip; knees largely tufted; inguinal pores distinct and bearded; ears moderate, with a naked spot on the outside of their base; hoofs triangular, false hoof distinct.

1. Scopophorus Ourebi. The Ourebi.

Temple-spot small, indistinct; fur red-brown; cheeks paler; crown darker red brown; orbits, chest, belly, and middle of upper part of inner side of legs white; end of tail, arched line before the eye and spot between the ears black.

Var. End of nose blackish.

Antilope Scoparius, Schreb. Licht. S. t. 13.—*A. Ourebi*, Shaw; Lesson.—*Ourebi*, Buffon, not F. Cuvier.—*A. melanura*, Bechst.

Inhabits S. Africa, Cape of Good Hope. Brit. Mus.

2. Scopophorus montanus. The Gibari.

Temple-spot large, deep (more than half an inch over), naked; fur greyish brown; cheeks paler; crown red brown; orbits, chest, belly, under side of tail and middle of the inner side of the upper parts of the legs white; end of tail and arched line before the eye black.

Antilope montanus, Rüppell, Zool. t. .—*Scopophorus montanus*, Gray, Knowsley Menag. t. 5.

Inhabits W. and E. Africa; Abyssinia (*Rüppell*); Gambia. Called Gebari, or Mahomet's Antelope (*Earl of Derby*). Brit. Mus.

Very like the former, but grey brown, and the temporal spot much larger, deeper, more distinct and bald, both when alive and in the skin, so that it does not depend on the stuffing.

12. Oreotragus, Gray, Sundevall; *Tragulus*, H. Smith, not Pallas.

Muffle large; tear-bag arched, transverse; horns subulate, elongate; hoofs squareish, high, compressed, much-contracted, concave beneath; false hoofs large, blunt; crown smooth; tail very short; hair thick, quill-like, spread out: female hornless; teats two.

1. Oreotragus saltatrix. The Kiansi or Klippspringer.

Dark brown, yellow grisled; hair grey, brown at the end, with a short yellow tip; beneath whitish; edge of ears and feet above the hoofs black.

Antilope Oreotragus, Forster; H. Smith; Licht. Saugth. t. 15.—*A. saltatrix*, Bodd.; Harris, W. A. A. t. 24.—*Oreotragus saltatrix*, Sundev.; Gray, Knowsley Men. 8.

Inhabits S. Africa; Abyssinia (*Rüppell*). Brit. Mus.

Varies in brightness and depth of colour according to the season.

13. Nesotragus, Von Duben, Sundev. MSS.

"Muffle large, bald; lachrymal sinus deep, large; face and forehead not crested; ears large; horns in males large; false hoofs none; tail very short.

Very like *Neotragus* in form and character.

1. Nesotragus moschatus. The Nesotragus.

Reddish grey; belly white; feet pale red; hair of back brown, with a pale subterminal band and black tip.

Nesotragus moschatus, Von Duben; Sundev. Vet. Ac. Oefversigt, 1846, 221; Pecora, 134; Gray, Knowsley Menag. 8.

Inhabits Zanzebar, east coast of Africa. Male and female in the Stockholm Museum."

14. Neotragus, H. Smith; *Madoqua*, Ogilby.

Muffle none; nose ovine; nostrils close together; false hoofs very small; tear-bag roundish; tail very short; crown crested.

1. Neotragus Saltiana. The Madoqua.

Antilope Saltiana, Blainv.—*A. Hemprichianus,* Ehrenb. S. P. t. 7; Licht. Saugth. t. 16.—*Neotragus madoka,* H. Smith.—*A. Grimmia,* Rüppell.—*A. Hemprichii,* Rüppell, Abyss. 25.—*N. Saltiana,* Gray, Knowsley Menag. 8.—*N. Hemprichianus,* Sundev.

Inhabits Abyssinia. Brit. Mus.

†† *A glandular line on the side of the face, in the place of the tear-bag; and the muffle large and bald.*

15. Cephalophus, H. Smith; *Sylvicapra,* Ogilby, Sundev.

Muffle large; tear-bag none, but a naked, glandular line, formed of two series of pores, on the side of the cheek; crown crested, ending in a tuft between the horns.

* "*Knees and hind legs tufted; ears and horns elongate; tear-bag small, under the eye, and a narrow naked streak on cheek.*"

1. Cephalophus? quadriscopa. The Four-tufted Antelope.

"Buff, paler on the sides; tail, knee-tufts, front of nose, narrow inferior lateral and anal streak and streaks across legs blackish; lips, breast, belly, inside of limbs, vent and houghs white."

Antilope quadriscopa, H. Smith, G. A. K. iv. 261. t. 188.—*Cephalophus? quadriscopa,* Gray, Knowsley Menag. 8.

"Inhabits Senegal."

This species is only known from Colonel H. Smith's description and figure.

** *Knees not tufted; ears elongate acute; horns slender, elongated.*

2. Cephalophus Grimmia. The Impoon or Duyker or Duyker Boc.

Yellowish brown, greyish in winter; hair yellowish, with blackish tip; forehead yellowish bay; inside of ears, chin, throat, abdomen and under side of tail white; feet, streak on the nose, up the legs, and upper part of tail black; ears elongate, nearly as long as head, acute; horns black, elongate, slender, base rugose and subangular in front.

Capra Grimmia, Linn. S. N. (ed.10) 70.—*Moschus Grimmia,* Linn. S. N. (ed. 12).—*Antilope mergens,* Blainv. Bull. Soc. Phil. 1817; H. Smith, G. A. K. v. 264; Licht. Saugth. t. 11; Harris, W. A. A. t. 15.—*A. nictitans,* Thunb. Mem. Petersb. 1811, iii. 312.—*A. Burchellii,* H. Smith, G. A. K. v. 262. adult in summer?—*A. Ptoox,* H. Smith, G. A. K. v. 265? jun.?—*A. Platous,* H. Smith, G. A. K. v. 266.—*Ceph. Grimmia,* Gray, Knowsley Menag. t. 1. f. 1, t. 2. f. 1, 2.

Inhabits S. Africa. Brit. Mus.

This species varies greatly in the intensity of the colours and in the extent of the black on the feet and nose. In one young specimen in the British Museum the black on the nose is quite deficient; though it has the bright colouring of the breeding-season, and is bright bay on the crown.

The specimen in the Museum of the London Missionary Society

(No. 8 Blomfield Street, Moorfields, formerly in Austin Friars), Case 5, described by Colonel H. Smith under the name of *A. Platous*, is the size and has the horns and ears of an adult *C. Grimmia*, but differs in being paler, and having no dark colour on the nose or feet; but it is evidently much bleached. It has certainly no relation to the *C. sylvicultrix*, with which Colonel Smith was afterwards inclined to place it as a variety (Griff. A. K. Syn. v. 344).

There are three species which have been called *Antilope Grimmia*:—

1. The *Capra sylvestris africana* of N. Grimm, Misc. Cur. Norimb. 1705, 131. t. 13, the authority for *Capra Grimmii*, Ray, Syn. 80, and Linn. S. N. (ed. 10) 70. *Moschus Grimmia*, Linn. S. N. ed. 12, from the Cape, of a dull grey colour. Probably the Duyker.

2. *Le Grimme* of Buffon, H. N. xii. 307. 329. t. 41. f. 2, 3, from a head sent from Senegal by Adanson; the *Antilope Grimmia* of Desmarest, F. Cuvier, and H. Smith, &c.; the *Cephalophus rufilatus*.

3. The *A. Grimmia* of Pallas, with large ears and a black streak to the horns, like *C. Campbelliæ*, but is from Guinea. I know of no species common to the W. and S. coast of Africa, so that it is probably yet to be distinguished.

The "*Fitomba*" or "*Philantomba*" appears to be the generic name of all the W. African *Cephalophi* or Bush Antelopes.

3. Cephalophus Campbelliæ. The Black-faced Philantomba.

Grey and black grisled, beneath white; cheeks, neck and chest yellowish; forehead yellow, with a black streak on the nose widening on the forehead and ending in a tuft behind the horns; feet and front of fore-legs reddish black; fur soft; hair grey, with black ring and tip; ears elongate acute.

Antilope Grimmia, Pallas, Spic. Zool. xii. 18. t. 1?—*C. Burchellii*, var. (*C. Campbelliæ*), Gray, Cat. B. M. 162.—*C. Campbelliæ*, Gray, Ann. and Mag. Nat. Hist. 1846, 164; Knowsley Menag. 9. t. 2. f. 3.

Inhabits S. Africa. Brit. Mus.

This species is at once known from the Duyker by being much darker and distinctly grisled or dotted, and the under side being much whiter.

We have an adult female of this species sent us as *A. mergens*, var. *Burchellii*, by M. Sundevall (the other specimen of the same name being a true Duyker), and a young specimen which has been in the British Museum for several years, sent from Africa, under the generic name of *Philantomba*, by Mrs. Campbell.

The *A. Grimmia* of Pallas, Spic. Zool. i. 18. t. 3, which he describes as grey grisled, becoming brownish ash on the buttocks; throat, chest and beneath the body white; head and neck yellowish grey; a black streak between the horns, forming a fascia on the forehead and broader on the nose; fur softer than the Deer, but rough, of lower part of the neck rougher and more lax; feet and line on fore-legs blackish; tail black above; ears rather acute: inhabits Guinea; agrees in most respects with this species, but most probably is yet to be procured from W. Africa.

**** Knees not tufted; ears moderate, acute; horns short, conical, thick.*

4. CEPHALOPHUS MADOQUA. The ABYSSINIAN BUSH BUCK.

Yellowish brown, slightly punctulated with black; neck yellowish; limbs blacker; face-streak and feet black; hair rather rigid, close-pressed, reddish grey at the base, end polished yellow brown, with dark tips; forehead reddish.

Antilope Madoqua, Rüpp. Abyss. t. 7. f. 2; Sundev.—*Madoqua,* Bruce's Travels, vii. 360. t. 56.—*C. Madoqua,* Gray, Knows. Men. 9.

Inhabits Abyssinia. Mus. Frankfort.

This species is very distinct from *C. coronatus,* being darker, and the fur more rigid and close-pressed.

5. CEPHALOPHUS CORONATUS. The RED-CROWNED BUSH BUCK.

Pale yellowish brown; middle of back and front of fore-legs varied with a few scattered black hairs; crown bright bay; crest blackish brown, bay in front; feet and streak up the nose blackish; inside of ears, chin, throat, chest, belly and inner side of legs whitish; horns short, conical; ears about half as long as the head, acute.

Cephalophus coronatus, Gray, Ann. and Mag. Nat. Hist. x. 1842, 266. 1846, 164; Knowsley Menag. 9. t. 6. f. 1, 2.

Inhabits W. Africa; Gambia, Macarthy's Island. Mr. Whitfield called it *The Coquetoon.* Brit. Mus.

***** Knees not tufted; ears moderate, rounded; horns conical, thick; without any streak over the eyes.*

6. CEPHALOPHUS SYLVICULTRIX. The WHITE-BACKED BUSH BUCK.

Blackish brown, minutely grisled; hair brown, with whitish tips; back with a large yellowish white spot, narrow in front; throat, chest and belly redder; crown, nape and legs darker; horns ——?

Antilope sylvicultrix, Afzelius, N. Act. Upsal. vii. 1238; H. Smith, G. A. K. t. 187.—*C. sylvicultrix,* Gray, Knowsley Menag. 10. t. 8. f. 1.

Inhabits Sierra Leone, in swampy places. Brit. Mus.

Varies in the size of the dorsal spot.

In the British Museum is a young male: length 29 inches; height 18; tarsus 6·9.

7. CEPHALOPHUS OGILBII. The BLACK-STRIPED BUSH BUCK.

Pale bay brown, with a deep black dorsal streak; beneath pale; crown and haunches brighter bay; neck and withers, and sides of the dorsal line varied with deep brown hairs; streak up the fore-leg, upper part of hock, feet (above the hoof) and end of tail blackish; horns short, thick, conical, very rugose on the inner front edges of the base.

Cephalophus Ogilbii, Gray, Ann. and Mag. Nat. Hist. 1842; Knowsley Menag. 10. t. 8. f. 2; Frazer, Zool. Typ. t. .—*Antilope Ogilbii,* Waterh. P. Z. S. 1838, 60. 1842, 129.

Inhabits Fernando Po (*J. Thompson, Esq.*). Brit. Mus. Not half the size of the preceding.

8. Cephalophus dorsalis. The Bay Bush Goat.

Dark bay; shoulders and legs darker; hair brown, a few on the haunches white-tipped; crown and nape, broad streak along the back to end of tail black; spot over each eye; lips, sides of chin, front of chest, under side of tail and inside of thighs pale brown.

Cephalophus dorsalis, Gray, Ann. and Mag. Nat. Hist. 1846, 165; Knowsley Menag. 10. t. 7. f. 1.

Inhabits Sierra Leone: called *Bush Goat*. Brit. Mus. The head is very large, the skull short, broad, forehead rounded.

9. Cephalophus niger. The Black Bush Buck.

Sooty black, greyer in the front half of the body; chin, throat, abdomen and inside of thighs grey; forehead and crown dark bay and black mixed: cheeks pale brown and black varied; tail, end whitish.

Antilope niger, Mus. Leyden.—*Cephalophus niger*, Gray, Ann. and Mag. Nat. Hist. 1846, 165; Knowsley Menag. 10. t. 7. f. 2.

Inhabits Guinea. British Museum. Sierra Leone (*Mr. Whitfield*). Knowsley Museum.

In the British Museum there is a male from the Leyden Museum, nearly as large as the former.

10. Cephalophus Natalensis. The Natal Bush Buck.

Bright red bay; nape, withers and feet varied with dark grey hairs; nose-streak short, blackish; lips, chin, upper part of throat and end of tail white; lower part of cheeks, throat and abdomen pale yellowish; crown and tuft bright red; horns short, conical.

Antilope natalensis, A. Smith, S. Afr. Quart. Journ. 217; Illust. Z. S. A. t. 32.—*Cephalophus natalensis*, Gray, Knowsley Menag. 10.

Inhabits S. Africa. Port Natal. Brit. Mus. Five specimens of different ages. Resembles *C. Ogilbii* in size and colouring, but wants the dorsal streak. The females are horned.

11. Cephalophus rufilatus. The Coquetoon.

Deep reddish bay; legs, nape, streak on the nose to the crown and broad streak on the back blackish grey; ears blackish; crest and upper part of tail black; cheeks rather paler; chin and abdomen pale yellowish; inside of ears whitish, with a brown spot on the outer side; horns conical, rather elongate, obscurely annulated, slightly recurved.

Cephalophus rufilatus, Gray, Ann. and Mag. Nat. Hist. 1846, 166; Knowsley Menag. 10. t. 9.—*Antilope Grimmia*, H. Smith, G. A. K. v. 266.—*Le Grimme*, Buffon, H. N. xii. t. 41. f. 2, 3?

Var. 1. Sides paler, greyish red; forehead rough.

Le Grimme, F. Cuv. Mamm. Lithog. t. . not good.

Inhabits Sierra Leone, called *Coquetoon*. Brit. Mus.

The hair is rather paler at the base, of the dorsal streak grey, with a blackish tip.

M. F. Cuvier's (Mamm. Lithog. t. .) figure is the pale variety, which Mr. Whitfield regards as distinct; he says it is called *Grimme* by the natives: the separate head of Cuvier's plate appears to have been taken from the *Guevei*.

***** ***Knees not tufted; ears moderate, rounded; horns short, thick, conical; head with a pale streak on each side over the eyes to the base of the horns.***

12. Cephalophus Maxwellii. The Guevei.

Grey brown or sooty brown; sides of head and body greyer; chin, throat, chest and belly whitish grey; abdomen and front of thigh white; broad streak over each eye to the base of the horns yellowish white; feet and end of nose rather darker; fur rather rigid; hair uniform.

Antilope Maxwellii, H. Smith, G. A. K. iv. 267.—*A. pygmea*, Pallas, Spic. xii. 18?—*The Guevei*, Buffon, H. N.—*A. pygmea* (*Guevei*), F. Cuv. Mamm. Lithog. t. . good.—*A. Frederici*, Laur.; Sundev. —*A. Philantomba*, Ogilby, P. Z. S. 1836, 121; 1839, 27.—*Cephalophus Maxwellii*, Gray, Knowsley Menag. 11. t. 12.

Inhabits W. Africa. Brit. Mus.

The adult male in the British Museum is bright sooty brown, darker near the rump; the female is nearly uniform pale grey brown. It is well figured by M. F. Cuvier. It is known from *C. monticola* by being larger, by the whiteness of the eye-streak, and of the front of the thigh and chest.

13. Cephalophus monticola. The Noumetge or Cape Guevei.

Grey brown; streak over the eyes, legs and outer part of thighs rufous; feet grey brown; chin, chest, abdomen, and under side of tail and inside of ears white; fur soft, grey, with intermixed rather rigid black hairs.

Antilope monticola, Thunb. Stockh. N. H. xxxii. t. 5.—*A. cærulea*, H. Smith, G. A. K. v. 855; Daniell's Afr. Scen. t. ; Harris, W. A. A. t. 26.—*A. perpusilla*, H. Smith, G. A. K. v. 854.—*A. pygmea*, Licht. Saugth. t. 16; Sundevall.—*Cephalophus monticola*, Gray, Knowsley Menag. 11.

Inhabits S. Africa. Brit. Mus.

The colours vary in intensity; in a female in the British Museum, the rufous colour of the thighs and the white of the chest are more distinct than in the male, but this may depend on the season when they were killed. A very young fawn (perhaps hardly born), which was brought home from the Cape by M. Verreaux, is darker, and the reddish tint extends over nearly the whole body.

Thunberg described the South African species, but says that there is a specimen in the Stockholm Museum, brought by Afzelius from Sierra Leone, which agrees with his animal; so he evidently did not observe the difference between the two species.

14. Cephalophus melanorheus. The Black-rumped Guevei.

Grey brown; throat and sides paler; rump and upper part of tail black; chin, chest, abdomen, back and front edge of thighs and under part of tail white; narrow streak over the eyes whitish; feet like the back; fur soft, pale grey, with intermixed rather rigid black hairs.

Cephalophus melanorheus, Gray, Ann. and Mag. Nat. Hist. 1846; Knowsley Menag. 11. t. 10.—*C. Philantomba*, Gray, Cat. Mamm. B. M. 163 (not H. Smith).

Inhabits Fernando Po (*J. Thompson, Esq.*). Brit. Mus.

This species is coloured like the *Guevei* from W. Africa, but smaller, and has the soft fur and interspersed black hair of the *Cape Guevei*, *C. monticola*, but it is easily known by the black mark on the rump.

15. Cephalophus punctulatus. The Grisled Guevei.

Dark fulvous brown; sides and legs rather paler; narrow streak over the eyes and inside of ears pale brown; chin, throat, chest, belly and front of thighs and under part of tail white; hair grey at the base, with brown ends and yellow subterminal rings; crown and upper part of tail darker; feet pale, varied.

Cephalophus punctulatus, Gray, Ann. and Mag. Nat. Hist. 1846; Knowsley Menag. 11. t. 11. f. 1.

Inhabits Sierra Leone. Brit. Mus. A young specimen presented by Colonel Sabine, R.E.

It is at once known from the other *Guereis* by the fulvous colour which is produced by the yellow subterminal rings of the hairs.

Colonel H. Smith indicates a species under the name of *C. Philantomba*, but so indistinctly, that it is impossible to know for what it is intended.

16. Cephalophus Whitfieldii. The White-footed Guevei.

Yellowish ash; shoulders, outside of limbs and hinder parts of back rather darker; ears and crown pale yellowish brown; streak over the eyes, cheeks, throat, belly, inside of the limbs and ring round the feet above the hoof ashy white; hair ashy grey; of the back brown at the end, with a yellow tip.

Cephalophus Whitfieldii, Gray, Knowsley Menag. 12. t. 11. f. 2.

Inhabits Gambia (*Mr. Whitfield*). Mus. Brit. Young.

Smaller than the *Grisled Guevei*, and much paler and yellower.

****** *No tear-bag nor glandular streak on the face, and the muffle large and moist; crown smooth.*

16. Nanotragus, Sundev.; *Neotragus*, part H. Smith.

Horns very short, conical; legs slender; tail subpectinate; hoofs small, triangular, false hoofs none; crown not crested; ears small, rounded.

1. Nanotragus perpusillus. The Royal Antelope.

Fulvous; throat, belly and edge of thighs and tip of tail white.

Capra perpusilla, Linn. Mus. Ad. Fred. i. 12.—*Moschus pygmeus*, Linn. S. N. (ed. 12) 92.—*Antilope pygmea*, Pallas, Spic. Zool. xii. 18; Cuv. D. S. N. ii. 241; H. Smith.—*A. regia*, Erxleben, 278.—*A. spiniger*, Temm. Monog.—*Nanotragus regius*, Gray, Knowsley Menag. 12.—*Royal Antelope*, Penn.

Inhabits W. Africa; Guinea. Brit. Mus.

The smallest-hoofed animal. The feet were formerly often used as tobacco-stoppers, and are figured mounted by Seba, t. 43. f. *a*, *b*; Buffon, H. N. xii. t. 42, 43.

17. ELEOTRAGUS, Gray; *Redunca*, H. Smith; *Cervicapra*, Blainv., Sundev.; *Nagor*, Laur.; *Sylvicapra*, Ogilby.

Horns conical, bent back and then forward at the top; hoofs and false hoofs rather large; tear-bag none; teats four; inguinal pores distinct.

† *Horns erect, slender, and face narrow; nose swollen; muffle large, extended far behind the nostrils; fur woolly hair.* PELEA. S. Africa.

1. ELEOTRAGUS CAPREOLUS. The REHBOCK or PEELE.

Temple-spot none; head slender, compressed; horns erect, scarcely diverging, very slender; fur short, woolly, grey brown; back redder; throat and beneath white; end of nose and chin blackish; feet darker.

Antilope Capreolus, Thunb.; Afzelius, N. Act. Upsal. vii. 251. 1818; Licht. Saugth. t. 8; Harris, W. A. A. t. 25. f. 1.—*A. villosa*, Burchell, 1822; H. Smith.—*A. lanata*, Desmoul.—*Eleotragus Capreolus*, Gray, Knowsley Menag. t. 12. from life.

Inhabits S. Africa. Brit. Mus. Knowsley, living.

†† *Horns diverging, thick, conical; head broad; nose not swollen.*

* *Muffle large, extended far behind nostrils; fur grisled, harsh, straight, with a subterminal pale band, and often whorled; a naked spot on the temple.* South Africa.

2. ELEOTRAGUS ARUNDINACEUS. The INGHALLA or REIT BOCK.

Head broad; temple-spot naked; horns diverging, conical, tapering. Brown, yellow grisled; hair pale brown, with a subterminal yellow band; cheeks and neck yellower; base of ears, chest, belly and insides of the legs and under side of bushy tail white; front of legs black.

Antilope arundinacea, Shaw, Zool.—*A. Eleotragus*, Schreb. Licht. t. 9; H. Smith; Harris, W. A. A. t. 26.—*A. redunca*, H. Smith; Gray, Cat. B. M.—*A. cinerea*, Afzelius, 1815.—*A. Lalandii*, Desm.; Fischer.—*A. Lalandiana*, Desm.—*Eleotragus arundinaceus*, Gray, Knowsley Menag. 12.

Var. Larger.

A. Isabellina, Afzelius, N. Act. Upsal. 1815, vii. 244; Licht. t. 10; H. Smith; Sundev.

Var. With a large black rhombic spot on the back of the head behind the ears. Female in Brit. Mus.

Inhabits S. Africa, in marshy places. Brit. Mus.

Afzelius, Lichtenstein, H. Smith and Sundevall have described two species of this genus as coming from South Africa; the smaller they call *A. Eleotragus*, and the larger *A. Isabellina*. The latter author has given a comparative character between the two kinds, but he has only seen two specimens of the former (a male at Berlin and a female at Stockholm), and several specimens of the larger kind. I have examined with care a series consisting of four males and five females from different parts of South Africa, and can find no distinction between them, except a slight difference in the length of the fur and in its colour. Two specimens in the British Museum are larger than the rest, and have the tarsus one-fourth longer than the others; they have a shorter fur and are of a rather brighter colour, and the front of the leg is blacker; but the fur and colour probably depend on the season when they were killed. In these respects they agree with Sundevall's description of *A. Isabellina,* but they both have the temporal spot large and quite naked, while Prof. Sundevall described the spot on this species as pubescent. The female of the larger specimen has the black spot on the back of the head; some of the smaller ones have the temple-spot much smaller and less naked than the others. The two larger specimens have a single whorl of hair in the middle of the back; the others, with longer hair, show the whorls more distinctly, and have the hair from the central whorls to the shoulders forming a more or less diverging line. After examining these specimens and those in other collections, I conclude that they form only a single species. M. Sundevall, in a note just received, observes, "Mr. Wahlberg considers *A. Isabellina* and *A. Eleotragus* as very distinct, and our specimens seem to show a difference, though not very well expressed. Also I have committed a mistake, for the young female described in my Synopsis as γ. under *A. Isabellina,* is really *A. Eleotragus.*"

** *The muffle smaller, scarcely extending beyond the nostrils; fur fulvous, not grisled; hair grey, with yellow tips; tail less bushy.* W. and E. Africa.

3. Eleotragus reduncus. The Wonto or Nagor, or Red Antelope.

Head broad; horns conical, thick at the base, diverging; fulvous brown, rather pale on the sides; hair soft, yellow tipped, all in regular order; chin, throat, spot under ears and over eyes, inside of limbs, under side of tail and lower side of body white; front of leg sometimes blackish.

Antilope redunca, Pallas?; Rüppell, Abyss. t. 7, good.—*A. rufa,* Afzelius, 250, from Buffon.—*A. reversa,* Pallas?—*Nagor,* Buffon, xii. t. 46?—*Oureby,* F. Cuv. Mamm. Lithog. t. ♀.—*A. Isabellina,* Gray, Cat. Mamm. Brit. Mus.—*Eleotragus reduncus,* Gray, Knowsley Menag. 13. t. 13.

Inhabits "Senegal." Mus. Frankfort and Mus. Leyden. Gambia (*Whitfield*), where it is called *Wonto.* Male and fawn, British Museum, and a young male living at Knowsley, from the Gambia.

Var. Larger, colour brighter.

A. Bohor, Rüppell, Abyss. t. 7; Sundev.

Inhabits Abyssinia. Mus. Frankfort.

Pallas and Afzelius's account of this species is derived from Buffon's description; both he and Adanson (Hist. Nat. xii. 326) say that it is "all pale red," and Buffon further observes that it has not the white on the belly of the Gazelles. This does not agree with our animal, which is white in several parts, but certainly not so white as the Gazelle, and has black on the legs; but as yet no other animal has been brought from West Africa, which better agrees with their account or figure.

M. Sundevall considers specimens of the *Nagor* of Senegal and the *Bohor* of Abyssinia, in the Frankfort Museum, as distinct, the former having the hair of the back whorled, the fore-leg with a dark stripe, and the latter having the hair not whorled and the legs pale. Our specimens, from Gambia, have the hair not whorled, and more or less distinct streaks on the fore-legs; hence I am inclined to believe the *Nagor* and the *Bohor* to be alike. Sundevall's animal may be the *Kob*, but that has only one whorl on each end of the back, a nearly cervine muffle, and the end of the tail black.

When in Frankfort, I observed that the male *Antilope Bohor*, from Abyssinia, was rather larger than the male of "*A. redunca*," from Senegal, in the same collection, and much brighter, and the horns more slender; the female was darker and browner than the male; both sexes have more black on the carpus and tarsus than in the specimen of *A. redunca* in the same museum.

Colonel Hamilton Smith formed a genus for two pairs of horns on part of the frontal bones in the College of Surgeons belonging to this group of Antelopes, which he called *Raphicerus acuticornis* and *R. subulata* (Griffith, A. K. t. 181. f. 2, 1). The figures are not sufficient to identify the species, and we now know that the horns of the same species differ greatly in individuals of the same species, and during the growth of the same specimen. *R. acuticornis* may be the horns of the *Duyker Boc, Ceph. Grimmia*?

[To be continued.]

LINNÆAN SOCIETY.

December 3, 1850.—Robert Brown, Esq., President, in the Chair.

Dr. Adolph Schlagintweit, at the request of the President, gave a summary of some of the principal results of the investigations of himself and his brother into the Vegetation of the Alps in connexion with height and temperature, as contained in their "Untersuchungen ueber die physikalische Geographie der Alpen."

He stated that very remarkable differences are to be observed in the limits of the altitude of vegetation in the district of the Alps. In the *mean results* for large divisions, we may plainly recognize the influence of geographical position, as well as that of the nature of the soil, and of the massiveness of the mountain range. The limit in fact becomes higher the more we approach the southern and western groups, a phænomenon which is connected with the general changes of climate. The mean temperature varies in these latitudes from 0·5° to 0·7° of Celsius for one degree; and at the same time the isothermal lines show an evident inclination from west to east. Many very essential differences cannot, however, be explained by geographical position alone; another important influence is dependent on the form of the mountain-range, the limits of vegetation being generally connected with the mean magnitude of the elevation, and reaching higher in massive and lofty groups of Alps than in the lower chains. The favourable influence which the massiveness of the elevation exercises on the vegetation, is essentially the same as that which is also evidenced with regard to the temperature of the air and soil; and corresponds to the difference which is remarked between the climate of a plateau, and that of a ridge or free peak in the neighbourhood. In different valleys or on the spurs of a mountain remarkable differences in the altitude of the limit of vegetation often manifest themselves according to the exposure, the direction of the wind, or the proximity of separate and extensive masses of glacier; but these influences are for the most part merely local, and the general variations of the limit of vegetation dependent on the massiveness of different groups of Alps are but little affected thereby. A comparison of the annual isotherms with the limits of vegetation proves that the different groups of vegetation do not always terminate at *the same* annual isotherm. With the exception of the Beech, he showed that up to the height of *Coniferæ,* these limits in the Northern Alps are reached at warmer isotherms than in the Central Alps; and a somewhat lower mean temperature is observed on corresponding points of the group of Monte Rosa and Mont Blanc. This is immediately dependent on the fact that the growth of plants is not determined alone by the mean temperature of the year, but also by that of the seasons and of the months. The warmth of the summer is in this view of peculiar influence; the greater this is in connexion with the same mean temperature of the whole year, the higher plants ascend, and the colder are the annual isotherms which mark their limits. A review of all the meteorological observations made in the district of the Alps shows that in the Central Alps and in the group of Mont Blanc and Monte Rosa, the summer warmth is greater and the climate consequently more extreme than in the lower chains of the Northern Alps; by which means the relation of the limits of vegetation to the annual isotherms in these different mountain-groups is explained.

He further stated that his and his brother's investigation of the periodical development of the vegetation at heights of from 1500 to 8000 Paris feet showed among other things that the retardation of the development by the elevation is in general less during the flowering than during the ripening of the fruit; it amounts in the Alps during the former period to ten days, during the latter to twelve and a half, and on the average of the whole period of vegetation to eleven days. The mean temperature is diminished in general about 2° of Celsius for the same difference of height, during the period of the development of vegetation. From their own observations on the influence of height on the growth of *Coniferæ,* he concluded that in *Pinus Larix, P. Abies, P. sylvestris* and *P. Cembra,* an evident diminution in the thickness of the annual rings takes place at greater elevations. A regular diminution, however, must not be expected for each degree of elevation. Not only the variations in the temperature of the air, of the soil, and in the climate generally (which concur to disturb the *Coniferæ* at greater heights) produce a diminution of their yearly growth; but the different nature of the soil has also great influence on their growth. The mass of well-decomposed earth, the presence of boulders or firm rock, the exposure of the locality, the humidity of the soil, and in some degree also its inclination, have so great an influence on the growth of the tree, and are moreover especially in the lower regions so irregularly distributed, that the influence of elevation, which should be most closely connected with the changes of climate, may be and is partially obliterated. Very frequently indeed in investigations of the geography of plants, a similar concurrence and a mutual correlation of the various causes by which the changes of vegetation are produced, are to be recognized. The observation of the progress from year to year shows that very frequently considerable variations occur in the amount of growth in separate stems. These are not, however, connected with definite years of the development, but irregularly distributed during the life of a tree. As they commonly extend over a long series of years, and do not agree in different trees for definite numbers of years, they cannot be produced by the climatic circumstances of unfavourable years. The larger oscillations of growth are dependent, on the contrary, on the nature of the soil, inasmuch as the roots during their extension meeting with more or less favourable and rocky spots, the productiveness of a tree may be essentially changed during many years.

An enumeration of all the phanerogamous plants found in the Upper Möll district (in the Tauern, in Upper Carinthia) at between 7000 to 8000 Paris feet high, and between 8500 to 10,000 feet, gave for the former region, the subnival, 224 species, for the latter, the nival, 32; while Prof. O. Heer obtained from the same regions in Glarus in Switzerland 219 and 12. Many families, as for example *Boragineæ, Euphorbiaceæ, Geraniaceæ, Labiatæ, Liliaceæ, Stellatæ, Umbelliferæ*, &c., compared with the lower regions and with Germany, diminish evidently and sometimes very strikingly in species in relation to the sum of *Phanerogamæ*. In some others no such regular differences are found in relation to height. A remarkable relative increase of species in connexion with increased elevation, is found in *Saxifrageæ* and *Primulaceæ*; and may also be remarked in *Campanulaceæ, Caryophylleæ, Compositæ, Gentianeæ*, and others. This depends, not on an absolute increase of species of these families, but on a diminution of the species of the other families. *Monocotyledones* generally diminish with height in relation to *Dicotyledones*; except that in the nival region and in the highest localities this proportion appears to be somewhat undefined. The covering of snow also is not completely universal in the high regions. In spots free from snow and furnished with earth, phanerogamous plants, as well as Mosses and Lichens, are found far above the snow-line. Among the species which are found at the extremest limits in the Central and Southern Alps, at 10,000 to 11,000 Paris feet high, are *Androsace glacialis* and *A. Helvetica, Cerastium latifolium, Cherleria sedoides,* *Chrysanthemum alpinum, Gentiana Bavarica, Ranunculus glacialis, Saxifraga bryoides, S. oppositifolia, Silene acaulis,* &c. &c. The extreme limit of Mosses is *in general* little above that of phanerogamous plants. The last Lichens are to be found on the highest summits of the Alps, attached to projecting rocks, without any limitation of height. The number of species and varieties, up to this time between 40 and 45 *species,* which have been found in the Alps between 10,000 and 14,780 Paris feet, is not inconsiderable, but this vegetation is limited to very few spots, surrounded by extensive masses of snow. Among the *Lecideæ, Parmeliæ* and *Umbilicariæ,* collected by Saussure, Agassiz, and themselves, on the *highest localities,* Dr. Schlagintweit enumerated *Lecidea geographica, L. confluens, Parmelia elegans, P. varia, P. polytropa, Umbilicaria proboscidea* β. *cylindrica,* &c.

December 17.—Robert Brown, Esq., President, in the Chair.

Read the conclusion of Mr. Benjamin Clarke's "Memoir on the Position of the Carpels when two and when single, including outlines of a new Method of Arrangement of the Orders of Exogens, and observations on the structure of Ovaries consisting of a single Carpel."

In this memoir Mr. Clarke details the results of his observations on the position of single and double carpella in reference to axis, with the view of ascertaining the mode in which the reduction of the carpella from a higher number takes place, and the value of the characters thus obtained in the formation of a natural arrangement of plants. He commences with dicarpous ovaries, in which he observes three different positions in relation to axis: 1st, *right and left,* resulting generally (as he believes to be shown by an examination of the genus *Carex* and of certain *Malpighiaceæ* and *Euphorbiaceæ*) from the suppression of a third and usually posterior carpellum, but occasionally also (as for example in *Lonicera, Fortunea, Diosma,* and probably *Cruciferæ*) from the abortion of the anterior and posterior carpella of an ovary originally consisting of four divisions; 2ndly, *anterior and posterior,* resulting in *Houttuynia cordata* from the disappearance of one of the lateral carpella and the displacement of the other so as to become opposed to the persistent posterior carpellum; in *Agrimonia* and *Spiræa* (when dicarpous) from a similar suppression; as also in reduced fruits of *Reseda luteola,* &c.; 3rdly, *oblique,* which he describes as of frequent occurrence both in plants in which the carpella are generally anterior and posterior, and in those in which they are as predominantly right and left, and which he supposes to arise from the remaining lateral carpellum of a tricarpous ovary retaining nearly its original position when the other lateral carpellum has disappeared, in consequence of which the posterior carpellum is somewhat displaced, becoming obliquely posterior. He regards the single carpellum as the result of the non-development of one of the carpella of a dicarpous ovarium, and its position may consequently vary in three different ways: 1st, *anterior,* as occurs in 1-carpellary ovaries of *Myrtaceæ, Onagrariæ, Polygaleæ, Leguminosæ* and *Acanthaceæ,* to which may probably be added *Hippurideæ, Bruniaceæ,* &c.; 2ndly, *posterior,* as in the 1-carpellary ovaries of *Houttuynia cordata* and *Piperaceæ*; 3rdly, *lateral* or *oblique,* instances of which occur in *Moreæ,* in *Elatostemma,* and in *Celtideæ.* The normal number of carpella in all ovaries he regards as three or a multiple of three; the additional series being frequently reduced by abortion in the same manner as the first, and thus giving rise to the formation of ovaries with four and five carpella. Tricarpous ovaries generally have their component parts placed two laterally and one posteriorly; but exceptions to this rule occur, as for example in *Viola,* where the third carpellum is anterior, and in *Clethra, Pittosporum* and *Delphinium,* in which the position of the carpella varies in the same plant.

Mr. Clarke next proceeds to consider the value of the characters derived from the position of the carpella, for which purpose he has framed a large table containing the results of long-continued observations on a multitude of exogenous plants with monocarpous or dicarpous ovaries. In this table he constitutes two primary divisions, viz. *Proterocarpous,* in which the carpella when single are anterior or lateral, never posterior; and *Heterocarpous,* in which the single carpellum is for the most part a mixture of lateral, anterior and posterior, and is rarely wholly posterior. The position of the component parts of the dicarpous ovarium also appears to be more permanent in the first than in the second division. From this table Mr. Clarke deduces various inferences in relation to the systematic arrangement of plants, and the importance of the characters derived from the position of the carpella, and more especially from that of the single carpellum, which is liable to fewer and less important exceptions. Thus for instance he considers the posterior position of the single carpellum of *Ceratophylleæ,* corresponding as it does with that of *Piperaceæ* and their allies, and differing as far as known from that of any other order with which it could be associated, as a strong argument of affinity. He refers to the case of two-celled ovaries with unequal cells, and regards the superior development of the larger cell or of the corresponding stigma as indicative of what would be the position of the single carpellum, were the ovary to be so reduced. These remarks are followed by observations on the general character of his divisions and subdivisions, and by some notes on the position of carpella as regards endogenous plants and *Rhizantheæ,* and on the relation of didynamous stamens and carpella as regards their order of suppression; and the first part of the memoir concludes with some remarks on the difficulty of determining with precision the true axis of the inflorescence, and the means of obviating this difficulty in certain cases.

The second part of the memoir is more especially devoted to the consideration of ovaries consisting of a single carpellum, to the relations borne by this carpellum to the axis in various families referred by the author to each of his two principal divisions, and to the grounds from which this relation is deduced. This being entirely matter of detail is scarcely susceptible of analysis, but some of the incidental observations connected with it may properly be noticed here. Mr. Clarke states that in *Scleranthus annuus* the funiculus is uniformly posterior to the seed and on the same side with the cotyledons, in which character that plant differs from *Chenopodeæ* and *Amaranthaceæ,* and as far as he has been able to ascertain from *Illecebreæ,* in which the funiculus is either anterior or lateral, and the cotyledons (in pendulous seeds) on the opposite side of the seed or less frequently lateral. Of thirty-two ovaries of *Circæa alpina,* thirteen had two cells with an ovule in each, but the posterior cell constantly smaller than the anterior, in twelve the posterior cell was empty, and in seven entirely absent; and this analogy with some particularities in structure led him to regard the single cell of *Hippuris* as most probably resulting from a single anterior carpellum. He shows by a series of diagrams that the position of the fertile cell in *Valerianeæ* is always lateral and external; and observes that in the genera with an irregular corolla it always bears the same relation to the irregularity of the flower. He infers from an inferiority of development of the posterior carpellum in *Stylidium graminifolium,* that if the ovary in that genus were reduced to a single carpellum, that carpellum would be anterior; a case which he has since found to occur in *St. adnatum,* in which there is a single anterior carpellum, or if two carpella are present the anterior only is fertile, the ovula being always attached to the posterior angle of the cell. He describes the carpellum of *Isopogon* and *Leucospermum* among *Proteaceæ* as anterior; and notes that in *Grevillea* the carpellum always alternates with the two larger sepala, but varies most extensively with reference to what he considers the axis. In *Anadenia* he states that the carpellum is always anterior in the lower half of the raceme, but varies in position towards the summit, and in rare instances is perhaps even posterior. In some species of *Acacia* also he believes that he has found instances of posterior carpella, but as the flowers were for the most part in threes, these carpella might belong to the lateral flowers. In *Pedicularis palustris* he has always found the anterior carpellum and the anterior division of the style larger than the posterior; and the same is the case with *Mendozia,* resulting in the latter instance in the suppression of the posterior carpellum in the fruit. He gives at length his reasons for regarding the carpellum as anterior in *Casuarina, Cannabis, Humulus, Parietaria, Urtica, Elatostemma* and *Celtis*; and he concludes his remarks on the Proterocarpous division by some observations on *Cuphea* and *Lythrum*; on *Magallana*; and on *Fumaria.*

Under the head of the Heterocarpous division he begins by recurring to the relations already mentioned as existing between *Ceratophyllum, Piperaceæ, Houttuynia* and *Chloranthus.* He then proceeds to notice *Gentianeæ,* among which he states that the dichotomous *Erythræa linarifolia* is an example of the two carpella being anterior and posterior, and infers from thence and from other variations, taken in connexion with the general statement that in this family the carpella are right and left, that their position (as in *Apocyneæ* and *Loganiaceæ,* according to M. Alphonse DeCandolle) is variable. He next refers to *Broussonetia* and *Morus* and to *Stilbe,* which latter he is disposed to consider as related to *Empetreæ* and *Euphorbiaceæ,* and then proceeds to the examination of *Cupuliferæ,* among which he finds extensive variations. He refers to *Coriaria* as agreeing with *Malpighiaceæ* in having its raphe turned away from the placenta and consequently next to the dorsal rib of each carpellum, which he describes as corresponding with the general position of the funiculus in that family. He describes the carpella of *Mirabilis* as being all lateral and internal; and again notices the peculiarities which he had before referred to in the position of the funiculus in *Chenopodeæ, Amaranthaceæ* and *Illecebreæ,* adding some remarks on the carpella of *Polygoneæ* and *Alsineæ.* He indicates certain characters in the flower of *Casearia* in which it approaches *Monotropa, Drosera,* and especially *Francoa.* In *Thymeleæ* he finds considerable variation in the position of the carpellum, and states that the relative position of carpellum and segments of perianthium is the reverse of what takes place in *Proteaceæ,* the carpellum being always opposite to one of the segments of the perianthium. The tendency to the suppression of stamens in *Thymeleæ* is also the reverse of that of *Proteaceæ,* being on the side opposite to the carpellum. In *Pimelea* and *Lachnæa* he states that the carpella are all posterior, while in *Daphne* the carpella of the two-flowered axillæ stand with their backs to each other, or more or less turned towards the stem: *Dais* is a mixture of these. Lastly, he notices various peculiarities in the ovary of *Sassafras officinale,* in *Sanguisorbeæ,* in *Combretum,* in *Aucuba Japonica* and in *Marlea.*

ROYAL IRISH ACADEMY.

April 28, 1851.—Rev. T. R. Robinson, President, in the Chair.

Professor Allman read a notice of the emission of light by *Anurophorus fimetarius,* Nicholi (*Podura fimetaria,* Linn.). During a walk over the Hill of Howth near Dublin, on a dark night in February last, he was struck with a luminous appearance in the earth when disturbed to the depth of three or four inches; the light proceeded from numerous distinct points and lasted for more than a minute after its first appearance. On carrying home some of the phosphorescent earth, Dr. Allman was enabled to trace the phænomenon in question to the presence of numerous living individuals of *Anurophorus fimetarius,* from each of which there proceeded in the dark a faint but very evident emanation of light. Specimens of the insect preserved alive in a glass phial continued for many nights to exhibit this beautiful phænomenon, which was also witnessed by Dr. Stokes and Mr. Haliday, as well as by numerous other friends whose attention was directed to it by Dr. Allman. The light could not be traced to any definite point in the insect. The Anurophorus was very abundant on the hill, and subsequent observation proved that the dark peaty soil which abounds in some places on Howth, was almost the only part of the district from which it could be affirmed to be absent.

MISCELLANEOUS.

On Wolves Suckling Children. By the Honourable F. EGERTON. Communicated by Sir RODERICK I. MURCHISON.

To the Editors of the Annals of Natural History.

16 Belgrave Square, July 19, 1851.

GENTLEMEN,—The annexed extract from the journal of the Hon. Capt. Francis Egerton, R.N., who recently travelled in India with Lord Grosvenor, was sent to me by his father, the Earl of Ellesmere, with this remark:—"It is odd that the same tale, like that of Sinbad the sailor, should extend to the Highlands. I got a story identical in all its particulars of the wolf time of Sutherland from the old forester of the Reay; in which district Gaelic tradition avers that wolves so abounded, that it was usual to bury in the Island of Handa to avoid desecration of the graves."

On referring the case to Professor Owen at the late Meeting of the British Association for the Advancement of Science at Ipswich, the following was his reply:—

"I have read with much interest the wolf story, and do not see very great improbability in it; but it could not be accepted at the Zoological Section because the facts are related at second-hand, the rule being that an observation must be communicated by the observer."

Under these circumstances, I think it right to give publicity to the little narrative of Capt. Egerton, which, although possibly printed in India, has not to my knowledge, nor to that of Professor Owen, been made known in England.

If this story be substantiated, may we not, after all the scepticism of the day, go back to the belief of our childhood, that Romulus and Remus were really suckled by a wolf?

Your very obedient servant,

RODERICK I. MURCHISON.

The Wolf Story.

February 14, 1851.

Colonel Sleeman told me one of the strangest stories I ever heard relative to some children, natives of this country (Oude), carried away and brought up by wolves. He is acquainted with five instances of this, in two of which he has both seen the children and knows the circumstances connected with their recapture from the animals. It seems that wolves are very numerous about Caunpore and Lucknow, and that children are constantly being carried off by them. Most of these have of course served as dinners for their captors, but some have been brought up and educated after their own fashion by them. Some time ago, two of the king of Oude's sowars (mounted gens d'armes), riding along the banks of the Goomptje, saw three animals come down to drink. Two were evidently young wolves, but the third was as evidently some other animal. The sowars rushed in upon them and captured the three, and to their great surprise found that one was a small naked boy. He was on all-fours like his companions, had callosities on his knees and elbows, evidently caused by the attitude used in moving about, and bit and scratched violently in resisting the capture. The boy was brought up in Lucknow, where he lived some time, and may for aught I know be living still. He was quite unable to articulate words, but had a dog-like intellect, quick at understanding signs and so on. Another *enfant trouvé* under the same circumstances lived with two English people for some time. He learnt at last to pronounce the name of a lady who was kind to him and for whom he showed some affection, but his intellect was always clouded, and more like the instinct of a dog than the mind of a human being. There was another more wonderful but hardly so well-authenticated story of a boy who never could get rid of a strong wolfish smell, and who was seen not long after his capture to be visited by three wolves which came evidently with hostile intentions, but which after closely examining him, he seeming not the least alarmed, played with him, and some nights afterwards brought their relations, making the number of visitors amount to five; the number of cubs the litter he had been taken from was composed of. I think Col. Sleeman believed this story to be perfectly true, though he could not vouch for it. There is no account of any grown-up person having been found among the wolves. Probably after a certain time they may have got into a set of less scrupulous wolves, not acquainted with the family; the result is obvious.

Col. Sleeman has, I think, published an account of one of these wolf-boys, but I forget where.

CARCHARIAS VULPES.

To the Editors of the Annals of Natural History.

Weymouth, July 12, 1851.

GENTLEMEN,—The following are further particulars of the Fox Shark (*Carcharias Vulpes*), a notice of which appeared in the 'Annals' for this present month of July. The extreme length from snout to tip of the tail 12 feet. Length of tail from base to tip 6 feet. Girth in the largest part 3 feet.

This fish was caught on Saturday, the 21st of June, in a mackerel seine shot in the West Bay from the Chesil Beach. It was apparently in pursuit of a schull of mackerel.

When inclosed in the seine it occasioned a great deal of damage by constant blows of the tail.

This shark had evidently been on the coast for some days, as a man, Jonah Fowler (who by the bye is quite a naturalist in his way, and an excellent person with whom to go dredging), told me he was in Portland Roads a day or two before the shark was caught (in the Fairy Yacht) and saw the dorsal of some very large fish floating slowly towards him; he got ready his boat-hook, and as the fish came alongside he attempted to hook it, but not penetrating it merely frightened the fish, which immediately dived almost perpendicularly, at the same time making a great splash with its tail. It was of a purplish colour in the water; he has since seen the subject of this notice, and at once identified it as being of the same species, and probably it is the same individual. I am, Gentlemen, yours obediently,

WILLIAM THOMPSON.

PRESERVATION OF PREPARATIONS FOR THE MICROSCOPE.

One of the greatest obstacles in the study of plants—in cases, at least, where the aid of the microscope is indispensable—is the difficulty of preserving the minute parts and sections which have formed the materials of observation, and which require to be compared again and again, before complete conviction as to the certainty of any particular facts can be obtained. Every one who has attempted to dive into the intimate structure of vegetables, knows how hard it is to make useful sections, and that it is often practically impossible to obtain a second of equal excellence with one which a happy direction of the knife has once achieved. An easy method, therefore, of preserving such preparations would be invaluable. It is true that the plan adopted by Mr. Thwaites and others with such success, is available for a very large class of objects, but there is much difficulty in preparing both the cells and fluid in which they are to be preserved; and after all, not only is the expense considerable, and the necessity of keeping a large quantity of very brittle objects in a separate cabinet, with a very strict system of labelling, if the collection is to be of any real value, an unavoidable waste of much time, but after all, even in the best hands, the varnish is apt, after some months, to get into the cells and destroy the delicate specimens. Besides which, objects so mounted are, in consequence of the thickness of the cells, of no use for the microscopes called doublets.

A very easy and compendious method of preserving all such preparations as readily imbibe water has lately been proposed by C. Müller, which bids fair to be of great value. Slices of the very best and most translucent talc are cut of any convenient size, and made so thin that they will admit of being easily divided with a fine pointed penknife. The lamina is then to be slit to the middle, and the object inserted in the fissure with a little water. It will be found convenient if possible to make the fissure nearer to one surface than the other, and to mark the divided end by cutting off the corners. With a little practice it will be found that the division will always be effected in such a way as to secure the cohesion of the two laminæ, and the retention of the object. When the objects are wanted for the microscope it will be necessary merely to dip the marked end of the talc in water, with a pair of pincers ; and by means of capillary attraction, the object will at once be properly moistened. A slip of paper neatly gummed upon the undivided end, will at once answer the purpose of a label, and will point out the upper surface of the talc, a matter of some importance where deep doublets are used, supposing the lower division of the plate to be thicker than the upper. It is clear that objects so preserved may be kept between the same sheets as the specimens from which they are taken, and will therefore be immediately accessible without any loss of time. In a collection of Mosses, for instance, and Jungermanniæ, especially where the specimens are small and unique, and where in consequence it is often impossible to examine the peristome more than once, unless the preparation can be preserved, we have an admirable method of making even the rarest individuals available for future observation.

The same method will apply to the greater part of fungi and other

Cryptogams, and to a host of minute analyses of higher vegetables. It is inapplicable only where, as in Algæ, the tissues alter so much in drying as to retain few of their characters, and where the application of moisture does not make the tissues swell out to their original size. It is, however, possible that this method may be modified, so as to comprise even this important class of microscopic objects.—*Gardeners' Chronicle*, April 26, 1851.

NOTICE OF A SEA-BEACH DURING THE SILURIAN EPOCH.

One of the localities where fossils are obtained amongst the Silurians of the southern highlands of Scotland, is at the eastern side of the entrance into Kirkcudbright Bay. At this locality they occur in several spots, and the deposits which afford them vary considerably in appearance. Several beds of dark-coloured flags containing abundance of Graptolites of the species *ludensis* and *sagittarius*, amongst which the *Orthoceras annulatum* occurs, are to be met with. A light grey shale is also found, having imbedded within it nodules, some of which abound in fossils named in the 'Quarterly Journal of the Geological Society,' vol. iv. p. 206, and which appear to have been transported from other fossiliferous beds, rather than to be concretions of limestone gathered around organic bodies, inasmuch as the fossils themselves are generally either on the surface of the nodule or occur in a line slightly within its margin; and the nodules often bear evidence of friction and rolling. Besides these beds, there are seen near Reaberry Head deposits consisting of fine-grained greywacke sandstone with intercalated shales, or rather indurated clays, which appear to be of considerable extent, and which, from the sandstones and clays being of nearly equal thickness, and also from their regularly alternating, offer characters which are uncommon amongst the Scotch Silurians. One of these clay beds has imbedded within it irregular lines of coarse sand, and amongst this sand fragments of shells occur. These fragments consist of portions of *Terebratula lacunosa* and *T. semisulcata*, *Orthocerata*, and minute pieces of other shells, together with crinoidal rings. In some of the cells of the *Orthocerata* the fragments of the other shells are seen mixed with sand; and the broken shells themselves are of a white colour, very different from what Silurian fossils commonly present; and on the whole their appearance is not far removed from that of the broken bleached and withered shells of our own shores.

The greywacke sandstone also affords some information concerning the origin and circumstances attendant on the beds which are intercalated with it. On the under surfaces of some of these sandstones lines of desiccation occur, indicating that the clayey deposits had been exposed to the influence of solar heat; and the nature of the deposits themselves shows that the circumstances under which they originated were somewhat similar to those which prevail on some of our coasts at the present time. On the whole the appearance of these thin beds of greywacke sandstone and indurated clay is such as to show that in this locality, during a portion of the Silurian epoch, there existed a sea-shore, on the rippled surface of which grains of coarse sand and fragments of shells were strewed. And as we find at the present time, on many spots of our shores, the lower parts of the ripple-markings often affording coarse sand and broken pieces of shells, so likewise during the Silurian epoch we have circumstances prevailing, such as to show that the sun bleached the empty shells and cracked the dry mud on this ancient sea-beach as it does at the present time.

The evidence of the occurrence of land in formations antecedent to the carboniferous is exceeding rare, the deposits being exclusively of a marine character; and although this deposit at Reaberry Head only affords marine remains, yet the circumstances under which it occurs, and also the state of the fossils which are imbedded in it, leave no doubt that the sea, at the period when this littoral deposit was being formed, rolled over a shore which skirted some portion of land then above the surface of its waters. And it is probable that this land had its fauna and flora, which this withered shell-bed may possibly at some time afford us some knowledge of.—ROBERT HARKNESS.

On the Cell-membrane of Diatomaceous Shells. By J. W. BAILEY.

If hydrofluoric acid is applied to recent Diatomaceæ, the shell soon dissolves, leaving distinct, internal, flexible cell-membranes retaining the general form of the shells. These may sometimes but not generally be detected even in the fossil specimens. When present, they materially interfere with the examination of the true nature of the markings of the siliceous shell, and should be destroyed by nitric acid and heat, before the hydrofluoric acid is employed, unless it is desired to study the cell-membrane itself. There is a curious difference in the action of hydrofluoric acid of the same strength upon specimens of fossil Diatomaceæ from different localities. Some dissolve with even too great rapidity in an acid which is slow and tedious in its action on other specimens. The Bermuda and Richmond Tripoli, and *some* specimens of fluviatile origin resist the action much longer than is usual with most specimens, whether they are recent marine, or either recent or fossil fluviatile ones. This difference is probably due to different degrees of hydration.—*From Silliman's American Journal of Science and Art,* No. 33, May 1851.

A Comparative Examination of the Objective Glasses of Microscopes from Mr. Ross of England; Mr. Spencer of America; and M. Nachez of Paris. By J. LAWRENCE SMITH, M.D.

Having had an opportunity, a short time since, while at Paris, to examine the comparative merit of the lenses of these makers, it might not be uninteresting to microscopists to know the result of my examination, particularly as it was made under peculiar circumstances; namely, by adapting alternately the objectives to the same mounting, and regarding the same object under the same illumination.

The glasses used were considered by their makers as among their best. That made by Ross was in the possession of M. Rutherford of U. S. Spencer's was owned by Dr. Burnet of Boston, and had just been brought by him from Spencer. That of Nachez belongs to Dr. Bigelow of Boston, now in Europe engaged in microscopic research very creditable to himself. Their magnifying powers varied from thirteen hundred to fifteen hundred diameters, with an ocular magnifying ten times; Ross's was the feeblest, that of Spencer the strongest.

The angular opening was first measured with great accuracy and found as follows:

Ross	145°
Spencer..............	135°
Nachez	120°

These measurements were all verified by the respective owners of these lenses.

The objects examined were the most difficult test-objects among the siliceous infusoria, as the *Navicula angulata,* one of the species of *Grammatophora,* and a Navicula called the Amici test. The first two were in balsam.

The lenses were first attached to one of Nachez's mounting, and the best adjustment of oblique light used that this instrument affords. The difference in the effect of the three lenses was very slight, all failing to show the lines on the *Grammatophora* or on the Amici test. As notwithstanding the admirable arrangement of Nachez's instrument for working purposes, we do not get the extreme obliquity of light which is required for examining their fine lines, I had them all arranged on a mounting of Amici, which furnishes the necessary obliquity of light. Thus arranged, the lines on the *Grammatophora* were distinctly and beautifully seen by all, with slight advantages in favour of Spencer and Ross, the former of which magnified them most.

The Amici test was next tried, which resulted in Ross showing the lines with perfect satisfaction; Spencer showing them, but not quite so well; Nachez still less distinctly.

I would remark that this difference between the lenses appears to be owing entirely to difference in the angle of opening, for where a very oblique light is necessary to show lines, the lenses must be so constructed as to admit this light. I would also state that Nachez's system lacks an adjustment which the others have, by which the relative position of the lenses can be changed, so as to compensate for the thickness of the glass which covers the object, and which appears favourable to the examination of those delicate tests. For the examination of globules we could not perceive any appreciable difference between the lenses.

I would here remark in justice to M. Nachez that he deserves much praise for the manner in which he has improved the microscope in France, without augmenting the cost of the instrument, and out of England he is undoubtedly the best maker in Europe. To furnish an idea of what he has done to diminish the cost of a good instrument, I will compare the price of the objectives which have been the subject of the experiments.

Ross....................	306 francs.
Spencer	230 „
Nachez..................	60 „

And what is still more, he is constantly improving his lenses without adding to their expense.

The lower powers of these makers were examined without finding any sensible difference in the defining effects of them, and what little there was, was in favour of Spencer. The field of the three differed, Nachez's being the least, and Spencer's the greatest. We cannot bestow too much praise on our American maker, for the immense progress which he has made in the construction of objective lenses, and it is to be regretted that he has not chosen a better mounting for them than that of Chevalier, which is very defective and prevents good glasses from showing their best effects.

I had intended making some remarks on oblique light, which has come very much in use lately in observing lines and points on certain objects, but it will be better for me to defer it. I would simply remark that much caution is necessary in using it, as it will not always give correct distances between lines.—*Ib.* No. 32, March 1851.

ANTIOPE CRISTATA.

To the British localities mentioned by Mr. Hancock in last month's Number may be added Langland Bay near Swansea, where my friend, Mr. Moggridge, took a fine specimen in the summer of 1849. It is noticed and figured in that year's Report of the Swansea Literary and Scientific Society under the last recorded name of "*Antiope splendida.*"—J. Gwyn Jeffreys, July 6th, 1851.

METEOROLOGICAL OBSERVATIONS FOR JUNE 1851*.

Chiswick.—June 1, 2. Very fine. 3. Fine: cloudy. 4. Cloudy: fine: clear: cold at night. 5. Densely clouded: rain. 6. Boisterous: cloudy and fine. 7. Densely overcast: slight rain. 8. Boisterous. 9. Drizzly. 10. Uniformly overcast: rain. 11. Very fine. 12. Densely clouded: showers. 13. Overcast: densely clouded: rain. 14. Fine: heavy clouds: slight rain. 15. Cloudy: rain. 16. Boisterous. 17. Cloudy and fine. 18. Very fine: boisterous. 19—21. Very fine. 22. Cloudy: clear. 23. Fine: clear and cold at night. 24, 25. Very fine. 26, 27. Hot and very dry. 28, 29. Hot and dry. 30. Slightly clouded.

Mean temperature of the month	59°·21
Mean temperature of June 1850	59 ·26
Mean temperature of June for the last twenty-five years .	60 ·72
Average amount of rain in June	1·80 inch.

Boston.—June 1, 2. Fine. 3. Fine: rain P.M. 4. Fine. 5—7. Cloudy: rain A.M. and P.M. 8. Cloudy. 9, 10. Cloudy: rain P.M. 11. Fine. 12. Cloudy: rain A.M. 13. Cloudy: rain P.M. 14. Fine. 15. Fine: rain P.M. 16. Cloudy: stormy. 17. Fine: stormy. 18—20. Cloudy. 21. Fine: thunder and lightning, with rain and hail P.M. 22—25. Cloudy. 26—30. Fine.

Sandwick Manse, Orkney.—June 1. Bright: showers. 2. Bright: rain. 3. Clear. 4. Showers: fine. 5. Fine: showers. 6. Fine: clear. 7. Bright: fine. 8. Rain: hazy. 9. Showers: clear. 10. Showers: damp. 11. Showers. 12. Clear: fine. 13. Bright: fine. 14. Fine: hazy. 15. Rain. 16. Rain: drizzle. 17. Showers: clear. 18. Fine: drizzle. 19. Showers: hazy. 20. Fine: clear. 21. Bright: showers. 22. Cloudy. 23. Bright: drizzle. 24. Cloudy. 25. Bright: damp. 26. Cloudy: clear. 27, 28. Clear: fine. 29, 30. Hot: fine.

* The observations from the Rev. W. Dunbar of Applegarth Manse have not reached us.

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

Days of Month.	Barometer.							Thermometer.								Wind.				Rain.			
	Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.			Chiswick. 1 p.m.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. June.	Max.	Min.		9 a.m.	9 p.m.	9¾ a.m.	8½ p.m.	Max.	Min.		Max.	Min.	9¾ a.m.	8½ p.m.								
1.	30·363	30·195	29·87			30·18	29·94	76	43	57			53½	51	ne.	wsw.		w.	......	......		......
2.	30·181	30·042	29·68			29·90	29·72	72	41	58			50	44	nw.	wnw.		nw.	......	......		·06
3.	29·879	29·672	29·36			29·58	29·68	74	39	64·5			45½	42½	sw.	w.		nw.	·08	......		·65
4.	29·904	29·819	29·40			29·64	29·70	66	36	50			44½	44	nw.	nw.		sw.	·01	·04		·02
5.	29·833	29·773	29·37			29·62	29·48	62	45	53			51	45½	sw.	s.		se.	·14	·04		·01
☽ 6.	29·950	29·822	29·27			29·48	29·60	61	52	60			54½	45	sw.	sw.		sw.	......	·42		·11
7.	29·965	29·937	29·44			29·72	29·68	66	53	61·5			51	49	sw.	ssw.		se.	·01	·20		·08
8.	29·960	29·936	29·38			29·32	29·28	71	56	63			52	49	sw.	w.		ne.	......	·18		·36
9.	29·963	29·551	29·46			29·72	29·70	61	48	57			47	45	se.	wnw.		n.	·02	......		·12
10.	29·720	29·642	29·22			29·60	29·68	55	43	50			44	43	ne.	n.		w.	·32	·82		·09
11.	29·980	29·965	29·53			29·74	29·74	67	48	51			48	49	sw.	wnw.		se.	·04	·08		·05
12.	29·737	29·650	29·23			29·66	29·66	61	56	57			53	49½	sw.	s.		e.	·23	......		·07
○ 13.	29·913	29·722	29·23			29·70	29·86	67	47	63·5			54½	57	sw.	w.		n.	·04	·02		......
14.	30·061	30·036	29·57			29·92	29·90	67	41	57			55½	49	sw.	w.		se.	·01	......		......
15.	30·056	29·904	29·55			29·68	29·36	64	52	64			52	51	sw.	sw.		se.	·38	......		·25
16.	30·031	29·832	29·33			29·33	29·46	67	45	61			50	50½	w.	w.		nw.	......	·21		·25
17.	30·383	30·209	29·67			29·94	30·20	66	38	57			47	48½	nw.	wnw.		w.	......	......		·07
18.	30·402	29·231	29·90			30·10	29·80	71	55	57			53½	50	w.	wnw.		w.	·05	......		......
19.	30·160	30·108	29·55			29·54	29·84	75	49	67			51	47½	sw.	wnw.		nw.	......	......		·11
20.	30·098	30·035	29·58			29·96	29·94	81	47	67			50	48½	sw.	w.		se.	......	......		......
☾ 21.	29·883	29·689	29·38			29·70	29·60	87	55	70			59	53	se.	s.		ne.	......	......		·04
22.	30·014	29·813	29·26			29·57	29·84	67	41	60			52	47½	nw.	nw.		wnw.	......	·08		·15
23.	30·248	30·163	29·68			30·00	30·05	67	35	59			49	48½	nw.	w.		nw.	......	......		·02
24.	30·267	30·242	29·76			30·05	29·94	73	45	59			56	53	w.	w.		se.	......	......		·04
25.	30·260	30·246	29·68			29·94	29·88	77	47	67			53½	53½	w.	w.		s.	......	......		·28
26.	30·267	30·200	29·70			29·84	30·09	85	46	65			62	52	s.	sw.		w.	......	......		·03
27.	30·169	30·125	29·63			30·17	30·17	91	52	69			58	58	e.	calm		e.	......	......		......
28.	30·147	30·137	29·63			30·13	30·11	84	51	69			64½	60½	e.	se.		e.	......	......		......
29.	30·148	30·125	29·62			30·11	30·11	82	50	67·5			69	67	e.	e.		......	......	......		......
● 30.	30·124	30·061	29·60			30·09	30·09	82	55	67			69	60	e.	e.		......	......	......		......
Mean.	30·060	29·929	29·51			29·797	29·803	71·40	47·03	60·9			53·31	50·56					1·33	2·09		2·86

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XV.—*Observations on the Affinities of the* Olacaceæ. By JOHN MIERS, Esq., F.R.S., F.L.S.

THE family of the *Olacaceæ*, first proposed by Mirbel, in 1813, under the name of *Olacineæ*, was placed by him near the *Aurantiaceæ*: Jussieu stationed it in proximity with the *Sapotaceæ*, while DeCandolle following the views of Mirbel arranged it close to *Aurantiaceæ*, a conclusion adopted by most succeeding botanists, and among these Endlicher and Meisner, who disposed it with *Aurantiaceæ*, *Meliaceæ*, *Humiriaceæ*, &c., in a class called *Hesperides*. Brongniart however followed the original views of Mr. Brown, in regard to the affinity of *Olax* with the *Santalaceæ*; but upon less satisfactory grounds, he associated with these the *Loranthaceæ*, excluding at the same time *Ximenia* from the family. Dr. Lindley in his 'Nixus Plantarum' and 'Natural System' offered a new view, by placing it, under the designation of the *Olacaceæ*, in the same alliance with the *Pittosporaceæ* and *Vitaceæ*, for which position few and not very satisfactory reasons could be offered. Mr. Bentham, in an excellent memoir on the *Olacineæ* (Linn. Trans. xviii. 676), proposed a new arrangement of the order into three distinct tribes, adding several new genera, together with his ingenious views in regard to its affinities, when he justly denied its relation with the *Aurantiaceæ*, although he admitted its approach to the *Humiriaceæ*, considering both these families to be approximate with the *Styraceæ*; and lastly he allowed, that through *Opilia* and *Cansjera*, the *Olacineæ* evidently osculate with the *Santalaceæ*. Finally, Dr. Lindley (Veg. Kingd. p. 43) repeated his former views, with some modifications, placing it in his alliance of the *Berberales*, together with *Droseraceæ*, *Berberidaceæ*, *Vitaceæ*, *Pittosporaceæ*, &c., an alliance which, as Dr. Asa Gray very justly remarks (Gen. Pl. Un. St. i. p. 78), "is there placed on peculiar grounds by no means compatible with ordinary views of botanical affinity." In estimating the value of these conflicting opinions, I will endeavour to show, that notwithstanding their extreme divergence, they will allow of a considerable degree of approximation.

We have the strongest evidence of the approach of the *Olacaceæ* towards the *Santalaceæ*, in the singular and important consideration of the structure of the ovarium and the seed; and if we consider the biserial floral envelopes of many of the genera of the latter order to be calyx and corolla, both of which are often most distinctly developed, as in *Choretrum*, *Leptomeria*, *Leptonium* and *Mida*, as also in *Quinchamalium*, *Arjoona* and *Myoschilos*, it is clear that its relationship towards the *Olacaceæ* is infinitely stronger than with the *Thymeleaceæ*, *Proteaceæ* and *Lauraceæ*, to which, in fact, they claim but a most distant affinity. This consideration did not escape the penetration of Mr. Brown, who more than forty years ago, and some time before the establishment of the family of the *Olacaceæ*, suggested* that the floral envelope called perianthium in the *Santalaceæ* may be looked upon as analogous to the same organ called corolla in *Olax*, and the calycular appendages may be viewed as a distinct calyx, alike in both instances; and hence, with equal reason in one case as in the other, we may consider the floral envelopes to be dichlamydeous rather than monochlamydeous: or we may imagine, that at a very early period in the development of the bud, the calyx and corolla have become connate, and hence grown into one common envelope,—an hypothesis rendered very probable from the constant thickness of its substance, and its divisibility into two distinct laminæ. I was led to a similar conclusion many years since by the examination of the Chilean genera *Quinchamalium*, *Myoschilos* and *Arjoona*, which have all a very distinct calyx, while the more conspicuous envelope, hitherto called perigonium, is decidedly petaloid in texture. Under this point of view, a close relationship will be found to exist between the *Olacaceæ*, *Santalaceæ* and *Styraceæ*, to which perhaps may also be added the *Myrsinaceæ* (but not the *Primulaceæ*), and it would then remain to be decided, in what part of the system such an alliance ought to find its place. I will not at present stop to offer proof of the alliance of the *Santalaceæ* with the orders above-mentioned, as I shall shortly have to revert to that consideration, but assume the fact for the present as one that admits of little doubt, and proceed to speak of the affinities of the *Olacaceæ* in other quarters, taking this family within the limits it has hitherto embraced.

I have alluded to the relationship of the *Olacaceæ* with the *Styraceæ*, but in so doing it is requisite here to state, that I consider the *Symplocaceæ* as ordinally distinct from the *Styraceæ*,

* Prodr. 352.

as will be made apparent when I describe two new genera appertaining to the former family. Don first suggested this separation, but he does not appear to have been aware of all the facts that prove their want of identity. In the *Symplocaceæ* we find a calyx of five imbricate sepals, a corolla with very imbricated æstivation, numerous stamens, placed in many series upon the corolla, having ovate 2-lobed anthers, without intervening connective, an inferior ovarium, showing a strict union of its carpels into five complete cells, and seeds of very different structure. In the *Styraceæ*, on the contrary, we have a tubular calyx with an almost entire border, petals with a distinctly valvate æstivation, stamens in a single series, generally double the number of the petals, and therefore by turns, opposite and alternate with them; here the anthers are linear, dorsally affixed upon a very fleshy connective; the ovarium is superior, wholly free from the calyx, with a remarkable pulvinate depressed epigynous gland; it is 3-locular at base, the dissepiments separating from the axis about its middle, and gradually disappearing at the apex, where it is completely unilocular, the base of the style being hollow, and continuous with the cavity of the cell; the cionosperm rises in the axis above the point of the separation of the dissepiments, and to the axile column are attached three fleshy placentæ, each bearing several ovules (about nine) in three rows, the upper series being erect, the middle horizontal, the lowermost suspended, the summit of each ovule being borne upon a cupshaped strophiole, as in the *Celastraceæ*: of these only a single seed becomes matured, as in *Olacaceæ*; it differs however in being erect, and showing at its base the remains of the abortive ovules: the radicle of the embryo, enclosed in fleshy albumen, is directed to the point of attachment, as in *Olacaceæ*, but owing to the different position of the seed, it of course assumes a contrary direction, and points to the base of the fruit; the cotyledons are much larger and more foliaceous than in *Olacaceæ*. These points of structure are evidently quite opposite to what we find in the *Symplocaceæ*, and it is surprising they could ever have been associated together. The characters of the *Styraceæ* are however analogous to those of the *Olacaceæ*, and there exists a very close affinity between the two families. The corolla is in no degree more gamopetalous in *Styraceæ* than it is in *Olacaceæ*, for in both cases the petals are valvate in æstivation, at first cohere slightly by their margins, and finally separate nearly to the base, where a short portion always remains agglutinated, by the adhesion of a very thin annulus, from which the stamens originate; but upon removing this annulus the petals will be found to separate easily, and not to be really confluent into a gamopetalous tube. We also see in *Liriosma* the same tendency to the adhesion of its parts, carried even to a greater extent than in any instance I have found in *Styraceæ;* and in *Schöpfia,* which is justly included by Mr. Bentham in the *Olacaceæ,* we see a still greater tendency to a confluence of its parts. If therefore the *Olacaceæ* have been placed by all botanists among the pleiopetalous orders, there can be no reason why the *Styraceæ* should be considered as a monopetalous family. The ovarium in *Styraceæ* is stated by most authors to be half inferior, but I have observed that at an early stage, and even after the fall of the flower, it is quite free, although partly surrounded by the tube of the calyx; and if it become subsequently agglutinated to the latter, it is probably only at a late period, as we find to occur in *Liriosma.*

The *Ebenaceæ,* by most botanists, have been held to be closely allied to the *Styraceæ,* but this does not appear to me quite evident. Though placed among *Corolliforæ,* it appears to me that they should rather be arranged among the polypetalous groups, for their petals are often quite distinct, or when united, cohere so slightly as to be separated by a little force. The stamens, although sometimes adnate to the corolla, are most generally free, or at least originate in a fleshy disk, which sometimes assumes the form of a very short hypogynous tube. In one Brazilian species of *Diospyros,* I have found the albumen in the seed to be distinctly ruminated, as in the *Anonaceæ,* the embryo having a terete radicle and broad foliaceous cotyledons, much resembling in structure that of *Monodora. Cargillia,* according to Mr. Brown, a genus of this family, so nearly approaches the *Anonaceæ,* that the typical species was described by Jacquin as the *Anona microcarpa* (Fragm. xl. tab. 44. fig. 7), and by Dunal as the *Monodora microcarpa.* In the Brazilian species of *Diospyros* above alluded to, the seeds are imbedded in pulp, and covered by a mucilaginous arillus: they are also compressed, with a linear, basal, and somewhat lateral umbilicus, forming a deep marginal furrow, into the bottom of which cavity the extremity of the radicle subtends, as in several genera of the *Anonaceæ*. Monotheca* and *Reptonia,* placed in *Theophrasteæ,* appear, from the descriptions given of them, to have little in common with that family, and to belong rather to *Styraceæ,* if we consider the basal placentations, which I have shown to exist in this last-

* A precisely similar structure is found in *Diospyros Candolleana,* according to Wight's 'Icones,' plate 1222, fig. 8 to 11. In several other instances in this family, the albumen is depicted in the same work as being distinctly ruminated, so that this may probably be a general character of the order, although so remarkable a feature is not noticed in any botanical work. Gaërtner however hints at the fact, but only in one instance out of the many species of *Diospyros* he describes; *D. tetrasperma,* which has its "albumen radiato-striatum, quasi fibrosum."

mentioned order, as in the *Olacaceæ*; and the approximation of these genera to the *Anonaceæ* is again confirmed by the ruminated albumen of the seed of *Reptonia*. The relation of the *Ebenaceæ* with the *Olacaceæ* was, I believe, first pointed out by Jussieu, but few botanists have attended to the suggestion; from the indications just mentioned, it will probably be found, that a more fitting position for the *Ebenaceæ* in the system exists among the hypogynous Polypetaleæ, not far from the *Anonaceæ*, rather than in the monopetalous group, where it is placed in the 'Prodromus' of DeCandolle, and in the arrangements of other modern botanists.

Mr. Bentham in his memoir before quoted gives his opinion, that among dichlamydeous plants, the family of the *Humiriaceæ* approaches most to that of the *Olacaceæ*; but in this inference he had probably in view his tribe *Icacineæ*, which I propose to remove altogether from the order: I cannot indeed perceive any such approximation between the two families. In the *Humiriaceæ*, the æstivation of the corolla is imbricated or contorsive, the stamens are many-seried, and numerous in respect to the petals, generally united into a monadelphous tube, or combined in phalanges, and they have a singular expansion of their fleshy connective; the ovarium is surrounded at its base by a thin, and somewhat membranaceous dentate ring; it has four or five complete cells, which by the thickening of the axile placenta are often again divided by a transverse partition. The fruit is a berry, having a 5-celled osseous nut, the cells being often 2-locellate, and the seeds are provided with the usual integumental coverings. This is in no way analogous to what is seen in *Olacaceæ*; but the *Humiriaceæ* present a more manifest affinity with the *Symplocaceæ*.

A considerable degree of analogy between the *Myrsinaceæ* and *Olacaceæ* is shown in the position of its stamens opposite the petals, which present an æstivation so little imbricated as to be sometimes mistaken for being valvate; they agree also much in habit and inflorescence. In *Icacorea* the ovarium is unilocular, with four ovules attached to a central free placenta, of which sometimes only one becomes matured, as in *Olacaceæ*; but here the analogy ceases, as the æstivation of the corolla is contorsively imbricate and the seed presents all the characters of the *Myrsinaceæ*. This family has been arranged by most authors among the *Monopetaleæ*, but for the reasons before urged in regard to the *Ebenaceæ* and *Styraceæ*, it should be transferred to the *Pleiopetaleæ*. In *Mæsa*, *Samara* (*Choripetalum*, A. DC.), and *Embelia*, the corolla is decidedly pleiopetalous, and in the other genera of the order the petals are only slightly coherent at base, the ovarium being in all cases superior, except in *Mæsa*, where it is said to be partly inferior, but probably not so at an early period. The disposition to produce red dots in all parts of the plant in *Liriosma*, as in the *Myrsinaceæ*, is common to several families of the *Thalamifloræ* of DeCandolle's arrangement. Some degree of analogy may also be perceived between the *Myrsinaceæ* and the *Anonaceæ*, *Lardizabalaceæ*, and *Menispermaceæ*, in the development of the ovule, in the arilliform growth of the placentary indusia, as constantly witnessed in the two former families, and frequently in the latter, and in the deeply concave hilum, formed by the increment of the seed around the placenta, which is drawn into its cavity, and the consequently somewhat arcuate direction of the embryo within the albumen, seen more especially in the tribe *Heteroclineæ* among the latter family. There are other considerations to be held in view, that the *Primulaceæ*, *Myrsinaceæ*, and *Theophrastaceæ*, offer a free central placenta within the ovarium, without any appearance of parietal septa, or any connexion of the placenta with the style: we see also in the *Illicibraceæ*, *Mesembryanthaceæ*, and *Portulacaceæ*, a somewhat analogous development; but in these cases we cannot imagine this to be the result of the rolling up of the placentary margins of one or more carpellary leaves, according to the hypothesis generally entertained; but we may rather conceive, that the margins of the carpellary leaves constituting the ovarium have not the power of developing ovuliferous placentæ, a power seemingly there confined to the rudimentary petiolar support or gynophorus, which throws out its placentary threads, that are free in *Portulacaceæ*, &c., but confluent in *Primulaceæ*, *Myrsinaceæ*, *Theophrastaceæ*, &c. This view is confirmed by the appearance of the lengthened thread that grows up from the torus with the elongation of its seed, and its placentary attachment, in the instance of *Ægiceras*. We may therefore look upon this mode of development as the opposite extreme of the case of the multilocular ovarium, where its intrafolded placentations unite in a central axis; and we may look upon the *Olacaceæ*, *Styraceæ*, &c., as forming an intermediate state of development. Under such an hypothesis, keeping in view the considerations before mentioned, it would tend to a more natural division of the system, to remove all the several orders, from the *Lentibulariæ* to the *Styraceæ*, from the position assigned to them in the arrangement of the 'Prodromus.' Yet because the development of the ovaria in these instances may be traced to somewhat similar causes, it does not necessarily follow that they must all be allied together, for other considerations of equal moment may tend to keep them far apart. Thus from circumstances before enumerated, the *Styraceæ* and *Myrsinaceæ* might be associated with the *Olacaceæ* and *Santalaceæ*, between *Berberidaceæ* and *Rhœades*, in a group that might be called *Cio-*

nospermæ, as I suggested on a former occasion (*huj. op.* vol. vii. p. 207), and in this group the anomalous genus *Aptandra* will naturally find its place. On the other hand, the *Sapotaceæ* with their truly axile placentation, the complete cells of their ovarium, and their corolla more pleiopetalous than monopetalous, appear more naturally allied to the *Aquifoliaceæ,* in which family the petals are also generally combined at the base into a tube. The *Ebenaceæ,* as before suggested, appear to belong to the neighbourhood of the *Anonaceæ* rather than of the *Aquifoliaceæ,* with which family they are strangely consociated by Dr. Lindley (Veg. Kingd. p. 594) in the same alliance with the *Gentianaceæ, Apocynaceæ,* &c. The affinity of the *Symplocaceæ* with the *Humiriaceæ* has been already indicated. The *Primulaceæ,* together with the *Lentibulariaceæ,* appear to have more relation with the *Plantaginaceæ* and *Hydrophyllaceæ,* an alliance that differs little from that shown by Dr. Lindley (Veg. Kingd. p. 637). The farther prosecution of these considerations would be foreign to the present purpose, and they are now only indicated with the view of assisting us in the determination of the true affinities of the *Olacaceæ.*

There is yet another family, to which the *Olacaceæ,* comprehending all the genera included in it by Mr. Bentham, will be found to offer many points of approximation,—I mean the *Aquifoliaceæ* of DeCandolle, the *Ilicineæ* of Brongniart, Endlicher and others; but I am not aware that this affinity has been before noticed. Many species of *Ilex* bear much the habit of the *Olacaceæ* and differ little in the structure of the flower from the tribe *Icacineæ,* except in the æstivation of the corolla and the unilocular apex of the ovarium. *Leretia,* indeed, bears a remarkable resemblance in its habit and inflorescence, and in the structure of its flowers, to a Brazilian species of *Villaresia,* differing principally in the æstivation of the corolla, and in the want of an inner carinated midrib in the petals; but in other points of arrangement there is very little variance, agreeing even in its unilocular ovarium, with two collateral ovules suspended almost parietally from near the apex of the cell. The structure of the fruit of *Villaresia* corresponds so far with that of the *Olacaceæ,* in having a single seed, with copious albumen, containing a small embryo near its summit, with a superior radicle, and small cotyledons. It may be well here to mention a fact, apparently yet unknown, which may serve to throw some better light upon the real affinities of the *Aquifoliaceæ.* I have found that the suspension of the ovules in the ovarium of *Villaresia* is not really parietal, as generally stated, for it is sometimes completely bilocular, with two ovules in each cell, collaterally suspended from each side of the dissepiment by a cupshaped strophiole, like that seen in the ovules of the *Celastraceæ*; but in ordinary cases the ovarium is unilocular, only by the suppression of one of the cells, and the confluence of the dissepiment with the pericarpial covering, for it is then always somewhat gibbous, and its wall much thicker on the side of the abortive cell, towards which the style is then constantly somewhat lateral: this fact serves to bring the genus completely within the pale of the *Aquifoliaceæ*, as it is evident that its ovules are really suspended from the normal dissepiment, not parietally attached to the wall of an originally solitary carpel. It will also serve to guide us to the true position in the system of *Leretia, Pogopetalum*, and the rest of the somewhat extensive group of the *Icacineæ*, which I shall be able to prove to be quite distinct, in many leading and essential characters, from the *Olacaceæ*. *Rhaptostylum*, an anomalous genus of the *Aquifoliaceæ*, accords with *Heisteria* in many remarkable points; they agree in habit and inflorescence, both having flowers in aggregated axillary clusters, growing out of imbricated buds; they have also a small 5-toothed calyx, a corolla of five petals partly cohering at base, but easily separable, with a valvate æstivation, ten stamens, five of which are opposite, and five alternate with the petals, and partly adhering to them, a trilocular depressed and somewhat stipitate ovarium, with a single ovule suspended in each cell, a short erect style, and a clavate stigma: this close approximation of characters is very apparent, but the subsequent development of the calyx is not recorded in *Rhaptostylum*, nor is the nature of its fruit known. The genus *Ptychopetalum* of Bentham also agrees with *Rhaptostylum* in its principal floral characters, but differs in its unilocular ovule with two suspended ovules, a nearly constant feature of the *Icacineæ*. From the description of Kunth, the three cells of the ovarium are symmetrical, and not lateral, as in *Pogopetalum*; and as the fact of the evanescence of the dissepiments at their summit probably escaped the observation of that botanist, we may safely conclude that *Rhaptostylum* will be found to belong to *Olacaceæ* rather than to the tribe of the *Icacineæ*, or to the family of the *Aquifoliaceæ*. *Iodina* again, which has always been referred to the last-mentioned family, really belongs, as I shall be able to show, to the *Olacaceæ*: this curious genus presents a minute cupshaped bractiform calyx, with an entirely free campanular fleshy corolla, half cleft into five acute lobes, with a valvate æstivation: a large fleshy cup-shaped disk, fixed on a distinct stipitate support within the corolla, surrounds the ovarium, and upon its margin the stamens are inserted; five of these are fertile, and placed opposite to the lobes of the corolla, the others are alternate, squamiform and petaloid, having been hitherto described as petals, but from their position they are evidently analogous to the sterile stamens of *Agonandra*, a new genus of *Olacaceæ*: the depressed ovarium, partly immersed in the disk, is unilocular, with two to five ovules suspended from a cionosperm, or free central placenta. *Iodina* from its habit, with its spinous leaves more resembling those of the Holly, might well be supposed to belong to *Aquifoliaceæ*, but the æstivation of its corolla, and the peculiar structure of its ovarium, refer it, without doubt, to *Olacaceæ*. The genus *Iodina*, at first sight, offers a close resemblance to *Cervantesia*, which has in like manner five large petaloid scales, alternating with as many fertile stamens, and all originating in one common whorl, from the margin of a cupuliform disk; but in this genus the disk is not free, as in *Iodina*, but is entirely adnate with the tube of the floral envelope, so that when the fruit ripens, the drupe exhibits on its sides the persistent lobes of the corolla, and the petaloid stamens; but as the principal floral envelope must be regarded as a perigonium, having no calyx at its base, and as the disk is adnate with this perigonium, this genus must be referred to *Santalaceæ*, while *Iodina* and *Agonandra* must belong to *Olacaceæ*. There is one very unusual point of structure in *Cervantesia*, which appears to me without example; the floral envelope, deeply cleft above into five equal segments, is adnate to the disk, a little below the level of its free margin, but at this point it descends again below the same line of attachment, in the form of five other reverse segments, equal in size and continuous with the upper ones, and quite free from the disk and pedicel, which they enclose, so that it appears to consist of five elliptical segments, pointed and free, both above and below, and confluent only with each other and with the margin of the disk by a narrow transverse zone running across their middle: these inferior free processes must be spurlike extensions of the perigonium.

We have still another striking instance of the consimilitude in the external characters of the *Olacaceæ* and *Aquifoliaceæ*, which has led to a confusion of reference, in an opposite direction: this occurs in the genus *Bursinopetalum* of Wight, who assigned it to the former family, but which appears to me clearly belonging to the latter, as it agrees with it in the imbricate æstivation of its corolla; the petals, though distinct, and somewhat valvate at base, are decidedly imbricated for at least two-thirds of their length, two alternate petals being exterior to the others, and their margins overlapping to a considerable extent; they have the same prominent internal keel, and the apex is deeply inflected by long processes, which are torsively complicated together, as in *Villaresia*; the ovarium (probably from a similar cause) is unilocular, with an ovule (or two?) suspended on one side from near the summit of the cell; so far all accords with the last-mentioned genus, but it differs in having its ovarium half immersed in the fleshy torus, which however occurs sometimes in *Ilex*. Although the ovarium is at first almost superior, it subsequently becomes inferior by the growth of the fleshy torus, or disk, and it is the lower portion only that acquires increment, for the fruit ultimately is invested by the enlarged calyx, now become adnate, and is crowned by its five persistent teeth, the originally superior portion of the ovarium, and the base of the style, forming an umbilical scar upon its summit. The most prominent feature, however, is in the development of the fruit, and its structural resemblance to that of *Villaresia*; this is a drupe containing a very thick ligneous putamen of considerable size, which is one-celled; but the longitudinal parietal placenta seen in the ovarium has now become so much thickened, and extended across the cavity of the cell, as to make it thus appear as if it were almost bilocular, and its single seed hence becomes inflected around the placenta, and made to assume the form of the cavity thus formed, which in its transverse section is hippocrepiform: the seed, as in the *Aquifoliaceæ*, has a copious albumen, with a small embryo near its summit, having a superior radicle, pointed towards its apex. From the identity of this construction to that of *Villaresia*, we may reasonably conclude, that in *Bursinopetalum* the more normal condition of the ovarium is also bilocular, which indeed is evident from the hollow, or longitudinal slit, lined with a distinct membrane, seen to extend down the middle of the thickened incomplete dissepiment, and which is most probably the vestige of the abortive cell. These facts all tend to prove, that however structurally opposed the *Aquifoliaceæ* may be to the *Olacaceæ*, they possess so many external characters in common, as to have led the most expert botanists of our time to confound the two orders, by placing several genera in one family that belong to the other, and *vice versâ*. I will here mention that *Pogopetalum*, placed by Mr. Bentham in *Olacaceæ*, differs from that order, and especially from all the other genera of his tribe *Icacineæ*, in which it is placed, by having its ovarium always completely 3-celled: from the lateral position of these cells, it is manifest that their normal number must be five, in correspondence with the other parts of the flower. This would bring the genus nearer in accordance with *Ilex*, but it differs from that genus and all others of the *Aquifoliaceæ* in the æstivation of the corolla.

In order to prevent the same confusion in future, it is very desirable to reduce the *Olacaceæ* within more uniform and certain limits, and I therefore propose to confine this family to those genera that have a free calyx, more or less entire; four to six distinct petals, always valvate in æstivation, and sometimes adhering by the margins at their base into a somewhat gamopetalous tube, but which by a little force may be separated from each other without any laceration; stamens generally equal in number to the petals and opposite to them, sometimes double that number, in which case they are by turns opposite and alternate, or at times one half of them are sterile and appendiciform, or in shape of petaloid scales. Around the ovary are sometimes free hypogynous glands, alternate with the petals, but generally these are combined into a cup-shaped nectary, which in some instances, as in *Liriosma*, is free from the ovarium and partially adnate to the calyx; but in others, as in *Schöpfia, Iodina, Arjoona,* and *Quinchamalium*, it is wholly adnate to the ovarium and free from the calyx, while in *Cathedra* it is free both from the calyx and ovarium. This hypogynous disk, when developed, always bears on its margin the petals and stamens. The ovarium is always wholly superior with respect to the calyx, but often partly immersed in the cupuliform disk, and is frequently surmounted by a remarkable fleshy epigynous gland, which sometimes wholly covers its upper moiety; it bears a simple style, and a more or less clavate stigma. The internal structure of the ovarium is always constant in its character; unilocular at its summit, and more or less divided at base into incomplete cells, by spurious dissepiments, which separating from the axis, are often continued along the walls of the cell, in the form of so many narrow parietal keels. The placenta is axile, united at base with the short incomplete dissepiments, but quite free above, in the shape of an axile column, from which are suspended as many ovules as there are pseudo-dissepiments; these are generally three in number, more seldom two or five, and rarely by abortion only one, as occurs sometimes, but not always, in *Opilia*: this axile placenta, very distinct from the ordinary trophosperm, and which I have elsewhere proposed to call a Cionosperm (from *κίων, columella*), sometimes does not extend beyond the point of insertion of the ovules, while at others it rises above, in the form of an apical point, as in *Ximenia*, where it is prolonged far into a cavity of the style that is continuous with the cell of the ovarium, but in such cases it is always free and unconnected with it. One ovule only (as in the *Santalaceæ*) becomes matured into a fleshy drupe, which is sometimes supported at its base upon its unchanged calyx, while in others, as in *Olax, Heisteria, Cathedra,* and *Quinchamalium*, the calyx enlarges and encloses the fruit; and in some cases, as in *Liriosma*, the calyx increases in size, and becoming adnate, forms the fleshy external covering of the drupe. The putamen is one-celled, containing a single suspended seed; this, at first sight, presents a naked albumen filling the cavity, as in

Santalaceæ, but the membranaceous and pellicular integument will be found adhering to the inner face of the cell, and when separated, there will be seen on one side a funicular raphe-like thread, extending from the base to near the summit, which is merely the attenuated remains of the placentary column, with the abortive ovules, still visible, at the apical point of attachment to the integument. The embryo is small, terete, and seated in the axis of the upper portion of the albumen, the radicle being always superior, and the cotyledons very small and compressed, directed towards the centre of the nucleus. To such characters I have found the following genera correspond, viz. *Ximenia, Heisteria, Olax, Schöpfia, Strombosia, Cathedra, Iodina, Liriosma, Opilia, Arjoona, Quinchamalium,* and two new genera, *Agonandra* and *Endusa*. The order thus restricted is marked by more distinct and coextensive characters than those proposed by Mr. Bentham, and will be seen to comprise only his tribes *Olaceæ* and *Opilieæ*. The latter tribe however cannot be maintained, as I find that *Cansjera* does not belong to the family*, and that

* The genus *Cansjera*, first placed in the *Thymeleæ* by Jussieu, was retained there by all subsequent botanists, till removed to the *Olacaceæ* by Mr. Bentham, who concluded it was allied to *Opilia*, because he considered it to have a small distinct adnate calyx, and an unilocular ovarium, with a single ovule suspended from the summit of a free central placenta. All the specimens I have examined of both known species, from various localities, and in different herbaria, present characters constantly at variance with these conclusions and more in accordance with the description given by Lamarck (Dict. iii. 433). Here I can observe no trace of any distinct calyx, but the floral envelope, which is a simple tubular perianthium, is supported at base upon a small and pointed navicular bract: the four stamens are adnate in the upper portion of the tube, equal to the number of the lobes of the border, and opposite to them; four tridentated, free, hypogynous scales alternate with the stamens; the long conical ovarium is seated upon a narrow glandular support, from which the scales originate, and the style is surmounted by a large 4-lobed capitate stigma. The ovarium I find to be constantly 4-locular at base, and one or more (generally two or three) of these minute cells extend irregularly like narrow and interrupted channels, to the upper portion, and the fecundating threads may be traced from all of them, most distinctly, to the style: a single ovule is seen, sometimes higher, sometimes lower, from a prominent line of placentation on one side of each ovuliferous channel which at the point of the development of the ovule becomes widened, and here the placenta is somewhat curved, by the ascending direction of the ovule. The seed is a drupe, apiculated by the base of the style, and supported below by the remains of the shrivelled perianthium; it contains an oval coriaceous putamen, which encloses a single erect seed; a short receptacle is seen at the base of the cell, which enters into a corresponding hollow in the seed, and from it extend, in a cruciform direction, four prominent keels or ridges, which penetrate as many furrows observable in the albumen: the testa and integument are membranaceous, the albumen solid and fleshy, and an embryo of half its length is placed in the axis of the upper moiety: this embryo is slender, cylindrical, and terete, its superior radicle is oval, clavate, six times shorter

Opilia, although often with only a single suspended ovule, sometimes exhibits two or three ovules, as I have distinctly seen in *O. amentacea.* This fact was evidently more than suspected by Mr. Bentham, who says (*loc. cit.* p. 674) that it appeared to him there were two ovules in *Opilia,* three or four in *Cansjera,* a circumstance rendered probable by the evidently compound nature of the stigma in both genera, but which on account of the excessive minuteness of the parts he could not ascertain from dried specimens: after fecundation he never found traces of more than one ovule. The order however will admit of being divided into tribes, by some of the characters already indicated, but in a subsequent memoir I will offer my views on this subject.

As I shall have shortly to treat of *Leretia,* and other correlative genera, I shall be able to detail at greater length the numerous observations that have induced me to propose the separation of Mr. Bentham's tribe *Icacineæ* from the *Olacaceæ*; it will at present be sufficient to state, that they constantly differ in having the stamens alternate with, not opposite to the petals; they always want the hypogynous disk that forms so frequent and so remarkable a feature in that family, although they sometimes exhibit a similar epigynous gland upon a superior ovarium; they differ also most essentially in the structure of their somewhat gibbous ovarium, which normally will be seen to be 5-celled, but which with a single exception is by abortion always completely unilocular, and without the smallest indication of any free central placenta, the ovules being generally two in number, attached somewhat laterally, from near the summit of the cell. The fruit differs most essentially in structure from that of the *Olaceæ,* being a drupe, enclosing a single nut, with a solitary albuminous seed, that is covered with the usual testa and inner integumental envelopes, and distinguished by a well-marked chalaza and raphe, which, as in *Euonymus,* is averse or dorsal in respect to the axis of placentation. This is very manifest in *Pennantia,* a genus clearly belonging to this family.

In a former page (*ante* p. 169), while speaking of *Villaresia* and *Bursinopetalum,* genera belonging to *Aquifoliaceæ,* I pointed out the existence of the identity of structure of the ovarium in those genera with that of the *Icacineæ,* and I stated many other circumstances, tending to prove how closely this tribe is related to

than the linear cotyledons, of which there were three, equal in size, in the specimen I examined: from the extremity of the cotyledons a thread extended to the umbilicus in the axis of the albumen, which was probably the remains of the embryonary sac. These characters cannot in any single respect be made to correspond with the *Olacaceæ,* and *Cansjera* must again be assigned to its former place, as an anomalous genus of the *Thymeleaceæ,* until a more fitting position can be given to it.

that family, and that its affinity with the *Olacaceæ* is in reality very distant. This very different structure of the ovarium did not escape the penetration of Mr. Bentham, but as he had not observed the constant, essential, and dissimilar points of floral structure, as above described, he states in the memoir before cited, that he did not consider the single fact noticed by him to be a sufficient reason for separating the *Icacineæ* from the *Olacaceæ*. It is evident however, from the many circumstances enumerated, that this group must form a distinct family (the *Icacinaceæ*), and it will consist of the genera *Icacina, Mappea* (Juss.), *Apodytes, Rhaphiostyles, Stemonurus* (identical with *Gomphandra*), *Leretia, Phlebocalymna* (Griff.), *Sarcostigma, Poraqueiba, Pennantia, Ptycopetalum, Pogopetalum,* and *Desmostachys*.

I am aware of the objections that will be raised by some botanists, who are averse to multiplying the present number of orders, but it appears to me most important to the advancement of science, to detect in the various natural groups of plants, a few decisive characters, by which they can be readily distinguished, and this should be accomplished, even at the risk of increasing the number of families: this indeed is a far less evil than the opposite extreme, where, by reducing too much the divisions of the system, the most opposite characters often become blended in one group, and we thus lose sight of every useful and well-defined line of demarcation. This inconvenience was pointed out on a former occasion (Illustr. South Amer. Plants, vol. i. p. 167), when I proposed the family of the *Atropaceæ*, but I then suggested, that if this were felt to be an evil, it might be counterbalanced, by classing in one immense family the *Scrophulariaceæ, Solanaceæ, Atropaceæ*, &c., which all partake of many similar general characters. In like manner the *Celastraceæ, Aquifoliaceæ, Icacinaceæ*, and perhaps some others, might be considered as suborders, but I am not yet prepared to define the exact limits of such a group. The same observations will equally apply to what I have said farther on, relative to the *Viscaceæ*.

We have now arrived at that point in this investigation, when we can better understand the exact relation existing between the *Olacaceæ* and the *Santalaceæ*, to which I have already alluded. The details given of the structure of *Cathedra* and *Liriosma* enable us to comprehend more fully the true nature of the floral parts seen in *Santalaceæ*. In the *Olacaceæ* we have observed that the ovarium is always superior, and quite unconnected with the real calyx, and that the cupshaped disk, which supports on its margin the corolla and the stamens, is sometimes, though not always, adnate with the ovarium, growing with it in such case, and producing a pseudo-inferior fruit, but which, in truth, never ceases to be superior. This we perceive in *Myoschilos*, a genus placed hitherto in *Santalaceæ*, where the hypogynous disk is adnate with the ovarium, and quite free from its triphyllous calyx, the stamens and petals being inserted on the margin of a free portion of the disk; thus it agrees with *Schöpfia* in all essential points of structure, except that its calyx consists of three distinct sepals, instead of being an urceolate 5-toothed tube. In *Quinchamalium* we meet with a still nearer approach to the last-mentioned genus, for its calyx is also quite free, and in the form of an urceolate tube with a 5-toothed border; we have likewise a similar fleshy hypogynous disk, wholly adnate with the ovarium, and bearing on its margin a gamopetalous corolla; here also we perceive a similar development of the very prominent epigynous gland, that covers the somewhat depressed conical apex of the ovarium, but in this instance it rises in the form of a 5-grooved cylindrical tube, with a border of five rounded patent lobes, encircling the base of the style, and quite free from it. In *Arjoona*, as in *Myoschilos*, the calyx consists of three imbricate leaflets, but the outer one is considerably larger, and being 3-nerved, it consists probably of three confluent leaflets, so that the normal number of its sepals will hence be five, corresponding with that of the lobes of the border and stamens: the hypogynous disk is here less conspicuous, but it still exists, wholly adnate and continuous with the tube of the corolla: the epigynous gland is highly developed, being entirely free from the base of the corolla, by which it is concealed; the style originating on its umbilical and rounded apex. These three genera have hitherto been placed in *Santalaceæ*, but it is evident that to whatever order they belong they must be classed side by side with *Schöpfia*, a decidedly *Olacaceous* genus. In all the genera of the *Santalaceæ*, we meet with the presence of a large cupuliform disk, supporting the stamens externally on its lobed margin, and forming a most prominent and constant feature, but with this difference, that while in *Olacaceæ* this disk is frequently adnate with the ovarium and free from the calyx, in *Santalaceæ* it never invests the ovarium, but is adnate with the tube of the perigonium or calyx, forming generally a deep cup about the superior moiety of the ovarium, which in most of its genera is only half inferior: the cupshaped disk, in these cases, is therefore continuous with the fleshy epigynous gland. I am aware that it might be, as it has already been contended, that in *Schöpfia* its disk may be looked upon as an adnate calyx, its corolla as a perigonium, and its calyx as a tubular involucre; but such an argument can no longer be tenable when confronted by the structure seen in *Liriosma* and *Cathedra*, where we find a true solution of the nature of the cupuliform disk. There is however always this essential difference constantly existing between the two families: in the *Olacaceæ* the insertion of the corolla and stamens is on the margin of the disk; in the *Santalaceæ* this insertion is always outside of it; in the former these organs are articulated with it, and easily fall away; in the latter family it is impossible to separate the free lobes of the perigonium and stamens without force, and a rupture of the parts. But notwithstanding these prominent marks of ordinal distinction, there exists a regular gradation from one family to the other, as will be seen from the analyses I propose to offer; this proceeds from one extreme, *Opilia* (where the disk is developed in distinct free glands), through *Agonandra, Olax, Liriosma, Cathedra, Schöpfia, Arjoona, Quinchamalium, Myoschilos, Iodina, Cervantesia, Mida, Exocarpus, Santalum,* &c., rendering it difficult, through the osculant genera *Iodina* and *Cervantesia,* to draw a line through the strong limits of demarcation that exist between the two families.

The word *torus* has been employed by Mr. Bentham (Linn. Trans. xviii. p. 676) to describe in *Olacaceæ* what I have termed a *disk,* and which I have shown to be the same organ, but differently situated, that forms a constant feature, both in that order and the *Santalaceæ*, where in both cases, with rare exceptions, it is always deeply cupuliform and more or less lobed on its margin. I have adopted in preference the term "discus cupuliformis" as that given by Dr. Lindley for such a structure in his 'Introduction to Botany,' p. 161. This may not differ in its nature from a stipitate torus, but the adaptation in such cases of this last term, which is generally used in another sense, will naturally lead to ambiguity in our definition of structural arrangement; thus Mr. Bentham, in a subsequent work, appears to agree with Dr. Hooker's observation, after an original suggestion of Mr. Brown, in what appears to me an inconsequent conclusion, viz. that because in *Olacaceæ* the corolla is inserted into the disk, which is sometimes stipitate, or what he calls the apex of the pedicel, that the calyx in such case should be considered in the light of an involucre (Flor. Nigrit. p. 261). I can perceive no reason why this should be a necessary consequence, for we see in the *Capparidaceæ* the development of the stipitate torus carried even to a much greater extent, supporting the stamens on its sides and the petals below them; but no botanist in these instances has ever thought of considering the calyx to be of the nature of an involucre, which it ought to be if the above reasoning were valid: this incongruity is rendered still more evident, when we remember that the argument was applied in the case of *Rhaphiolepis,* a genus of the *Icacineæ,* which I have shown to differ little from the *Aquifoliaceæ*. The word torus is generally confined to that fleshy termination of the peduncle in the bottom of the calyx seen in *Ranunculaceæ*, and more especially developed in such orders as the *Anonaceæ*, *Magnoliaceæ*, &c., but when it rises in more varied or determinate shapes, it takes the name of hypogynous glands, annular ring, flat, pulvinate or cupuliform disk, &c., according to the peculiar form it may assume, or the position in which it is engendered.

The epigynous gland, so highly developed in *Schöpfia*, *Arjoona*, *Cathedra*, and other genera of the *Olacaceæ*, is an equally constant feature of the *Santalaceæ*, where in *Exocarpus aphyllus* it is largely and prominently seen in the form of a 4-lobed cushion, broader than the summit of the ovarium, which is almost entirely superior; this is quite independent of its hypogynous disk, which is also present as usual in the family. This organ, whose existence I first pointed out in *Hyoscyamus*, I have since found to occur frequently upon the summit of a superior ovarium.

This inquiry into the affinities of the *Olacaceæ* has led to another conclusion of some interest. In my memoir upon *Cathedra* (*huj. op.* vol. vii. p. 454), while describing its curious anthers, I pointed out a very analogous structure in *Choretrum* and other genera, mentioning at the same time a similar formation of the anthers in *Myzodendron*, so beautifully illustrated in the 'Flora Antarctica' by Dr. Hooker, who has there also given the analysis of its ovarium and fruit, proving by indisputable evidence its relation to the *Santalaceæ* and *Olacaceæ*. I will now endeavour to show, that neither this genus, nor *Viscum*, bear any relation to the *Loranthaceæ*, where they have been placed by almost every botanist. The genus *Viscum* has been a frequent subject of investigation by many eminent physiological botanists, and Richard first described the very remarkable structure of the anthers of *Viscum album*, of which we find no parallel formation: these are well represented (Ann. Mus. tom. xii. tab. 27) as being composed of very numerous cells, each containing distinct aggregations of pollen-grains, and which burst open and discharge their contents by the rupture and contraction of the vesicular tissue that covers their surface; in this respect it bears no resemblance to the structure of the anthers of *Myzodendron*. On the other hand, upon examining the anthers of the Brazilian species of *Viscum*, I find their structure quite opposed to that described in *V. album*, and somewhat analogous to those of *Myzodendron*; they are 2-lobed and subcordate, approaching much the form of those of *Cathedra*; they are quite distinct and free from the lobes of the perianthium, are nearly sessile, and consist of two parallel cells, enclosed in thick crystalline walls, as described in that genus, and appear to discharge their fertilizing power in the same ambiguous manner by two covered pores in the apex: the pollen is globular, quite smooth, vesicular, bursting irregularly, and so thin is their texture, that the sporular granules can easily be distinguished in them by transmitted light. All such species will therefore constitute a group generically distinct from *Viscum,* to which the name of *Allobium* may be given, from *ἄλλος, alius, βιόω, vivo,* in allusion to their deriving their support and nourishment from other trees. As far as my observation extends, many of the Asiatic species will be found to conform with the same genus. On some future occasion I will give more in detail the facts upon which I propose to separate from the *Loranthaceæ,* the genera *Viscum, Myzodendron,* and *Lepidoceras*: respecting *Eubrachion* and *Ginalloa* I cannot offer an opinion: *Antidaphne* from Pöppig's description is evidently related to *Loranthaceæ,* as well as *Tupeia**, on account of the structure of the ovarium.

It will be sufficient to remark at present, that in *Loranthaceæ* the flowers are generally hermaphrodite; the calyx, with a free and entire margin, is adnate with the ovarium; the petals are linear, frequently very long; the opposite stamens with lengthened filaments are free or only partially adnate with the petals; the anthers often versatile, always 2-lobed and 4-celled, bursting by two longitudinal furrows; the pollen is flattened, 3-lobed, and marked by three lines radiating from the centre; the ovarium is unilocular with a single ovule suspended from the summit of its cell; and the embryo, with large fleshy cotyledons, almost fills the cavity of the cell of the fruit, being covered with very thin albumen: finally they often form distinct trees, are frequently more epiphytic than parasitic, and the inflorescence is generally paniculate, with numerous pedicelled flowers, often of great size and brilliant colours. We perceive nothing like this in *Viscum, Myzodendron,* or *Lepidoceras,* where the flowers are always very minute, either diœcious or monœcious, and generally imbedded in decussate pairs in a fleshy spikelet. In the group I have called *Allobium,* the structure of the flower corresponds with that of most of the genera of the *Santalaceæ,* the calyx is obsolete, the corolla or perigonium has three or four short and 3-angular lobes, the sessile anthers already described are opposite to these segments, and alternate with the lobes of an internal adnate disk;

* I have had an opportunity of examining the *Tupeia Cunninghamii,* which scarcely differs from the typical species, *Viscum antarcticum,* Forst.; it agrees with the characters assigned to it by Forster, Chamisso, and Schlechtendahl (Linn. iii. 203), Richard (Voy. Astrol. p. 269), and Miquel (Linn. xviii. 85). At the same time that it is in no way related to *Viscum,* it quite accords with the *Loranthaceæ,* and agrees in every respect with the characters given in Endlicher's 'Gen. Pl.' p. 802, of *Spirostylis,* a subgenus proposed by Presl and adopted by Blume (DC. Prodr. iv. 315). This species from Acapulco will therefore claim the name of *Tupeia Haënckeana, Spirostylis Haënckeana,* Presl, the former genus being proposed in 1828, the latter in 1829.

in the female flowers, also 3- or 4-lobed, the ovarium is half immersed in a similar adnate fleshy cupshaped disk; it is 1-celled, with three ovules suspended from a free central placenta; the berry contains a single naked seed, enclosing a compressed heart-shaped albumen, with a minute embryo in its almost cordate summit; the radicle is terete, the upper moiety of which is nearly exserted, having only a thin pellicular albuminous covering; while its lower moiety, and two exceedingly diminutive cotyledons, are imbedded within the substance of the albumen, in the marginal sinus. These characters are so perfectly distinct from the *Loranthaceæ*, that it appears to me the genera above mentioned should form either a separate family (the *Viscaceæ*), or be considered as a suborder of the *Santalaceæ*. The only points of resemblance between *Viscum* and the *Loranthaceæ* are, the position of the stamens opposite the lobes of the corolla or perianthium, the manner of development of their seeds, their glutinous properties, and their parasiticism, characters equally possessed by other families: they are certainly quite distinct in habit. Mr. Griffith states, that the Indian species of *Viscum* have three ovules suspended from a central column, thus agreeing with the Brazilian species, which I have called *Allobium*. The ovules of *Viscum album* are said by M. Decaisne to be erect, but I have elsewhere offered reasons why we may infer that they are in reality suspended, and only apparently erect, as in *Champereia*, &c.

In first pointing out the affinity of the *Loranthaceæ* with the *Santalaceæ*, many years ago (Prodr. 352), Mr. Brown probably had *Myzodendron* and *Viscum* in view, as at a later period (Linn. Trans. xix. 232) he has alluded more distinctly to the similarity in the construction of the ovarium of the former genus with that which forms a pecular feature in the *Santalaceæ*. In indicating, on the other hand, the relation of the *Loranthaceæ* with the *Proteaceæ* (Flind. Voy. App. 549), the same distinguished botanist probably had only *Loranthus* in consideration. The evident affinity of *Viscum*, just mentioned, was also remarked by Prof. Decaisne, in his memoir on the pollen of that genus, before cited, on comparing the ovules of *Viscum album* with those of *Thesium*. Brongniart (1843), adopting this view, arranged the *Loranthaceæ* in a separate class, with the *Santalaceæ* and *Olacaceæ*. The same affinity between these three families (at least as far as regards *Myzodendron* and *Viscum*) has since been confirmed by Dr. Hooker, in his very able investigation into the relations of the former genus (Flor. Antarct. 293); and the strongest evidence in proof of this affinity is given in the complete analysis of its ovarium, from its early development to the perfection of the fruit, the details of which are there exemplified in plate 104. fig. 10 to 20, and plate 105. fig. 12 to 21.

After reviewing all that is here advanced, in regard to the affinities of the *Olacaceæ*, it is satisfactory to know that the conclusions to which my own observations have led me have been in great measure already anticipated by the inferences of such distinguished botanists: it is therefore with more confidence that I now repeat the suggestion proposed some time ago (*huj. op.* vii. p. 207), of uniting the several families distinguished by the characters there indicated into a distinct class (*Cionospermæ*), the place which it should occupy in the system having been already made obvious. If we look to the development of the reproductive organs in plants as a main element in the foundation upon which every natural method of classification should be based, then the arguments before adduced on this head ought to be considered with all the weight due to them (*ante* p. 166). I have there pointed out what appears to be the normal construction of the carpels in this group of families, and the sources from which the placentæ and ovules spring, and have again contrasted this with the normal structure of other classes of the system, the clear inference being, that the *Cionospermæ* should range in the *Thalamifloræ*, between *Polycarpicæ* and *Rhæades* (*ante* p. 166). Whatever may be conceded on this point as regards *Olacaceæ*, it may perhaps be objected, that a position so high in the scale is not compatible with the *Santalaceæ*, generally placed in a far lower grade; but if we consider the usual floral parts to be there existing and perfect, as we must admit from analogy, although but sparingly developed, this cannot be urged as a sufficient reason against the admission of that family into such a position, especially when no objections have been urged against the station assigned to the *Menispermaceæ*, placed in the midst of other families possessed of an unusually high extent of development in its floral parts, merely because its petals are reduced to the size of minute scales and its flowers very diminutive and diœcious. Neither did DeCandolle hesitate to arrange the *Myristicaceæ* in a similar position, although they have small diœcious flowers, with a simple perigonium; nor have any obstacles been raised against such a position by other botanists upon this score alone. Another objection may be urged, that in *Santalaceæ* the seed is often naked*, that is, deficient of any testa or integuments; but this is perhaps not always so, and its occurrence here, as we

* I do not use this term in the meaning employed by Linnæus, for seeds developed upon a gynophorus, such as *Labiatæ*, &c.; nor as used by Mr. Brown, to denote the seeds of *Coniferæ*, *Cycadeæ*, &c., in which sense it is now generally understood; but as no expression has been applied to the peculiar development under consideration, I would suggest that of *Semina exutiva*, as more peculiarly fitted to specify those, distinguished by the absence of the usual seminal tunics, contrary to the ordinary development in *Semina indutiva*.

know it to be in other cases, is probably due to adventitious causes. We have every reason to believe, that the development of the ovule and its embryo in the *Olacaceæ* is analogous to what has been observed in *Santalaceæ*: assuredly the early growth of the ovules is effected under the same peculiar circumstances, and in the seeds of *Liriosma, Ximenia,* &c., the albumen appears naked, or at least, their only covering is reduced to a thin membrane, which in the dried state remains more or less attached to the inner surface of the putamen. The phænomenon of the development of these, which I have proposed to call exutive seeds (see last note), has been frequently observed by many eminent physiological botanists, more particularly by Mirbel, Schleiden, Meyen, Decaisne, and Griffith. The latter has shown, that among the changes that take place in these cases, is the constant prolongation of the embryonary sac, outside of the "nucleus*," or body of the ovule, and that it is curious to witness the rapidity with which this exserted portion grows, and here becomes filled with albuminous tissue: another result being the incorporation of the remaining portion of the sac with that tissue. A similar prolongation of the embryo-sac was also noticed by the same accurate observer in *Avicennia*†, and he infers that this phænomenon has only been remarked in cases associated with a particular form of free central placenta‡; but this is not correct, for we have evidence, that its occurrence is not constant among the *Cionospermæ*. We know likewise, from the observations of Mr. Griffith himself, that the same occurs in *Congea, Loranthus,* &c. Dr. Planchon also has minutely described a similar phænomenon in the seeds of *Veronica*§, where the embryo is formed without the usual integuments, and remains covered merely by its embryo-sac, that protrudes outside the main body of the ovule, improperly called the "nucleus," and which afterwards shrivels into the form of a secondary funicular cord: in these instances the embryonary sac becomes thickened, and assumes the appearance of a perispermal covering around the albumen of the seed, very different in its origin from the true testa of indutive seeds.

* This term, though generally used in this case by botanists, is manifestly incorrect, and has been employed only because it is applied to the identical body which is enclosed within its several tunics in ordinary seeds; it leads to misconception, because it is difficult to imagine the "nucleus" can mean the external covering of the ovule, while the protruding real nucleary body becomes the entire seed. It would be more conformable to fact, and render the details of the phænomena more intelligible, to denominate the former, what it really is, the external body of the ovule, and not a "nucleus."

† Linn. Trans. vol. xx. p. 2.

‡ *Ibid.* p. 3.

§ Mémoire sur les développemens et les caractères des vrais et faux arilles. Montpelier, 1844.

We may infer that nearly the same changes take place in the development of the seed in *Olacaceæ* that Mr. Griffith has so minutely observed in *Santalum* and *Osyris;* for in the ripe fruit of *Liriosma,* examined in the dried state, independently of the thickened and lengthened cionosperm, which is pressed into a deep longitudinal groove, formed by its pressure, in one side of the albumen, I find constantly, midway between the axis and this groove, and imbedded in the substance of the albumen, a very distinct, long, cylindrical, membranous tube, which proceeding from the base terminates abruptly, by an almost truncated closed apex, at about half the length of the seed; the lower portion, at its exit, is reflected upwards round the base, for a short distance, in a small groove, and is soon gradually lost in the substance of the enveloping integument. We cannot imagine this tube to be anything else than the posterior end of the embryonary sac, which in *Osyris* Mr. Griffith describes as becoming incorporated with the nascent albuminous tissue, but which here appears to remain entire, and its existence in the position above described can only be accounted for by supposing its reduplication during the development of the albuminous tissue. On dividing the putamen, the albumen will be found quite bare of any integumental covering, except at the lacerated margin of the cionosperm, around the hollow space at the base, and about the summit, where it has broken away from the abortive ovules, which as well as the cionosperm become entirely pressed into the substance of the albumen: the rest of the extremely thin integumental covering remains adhering to the inner surface of the putamen; but whether the external body of the ovule becomes withered and contracted into the substance of the cionosperm, or whether its induvial remains are to be referred to the quantity of colourless, dislocated tissue found between the adherent membranes that form the lining of the putamen and the seminal integument, it is impossible to determine from an examination of dried specimens.

Besides the knowledge of the singular fact of the exsertion of the embryonary sac, and the development of the embryo outside of the body of the ovule, common to the *Santalaceæ,* and by analogy to the *Olacaceæ* and other *Cionospermæ,* that of the confluence of the albumina of several sacs into one albumen is stated to occur in *Viscum album*: this however is not quite a manifest explanation of the phænomenon, for if these were confluent, the embryos would not unite at base, but would remain distinct, by the intervention of the confluent sacs, unless we imagine these membranes to become absorbed into the substance of the nascent albumen. Dr. Meyen, on the contrary, denies the fact so minutely described by M. Decaisne, in the memoir before quoted, of the growing together of several embryos; for he asserts, that several embryonary sacs are contained in a single ovule, and are fertilized, but it rarely happens that more than one of these arrives at perfect development*, and he therefore concludes, that the doubling or trebling of the radicular end of the embryo of *Viscum* cannot be owing to the cohesion of several embryos. It appears to me that many of the changes that really take place in such cases have not yet been observed, and that we have still much to learn concerning the true nature of such developments: this is a subject of deep interest, worthy of the most attentive examination. I have mentioned that in the *Olacaceæ*, as well as the *Santalaceæ*, although the cionosperm sometimes exceeds the limits of the ovules, the free apices of the three ovular bodies are more frequently seen to extend above the top of the column. M. Decaisne describes the ovules in *Viscum album* to be several and erect, that one of these becomes fertile, while the two others are abortive and appear like filaments at its base. It is probable that the cionosperm is here very short, and that the free apices of the ovules have been mistaken for the ovules themselves; it may be also that the free apices of the probably yet unimpregnated ovules, distinguishable in the ovarium of the *Olacaceæ*, *Santalaceæ*, &c., may be nothing more than the exserted portions of the embryonary sacs, so ably described by Mr. Griffith: these are points very difficult of determination in dried plants especially, where the parts are so extremely minute and delicate. In *Opilia*, and again in *Champereia*, the three suspended ovules, at the period of the fall of the flower, appear closely aggregated upon their columnar support, and from their extreme minuteness, they are easily mistaken for a single erect, stipitate ovule; but I have found, by alternately moistening and allowing them to dry, that air intervenes between the delicate membranes, and renders them clearly distinct. I have already alluded to the fact, but as yet we know nothing of the cause, of the non-production in all the *Cionospermæ*, as well as in *Viscum*, of the usual coverings that in ordinary cases are generated over the pristine ovule. We must not lose sight of the important circumstance, observed by M. Decaisne, that in *Viscum album* the embryo is not developed till a long period after the fall of the anthers†, nor of those of Mr. Griffith‡, equally showing, that both in the Indian species of *Viscum* and *Loranthus*, the ovulum is a formation, subsequent to the act of impregnation; "a remarkable and unparalleled fact, that tends to increase the difficulty of understanding, or even conjecturing, the nature of

* Ann. Nat. Hist. Ser. 1. vii. p. 171.

† Sur le développement du Pollen du Guy, &c., Mém. Acad. Roy. Bruxelles, vol. xii.

‡ Linn. Trans. vol. xviii. p. 77.

the first steps in the formation of an embryo." These considerations become analogically of importance in leading us to the discovery of the real history of the *Olacaceæ*. Something in relation to this subject might be learned, if we could better understand the origin and development of the embryo under ordinary circumstances, for the facts are still undetermined that can prove which of the two theories of the nature of vegetable reproduction is founded on truth; the one maintaining that the pollen-grain penetrates the embryo-sac, and hence comes into immediate contact with the body of the nucleary vesicle, in order to effect its fertilization; the other denying this assertion, and declaring that it does not penetrate the sac, but merely discharges its function of impregnation, by external impression. Similar theories have long been disputed among zoologists, some contending that the spermatozoon does not penetrate the ovum in order to effect its impregnation, as mere external impact is sufficient to accomplish this function, while others declare the necessity of immediate contact, and that in proof of this they have seen the spermatozoa within the shell of the ovum. This point has just been determined by Mr. Newport, in a very interesting paper read before the Linnæan Society, in which he proves satisfactorily that the former view is conformable to truth. He has ascertained the important facts, that the presence of active spermatozoa are absolutely necessary to impregnate the ovum; that this is effected by simple impact; he has noted the time necessary to complete the operation, and has observed the internal change that immediately takes place in the body of the nucleus; and moreover he has found that the spermatozoa, after producing this effect by simple external impact, become inert and lose all power of motion. Mr. Newport has suggested that these circumstances, by analogy, may assist in determining the theories in dispute among vegetable physiologists; and he has pointed to the curious fact recorded by Mr. Griffith (Linn. Trans. vol. xx. p. 393) of the irritability or oscillatory motion seen within the boyaux of the pollen-grains of *Dischidia* at the period of impregnation of the ovules, which may perhaps be in some degree analogous to the vivacity of spermatozoa under parallel circumstances.

XVI.—*Geographical Notices, and Characters of fourteen new species of* Cyclostoma, *from the East Indies.* By W. H. Benson, Esq.

The following new species of an interesting genus of operculated Land-snails belong chiefly to the mainland of India, and were collected in the Sikkim Himalaya; among the hills to the northeast of Bengal, and in the Peninsula of Southern India, from the east near Bombay to its western shore. For the specimens from Southern India I am indebted to Dr. T. Jerdon, the illustrator of the ornithology of that quarter; a single species forms part of Dr. Cantor's acquisitions in Pulo Penang. I shall conclude with some remarks on the geographical distribution of ascertained Indian species, and on others which have been attributed, erroneously in my opinion, to the same country.

1. *C. Pearsoni*, nobis, n. s.

Testa umbilicata, depresso-turbinata, lævigata, obsolete spiraliter striata, supra castaneo marmorata et late fasciata, subtus spiraliter castaneo-lineata, fascia alba ad periphæriam, subtus altera nigro-castaneo concurrente ornata; spira depresso-conoidea, apice acuto; anfractibus 5 convexiusculis, ultimo lato, subtus convexo; apertura vix obliqua, ampla, circulari, intus cærulescente; peristomate expanso, undique reflexo, læte aurantio, marginibus callo brevi junctis; umbilico subangusto, pervio, intus angustiori.

Diam. major 42, minor 33, axis 25 mill.

Hab. in montibus Khasya dictis, ultra fines Provinciæ Bengaliæ, ad orientem spectantes.

Named after the late Dr. J. T. Pearson, of the Bengal Medical Service, a successful investigator of the natural history of Bengal, and formerly Curator of the Museum of the Asiatic Society of Calcutta. To him we owe the establishment of two interesting species of *Pterocyclos*, *P. parvus* and *P. hispidus*, in the Journal of that Society, and from him I received the species now described.

In form, sculpture, and markings *C. Pearsoni* much resembles, in the back view, the shell figured by Sowerby, no. 128. pl. 27. of the 'Thesaurus,' as *C. Perdix*, but the spire is less acute. It differs otherwise in the narrower umbilicus, in the orange colour and rounded edge of the peristome (which is destitute of the flatness observable in *C. Perdix*), as well as in the amplitude of the aperture, convexity and want of keel in the whorls, and in the absence of the articulated band at the suture. Can this be the shell alluded to by Sowerby in the following words? "Another variety has ventricose volutions and an orange-coloured aperture." It is probable that two or more distinct species were referred by Sowerby to *C. Perdix*, and that he has also figured two different species.

2. *C. Jerdoni*, nobis, n. s.

Testa umbilicata, depresso-turbinata, supra lineis elevatis spiralibus confertissimis corrugatis, strias obliquas decussantibus, subtus striis decussatis levioribus munita, albida, flammis fulguratis castaneis superne, et usque ad dimidium basis picta, fascia pallida mediana, flammulis attenuatis articulata, cincta; spira depressa, apice prominula, sutura distincta; anfractibus 5 convexis, ultimo prope suturam depresso-planulato, periphæria subangulata; apertura vix obliqua, subcirculari, ad apicem angulata, peristomate expansiusculo, incrassato, albido, ad umbilicum subreflexo; marginibus callo crasso junctis, umbilico mediocri, profundo, pervio, anfractus 2 exhibente.

Diam. maj. 35, min. 28, axis 20 mill.

Hab. ad latus montium "Nilgherries." Teste Jerdon.

Distinguished by its peculiar sculpture, more depressed form, rather wider umbilicus, and less expanded and less reflected peristome, from the white-lipped shell figured by Sowerby, Pl. Supp. no. 31 B. f. 321, as *C. Indicum,* Deshayes, and by Pfeiffer as *C. Ceylanicum,* Sowerby, who subsequently suppressed his MS. name. It is also less darkly coloured than that species, and the whitish ground forms a greater proportion in the markings. The red-mouthed var. of *C. Indicum,* figured by Sowerby, was sent to me by Dr. Jerdon as found on the opposite face of the Nilgherries.

3. *C. Aurora,* nobis, n. s.

Testa anguste umbilicata, globoso-subturbinata, spiraliter 5–6 obsolete carinata, ferruginea, versus apicem rubente, oblique rugulosa; spira conoidea, apice obtusiusculo; anfractibus $4\frac{1}{2}$ convexiusculis, ultimi periphæria obsolete angulata; apertura ampla, vix obliqua, circulari, superne angulata; peristomate continuo, expansiusculo, subincrassato, reflexiusculo, aurantio; fauce rubente.

Diam. maj. 28, min. 23, axis 19 mill.

Hab. ad Darjiling Regionis Sikkimensis ad montes Himalayanos.

This species is decorticate, but from the colouring apparent on the body-whorl within the aperture, where it is protected by a transparent enamel, it would appear that the fresh shell is surrounded, in the portion above the umbilicus, by narrow chestnut bands closely set. It is nearly related to a gigantic species from the same locality which is undescribed; but, having reason to believe, from a written communication made to me by Dr. Pfeiffer, that it is identical with an unedited species to which he has assigned the name *C. Himalayanum,* I refrain at present from describing it. The species in question is more depressed in proportion than *C. Aurora,* and being similarly decorticate, is white, with the exception of the peristome which is bright orange, and the apex which in my specimen is reddish. *C. Aurora* has also a narrower umbilicus.

4. *C. Cantori,* nobis, n. s.

Testa subanguste umbilicata, subgloboso-conoidea, spiraliter leviter striatissima, fulvida, sub epidermide albido-cæsia, rufo-fusco marmorata punctata et lineata, plerumque fascia unica nigrescente conspicua ad periphæriam cincta; spira conoidea, acuta; anfractibus 5 convexiusculis, primis oblique striatis, ultimi periphæria obsolete angulata; apertura ampla, circulari, subverticali, marginibus callo tenui junctis; peristomate expanso, sub-planato-reflexo; umbilico pervio. Operculo tenui, corneo, multispirato.

Diam. maj. 30, minor 23, axis 19 mill.; sp. major.
Diam. maj. 24, minor 19, axis $14\frac{1}{2}$ mill.; sp. minor.
Hab. ad Insulam Penang. Teste Cantor.

I have thought it advisable to introduce this species here, in order that it may accompany the three preceding species and that immediately following, which, equally with it, belong to the same division of Pfeiffer's subgenus *Cyclophorus*. The shell forms part of a collection of Penang and Malay species, of which Dr. Cantor entrusted the publication to me, together with some interesting drawings of the inhabiting mollusks, which, I hope, will now shortly see the light.

5. *C. porphyriticum*, nobis, n. s.

Testa mediocriter umbilicata, depresso-conoidea, tenui, striis confertissimis distinctis, elevatis, subundulatis, spiraliter munita, albida, superne saturate castaneo, subtus pallidiore ornata, maculis angulatis, circa suturam majoribus, conspersa, fasciis saturatis duabus albo-articulatis, altera ad periphæriam, altera inferiori cincta; spira brevi, apice acuto, sutura vix distincta; anfractibus $4\frac{1}{2}$ planulatis, ultimo angulato, subtus planiusculo; apertura ampla, ovato-circulari, livide albida, peristomate tenui, expanso, reflexo, marginibus callo tenui junctis, conniventibus, columellari angustato, leviter emarginato.

Diam. major 31, minor $24\frac{1}{2}$, axis 18 mill.
Hab. in India Orientali.

Allied to *C. aquilum*, Sow., but differing in tenuity, depressed form, keel, and sculpture. I received this shell from Sowerby, in 1834, as one of the varieties of *C. Perdix*; however, the compressed form of the shell, its sharply sculptured striæ, and the characters of the aperture sufficiently justify its separation. In Sowerby's fig. 127, and in Küster's fig. 7. pl. 8, the columellar lip is expanded above the umbilicus, instead of being narrow and connivent with the superior margin. Sowerby omits any notice of the sculpture, and that which is ascribed to it by Pfeiffer is of a very different character. In form *C. porphyriticum* somewhat approaches *C. zebrinum*, mihi, but differs in sculpture, markings, less produced spire, less flattened underside, much wider umbilicus, and in the absence of the peculiar hispid epidermis which clothes that rare species. Sowerby, in his description of *C. zebrinum*, notes the umbilicus as moderate. In my original description (Journ. Asiat. Soc. Calcutta for 1836), I described it as small; and, on comparison, it proves to be even narrower than that of *C. stenomphalum*, Pfeiffer. *C. porphyriticum* is also allied to, but quite distinct from, Mousson's *C. Zollingeri*.

6. *C. constrictum*, nobis, n. s.

Testa perforata, ovato-conica, glabra, costis angustis obliquis distantibus munita, translucente, albida vel rufula; spira elongato-conica, apice obtuso, sutura valde impressa; anfractibus 4 rotundatis, superioribus glabris, sequentibus remote costulatis, ultimo mox confertissime costulato-striata, pone aperturam strangulato, anticeque late constricto; apertura circulari, verticali, $\frac{3}{8}$ longitudinis æquante, peristomate undique reflexo; operculo testaceo, multispirato, sutura inconspicua.

Diam. 2, alt. $3\frac{1}{2}$ mill.

Hab. ad Darjiling Himalayæ Sikkimensis.

This shell has apparently an affinity with the Philippine *C. minus* of Sowerby, but differs in its more tapering form, smaller size, perforation, diverse sculpture, and in the strangulation of the last whorl behind the aperture, in which feature it exhibits an approach to the more shortened *C. gibbum*, Fér., from Turon in Cochin China, and to the depressed *C. strangulatum*, Hutton, so abundant in the more western portion of the Himalaya.

7. *C. filocinctum*, nobis, n. s.

Testa subaperte umbilicata, turbinato-globosa, infra spatium humerale glabrum lineis frequentibus elevatis cingulata, albida, epidermide fusca induta; spira elevata, subconica, sutura impressa, apice papillari; anfractibus $4\frac{1}{2}$ rotundatis, ultimo cylindraceo; apertura circulari, superne vix angulata, prope umbilicum leviter sinuata, $\frac{2}{5}$ longitudinis æquante; peristomate duplici, interiori simplici acuto, exteriori breviter reflexo; umbilico profundo, perspectivo.

Diam. maj. 3, minor $2\frac{1}{2}$, alt. $2\frac{1}{2}$ mill.

Hab. ad apices montium Nilgherries. Teste Jerdon.

This little species is distinguished by the spiral ridges, which are numerous between the shoulder of the whorl and the umbilicus, but are deficient near the suture, as well as by its double peristome. The epidermis is deciduous.

8. *C. sarritum*, nobis, n. s.

Testa subimperforata, ovato-conica, liris spiralibus crebris, sulcis angustis divisis, munita, ferrugineo-albida, apice rubente, sutura bene impressa, apice obtuso; anfractibus 4 valde convexis; apertura vix obliqua, ovata, $\frac{3}{8}$ longitudinis æquante, peristomate acuto, expansiusculo, marginibus disjunctis, columellari superne angulato, pariete calloso.

Long. 2, diam. $1\frac{1}{4}$ mill.

Hab. in muscis arborum vallis profundæ, prope Cherra Poonjee, in montibus Garo dictis, præter fines Orientales Provinciæ Bengaliæ.

I got specimens of this minute species, with other minute land shells as yet undescribed, in long tree moss, in which specimens of jasper, from the deep valley of Musmai, below Cherra Poonjee, had been packed on the spot.

9. *C. cœloconus**, nobis, n. s.

Testa subaperte umbilicata, turbinata, tenui, scabre confertim radiato-striata, olivaceo-lutescente, fascia unica submediana, strigisque undatis, radiatis, rufo-fuscis, ornata; spira conoidea, apice acutiusculo; sutura bene impressa; anfractibus $4\frac{1}{2}$ valde convexis, ultimo cylindrico; apertura obliqua, ovato-circulari, peristomate tenui, acuto, umbilico profundo omnes anfractus exhibente.

Diam. major 13, minor 11, axis 9 mill.

Hab. ad radices montium Nilgherries Indiæ Orientalis. Teste Jerdon.

This shells holds an intermediate place between the planorbiform *Cyclostomata* and the turbinate *Cyclophori* with a moderate or narrow umbilicus.

10. *C. cuspidatum*, nobis, n. s.

Testa umbilicata, acuminato-conoidea, oblique striata, lineis spiralibus circumdata, epidermide olivaceo-fusca; spira elongata, attenuata, apice mamillari; anfractibus 5, primis convexis, ultimo et penultimo superne convexiusculis, lira unica præditis, ultimo subtus convexo, periphæria carinata, carina lamellato-fimbriata; basi 3-lirata, lira subumbilicari fimbriata; apertura perobliqua, subcirculari, superne subangulata, dimidium longitudinis æquante, peristomate tenui, acuto, margine columellari expansiusculo; umbilico mediocri profundo, anfractus plures exhibente.

Diam. major 6, minor 5, alt. 4 mill.

Hab. ad apices montium Nilgherries. Teste Jerdon.

This species is singular on account of its attenuated spire, and the hirsute lamellar appendages to the keels, at the periphery and umbilicus; but the latter character is apt to be obliterated.

11. *C. Trochlea*, nobis, n. s.

Testa anguste umbilicata, pyramidato-turrita, glabra, albida, apice obtusiusculo, sutura impressa; anfractibus 5, angulato-convexis, superne 1 carinatis, ultimo tricarinato, carina 1 superiori, 1 submediana, 1 circumumbilicari; apertura obliqua, circulari, $\frac{2}{7}$ longitudinis æquante; peristomate acuta, ad finem carinæ inferioris vix angulato; umbilico pervio.

Diam. 2, long. 3 mill.

Hab. rarum in montibus Nilgherries. Teste Jerdon.

This minute shell is singular in its turrited form, and in the arrangement of its keels, which gives a flat cylindrical appearance to the periphery of the lower whorl. I do not know any species which can be compared with it.

* *κοῖλος, cavus; κῶνος, conus.*

12. *C. aratum*, nobis, n. s.

Testa aperte umbilicata, orbiculato-depressa, ferrugineo-albida, unicolori, vel ferrugineo-marmorata et fasciata, spiraliter sulcata, sulcis radiato-striatis; spira elevatiuscula, apice acutiuscula; anfractibus $4\frac{1}{2}$ convexis, ultimo cylindraceo, antice descendente, dilatato; apertura ovato-circulari, valde obliqua, margine parietali angulato, calloso, superiori expanso, arcuato, obsolete crenulato, inferiori breviter reflexo; umbilico infundibuliformi omnes anfractus exhibente.
Operculo calcareo multispirato, intus membrana induto, concaviusculo, extus carina elevata spirali subhorizontali munito.
Diam. major 18, minor 15, axis $9\frac{1}{2}$ mill.
Hab. in Indiæ Orientalis Provincia "Northern Circars." Teste Jerdon.

Nearly allied to *subdiscoideum*, Sow., and *modestum*, Petit de la Saussaye, Journ. de Conchyl. 1850. It belongs to *Aperostoma*, Troschel, as well as the more conical *semistriatum*, Sow., which is a denizen of the opposite or western side of the Indian Peninsula.

In one specimen there is a broad interrupted band above, and a narrow darker band below the periphery.

13. *C. ravidum*, nobis, n. s.

Testa aperte umbilicata, subdiscoidea, nitidiuscula, confertim scabre tenuiter radiato-striata, olivaceo-lutea, sub epidermide alba; spira vix elevata, apice planato, obtuso, sutura impressa; anfractibus 4 convexiusculis, lente accrescentibus, ultimo cylindraceo, antice vix descendente, superne prope suturam sub lente obsolete spiraliter striato; apertura obliqua, circulari, peristomate tenui, recto, marginibus callo tenui junctis; umbilico lato, perspectivo; operculo tenui, corneo, multispirato, extus concaviusculo.
Diam. major 15, minor 13, axis 7 mill.
Hab. ad apices montium Nilgherries Indiæ Meridionalis. Teste Jerdon.

The peristome is not quite perfect in the only specimen received by me from Dr. Jerdon, and some modification of its characters may be eventually necessary. The species differs from *C. annulatum*, Troschel, which has a similar operculum, in the more closely wound whorls, in the narrower umbilicus, more delicate sculpture, and absence of any pattern on the upper side.

14. *C. Phænotopicum**, nobis, n. s.

Testa subaperte umbilicata, depressa, subdiscoidea, tenui, non nitente, striis scabris, acutis, radiatis, elevatis, aliis impressis spiralibus, sub lente vix percipiendis, prope suturam decussatis, rufo-fusca, strigis angulatis, interruptis picta; spira depressa, apice prominula,

* The name "Darjiling" Hellenized.

sutura impressa; anfractibus $4\frac{1}{2}$ convexis, sensim accrescentibus; apertura circulari, peristomate tenui, recto, marginibus approximatis; umbilico profundo, perspectivo.

Operculo corneo, tenui, concaviusculo, arctispirali; anfractibus 7–8.

Diam. major 12, minor 10, alt. 4 mill.

Hab. ad Darjiling, Himalayæ Sikkimensis.

With reference to its operculum and aperture it belongs to the third division of Pfeiffer's *Cyclophorus*. Although the larger of my two specimens does not bear the signs of age, yet, even if the peristome should be found to acquire a further development, the peculiar dull and sharp scabrous sculpture, as well as the narrower umbilicus, will serve to prevent the species from being confounded with any allied form, such as *C. annulatum* and *C. stenostoma*, which possess a similar operculum. The impressed spiral striæ are confined to the inner slope of the whorl, towards the suture, and are only visible under a lens. *C. planorbulum*, Sow., has a very different operculum, and belongs to *Aperostoma*, Troschel.

C. stenomphalum, Pfr., Zeitschr. 1846, and Conch. Cab. 2nd edition, p. 59. t. 8. f. 5, 6.—Pfeiffer notes that the habitat of this species is unknown, but that a smaller bleached specimen occurs in Dr. V. d. Busch's collection, marked "from Bengal." I have recognised this species in a shell sent to me by Dr. Jerdon from the island of Elephanta, near Bombay, where it was found by Brigadier Watson. Petit de la Saussaye, Journal de Conchyliologie, 1850, marks *C. stenomphalum* with doubt as a variety of *C. Indicum*, Desh., a species which has been productive of much disagreement among conchologists, *e. g.* Pfeiffer, Philippi, Sowerby, Mousson, and Petit. Philippi figured a shell for it which Pfeiffer, Mousson, and Petit agree in considering to be *C. oculus Capri*. Pfeiffer, however, refers Deshayes' original shell to the same, but Mousson and Petit agree in considering it distinct. Sowerby figured an orange-mouthed shell from the Nilgherries, which I received from Dr. Jerdon, as *C. Indicum*, and united it with a white-mouthed shell from Ceylon which he had named, in MSS., *C. Ceylanicum*. Under this name the latter variety is described by Pfeiffer, and figured by Küster. It is worthy of remark, that Belanger's specimen, described as *C. Indicum* by Deshayes, is from the same locality as my large specimen of *C. stenomphalum*.

With reference to Dr. Von dem Busch's small bleached variety, if the specimen should appear to have been received from Capt. W. J. Boys, I should have little hesitation in assigning to it the locality of Bhamoury, at the foot of the Western Himalaya, on the road leading to Almorah, where a very similar shell was discovered by that officer in 1843, on the day following that on which I had bespoken his attention to terrestrial and fluviatile conchology at the neighbouring mountain-lake "Bhimtâl." I have not access, at present, to a specimen, so as to be able, at once, to confirm or reject the supposition.

C. funiculatum, nobis.—Sowerby in his Supplement to his Monograph has figured this species, and cited the Khasya Hills as the habitat. I have never heard of its existence in that quarter. My first specimen was obtained from Darjiling in the Sikkim Himalaya, as stated in the Journ. Asiat. Soc. Calcutta, 1838, as were also those which I subsequently sent to Mr. Cuming, and furnished to Sowerby for the purpose of being figured. Even in the adjoining country of Bhotan the species appears to give place to *C. pauperculum*, Sowerby, and direct evidence is necessary to establish its habitat in the mountain-group to the south and east of the river Burhampooter.

C. stenostoma, Sow.—Sowerby gives Arabia, without any definite locality in that extensive tract, for this species, on the authority of Mr. Powis. The Paris Museum, according to Pfeiffer, gives the habitat as Pondicherry, and the large variety figured in Küster, pl. 20. f. 18, 19, is stated to have been received by Dr. Pfeiffer from Delessert as from Cochin China. Dr. Jerdon sent it to me from woods at the top of the Nilgherries, where the small variety occurs as well as specimens equalling in size that above referred to. It can hardly inhabit such various elevations, or exist under such different hygrometric conditions as are necessarily involved in all these assigned localities.

C. Menkeanum, Philippi.—Pfeiffer has no information regarding the locality of this species. It proves to be the shell which I found abundantly near Point de Galle, and which I regarded as a variety of *C. Involvulus*. Unfortunately nearly all my specimens, including beautifully marked varieties, were abstracted, with other shells, from my baggage, on a railway, soon after my arrival in England. Petit cites Ceylon, with a note of interrogation; I am glad to be able to confirm his conjecture. I have also a specimen from a collection of shells made at Trincomalee.

I now proceed to give a geographical view of the species inhabiting Hindustan, the neighbouring mainland, and the islands in view from their shores, as far as our information extends at present.

We know of no species from Affghanistán, and the Punjáb has not as yet contributed anything to the genus. Beginning at the north-west, *C. strangulatum*, Hutton, ranges along the secondary heights of the Himalaya from the Sutlej as far as the western border of Nipál, where the observations of conchological inquirers have hitherto abruptly terminated. At one spot, near this border, a goodly-sized *Cyclophorus,* possibly the small variety of *C. stenomphalum,* Pfr., appears at Bhamoury, a few feet above the point where the Lower Himalaya springs from the forest of the Terai. Proceeding along the Himalaya, to the east of Nipal, Darjiling, in Sikkim, furnishes *C. Himalayanum*? Pfr. MSS., *Aurora, constrictum, Phænotopicum,* and *funiculatum,* nobis, and the country of Bhotán *C. pauperculum,* Sow., a species nearly allied to the last. Crossing the Burhampooter river, the hills to the south of Assám present us with *C. zebrinum, Pearsoni,* and *sarritum,* nobis, also with *Pterocyclos hispidus,* and *parvus,* Pearson.

Singular as it may appear, the whole of the extensive tract of Gangetic plains stretching from the Desert west of the Jumna to the seaboard of the Delta, in Bengal, fails to furnish a single species, except where the rocks of the mountain-ranges south of the Ganges impinge on the stream below Patna in Bahar. At these places *C. Involvulus,* Müll., and *Pterocyclos rupestris,* nobis, make their appearance, but they seem to be interrupted towards the west by the sandstone formation of the Vindhyan chain. Still further west, and north of the Nerbudda river, *C. semistriatum,* Sow., appears at Neemuch, in lat. 25° N., and extends to the south as far as Poonah, which lies south-east of Bombay. On the eastern side its place is taken, in the Northern Circars of Madras, by *C. aratum,* nobis, where according to Jerdon this species is accompanied by *Pterocyclos rupestris.*

Near Bombay again, at Elephanta, *C. Indicum,* Desh., and *C. stenomphalum,* Pfr. (the large var.) are found, the former extending to the Nilgherries, where *C. Jerdoni* and *cœloconus,* nobis, *stenostoma,* Sow., *Trochlea, ravidum, cuspidatum* and *filocinctum,* nobis, also *C. nitidum,* Sow. (on the authority of Pfeiffer and Mr. Cuming's collection), add materially to the list, while at their eastern base the singular *Pterocyclos bilabiatus,* Sowerby, occurs.

Descending southward to the rich island of Ceylon, we find *C. Menkeanum,* Phil., *Ceylanicum,* Pfr. (if distinct from the true *Indicum*), *C. annulatum,* Trosch., *halophilum,* nobis, *helicinum,* Ch., *Itieri,* Guérin (*cornu venatorium,* Ch.?), and *Hoffmeisteri,* Trosch., of which the specimens found by myself at Galle, and agreeing apparently with Troschel's short description, cannot be confounded with Küster's figure of the species previously named. To the same island belong also the magnificent *Pterocyclos Cumingi,* Pfr., recently published*, and a fine species captured by Dr. Bland at Trincomalee.

* In the 1st No. of the 'Zeitschrift' for 1851, Pfeiffer publishes a review of *Pterocyclos* as at present known, following the synonymy given in my

Taking up the thread dropped east of the Burhampooter river, and descending through the Burmese territories and the Malayan peninsula, we find at Tavoy and Tenasserim, Pulo Penang and Malacca, *C. aurantiacum*, Schum. (*pernobile*, Gould), *sectilabrum*, Gould, *Perdix*, Sow., *Cantori*, nobis, *semidecussatum* and *Tuba*, Sow.; and at Singapore, near the extremity of the peninsula, *C. aquilum*, Sow., and *rostellatum*, Pfr., Zeitschr. No. 1, 1851; in the Siamese territory, *C. Siamense*, Sow.; in Cochin China, *C. gibbum*, and *stenostoma*, with *Pterocyclos anguliferus*, Souleyet; and in Southern China, *C. punctatum*, Grateloup (*irroratum*, Sow.), rightly attributed by Sowerby to that country, whence I have received it through Dr. Cantor, but assigned by Grateloup to Ceylon. At Pulo Susson, near Penang, a very distinct species of *Pterocyclos* was taken by Dr. Bland; and on the same island Dr. Cantor procured the small pale variety of *C. nitidum*, Sowerby, a species which is very widely spread, appearing in the Nilgherries as well as in Java and the Philippine islands. *Pterocyclos biciliatus*, Mousson, of which only an imperfect specimen has been observed, belongs to Burmah.

Sowerby has referred *C. undulatum* to Bengal. I have never heard of its existence there, and I obtained a specimen at the Mauritius from Sir David Barclay, from the shore to the south of the harbour of Port Louis. *C. cinctum*, Sowerby, is also cited by that author as an East Indian shell. It has all the characters of a group from the islands of East Africa, and Petit gives Madagascar as the habitat. Sowerby and Petit are equally at variance regarding the habitat of another insular African form, *C. filosum*, Sow., who calls it a rare East Indian shell. Sir D. Barclay presented me with a specimen taken in the island of Rodriguez. *C. Belangeri*, Pfr. (*aurantiacum*, Desh.), is noted as found only in the environs of Pondicherry. The type is oceanic, and I have lately found two undoubted specimens among shells sent from the Mauritius as *C. Rangii*. May it not have been imported into the French Indian settlement, with plants, from that island?

Great diversity of opinion exists regarding the true *C. planorbulum* of Lamarck. A gigantic species which I observed last year, in the Senkenberg Museum, at Frankfurt am Main, appears to me to agree better with the figure copied in pl. 29. f. 18 of Küster, than any other form attributed to it. It is labelled

paper in the 'Annals' for 1848, except in recognising correctly *Pt. anguliferum*, Souleyet, from Cochin China as a separate species, and adding some forms since described. Nine true *Pterocycli* are admitted, only one (*C. spiracellum*, Ad. and Reeve) being doubtful, and two species of the transitionary form *Myxostoma* of Troschel. Dr. Bland's two undoubtedly distinct species would, if accessible for description, increase the number of true *Pterocycli* to eleven.

"from Sumatra" on the authority of Lafargue. A gigantic *Cyclostoma* appears as *C. oculus Capri*, from the same island, on the like authority, in the collection. Having pointed out these shells to Dr. Pfeiffer's notice, further information respecting them may eventually be obtained in the Supplement to his 'Monograph.'

Dublin, 3rd July, 1851.

P.S.—Two other species have been assigned to India, *C. Turbo*, Ch., and *C. tricarinatum*, Müll.; the former by Chemnitz, who cites Tranquebar and Coromandel as the habitat. Later observers have not confirmed this reference. Sowerby mentions Sumatra, but quotes no authority. *C. tricarinatum* is attributed by the last-named author to India. The form at once suggests an East African insular origin, and Petit de la Saussaye refers it to the Mauritius, citing however no authority in the 'Journal de Conchyliologie.' I am able to corroborate this statement. Sir David Barclay presented me with a worn and bleached specimen which he had himself picked up in the island at the Caverns of M. du Plessis, near the Petite Rivière; and he showed me another specimen, recently dead, which had just been brought to him from the woods.

Cyclostoma Michaudi, Grat. (*carinatum*, Sowerby), for which no locality is given in the 'Thesaurus,' and which Petit ascribes to Madagascar, was procured by Sir D. Barclay from the Piton de la Rivière Noire in the Mauritius. They occurred with both a white and an orange peristome. In the former variety the carinæ were more distant, as shown in Sowerby's figures; it may perhaps be found to constitute a distinct species.

Dublin, July 5, 1851.

XVII.—*Descriptive characters of two species of the Genus* Pterocyclos, *discovered by* Dr. Bland. By W. H. Benson, Esq.

[With a Plate.]

In the 5th volume of the Journal of the Asiatic Society of Calcutta, Dr. William Bland, of H.M.S. Wolf, published, in 1836, a note on two unnamed species of *Pterocyclos*, to which, on inspection of the coloured drawings forwarded to me by the Secretary, but unfortunately not engraved, I added a note on their affinities. Previously to returning them to Mr. James Prinsep, I took a pencil outline of the figures, for the purpose of reference, and from these outlines, with the assistance of Dr. Bland's note, I now endeavour, at Dr. Pfeiffer's suggestion, to affix specific characters (necessarily imperfect) to two novel forms of a rare and interesting genus, of which eleven distinct Asiatic species may now be enumerated, viz.:—

1. *Pterocyclos rupestris*, Benson, 1832, Bahár.
2. —— *hispidus*, Pearson, 1833, Khasya Hills.
3. —— *parvus*, Pearson, 1833, Khasya Hills.
4. —— *anguliferus*, Soul. 1841, Cochin China.
5. —— *bilabiatus*, Sow. 1843, South India.
6. —— *Albersi*, Pfeiffer, 1847.
7. —— *biciliatus*, Mousson, 1849, Burma.
8. —— *spiracellum*, Ad. & Reeve, 1850, Borneo.
9. —— *Cumingi*, Pfr. 1851, Ceylon.
10. —— *Blandi*, nobis, Straits of Malacca.
11. —— *Troscheli*, nobis, Ceylon.

Full descriptions of the species, and the specimens themselves, having been so long withheld from the public eye, I have overcome my objection to publish characters, founded on the only materials available, in the hope that more particular attention may be directed to these shells by travellers who may have opportunities for exploring the localities whence they were obtained.

Pterocyclos Blandi, nobis.

Testa latissime umbilicata, orbiculato-depressa, albida, strigis undatis radiatis fusco-aurantiis, fasciaque unica saturatiore ad periphæriam ornata; anfractibus $4\frac{1}{2}$ rapide accrescentibus, ultimo antice subito valde alatim dilatato; apertura obliqua, peristomate subduplici, interno incrassato, superne libero sinuato, externo superne valde expanso, ala soluta antice angulata, descendente, supra anfractum penultimum projecta, postice sinum exhibente munito; umbilico latissimo.

Diam. 1 inch. *Bland.*

Diam. major 29, minor 23 mill. ex icone.

Hab. ad Pulo Susson insulam prope Pulo Penang jacentem. Teste *Bland.*

Pterocyclos Troscheli, nobis.

Testa latissime umbilicata, orbiculato-depressa; anfractibus 4 lente accrescentibus, ultimo antice subdilatato; apertura circulari peristomate incrassato, reflexo, superne antice obsolete sinuato, ala cucullata, antice angulata, deflexa, anfractui penultimo adhærente; umbilico latissimo.

Operculo convexo, corneo.

Diam. $\frac{7}{10}$ inch. *Bland.*

Diam. major 20, minor 18 mill. ex icone.

Hab. ad Trincomalee Insulæ Ceylon. Teste *Bland.*

In character it approaches the group *Myxostoma* of Troschel, to whom I have the pleasure of dedicating this species of a genus, which, unaware of its publication five years previously, he recognised and defined under another appellation.

In order to illustrate this memoir more perfectly, I forward outline figures of the two species, a step which will doubtless meet with the approbation of the discoverer (now resident in a distant colony), who evidently intended the publication of his own original and beautiful drawings.

Dublin, July 1851.

P.S.—Dr. Pfeiffer writes, from London, that a perfect specimen of *Pterocyclos biciliatus* is to be seen in a collection there, and that the true *Cyclostoma planorbulum* of Lamarck (Encycl. Méth.) must be referred to *Pterocyclos,* as well as *C. tenuilabiatum,* lately described by Mr. Metcalfe, from Borneo. Dr. Pfeiffer has failed, equally with myself, in procuring an examination of *C. spiracellum,* Adams and Reeve, which is not to be found in any London collection.

15th August, 1851.

EXPLANATION OF PLATE V.

Fig. 1. *Pterocyclos Blandi.*
Fig. 2. —— *Troscheli**.

XVIII.—*A Catalogue of* Rotifera *found in Britain; with descriptions of five new Genera and thirty-two new Species.* By Philip Henry Gosse, A.L.S.

The following catalogue contains the species of the class Rotifera that have occurred to my observations within the last three years, for the most part in the immediate vicinity of London, and all in fresh water where not otherwise stated. I have arranged them on the system of Professor Ehrenberg; not that I think his classification natural, but because none more convenient has been published. I hope soon to be able to give to the world an arrangement of this interesting group constructed more according to the organization and the natural affinities of its members. This list of species, however, needs not be delayed until that system be perfected.

Of the species here enumerated, one hundred and eight in number, seventy-one are found in Prof. Ehrenberg's 'Die Infu-

* Figures of the following species will be found in the Nuremberg 2nd edition of Chemnitz, vol. Cyclostomacea:—

P. rupestris, pl. 24. f. 21–5.	*P. anguliferus*, pl. 24. f. 3–6.
— var. *minor*, pl. 31. f. 9–11.	— *bilabiatus*, pl. 24. f. 11–14.
— *hispidus*, pl. 24. f. 7–10.	— *Albersi*, pl. 28. f. 1–5.
— *parvus*, pl. 31. f. 12–14.	— *Cumingi*, pl. 31. f. 6–8.

sionsthierchen'; five have been described since, and thirty-two are new.

Family Ichthydina.

Chætonotus maximus.
C. squamatus (Dujardin).
C. larus.

Gen. Dasydytes. (*δασὺς, hairy,* and *δύτης, a diver.*) Eyes absent; body furnished with bristle-like hair; tail simple, truncate.

D. goniathrix. Hairs long, each hair bent with an abrupt angle: neck constricted. Length $\frac{1}{146}$th inch. Leamington.

D. antenniger. Hair short, downy; a pencil of long hairs at each angle of the posterior extremity of the body: head furnished with two club-shaped organs resembling antennæ. Length $\frac{1}{170}$th inch.

Gen. Sacculus. One eye, frontal; body destitute of hair, and without a foot: rotatory organ a simple wreath; alimentary canal very large: jaws set far forward, apparently consisting of two delicate, unequal *mallei,* and a slender *incus*; very evanescent: eggs attached behind, after deposition.

S. viridis. Body pear-shaped; flattened ventrally; the anterior end the narrower: head conical, pointed, surrounded by a wreath of long cilia: digestive canal occupying nearly the whole body, and always filled with a substance of a rich green hue, in masses. Length $\frac{1}{150}$th inch. This curious animal, found in considerable number in a little pool on Hampstead Heath, must be placed in this family according to Prof. Ehrenberg's system, but the mode of carrying its eggs indicates an affinity with the *Brachionæa.*

Family Œcistina.

Œcistes crystallinus.
Conochilus volvox (?).

Family Megalotrochæa.

Megalotrocha velata. Animals separate: disk partially enveloped in a cleft granular integument: eggs not attached to the parent after deposition. Length $\frac{1}{33}$th inch.

Family Floscularia.

Stephanoceros Eichhornii.
Limnias ceratophylli.
Melicerta ringens.
Floscularia complanata (Dobie, Ann. Nat. Hist. 1849).
F. ornata (?). The 5-lobed variety; or species?
F. cornuta (Dobie).

Family Hydatinæa.

Gen. Taphrocampa. (*τάφρος, a ditch,* and *κάμπη, a caterpillar.*) Rotatory organs wanting, body fusiform, annulose; tail forked: gizzard oval; *mallei* incurved, shorter than *incus,* which is also incurved *.

T. annulosa. Occipital mass opake, white; alimentary canal simple, wide, cylindrical: points of tail short, conical. Length $\frac{1}{110}$th inch. This species is evidently allied to M. Dujardin's *Lindia torulosa* (Hist. Nat. des Infusoires, p. 653), but differs from it in the structure of the dental apparatus, and of the digestive canal. It seems to connect the genus *Chætonotus* with the Hydatinæous genera *Notommata* and *Furcularia,* for it has the jaws of these larviform Rotifera, and the glandular occipital mass found in some of them, with the form, simple digestive canal, and manners of *Chætonotus.* It was found at Leamington.

Hydatina senta (?).

Pleurotrocha gibba.

P. truncata. Body subcylindrical; truncate behind, above the foot: toes short, straight, slender. Length $\frac{1}{175}$th inch.

Furcularia gibba.

F. cæca. Body cylindrical: eye wanting, or not discernible: toes slender, obtuse. Length, including toes, $\frac{1}{135}$th inch. Leamington.

F. forficula.

F. gracilis.

Monocerca rattus.

M. brachyura. Form that of *M. rattus,* but the foot short (one-fourth of total length), slightly curved, and horizontally flattened: a large eye in the occiput, *and another small one in the breast.* Length, including foot, $\frac{1}{135}$th inch.

M. porcellus. Body thick and plump; foot short, much curved and bent under the body, dilated, flattened horizontally, and carrying a smaller spine beneath it as in a sheath: front and chin each armed with a short sharp spine. Length, including foot, $\frac{1}{110}$th inch.

M. bicornis.

M. stylata. Body soft, irregularly oval; foot a nearly straight spine, less than one-third of total length: eye large, red, set like a wart on the back of the occipital sac: forehead conical, pointed. Length, including foot, $\frac{1}{170}$th inch.

Asplanchna Brightwellii.

A. priodonta. This genus was established by me in a paper published in the 'Ann. and Mag. of Nat. Hist.' for July 1850.

* For the use of these terms the reader is referred to a paper "On the Anatomy of *Notommata aurita,*" in the Trans. Micros. Soc. vol. iii. pt. 2.

The species named *A. Bowesii* in that paper must be cancelled, as it is identical with *A. Brightwellii.*

Notommata parasita.

N. petromyzon.

N. lacinulata.

N. collaris (?).

N. aurita.

N. gibba (?).

N. decipiens.

N. centrura.

Synchæta pectinata (?).

S. Baltica. Sea-water: mouth of the Neeze, coast of Essex.

S. tremula. Leamington.

S. oblonga (?).

S. mordax. Body conical, subventricose: toes minute: auricles large, pendent: principal styles four, the larger (or lateral) pair sometimes branched: eye rather small, brilliant: two pairs of protrusile, snapping jaws. Length $\frac{1}{72}$nd inch.

Polyarthra platyptera.

Diglena forcipata.

D. aurita (?).

D. (?) *biraphis.* Body oblong, the head and abdomen gently swelling: toes long, slender, straight, and perfectly even in thickness: eyes placed close together, frontally: jaws protrusile: alimentary canal very large, projecting behind and above the gizzard, always filled with green matter. Length, including toes, $\frac{1}{110}$th inch.

Triarthra longiseta.

T. breviseta. Body cylindrical: pectoral and caudal spines each about one-fifth of total length and very slender. Length, including foot, $\frac{1}{185}$th inch. Leamington.

Family Euchlanidota.

Monostyla cornuta.

M. quadridentata.

M. bulla. Body ovate, inflated, the back very gibbous: lorica plicated along each side with a deep furrow; the occipital and mental extremities deeply incised. Colour yellowish brown. Length of lorica $\frac{1}{175}$th inch.

Mastigocerca carinata.

Euchlanis luna.

E. triquetra (?).

E. deflexa. Body semi-oval: ventral surface of the lorica divided longitudinally, and the edges of the fissure bent out at right angles: foot furnished with two pairs of bristles; toes spindle-shaped. Lorica $\frac{1}{80}$th inch.

E. pyriformis. Outline of body (viewed dorsally) nearly oval with a slight constriction in the middle: lorica divided longitudinally along the ventral surface, the gape widening anteriorly: toes parallel-edged: eye minute. Lorica $\frac{1}{62}$nd inch.

E. hipposideros. Body nearly oval in outline; the ventral side flat; the dorsal greatly arched, and ridged down the middle: lorica formed of two distinct plates; the dorsal plate enveloping the back and reaching half down the sides; the ventral separated from it by a wide space, and hollowed in the middle so as to present the figure of a narrow horse-shoe, whose points are forwards: foot armed with one pair of bristles. Lorica $\frac{1}{110}$th inch.

Salpina spinigera.

S. mucronata.

S. brevispina.

Gen. Diplax. Resembles *Salpina*, but the eye is wanting; and the lorica (which, as in that genus, is cleft down the back) is destitute of spines both in front and rear: foot and toes long and slender. It forms a connecting link between *Salpina* and *Dinocharis*. The name (δίπλαξ, *double*) alludes to the gaping lorica, which forms two parallel plates.

D. compressa. Form of lorica (viewed laterally) nearly a parallelogram, greatly compressed. Lorica $\frac{1}{176}$th inch. Leamington.

D. trigona. Lorica three-sided, a section forming a nearly equilateral triangle; surface delicately punctured or stippled: toes long and slender. Lorica $\frac{1}{160}$th inch. Leamington.

Dinocharis tetractis.

D. pocillum.

Colurus bicuspidatus.

C. deflexus.

C. caudatus.

Metopidia lepadella.

M. solidus. Much resembles *M. lepadella*, but is considerably larger: lorica nearly circular, brilliantly transparent: a slight puncturing runs round near the edge, like the legend on a coin. Lorica $\frac{1}{150}$th inch.

M. acuminata.

M. triptera.

M. oxysternon. Resembles *M. triptera*, but the dorsal keel is much higher and thinner; the anterior two-thirds of the ventral surface form a prominent ridge terminating abruptly like the breast-bone of a bird; and the posterior portion is hollowed out remarkably. Viewed laterally the outline of the back is very gibbous behind. Lorica $\frac{1}{175}$th inch.

Stephanops lamellaris.

S. muticus.

Family PHILODINÆA.

Callidina bidens. Body spindle-shaped: jaws furnished with two distinct teeth. Length $\frac{1}{45}$th inch. Perhaps this is no other than Prof. Ehrenberg's *C. elegans,* of which he describes the jaws as having many delicate teeth. I have, however, examined numerous specimens, and have always found them distinctly two-toothed.

Rotifer vulgaris.

R. citrinus.

R. macrurus.

R. macroceros. Wheels large; antennal process (the "respiratory tube" of Prof. Ehrenberg) very long and mobile. Length $\frac{1}{100}$th inch.

Philodina roseola.

P. citrina.

P. aculeata.

P. megalotrocha.

Family BRACHIONÆA.

Noteus quadricornis.

Anuræa curvicornis.

A. fissa. Lorica smooth, hyaline, swollen at the sides and at the back; flattish on the belly; truncate in front, without any spines, attenuated and truncate posteriorly. There is a deep fold running down each side, or else the ventral plate is distinct from the dorsal; the ventral is also cleft through its medial line. Eye very large, pale. Length $\frac{1}{220}$th inch.

A. tecta. Nearly agrees in form with *A. curvicornis,* but the posterior extremity is rather more pointed, and the tessellations are different; being larger and arranged on each side of a mesial dorsal ridge, which gives to the back the form of a vaulted roof. Length $\frac{1}{200}$th inch.

A. acuminata.

A. aculeata.

A. brevispina. Nearly agrees with *A. aculeata,* but the posterior spines are very short; the frontal spines are much less curved forwards; the surface is not punctated; and it is colourless. Length $\frac{1}{146}$th inch.

A. cochlearis. Lorica spoon-shaped; with six spines in front; the medial pair curving strongly forwards: posterior extremity attenuated into a long slender spine, inclined forwards: back ridged and tessellated as in *A. tecta.*

A. serrulata.

Brachionus pala.

B. oön. Lorica ovate, the back swelling with an uniform curve, by which it is distinguished from *B. pala,* which is truncate or slightly cavate posteriorly: anterior spines four, straight, wide at the base and pointed; the occipital pair taller than the lateral. Lorica $\frac{1}{125}$th inch.

B. dorcas. Lorica ovate, or subconical; occipital edge with four long slender spines, the middle pair curving forwards, and bent first from, and then towards, each other, like the horns of an antelope; mental edge undulated, with a notch in the centre. Lorica $\frac{1}{60}$th inch.

B. amphiceros.

B. urceolaris (?).

B. rubens.

B. Mülleri. Kenilworth Castle.

B. hepatotomus. Lorica ovate; occipital edge cut into six saw-like teeth much shallower than in *B. Mülleri,* with the central notch deeper and rounder than the rest; mental edge with four rounded lobes separated by notches: posterior extremity with two nipple-like points: biliary (or pancreatic) glands very large and cleft into two lobes almost to their base. Hence the name, *ἧπαρ, the liver,* and *τέμνω, to cut.* Lorica $\frac{1}{103}$rd inch. Sea-water; mouth of the Neeze, Essex.

B. Bakeri.

B. angularis. Lorica hexagonal-oval in a dorsal aspect; occipital edge with two small teeth divided by a rounded notch (in some specimens there are obsolescent traces of a lateral pair); mental edge slightly undulated, sometimes with two low points divided by a notch, like the occiput, but still more faintly: posterior extremity with two short, blunt, well-marked processes. The general surface is roughened with angular ridges, and is sometimes subopake and brown. Lorica $\frac{1}{200}$th inch. This curious species has relations with *Noteus* and with *Pterodina.*

Pterodina patina.

P. elliptica.

P. clypeata. Sea-water; mouth of the Neeze, Essex.

Gen. Pompholyx. Two frontal eyes: foot wanting: rotatory organ double in the rear, entire in front: eggs attached behind, after deposition. The name alludes to the resemblance of the lorica to a round flat smelling-bottle.

P. complanata. Lorica much depressed, nearly circular, with the lateral edges rounded; anteriorly truncate; occipital edge gradually rising to a central blunt point; mental edge with two rounded lobes, divided by a central notch. Lorica $\frac{1}{300}$th inch.

De Beauvoir Square, July 28th, 1851.

XIX.—*Remarks on* Dickieia. By John Ralfs, Esq.*

Dickieia, *Berk. & Ralfs.*

Frond subgelatinous, tender, plane, containing oblong scattered frustules.

In this genus the frond is so extremely tender that dried specimens are destroyed in the act of removing them from the paper, their gelatinous matrix being apparently dissolved by the application of moisture. The frond tapers at the base and expands upwards into a lanceolate or obovate form. I could detect neither striæ nor puncta in the frustules, which in the front view are nearly quadrate, and are rarely twice as long as broad; in the lateral view they are narrow-linear with rounded ends; as they do not appear to be siliceous, it is probable that dried specimens (the only ones I have examined) become, in that view, somewhat narrower than they are when recent,—a fact which I have noticed in some genera of this order, whose frustules cannot without injury be submitted to the action of nitric acid.

Dickieia differs from *Schizonema* by its flat fronds and scattered frustules.

Dickieia Dansii (Thwaites) does not belong to this genus, since its gelatinous matrix forms an irregular mass and not a plane frond. Its frustules also differ, being decidedly siliceous, striated, and having a longitudinal pellucid line and central punctum (aperture, Kützing) in the lateral view.

1. *D. ulvoides* (Berk. and Ralfs). Frond undivided, obtuse at the apex. *Dickieia ulvoides*, Berk and Ralfs, Annals of Nat. Hist. vol. xiv. p. 328. t. 9; Kützing, Die Kieselschaligen Bacillarien, p. 119; Species Algarum, p. 109.

Rocky shore, Aberdeen, April, *Professor Dickie.*

2. *D. pinnata* (——). Frond sparingly pinnate, all the divisions lanceolate.

Small shallow marine pools, especially on detached masses of rock; Torquay, September, *J. R.*

Fronds olive-brown, becoming greener when dried, 1 to 2 inches high, lanceolate, irregularly pinnated; the pinnæ lanceolate and alternate. The margins, both of the primary portion and of the divisions, are uneven and minutely laciniated. The frustules are like those of the preceding species.

In 1836 I observed this plant growing plentifully near Torquay, since which time I have had no opportunity of searching for it. In the recent state it has, to the naked eye, much the appearance of a minute species of *Dictyota*; but it is so exceed-

* Read before the Botanical Society of Edinburgh, May 16, 1850.

ingly tender, that it is difficult to carry it home in a condition fit for preservation. It differs from *Dickieia ulvoides* in its darker colour, divided frond, and more tapering extremities; besides, it is an autumnal and the other a vernal species.

Plate V. fig. 6. Frond of *Dickieia pinnata,* natural size.

Note on Spirulina.

Professor Kützing has described and figured eleven species of this genus, but the specific differences which he relies on do not seem to me satisfactory. They are chiefly the colour of the stratum and comparative closeness and diameters of the spires or coils. But the colours I have found to vary much, according to the age of the stratum, its greater or less exposure to light, and the state of the weather. In all the specimens whose growth I have watched, the spires were at first very dense, but became laxer after a short time; and in a specimen of *Spirulina tenuissima* sent me from Bristol by Mr. Thwaites, the spires were relaxed at the extremities of many of the filaments, though at the middle they remained compact. In *Spirulina* the diameters of the filaments increase considerably as they advance towards maturity, but this increase has its limits, and an acquaintance with all the species is necessary to enable the observer to determine what value he should assign to this character as a specific distinction.

Plate V. fig. 5. Filament of *Spirulina tenuissima,* having laxer spires at its extremities.

XX.—*A few Remarks upon the Crag of Suffolk.* By W. B. Clarke, M.D., of Ipswich.

In the 'Philosophical Magazine' for August 1835 Mr. Edward Charlesworth published some papers upon the Crag of Suffolk and Norfolk, in which he divided the formation into three successive deposits. The oldest, from the abundance of zoophytes contained within it, he termed the *Coralline Crag.* The second, from the peculiar red or ochreous colour which pervades it, produced by the presence of hydrous oxide of iron, he termed the *Red Crag,* which is characterized by the dying-out or absence of a great proportion of zoophytes and the introduction of new groups of testacea. The third, from its containing many fossil remains of mammalian animals, he termed the *Mammaliferous Crag.*

The representatives of these groups may be seen as follows:—

Miocene Group.

Coralline Crag of England: Loire and Gironde in France; containing 17 per cent. of recent species.

Pliocene Group.

Red Crag of England: Subapennine Hills; containing from 35 to 50 per cent. of recent species.

Pleistocene Group.

Mammaliferous Crag of England: Sicilian deposits; containing from 90 to 95 per cent. of recent species.

Since the publication of these characteristics of the Crag, extensive excavations have been made within it in several localities between the rivers Orwell and Deben, and on the banks of the latter, in which many interesting discoveries have been made in the organic remains of the deposit.

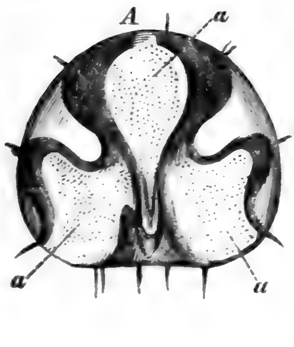
The above-mentioned excavations have shown that above the London clay and beneath the Red Crag, extending over certain spaces, a bed is found varying in thickness from 3 or 4 inches to about a foot and a half, consisting of fragments of bone, usually of flattened form, with their ends and edges rounded by attrition, interspersed amongst numerous irregularly-formed, more or less rounded nodules, which appear to be indurated clay: some of these latter exhibit an irregular cleavage in angular fragments, the inner surfaces of which show the presence and infiltration of phosphates and carbonates of iron. Amongst these are found others exhibiting a concentric structure, exposing and disintegrating the contiguous layers of which the nodule consists. Some of these appear to owe their origin to a nucleus of organic matter, as a vertebra, a tooth, a shell, a small branch of wood, or some other substance around which the argillaceous layers have accumulated. Others exhibit a minute structure corresponding in character with the usual appearance of septaria from the London clay, having the interstices of the clay filled with carbonate of lime frequently tinged by phosphate of iron. These nodules not only abound in the stratum beneath the Red Crag, but are also dispersed in various directions throughout the general mass without any disposition to stratification, showing they have been deposited promiscuously during the whole of the Red Crag period, or whilst that deposit was being formed.

Again, we find arenaceous clay nodules that have been rounded by attrition into forms more or less spherical, upon breaking which a shell, frequently a bivalve, is found in the interior, having served as a nucleus around which the argillaceous substance has consolidated: in some instances the shell itself is found; in others nothing but the cast of it remains. It is not unlikely that the presence of the shell and its molluscous inhabitant involving certain chemical changes within the mass of clay may have given rise to the consolidation of the surrounding mass, so as to have prevented disintegration at the time of its removal from its former bed and the act of rolling previous to its subsequent deposit in the Crag.

Many of the nodules found in the Crag appear to have originated in causes similar to those in operation at the present day, where masses of cliff have fallen and broken into fragments of various sizes; these subsequently, having been rolled along the beach and amongst each other by the action of the waves, have been rounded into the forms they now assume. Clay nodules of similar shape, but in a soft state, are frequent upon the Suffolk and Essex beaches, where the clay cliffs are disintegrating at the present day by the inroads of the sea.

Fragments of clay bored by Pholades, and wood by Teredines, are found in this Crag deposit.

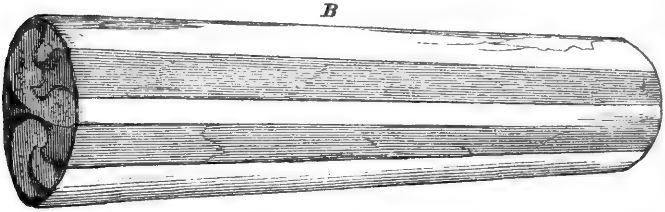
Within this formation have been discovered an interesting collection of remains of several species of mammalian and other animals, consisting of flat portions of bones, apparently ribs of large quadrupeds, which subsequently to their fracture have been rounded by attrition at their ends and edges; with these are found various other bones and teeth of Elephants, Mastodon and Rhinoceros, teeth of Bears, and fragments of the extremities of small quadrupeds, but which are often so much disfigured by fracture and subsequent rolling that it is difficult to identify and associate them with living forms. The antlers of several species of Deer, some of large size, nearly allied to, if not identical with, the Megaceros or "Giant Elk of Ireland:" the tympanic or auditory bones, teeth, and other parts of several species of Whale and Cachalot, amongst which may be mentioned a fragment of considerable interest of the anterior part of the head or nose of a long-nosed Cetacean allied to Macrorhinus, which has been examined by Prof. Owen with much interest. The accompanying figure is a representation of it.



A. Transverse section of nose of a long-nosed Cetacean from the Red Crag of Suffolk.

The figure is of the nat. size: *a*, *a*, *a*, is matrix, an arenaceous mass which has been washed into the interior.

B



B. Longitudinal view of the same fossil, half the natural size.

All these fossils are in a highly mineralized state, apparently produced by the ferruginous particles contained within the Crag, in conjunction with certain peculiar conditions of the fossil itself.

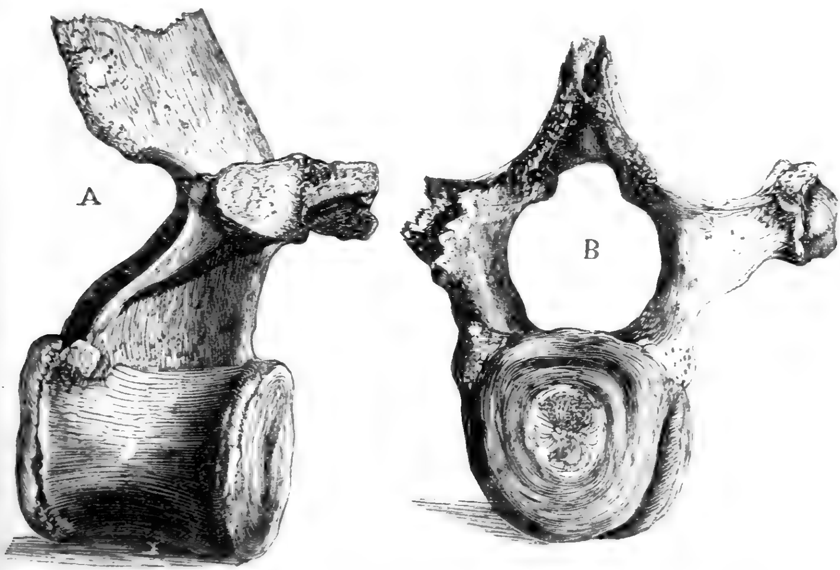
With the above are also found teeth and vertebræ of several species of fish allied to Sharks, some extremely large, as the *Carcharodon megalodon*: the spines, tubercles, and teeth of Rays, some of which are completely mineralized, and others not, but partaking of the condition of the generality of fossils of the Crag epoch: amongst these are found specimens of fish derived from the London clay, surrounded more or less by their argillaceous matrix. In the same condition are found short- and long-tailed (Brachyurous and Macrurous) crustaceans all highly mineralized, the greatest amount of which occur beneath the general Crag deposit; but in various parts throughout the Red Crag formation are found the claws of Crabs in the usual condition of the Crag fossils, without any appearance of mineralization, but in an extremely friable state from their having lost their animal matter: with these are associated spines of Echini and flints from the Chalk.

As the mammalian remains contain a large proportion of phosphate of lime, considerable interest has been attached to them of late: the Crag has been laid open, carefully overlooked, and these remains collected and preserved for agricultural purposes after having been ground to powder and converted into superphosphates by digestion in sulphuric acid. The argillaceous nodules when thus ground are said to be used in large quantities in the adulteration of guano and bone-dust, and thus applied by the agriculturist.

At intervals are found beds of ferruginous clay nodules, which upon being broken present a highly mineralized crust or exterior, containing a pulverulent ochreous substance; these are usually of a flattened form, and lie parallel with the plane of stratification. The mineralization of these nodules probably continues to the present time through the agency of ferruginous matter involved in the Crag.

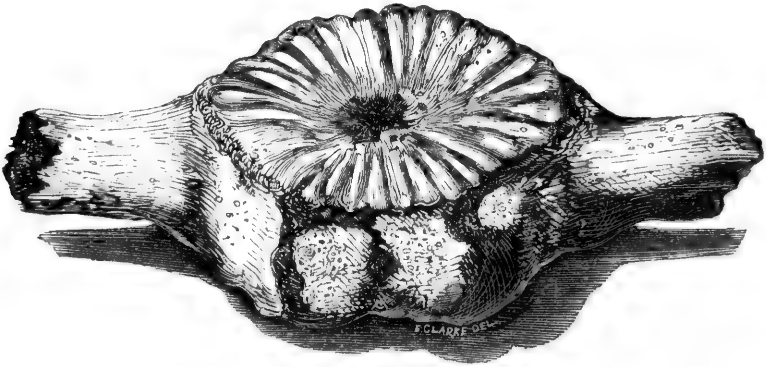
This appears evident in the process now in operation, resulting in the formation of columnar concretions upon the face of the Crag, through the chemical and mechanical agency of water as it trickles down the vertical surface, carrying with it small portions of sand and comminuted shells, which it deposits generally in a stalactitic form, the ferruginous particles held in solution in the water cementing the mass firmly together: these abound in some localities in which the Crag is exposed, and have been regarded by the uninitiated as fossil antlers, and have been gravely collected and treasured as such. These substances vary in diameter from 2 inches to the eighth of an inch, and are variously contorted or branched.

Within a short time a fragment of a jaw, apparently of a large Cetacean nearly equal in size to the Greenland Whale, has been discovered in the Coralline Crag, and the remains of other species of the same tribe of creatures have been found in the same deposit. The accompanying xylographs represent two of these fossils.



A. lateral view, and B. posterior view of a dorsal vertebra of a Cetacean from the Coralline Crag of Suffolk.

A and B are two figures of a dorsal vertebra of a Cetacean, allied to the Grampus, discovered in the Coralline Crag at Orford in Suffolk: the specimen is in fine condition, but a portion of the spinous process and part of one of the transverse processes were injured in the act of removing it from the deposit in which it was found.



C.

Caudal vertebra of a Cetacean from the Coralline Crag of Suffolk.

C represents the body and transverse processes of a caudal vertebra of a Cetacean, also found in the Coralline Crag of Suffolk.

In addition to the above-mentioned organic remains are the numerous interesting and beautiful species of Testacea which abound in the several divisions of the Crag deposit, and which are now so much sought after as objects of great interest to geologists and the "general collectors" of the neighbourhood, and which are so ably described and figured by Messrs. S. V. Wood and Sowerby in the works recently published by the Palæontographical Society.

In reference to the various fossils discovered in the Crag, and which are derived from other formations, it will be remembered that by the action of the sea and other causes, deposits previously formed are broken up and large quantities of such material are transported, in some instances to very great distances, examples of which are observed everywhere around us in the 'gravel' or 'till': and there are accumulations forming in the German Ocean at the present time, from the 'debris' of various parts of the shores of England, Scotland and the continent, which are being driven together by the continuous agency of currents, and thus, for instance, are carried into the same deposit, the chalk of Kent; the London clay, crag and upper tertiary of Essex; clay, crag and chalk of the Suffolk and Norfolk coasts; chalk, oolite and lias of Yorkshire; magnesian limestone of Durham; sandstone and coal of Northumberland; together with the trap and plutonic rocks of Scotland; all of which are associated with the tertiary and other deposits from the continent, and with the remains of recent species that inhabit these coasts, in conjunction with parts of recent land and freshwater animals and plants which are carried amongst them by the currents of various rivers that are discharging their contents into these seas: disintegration is continually occurring, and masses of 'rocks,' with or without their organic contents, are annually being swept into the sea and deposited at various depths beneath its surface, frequently burying hosts of living forms amongst them.

Berners Street, Ipswich, August 16, 1851.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 11, 1850.—W. Spence, Esq., F.R.S., in the Chair.

SYNOPSIS OF THE SPECIES OF ANTELOPES AND STREPSICERES, WITH DESCRIPTIONS OF SOME NEW SPECIES. BY J. E. GRAY, ESQ., F.R.S., P.B.S. ETC.

[Concluded from p. 146.]

2. The CERVINE ANTELOPES have an elongated tail, cylindrical at the base, and with long hair at the end, often forming a compressed ridge; the body heavy and the limbs strong. They are of a large size.

A. *Neck not maned.*

18. ADENOTA.

Muffle cordate, moderate, cervine; nose hairy between the back of the nostrils; horns sublyrate, ringed, when young rather recurved; place of tear-bag covered with a tuft of hair; hair of the back whorled, of dorsal line and back of head reversed; tail elongate, hairy.

This genus is very like *Eleotragus*, but has a smaller, more cervine muzzle and lyrated horns; it differs from *Cobus* in the form of the tail, and wanting the mane, and from both in having a tuft of hair in the front of the orbit.

* *Horns sublyrate; tail hairy.*

1. ADENOTA KOB. The ÆQUITOON.

Pale brown; end of nose, inside of ears, chest, belly, inside of legs and thighs, tip of tail, and band above hoofs white; front of fore and hind legs, and end of ears and tail black; hair of the dorsal line reversed, with a whorl on the shoulders and loins.

Antilope Kob, Erxl. from *Kob*, Buffon, H. N. xii. t. 32. f. 1?—*Kobus Adansonii*, A. Smith, from Buffon.—*Gambian Antelope*, Penn. Syn. 39, from Buffon.—*A. adenota*, H. Smith, G. A. K. iv. 224. t. 184. and t. 183. f. 3, 4. horns?

A. Kob, Ogilby, P.Z.S. 1836.—*A. annulipes*, Gray, Ann. and Mag. Nat. Hist. 1843.—*Adenota Kob*, Gray, Knows. Menag. 14. t. 14, 15.

Var. Female, hair longer, sides of face whitish.

A. sing-sing, Gray, Cat. Mamm. Brit. Mus. 159, not Bennett.

Inhabits W. Africa; Gambia. Called *Æquitoon* by the Joliffs, and *Kob* by the Mandingoes.

A fine pair has been at Knowsley some years. Thinking them new, I described them as *A. annulipes*. Mr. Ogilby has called it the *Nagor*, but it is scarcely the *Nagor* of Buffon. An adult male noticed by Mr. Ogilby as the *Kob* is now in the Museum of the Zoological Society; its horns, like the male at Knowsley, are much worn down. They whistle like a stag.

Buffon (H. N. xii. 219. 267. t. 32. f. 1) figures a skull with horns, brought from Senegal by Adanson, under the name of *Kob*, which is also called the *Petit vache brune*. Erxleben gave this figure the name of *A. kob*, and Pennant called it the *Gambian Antelope*, Syn. i. 39. The figures somewhat resemble the head of a half-grown male of this species, but the horns are longer, and have more rings than the specimen in the British Museum; but I am inclined to agree with Mr. Ogilby in believing that it was intended for this species. In the Jardin des Plantes they called the Sing-Sing the *Kob* of Senegal; this may be a mistake for the *Koba*. I may remark that the horns of the *Koba* in the same plate of Buffon are represented with more rings than are mentioned in the description.

Colonel Hamilton Smith describes and figures a male and female specimen which were alive in Exeter Change, and figures the male and its skull and horns under the name of *A. adenota*, which well agrees with this species, and has the peculiar distribution of its hair; hence its name: but he says, it has "a long open suborbital slit, and small black brushes on the knees;" this I suspect must be a mistake, as he himself observes no lachrymal cavity was found in the skull. He might have mistaken the tuft of hair for the gland at the distance at which he saw the specimens. He also (G. A. K. iv. 221) described a specimen which was in Exeter Change, which he regarded as the *Gambian Antelope* of Pennant, and calls *A. forfex*. His characters agree in most particulars with this species, but he says it had "a long lachrymal sinus, and had small brushes on the knees." If there was not some mistake in transcribing these descriptions, both these animals should be *Gazellas*, but I have never seen any which agreed with them.

The young male in the British Museum shows the development of the horns of these animals. The upper rings of the growing horn fall off in large thick flakes as the horn increases in size beneath: this explains how the extent of the smooth tapering part of the horns increases in length as the horn grows, and how the number of rings are found to be nearly the same in the various ages, and different individuals of the various species. Mr. Whitfield informs me that the scrotum is rarely developed or dependent externally in different kinds of Antelopes before they have completed their first year.

** *Horns elongate, recurved at the tip; tail slender, end tufted.*

2. Adenota Lechè. The Lechè.

Pale brown; orbits, chest and beneath white; front of legs dark brown; fur short, adpressed, upper part of nape and withers with a small whorl of hair; tail slender at the base.

Léchee, Oswell, Journ. Roy. Geog. Soc. xx. 150, 1850.—*Kobus Lechè*, Gray, Knowsley Menag. 23.

Inhabits S. Africa; bank of river Zouga, lat. 22° S. (*Capt. Frank Vardon*). *Oswell*, l. c. 150, Brit. Mus.

This animal is nearly as large as the *Water Buck*. The horns are very like those of that animal; the neck is covered with short adpressed hair, and has no appearance of a mane.

B. *Neck maned on the sides.*

19. KOBUS, H. Smith; *Cervicapra*, § Sundev.; *Ægocerus*, Harris; *Kolus*, Gesner, Gray.

Horns elongate, sublyrate, bent back and then forward at the top; muzzle cervine; tear-bag none; inguinal pores none; hair rough, elongate; neck covered with longer, diverging and drooping hair; tail rather elongated, depressed, hairy on the sides and below: females hornless; teats four; animal very large.

1. KOBUS ELLIPSIPRYMNUS. The PHOTOMOK or WATERBUCK.

Rump with a whitish elliptical ring near the base of the tail, brownish; horns converging at the tip.

Antilope Ellipsiprymna, Ogilby, P. Z. S. 1833, 47; Harris, W. A. Africa, t. 14.—*Kobus Ellipsiprymnus*, A. Smith, Illus. Z. S. A. t. 28, 29.—Gray, Knows. Menag. 15.

Inhabits S. Africa. Brit. Mus.

The horns figured as *A. Kemas*? (H. Smith, G. A. K. t. 181. f. 6) appear to belong to this species.

2. KOBUS SING-SING. The SING-SING.

Anal ring none. Reddish or yellowish grey brown, rather greyer on the shoulders; nose, lips and hinder part of the thighs, under the neck, from the ears to the gullet, a streak over each eye, and ring above the hoofs and false hoofs white; belly and legs blacker; end of tail, and legs from shoulder to hough black. Female greyer; belly and upper part of legs paler.

Antilope Sing-Sing, Bennett, Waterhouse, Cat. Zool. Soc. Mus. 41. n. 378.—*A. defassa*, Rüppell, Abyss. t. 3.—*A. unctuosa*, Laur., D'Orbig. Dict. Univ. H. N. i. t. 622. ♂. good. —*A. Koba*, Ogilby, Penny Cyclop. ii. 79. fig. ♀; P. Z. S. 1836, not Erxleben.—*Koba*, Buffon, H. N. xii. 210, 267. t. 32. f. 2, horns?—*Senegal Antelope*, Pennant, Syn. 38 (part from Buffon only).—*Kobus Sing-Sing*, Gray, Knows. Menag. 15.

Inhabits N. and W. Africa; Senegal; Gambia, where it is called *Kassimause* and *Kob* (*Whitfield*). Brit. Mus. Abyssinia (*Rüppell*). Mus. Frankfort.

This species varies much in the tint of the colouring, and in the length of the hair in the different seasons. In summer they are covered with very short, closely pressed fur, letting the skin be seen between the hairs. In the cold weather, and in England, the fur is longer and more abundant. The hair of the chin and neck is long and rigid in all seasons, and even in the young animals. The tail of the adult specimen is cylindrical and nearly bald, ending in a tuft of black hair; in the young specimens, especially in the winter fur, the base of the tail is fringed with hair on each side. The male is much brighter coloured, and the chest and belly are nearly black like the legs. The hinder parts of the rump of the young animals are greyish white; in the older specimens it becomes pure white and broader in extent.

This animal is called *Sing-Sing* by all the negroes. They do not think their flocks of cattle will be healthy or fruitful unless they have one of the Sing-Sings accompanying them, as some persons think a Goat necessary to be in a stable in England. The English on the Gambia call it the *Jackass Deer* from its appearance, and it is called *Koba* and *Kassimause* by the negroes at Macarthy's Island. Its flesh is very strong, unpleasant, and scarcely palatable.

As far as I could judge by my recollection and description, the adult specimen at Knowsley, the young male and adult female in the British Museum, the male and female at Frankfort, and the adult male in the Paris menageries, are the same species.

Buffon figured (Hist. Nat. 210, 267. xii. t. 32. f. 2) under the name of *Koba* a pair of horns which were in the library of St. Victor at Paris. He described them as larger and more curved above than those of the *Kob*, eighteen inches long and five inches in circumference at the base, and he refers them to an animal which Adanson says is called *Koba* in Senegal, and the *Great Brown Cow* by the French colonists. Pallas refers these horns to *A. Pygargus*, and the figures and description agree in many particulars with the horns of that species; but they are rather longer, and have more rings. Pennant (Syn. Mam. 38) has given the name of *Senegal Antelope* to Buffon's short account and figure, but has added to it the description and the figure of the head of a skin which came from Amsterdam, and appears to be *A. Caama* of South Africa. Cuvier (Dict. Sci. Nat. ii. 235) has translated Pennant's name to *A. Senegalensis*. Erxleben (Syn. 293) and Zimmerman (Zool. 345) have translated Pennant's description of his skin of *A. Caama*, and called it *A. Koba*, referring to Buffon's description and Daubenton's figure. Fischer, Hamilton Smith and M. Sundevall regard the *Koba* of Buffon the same as the *Korrigum* of Denham and Clapperton, but the horns of that species are considerably longer and much thicker at the base than those described by Daubenton, and the annulations of the horns are higher and more regular: it may however be remarked that Buffon describes his horns as having eleven or twelve rings, but figures them as having seventeen or eighteen. Mr. Ogilby (Penny Cyclopædia and the Proceedings of the Zoological Society) considers Buffon's *Koba* to be the *Sing-Sing*; and in the length of the horns, and in the number, disposition and form of the rings, his figure more nearly agrees with the horns of that species than of that of the *A. Pygarga*, to which Pallas first referred it; but the horns are represented much more lyrated than any horns of the *Sing-Sing* I have seen; indeed, not one of the specimens which have come under my observation have had any inclination to assume that form: but as this is the only Western-African species which in any way agrees with Buffon's figure, perhaps it is best to adopt Mr. Ogilby's suggestion. The name of *Koba* or *Kob* appears to be common to many species. Schinz erroneously considers *Damalis Senegalensis, Antilope adenota* and *A. forfex* (H. Smith) as synonyms of this species.

c. *Nape with a linear, central, compressed, recurved mane.*

20. AIGOCERUS, H. Smith; *Egocerus,* Desm.; *Hippotragus,* Sundev.

Horns conical, elongate, rather compressed, ringed, recurved; back of the neck with a linear reversed mane; tear-gland covered with a tuft of hair; teats two.

1. AIGOCERUS EQUINUS. The ETAAK or EQUINE ANTELOPE.

Spot above the eyes and pencil before the eyes fulvous grey; nose whitish; face black; nuchal mane distinct.

Aigoceros Equina, H. Smith; Harris, W. A. A. t. 21.—*A. glauca,* Forster.—*A. Osanne,* Geoff.—*A. barbata,* H. Smith.—*A. Truteri,* Fischer.—*A. aurita,* Burch. MSS.—*Capra Æthiopica,* Schinz.—*Tzeiran,* Buffon, H. N. xii. t. 31. f. 6, horn.—*Aigocerus Equinus* and *A. leucophæus,* Gray, Knows. Men. 16.

Inhabits S. Africa. Brit. Mus. W. Africa; Gambia (*Whitfield*). Horns. Brit. Mus.

Var.? Smaller. "Fur glaucous grey; tuft before the eye short, brown; nuchal crest none; hoofs small."—*Sunderall.*

Antilope leucophæus, Pallas; H. Smith, G. A. K. v. t. 179.—*Aigocerus leucophæus,* Gray, Knows. Menag. 16.

Inhabits the Cape of Good Hope; now extinct. Mus. Stockholm, Mus. Upsal and Mus. Paris.

The head of the female covered with the skin from Macarthy's Island, on the coast of Gambia, which Mr. Whitfield brought home, did not appear to differ from the specimen from the Cape in the British Museum. The species does not appear to be uncommon in the locality, for Mr. Whitfield brought over several pairs of horns. He states the flesh is very good venison. "It is called *Dacoi* or *White Mouth* by the Mandingoes, *Kob* and *Koba* by the Joliffs, and *Vache brune* by the French at Senegal." This is certainly not the *Kob* of Buffon (xii. t. 32. f. 1, 2). The negroes at the Gambia declare that this animal never bears more than one fawn; for after that period, the horns increase in length, and enter the loins and destroy the animals!

Buffon (xii. 271. t. 31. f. 6) figures the horn of this species, which had been made into a powder-flask, under the name of *Tzeiran.*

A. barbata of Daniels appears to be only a bad drawing of this species.

The variety is the size of the Common Stag, *Cervus Elaphus.* M. Sundevall observes that it is as different from *A. Equina,* as the species of *Eleotragi* and *Tragelaphi* are from one another; and he observes, in a letter I have just received, "I must tell you, that after the inspection of a whole series of *A. Equina,* which Wahlberg brought home, I am convinced that the *A. leucophæa* of Pallas is a very distinct race. Our stuffed specimen, that must have been adult, has much smaller hoofs than the very young *A. Equina,* male as well as female, amongst Wahlberg's, and in the tuft over the lachrymal sinus, as I have shortly expressed in the printed survey."

When I examined the specimen at Paris I regarded it as a young or rather dwarf specimen of *A. Equina,* and the absence of the nuchal crest led to this belief; and I am not satisfied that the number of rings on the horns are a sufficient proof of its being adult.

2. AIGOCERUS NIGER. The BLACK BOK.

Black; female and young brown; face white, with a dark streak.

Antilope niger and *A. Harrisii,* Harris, Wild African Anim. t. 23.—*Aigocerus niger,* Gray, Knows. Menag. 17.

Inhabits S. Africa. Brit. Mus. Males and female and young.

21. ORYX, Blainv., H. Smith.

Horns elongate, subulate, ringed at the base, straight, or slightly arched, placed in a line with the face; neck maned above and below; tear-bag none; nose subcervine, with a marginal muffle; hoofs narrowed in front, false hoofs large; teats four (two, *Harris*). In the skull there is a slight suborbital fissure, but no pit, and the grinders have supplementary lobes.

* *Horns straight.*

1. ORYX GAZELLA. The KOOKAAM or GEMSBOC.

Horns straight, shelving backwards; throat with a bunch of black hairs; black streak on the face, conjoined under the chin; rump, face, spinal line, lateral streak, and very broad band on the thigh and cubitus black in summer. Young pale brown; hairs blackish at the base.

Capra Gazella, Linn.—*Antilope Oryx,* Pallas; H. Smith.—*A. bezoartica,* Pallas.—*A. recticornis,* Erxl.; Pallas, Nov. Comm. Petrop. xiii. t. 10. f. 6.—*Oryx Capensis,* Ogilby; Harris, W. A. A. t. 9.—*O. Gazella,* Gray, Knows. Menag. 17. t. 16. f. 2, young.

Inhabits S. Africa; Cape of Good Hope. Brit. Mus. Adult and young.

2. ORYX BEISA. The BËISA.

Horns straight; throat without any bunch of hairs; black face-streaks separate. "Pale; face, belly and limbs white; front of face, two streaks on cheek, narrow line along throat, dorsal streak, streak on each side of abdomen, band round upper part, and streak in front of lower part of fore-leg and end of tail black."

Antilope Beisa, Rüppell, Atlas, t. 5.—*Oryx Beisa,* Sundevall.—*A. Dammah,* Rüppell.

Inhabits Abyssinia. Mus. Frankfort.

There is a male and female in the Frankfort Museum; they are smaller than *A. Gazella* of the Cape, and both have the face-streaks separate: there is a black streak on the throat, as in *A. Gazella,* but no bunch, nor is there any in the Frankfort specimen of *A. Gazella*: the mane of the nape of the male is small, indistinct, continued behind in a broader dark streak to the middle of the loins. In the male the mane is blackish, in the female like the back. They have no dark mark on the rump, found in *A. Gazella.*

** *Horns arched, recurved.*

3. ORYX LEUCORYX. The ORYX.

Horns slender, slightly arched: white, reddish varied; in winter greyish.

Antilope leucoryx, Pallas; Ehrenb. S. P. t. 3; Licht. Saugth. t. 1. —*A. ensicornis,* Ehrenb.—*A. Algazella,* Rüpp. t. .—*A. Gazella,* Pallas.—*A. bezoartica,* Erxl.; H. Smith.—*Algazelle,* F. Cuv. Mam. Lith. t. .—*A. Eleotragus,* Schreb. t. . (not descrip.)—*Oryx leucoryx,* Gray, Knows. Menag. 17. t. 16. f. 1, young; t. 17, adult.

Inhabits N. and W. Africa; Nubia; Sennaar; Senegal. Brit. Mus. I have compared the Nubian and Senegal specimens, and cannot discover any difference between them.

D. *Throat slightly maned, neck simple.*

22. ADDAX; *Oryx,* part Blainv. and others; *Gazella,* part H. Smith.

Horns slender, elongate, ringed, slightly spirally twisted, nearly on a line with the face; neck with a slight gular, but no nuchal mane; nose ovine, hairy; hoofs semicircular, edged; tear-bag marked by a tuft of hair; forehead longly hairy.

1. ADDAX NASOMACULATUS. The ADDAX.

White; forehead and front of face darker; grey in winter.

Antilope nasomaculatus, Blainv. Bull. Soc. Phil. 1816, 78; H. Smith.—*A. Addax,* Licht. Saugth. t. 2; Rüpp. Atlas, t. 7; Mam. Lith. t. .—*A. suturosa,* Otto, N. A. Nat. Cur. xii. t. 48; Griffith, A. K. t. 180.—*A. gibbosa,* Savi.—*A. Tao,* H. Smith.—*A. Mytilopes,* H. Smith, G. A. K. t. 182, 183. f. 6.—*Strepsiceros,* Cajus.—*Addax,* F. Cuvier, Mam. Lith. t. . (winter and summer); Ehrenberg, S. Phys. t. 4, male and female.—*Capra Cervicapra,* Linn. S. N. ed. 10. —*Ant. Cervicapra,* Children, Denham Trav.—*Addax nasomaculatus,* Gray, Knows. Men. 17. t. 18.

Inhabits N. Africa. Brit. Mus.

3. The GOAT-LIKE ANTELOPES have a very short flat tail, hairy above. They have heavy bodies, covered with rough, rigid or woolly fur, strong legs, large hoofs and false hoofs. The horns are conical and recurved.

* *Nose cervine, muffle moderate; horns short, inclined, recurved.*

23. CAPRICORNIS, Ogilby; *Nemorhedus,* part H. Smith.

Horns short, strong, conical, ringed, inclined and recurved, arising behind the orbits; nose cervine, muffle moderate, bald; tear-bag and interdigital pores large; skull with a more or less deep rounded pit, and no suborbital fissure; grinders without supplemental lobes. Asia.

1. Capricornis Sumatrensis. The Cambing Outan.

Black; chin and linear nuchal mane yellowish, especially near the withers; inside of the ears white. Young like the adult.

Antilope Sumatrensis, Shaw; H. Smith, G. A. K. t. 189 (cop. from); F. Cuv. Mam. Lith. t. .—*A. interscapularis*, Licht.—*Capricornis Sumatrensis*, Gray, Knows. Menag. 18.

Inhabits Sumatra. Mus. Leyden.

2. Capricornis Bubalina. The Thaar or Thar.

Grey brown, blackish washed; crown and dorsal line black; thighs and outside of legs rufous; nose, chin, inside of ear, lower part of mane and legs below the hocks whitish.

Antilope Bubalina, Hodgson, P. Z. S. 1832, 12.—*A. Thar*, Hodgson.—*Nemorhedus proclivis*, Hodgson.—*Capricornis Bubalina*, Gray, Knows. Menag. 18.

Inhabits India; Nepal. Mus. Brit.

A head was sent to the United Service Museum by Lieut.-Colonel Childers, of the 11th Dragoons, in 1820, under the name of *Serow* or *Imo*. "It is not speedy, as might be inferred from its make. Its flesh is very coarse and bad. It is usually killed with poisoned arrows."—*Hodgson*, l. c. 14.

3. Capricornis? crispa. The Japanese Goat Antelope.

Fur very fine, elongate, rather woolly, crisp; brown or brownish; feet and ears darker; throat whitish: female paler; tear-bag a naked spot?

Antilope crispa, Temm. Faun. Japan. t. 18, 19.—*Capricornis crispa*, Gray, Knows. Menag. 18.

Inhabits Japan. Mus. Leyden.

** *Nose ovine, hairy, without any muffle; horns short, conical, recurved, ringed.*

24. Nemorhedus, part H. Smith; *Kemas*, Hodgson.

Horns short, conical, inclined and recurved, arising from behind the orbits; nose ovine, hairy; muffle none; tear-bag none; interdigital pores large; fur short.

1. Nemorhedus Goral. The Goral.

Grey brown, black punctulated; streak on lower part of back of neck blackish; cheeks, chin and upper part of throat white; front of fore-legs blackish; feet rufous. Young paler; dorsal line rather darker.

Antilope Goral, Hardw. Linn. Trans. xiv. t. 14; Calcutta J. N. H. i. t. 12. f. 2, 3.—*A. Goural*, Hodgson.—*Bouquetin du Nepaul*, F. Cuv. Mam. Lith. t. . (copy from Hardw.)—*A. Duvaucellii*, H. Smith.—*Nemorhedus Goral*, H. Smith; Gray, Knows. Menag. 18.

Inhabits Nepal. Brit. Mus.

A. Duvaucellii (H. Smith) was described from a drawing traced from one of General Hardwicke's figures of this species, and badly coloured, which Duvaucel sent to Paris without any notes. It has no connection with *C. Sumatrensis*, to which many naturalists have referred it. In the Bengal Journal two Antelopes, said to resemble the *Goral*, are mentioned as found in Affghanistan, one called *Suja* and the other *Goomast*.

25. MAZAMA, Rafinesque; *Aplocerus*, H. Smith.

Horns small, conical, nearly erect, slightly inclined and recurved at the tip, ringed at the base; nose ovine, hairy; muffle none; tear-bag none: fur short, under fur woolly, outer very long, hairy and dependent.

1. MAZAMA AMERICANA. The MAZAMA or SPRINGBUCK.

White; horns, hoof and edge of nostrils black.

Rupicapra Americana, Blainv.—*Antilope Americana*, Desm.—*Capra Americana*, Rich. F. B. A. 268. t. 22.—*Ovis montana*, Ord.—*Capra montana*, Harlan.—*A. lanigera*, H. Smith.—*Mazama dorsata* and *M. sericea*, Rafin.—*A. Mazama* and *Apl. Femmamazama*, H. Smith.—*Capra? Columbiana*, Desmoul.—*Rock Mountain Sheep*, Jameson, Mem. Wern. Soc. iii. 306.—*Mazama Americana*, Gray, K. M. 19.

Inhabits N. America; Rocky Mountains. Mus. Linn. Soc. and Zool. Soc.

26. RUPICAPRA, H. Smith; *Capella*, Keys. & Blas.; *Kemas*, Ogilby.

Horns elongate, slender, erect, recurved at the tip; nose ovine, hairy; muffle none; fur soft; skull without any pit, and with a minute suborbital fissure; grinders without supplemental lobes, cutting-teeth equal-sized, erect.

1. RUPICAPRA TRAGUS. The CHAMOISE or GERUS.

Brown yellowish, with a dark dorsal streak in summer, blackish in winter.

Capra Rupicapra, Linn.—*A. Rupicapra*, Pallas; H. Smith, G.A.K. t. 90.—*Rupicapra Tragus*, Gray, K. M. 19.—*R. Capella*, Bonap.—*R. pyrenaica*, Bonap.—*Tragus Dorcas*, Klein.—*Chamoise*, Buffon, H. N. xii. t. 16; F. Cuv. Mam. Lith. t. .

Inhabits S. Europe; Switzerland, Pyrenees, and Pindarus. Brit. Mus.

I have compared the Swiss, Pyrenean and Greek specimens, and cannot find any character to separate them.

27. ANTILOCAPRA, Ord; *Dicranocerus*, H. Smith; *Oreammos*, Rafin.; *Cervus*, Blainv.

Horns erect, the base compressed with a flattened process in front, the end conical, recurved; nose ovine, hairy; muffle none; fur very close; hair stiff, coarse, flattened, wavy; tail very short; false hoofs none; tear-bag none; inguinal pores none; legs rather slenderer than the other *Goat Antelopes*; skull without any sub-orbital depression, but with a lengthened fissure; grinders without supplemental lobes, cutting-teeth equal-sized and shelving.

1. ANTILOCAPRA AMERICANA. The CABRIT or PRONGHORN.

Pale fulvous; upper part of rump white.

Antilope Americana, Ord, 1815.—*A. furcifer*, *A. palmata*, H. Smith, Linn. Trans. xiv. t. 2, 3; G. A. K. t. 178. t. 199. f. 1–5; Richards. Z. B. A. t. 21.—*Cervus hamatus*, Blainv.—*C. bifurcatus*, Rafin.—*Antilocapra Americana*, Ord; Gray, K. M. 19.

Inhabits N. America; in the plains in summer and in the mountains in winter. Called the *Goat*. Mexico (*Coulter*). Brit. Mus.

Dr. Coulter brought a head from Mexico which had the face dark brown, and the horns large, wide-spreading and much hooked at the tip, like the *A. palmata* of H. Smith (Proc. Zool. Soc. 1826, 121). This is probably only a larger variety in the summer fur.

II. The ANTELOPES OF THE DESERT. Nostrils bearded within beneath, operculated, far apart; horns on the frontal ridge; nose subcervine, with a small muffle; legs rather stout; tail elongate; hoofs rather large.

4. The EQUINE ANTELOPES have a very depressed, spongy and bristly muzzle.

28. CATOBLEPAS, Gray; *Connochætes*, Licht.; *Bos*, Forster.

Horns bent down on the sides, recurved at the tip; nose very broad, dilated, spongy, bristly; nostrils operculated; tail elongate, bushy, hairy from the base; hoofs compressed in front; teats four.

This genus has been placed with the Oxen by Forster, and in the Bovine group of genera by Sundevall, but it has all the characters of the true Antelopes in the proportion of its leg-bone.

* *Nose with a crest of reversed hair; chest maned.* Catoblepas.

1. CATOBLEPAS GNU. The GNU or KOKOON.

Nose with a tuft of reversed hair; chest maned. Brown or blackish; the lower part of the mane and tail often paler or white. Young: pale fulvous; nasal, gular, and nuchal mane black.

Antilope Gnu, Sparm.; Zimmerm.—*Bos Connochætes*, Forster.—*Antilope taurina*, Burchell.—*C. Gnu*, H. Smith.—*C. taurina*, H. Smith, not A. Smith.—*Gnu*, F. Cuvier, Mam. Lith. t. ; Harris, W. A. A. t. 1.—*Catoblepas Gnu*, Gray, Knows. Menag. 19. t. 19. f. 1, young.

Var. Mane and tail black.

A. taurina, Burchell; A. Smith.

Inhabits S. Africa. Brit. Mus.

The *A. Gnu* of Burchell, H. Smith, F. Cuvier and Harris, "and the *Kokong* of Lichtenstein," has a white tail and mane. Burchell and H. Smith have given the name of *A. taurina* to the specimens, which have those parts black. When young they are fulvous, and become black as they reach maturity. The specimen of the *Kokoon* in the Museum of the London Missionary Society (Blomfield Street, Moorfields), named by Colonel H. Smith *Kokoon* (*Cat. taurina*, Griff. A. K. iv. 369, v. 368), is an adult common *Gnu, C. Gnu* (*Var.* mane and tail white; *Kokong*, Licht. Trav. Cape), and his description of Dr. Burchell's specimen in the British Museum agrees with the *Gnu*, in having the ridge of hair on the face. Indeed Dr. Burchell (Travels, ii. 278) appears to consider the difference between the *Gnu* and *A. taurina*, that the former has a white and the latter a black tail. Dr. Andrew Smith (Illust. Zool. S. A.) has regarded the *C. taurina* and *C. Gorgon* as the same species. Dr. Sundevall, in his Synopsis, has, by mistake, given the name of *C. taurina* to the *Gorgon*, or *Brindled Gnu* (*C. Gorgon*, H. Smith).

** *Nose with smooth hair; chest not maned.* Gorgon.

2. Catoblepas Gorgon. The Gorgon.

Face convex, smooth, covered with hair, lying towards the nose; chest not maned; black grey, varied and striped. Young: dark grey; face, gular and nuchal mane and end of tail black. Half-grown: blackish; crown grey.

Antilope Gorgon, H. Smith; Harris, W. A. A. t. 4.—*Cat. taurina*, Sundev., not Burch. or Smith.—*Catoblepas Gorgon* or *Gorgon fasciatus*, Gray, Knows. Menag. 20. t. 19. f. 2, young.

Inhabits S. Africa. Brit. Mus.

Colonel H. Smith has figured a pair of horns which were in Mr. Brookes's Museum under the name of *C. Brookesii* (t. 201. f. 1). He thinks it is also probable that *Bos Pegaseus* (H. Smith, G. A. K. t. 204, from a drawing of Prince Maurice's) is a species of this genus (H. Smith, Jard. Nat. Lib.).

5. The Bovine Antelopes have the nose moderately broad, with a moderate or small, bald, moist muffle; the grinders are rather small, without supplemental lobes, the central cutting-teeth enlarged at the end.

29. Boselaphus; *Bubalis*, Licht., Ogilby; *Acronotus*, H. Smith; *Bubalus*, A. Smith; *Alcelaphus*, Blainv.; *Buselaphus*, Ray.

Horns lyrate, end suddenly curved at a nearly right angle, thick at base, on the upper edge of the frontal bones; nose moderately broad, cervine; muffle moderate, bald, moist; tear-bag covered with a tuft of hair. Females: teats two.

1. Boselaphus Bubalis. The Bubale.

Pale brown in early uniform; rump like back.

Antilope Bubalis, Pallas.—*Capra Dorcas*, Houttayn, t. 24. f. 3.—*Buselaphus Caji*, Ray.—*Bubalis Mauretanica*, Ogilby; Sundevall.—*Acronotus Bubalis*, H. Smith.—*Bubale*, F. Cuv. Mam. Lith. t. .—*Cervine Antelope*, Penn.—*Boselaphus Bubalis*, Gray, K. M. 20. t. 20. f. 1, young.

Inhabits N. Africa. Brit. Mus.

Var. 1. Uniform pale brown; with a dark brown streak down the outer side of the front of the fore-legs, like the streak on the leg of the *Lecama* or *Harte beest* from South Africa, which is not generally found in this species. This skin, without a head or hoofs, was brought by Mr. Frazer to the British Museum, from Tunis; it probably indicates a third species, or perhaps this streak is only marked in the very adult or fully-coloured specimens.

2. Boselaphus Caama. The Lecama or Harte beest.

Grey brown; dorsal line, streak on face, outer side of limbs black; large triangular spot on the haunches whitish.

Antilope Caama, Cuv. D. S. N. ii. 242 (1816); Harris, W. A. A. t. 7; A. Smith, Illust. Z. S. A. t. 31.—*A. Bubalis,* Licht.; Erxleb. 291.—*Acronotus Caama,* H. Smith, G. A. K. t. 197.—*A. Dorcas,* Thunb.; Sparm. K. V. Hand. 1779, t. 5.—*Bubale,* Buffon, H. N. xii. t. 38. f. 2; Supp. iv. t. 15.—*Caama,* Cuvier, Menag. t. .—*Senegal Antelope,* Penn. Synn. 38.—*A. Senegalensis,* Cuvier, Dict. Sci. Nat., from Pennant.—*A. Koba,* Erxleb. Syn. 293, from Pennant. —*Boselaphus Caama,* Gray, Knows. Menag. 20. t. 20. f. 2, young.

Inhabits S. Africa. Brit. Mus.

Pennant figures the head and horns of this species under the name of *Senegal Antelope,* and erroneously refers to Buffon's figures of the horns of the *Koba* as representing the species, which lead to some confusion; for the *A. Senegalensis* (Cuvier, Dict. Sci. Nat. ii. 235) is an abbreviation, and *A. Koba* (Erxleben, Syn. 293) is a translation, of Pennant's description of this species. Pennant's specimen is said to come from Senegal, but he describes the nuchal line and the knees as black, and the figure indicates the dark colour on the face of the Cape species.

30. Damalis; *Damalis acronotus,* sp. H. Smith; *Bubalis,* sp. Sundev.

Horns lyrate, diverging, subcylindrical; nose moderately broad, cervine, with a small, bald, moist muffle between and below the nostrils; tear-bag exposed: females, teats two.

* *Horns recurved above, diverging from the base; face dark in front.*

1. Damalis lunatus. The Sassayby.

Rufous glaucous, outer sides of the limbs dark.

Antilope lunata, Burchell, Trav. ii. 334, 335. fig. .—*Damalis* (*acronotus*) *lunatus,* H. Smith, G. A. K. t. 198; A. Smith, Zool. S. Afr. t. 31; Harris, W. A. A. t. 8.—*Bubalis lunata,* Sundev.—*Sassaybi,* Daniel, Afr. Scenery, t. .—*Damalis lunatus,* Gray, Knows. Menag. 21.

Inhabits S. Africa. Brit. Mus.

** *Horns regularly lyrate, nearly parallel at the base, then diverging, and approaching at the tips; face black marked; tear-bag moderate.*

2. Damalis Senegalensis. The Korrigum.

Reddish grey; front of face from nose to occiput, a small spot behind the eyes, a small streak above the angle of the mouth, and streak on outside of the limbs above the knees, and tuft of the tail, black. Very young: uniform pale brown, without any dark marks.

Antilope and Damalis (*acronotus*) *Senegalensis*, H. Smith, G.A.K. v. t. 199. f. 3.—*Antilope Koba*, Children, in Denham and Clapperton's Travels, not Erxleben.—*Bubalis Koba*, Sundevall.—*B. lunata*, Sundev. Act. Stockh. 1842, 201, 243, not Burchell.—*A. Corrigum*, Ogilby.—*Damalis Senegalensis*, Gray, Knows. Menag. 21. t. 21.

Inhabits W. Africa; Gambia River, Macarthy's Island; called *Yonga* or *Yongah* by the Joliffs, and *Tan Rong* by the Mandingoes, Mr. Whitfield. Brit. Mus. Senegal? Sennaar. Mus. Stockholm.

In Denham and Clapperton's Travels I regarded this species as the *Koba* of Buffon, and H. Smith and Dr. Sundevall are of the same opinion: but on comparing the six pairs of horns of this species which I have been able to examine with Buffon's figure and descriptions, I find them all longer and much thicker at the base than Buffon describes them; the thinner (a female?) being 7 and the others 9 or 9½ inches in circumference, while that which Buffon described is only 5 inches. The rings are also more elevated, and reach nearer to the top than in Buffon's figure. All the characters lead me to believe that the horns figured as those of the *Koba* by Buffon belong to *Damalis Pygarga*. They afford very good venison.

Colonel Hamilton Smith, in 'Griffith's Animal Kingdom,' described and figured the heads brought home by Messrs. Denham and Clapperton as *A. Senegalensis*, but they are different from the one so called by Cuvier. Mr. Ogilby, in the 'Proceedings of the Zoological Society' (1826, 103), proposed to call these heads, *A. Corrigum*.

Under the name of *Antilope Koba*, Schinz (Syn. Mam. ii. 407) combines the *A. defassa*, Rüppell, *Damalis Senegalensis* and *Antilope adenota*, H. Smith, the *Koba* of Buffon, and the *Antilope Koba* or *Caama* of Erxleben.

**** Horns regularly lyrate, parallel at the base; face of adult white.*

3. Damalis Pygarga. The Bonte Boc.

Purple red, outside of limb dark; rump and face white: *fawn* pale yellowish brown.

Antilope Pygarga, Pallas.—*Bonte Boc* or *Pied Antelope, Gazella Pygarga*, Harris, W. A. A. t. 17.—*Bubalis Pygarga*, Sundev.—*A. Dorcas*, Pallas.—*Antilope* (*Gazella*) *Pygarga*, H. Smith.—*Damalis Pygarga*, Gray, Knows. Menag. 21. t. 20. f. 3, young; t. 22. f. 2 & 3, adult.

Half-grown, face whitish.

A. personata, Wood, Zool. Journ. ii. t. .

Inhabits S. Africa. Brit. Mus.

Male: bright purple red, face whitish, dark-edged, with a dark-edged white streak to between the horns; legs whitish, upper and lower part brown varied; temple and upper part of the throat whitish; rump to above the tail pure white; tear-bag round, distinct, moist. The female is similar, but the throat and under part of the body are white. These animals are often brought to the Cape market for food.

4. Damalis albifrons. The Bless Bock.

Purplish red; face and back of thighs white; rump like back.

Bless bok or *Antilope albifrons*, Burchell, Trav. ii. 335?; Harris, W. A. A. t. 21.—*Bubalis albifrons*, Sundev.—*Damalis albifrons*, Gray, Knows. Menag. 22. t. 22. f. 1, half-grown.

Inhabits S. Africa.

A half-grown specimen was darker, with a pale spot between the horns, separated by a dark spot from the white on the face; the temple was white, with a white spot; the legs had a brown stripe down the outer side of the front; and the throat and rump brown, the latter without any white spot.

Dr. Burchell, when speaking of the *Bless bock*, proposed to call it *A. albifrons*, as the name *Pygarga* has been used for both the *Springer* and the *Bless bock*; but it is not certain if he intended by *Bless bock* this or the preceding species. Captain Harris's figure shows the distinction of the species.

**** *Horn unknown.*

5. Damalis? Zebra. The Doria.

Bright golden brown, with numerous black cross bands narrowing at the sides; outer sides of fore and hind legs dark.

Antilope Zebra, Gray, Ann. Nat. Hist. 1836.—*A. Doria*, Ogilby, P. Z. S. 1836, 121; Frazer, Z. T. t. .—*A. Zebrata*, Robert.—*Viverra Zebra*, Whitfield's MSS.—*Cephalophus? zebra*, Gray, Cat. Mam. B. M.—*Damalis? zebra*, Gray, Knows. Menag. 22.

Inhabits W. Africa; Gambia. Brit. Mus.

Skins without head and feet are alone known; they are brought down by the negroes. In the Catalogue of the Mammalia in the British Museum I have referred this species with doubt to *Cephalophus*. Mr. Ogilby (P. Z. S. 1836, 121) thinks it should be referred with the Harness Antelopes to *Calliope*. I am inclined, on account of the dark mark on the outside of the limb, to think it belongs to the genus *Damalis*. Mr. Whitfield believes it to be a species of *Viverra*.

THE STREPSICERES.

The animals of this family are peculiar as being the only hollow-horned or Bovine Ruminants which are marked with white stripes and spots. The bands are not very distinct in the *Impoofo* or *Eland*, but they are easily to be observed in the female, if it is looked at obliquely, which was brought home by Burke, and presented to the British Museum by the Earl of Derby. Their nostrils are near together in front. They have four teats in a small udder. The horns generally incline backwards from their base; the skull, which somewhat resembles that of the Deer, has a rather small nasal opening, no suborbital pit, and only a small suborbital fissure.

Colonel H. Smith forms of the larger species three of his four subgenera of *Damalis*: he places the smaller kinds as a subgenus (*Tragelaphus*) of Antelopes.

Prof. Sundevall placed the genera I have here brought together in two different families; the genus *Portax* with the *Bovina*, and the others in the *Sylvicaprina*, or True Antelopes.

The AFRICAN GENERA have large heavy horns, only the rudiments of a tear-bag, and their limbs are nearly equal; they have no supplementary lobes to the grinders, and the central cutting-teeth are enlarged above.

A. *The nose hairy, cervine, with only a small moist naked space between the edges of the nostrils, and a narrow streak on the upper lip; the body is large, heavy; the neck is maned.*

1. STREPSICEROS, H. Smith; *Calliope*, Ogilby; *Tragelaphus*, sp. Blainv.

Horns large, heavy, spirally twisted, keeled in front; tear-bag a naked space; throat with a central, linear mane: female hornless.

1. STREPSICEROS KUDU. The EECHLONGOLE or KOODOO.

The horns diverge from the line of the forehead, and have two twists; the calf is marked like the adult.

Antilope Strepsiceros, Pallas.—*Damalis* (*Strepsiceros*) *Strepsiceros*, H. Smith, G. A. K.—*A. Tendal*, Rüppell, Abyss. 22; Fischer, Syn. 475.—*Strepsiceros Kudu*, Gray, Cat. B. M.; Knowsley Menag. 26. t. 24. f. 2, young.—*S. Capensis*, Harris, W. A. A. t. 20.—*S. excelsus*, Sundev.—*Striped Antelope*, Penn.—*Comdoma*, Buffon, H. N. xii. t. 39; Supp. vi. t. 13.

Inhabits S. Africa. Mus. Brit.

Var. Smaller.

Inhab. Abyssinia. Mus. E. India Company, adult. Mus. Frankfort, adult and young.

2. OREAS, Desm.; *Boselaphus*, sp. Blainv., Gray; *Damalis* (*Boselaphus*), sp. H. Smith; *Damalis*, Sundev.

Horns large, erect, slightly curved, with a spiral keel; throat with a longitudinal, crested dewlap; hoofs narrowed in front. Female with smaller, thinner horns.

I formerly adopted the name of *Boselaphus*, which Blainville had used for the genus, but Ray had previously applied this name to the *Bubale*, and Desmarest has formed a subgenus specially for it under the name of *Oreas*.

1. OREAS CANNA. The IMPOOFO or ELAND.

Pale brown; throat and beneath whitish.

Antilope Oreas, Pallas.—*Damalis* (*Boselaphus*) *Oreas*, H. Smith, G. A. K. t. 200.—*A. Oryx*, Pallas, Misc. 9.—*D. Boselaphus Canna*, H. Smith, G. A. K. t. 181. f. 5, horn ♂.—*Oreas Canna*, Gray, Knows. Menag. 27. t. 26, 27.—*Coudou*, Buffon, H. N. xii. t. 46 *b*.—*Canna*, Buffon, Supp. iii. t. 12.—*Eland*, Kolbe, Sparmann, K. Vet. Handl. 1779, t. 8; Harris, W. A. A. t. 6; Daniel, Afr. Scen. t. .

Inhabits S. Africa; Cape of Good Hope (*Sparmann*). Brit. Mus.

This Antelope has much the character of the Oxen, and Dr. Burchell informs me that it is the best food of any of the genus at the Cape, being the only one which is moist and has any fat intermixed with the muscle; the flesh of the others is dry and hard. At Knowsley it breeds with the facility of domestic cattle, but they are ravenous feeders, and appear liable to an epidemic.

It should be remarked that the skin of the specimen shot by Burke at the Cape (the female especially) shows several pale whitish cross-bands on the hinder half of the body, similar to the streaks on the *Koodoo,* showing the affinity of this animal to that species; but I could not observe these bands in the living specimens at Knowsley Park.

2. OREAS DERBIANUS. The GING-E-JONGA.

Pale reddish brown; front of the face, the neck, the front part of the under side, a spot on the front and hinder side of the upper part of the fore-leg, the dorsal streak, dark black; the belly, the front and back edge of the upper part of the legs and under side of tail whitish; a broad half-collar in front of the shoulder, narrowed above; fourteen or fifteen narrow, waved, perpendicular streaks on each side of the body white; withers with intermixed black hairs: female, throat dark brown; crown reddish brown.

Boselaphus Derbianus, Gray, Ann. and Mag. N. Hist. xx. 286; Silliman's Amer. Journ. v. 279.—*Oreas Derbianus,* Gray, Knowsley Menag. 27. t. 25.

Inhabits W. Africa; river Casaman. Called *Ging-e-jonga.* Mr. Whitfield. Brit. Mus. Imperfect skin of male and female, and horns.

B. *The nose bovine, with a large coriaceous moist muffle, and a narrow bald space on the upper lip. The animals have very slender, elegant legs; small hoofs and false hoofs; conical, subangular horns; with an oblique, indistinct keel.*

3. TRAGELAPHUS; *Antilope* (*Tragelaphus*), Blainv., H. Smith.

Horns conical, subangular; tear-bag distinct; nape and back with a more or less distinct mane: they are brown; with spots on haunches, crescent on chest, and inside of legs white, and a dark dorsal stripe.

* *Face with a curved band between the eyes; horns large; back cross-banded.* Euryceros.

1. TRAGELAPHUS EURYCEROS. The EURYCEROS.

Head pale brown; broad band before the eyes, and two large spots on cheeks, chin and front of upper lip white; horns elongate, thick, scarcely bent forward at the tip; throat with long black hairs.

Antilope Eurycerus, Ogilby, P. Z. S. 1836, 120.—*A.*, n. sp., Afzelius, N. Act. Upsal. vii. 269. t. 8. f. 3; H. Smith, G. A. K. v. 361. —*Tragelaphus Euryceros,* Gray, Knows. Menag. 27. t. 23. f. 1, horns.

Inhabits W. Africa. Horns in Brit. Mus. and Zool. Soc.

2. TRAGELAPHUS ANGASII. The INYALA.

Black; back with a dorsal streak and four or five bands on each side; head blackish; narrow band before eyes, two small spots on cheeks, front of upper lip and chin white; forehead and feet bay; throat with a mane of long rigid blackish hair; horns rather slender, elongate, rather bent forward at the tip; female bay, with many white bands.

Tragelaphus Angasii, Gray, P. Z. S. 1848, 89. t. 4 & 5, male, female and young; Knows. Menag. 27.

Inhabits S. Africa; Port Natal. Brit. Mus. male, imperfect skin.

** *Face without any frontal streak; horns small.*

† *Back with transverse white stripes.*

3. TRAGELAPHUS SCRIPTUS. The ZALOFES or HARNESS ANTELOPE.

Pale bay; back with four cross-bands and a central white streak; haunches white spotted; cheek with two white spots; spot on chest, nose, feet, and spots on the legs blackish; dorsal streak and end of tail black. Adult: chest and outside of shoulder and haunches and legs black: the male with a high ridge of long, coarse white hair extending the whole length of the back to the tail.

Antilope scripta, Pallas, Misc. 8.—*Antilope* (*Tragelaphus*) *scripta*, H. Smith.—*A. maculata*, Thunb.—*A.* (*Tragelaphus*) *Phalerata*, H. Smith.—*Tragelaphus scripta*, Gray, Knows. Menag. 28. t. 28.—*The Harness Antelope*, Pennant, Syn. 27.—*Guib*, Buffon, H. N. xii. 305, 307. t. 40. t. 41. f. 1; F. Cuv. Mamm. Lithog. t. ; Dict. Sci. Nat. t. .

Inhabits W. Africa; Senegal and Gambia. Called *Oualofes* or *Zalofes*.

The dark colour of the chest and outside of the limbs, and the high crest of the male, are not developed until they are four or more years old.

This species varies in some having seven and others nine white cross-bands, and some are spotted and others not; but they breed together, and the produce is often a different variety from the parent.

They breed constantly at Knowsley: in May 1845 they had a small herd of two males and four females, three of which were expected to bear young.

4. TRAGELAPHUS DECULA. The DECULA.

Grey brown; back with three or four indistinct cross-bands; an arched streak on upper part of side, a few spots forming an arch on the haunches; dorsal line, streak on nose, and in front of fore-legs blackish.

Antilope Decula, Rüppell, Abyss. t. 4.—*Tragelaphus Decula*, Gray, Knows. Menag. 28.

Var. Back without the cross-bands.

Inhabits Africa; Abyssinia (*Rüppell*).

†† *Back without any cross-bands or lateral streak.*

5. TRAGELAPHUS SYLVATICUS. The BOSCH BOC.

Blackish brown; head pale brown; back, across forehead, black; small spot on haunches, larger spot on insides of legs and on feet white; dorsal line longly crested, black, white varied in. Female paler brown. Young: pale bay.

Antilope sylvatica, Sparmann, Act. Holm. iii. t. 7.—*Tragelaphus sylvatica,* Harris, W. A. A. t. 26; Gray, Knowsley Menag. 28.—*Forest Antelope,* Pennant.

Inhabits S. Africa; Cape of Good Hope. Brit. Mus.

Var.? Smaller horns, rather more erect.

Antelopus Ronleynei (the *Serolomoot broque*), Ronaleyn; G. Cumming, Hunter's Life S. A. ii. 178, 179.

Inhabits Limpopo.

Of the two pairs of horns, named by Colonel H. Smith *Boselaphus canna* (*a, b,* in the List of Mamm. Brit. Mus. 155), the one pair, presented by Dr. W. Burchell, is certainly the horns of this species; the other appears to be those of a young male, *Strepsiceros Kudu.*

The Asiatic Strepsiceres have a bovine nose, with a large coriaceous moist muffle extending over the whole front of the upper lip; small, short, angular horns; a deep longitudinal tear-bag; and the hind-legs much shorter than the fore-ones; the skull without any suborbital pit, and only a minute fissure; and with supplementary lobes to the grinders.

4. Portax; *Oreas,* sp. Fischer; *Tragelaphus,* Ogilby; *Damalis* (*Portax*), H. Smith.

Horns short, conical, angular, with an obscure oblique ridge; tear-bag deep, longitudinal; shoulders higher than the rump.

1. Portax tragocamelus. The Nylghau.

Grey; under surface, rhombic spot on the forehead and above the hoofs black and white ringed; tail, end black. Female browner. Young: dull reddish fawn; lower part of fore-legs brighter; under lip, spot on jaws, and line along belly on inside of legs and fore-part of hock, white; tip of tail, line on back of nose and on front of legs black.

Antilope Trago-camelus, Pallas, Misc. 5.—*A. picta,* Pallas, Spicil. xiii. 54; Gray, Cat. B. M.—*A. albipes,* Erxl. 280.—*A. leucopus,* Zimm. Zool. 541.—*Damalis (Portax) Risia,* H. Smith.—*Portax picta,* Gray, Cat. B. M.—*P. Tragocamelus,* Gray, Knows. Menag. 28. t. 29.—*Tragelaphus Hippelaphus,* Ogilby.—*P. Tragelaphus,* Sundev.—*Biggel,* Mandelst. Reise (1658), p. 122.—*Tragelaphus Caii,* Raii Syn. 82?; Parsons, Phil. Trans. No. 476. p. 465. t. 3. f. 9.—*Nylghau,* Hunter, Phil. Trans. lxi. 170. t. 5.—*Nilghaut,* Buffon, H. N. Supp. v. t. 10, 11; F. Cuv. Mamm. Lithog. t. .—*Indostan Antelope,* Penn. Syn. 29.—*White-footed Antelope,* Penn. Syn. 29. t. 6. f. 1, 2.

Inhabits India. The *Roou* of the Mahrattas, the *Nylghau* of the Persians.

This species has bred at Knowsley. In December 1845 they had two calves, both females, making a flock of one male and four females; they are in the paddock with the *Eland* in summer. They have also bred in the Gardens of the Zoological Society and in the Menagerie of Sir Robert Heron at Shibton.

LINNÆAN SOCIETY.

January 21, 1851.—William Yarrell, Esq., V.P., in the Chair.

Read a memoir "On the various forms of *Salicornia*." By Joseph Woods, Esq., F.L.S.: with some additional remarks by Richard Kippist, Esq., Libr. L.S.

The paper relates almost exclusively to the British species of *Salicornia*, and more particularly to those which occur on the coasts of Sussex and Hampshire.

The author begins by noticing what he considers as the typical form of *S. herbacea*. This he describes as always erect, except that late in the autumn, the branches, usually spreading or ascending, are sometimes borne down by the weight of the fruit-spikes. The colour is green, generally glaucous, but never red. The spikes of fruit are cylindrical, 2 or 3 inches long, (ten to fifteen times their thickness,) and contain from ten to fifteen sets of seeds.

The second form (*S. procumbens*, Sm.), which is stated to be more common than the first, is described as procumbent, decumbent, or ascending, but always with a bend at the top of the root, and therefore never erect: the branches and their subdivisions are much shorter and more numerous than in the typical form, and at the same time much more divaricate, the lower ones especially being frequently recurved; and these lower branches being much longer than the succeeding ones, give to the entire plant a triangular outline. The colour at maturity is always red. The spikes hardly exceed half an inch in length (about four or five times their own thickness) and contain about six sets of seeds each.

The next form noticed by Mr. Woods, and which he proposes to call *S. ramosissima*, is described as much larger than either of the preceding, erect, very much branched and bushy, of a grass-green colour, but touched with red, the branches ascending, and the spikes not cylindrical or oblong, but somewhat lanceolate, the longest about an inch in length (six or seven times their thickness) and containing about the same number of sets of seeds as *S. procumbens*. This, which appears to be a rare form, was gathered in Haling Island.

Mr. Woods now proceeds to describe two intermediate forms, apparently serving to unite the three preceding. The smallest of these, which the author proposes to designate *S. pusilla*, seems closely to resemble *S. procumbens*, from which it differs in its smaller size and less triangular outline, its erect or suberect branches, the lowest of which are neither larger nor more branched than the succeeding ones, and in its still shorter spikes, which scarcely exceed $\frac{1}{4}$ inch in length, being sometimes almost globular, and containing about five sets of seeds. The other form, which the author calls *S. intermedia*, and which is stated to be the most abundant on the muddy salt marshes of Sussex, embraces several subvarieties, all of which are erect, but vary much in other respects, sometimes resembling *S. pusilla*, but with much longer and redder spikes; in other cases approaching the typical form of *S. herbacea*, in their yellowish green colour, hardly tinged with red, cylindrical spikes an inch or more in length (eight or nine times their width), but with not more than eight or nine sets of seeds; while others again, in their bushy habit and colour, and in the form of their spikes, show an affinity to *S. ramosissima*.

All the above-mentioned varieties have oval or oblong seeds, about half as long again as broad, and thinly covered with hooked hairs, upon an even surface. In the two following the seeds are shorter, nearly globular, but covered in the same manner with hooked hairs.

S. radicans, the next species, is described as differing exceedingly in its mode of growth from any of the foregoing. In all these the root is evidently annual, and produces a single stem, which is hard, and in *S. ramosissima* may fairly be called woody. In *S. radicans*, however, a small plant, with only one or two branches, rises at first from the seed. The stem of this lies down, and, generally burying itself in the mud, sends out radical fibres and new shoots. The process is continued from year to year, the old stems of one year becoming the rhizomes of the next, and these successively dying away as new rhizomes are formed, thus producing a very rambling and diffuse plant. In the preceding forms, every branch and subdivision is terminated by a spike of flowers. In *S. radicans* many are barren. The spikes, when they occur, are sometimes interrupted, half an inch to an inch long, and composed of about six joints. The colour is a dull greyish green; with the ends of the spikes brownish, but never red. Though much less abundant than the first, second, and fourth forms, it is by no means rare in the muddy creeks of Sussex and Hants.

The last form mentioned, under the name *S. lignosa*, bears some resemblance in its diffuse mode of growth to *S. radicans*, and Mr. Woods found some indications of radical fibres from the lower part of the stem, but was unable to ascertain positively the existence of a creeping rhizome. It differs however from *S. radicans* in the thickness, and firm solid structure of the lower part of the stem, which as in every European species is destitute of annual rings, and attains its thickness and hardness in the course of one year. From *S. fruticosa*, L., to which it approaches nearly in many respects, it is distinguished by the multitude of its slender branches, and probably also by the structure of its seed, which Koch and Bertoloni describe as tubercled and not hairy in *S. fruticosa*. The spikes of our English plant are an inch or a little more in length, and about six times their width: those of the true *S. fruticosa* are usually both absolutely and relatively longer.

Mr. Woods next makes some observations on the synonymy of the *Salicornias* described by Ray, who appears originally to have admitted but two species; the first including all the forms of *S. herbacea* and also *S. procumbens*; the second attributed by Smith to *S. fruticosa*, L., but now generally regarded as *S. radicans*. To these Dillenius adds three others, of which the first, *S. myosuroides procumbens*, &c., is considered by Mr. Woods as *S. radicans*; the second, *S. ramosior procumbens*, &c., as probably *S. procumbens*, Sm.; and the third, *S. erecta foliis brevibus cupressiformis*, he refers with some doubt to his *S. intermedia*.

Then follow some remarks on the characters of *Arthrocnemum*, a genus separated by M. Moquin-Tandon from *Salicornia*, principally on account of the different form of its embryo, and to which he refers *S. fruticosa* and *S. radicans*. In all specimens of *S. radicans*, and in some of *what is called S. fruticosa*, Mr. Woods finds the seeds apparently destitute of albumen, and with the radicle lying against the edges of the cotyledons; but in the true *S. fruticosa*, supposing that name to be correctly applied only where the seed is tubercled and hairless, he finds a portion of albumen, but the extremity of the cotyledons still close to the point of the embryo.

The author concludes with the following résumé:—"If I were to sum up the result of my observations of this year on the genus *Salicornia*, I should say that *S. procumbens* is a distinct species; that *S. radicans* and *S. lignosa* are certainly specifically distinct from *S. herbacea*; but whether they are so from each other, and whether, if that be the case, *S. lignosa* ought not to be considered as a variety of *S. fruticosa*, L., and the plant with tubercled seeds to be called *S. megastachya*, I do not feel competent to decide. The other forms of *S. pusilla*, *S. intermedia* and *S. ramosissima*, may perhaps be varieties of *S. herbacea*, but this also is a subject for further investigation."

The paper was accompanied by specimens of the various forms therein described, for the Society's herbarium; and a note was added by Mr. Kippist, Libr. L.S., who at the request of Mr. Woods had examined the seeds of the specimens sent. He had found the structure of the embryo to be nearly the same in all the British forms; consisting of thick, fleshy, almost semicylindrical, bright green cotyledons, in some species scarcely wider than the radicle, which is bent sharply round, and lies not against their *edges*, but on the *back* of one of them, the radicle being therefore *incumbent*. In one or two instances the cotyledons were found to be inclined rather obliquely towards the radicle, but this appeared to be the result of accidental pressure, the majority of the seeds examined of each variety presenting the same character of incumbent cotyledons. In all, the albumen was either entirely wanting, or in very small quantity. This seems to be equally the case with *S. radicans*, notwithstanding that M. Moquin-Tandon refers this species, as a variety, to his *Arthrocnemum fruticosum*, to which he ascribes copious albumen. As regards the structure of the seed, Mr. Kippist agrees with Mr. Woods in thinking that the *S. radicans*, Sm., would be much better placed in *Salicornia*, as defined by Moquin-Tandon, than in his genus *Arthrocnemum*, to which he attributes a crustaceous testa and semi-annular peripherical embryo, characters which Mr. Kippist had not met with in any British species. In all the specimens gathered by Mr. Woods on our own coast, the covering of the seed is thin and membranous, and clothed with hairs, which differ much in length in different species. In *S. herbacea* and the species most nearly related to it, they are of a sigmoid form, spreading at the base, but curled inwards at their extremity, unbranched, and destitute of septa or spiral fibre. They are longest in the form which Mr. Woods calls *intermedia*, much shorter in *lignosa*, while in *radicans*, they are so short, and so closely pressed against the integument of the seed, that it is difficult to distinguish them: the seeds of this species, however, were all obtained from one specimen, and may not have been thoroughly ripe.

In the plant for which Mr. Woods proposes the name of *S. megastachya* (and which is in all probability a species of *Arthrocnemum*), a native of the South of Europe, the structure of the seeds is extremely different. The testa is hard, black, and crustaceous, quite destitute of hairs, and covered with concentric rows of little tubercles. The albumen is very evident, and principally confined to the straighter side of the seed, the convex side being occupied by the embryo, which is cylindrical and but slightly curved; the thick, fleshy cotyledons, taken together, are about equal in diameter to the radicle, which seems to be nearly continuous with them in direction, not bent sharply round upon them as in *S. herbacea*, and probably in all the true *Salicornias*.

BOTANICAL SOCIETY OF EDINBURGH.

May 15, 1851.—Professor Balfour, President, in the Chair.

The following papers were read:—

1. "Biographical Notice of the late Mr. George Don." By Dr. Neill.

2. "List of Plants found in Peebleshire." By George S. Blackie. Of the plants included in this list the following may be mentioned:—*Vicia Orobus*, Manor-head; *Galium pusillum; Pyrola rotundifolia; Primula farinosa; Betula nana*; *Sibbaldia procumbens*, Manor-head; *Saxifraga stellaris; Arctostaphylos Uva-ursi; Hymenophyllum tunbridgense*, and *H. Wilsoni*.

3. "Notice of *Exidia hispidula*, Berk., used in China as a remedy in disease, and also as an article of diet." By Dr. Dill. Dr. Dill remarks:—"The fungus was first brought to my notice in Hong Kong as a favourite remedy of the Chinese in attacks of dysentery. It is used by them in the form of decoction, boiled along with dried plums, the latter being added merely to give flavour, &c. to the decoction. The first time I ever saw it used was in the case of the person who told me of its efficacy in the before-mentioned malady. This man, an English gardener, was suffering from a severe attack of dysentery, and as his house was a most unhealthy one, I strongly advised his going into hospital. He said, before doing so he would like to try a Chinese medicine, which had been strongly recommended to him by an old Chinaman, a friend of his. I said, 'Take care what you do with yourself, for your case won't do to be trifled with.' Three days after this I was surprised to find him at his work, and well again. 'Sir,' he said, 'this medicine has had such a wonderful effect upon me, that I have kept some of it to show you.' The specimen he then gave me I handed to my Chinese servant, who seemed perfectly familiar with it, and speedily obtained me a large supply. I then determined to try it in the first case that came before me. A few days afterwards a sailor applied to me having chronic dysentery,

which had been going on for eighteen months. I immediately gave him a strong decoction of the fungus, which he took in 2-oz. doses, three times a day; and in eight or ten days he seemed quite cured. Being then permitted to go out, he got drunk, was exposed to night air, &c., and had a return of his malady. Again, however, the same medicine was employed with the same favourable result, and he joined his ship in the enjoyment of recruited health. These two cases made me very sanguine of the value of the fungus as a cure in diarrhœa and dysentery, but future experience by no means realized the hopes I entertained respecting it. Since then I have so often found it fail completely, that I now regard it as being inferior in efficacy to many of the remedial agents we already possess. Mr. A. H. Balfour has also tried it successfully at Hong Kong, but I think his experience has been similar to my own. It grows on old, dead trees and rotten timber; hence, and from its shape, the name by which it is designated in China—'Mok-yii,' the ear of a tree. The fungus itself is much prized by them as an article of food on account of its mucilaginous properties. They eat it in soups, stews, &c., and consider it a great dainty. In taste it is very insipid, but certainly not more so than the far-famed bird's nest."

Dr. Douglas Maclagan exhibited specimens of the plant brought from Penang by Mr. W. D. Maclagan. In that country it is called Sweekiang, and is used for food.

4. "On Poisoning with Indian species of *Datura*." By Dr. Herbert Giraud, Professor of Chemistry and Materia Medica in Grant Medical College, Bombay. Dr. Giraud brought this subject before the Medical and Physical Society of Bombay, and the observations forming the present paper were communicated to the Botanical Society by Dr. Balfour. The very numerous cases of poisoning by *Datura* that have of late occurred in Bombay, have afforded opportunities for observing the action of a poison, of which but a scanty record is to be found in the standard works on Materia Medica and Toxicology. Several species of the genus *Datura* are indigenous throughout India; and "*Datura alba*" (*D. metel*, Roxb. Flora, i. 561) and "*Datura fastuosa*" (Roxb. Flora, i. 561) are found growing in gardens and amongst rubbish, about villages, all over the country. The intoxicating properties of these plants appear to have been known amongst Eastern nations from time immemorial, and they have long been employed in India, China (where *D. ferox* is used), and the islands of the Eastern Archipelago to facilitate the commission of theft and other crimes; for which nefarious purposes the *Datura Stramonium* appears, of late years, to have been in some few instances employed in France and Germany. Here the cases of poisoning by the species of *Datura* are so frequent, that the natives usually recognise them by their characteristic symptoms. It is remarkable, that although administered under many different circumstances, and with varied motives, it should so seldom prove fatal here, that not a single case, in which the effects of *Datura* could be distinctly traced, has terminated fatally; and of fifty-one cases that were treated in the Bombay Hospital during the past year, only four

presented alarming symptoms. Notwithstanding the recent prevalence of Datura-poisoning, it has been only on the presumptive evidence of its characteristic symptoms that its action has been inferred. The poison is administered so stealthily, and the natives are so backward in aiding the cause of justice, that it is next to impossible to obtain positive evidence of the administration of the poison, or to trace it to the culprit; although, from their familiarity with its nature and with the modes of its administration, it is evident that many of the lower orders of the people are acquainted with the adepts who employ it. These remarks, however, apply, with equal truth, to cases of poisoning by such substances as arsenic and corrosive sublimate, the presence of which may be determined by the surer methods of chemical analysis. From the information Dr. Giraud has been able to collect from natives, it would appear that the seeds are the parts of the plant usually administered. They are powdered and thrown into rice, bajree, and other grains; or mixed up with cakes and sweetmeats. Sometimes, however, an infusion or decoction of the leaves is prepared and introduced into the vessels in which food is being cooked; but of the usual quantities of the seeds employed, or of the strength of the infusion and decoction, Dr. Giraud has had no means of judging. Of the cause that has produced so sudden and remarkable an increase in the use of this poison, it is difficult to form any conjecture. Viewing the most prevalent motive to Datura-poisoning, it would seem as if some regularly organized band of thieves had, within the last year, invaded our island. From 1837 and 1838, when a few cases of poisoning supposed to be from *Datura* were noticed by Drs. Bell and M'Lennan, in the annual reports of the Native General Hospital, up to 1848, only from six to ten such cases have been annually recorded; but during the past year, fifty-one cases have come under hospital treatment.

In a note received by Dr. Cleghorn from the Superintendent of Thuggee in Mysore, it was stated, that the seeds of *Datura alba* were employed by thieves and other rogues to narcotise their victims, and deprive them of the power of resistance.

5. "Report on the State of Vegetation in the Edinburgh Botanic Garden." By Mr. M'Nab.

A note was read from Mr. Babington, stating that *Ranunculus trichophyllus*, mentioned by Mr. Syme as found near Edinburgh, is a very common form of *R. aquatilis*.

It was stated by Dr. Mitchell, that the plant called by Dr. Howitt *Œnanthe pimpinelloides*, and for which he gives several stations in his 'Flora of Nottingham,' is *Œ. Lachenalii*. It is very abundant in the blue lias districts. All the Leicestershire stations for *Œ. pimpinelloides* are those of *Œ. Lachenalii*, the former species not being found either in Leicestershire or Nottinghamshire. These facts render it probable that *Œ. Lachenalii* is not so "rare in fresh water," as it is said to be both in Babington's 'Manual,' and in the last edition of Hooker's 'Flora'; the mistake has doubtless arisen from the roots not having been examined. Specimens of the plant were sent by Dr. Mitchell.

Mr. M'Nab exhibited several sections of oak-stems found in the course of excavations made at Tanfield, Canonmills, and read the following notice supplied by Mr. M'Caul, who had superintended the operations:—"In the course of excavating a pit for a new gasometer nine years ago, a number of oak-stems, the largest 2 feet in diameter, were found. In the pit now excavating, and from 80 to 90 feet from the one alluded to, two fine trees were found. The position they occupied was about 10 feet below the original surface, beneath the lowest bed of gravel, and immediately over the boulder clay, their direction being nearly east and west. Three of the pieces were lying horizontally, and two of them had a rise towards the east at an angle of 10°. At the western or lower part of these stems, roots in connection with them could be traced; but they mouldered away to the touch."

A specimen of yellow-flowered *Hibiscus*, raised by Mr. Isaac Anderson from seeds sent from China by Colonel Eyre, was exhibited. The plant was about 2 feet high and had a woody stem. The leaves are hairy, the petals sulphur-yellow, the flower when expanded being 3 to 4 inches across. The epicalyx consists of eight to ten linear sepals, while the calyx consists of two sepals united and thrown to one side.

A specimen of *Hyoscyamus* raised from seeds communicated to Mr. Moore of the Chelsea Botanic Garden by Major Madden, was exhibited. The plant grows in the Himalaya, and resembles *H. albus* in some respects. In the open border it attains the height of 2 feet. It has ovate leaves and terminal cymes. The flowers are of a dingy yellow, and the calyx is covered with glandular pubescence. Dr. Douglas Maclagan tried the effect of the plant on the eye. A single drop of the fresh juice caused dilatation of the pupil in twenty minutes, and the dilatation with slight double vision continued for twenty-four hours.

MISCELLANEOUS.

HOLOSTOMUM CUTICOLA. Pl. V. figs. 3 & 4.

Norwich, June 10th, 1851.

To the Editors of the Annals of Natural History.

Gentlemen,—Should you consider the following notice worthy of insertion in the 'Annals,' you will oblige me by its publication.

I remain, Gentlemen, your very obedient servant,

Robert Wigham.

Specimens of the Bream and Roach have long been observed in the rivers of this part of the country to be frequently covered with black spots, and have been generally considered, when in this condition, to be in a diseased state. I have lately examined these spots with the microscope, and find them to consist of a collection of minute black granules of a branched radiating structure and of a confervoid appearance, and which form the outer coat of cysts containing a transparent membranous cyst in which I found an animalcule. Not being able to find it described in any British author, I sent it to Prof. Allman of Trinity College, Dublin, who kindly informed me it is the *Holostomum cuticola* of Nordmann, and is described and figured in his 'Mikrographische Beiträge,' which work has not been yet translated, and that he had not seen it before, and was not aware that it had before been observed in Britain. Prof. Allman very kindly sent me a neat sketch of the animal, a copy of which I inclose.

Pl. V. fig. 3. *Holostomum cuticola*, front view under slight compression.
—— fig. 4. The same, side view.

On the Occurrence of Trigonellites *in the Upper Chalk at Norwich.* By T. G. Bayfield.

Norwich, Aug. 11, 1851.

Sir,—I have lately obtained from a chalk-pit, near this city, an example of the problematic fossil called *Trigonellites* by Parkinson, and *Aptychus* by Meyer. The specimen exhibits the inner surface marked by lines of growth, as in the Oolitic species. In the same pit have been found *Ammonites peramplus*, and another species, which are usually rare in the Upper Chalk. This discovery is interesting, as it proves the distribution of the Trigonellite to be co-extensive with that of the Ammonite, of which it has been regarded as the operculum.

Yours respectfully,
To Dr. Francis. T. G. Bayfield.

LOCALITIES OF RARE BRITISH CRUSTACEA.

To the Editors of the Annals of Natural History.

Shantalla, Galway, August 18, 1851.

Gentlemen,—Allow me to communicate the following localities in the county of Galway for some of the rarer British Crustacea:—

Achæus Cranchii; in 5 fathoms, Bar of Killeany Bay, Great South Island of Aran.

Pagurus Hyndmani; } common at various depths—6 to 40 fa-
P. lævis; } thoms.

P. Forbesii; one specimen in 20 fathoms, and a second in 35 fathoms, outside of the Great Isle of Aran.

Crangon fasciatus; along with
Achæus Cranchii.

Crangon spinosus; in 20 fathoms, South Sound of Aran.

C. sculptus; one specimen in 6 fathoms, off Deer Island, Galway Bay, and two in 20 fathoms, South Sound of Aran.

C. bispinosus?; two specimens in 30 fathoms, limestone gravel bottom, outside of the Great Isle of Aran.

I have no doubt that these specimens are referable to *C. bispinosus*; but the learned author of the 'British Crustacea' will decide the point, as the specimens will shortly be in his possession.

Nika edulis; Bertraghboy Bay.

I am, Sir, your obedient servant,
Alexander G. Melville.

NOTE ON PEDICELLARIA.

To the Editors of the Annals of Natural History.

Royal Naval Hospital, Haslar, Aug. 8th.

Gentlemen,—The bodies named Pedicellariæ found upon the bodies and around the mouths of Echinoderms, have been considered by Oken, Forbes, and Sharpey as special organs of the animals on which they are found. The discovery by myself of a new species (*P. volutarum*), parasitic on the skin of *Voluta vespertilio*, will I think confirm the opinion of Cuvier and Müller, that the bodies in question are independent parasitic organisms. The specimen obtained I have preserved in spirits. I am, Gentlemen, yours very truly,

Arthur Adams.

Addendum to Mr. Benson's *Paper on* Cyclostoma, *in the present Number, page* 191.

Dr. Pfeiffer, having examined the original specimen of *Cyclostoma Indicum*, now writes that it has nothing in common with *C. oculus Capri*, and that it is distinct also from *C. Ceylanicum* and *stenomphalum*, to both of which it is allied.

TEREBELLA MEDUSA. BY C. SPENCE BATE.

The manner in which this animal proceeds to construct its case is very interesting to watch. By the long feelers or tentacular cirri which surround its head, anything is grasped with which it may come into contact, such as minute shells, grains of sand, &c. These, upon being drawn near, are placed upon its mouth, the lower edge of which forms a prehensile lip. While resting here, it is, I presume, that the glutinous substance, which, when dried, forms the membranous lining of the tube, is poured over it. With its lip the creature places the sand upon its back, and then rolls itself over from side to side, and again puts forth its tentacula in search of fresh building material.

Their tubes are buried in the sand, to the depth of about a foot or more, with one end above and open to the sea, at which extremity minuter ones branch off, giving it an arborescent appearance.

The tentacular cirri are hollow, crescent-shaped tubes, which are extended and retracted by the injection into its centre of a fluid sent from the body of the animal. [It is a similar power employed by the Nereid Worms to extend the internal mouth of that family.] When it seizes anything, it does so, I presume, by exhausting the water from the convex side of the crescent-shaped tube, and consequently holds by means of the pressure of the surrounding fluid.

Within its case the Annelid has the power of moving freely and turning itself at will. Its progressing movement is performed by means of setæ, or oars, planted in thick muscular sheaths, which enable it to pass freely in one direction, but which, being directed backwards, wholly preclude a retrograde movement. The mechanism by which this latter power is executed, is by means of a long row of minute triple-pointed hooks situated at the base of each set of setæ ;

each hook, which has three points at one extremity, is finished off with a blind hook at the opposite end, the whole of which turns upon a central hinge, so that the elevation of the blind extremity, which is perhaps the ordinary position in which the apparatus rests when not employed, precludes the triple-pointed hook from interfering with the advancement of the animal in its naturally confined abode; but the instant that the blind or protecting hook is depressed, the sharp triple-pointed end becomes a most powerful agent to assist in its retiring within its own abode, and is, I believe, the only external instrument belonging to the worm possessed of this capability.

These hook-like appendages are common to most of the *Tubicolæ*, but vary in form and shape, not only with genera, but species.

The whole internal cavity of the worm, in which the viscera exist, is filled by a fluid, by means of which the animal moves; the loss of this entails destruction of motive power, to preclude which, upon receiving any external wound, the animal will cut itself, by contraction of the annular muscles, above the injury inflicted. It also will perform the same act of bisection as a means of escape from the grasp of an enemy; and this is done not only without the loss of any particle of fluid, but without any appearance of discomfort or pain to the animal.

The intestinal canal is folded upon itself for about one-third of the entire length of the worm, when it joins the outer walls, and is continued into a sort of tail or prolongated rectum. The stomach is but a slight enlargement of the alimentary passage, which again contracts into an œsophagus, the extremity of which is surrounded by a prehensile muscle, which closes and forms the mouth, surrounding the abdominal ridge of which are situated the tentacular cirri.

The respiratory apparatus consists of arborescent branchial filaments, three or four upon either side of the head. These receive the blood from the abdominal artery, (which is, in truth, a respiratory heart, since it injects the blood which it receives from a vascular plexus into the branchial apparatus, from whence it is returned to the dorsal artery,) which carries it beyond the principal viscera of the animal, and then loses itself in small branches upon the walls of the animal, and anastomoses with those which cover the alimentary canal.

Above the gills are situated two ear-like appendages, which seem adapted for the purpose of protecting the excessively delicate branchial organs from the friction of the tube, occasioned by the creature's passing to and fro.

From the head of the animal to about the lower extremity of the stomach is a mass of white granulous material, which I presume to be the ovary, and on either side several ducts lead into pear-shaped sacs. Within these sacs, early in February, I observed active motion of the fluid passing as a current in one direction, excited by a powerful set of cilia. All the sacs do not seem to be in the same state of advancement; but the progress of the young creature's development, as far as I was able to make out, is as follows:—Some of the particles of the fluid existing within the sacs seem to unite into a nucleus, which in a short time becomes the earliest formation of the new animal. This little creature is nourished in its earlier stage by the introduction within its own system of the parent fluid in which it exists. This is done through a circular umbilical pulsating heart, which opens by a slit, situated about the centre of the young animal. At this early stage the future intestinal canal is not visible, but certain oval-shaped cells are apparent in irregular positions, sometimes connected in chain-like line.

Shortly, that which I here call umbilical circulation ceases, and the young worm moves within the uterine sac; the intestinal canal becomes now more apparent, the oval cells lying more compact, and the whole surrounded by a wall. Before this is quite perfect, the young creature leaves the sac and passes into a passage or oviduct, one of which on either side of the animal traverses the walls of the worm, and opens into the rectum, beyond the point where the intestinal tube is incorporated with the outer walls of the worm, and is thus voided. Sometimes, though rarely, two young worms exist within the same sac. The greatest number which one might have is perhaps about a dozen. The average number of young found in any specimen at one time is three or four.—*Report of the Swansea Literary and Scientific Society for* 1850.

METEOROLOGICAL OBSERVATIONS FOR JULY 1851*.

Chiswick.—July 1. Hazy and mild : rain : cloudy and fine : thunder and lightning, with very heavy rain. 2. Fine : very fine : clear. 3. Uniformly overcast : cloudy and fine : densely clouded. 4. Overcast : very fine : clear. 5—7. Very fine. 8. Cloudy : rain. 9. Cloudy and fine. 10. Rain. 11, 12. Very fine. 13. Cloudy and fine : overcast : rain. 14. Cloudy : windy. 15. Fine : windy : slight rain. 16, 17. Very fine. 18. Cloudy. 19. Fine : rain : constant heavy rain in the evening. 20. Cloudy and fine. 21. Very fine. 22. Dry haze : very fine. 23. Rain. 24. Heavy rain. 25, 26. Very fine. 27. Cloudy and fine. 28. Cloudy : rain. 29. Very fine. 30. Foggy : very fine. 31. Hazy : overcast.

Mean temperature of the month .... 60°·71
Mean temperature of July 1850 .... 61 ·91
Mean temperature of July for the last twenty-five years . 63 ·13
Average amount of rain in July .... 2·30 inches.

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

Sandwick Manse, Orkney.—July 1. Fog. 2. Cloudy : clear. 3. Clear. 4. Cloudy : drizzle. 5. Damp : clear. 6. Damp : drizzle. 7. Drizzle : rain. 8. Bright : clear. 9. Bright : clear : fine. 10. Drops. 11. Showers : fog. 12. Rain. 13. Cloudy : rain. 14. Damp. 15. Drizzle : rain. 16. Cloudy. 17. Damp : drizzle. 18. Bright : fine. 19. Fine. 20. Bright : rain. 21. Drizzle : rain : cloudy. 22. Bright : clear : fine. 23. Fine : clear : fine. 24. Cloudy : fine. 25. Cloudy : drizzle. 26. Cloudy : rain. 27. Drizzle : fine. 28. Rain : cloudy. 29, 30. Cloudy. 31. Rain : drizzle.

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* The observations from the Rev. W. Dunbar of Applegarth Manse have not reached us.

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

Days of Month.	Barometer.							Thermometer.							Wind.				Rain.			
	Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. July.	Max.	Min.		9 a.m.	9 p.m.	9½ a.m.	8½ p.m.	Max.	Min.		Max.	Min.	9½ a.m.	8½ p.m.								
1.	30·005	29·899	29·48			30·08	30·10	78	59	69			57	53	e.	e.		n.	1·18	......		......
2.	29·988	29·851	29·37			30·26	30·33	82	54	67			53	53	ne.	ne.		nne.	......	......		......
3.	30·021	30·013	29·56			30·30	30·19	66	52	58			52	53	ne.	n.		wnw.	......	......		......
4.	30·027	30·011	29·57			30·03	29·94	67	37	58·5			53	51	ne.	n.		wnw.	......	......		......
☽ 5.	30·021	29·975	29·54			29·94	29·97	75	45	55			53½	49	n.	sw.		calm	......	......		·04
6.	30·058	30·050	29·54			29·93	29·86	74	50	63			53	54	nw.	sw.		w.	......	......		·05
7.	30·051	29·903	29·53			29·83	29·73	75	55	65			54	53	nw.	w.		nw.	......	......		·04
8.	29·798	29·714	29·20			29·79	29·85	71	50	63·5			52	45	nw.	w.		nnw.	·08	·14		·28
9.	29·811	29·696	29·30			29·73	29·70	67	43	58			51½	46	sw.	wsw.		n.	·16	·34		......
10.	29·864	29·677	29·20			29·74	29·84	69	38	60			46	48	nw.	wnw.		wnw.	·24	·05		·09
11.	30·140	30·089	29·63			29·84	29·73	70	56	57·5			51	53	w.	w.		w.	......	......		·08
12.	30·036	29·919	29·50			29·66	29·45	75	48	65			56½	52	w.	wnw.		wnw.	......	......		·19
○ 13.	29·866	29·571	29·27			29·45	28·94	73	51	66			56	56	sw.	sw.		sse.	·20	......		·30
14.	29·577	29·452	28·85			28·84	29·00	71	50	63			60	51½	w.	w.		wnw.	......	·17		·40
15.	29·730	29·727	29·18			29·28	29·47	70	41	59			49	47	w.	w.		nw.	·02	·01		·05
16.	29·884	29·763	29·30			29·62	29·74	67	46	56			48	47	nw.	wnw.		nw.	......	......		·18
17.	29·851	29·826	29·48			29·76	29·77	74	41	63			50	49	nw.	calm		w.	......	......		......
18.	29·950	29·893	29·44			29·79	29·83	72	39	57			53	52	nw.	nw.		calm	......	·41		·03
19.	29·970	29·806	29·48			29·84	29·82	71	52	61			61	53	sw.	w.		calm	·31	......		......
20.	29·775	29·708	29·16			29·73	29·68	72	50	67			58	51	sw.	sw.		nne.	......	·10		......
☾ 21.	29·979	29·960	29·44			29·65	29·87	72	42	58			51	49½	w.	w.		nw.	......	·63		·19
22.	30·036	29·806	29·57			29·96	29·96	76	58	59			53	51	e.	calm		calm	·08	......		·30
23.	29·737	29·550	29·32			29·86	29·80	71	57	64			56½	55	e.	ese.		calm	·70	......		......
24.	29·553	29·473	29·03			29·74	29·73	60	53	54			58	51	sw.	n.		calm	·28	2·65		......
25.	29·888	29·469	29·05			29·66	29·61	71	51	59			52½	51	ne.	nw.		n.	......	·40		......
26.	29·749	29·656	29·20			29·56	29·60	69	44	57·5			54	49	w.	nw.		nw.	·01	·30		·18
27.	29·914	29·898	29·40			29·70	29·75	72	57	58			54	55	sw.	w.		e.	·02	·02		·18
● 28.	29·895	29·803	29·33			29·60	29·62	69	57	62			53	52	sw.	s.		nnw.	·06	·26		·27
29.	29·790	29·768	29·30			29·75	29·97	75	49	67			56	50½	sw.	w.		n.	·03	·18		·06
30.	29·973	29·837	29·43			30·03	29·93	75	55	64			57½	52	nw.	n.		se.	·52	·07		......
31.	30·000	29·886	29·50			29·58	29·58	73	62	63			54	55	sw.	calm		w.	·01	......		·41
Mean.	29·901	29·795	29·36			29·759	29·753	71·68	49·74	61·2			53·77	51·20					3·90	5·73		3·32

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 46. OCTOBER 1851.

XXI.—*On the* Cidaridæ *of the Oolites, with a description of some new species of that family.* By Thomas Wright, M.D. &c.*

[With three Plates.]

The Echinoderms form the highest class of the radiated animals; it includes organisms which are either fixed or free, composed of a regular but very complicated skeleton, secreted by and inclosed within organized membranes, and often preserved in admirable perfection in the fossiliferous strata of all periods of the earth's history. The study of this class, although hitherto much neglected by geologists, presents many points of importance to the progress of their science, for the test of Echinoderms exhibits characters of more import and significance than those afforded by the shells of Mollusca. Unlike the testaceous covering of that class, the test of Echinoderms constitutes an internal and integral part of the animal, participating in its life, intimately connected with the organs of digestion, respiration and generation, as well as with those of locomotion and vision, and having in consequence many of the distinctive characters of the organism impressed upon it.

In all Echinoderms, the external parts of the body, with the organs of locomotion, are disposed around a common centre; in the spherical forms they are arranged in rows like the lines of longitude on a terrestrial globe, and the mouth and the anus are situated at the opposite poles: the elements of the body are repeated several times in the composition of the skeleton.

It has been shown by M. Agassiz† that the radiated type of

* Read at Cheltenham at the Meeting of the Cotteswold Naturalists' Club, June 24, 1851.

† Prodrome d'une Monogr. des Echin., Mém. Soc. de Neuchâtel, tom. i. p. 168.

structure observable in this class can be resolved into a modification of the bilateral symmetry seen in the higher groups of the animal kingdom. The elements of the skeleton are arranged on two sides of a median line. If we take for example the *Spatangus purpureus,* we observe that the test is elongated in the direction of the line which connects the mouth with the anus; the mouth being situated at the base and nearer the anterior border of the test, whilst the anus occupies an elevated position on the posterior border. Were we to make a transverse section of the Spatangus, we should have an oral or anterior half, and an anal or posterior half; whilst, on the contrary, were we to split the test asunder in the line of its long diameter, we should have the right half and the left half of the body. The five ambulacral areæ are unequal. The anterior area is not identical with either of the others; the first pair are symmetrical, but differ from the second pair, which are likewise symmetrical; the bilateral symmetry of these oblong Spatangoidæ is therefore very evident. In the globular forms of Cidaridæ, however, a more careful study is requisite to make the demonstration complete. In them the test is formed of polygonal plates united together by sutures and divided into ten segments, of which five are named ambulacral areæ, and five interambulacral areæ, each area being formed of two columns of plates; the ambulacral and interambulacral areæ alternate with each other, and are separated by ten zones of small plates perforated for the passage of tubular retractile organs connected with locomotion and respiration, and forming the poriferous avenues.

The test of *Echinus sphæra* is composed of twenty distinct zones of elementary parts, which are narrow at the summit, from whence they divide in rays, and gradually increase in width towards the circumference or equator, where they are widest; they again contract as they approach the mouth, which occupies the base. The symmetrical disposition of these elementary zones occasions the radiated form which characterizes the Cidaridæ. Besides the plates of the ambulacra, interambulacra, and poriferous avenues, the summit of the test is furnished with a circle of plates surrounding the anus, composed of five larger plates in relation with the generative organs, and called ovarial, and five smaller plates disposed between them, in which are lodged the organs of vision, and called ocular; each of the ten plates is perforated with a small hole for giving passage to the genital ducts and for lodging the eyes. This anal circle of plates is called the apical rosette or disc.

The ovarial plates occupy the summit of the interambulacral areæ, and the ocular plates the summit of the ambulacral areæ; the ovarial plates are not all of equal size or of the same structure;

one is larger and more prominent than the others, presenting a spongy porous surface, and called the madreporiform plate; it is placed opposite the ambulacra, which is the analogue of the anterior area in the *Spatangus*, and occupies therefore the posterior border of the apical disc, affording thereby a key for ascertaining the antero-posterior diameter of the body; the other four ovarial plates are disposed in pairs before the single madreporiform plate. The polygonal plates of both areæ are arranged in double vertical rows, two columns of ambulacral plates alternating with two columns of interambulacral plates; the plates of each pair are united by a zigzag suture formed by the re-entrant angles of the plates; the plates of the ambulacra are united to those of the interambulacra by minutely serrated edges. The poriferous zones have small plates, the sutures of which cut through the centre of the holes, by which arrangement the enlargement of the foramina with the growth of the test is provided for.

The surface of the test is covered with tubercles for supporting spines; these are of two kinds, the principal and the miliary tubercles. The principal tubercles are in general raised on mammillated eminences with or without crenulations at their summit, and arranged in vertical rows on the sides of the areæ between the mouth and the anus. The miliary tubercles are much smaller and more numerous; they are not disposed with the same regularity, but are frequently scattered on the surface of the plates, or disposed in circles around the bases of the principal tubercles.

Each tubercle supports a spine, the size of which corresponds with that of its tubercle; the spines are composed of three distinct parts, the stem, the neck, and the articular head. The stem is more or less elongated and of various forms; the head is surrounded by a raised ridge, and has a concave excavation for its articulation with the tubercle; the head is separated from the stem by a smooth neck, the extent of which varies in the different species. The spines present very numerous modifications of size, form and sculpture, which are closely connected with specific distinctions; some are elongated, cylindrical, fusiform, or subulate; others are compressed, spatuliform, or triangular; whilst others, on the contrary, are expanded, pyriform or claviform.

The surface of the spines is smooth, striated, or furnished with granules, prickles, or other asperities disposed in regular order or scattered at hazard over the stem. The same individual has its test occupied with different kinds of spines; hence the great importance of obtaining these appendages in connection with the test.

We have made the following estimate of the number of separate pieces which enter into the composition of the test of *Echinus sphæra*:—

Interambulacral areæ 32 plates in each column	$32 \times 2 \times 5 =$	320 plates.
Ambulacral areæ 80 do. do.	$80 \times 2 \times 5 =$	800 do.
Poriferous avenues 160 do. do.	$160 \times 2 \times 5 =$	1600 do.
Apical disc 10 plates		10 do.
Each interambulacral plate supports 10 tubercles	$320 \times 10 =$	3200 tubercles.
Each tubercle supports a moveable spine		3200 spines.
Each ambulacral plate supports 2 tubercles ...	800×2	1600 tubercles.
Each tubercle supports a moveable spine		1600 spines.
There are 70 rows of holes in each avenue, and in each row these six holes are disposed in pairs obliquely	$70 \times 6 \times 10 =$	4200 foramina.

The mouth in the Cidaridæ is situated at the centre of the basal surface, and provided with five jaws, each armed with a long tooth; the jaws are united by ligaments and moved by numerous muscles belonging to the voluntary class.

According to Prof. Brunner, the analysis of the test of *Echinus lividus* gave the following result as its chemical composition:—

Carbonate of lime	96·27
Sulphate of lime	1·53
Carbonate of magnesia . . .	0·93
	98·73

The fracture of the test and the spines presents a peculiar crystalline surface altogether unlike that of the external skeleton of other Invertebrata, depending probably on the manner the salts of lime and magnesia are deposited in the cells of the animal basement membrane. The external and internal surfaces of the test are covered by organized membranes, which extend through the sutures and invest the spines and pedicellariæ, and are the producers and the sheath of the test and its appendages.

The mode by which the spheroidal test of an Urchin maintains its original form, whilst it increases in all directions, is easily understood after what we have stated relative to its composition. The viscera of the animal are inclosed in this fragile and inflexible globular crust, which is never shed like the external skeleton of the Crustacea, but grows by a process which has some analogy with the expansion of the skull in the vertebrate classes. By the division and subdivision of the hollow globe into a number of elements inclosed between two layers of membrane, additions are made to the periphery of the plates, whereby they are enlarged and increase in thickness in proportion to the requirements of the animal, so that the form of the test is maintained and its expansion provided for at the same time: the difference between the test of a young and an old Urchin chiefly consists in the number and size of the plates entering into the composition of the same. The new plates are developed around the oral and anal poles, but chiefly near the latter region, where we may observe in young Urchins small plates loosely connected together and supporting incomplete spines.

The numerous genera of the family Cidaridæ are distributed by M. Agassiz into four groups :—

1. The Cidaridæ are characterized by their thick test, narrow ambulacra, and large principal tubercles in the interambulacral areæ.

2. The Salenians are characterized by the development of their apical disc, and the presence of an additional central or suranal plate in the same.

3. The Echinidæ have a thin test, and numerous small principal tubercles in the ambulacral and interambulacral areæ.

4. The Echinometrans have an elongated oblong form in a direction oblique to the antero-posterior diameter of the test.

Family Cidaridæ*.

Form circular. Mouth central, situated at the inferior pole, closed by a buccal membrane which is either naked or covered with granules. Anus opposite the mouth, opening in a ring composed of ten plates, five of which appertain to the genital, and five to the visual organs. The antero-posterior diameter is indicated by the median madreporiform body which becomes united to the single ovarial plate. The plates of the test support tubercles disposed in regular order for carrying moveable spines of various forms, some of which are proportionably large. The organs of mastication consist of five jaws, each armed with a long tooth. This framework is articulated to the test by several arched processes called auricles.

Genus Cidaris, Lamk.

Form circular, test thick, flattened at both poles. Ambulacral areæ narrow, about one-fourth the diameter of the interambulacral areæ, and covered with small close-set granules. Pores disposed in simple pairs. The principal tubercles in the interambulacral columns are perforated, and carry large heavy spines which are smooth or furrowed, spiny or granular. The ovarial plates are large, pentagonal and equal ; the ocular plates are small and triangular, and wedged between the ovarial. The mouth is circular and without indentations ; the buccal membrane is covered with imbricated scales upon which the ambulacral pores extend. Jaws powerful, composed of five pyramids, the branches of

* The group of Cidaridæ includes six genera : *Cidaris*, Lam., *Goniocidaris*, Desor, *Hemicidaris*, Agass., *Acrocidaris*, Agass., *Acropeltis*, Agass., *Palæocidaris*, Agass.

which are not united at their summits. Teeth channelled, not carinated on their internal surface. This genus admits of a natural division into two types; in the one the tubercles are smooth, in the other they are crenulated at their base.

The first type.—*Tubercles with the base not crenulated. Are found in our present seas, and fossil in the carboniferous, triasic, cretaceous, and tertiary rocks. They are not found in the Oolitic strata, to which group the present paper is restricted.*

The second type.—*Tubercles with the base crenulated. Comprehends oolitic and triasic forms.*

The circular mouth without indentations serves to distinguish the genus *Cidaris* from the genus *Hemicidaris.* The form of the ambulacral areæ, the number and arrangement of the granules on the same, the size of the tubercles, and the number of their crenulations afford good specific characters. The ovarial and ocular plates are seldom preserved. The lantern and teeth ought to be carefully studied, as they are sometimes found detached; the spines likewise yield good specific characters, but they are seldom preserved along with the test.

Cidaris Fowleri, Wright, n. sp. Pl. XI. fig. 5 *a, b, c.*

Test spheroidal, depressed at both poles; ambulacral areæ flat, narrow and undulated, furnished with two rows of small, regular marginal granules and two rows of central blunt irregular microscopic granules; poriferous avenues wide; pores oblong and distant; interambulacral areæ furnished with two rows of from 8–10 principal tubercles; intertubercular spaces wide and covered with small granulations; spines large, with irregular forward-directed prickles.

Height 1 inch $\frac{1}{10}$th, transverse diameter 1 inch and $\frac{8}{10}$ths. Specimens from the upper stages of the Oolites measure in height 1 inch and $\frac{8}{10}$ths, transverse diameter 2 inches and $\frac{8}{10}$ths.

Description.—This beautiful Urchin has been catalogued as *C. coronata,* but it presents characters very distinct from that form; a fact which has been ascertained by comparing *C. Fowleri* with the typical specimens of *C. coronata* in the British Museum: the latter species has hitherto been found only in France, Germany, and Switzerland, and figured in the works of Goldfuss, Agassiz, and Cotteau. In the Swiss Jura *C. coronata* characterizes the terrain à chailles, a local formation, the greatest similarity to which exists palæontologically with the lower calcareous grit of Yorkshire; in l'Albe Wurtembergeoise it appertains to the Coralline Oolite.

The ambulacral areæ of *C. Fowleri* are slightly serpentine and ribbon-shaped, and nearly of a uniform breadth throughout. The poriferous avenues are broad; the pores are oblong and set in pairs in a single file at short distances apart. The areæ are flat, slightly raised, and have four rows of granules; the external rows consist of larger granules, which range regularly on the margins of the areæ; the internal rows consist of small, flat, almost microscopic granules; there are fifteen pairs of holes opposite each of the large tubercular plates.

The interambulacral areæ are formed of broad plates; the zig-zag median sutural line is very clearly defined; each column contains from eight to ten primary tubercles, so that the test of this Urchin supports from 80 to 100 large spines. Each plate is occupied with a smooth areola slightly furrowed at its circumference and raised into a boss towards the centre. The summit of the boss is sculptured with fifteen deep crenulations; from the boss arises a short cylindrical stem terminated by a small hemispherical deeply perforated spinigerous tubercle, the diameter of which exceeds a little that of its stem; the margin of each areola is bounded by a circle of fifteen prominent granules, some of which from the equator to the anal pole are raised upon broader bases. There is a granular circle around each areola, but from the equator to the buccal pole one row of granules is common to two areolæ. The interareolar spaces are covered with small close-set granules of two different sizes. The mouth is large, and is half the diameter of the test at the equator. In the specimen before me the five strong pyramids of the lantern are armed with conical triangular teeth *in situ*. The anal disc was broken in all the specimens hitherto found.

The spines are never seen attached to the test, but in the same bed and lying near some of these Urchins, long cylindrical slightly flattened spines have been found about $1\frac{1}{2}$ inch in length and from 2 to 3 lines in diameter, with a crenulated base, short neck, and having the surface of the flattened stem covered with short sharp prickles, the points of which are directed forwards; these spines most probably belonged to *C. Fowleri*, as it is the only Urchin found in the same bed whose test could support such large spines (fig. 5 *c*).

Affinities and differences.—Cidaris Fowleri resembles *C. Blumenbachii* in the general form and structure of the test, but it differs from that well-known species in the flatness of the ambulacral areæ, in the greater breadth of the poriferous avenues, and in having a greater number of plates in the interambulacral columns; the granulated space between the principal tubercles is wider, and the granular wreath encircling the areolæ is likewise composed of smaller granules. It differs from *C. Parandieri*, Ag., in having a greater number of tubercular plates in the interambulacral areæ. It resembles *C. maxima*, Goldf., in the general outline of the test, the width of the granular spaces between the tubercles, and in the spines supposed to belong to *C. Fowleri* being armed with short forward-directed prickly processes like those of *C. maxima*. It differs from *C. propinqua* in having a greater number of plates in the interambulacral areæ.

Locality and stratigraphical range.—*Cidaris Fowleri* was obtained from the ferruginous beds of the Pea-grit at Crickley Hill. I have dedicated this beautiful species to my friend Charles Fowler, Esq., who obtained two fine specimens from this locality, and to whose generosity I am indebted for the one which has served for my description and enriches my cabinet.

Cidaris Blumenbachii, Munster.

Syn. *Cidarites Blumenbachii*, Munst.; Goldfuss, Petref. Germaniæ, t. 39. p. 117.

Cidaris Blumenbachii, Agassiz, Echin. Foss. 2nd part, t. 21. p. 61; Park. Org. Rem. vol. iii. t. 4. fig. 15.

Cidaris florigemma, Phillips, Geol. of York. t. 3. fig. 12.

Cidarites Blumenbachii, Munst.; Cotteau, Etudes Echin. Foss. t. 10. p. 108.

Test circular, inflated at the sides and depressed at the poles; ambulacral areæ narrow, elevated, undulated, and furnished with four rows of granules; interambulacral areæ with two rows of from six to seven tubercles; areolæ approximated, elliptical and excavated, and surrounded by a circle of small tubercles; spines large, thick, subcylindrical, and ornamented with longitudinal rows of granules; neck short and smooth.

Height 1 inch and $\frac{4}{10}$ths, transverse diameter 2 inches; spines 1 inch and $\frac{8}{10}$ths in length, and $\frac{4}{10}$ths of an inch in diameter.

Description.—This typical species was very abundant in the seas which deposited the Coralline Oolites of Europe. It has a globular form considerably depressed at the poles; the ambulacral areæ are narrow, nearly of a uniform breadth throughout; they are much undulated and furnished with four rows of granules; the external rows are larger, more regular and prominent, and more developed towards the base than the internal rows. The poriferous avenues follow the undulations of the areæ; they are narrow, and lie in a groove formed by the prominent granules of the ambulacral and the external marginal granules of the interambulacral areæ. The interambulacral areæ are five times as wide as the ambulacral, and are occupied with two rows of large prominent tubercles from six to seven in each row, which are supported on large mammillary eminences gradually rising from smooth elliptical areolæ. The mammæ at their summits are sculptured with from 18–20 crenulations, and the areolæ are separated from each other by a circle of granules made more prominent, inasmuch as they are raised on oval elevations of the test. The principal tubercles are small and closely set together at the base, but at the equator, and always at the upper part of the test, they become largely developed; the narrow central space between the ranges of the large tubercles is occupied with an abundant granulation, the granules of which are smaller, however, than those encircling the areolæ.

The mouth is armed with powerful jaws and teeth, which are not, however, preserved in the specimens before me; the apical disc is unknown.

The spines attain a great size; they have an elongated thick subcylindrical form which suddenly expands above the neck, and then gradually tapers towards the apex; their surface is covered with small granulations, very uniform in size and disposed in longitudinal rows; the tubercles of the adjoining rows alternate, and each series is connected by a filament which passes from one tubercle to another; at the summit of the spine the granules become elongated, and expand to form a radiated star-like disc; the neck of the spine is short and smooth, the articulating head is small, and the rim of the acetabulum is encircled with crenulations.

Affinities and differences.—*C. Blumenbachii* is distinguished from *C. Fowleri* in the extreme narrowness of the ambulacral areæ, the size and prominence of the granules which cover the same, and in the closer approximation of the pairs of pores in the avenues. The interambulacral areæ are wider, whilst the central granular space between the tubercles is narrower; there are fewer ranges of tubercles in the areæ, and the areolæ are encircled by much larger granules; but it is in the structure of the spines that the greatest difference is observed: instead of the well-known regular form of the tubercles so constant in the spines of *C. Blumenbachii*, the spines of *C. Fowleri* are compressed and covered with irregular rows of prickles.

Locality and stratigraphical range.—This Urchin is very characteristic of the Coralline Oolites of Wilts, Oxfordshire, and Yorkshire; we have never seen it either in the Inferior or the Great Oolite; our specimens are from the Coral Rag of Wiltshire; it occurs in France in the corallian stages of Châtel-Censoir and Druyes and in the environs of Tonnerre, and at Bailly and at Courson *. In Germany it was found at Thurnau and Muggendorf †; in the coralline Oolite of Hildesheim in the kingdom of Hanover ‡; in Switzerland in the terrain à chailles of Fringelli,

* Cotteau, Echin. Foss. p. 110. † Goldfuss, Petr. Germaniæ, p. 117.
‡ A. Roemer, Norddeutsches Oolithen Gebirge.

Wahlen, and Gunsberg in the canton of Soleure, and in the white corallian of Hoggerwald *.

History.—This beautiful species was long ago figured by Parkinson in his 'Organic Remains,' afterwards it was most accurately figured and described by Goldfuss in his 'Petrefacta,' and subsequently by Agassiz, Phillips, and Cotteau, in their respective works.

Cidaris propinqua, Münster. Pl. XI. fig. 6.

Syn. *Cidarites propinquus*, Münst.; Goldfuss, Petrefact. German. p. 119. t. 40. fig. 1, 2; Agassiz, Prodrom. Echin. p. 21; Echinoderm. Foss. Suisse, p. 62. t. 21. fig. 5–10; Desmoulins, Tabl. Synop. p. 328. No. 17.

Cidaris monilifera, Agassiz, Catal. Syst. Ectyp. Neoc. p. 9.

Cidaris coronata, var. *minor*, Agassiz and Desor, Cat. raisonné des Echinides; Cotteau, Echinides Foss. du Départ. de l'Yonne, p. 104.

Test thick, circular, and depressed at the poles; ambulacral areæ narrow, sinuous, and furnished with two rows of small round prominent granules; interambulacral areæ with two rows of large prominent tubercles, six in each row, raised on small mammillary eminences with smooth summits; "spines with a short neck and a thick granulated stem;" apical disc unknown.

Height $\frac{6}{10}$ths of an inch, transverse diameter 1 inch.

Description.—This Urchin resembles in many points the preceding species, but exhibits characters very distinct from it. The ambulacral areæ are extremely narrow and serpentine, having two rows of small prominent granules arranged on the margins of the areæ, with a few central microscopic ones between them about the equator. The pores are placed in rather deep winding avenues, closely and obliquely together in single pairs. The interambulacral areæ are nearly five times the width of the ambulacral, and furnished with two rows of tubercles, six in each row; they are large, prominent, slightly perforated, and nearly spherical; the mammillated eminences on which they are supported being disproportionately small, and having smooth and convex summits, unlike the crenulated summits observed in the mammæ of other Oolitic *Cidaridæ*. The specimen before us is too much injured to enable us to state whether any rudimentary sculpture surrounds the summits of the mammæ on the superior surface of the test, as is the case in the Swiss and German specimens. The areolæ are shallow and nearly of a circular form, their margins being encircled by a wreath of twelve small round prominent granules supported on little eminences, and forming a distinct beaded boundary for each tubercle. The median space down the centre of the areæ is slightly concave, and filled with

* Agassiz, Echin. Foss. Suisse.

granules of a much smaller size than those encircling the margins of the areolæ. The mouth-opening is circular and about one-half the diameter of the test at the equator; the tubercles surrounding the mouth are well developed, but smaller than those occupying the middle and upper part of the test. The apical disc is absent, but the space which it filled is of considerable diameter. The spines have not been met with in our locality.

Affinities and differences.—*C. propinqua* so nearly resembles *C. coronata,* that although it was described as a distinct species by Agassiz in his 'Echinoderm. Foss. de la Suisse,' it was afterwards grouped as var. *minor* of *C. coronata* in the 'Catalogue raisonné des Echinides*' of the same author. The test of this Urchin has unquestionably a very close resemblance to *C. coronata,* but a fact mentioned by Goldfuss should not be overlooked; he found peculiar spines associated only with *C. propinqua,* which never occurred with *C. coronata*†. The extreme narrowness of the ambulacral areæ with the two marginal rows of granules likewise distinguish it from *C. coronata,* which has six rows in the same areæ. In the absence of crenulations from the mammillary eminences on the lower part of the test, together with the bead-like granular circle around the areolæ, it resembles *C. coronata.* Not having a specimen of that species in our cabinet with which to compare the specimen before us, we are unable to pursue the comparison further.

Locality and stratigraphical range.—Whilst searching the Pea-grit of Crickley Hill to find a more perfect specimen of *Goniopygus* for Mr. Baily to figure, I discovered *C. propinqua,* having only seen a defaced specimen once before from the same bed and locality, which was too much worn to be identified. We have never seen this species in any collection of Inferior Oolite fossils, and from the pains we have taken to ascertain the different species found in the Cotteswold Hills, it must be rare; it occurs in the Stonesfield slate at Eyeford, but is very rare ‡. In Germany it was found by Count Münster in the Baireutheschen Jurakalke, principally in the vicinity of Streitberg §. In Switzerland it occurs in the Terrain à chailles in the environs of Besançon, Bâle, Randen, and Sirchingen ||. In France it was collected by M. Cotteau from the corallian stage at Druyes, but always in the state of moulds, the specimens being of small size and having very narrow ambulacral areæ ¶.

* Annales des Sciences Nat. tom. vi. 3rd series, p. 331.

† Goldfuss, Petrefact. part 1. p. 120.

‡ Sir R. Murchison, Geol. of Cheltenham, 2nd ed., by Buckman and Strickland, p. 68.

§ Goldfuss, Petrefact. German. part 1. p. 120.

|| Annales des Sciences Nat. tom. vi. 3rd series, p. 331.

¶ Echinides Foss. du Départ. de l'Yonne, p. 106.

History.—First figured and described by Goldfuss in his 'Petrefacta Germaniæ,' and afterwards by Agassiz in his 'Déscription des Echinodermes Foss. de la Suisse,' and now figured and described as a British fossil from the Inferior Oolite near Cheltenham for the first time.

Genus Hemicidaris (Agassiz).

Test subglobose, more or less flattened at the poles. Ambulacral areæ narrow and sinuous, furnished with primary tubercles on the lower fourth part of each area, which suddenly diminish into small tubercles or granules above, set more or less closely together like those in the areæ of *Cidaris*. Interambulacral areæ much larger than the ambulacral, widest at the equator of the test and narrowest at the poles; around the circumference of the mouth they are about the same breadth as those of the ambulacral areæ.

The primary tubercles of the interambulacral areæ are raised upon large prominent mammillary eminences, having a crenulated margin encircling the base of the tubercle; the equatorial plates carry the largest mammillary eminences. Pores biserial, except near the mouth, where they are triserial. Mouth large, with decagonal indentations around its circumference. Anus central, surrounded by a solid circle of ten plates which are often well preserved. The five ovarial plates are larger and perforated at their summits. The single or madreporiform plate is the largest; it has a more porous structure, and is differently sculptured from the pairs of plates. The five ocular plates are small and triangular: both ovarial and ocular plates are covered with minute granulations.

Spines of two orders: the primaries are long, cylindrical, and mostly of considerable dimensions, the secondaries are small and compressed. This genus differs from the true *Cidaris* in the bases of the ambulacral areæ supporting primary tubercles. *Hemicidaris* thus forms a type of structure intermediate between *Cidaris* and *Diadema*. In *Hemicidaris* the mouth is decagonal, in *Cidaris* it is circular.

All the species are fossil, and characterize the middle and upper stages of the oolitic rocks. Some are found in the Neocomian and in the Chalk.

Hemicidaris intermedia, Fleming.

Syn. *Cidaris papillata*, var. Park. Org. Rem. pl. 1. fig. 6. vol. iii.
Cidaris intermedia, Fleming, Brit. Animals, p. 478.
Hemicidaris crenularis, Morris, Cat. Brit. Foss. p. 53; Strickland and Buckman, Geol. of Chelt.
Hemicidaris intermedia, Forbes, Brit. Org. Rem. Decade 3. pl. 4.

Test subglobose or subconical; ambulacral areæ narrow and slightly undulated, with a double row of small perforated tubercles on the margins, and ten larger tubercles at the basis of the areæ; interambulacral areæ occupied with six or seven pairs of primary tubercles which are raised on large closely-approximated prominent mammæ, with deeply crenulated summits; mouth large and decagonal, margins deeply notched; spines long, cylindrical, and striated longitudinally, with a tumid base; apical rosette not prominent.

Great Oolite specimens: height $\frac{9}{10}$ths of an inch, transverse diameter 1 inch and $\frac{3}{10}$ths. Coral Rag specimens: height 1 inch and $\frac{4}{10}$ths, transverse diameter 1 inch and $\frac{6}{10}$ths.

Description.—The test of this Urchin has sometimes a subglobose form; in other varieties the height exceeds the breadth, and it then presents a subconical outline. The summit is slightly depressed and the base is flat. The ambulacral areæ are narrow and gently undulated; at the base or lower third we observe five pairs of moderate-sized tubercles; at the upper two-thirds the tubercles become very small and are ranged on the margins of the areæ; both the large and small tubercles are mammillated and perforated. The pores are arranged in simple pairs, but at the enlarged space around the mouth additional pairs are introduced. The interambulacral areæ are nearly four times the width of the ambulacral, and furnished with six or seven pairs of large primary deeply perforated tubercles. The mammillary eminences on which these tubercles are placed are largely developed and form prominent projecting cones, the bases of which touch those of the adjoining cones in the same range; an undulating line of small perforated granules separates the external border of the mammillary bases from the poriferous avenues, and a double row of similar granules forms a zigzag division down the centre of the areæ. The upper and lower boundaries of the areolæ of the mammæ are confluent, whilst their outer and inner boundaries are surrounded with the granules already described.

The apical rosette is moderate in size, being about one-fourth the diameter of the test; the madreporiform plate is larger than the pairs of ovarial plates; the ocular plates are heart-shaped, and the surface of the elements of this disc is studded with small granules.

The mouth is large, being half the diameter of the test; it has a decagonal form; and the margin is deeply notched.

The spines are of two kinds: the primary ones are long, cylindrical and tapering, and grow to double the length of the diameter of the test, some of them measuring $3\frac{3}{4}$ inches in length; they are delicately grooved in the longitudinal direction, and the base is provided with a raised crenulated band, situated between two convex smooth bands; another smaller crenulated band surrounds the rim of the socket which affords attachment to the ligaments articulating the spine with the tubercle. The secondary spines are small, needle-shaped and compressed, and striated longitudinally.

Affinities and differences.—This species approaches so near to *H. crenularis* that it was long regarded as Lamarck's species. The form and development of the spines of the two Urchins however prove them to be distinct; this circumstance shows the necessity of caution in the identification of species of Echinidæ in the absence of any of the data upon which a correct opinion can alone be formed. *H. intermedia* resembles *H. icaunensis* in its general outline, but is distinguished from that species by its more prominent tubercles, in having the ambulacral areæ more undulated and having larger tubercles at the base. These characters likewise sufficiently distinguish it from *H. alpina* and *H. granulosa.*

Locality and stratigraphical range.—One of our specimens was obtained from the spoil of Salperton Tunnel from a bed belonging to the Great Oolite; the other specimen was collected from the Bradford clay near Cirencester. We have never met with *H. intermedia* in the Inferior Oolite. This Urchin is very abundant in the Coral Rag of Calne, from whence most cabinets have been supplied. The varieties in the Great Oolite are more globular and depressed than those obtained from the Coral Rag.

History.—As it is uncertain whether we possess *H. crenularis* in our beds, it is probable that *H. intermedia* was figured and described by Martin Lister*. Our synonyms show the changes of name through which this species has passed. It has, however, been so accurately described by Prof. Forbes, and so admirably figured† in the 'Memoirs of the Geological Survey,' that we must refer to that work for further details of the species.

Hemicidaris icaunensis, Cotteau.

Syn. *Hemicidaris icaunensis,* Cotteau, Echin. Foss. t. 3. fig. 1–5. p. 56; Forbes, Geological Survey, Mem. Decade 3.

Test hemispherical, inflated and slightly depressed; ambulacral areæ with two rows of small marginal tubercles, and with three or four pairs of larger tubercles at the base; interambulacral areæ with two ranges of primary tubercles; mouth large and decagonal; margin deeply notched.

Height $\frac{8}{10}$ths of an inch, transverse diameter 1 inch and $\frac{2}{10}$ths.

Description.—This species is hemispherical and inflated at the

* Historia Animalium Angliæ, t. 7. fig. 21, 1678.

† British Organic Remains, Decade 3. pl. 4.

sides, and its transverse diameter is one-half more than its height. The interambulacral areæ are furnished with two rows of large primary tubercles; in each range there are from six to seven tubercles, which attain their greatest development at the equator of the test, and diminish in size near the anal and buccal openings. The mammillary eminences supporting the tubercles are large, prominent, and surrounded by areolæ. The tubercles are small and perforated; one row of granules separates the large tubercles from the poriferous avenues, and a double row occupies the middle of the areæ. The lateral boundaries of the areolæ are surrounded by a semicircle of granules, whilst the upper and lower boundaries of the same blend into each other.

The ambulacral areæ are narrow, slightly undulated, and furnished through nearly all their extent with a double row of small tubercles, which are not very apparent, but are larger on the sides than at the apex of the areæ; between the size of these and the three pairs of tubercles at the base a sensible difference exists. The mouth-opening is large, and is one-half the diameter of the test; it is of a decagonal form with the margin deeply notched. The apical disc is not preserved and the spines are unknown.

Affinities and differences.—The *Hemicidaris icaunensis* in its general form and characters closely resembles the *H. intermedia*; it is distinguished from the latter by having the primary tubercles of the interambulacral areæ less prominent, by the ambulacral areæ being less waved, and in having the basal tubercles much smaller. This character assimilates *H. icaunensis* to *H. Thurmanni*, but it is sufficiently distinguished from that Urchin by its greater height, less undulated ambulacra and the greater number of tubercular plates in the interambulacral areæ.

Locality and stratigraphical range.—This rare species was obtained by Mr. Lycett from the Great Oolite of Minchinhampton. M. Cotteau collected it in France from the superior beds of the Bathonian stage at Châtel-Censoir, and M. Rathier found it in the Forest marble of Châtel-Gérard, where it is likewise rare.

History.—This species was first figured and described by M. Cotteau*, and was provisionally identified by Prof. Forbes†; it is figured in plate A. fig. 9. of the 'Monograph of Great Oolite Fossils' to be published by the Palæontographical Society. The specimen that has come under our notice is so imperfect that we have followed M. Cotteau's description.

* Echinides Foss. du Département de l'Yonne, tab. iii. p. 56.

† Memoirs of the Geological Survey; Brit. Organic Remains, Decade 3. Description of plate 5.

Hemicidaris alpina, Agass. Pl. XI. fig. 3 *a, b*.

SYN. *Hemicidaris alpina*, Echin. Foss. Suisse, Agass. t. 18. fig. 19–22.

Test subglobose; ambulacral areæ undulated, prominent and convex, covered with small hemispherical granules closely set together; base of the areæ with four mammillated and perforated tubercles; apical disc large, convex and prominent.

Height nearly $\frac{6}{10}$ths of an inch, transverse diameter $\frac{9}{10}$ths of an inch.

Description.—The test of this beautiful species is subglobose; the ambulacral areæ are slightly undulated and of a medium size; they are prominent and convex, of an elongated conical form, and are thickly covered with small hemispherical granules without perforations or other sculpture; the marginal rows are larger and more regular. Between them are from four to six rows of smaller granules closely set together.

At the base of the areæ are four mammillated and perforated tubercles which are limited to this region. The pores are set obliquely in pairs with a smooth elevated granule between each pair, which forms a moniliform sinuous line running between the pores. The interambulacral areæ are of moderate breadth, with two rows of primary tubercles, five or six in each column. The mammillary eminences of the two central tubercles are large and prominent. Those towards the anal and oral poles are smaller; they are all crenulated at their summits; the tubercles are deeply perforated, and supported on a short stem, the hemispherical head of the tubercle not exceeding in diameter that of the stem; the areolæ around the mammæ are slightly channelled and nearly all confluent, those towards the anal pole have a circle of granules encircling the areolæ; the interareolar spaces are covered with small smooth granules similar in form and size to those occupying the ambulacral areæ. The apical disc is prominent, the ovarial plates are large, convex, and much granulated, and the ocular plates are of a proportionate size; the spines are unknown.

The mouth-opening is of moderate size, its margin being deeply notched and reflexed as in *H. intermedia*; the pores are disposed in simple pairs all the length of the poriferous avenues, but are arranged in double files around the border of the oral aperture in such a manner as to occupy the free space in the ambulacral areæ, resulting from the contraction of the interambulacral areæ in this region.

Affinities and differences.—Our specimen is smaller in size than the one figured by Agassiz from the Calcaire de Saanen. The ambulacra are more prominent and convex than those of the Swiss specimen; the rows of marginal granules are not so proportionately large nor are the basal tubercles so numerous as those delineated in Agassiz's figure. We consider our Urchin, however, merely as a variety of the Swiss species, for which we propose the name var. *granularis*. This beautiful species is easily distinguished from its congeners by the structure of the ambulacral areæ, which are convex, prominent, and thickly covered with small close-set granulations unlike any other species of *Hemicidaris* yet known.

Locality and stratigraphical range.—This species was collected from the Bradford clay of Pickwick, Wilts; a valve of *Ter. digona* was attached to the test, and it is adherent to *Ter. concinna*. Plates of this Urchin have been found in the same stratum at the Tetbury Road Station of the Great Western Railway. Mr. Lowe of Chippenham has found it in the Forest marble of Wilts, but it is a rare species.

History.—First figured and described by Agassiz in the 'Description des Echinodermes Fossiles de la Suisse,' afterwards identified in the British Museum collection by Mr. S. P. Woodward, and recorded by Prof. Forbes in Decade 3. of his 'Memoirs of the Geological Survey,' and now described as a British species for the first time.

Hemicidaris granulosa, Wright. Pl. XI. fig. 4 *a, b, c.*

Test spheroidal, depressed; ambulacral areæ straight, with two rows of prominent defined granules, the three inferior pair only being perforated and raised upon crenulated mammillary eminences; interambulacral areæ with from two to three pairs of primary tubercles, the superior part of the areæ being occupied with warty granules; apical rosette formed of large petaloidal plates.

Height $\frac{7}{10}$ths of an inch, transverse diameter 1 inch and $\frac{2}{10}$ths.

Description.—This beautiful Urchin constitutes a well-marked species; the double row of prominent wart-like granules on the ambulacral areæ, which are neither perforated nor raised on eminences, serving as a good diagnostic character. The base of the area is enlarged to give space for the three pairs of crenulated and perforated tubercles found in this region in all the species of *Hemicidaris*. The upper part of the areæ is occupied with from 10–12 pairs of warty granules, which are smooth, deformed, and set regularly in rows alternating with each other; the intervening surface of the ambulacral plates being occupied with small ill-defined scattered granulations. The pores are disposed in slightly oblique pairs, with a raised eminence between them; at the wide basal region of the avenues they fall into triple oblique pairs.

The interambulacral areæ are twice and a half the diameter of the ambulacral; in each column there are from six to seven plates, the three or four inferior of which support moderate-sized mammillary eminences with crenulated summits, from the centre of which a large prominent deeply perforate tubercle rises. The areolæ are smooth and gently inclined, and around their circumference fifteen small granules are set. The three superior plates are destitute of mammillary eminences, and in lieu thereof have clusters of granules on each plate similar to those occupying the ambulacral areæ. There are from two to five such granules protruding from the upper surface of the test; they are arranged in pairs, or form triangular, quadrangular or pentagonal figures. The apical rosette is well developed; the *ovarial* plates are large and marked with a depression near their centre, and their internal borders are slightly raised. The *madreporiform* plate is larger than the pairs of plates, and its centre is occupied with a porous structure. The *ocular* plates are large and heart-shaped, with a depression down the centre of each plate. In the specimen before me the plates of the apical rosette are devoid of other sculpture.

The base is flat, the mouth large and decagonal, the opening being more than half the diameter of the test at its equator.

The spines are unknown.

Affinities and differences.—This Urchin differs from *H. intermedia* in the absence of tubercles from the upper part of the interambulacral areæ, in the form and size of the ovarial and ocular plates, and in the form and structure of the granules covering the ambulacral areæ. It is distinguished from *H. alpina* by the absence of the close-set granulations covering the convex ambulacra of that Urchin. It has some resemblance to *H. icaunensis*, but is distinguished from it by the small number of its primary tubercles, and the warty figures which take the place of the tubercles on the upper surface of the test.

Locality and stratigraphical range.—From the Inferior Oolite of Dundry. Imperfect specimens, probably belonging to this species, have been collected from the upper beds of Leckhampton.

Hemicidaris confluens, M'Coy.

Syn. *Hemicidaris confluens*, M'Coy, Annals of Nat. Hist. vol. ii. New Series, p. 411.

Test spheroidal, much-depressed; ambulacral areæ slightly convex and nearly straight, with two alternate marginal rows of small microscopic mammillated and perforated tubercles, four pairs of larger tubercles at the base; intermediate surface covered with small close-set granulations; interambulacral areæ with three pairs of large tubercles at the middle, four small tubercles at the base, and six rudimentary tubercles at the apex of the areæ; mouth moderate and decagonal.

Height $\frac{9}{20}$ths of an inch, transverse diameter $\frac{9}{10}$ths of an inch.

Description.—The spheroidal test of this Urchin is much depressed at the anal pole and flattened at the base. The ambulacral areæ are nearly straight and of a tolerably uniform width throughout, and furnished with two rows of small, quite microscopic, but nevertheless mammillated and perforated tubercles, about fourteen in each row, disposed alternately on the margins of the areæ, and increasing slightly in size towards the basal angle. The base of the areæ has four pairs of larger tubercles as in the other species of this genus. The interambulacral areæ are nearly three times the width of the ambulacral, and furnished with two rows of tubercles from 9–10 in each row, the three pairs at the equator of the test alone attaining their full development; those at the base being of a secondary size, whilst those on the upper part of the areæ are disproportionately small and even rudimentary. The upper surface of the test is covered with small close-set granulations, in the midst of which the rudimentary tubercles rise at distant intervals apart. The mammillated eminences of the six large tubercles are surrounded by well-defined areolæ, which are confluent at their upper and lower margins; but down the centre of the areæ two or four rows of granules, and at the lateral borders thereof one or two rows of granules descend, which form lateral wreaths surrounding the side margins of the areolæ: these marginal granules are larger and more uniform in their arrangement than those occupying other parts of the surface of the test.

The mouth-opening, of a decagonal form, is one-half the diameter of the body, with deep marginal notches dividing its circumference into ten nearly equal lobes, those of the ambulacral areæ being the largest.

The apical disc is either absent or concealed in the specimens before me, and the spines are unknown.

Affinities and differences.—*H. confluens* resembles *H. Thurmanni*, Ag., in its depressed form and in the small number of the primary tubercles on the interambulacral areæ; it is distinguished from that species in the partial absence of the circle of granules which entirely surround the tubercles in *H. Thurmanni*, and in the rudimentary condition of those occupying the upper surface of the test. The ambulacral areæ are nearly straight in *H. confluens*, and much undulated in *H. Thurmanni*. This Urchin has many points of affinity with *Acrosaleniæ*, but our ignorance of the apical disc leaves a doubt in our mind whether it may not belong to that genus. Until specimens with the disc preserved are found, that doubt cannot be removed.

Locality and stratigraphical range.—This species was collected by Mr. Lycett from the planking beds of the Great Oolite at Minchinhampton, and we have received several specimens from the same stratum at Kiddington (Oxfordshire).

Hemicidaris pustulosa, Forbes.

Memoir of Palæontograph. Soc., Forbes, plate A. fig. 8, Great Oolite Fossils.

We have not seen *Hemicidaris pustulosa* figured by Professor Forbes in the above memoir; its nearest ally, it is stated, "is *Hemicidaris diademata*, Agass., which it resembles in the sudden diminution and very small size of the uppermost interambulacral tubercles, but differs in having the sutural granulated space of the interambulacral areas very wide*."

The SALENIANS†, Gray.

This group is composed of small Urchins resembling *Hemicidaris*; they are distinguished from that genus, however, by the number, structure, and mode of arrangement of the plates forming the apical disc, which is composed of five ovarial, five ocular, and a supra-anal plate. The ambulacral areæ are narrow, carrying secondary tubercles like *Hemicidaris*. The pores are disposed in distinct poriferous avenues in single pairs. The interambulacral areæ are wide, and their plates support primary tubercles raised on mammillary eminences. We divide the Salenians into two groups:—

In the first group the tubercles are not perforated; they form the genera *Salenia*, *Peltastes*, and *Goniophorus*, which are limited to the rocks of the Cretaceous period.

In the second group the tubercles are perforated, forming the genus *Acrosalenia*, the species of which are distributed throughout the Jurassic strata.

Genus ACROSALENIA, Agass.

Test small, more or less depressed; anal pole surrounded by a well-developed circular disc, composed of five ovarial and five ocular plates, with a central *supra-anal plate*, composed of one or more elements. The anal opening is situated at one side of the supra-anal plate, and is therefore eccentrical. The ambulacral areæ are narrow, and support a double row of from ten to twelve small perforated tubercles set on crenulated mammæ.

* Memoirs of Geological Survey, Prof. Forbes, Decade 3.

† The group of Salenians is composed of five genera: *Salenia*, Gray; *Peltastes*, Agass.; *Goniophorus*, Agass.; *Acrosalenia*, Agass.; *Goniopygus*, Agass.

The interambulacral areæ are nearly three times the width of the ambulacral areæ, and support two rows of from six to eight large perforated tubercles raised upon crenulated mammillary eminences; the base is flat, the mouth large, decagonal and notched, and the margin reflexed. The apices of the notches point to the centres of the columns of the interambulacral plates.

Acrosalenia hemicidaroides, Wright, n. s. Pl. XI. fig. 1 *a, b, c, d.*

Test hemispherical, considerably depressed; ambulacral areæ with two ranges of from fourteen to sixteen small perforated tubercles, gradually decreasing in size from the base to the apex; interambulacral areæ with two ranges of primary tubercles, eight in each range. The supra-anal plate is composed of several elements; the anus is situated before and to the left side; the surface of the ovarial, ocular, and supra-anal plates is studded with small granulations; primary spines long, tapering, smooth and slightly compressed; secondary spines small and needle-shaped; mouth large and decagonal; margin reflexed.

Height $\frac{7}{10}$ths of an inch, transverse diameter 1 inch and $\frac{1}{10}$th. One large specimen measures 1 inch and $\frac{3}{10}$ths in diameter, but the proportional height cannot be ascertained, as its base is crushed.

Description.—Test spheroidal, depressed; ambulacral areæ slightly sinuous, nearly uniform in breadth, tapering towards both poles, and supporting two rows of secondary mammillated perforated tubercles, which are largest at the inferior third of the area, diminishing in size as they approach the mouth and the anus. The tubercles, from fourteen to sixteen in number in each row, are situated alternately on the margins of the area; a zigzag line of granulations, with lateral branches passing down the centre of the area, separates the tubercles from each other. The poriferous avenues consist of about forty-five pairs of pores set obliquely in a single file. The interambulacral areæ are three times the breadth of the ambulacral; each area is composed of two columns. There are eight plates in each column, and each plate supports a large smooth mammillated eminence surmounted by a tubercle, which occupies the greater part of the plate; it is of a conical form, and is encircled by a concave smooth areola. The summits of the mammæ are sculptured on their margins with eleven crenulations, in the centre of which a deeply perforated tubercle rises, with a rather depressed articular surface. In some specimens the areolæ of the mammæ are confluent, in others they are separated by a row of small granules. The external and internal margins of the plates are furnished with rows of small granulations, with still smaller granules here and there interspersed; on the external side of each plate there are nine granulations, which, with those of the adjoining plates, form a sinuous granulated line which defines the internal boundary of the poriferous avenues. The internal row of granulations, with those of the opposite and adjoining plates, form a double granulated zigzag space, occupying the centre of the areæ, and forming an elevated ridge which serves to separate the two ranges of primary tubercles from each other.

The mouth is large and decagonal, and is one-half the diameter of the test. The margin is deeply notched with ten indentations. The divisions of the circumference are not equal, as the arch over the ambulacral is one-half greater than the arch over the interambulacral areæ.

The apical disc is greatly developed, occupying more than one-third the diameter of the test; it is of a pentagonal form, the left anterior angle being more developed than the right. The madreporiform plate is large, and divided into a posterior porous and an anterior non-porous segment. The posterior pair of ovarial plates are likewise large, the anterior pair are small and imperfectly developed; the left plate is rudimentary, in consequence of the anal opening being eccentric and situated before and towards the left side; the supra-anal plate is in general of a pentagonal form, and composed of from four to six elements united together and set round the posterior border of the anal opening. The ocular plates are triangular and well-developed; all the plates of the apical disc are studded with small granules. This species belongs to Agassiz's first division of the Salenians which have the sur-anal plate and the oviductal apparatus situated before the madreporiform plate. The primary spines (fig. 1 *d*) are long, tapering, and slightly compressed, so that a transverse section of one of them forms an ellipsis in the specimen before me. They are in length about twice the diameter of the test. The body of the spine is smooth throughout; the base is encircled with a prominent elevated ring of small oblong closely-set granulations; a smaller circle of larger crenulations surrounding the margin of the concave articulating surface. The secondary spines articulating with the tubercles of the ambulacral areæ resemble the primaries in miniature, some of them measuring $\frac{3}{10}$ths of an inch in length.

The dental apparatus is well-developed. The teeth are strong, triangular, and slightly curved towards the point.

Affinities and differences.—*Acrosalenia hemicidaroides* is distinguished from its congeners by its size, the number and regularity of the primary tubercles, the compound structure of the supra-anal plate, and the granular surface of the apical disc. This Urchin so much resembles a *Hemicidaris* in the form of the test, the structure of the ambulacra and poriferous avenues, that it was not until we had obtained specimens with the apical disc preserved that we were satisfied of its being an *Acrosalenia*, of which it certainly forms the finest species. The genera *Hemicidaris* and *Acrosalenia* have so many characters in *common*, which are almost always well-preserved, and so few that are *special*, and which are for the most part either broken or absent, that it is difficult to decide upon the genus unless the apical disc is more or less preserved; it is for this reason we conjecture that so few *Acrosaleniæ* have been hitherto catalogued from the Oolites, most of the species having been erroneously referred to other genera. The development of from four to six larger mammillated tubercles at the base of the ambulacral areæ is a good character for *Hemicidaris*. In *A. hemicidaroides* the tubercles in this region are well developed, but are not so well defined as in *Hemicidaris*. When doubts exist, they can only be solved by the discovery of the apical disc with its supra-anal plate.

Locality and stratigraphical range.—I have collected this beautiful Urchin from the upper beds of the Inferior Oolite at Leckhampton, and the Rev. P. B. Brodie found it with its spines attached in the same zone at Selsley Hill. It is found in the planking beds of the Great Oolite at Minchinhampton, and in the Cornbrash near Chippenham. Several fine specimens with the spines attached to the test were obtained from the Forest marble near Malmsbury in Wilts, which are now in the British Museum and the Museum of Economic Geology, and several private cabinets. We have the same species from Kiddington, Oxfordshire, in slabs of Great Oolite. From these facts we infer that this large *Acrosalenian* had not only a considerable stratigraphical range, but likewise that the species was very abundant.

Acrosalenia Lycetti, Wright, n. s. Pl. XI. fig. 2 *a, b, c, d.*

Test hemispherical, depressed, circumference subpentagonal; ambulacral areæ prominent, having a double series of small tubercles; interambulacral areæ with two ranges of large tubercles; mammillary eminences of both areæ conical and projecting; tubercles of the interambulacral areæ disproportionately small.

Height half an inch, transverse diameter 1 inch.

Description.—This Urchin resembles *A. hemicidaroides* in many of its characters, but presents others which justify its separation from that species. The ambulacral areæ are straight, prominent, and furnished with a double row of small well-developed tubercles, about twelve in each row; a zigzag line of small granules descends down the centre of the areæ, sending out lateral branches which inclose the areolæ of the tubercles for about two-thirds of their circumference, leaving the areolæ open to the poriferous avenues. The interambulacral areæ are nearly three times the width of the ambulacral, and possess a double range of primary tubercles from seven to eight in each range. The mammillary eminences supporting them are very prominent, and are surrounded by an elliptical areola. The summits of the mammæ are sculptured with about ten crenulations. The tubercles are disproportionately small when compared with the development of the mammæ supporting them; the two ranges of tubercles are separated by four rows of granulations which form zigzag granular bands descending down the centre of the areæ; similar bands of granulations bound the external borders of the interambulacra, and separate the ranges of the principal tubercles from the poriferous avenues; the upper and lower borders of the areolæ are confluent, but the other parts of their circumference are surrounded by a wreath of granules. The mammillary eminences and tubercles are largest at the equator, gradually diminishing as they approach the oral and anal poles. The pores are large and disposed obliquely in simple pairs. The mouth-opening is large and decagonal, the marginal notches being of moderate depth. The apical disc is absent in all the specimens we have found; it is therefore impossible to state whether the anal opening was situated before or behind the single madreporiform plate.

Affinities and differences.—This species is distinguished from *A. hemicidaroides* in having the areolæ more excavated and elliptical. The granules occupying the intertubercular spaces are smaller and more numerous. The tubercles of the interambulacra are disproportionately small when compared with the development of their mammæ; the circumference has in general a subpentagonal outline, from the prominence of the ambulacral areæ, the double row of tubercles on which is more fully developed than in *A. hemicidaroides.* These differences between the tests of our two species although inconsiderable are nevertheless connected with others, which although not seen may be inferred, as the differences in the size and form of the primary and secondary spines belonging to the tubercles of both areæ leave no doubt on our mind that *A. Lycetti* is distinct from *A. hemicidaroides,* and we know of no other species among its congeners for which it could be mistaken. A granulated spine, and of which we give a figure (2 *d*), found frequently in the same beds with *A. Lycetti,* and probably belonging to this species, if proved to be such, would form an important specific character.

Locality and stratigraphical range.—We collected this Urchin from the lower ferruginous beds, Pea-grit, of Crickley Hill, and have found it in the same stratum at Leckhampton, Cleeve, and

Brockhampton quarries. The specimens are in general much crushed, and the apical disc is always absent.

The two specimens which have preserved their form and served for the foregoing description were only obtained within the last few days; all those previously collected having been too much injured to serve for minute observation.

I dedicate this species to my friend John Lycett, Esq., one of the learned authors of a monograph of the Mollusca from the Great Oolite.

Acrosalenia spinosa, Agassiz. Pl. XII. fig. 3 *a, b, c, d.*

Acrosalenia spinosa, Agassiz, Echin. de la Suisse, 2nd part, t. 18. fig. 1–5. p. 39; Cotteau, Echin. Foss. du Département de l'Yonne, t. 3. fig. 6–11.

Test subpentagonal, depressed; a double row of small tubercles occupies the ambulacra, and a double range of large mammillated tubercles the interambulacral areæ; the ovarial disc is large, the madreporiform plate rudimentary, the anal opening behind the supra-anal plate; mouth decagonal, margin deeply incised.

Height $\frac{3}{10}$ths of an inch, transverse diameter $\frac{12}{20}$ths of an inch.

Description.—The test of this beautiful little Urchin has a subpentagonal form arising from the convexity of the ambulacral areæ, which converge in straight lines from the base to the summit, and are furnished with two ranges of from ten to twelve very small tubercles, which, although microscopic, are nevertheless mammillated and perforated. The intertubercular spaces are covered with small granules which form circles around the tubercles. The pores are disposed obliquely in simple pairs, forming a single rectilineal file on each side of the areæ. The interambulacral areæ are twice the width of the ambulacral, and ornamented with a double range of primary tubercles, eight in each range. The two inferior tubercles are small, the two or three succeeding ones are very large, whilst those on the upper part of the test suddenly diminish in size and gradually become dwarfed as they approach the anal disc: they are all crenulated and perforated. The primary tubercles occupying the equator of the test are seated upon large prominent mammillary eminences, surrounded by deeply grooved elliptical areolæ, and encircled by a wreath of small granules. The intertubercular surface on the upper part of the test is studded with very fine granules. The apical rosette, formed of ovarial, ocular, and sur-anal plates, is admirably preserved in the specimens before us; it is large and of a pentagonal form (fig. 3 *d*). The two anterior pairs of ovarial plates are nearly of the same size, the posterior pair being notched to form the basal angles of the triangular anal opening; the sur-anal plate occupying the centre of the rosette is small, single and pentagonal; the single or madreporiform plate is rudimentary, to make space for the apex of the anal opening. By this arrangement it is evident that the anus is eccentrical and situated behind the sur-anal plate; its opening is in a great measure formed by the imperfect development of the madreporiform plate, a condition the opposite to that existing in *A. hemicidaroides*, where the anus is situated in front of the sur-anal plate, and is excavated at the expense of the left anterior ovarial plate. The four ovarial and sur-anal plates are adorned with a delicate sculpture which occupies their centres; the ocular plates are small; the three anterior are inserted between the prominent angles of the ovarials, whilst the two posterior lying between the madreporiform plate and the posterior pair of ovarials form the lateral walls of the anal opening; all the plates are finely granulated.

The mouth is large, its circumference being divided into ten nearly equal lobes, and the margin is much reflexed.

Affinities and differences.—*Acrosalenia spinosa* is distinguished from its congeners by its subpentagonal form, the volume of the mammillary eminences of the primary tubercles at its equator, and the sudden smallness of those occupying the upper part of the test, the position of the anal opening behind the sur-anal plate, and the rudimentary condition of the madreporiform plate.

Locality and stratigraphical range.—I collected this Urchin from the yellow clay resting on the Stonesfield slate at Sevenhampton with *Anabacia orbulites, Pecten vagans, Ostrea acuminata*, and other Great Oolite shells. Likewise from the Cornbrash near Chippenham, Wilts, where it is very abundant. The specimens from both localities are as perfect as recent *Echini*.

Many of the Cornbrash specimens are attached to *Avicula echinata*. In Switzerland *A. spinosa* was collected from marls containing *Ostrea acuminata* in the Canton of Soleure. It is found in great abundance in France in the Great Oolite of Caen, and has been collected by M. Cotteau from the upper beds of the Bathonian stage in the environs of Châtel-Censoir.

History.—This species was figured and described for the first time by M. Agassiz in his 'Echinoderm. Fossiles de la Suisse,' and entered in his 'Catalogue raisonné des Echinides.' It has been figured and described by M. Cotteau from specimens obtained in the department of l'Yonne. It is catalogued by Mr. M'Coy as a Minchinhampton species from the Great Oolite, and is now described from British specimens for the first time.

Genus Goniopygus, Agassiz.

Test circular, subconical; apical disc very solid with an angular circumference, composed of ten plates; sur-anal plate absent; mouth large; tubercles imperforate without crenulations at their base; pores disposed in simple pairs throughout.

Goniopygus (?) *perforatus*, Wright, n. s. Pl. XIII. fig. 5 *a, b*.

Test spheroidal, depressed; ambulacral areæ with two rows of small tubercles; interambulacral areæ with two rows of nearly equal-sized primary tubercles, each surrounded by a circle of granules; tubercles perforated.

Height $\frac{3}{10}$ths of an inch, transverse diameter $\frac{6}{10}$ths of an inch.

Description.—The ambulacral areæ of this little anomalous Urchin carry small marginal tubercles increasing in size towards the base of the areæ, and having a few granules interspersed between them. The interambulacral areæ are about twice and a half the width of the ambulacral, and furnished with two rows of tubercles from seven to eight in each row. The tubercles are raised on mammillated eminences which are destitute of crenulations; the summit of the tubercles is slightly perforated, they detach themselves in a well-defined manner from the surface of the test and are very uniform in size, and each mamma is encircled by a distinct wreath of small granules. There are a few other granules studding the plates besides those forming the boundary circles of the areolæ. The apical disc is absent; the mouth is large and deeply notched.

Affinities and differences.—I have placed this Urchin provisionally in the genus *Goniopygus*, as it comes nearer to the characters of that form than any other. Agassiz states in his Catalogue that the tubercles are imperforate, but this character is not alluded to in his 'Echin. Foss.' The absence of crenulations from the mammæ, the nearly uniform size of the tubercles, the distinctness with which they stand out from the test, and a fragment of the angular apical disc *in situ*, seem to justify the supposition of its being *Goniopygus*; but the perforations in the tubercles make the exception, and suggest the query whether the absence of perforations is a generic or only a sectional character. The specimens before me, the only three yet found, are so imperfect, that I write with much reserve regarding them; they may perhaps prove to be the young tests of *Pedina*, in which we have observed that the pores change from simple pairs to triple oblique pairs with age, and the crenulations of the mammæ can scarcely be seen.

Locality.—I collected these Urchins from the Pea-grit of Crickley Hill with *Acrosalenia Lycetti* and small Bryozoan polypifera.

The Echinidæ*

Have a thin test, and are distinguished from the Cidaridæ and

* The group of *Echinidæ* includes twenty-three genera: *Astropyga*, Gray; *Diadema*, Gray; *Hemidiadema*, Agass.; *Cyphosoma*, Agass.; *Echinocidaris*,

Salenians by having numerous nearly equal-sized tubercles upon the ambulacral and interambulacral areæ. The pores are differently arranged in the avenues in the different genera; the apical disc consists of five ovarial and five ocular plates.

Genus Diadema, Gray.

Test thin, of a circular or pentagonal form, more or less depressed, supporting perforated tubercles raised on mammillary eminences with slightly crenulated summits. The ambulacral areæ are wide, straight, and well developed; each area has two rows of primary tubercles nearly as large as those occupying the interambulacral areæ. The pores are set in pairs, uniformly superimposed on each other, with one or two exceptions, where they fall into double files. The interambulacral areæ have two rows of primary tubercles, and sometimes ranges of secondary tubercles placed external to them. The mouth is large and decagonal, with shallow marginal notches. The five ovarial plates have an elongated hexagonal form; the madreporiform is larger than the pairs of plates; the five ocular plates are small and triangular, and are lodged at the summits of the ambulacra between the re-entrant angles formed by the ovarial plates. The spines are long, slender, and subulate, and of a very uniform size throughout.

Diadema depressum, Agassiz. Pl. XII. fig. 2 *a, b, c, d*.

Syn. *Diadema depressum*, Agassiz and Desor, Catalogue raisonné des Echinides, Ann. des Sciences Nat. 1846; Cotteau, Etudes sur Echinides Fossiles, p. 43. t. 2.

Test pentagonal, depressed; ambulacral areæ convex and prominent; interambulacral areæ flattened; two rows of nearly equal-sized primary tubercles in both areæ; secondary tubercles absent or rudimentary; mouth large and slightly decagonal.

Height $\frac{5}{10}$ths of an inch, breadth 1 inch and $\frac{1}{10}$th.

Description.—The ambulacral areæ of this Urchin are rather more than one-half the breadth of the interambulacral areæ, and have from ten to twelve pairs of well-developed primary tubercles separated by a zigzag line of small granulations. The interambulacral areæ are nearly of a uniform breadth throughout; there are about ten pairs of tubercles in each area; in consequence of

Desmoulins; *Echinopsis*, Agass.; *Arbacia*, Gray; *Eucosmus*, Agass.; *Cœlopleurus*, Agass.; *Codiopsis*, Agass.; *Mespilia*, Desor; *Microcyphus*, Agass.; *Salmacis*, Agass.; *Temnopleurus*, Agass.; *Glypticus*, Agass.; *Polycyphus*, Agass.; *Amblypneustes*, Agass.; *Boletia*, Desor; *Tripneustes*, Agass.; *Holopneustes*, Agass.; *Echinus*, Linn.; *Pedina*, Agass.; *Heliocidaris*, Desmoulins.

these segments of the test being double the width of the ambulacral, the tubercles stand more apart. The tubercles of both areæ are nearly uniform in size, they have a smooth base with a finely crenulated summit, and are perforated; there are no secondary tubercles, but the intertubercular spaces are covered with small granulations, which are closely set together on the surface of the plates; three or four of these at the base of the areæ are perforated. The mammillary eminences of both areæ are surrounded by smooth areolæ, which are nearly all confluent. The ambulacral areæ become rapidly contracted towards the vertex, whilst the interambulacral areæ maintain their breadth, so that the space between the rows of primary tubercles is very uniform in width throughout. The intertubercular spaces, with the exception of the internal border of the four superior interambulacral plates, are covered with small close-set granulations of different sizes, which form semicircles around the areolæ, and zigzag lines down the centres of the areæ. The pores consist of thirty-six pair in each avenue superimposed in a single file; in the wide space of the avenues around the mouth they form double or triple rows. The mouth is large and decagonal; the notches are slight, and the borders are reflexed at the angles; the apical disc is unknown; the spines are small, subulate, and delicately striated longitudinally (fig. 2 *d*).

Affinities and differences.—This Urchin resembles *D. æquale*, Agass., but differs from it in the absence of secondary tubercles in the interambulacral areæ: by its pentagonal form it resembles *D. subangulare*, but is distinguished from that species in having the pores arranged in a single file, whereas in *D. subangulare*, from the equator to the apical disc, the pores fall into double files. The tubercles are likewise smaller and more deeply perforated; it belongs moreover to a lower zone of the Oolitic group, *D. subangulare* being a characteristic Urchin of the Coral Rag of Wilts and the "Terrain à chailles" of Switzerland and Germany*. Like *D. subangulare*, *D. depressum* possesses a pentagonal form, a peculiarity depending on the prominence of the ambulacral areæ, and common to several species of this genus.

Locality and stratigraphical range.—This Urchin is common in the lower ferruginous beds of the Inferior Oolite, the Pea-grit of Crickley, Leckhampton and Dundry Hills; I have collected it from the Great Oolite at Minchinhampton and from the Bradford clay at Tetbury road station; the latter were extremely small. The specimens are in general much crushed; the anal disc is always broken, and the spines are sometimes adherent to the test. It has been collected by M. D'Orbigny in the Inferior oolite of

* Goldfuss, Petrefacta Germaniæ; and Agassiz, Echinodermes Fossiles de la Suisse.

Saint Honorine Ranville, where it is abundant. It has been obtained by M. Cotteau from the ferruginous oolite, from Tour-du-Pré, near Avallon, Département de l'Yonne, which bed lies upon the Calcaire à entroques, the true equivalent of the Dundry, Cotteswold and Dorsetshire beds of the Inferior Oolite.

History.—The *D. depressum* was first mentioned in the 'Catalogue raisonné des Echinides' by Agassiz and Desor, but was neither figured nor described by them. This however has been done by M. Cotteau in his 'Etudes sur les Echinides Fossiles,' and is now figured and described from the English Oolites for the first time. In both countries it appears to characterize beds belonging to the same geological horizon.

Diadema subangulare, Agass.

Syn. *Cidarites subangularis*, Goldfuss, Petref. t. 40. f. 3; Rœmer, Verstein. t. 1. fig. 20.

Diadema subangulare, Agassiz, Echin. Foss. t. 17. fig. 21–25. p. 19.

Test subpentagonal, depressed; interambulacral areæ with primary and secondary tubercles; upper part of the poriferous avenues with a double series of pores.

Height $\frac{9}{20}$ths of an inch, transverse diameter 1 inch and $\frac{2}{10}$ths.

Description.—The test of this Urchin has a depressed and pentagonal form arising from the prominence and development of the ambulacral areæ, which are narrow and contracted above and furnished with ten pairs of primary tubercles. The interambulacral areæ are nearly twice as wide as the ambulacral, and are adorned with two rows of primary tubercles from ten to eleven in each row, and two rows of secondary tubercles arranged on the sides of the primaries, but irregular both as regards their number and size. Secondary tubercles are absent in the ambulacral areæ. The tubercles of both areæ are proportionally large and raised upon inconsiderable mammillary eminences with delicately crenulated summits; the mammæ are surrounded by elliptical areolæ, and round two-thirds of their circumference small granules are disposed in circles; although the tubercles are large and spherical, the perforations are small and of inconsiderable depth. Down the centres of both areæ numerous small granulations occupy the intertubercular surface of the plates, and similar granular bands descend down the external margins of the interambulacral areæ; but the distinctive character of this Urchin resides in the structure of the poriferous avenues, which, instead of forming, as in other *Diademata*, a *single row* of pores from the base to the apex, from the equator to the apical disc they form *double rows of pores disposed in oblique lines.*

The mouth is large and decagonal, but the marginal notches are not deep. None of the specimens that we have seen possess the apical disc, but the vacant space left by the absence of the ovarial and ocular plates proves that this part of the test was well developed.

Affinities and differences.—In its pentagonal form it is allied to *D. depressum*, but its secondary tubercles and double file of pores form a good diagnosis between *D. subangulare* and other species of the same genus.

Locality and stratigraphical range.—We know this species only from the Coral Rag of Wilts and Oxford; in Germany it is found in the same stages at Thurnau and Muggendorf; and in Switzerland it is obtained from the "Terrain à chailles" of the valley of the Birse, of Blochmont and of Weissenstein.

History.—First figured by Goldfuss, afterwards more accurately described and figured in detail by M. Agassiz, and now described as a British species for the first time; the specimens previously catalogued under this name having been *D. depressum* and not *D. subangulare*.

Diadema pseudo-diadema, Agass. Pl. XII. fig. 1 *a, b, c*.

Syn. *Cidarites pseudo-diadema*, Lamarck, Syst. Anim. sans Vert. tom. iii. p. 385.

Diadema Lamarckii, Desmoulins, Tabl. Synopt. p. 316. No. 18.

Diadema pseudo-diadema, Agassiz, Echin. Foss. t. 17. fig. 49–53.

Test hemispherical, depressed; interambulacral areæ with primary and secondary tubercles; ambulacral areæ with primary tubercles and a few scattered rudimentary ones. Mouth large and decagonal; margin deeply notched; apical disc large; spines long and needle-shaped.

Height 1 inch and $\frac{5}{20}$ths, transverse diameter 2 inches and $\frac{4}{10}$ths.

Description.—This fine species has a hemispherical form, much depressed at the anal pole and flattened at the base. The ambulacral areæ are straight and well developed, and furnished with two rows of primary tubercles from 18–20 in each row; between these a zigzag line of small secondary tubercles extends two-thirds up the areæ; the poriferous avenues are not well defined; the pores are disposed in pairs; between each pair of holes there are elevated smooth tubercles forming a range of small bead-like bodies which define the limits of the areæ; at the base the pores fall into double and triple files.

The interambulacral areæ are more than twice the width of the ambulacral, and are furnished with two rows of large primary crenulated and perforated tubercles, and several rows of secondary tubercles likewise crenulated and perforated; down the centre of the areæ two rows of secondary tubercles are arranged which separate the principal ranges from each other, and like rows of secondary tubercles separate the principal tubercles from the ambulacral areæ. These secondary tubercles are very irregular as to size and arrangement, and are in general best developed at the base and equator of the test; besides the primary and secondary tubercles, the surface is studded with small granulations. The mouth-opening is large and decagonal, and its margin is divided by deep notches. The lobes which correspond to the ambulacral areæ are twice as large as those corresponding to the interambulacral areæ. The apical disc is broken in the specimen before me. According to Agassiz the oviductal apparatus is generally very apparent. The ovarial plates are large and pentagonal; their summit forms a prominent angle which advances into the interambulacral areæ. The madreporiform plate is larger than the pairs of plates, and like them is perforated and finely granulated. The ocular plates are very small and inserted between the angles of the ovarials and dovetailed with the apex of the ambulacra. The anal opening is large and of a circular form. The spines are long, needle-shaped, and finely striated longitudinally.

Affinities and differences.—The size of this species, the arrangement of the secondary tubercles, and the structure of the poriferous avenues form a group of characters by which it is readily distinguished from its congeners.

Locality and stratigraphical range.—The specimen before me was obtained from the Coral Rag of Wiltshire or Oxfordshire; it is found in the Corallian stage of Besançon, canton of Soleure, in Switzerland, and in the Coral Rag of Angoulin, near Rochelle, in France.

History.—Figured and accurately described for the first time by M. Agassiz in his 'Echin. Foss.,' and now first figured and registered as a British fossil.

Genus Pedina, Agassiz.

Test thin, circular and depressed; primary tubercles very small, but still perforated and crenulated like those of *Diadema*. Pores arranged in triple oblique pairs as in the genus *Echinus*. Mouth small, slightly decagonal; margin not much notched. The ovarial disc not prominent; the surface of the test comparatively smooth when compared with the other genera of the *Echinidæ*. The ambulacral areæ have two ranges of tubercles, and the interambulacral areæ have two ranges of primary, and one or more rows, more or less complete, of secondary tubercles, situated at the external and internal sides of the primaries. This genus is extinct, and the species are found in the Oolitic and Cretaceous rocks.

Pedina rotata, Agassiz.

Syn. *Pedina rotata*, Agassiz, Echin. Foss. de la Suisse, pl. 15. fig. 4–6. p. 36.

Test hemispherical, depressed; ambulacral areæ with two marginal rows of small tubercles; interambulacral areæ with two ranges of primary tubercles and a few secondary tubercles; mouth small; margin slightly notched and divided into ten nearly equal-sized lobes.

Height $\frac{8}{10}$ths of an inch, transverse diameter 1 inch and $\frac{4}{10}$ths.

Description.—The test of this Urchin is circular; in some specimens a fullness of the ambulacral areæ gives it a slightly-subpentagonal outline, and it is depressed at both poles. The ambulacral areæ have two rows of small tubercles disposed on the external border of the areæ, between which small granules are arranged with less regularity. The interambulacral areæ are twice and a half the width of the ambulacral, and furnished with a double range of primary tubercles extending from the mouth to the ovarial plates; two ranges of secondary tubercles, not very regular however in their arrangement, extend from the mouth to near the middle of the areæ. The tubercles of both classes are very small in size, but perforated and crenulated on the surface of the test a number of small microscopic granules cluster together, and form circles around the areolæ of the small mammillated eminences. The poriferous avenues are narrow, in which the holes are closely set in triple oblique pairs; in the three specimens before me the apical disc is either absent or concealed by the oolitic matrix. The mouth is small and decagonal. The margin is slightly notched, and divided into ten nearly equal-sized lobes; no reflection of the test is observed at the angles of the notches. The spines are unknown.

Affinities and differences.—This species is distinguished from *P. sublævis* by the rudimentary development of the secondary tubercles in the interambulacral areæ, which can only be said to exist at the internal side of the primaries, between the mouth and the equator; in the rest of the areæ they degenerate into granules. The other characters of the Urchin agree so well with Agassiz's very incomplete description, that we have not hesitated to identify it with the Swiss species. Our specimens are all much worn, and we know nothing of the apical disc.

Locality and stratigraphical range.—This Urchin was collected from the upper beds of the Inferior Oolite at Shurdington Hill, along with *Discoidea depressa* and *Clypeus sinuatus.*

History.—First described and figured by Agassiz in his 'Echinodermes Fossiles.' Mr. M'Coy catalogues this species from the Great Oolite of Minchinhampton, but we know of no specimens from that locality; all the examples, five in number, examined by us, have been obtained from the upper beds of the Inferior Oolite.

Genus Echinus, Linnæus.

Test more or less globular. Ambulacra in general about half the width of the interambulacra; primary tubercles of nearly the same size in both areæ, and forming vertical ranges more or less numerous in the different species, but neither having perforated summits nor crenulations at their base; the poriferous avenues are well-developed; the pores are numerous, and disposed in transverse ranges in arched or triple oblique pairs; the mouth is large, of a circular or pentagonal form, and more or less divided at the margin by notches into ten lobes. The apical disc is composed of four nearly equal-sized ovarial plates, and a single larger madreporiform plate, and between the ovarial the five ocular plates are lodged. The masticatory organs or lantern are formed as in the genus *Cidaris*; but the pyramids are excavated in their superior part, and the two branches are united by an arch at the summit. The teeth are tricarinated.

Echinus perlatus, Desmarest. Pl. XIII. fig. 1 *a, b, c, d.*

Syn. *Echinus perlatus*, Desm. Dict. Sc. Nat. t. xxxvii. p. 100.
Echinus lineatus, Goldf. Petrefact. Germaniæ, t. 40. fig. 11.
Echinus germinans, Phillips, Geology of Yorkshire, pl. 3. fig. 15.
Echinus perlatus, Agassiz, Echin. Foss. de la Suisse, t. 22. fig. 13–15.
Echinus diademata, M'Coy, Ann. Nat. Hist. vol. ii. S. 2. p. 410.
Echinus multigranularis, Cotteau, Echinides Foss. de l'Yonne, p. 61. tab. 7. fig. 6–8.

Test hemispherico-conoidal with a pentagonal circumference; ambulacral areæ with two ranges of primary tubercles; interambulacral areæ furnished with two complete ranges of primary tubercles and six incomplete ranges of secondary tubercles, and a median depression in the centre of the areæ; apical disc small; anus eccentrical.

Height $1\frac{1}{2}$ inch, transverse diameter 2 inches.

Description.—The ambulacral are about one-half the breadth of the interambulacral areæ, and are very uniform in width throughout; they are prominent and convex, giving the circumference of the test of this beautiful Urchin a pentagonal form. The ambulacral columns have two rows of primary tubercles, about thirty in each row, placed on the poriferous borders of the plates, and from four to six tubercles between these rows at the base and angle of the test. The interambulacral areæ are slightly convex, and taper very uniformly from the base to the summit. The lower half of the areæ is occupied by eight rows of primary tubercles, four in each column; at the base and for a short distance up the sides of the test, these tubercles are of a uniform size, but beyond this two rows only maintain their development, and numbering twenty-four pairs of primary tubercles in each area; the two external rows and the single internal row of tubercles are arrested in their development, and therefore become of a secondary size. The tubercles of both areæ are surrounded by a smooth areola encircled by a groove, on the external margin of which a wreath of small granules is disposed, reminding us of the granular zone surrounding the primary tubercles in the genus *Cidaris*. The intertubercular spaces of the areæ are filled up with small granules. The interambulacral areæ are separated along the median line by a somewhat depressed furrow, which is most conspicuous between the equator and the anal pole. This furrow arises from the convexity of the new-formed plates, and becomes less evident when the plates attain a greater width; this depression is likewise destitute of granulations, and affords a good specific character for this Urchin. The poriferous avenues are of uniform width on the sides of the test; they become slightly contracted at the basal angle, and expand from that point to the margin of the mouth-opening. The avenues have three pairs of holes disposed obliquely throughout, but increased to four or five pairs to fill up the increased spaces of the avenues in the vicinity of the mouth. The ovarial and ocular plates are in general preserved. The anal opening is always eccentrical, which gives the summit of the test an irregular form; the opening is placed forward, so that the madreporiform plate occupies nearly the centre of the anal polar axis. The pairs of ovarial and ocular plates are small and imperfectly developed.

The base is concave, and in this region all the primary tubercles of the interambulacral areæ attain their full development. The mouth-opening is large and decagonal, occupying nearly one-half the diameter of the base; the circumference is deeply notched with ten indentations which extend into the interambulacral areæ, and have their borders reflexed.

The spines are small, delicate, and subulate, but are very seldom found in connection with the test.

Affinities and differences.—We have, through the courtesy of Mr. S. P. Woodward, compared our Urchins with the typical specimens of *E. perlatus* in the Brit. Mus., and through the kindness of Professor Forbes with a specimen of *E. germinans*, sent by Mr. Phillips from Yorkshire; from this examination it is certain that the Gloucestershire and Yorkshire *Echini* are the same species, and that the difference between them and the foreign *E. perlatus* from the evidence afforded by the test alone amounts at most to a more granular variety. We may consider therefore *E. perlatus,* var. *germinans,* as characteristic of the inferior stages, and *E. perlatus* of the upper stages of the Oolitic group. *E. diademata* of M'Coy agrees so nearly with our specimens of the young of this species that we think them the same.

Stratigraphical range and localities.—This Urchin is found in good preservation in the inferior ferruginous beds of the Pea-grit at Leckhampton, Cleeve, and Crickley Hills. Our best specimens were obtained from the latter locality; it is found in the shelly freestone of the above hills, and in the Inferior Oolite of Stroud, Nailsworth, Minchinhampton and Dundry; its convex prominent ambulacral columns, and the median furrow down the centre of the interambulacral areæ, serving to determine the species even when its other characters are effaced. On the continent *E. perlatus* is considered a characteristic Urchin of the "Terrain à chailles," and was long ago described by Desmarest. The specimens from the Inferior Oolite are more granular than those obtained from the upper stages of the Oolitic series, but in other respects the specific characters are identical.

History.—*Echinus perlatus,* figured and described by Desmarest and Goldfuss, has been long known to characterize the upper Oolitic beds of the continent. We have no doubt that Mr. Phillips's *E. germinans* is at most only a variety of this species found in the Inferior Oolites of England. Mr. M'Coy's description of *E. dimidiata* corresponds so closely with young specimens of this species, a series of which now lies before us, that we cannot doubt their identity.

Echinus serialis, Agass. Pl. XIII. fig. 2 *a, b, c, d.*

Syn. *Echinus serialis,* Agassiz, Echin. Foss. de la Suisse, t. 22. fig. 10–12.

Test hemispherical, depressed, circumference slightly pentagonal; ambulacral areæ with two rows of marginal tubercles; interambulacral areæ with two ranges of tubercles in the centre of the columns; base concave, mouth moderate-sized, decagonal, and slightly notched; apical disc small; anus slightly eccentrical.

Height 1 inch, transverse diameter 1 inch and $\frac{7}{10}$ths.

Description.—This Echinus resembles a *Diadema* in having two ranges of tubercles very nearly the same size on both areæ; the ambulacral are rather more than one-third the width of the interambulacral areæ, and are furnished with two rows of small tubercles, each alternate plate supporting a tubercle on its poriferous margin; the interambulacral areæ are wide, and have in like manner two ranges of small tubercles, about twenty in each range, occupying the centre of the plates; the tubercles are raised on inconsiderable mammillary eminences surrounded by smooth areolæ, and encircled by a zone of small granules; the intertubercular spaces of both areæ are covered with similar small granulations; there are a few irregular secondary tubercles about the base, but none on the sides of the interambulacral or ambulacral areæ; the poriferous avenues are narrow, and occupied by numerous close-set pores arranged in triple oblique pairs; the basal angle is obtuse, and the base concave; in this region the tubercles are largest, and a few additional ones are introduced at each side of the central range; the mouth-opening is moderate, being $\frac{7}{10}$ths of an inch in diameter; it is nearly of a circular form, the marginal notches being of inconsiderable depth; the ovarial and ocular plates are small and preserved; in some of the smaller specimens the madreporiform plate is larger than the pairs of ovarials; the anus is situated before the single plate, and to the right side, and is therefore slightly eccentrical. The spines are unknown.

Affinities and differences.—The comparative smoothness of the test, and the absence of secondary tubercles, with the smallness of the marginal notches in the mouth-opening, form diagnostic characters by which we distinguish *E. serialis* from *E. perlatus*; the median depression between the two columns of interambulacra is likewise absent in this species.

Locality and stratigraphical range.—This species has been collected from the Inferior Oolite at Shurdington and Dundry Hills; the specimen from the latter locality is the one which has served for our description, the parts of the test which are broken being fortunately present in the smaller Urchin from the former locality; the Swiss specimens were found in the "Terrain à chailles" at Fringeli (Canton of Soleure), where it is very rare.

History.—First found by M. Gressly and figured and described by M. Agassiz in his 'Echin. Fossiles'; we are not aware of its having been noticed before as a British species.

Echinus granularis (Wright), n. s.

Test depressed, pentagonal; ambulacral areæ with two rows of tubercles; interambulacra with eight rows of tubercles, at the base and lower third of the areæ diminishing in size and number from six to four rows towards the apex; mouth large with marginal indentations; anus central; ovarial and ocular plates small.

Height $\frac{7}{10}$ths of an inch, transverse diameter $1\frac{1}{2}$ inch.

Description.—This Urchin is distinguished from the foregoing species by its depressed poles and pentagonal form, arising from the prominence of the ambulacral areæ, which are not quite one-half the width of the interambulacral, and have two rows of tubercles throughout, and an additional row of from six to eight arranged between the marginal rows at the widest part of the areæ near the basal angle; the interambulacral areæ are wide and covered with tubercles; at the basal angle and lower third of the areæ we observe eight rows of tubercles, but at the upper part of the sides and near the apex there are only six rows: the specimen before us being much defaced about the apices of the areæ, this part of the test cannot be accurately described. The poriferous avenues are occupied with close-set pairs of pores arranged in triple oblique rows; the basal angle is obtuse, and the base is flat; the mouth is large and indented at the circumference; the ovarial and ocular plates are small, and the anus is central.

Affinities and differences.—The depressed test, pentagonal form, central anus and granular surface serve to distinguish this species from *E. perlatus,* which it much resembles. The same characters form a clear diagnosis between it and *E. serialis,* the number and smallness of the tubercles giving the upper surface of the test a rugous or granular appearance.

Locality and stratigraphical range.—This Urchin was obtained from the upper ragstone of Leckhampton Hill (Inferior Oolite), where it is rare; we have only seen three specimens of the species.

Genus Arbacia, Gray.

Small Urchins of a subspherical form, having the test covered with numerous small smooth-based imperforate tubercles, forming numerous rows on the ambulacral and interambulacral areæ; the pores arranged in rather deep avenues in single pairs; base concave; mouth large, margin with ten inconsiderable notches; apical disc narrow, prominent, and ring-shaped.

Arbacia Forbesii, Wright, n. s. Pl. XIII. fig. 4 *a, b, c.*

Test hemispherical; ambulacral areæ narrow, with four rows of small tubercles; interambulacral areæ wide, divided by deep median depressed lines, and covered with from twenty to thirty rows of small nearly equal-sized tubercles.

Height $\frac{9}{20}$ths of an inch, transverse diameter $\frac{15}{20}$ths of an inch.

Description.—The test of this beautiful little Urchin is divided into fifteen unequal lobes; five of these are narrow and form the ambulacral, and ten are wider, forming the divided interambulacral areæ, which present an unusual appearance, having a median furrow descending down the centre of the areæ and dividing them into two equal convex conical lobes; the surface of the areæ is thickly studded with small smooth tubercles; at the widest part there are from twenty-five to thirty rows; the number of these diminish at the apex and base, the basal tubercles are however larger than the others; the ambulacral areæ are narrow and of a nearly uniform width; they are furnished with four rows of small tubercles similar to those occupying the interambulacral areæ; they are in fact so closely set together that the plates are invisible, so that the test presents only a uniform granulated surface; the avenues are straight, narrow, but well defined; the pores are closely arranged in simple pairs; the base is concave and the tubercles in this region are larger; the mouth presents almost a pentagonal form in consequence of the wide straight arch made by the margin over the ambulacra and the small angles which the shallow notches make in the interambulacra; the apical disc is narrow and prominent; the madreporiform is larger than the pairs of ovarial plates, and the oculars are small, but apparently soldered into the angles formed by the ovarials.

Affinities and differences.—The greater number and the diminished size of the tubercles, with the deep median furrow down the centre of the interambulacral areæ, serve to distinguish *A. Forbesii* from *A. nodulosa*: as they are the only two forms of this genus hitherto found in our Oolites, these characters form a good diagnosis.

Locality and stratigraphical range.—This Arbacian was collected from the upper beds of the Inferior Oolite near Dundry, and we only know it from that locality. I have dedicated this species to Prof. Edward Forbes, to whose genius, talents, and learning natural history is so largely indebted.

Arbacia nodulosa, Wright. Pl. XIII. fig. 3 *a, b.*

Syn. *Echinus nodulosus,* Goldfuss, Petr. Germaniæ, t. 40. fig. 16. p. 125.

Test hemispherical, with a subpentagonal circumference; ambulacral areæ prominent and bounded by deep poriferous avenues; interambulacral areæ divided by a slight median depression; tubercles nearly equal-sized in both areæ, and arranged in longitudinal rows.

Height $\frac{7}{20}$ths of an inch, transverse diameter $\frac{11}{20}$ths of an inch.

Description.—This nodulated Urchin is hemispherical and has a subpentagonal form from the development of the ambulacral areæ, which are very prominent, especially at the basal angle; they are furnished with three rows of smooth prominent spherical tubercles set at short distances apart, the central row being absent at the base and apex of the areæ; the interambulacral areæ are twice the width of the ambulacral, and are occupied at their widest parts with about ten rows of tubercles, about the same size as those of the ambulacral, and like them set distinct from each other, which gives the surface of the test a nodulated air; a slight furrow passes down the centre of the interambulacral areæ, dividing them into two parts; the rows of tubercles diminish in number at the apex and base of the areæ, they are larger and more fully developed, however, in the latter region; the apical disc is small, ring-formed, and prominent; the poriferous avenues are deep and strongly defined, the pores are arranged in simple pairs above, but they form double ranges which fill up the wide space at the basis of the areæ; the base is concave, the mouth is large and pentagonal like the former species, the notches are closely approximated at the bases of the interambulacra, and the marginal arch over the ambulacra is straight and wide; the tubercles disposed at the bases of both areæ are larger and more fully developed than those occupying the sides.

Affinities and differences.—The size of the tubercles and their diminished numbers when compared with *A. Forbesii* serve as a sufficient diagnosis whereby *A. nodulosa* may be distinguished from the former Urchin; the slight median furrow down the centre of the interambulacral areæ is very different from the deep line separating the areæ in *A. Forbesii* into two equal nearly conical lobes.

Locality and stratigraphical range.—This species was collected by my friend the Rev. P. B. Brodie from the bed of clay resting on the Stonesfield slate at Sevenhampton Common, along with *Acrosalenia spinosa* and *Pecten varians*; this bed occupies the same relative position in other parts of Gloucestershire, and is probably the basal clay band on which the shelly freestone beds of the Great Oolite rest. I only know the solitary specimen before me; in Germany, Count Münster found it in the Jurakalk of Baireuth.

History.—First figured and described as an *Echinus* by Goldfuss. I am not aware of its having been noticed before as a British fossil.

My thanks are especially due to Mr. W. H. Baily for the pains he has taken with the beautiful figures which accompany this paper, the original specimens of which are in my cabinet.

XXII.—*Observations on the Connexion between the* Crinoideæ *and the* Echinodermata *generally.* By Thomas Austin, F.G.S., Fort Major, &c.

In offering these observations and generalizations relative to the Crinoideæ, it is but an act of justice to acknowledge how deeply we are indebted to the laborious researches of those who have preceded us in this branch of inquiry. Among the writers on the Crinoideæ who have thrown considerable light on this important group of animals, the late Mr. J. S. Miller is entitled to a prominent place; and although the correctness of many of his inductions may be fairly doubted, we must nevertheless be sensible of his great assiduity, deep research, and persevering industry in raising the Crinoideæ from a miscellaneous state of confusion to a position of arrangement and order, which has caused them to be better understood and appreciated.

Subsequently, however, to Miller's investigation, so numerous have been the discoveries, that out of three or four hundred species of fossil Crinoids now known to science, he was only acquainted with twenty-four. The number of genera since established greatly outnumbers even the species discovered up to the period at which he wrote. Not only have new discoveries been made as regards numbers, but more perfect specimens have been obtained, so as to enable the naturalist to draw inductions and prove analogies between them and existing groups of animals, and thus in a manner compel him to re-arrange the whole tribe, to use a new nomenclature, and, in short, to raise it to a parallel position with the class to which it belongs, and which the advanced state of knowledge imperatively demands.

As we advance in our acquaintance with this very interesting class of animals, we are soon struck with the manner in which this remarkable tribe demonstrate the changes of organic life on our earth and the mutations it has undergone, and also the various physical changes that have taken place; the distribution of fossil zoological remains proving that these repeated changes in animal life have been in perfect accordance with the altered physical conditions of the planet.

The discoveries I have been fortunate enough to make of many new species, and nearly perfect in form, has thrown considerable light on the subject. Mr. Fletcher and Mr. Gray, of Dudley, have done good service to science in collecting many fine specimens of Crinoideæ, while the extensive addition of new forms made by Dr. Troost, of Tennessee, and other American geologists, reflects honour on their country. Dr. Troost has added between one and two hundred new genera and species, all of which he obtained from the American rocks. As far as my own observation yet extends, the species are without exception unknown to the rocks of Europe. Sir Charles Lyell found that the American marine shells agree with the European to the extent of 35 per cent. This is the more remarkable, as of the American fossil Crinoids which have come under my notice, consisting of upwards of twenty species, together with six new *Pentremites* and the allied *Olivanites*, and for which I am mostly indebted to the liberality of Dr. Yandell, I cannot recognise a single individual as being exactly identical with any European species.

One or two detached pieces, it is true, appear to belong to well-known European species, but till more perfect specimens are obtained the identification cannot be complete.

Dr. Troost claims to have added two hundred new forms to the long catalogue of these fossils already known. After making considerable allowance for the zeal of a first discoverer in bestowing a name on every fossil new to him, by deducting a fair percentage from the gross amount, a very considerable number of new genera and species (probably all the latter) still remain to make Dr. Troost's discoveries of great value and interest to science in various ways, not the least of which is that of enabling us to compare the forms inhabiting the seas of our own latitude in remote epochs with those which existed three thousand miles distant in the West. On making this comparison we find that each portion of the globe had in those earlier periods its own peculiar animals, each equally distinct and strongly marked in character as at the present day. Few genera and species being common to such distant localities as Europe and America, yet when we take a casual view of the fossils found on the two continents, we are instantly impressed with the idea of their general resemblance to each other; but when we come to examine them more closely, the resemblance is no longer maintained. Genera that at first appear identical with long known forms, prove perfectly distinct, and species which seem to a casual observer as one and the same, under the eye of the scientific inquirer are found to be wholly dissimilar in the arrangement of the calcareous framework. Thus the *Agaricocrinus* of America closely approaches our *Amphoracrinus*, but it is in reality intermediate between that genus and *Actinocrinus*, and so on of many others.

Many distinguished naturalists have published detailed descriptions of various Crinoids; among these may be mentioned M. d'Orbigny, Count Munster, and M. Römer. The researches of these and other observers have greatly enlarged the limits of fossil zoology by increasing our acquaintance with those ancient and extinct genera and species of Crinoideæ which supply many important links which were before wanting to complete the chain in the scale of organic life, from the period when the world was first inhabited to the present time. In this manner as our information increases we find a perfect and unbroken succession of organic beings gradually developed in accordance with the physical changes that have taken place on the earth; changes so manifest, that the stratified rocks may be distinguished from each other not only by mechanical structure, mineral condition, chemical composition, arrangement and position, but above all by their fossil contents.

The manner in which these fossil bodies or organic remains are distributed through the strata greatly aids the geologist in his inquiries. They enable him to identify at distant points rocks which may perhaps present different appearances of mineral composition and whose geological position is but obscurely indicated, but which, when the imbedded fossils are carefully examined, prove them to be of contemporaneous age; for we know by experience that certain genera and species of animal remains occur in regular and beautiful sequence in the different groups of rocks, and that in many cases certain species are peculiar to a single formation, by which it can be distinguished even amidst the greatest confusion; that is, when the original arrangement of the strata has been so disturbed as to reverse the order of their superposition, or their complications by faults so great that every relation to distant masses is rendered obscure and doubtful.

In the Crinoideæ, Mollusca, and other remains of ancient and by-gone periods, we find so many beacon-lights, or directing points, that, by an accurate knowledge of genera and species, we can arrive at results and conclusions, that under other circumstances we could never hope for, and but for such knowledge could never be attained. With a view of contributing to this desirable end, we have undertaken the task of describing the Crinoideæ in a monograph, not only because their remains are found so abundantly in the older formations, but also on account of the many new forms which have been discovered, and which have thrown so much additional light on a subject formerly so obscure and complicated.

Since those early periods in the earth's history when the Crinoideæ existed in countless myriads, they have gradually diminished in numbers during subsequent ages, until only a few species are found amongst the living creation; and these, with the exception of one, the *Pentacrinus Caput Medusæ,* are so unlike ancient forms, that few persons, except the scientific, would identify them as allied to this once abounding tribe.

To the geologist, the zoologist, and those who desire information, the fossil genera present a wide field for inquiry and contemplation:—their symmetry of form, and the beautiful arrangement seen in the elaborate contrivance by which hundreds of thousands of separate indurated pieces are so placed that each piece is so nicely fitted to the adjacent pieces, that a skeleton seemingly so complicated in its mechanism becomes obviously, as we study the uses of the various parts, as simple in action as it is delicately articulated and geometrically constructed.

In the *Extracrinus Briareus* I have counted upwards of 741,710 joints or separate pieces, exclusive of the small plates which stud the membrane that covers the inside of each ray, and which if taken into the calculation would swell the number to upwards of a million. And if we consider the number of muscles requisite to put this million of parts in motion, we are lost in admiration at the apparent complexity, but in reality simplicity of structure in the indurated skeleton of this animal.

For the better comprehension of this important and interesting group of animals it is desirable to enter into some detail respecting the whole tribe of Echinoderms, a term applied by Bruguière to those animals whose skin is generally furnished with calcareous spines. Accordingly the Star-fishes or *Asteriadæ* are first noticed. These animals are enveloped in a coriaceous integument studded in various degrees with granules of calcareous matter. They present different modifications of form, and according to that form depend in a great degree the characters which have enabled naturalists to divide them into various genera and species.

The genus *Goniaster* may be described as an animal of a pentangular form; on the inferior surface and on a line with the angles run five furrows or depressions, on the margins of which are numerous foramina, through which protrude the tubuliform tentacula, which are furnished with cup-like appendages. These may be considered as the feet, as they are the only locomotive organs possessed by animals of this genus.

The true *Asterias* are known by their simple flattened rays, which are generally five in number, but some species have as many as ten or twelve. All these have the mouth placed beneath, around which are several perforated plates; these perforations are known to be the ovarial passages. There are other openings which probably aid in the purposes of respiration, as well as in the water circulation, as they lead to the canals known as the aquiferous system. The term 'oviducal plates' has been applied to the pieces through which the ovarial apertures pass.

Next, the *Ophiura* may be known by a small orbicular disc-like body, from which emanate five circular attenuated rays. These are in many instances furnished with spines which aid them in locomotion.

The *Euryale*, or *Gorgonocephalus* of Leach, bears some resemblance to the *Ophiura*; but in place of the five simple rays, each of its rays branches off into so many subdivisions, that 512 have been counted as given off by each ray, which multiplied by 5, the number of the parent rays, gives 2560 lesser subdivisions or filaments capable of forming a net for the capture of food, and also by its undulatory motion of producing progression through the water. By means of these filaments the *Euryale* can attach itself to extraneous bodies, such as *Gorgoniæ*, and thus moor itself in order to repose, or as a protection against the violence of an agitated sea.

Before passing from the *Stelleridæ,* it will be well to bear in mind that among their essential characters that of being free locomotive animals must not be lost sight of; also, that their natural position is with the mouth downwards; that the cavity containing the digestive organs is a pouch-like sac giving off cæca, the refuse of their food in all the *Ophiuridæ,* and in many true Star-fishes, being rejected by the mouth; likewise, that they possess distinct, well-defined oviducts, and are supposed by many naturalists to possess the power of self-impregnation.

In connecting the Star-fishes with the Crinoideæ it will be well to notice two genera, one now extinct, and the other an inhabitant of the seas of our own times. These in a very decided manner unite the more ancient Crinoids with the recent Echinoderms.

First the *Marsupite,* whose body, that is, the dorsal portion of it, is covered by sixteen pentagonal plates. Fifteen of these plates are arranged in three tiers or series of five each; the upper row, being the ray-bearing plates, has in each piece a horseshoe-shaped concavity in its centre for the insertion of the rays, while the lower series rest on the dorso-central pentagonal plate.

The *Marsupite* has only been discovered in a fossil state in the chalk beds of Sussex, and has no doubt been long extinct; and consequently although it furnishes us with but few indications of its habits and mode of life, yet it directs our attention to a genus which is found in a living state in our own seas, and which may be considered as the representative of the extinct *Marsupite,* namely the *Comatula,* which at once leads us back again to the Crinoids.

The *Comatula* in its mature state is an unattached animal having a depressed orbicular body covered with calcareous plates which inclose the digestive organs. The mouth is centrical and somewhat protrusive, and is surrounded by tentaculated jointed rays or arms. On the dorsal side of the body below the rays are several claspers terminating in a hooked point. These bear a striking analogy to the auxiliary side-arms so common to many species of true Crinoids.

The *Comatula* possesses both an oral and anal opening. In its early state it is attached to extraneous substances by a flexible column, and when first discovered was described as the *Pentacrinus Europæus.*

When examining these two genera, we see in a very remarkable manner the connection between the free swimming and the permanently attached *Asteriadæ,* or between the Star-fishes and the Crinoids.

So perfect are all the arrangements in the organized world, and so complete the gradations from genera to genera and species to species, that in studying any one class of animals we find that no connecting link is wanting in the chain which seems to run through animated nature from an early period of time to the present day. Thus again the Lansdown Encrinite, discovered some years since by Mr. Baretti, of Bath, in the Oolite at Lansdown, is another connecting link between the fixed and free Echinoderms. This Crinoid has heretofore been placed in the genus *Apiocrinus*, but the impropriety of arranging a free locomotive animal in the same genus with those which were permanently attached by a massive base, and from which it so essentially differs, is too apparent to require a moment's hesitation in elevating it into a new genus, for which the name of *Gnathocrinus* has been proposed.

The column of this fossil consists of a series of annular pieces, more or less numerous in different individuals; each joint gradually decreases in size as it recedes from the body, until the terminal joint ends in a small obtuse point without the slightest indication of root, or other appendage for permanent attachment. It would seem from this, that the animal possessed the power of free locomotion, and it may also be inferred that by twining its tapering column round extraneous objects, such as coral branches, sea weed, &c., it could moor itself securely to watch for its prey, or in order to remain at rest.

The genus *Apiocrinus* affords considerable insight into the anatomy of the whole tribe. In this genus, I have examined specimens ranging from the embryonic monad to the mature and perfect animal, which at its first dawn of existence seems to have borne some resemblance to a minute *Actinea* encased in a calcareous integument. In the fossilized embryonic roots and stems the form of the parent Crinoid had not yet become fully developed, therefore proving that these animals were oviparous, since from the smallness of these rudimentary specimens, it is evident they were in their earliest state of existence mere monads, and yet are found attached, not to the parent's body, but to a plate that had been separated from its original place, and had lain for some time exposed at the bottom of the sea. Whereas the offspring produced by gemmiferous generation never become detached from the body of the parent until they have attained a considerable size and more perfect form.

Some well-preserved specimens show the oviducts in different stages of advancement towards ejecting the ova. In others we see, through the displacement of the pieces, the internal opening for the passage of the oviduct, and in others the oviducts appear as if turgid with ova. These specimens prove that the animals possessed ovaries with five ducts as in *Echini*.

If we make a horizontal section of an *Actinocrinus* where the rays divide the body into the dorsal and ventral parts, the figure approaches that of a *Goniaster*; and if the ovarial pores in *Actinocrinus* are situated at the base of the rays, as is generally believed, then the resemblance becomes more complete; the difference in this respect being that in *Goniaster* the ovarian pores are marginal and situated between the rays, and in *Actinocrinus* at the points from whence the rays emanate. The *Actinocrinus* section also closely resembles in outline an impregnated *Apiocrinus,* making the connecting links still more perfect.

In the American *Agaricocrinus* of Dr. Troost, the ovarial ducts are clearly seen at the base of the rays. This newly discovered genus, forming as it does a connecting link between the genera *Actinocrinus* and *Amphoracrinus,* again shows the gradations by analogy that exist between the different genera in the whole group.

Passing from the Encrinites proper, another very singular extinct family presents itself to our notice, of which we have no exact type in the living creation, namely the *Blastoidea,* established by Say. This family contains but one genus, named *Pentremites.* The genus may be defined thus:—Perisomic plates so united and fitted to each other as to completely inclose the digestive organs and generative system; the mouth and ovarial pores placed on and around the apex; branchiæ arranged in five ambulacral rows; column cylindrical, perforated in the centre and composed of numerous articulating joints; arms none.

This remarkable genus bears so little affinity to any other yet discovered, excepting Dr. Troost's recent discovery of the *Olivanites,* to which it is allied, that it cannot with propriety be referred to any natural family hitherto instituted, for to those which most nearly approach it, it is but remotely and obscurely allied. Its columnar attachment seems to connect it with the true Crinoids, but the absence of projecting rays altogether excludes it from that group; while the body in which are situated the ambulacral cilia, circularly placed openings and the central generally angulated one, proves its affinity to the *Echinidæ,* but the columnar support and attachment prove that it cannot be properly grouped with them.

Considerable analogy also exists between some species of *Pentremites,* the *P. inflatus* and *P. pentangularis* for example, and the Star-fishes. Likewise, if the internal sac of a small *Goniaster* be filled or inflated to turgidity, the body assumes a conoid form, and then the general resemblance becomes strikingly obvious, while the ovarial apertures bear considerable analogy to each other. The *Pentremites astraformis* even more nearly approaches the *Goniaster Templetoni* (Thompson) than the *P. inflatus* or *P. pentangularis.* It also presents on its ventral surface some characters common to both *Asterias* and *Ophiura.* The genital openings however differ in position. Those of the *Pentremites* encircle the mouth, whilst those of the former are marginal; yet here we have links which connect the *Pentremites* with *Asterias* and *Ophiura*.

By investigating the family of *Pentremites* we are led progressively, as before indicated, to the *Echinidæ*, when, taking *Cidaris* for the type, we find the skeleton formed of five tumid or blunt rays, each composed of a double series of hexagonal plates, these rays being separated by a similar number of ambulacra, sinuous and perforated by minute foramina or ambulacral pores. The ambulacra radiating from the mouth, which is beneath, and taking an upward course, terminate near the apex, which is composed of five plates, each of which has a central opening or ovarial aperture. These pieces united may be considered as the dorso-central plate, in the centre of which the vent is situated.

From this genus we pass by natural gradations to others; but we may pause for an instant to remark on the resemblance which exists between the genus *Conulus* and some species of *Pentremites*, in which the ovarian openings exhibit considerable similitude to each other.

As previously observed, in *Cidaris* and *Echinus* the mouth is found beneath, and the anal opening above or opposite; but in *Spatangus* and other allied forms the anal pore occupies a lateral position, and as we extend our observations we find it, by gradual modifications in different genera or species, becoming more remote from the dorsal plane, and consequently by degrees approaching the oral aperture. Thus in *Clypeaster* its position is in the extreme margin, in *Echinoneus* it is seen on the same plane as the mouth, and finally its approximation becomes so close, that at length in some instances it is merged in the oral opening as in *Echinocyamus*, thus returning through various and beautiful modifications of form and structure to the starting-point, or until it becomes typical with the Star-fishes.

If a common Star-fish of five rays or lobes be examined, we find it to have a well-defined ambulacrum on the inner surface, sunk as it were in a deep furrow, which diverges from the central disc in the direction of the rays. Numerous foramina and small spines will also be observed. By flattening out the rays, the perforated ambulacra will be found ranged along the sides; and if we bring up the points of the Star-fish to meet in a centre above, a spherical body is at once produced closely resembling an *Echinus*, the now curved ambulacra meeting and forming the double lines as seen most clearly in *Cidaris*; and further, if the extreme points of the star are turned inwards, an apophysis is formed capable of supporting the muscles which in *Echinus* move and sustain the maxillary process or jaws.

Again, if we take an *Echinus* and separate the plates down the middle of the interambulacral spaces and fold them back so as to meet above, and then turn down the separated bands, we have a complete Star-fish with the ambulacra and mouth beneath as in the *Asteriadæ* generally. Likewise, if an *Echinus* is placed with the mouth upwards, we find the central plate beneath the proper axis. This not inaptly represents the upper joint of the column to which it bears considerable analogy. The five oviducal plates may be considered as corresponding to the quinquepartite dorso-central plate of the *Apiocrinus*, in which are seen the openings of the oviducts. Above these pieces are the double range of hexagonal plates which indifferently represent the perisomic plates, rays, &c., of the Crinoid.

Having traced the gradual transition from the *Asteriadæ* to the *Crinoideæ*, from the *Crinoideæ* to the *Blastoidea*, and from these again to the *Echinidæ*, and these last into the Star-fishes, it now only remains to notice the *Cystideæ* or *Sphæronidæ*, in which analogies and gradations may be traced connecting them with the *Pentremites* and *Crinoideæ*, as well as with the *Asteriadæ* and *Echinidæ*, in a similar manner to those links which I have endeavoured to indicate in the preceding observations as existing between the different groups of Echinoderms, but which will however form the subject of further investigation.

The *Cystideæ* is an order of radiated animals which has long been known to naturalists, but until recently no attempt was made to place them in a position which their geological and zoological importance seemed to demand. Mr. Gray of the British Museum was the first, I believe, to see the necessity of establishing a family for the grouping together of those ancient forms of Radiata which closely resemble true Crinoids, but which are devoid of arms, properly so called. With this view Mr. Gray appears to have proposed the name of *Sphæronidæ* for the group. Subsequently Baron von Buch, in his essay "Ueber Cystideen," published at Berlin in 1845, grouped them together under the above title. But I reserve further observations on this portion of the subject to another opportunity, remarking however that Prof. E. Forbes, at p. 531, part 2. vol. ii. of the 'Geological Memoirs,' seems to doubt the occurrence of Cystideans in our Mountain Limestone, and asserts that the bodies I have described as such he has "inspected through the kindness of Mr. Morris, and they appear rather to belong to a group along with *Pentremites* rather than to true *Cystidea*."

In reply to this observation I can only remark, that the specimens in my possession were not seen either by Prof. Forbes or Mr. Morris, and that I ventured to group them with the *Cystidea* on the authority of Von Buch himself, who founded the family, as the following extract from the translation of his paper on the *Cystidea** will prove:—

"Mr. Austin states that *Sycocrinites* exhibits three dorso-central plates," &c. (see Annals of Nat. Hist. vol. xi. p. 206). "This is manifestly the description of a *Cryptocrinite* (so named in 1840); but this author does not state the locality of his specimen," &c.

I will only add, that *Cryptocrinus* is a genus arranged with Von Buch's family of *Cystidea*, and that it does not appear to belong to a group along with *Pentremites*.

August 9th, 1851.

XXIII.—*Descriptions of two new species of Nudibranchiate Mollusca, one of them forming the type of a new Genus.* By Joshua Alder and Albany Hancock. *With the Anatomy of the Genus*, by Albany Hancock.

[With two Plates.]

The Nudibranchiate Mollusks, which we have now the pleasure of introducing for the first time to the notice of naturalists, we owe to the persevering researches of our friend Mr. W. P. Cocks of Falmouth, by whom they have been communicated to us, with kind permission to publish descriptions of them. The first species we shall notice we refer to the *Thecacera* of Fleming, a genus at present so imperfectly understood that any addition to our knowledge of its characters may be considered as furnishing a desideratum in this family of the Mollusca. We propose to characterize it as follows:—

Thecacera virescens. Body rather convex, smooth, of a light peach-blossom tint, blotched with green anteriorly and posteriorly. Head with a plain subvelar margin in front. Tentacles broadly laminated, the laminated portion green, the lower or smooth portion of the same colour as the body; they are retractile within moderately-sized sheaths with smooth margins. Branchial plumes five, green, margined with white. A single row of obsolete tubercles encircles the branchial region. Foot of a dull yellowish white. Length $\frac{3}{10}$ths of an inch.

This beautiful little animal differs in several respects from the *Doris pennigera* of Montagu, which is the type of the genus *Thecacera*, and might by some naturalists be thought entitled to rank as a new genus; we prefer, however, to consider it an ab-

* A translation of this paper appeared in the Journal of the Geological Society, Feb. 1st, 1846.

normal form of *Thecacera,* with which it agrees in the sheathed tentacles and the plain frontal veil without filaments or tubercles. It seems to bear much the same relationship to *T. pennigera* as *Polycera ocellata* and *P. Lessonii* do to *P. quadrilineata.*

Two specimens were found by Mr. Cocks in March 1849, at low-water mark on the oyster bed at Bar Point, Falmouth.

The next novelty we have to describe is still more interesting. It belongs to the family *Eolididæ,* but presents peculiarities that forbid its being associated generically with any known form of that family. It will be necessary therefore to establish for it a new genus.

OITHONA*, n. g.

Body elongated, limaciform; head with four linear tentacles, constituting two pairs, both subdorsal; the anterior pair, corresponding to the oral tentacles of *Eolis,* being situated considerably behind the lips. Mouth with corneous jaws. Branchiæ papillary, clothing irregularly a subpallial expansion on the sides of the back and meeting posteriorly; a produced membranous margin or fringe runs down the inner side of each papilla. Anus latero-dorsal, situated towards the right side. Orifices of the generative organs separate; situated below the tentacles on the right side.

This genus differs from *Eolis* in the anterior pair of tentacles not being placed on the lip, in the subdorsal position of the anus, and more especially in the curious frilled membrane that runs down the side of each branchial papilla. The papillæ are also much more firmly attached to the back than in *Eolis,* and the apertures of the sexual organs are disunited. The anatomy also shows several interesting points of divergence.

O. nobilis. Body pale buff or whitish, smooth; tentacles long, broad at the base, and tapering to a fine point at the apex; not wrinkled or laminated; both pairs nearly equal in length. Branchiæ very numerous and crowded, commencing behind the tentacles and set without apparent order on the sides of the back on a subpallial expansion which is considerably produced posteriorly. They are linear-conical and rather compressed, particularly towards the base; the lateral fringe wide and strongly waved: the central vessel is of a rich dark brown, the sheath and waved membrane of a transparent buff-colour: the apices have an iridescent or metallic lustre, which is observable also on the back. The foot is long and lanceolate, rounded in front and produced into a fine point behind; the margins thin. Length 2 inches.

* *Oithona* (*the virgin of the wave*), one of the heroines of Ossian.

Two specimens were found under a stone at Bar Point, Falmouth, together with some patches of spawn deposited on the surface of the stone. "When first taken," Mr. Cocks says, "the iridescent appearance of the back and the tips of the branchiæ was delightful." The tentacles were not carried erect, but projected horizontally "like the horns of a bull." The spawn was of a hemispherical form, composed of a broadish band of ova disposed in a single coil, and curved inwards above.

Unfortunately these beautiful creatures were killed during the first night after their capture by having been accidentally placed in a bottle that had contained quinine, and we thus lost the opportunity of seeing them in a living state.

Anatomy of Oithona, *by* Albany Hancock.

The anatomy of this animal amply proves its generic distinctness. Unfortunately we have not been able to go very minutely into the subject, having dissected only one of the two individuals captured; the other being preserved for external identification. We have, however, ascertained all the leading features with sufficient accuracy, and therefore confidently give the following account of them.

The tissues of *Oithona* are very tough and firm when compared with those of the other *Eolididæ*, particularly the skin and the cellular tissue uniting the viscera. Of course we are now speaking of the animal, after having been subjected to the hardening action of spirit. *Doto fragilis* is the only species, with which we are acquainted, that at all approaches to it in this respect. The branchial papillæ, too, are much more firmly attached than usual, and require considerable force to remove them.

The oral orifice is situated in the inferior surface of the head; it is small, and the external lip is divided behind on the median line much as in *Eolis*. The channel leading to the buccal apparatus is very short and constricted; and, just before it opens into that apparatus, receives on either side below, a very slender duct from a large, much folliculated, salivary gland (Pl. IX. fig. 7 *c, c*). These glands lie beneath the stomach and extend almost halfway down the body. That on the right side is considerably less than the other, and is somewhat tubular,—distinctly so towards its termination; the one on the left side is much complicated in form, being irregularly and extensively sacculated. The position of these glands is unusual: *Doto fragilis* is the only other species in which they open into the channel of the mouth in advance of the buccal mass.

The buccal mass (Pl. X. fig. 1 *a* & Pl. IX. figs. 4, 5) is small, rather long, slender, and irregularly elliptical, the corneous plates or jaws (Pl. IX. fig. 5 *c*) being visible at the sides: it is slightly prolonged behind for the reception of the posterior portion of the tongue, and the muscles are arranged much as in *Eolis*. On the dorsal aspect they are extensively developed, forming a dense mass, the fibres passing transversely and having their extremities inserted into the dorsal margins of the plates. These muscles undoubtedly assist in the motion of the jaws. Those for moving the whole apparatus forward are composed of flattened, isolated bands with their extremities attached to the posterior margin of the plates and to the muscles forming the walls of the channel of the mouth.

The tongue is supported on a fleshy ridge that rises up from the floor of the buccal cavity, and extends in the antero-posterior direction from the œsophagus towards the anterior opening. This organ (fig. 6) is long, linear, and strap-formed, and is composed of forty transverse, semicircular plates (Pl. X. fig. 7) of an orange colour, each bearing a stoutish central spine and six or seven smaller ones at the sides; these latter having apparently a minute denticle at the base of their outer margin. All the spines are a little bent, and have their points directed backwards towards the œsophageal opening.

The corneous plates (Pl. X. figs. 5, 6) are little short of the size of the buccal mass, and much elongated, well arched and ovate; and, when united and entirely isolated, strongly resemble the valves of a minute *Mytilus*. They are smooth, glossy, and of a brownish amber colour, darkest towards the anterior extremity, which gives support to the cutting blade (*a*). This is a wing-like appendage of no great size, terminating below in a free point, and having the cutting margin arched forward, plain, and nearly at right angles to the general direction of the plate; above is a small process or fulcrum (*b*)—the point at which the two plates are articulated; and immediately behind this point the dorsal margin of the plates is reflected and expanded into an arched lobe (*c*) for muscular attachment.

The œsophagus (fig. 1 *b*) is a short and rather slender tube, which, passing from the upper aspect of the buccal mass towards its posterior extremity, opens into the anterior margin of a distinct pyriform stomach (*c*). This organ has the broad end forward, is placed above the reproductive apparatus, and lies quite in the anterior p rtion of the visceral cavity. The internal surface of the gastric organ does not appear to be lamellated. The intestine (*d*) passes from the posterior extremity of the stomach, and inclining slightly to the right side, passes backwards to the tubular anus (Pl. IX. fig. 2 *a*), which is placed a little to the right of the median line of the back, immediately behind the heart. The intestinal tube is rather short, of equal diameter throughout, and internally plicated longitudinally.

The hepatic apparatus is very peculiar in this animal. The pyloric extremity of the stomach receives two biliary ducts, one on each side of the intestine. These ducts or hepatic canals (Pl. X. fig. 1 *e, e*) are nearly as wide as the intestine, and, diverging as they leave the stomach, very shortly pass into the skin at the sides of the back, where each opens into a wide channel that extends nearly the whole length of the body. The channels receive numerous branches (*f*), which communicate with the glands of the papillæ, and as they approach the lateral expansion at the side of the body, they appear to be subdivided several times. The exact order of their subdivisions, however, was not determined; but as the papillæ have no definite arrangement, it is probable that these branches also are irregularly disposed. The anterior portions of the great hepatic channels are apparently connected with two folliculated glandular bodies (*g, g*), much and irregularly sacculated. These bodies are united to the skin, one on each side near the region of the stomach, and probably form the inner walls of those portions of the channels. Amidst the cellular tissue at the extremity of the body, behind the ovary, there is likewise a glandular substance (*h*), of a reddish colour, folliculated and apparently branched, in connexion with the branches of the hepatic canals (*i*) within the skin. These branches at the posterior portion of the body probably form a sort of network of tubes across the dorsal aspect. Such perhaps may be inferred from the appearance the branches present when the skin of the back is divided down the median line.

The arrangement of the hepatic canals differs from that which prevails in the *Eolididæ*. In *Eolis, Embletonia, Doto, Dendronotus, Lomonotus,* and *Antiopa,* the principal canals lie free in the visceral cavity, and in all of them there is a median posterior trunk. In this genus there is no such trunk, and the canals are almost entirely within the skin. In these respects *Oithona* would appear to resemble *Hermæa,* in which the whole of the hepatic ramifications are apparently connected with the skin, and there are only two principal trunks, which pass down the sides of the back. It is evident, however, that the digestive system alone sufficiently distinguishes *Oithona* from all the above genera, not even excepting *Hermæa*.

The hepatic glands are large, nearly filling the papillæ; they are slightly and irregularly sacculated, with the inner surface of the investing membrane lined with a dark granular substance; above, this substance is very abundant, forming a dense mass; below, the membrane in some of the papillæ is entirely devoid of it. We failed to detect any ovate vesicle like that of *Eolis* in the apex of the papillæ, neither have we been able to determine whether or not the apex is perforated.

Reproductive Organs.—There are two external orifices, one placed a little in advance of the other on the right side of the head between and a little below the tentacles. The one (Pl. IX. fig. 1 *a*) in front is for the exsertion of the intromittent organ, the other (*b*) is rather small and is common to both the female and androgynous apparatus.

On laying open the dorsal skin, the reproductive organs are found as usual to occupy much of the visceral cavity, having the stomach and intestine lying above, and the buccal mass in front. The intromittent organ (Pl. X. fig. 2 *a*) is placed in advance of the other parts, and, in its retracted state, is long, rather slender, and linear; differing considerably from the usual conical form of this organ when in this state. The outer extremity leads through the wall of the visceral cavity to the external orifice, and on its way the sheath or external covering becomes firmly attached to the muscles of the skin. The testis (*b*), a stout flesh-coloured tube two or three times convoluted, tapers at one extremity into a long slender duct or vas deferens (*c*), which is united to the inner extremity of the penis. The other extremity of the testis suddenly contracts into an equally slender duct (*d*), but very much shorter, and is joined by this duct to the oviduct. The ovary (*e*) fills the posterior portion of the visceral cavity, and is composed of large irregular lobules made up almost entirely of eggs, and packed into a dense mass, tapering a little behind and truncated in front. The oviduct (*f*) leaves the anterior border of the ovary as a slender tube, but, almost immediately dilating (*g*), equals the diameter of the testis. This dilated portion of the oviduct rests between the lobes of the mucus-gland, and is at first somewhat sacculated and convoluted; it then passes forward and suddenly contracts (*h*) to its original diameter, and then advances to the anterior border of the mucus-gland and receives the duct from the testis as before described; it then bends a little backward and is shortly joined by a duct (*k*) from the spermatheca. This latter organ (*j*) is a small oval membranous sac, lying between the lobes and at the front margin of the mucus-gland. The duct, which is short and slender, passes from one end of the sac, and, at the point where the duct is united to the oviduct, it is joined by a tube (*m*) which comes from the external orifice immediately within the female opening. This tube is the vagina or copulatory channel, and is cemented to the upper wall of the female channel. Just before the vagina reaches the duct of the spermatheca and oviduct, it gives off a branch which sinks into the female channel, and so far may be looked upon as a portion of the oviduct, for it is by this branch that the eggs find their way to the female outlet.

The mucus-gland (*n*, *n*, *n'*), for the secretion of the mucus-like envelope of the eggs, is composed of two lateral lobes separated on the upper surface by a deep fissure. These lobes are semi-pellucid and are formed of a coarsely convoluted tube; that on the right side having its anterior portion (n') opake and flesh-coloured. The two lobes open into the female channel (l), which is wide and much longer than usual.

The reproductive apparatus, we see, is formed on the type of that of *Eolis*. The mucus-gland is exactly of the same form, and the mode of union of the androgynous parts with the oviduct and testis is the same as in that genus. The only modification of any interest is in connexion with the testis. We know of no other species, in the whole of the *Eolididæ*, in which it is furnished with a distinct vas deferens. In this respect our new genus resembles some of the *Dorides*, particularly *Doris repanda*, in which the testis has appended to it not only a vas deferens but is likewise supplied with a much-constricted duct, which unites it to the oviduct just as in *Oithona*; and the testis, too, of this *Doris* is very similar to the same organ in this animal.

In *Oithona*, then, as in all the Nudibranchs, it is evident, from the connexion of the various parts of the genitalia, that self-impregnation is not only possible but probable; while at the same time it is apparent that the ova may be fertilized by the congress of two individuals.

Vascular and Respiratory Systems.—The vascular system is very interesting in this animal, inasmuch as we have been able to trace the efferent or branchio-cardiac vessels more completely than in any other member of the family. Indeed nearly the whole of these vessels are distinctly visible on the skin of the back, rising above the general surface, and exhibiting a very curious and novel appearance. The heart (Pl. IX. fig. 2 *c*) is situated about the middle of the back, where it forms a large oval swelling immediately below the skin, having the generative organs beneath. From the posterior extremity of the swelling a broad elevated but rounded ridge (*d*) passes down the median line of the back to the termination of the body. This ridge is joined on either side by numerous similarly elevated branches (*e*), which divide and subdivide as they approach the pallial-like expansion on the sides of the body. The whole of these branches and their subdivisions, standing boldly up from the general surface of the skin, have the branchial papillæ set along them (fig. 3 *a*), and they give off twigs, which pass up the margin of the broad, flounced, membranous expansion (*b*) of the papillæ.

On opening the heart from above, the ventricle and auricle are found to occupy a well-defined oval pericardium. The ventricle (Pl. X. fig. 3 *a*) is large and muscular, of an irregular elliptical form, giving off the aorta (*b*) in front, which in the usual manner supplies branches to the various organs. The auricle (*c*) is united to it behind, a little on the left side; it is delicate in comparison with the ventricle, but is nevertheless abundantly supplied with muscular fibres; it lies diagonally in the pericardium, having the left side advanced almost to the front of that organ where it receives a trunk-vein from the skin. The right side of the auricle stretches backward, and receives a similar trunk-vein from the skin of this side almost at the posterior extremity of the pericardium.

On laying the dorsal wall of the auricle open, its cavity is found to be continuous with that of the great posterior elevated median ridge or trunk-vein (*d*) before alluded to, and on opening this trunk-vein the various lateral branches (*f*) are observed debouching into it on either side. It is therefore evident that this trunk-vein, which lies entirely within the skin, is the great posterior efferent or branchio-cardiac vein, and that all the elevated branches coming to it from the papillæ are also efferent vessels. In this beautiful system of veins, then, we have a clear proof of the branchial character of the papillæ.

The papillæ are, as we are already aware, of a very peculiar character in our animal, being somewhat compressed as in *Eolis papillosa*, and having a distinct, widish, frilled membrane, extending up their inner margin. It is, as before remarked, to the border of this membrane that the twigs of the efferent vessels are given, and they pass up its entire length. Of this there can be no doubt, for we succeeded in forcing a creamy fluid which pervaded these vessels almost to the top of the membrane. When a transverse section of a papilla is made, a widish canal (fig. 8 *b*) is seen to pass up the opposite margin. This may be looked upon as an afferent branchial vein, and deteriorated blood, passing from the skin up this canal, may be supposed to filter through the cellular tissue (*d*) between the external skin and the glandular sheath of the papilla, and so find its way to the vessel (*c*) at the free border of the membrane. If this view be correct, and it would seem scarcely possible to doubt it, the papillæ are evidently specialized breathing organs, and by no means so low in organization as has been thought.

At the same time, from the arrangement of the efferent vessels, from their elevation above the general surface of the skin, thus exposing to the influence of the surrounding medium nearly three-fourths of their circumference, it is pretty clear that the dorsal skin itself must act, to some extent, as a gill, especially when we consider further, that the whole of the blood returned to the heart does not pass through the papillæ: much of it, no doubt, circulating in the spongy tissue of the skin, passes at once into the efferent vessels; and, indeed, small orifices for this purpose are seen in the wall of the great median trunk-vein. Here then, as in *Doris*, the blood is partly aërated in specialized breathing organs, and partly in the skin. In this respect also our animal resembles *Eolis*, in which some time ago, we, in conjunction with Dr. Embleton*, described the existence of two canals, passing up the margins of the papillæ, much in the same manner as in this animal, and then pointed out the fact as evincing the probability of a system of veins, such as the anatomy of *Oithona* has brought to light.

We have not been able to carry our investigations of the vascular system further; but from what we know, we cannot doubt that the peripheral portion of it is made up of lacunæ as is usual in the Mollusca, and probably to the same extent as in the other *Eolididæ*.

In connexion with the vascular system, *Oithona* is provided with an additional propelling organ similar to what in *Doris* we have called a portal heart. As in that genus, this propelling organ (Pl. X. fig. 1 *s*, and fig. 3 *e*) lies below the floor of the pericardium, and in like manner opens into that organ. In this species it is considerably elongated, with the ends rounded, and is placed far back on the right side of the pericardium. It is firmly attached to the skin of the body, and is internally longitudinally plicated. Judging from our knowledge of this heart in the *Dorides*, it may be supposed to throw venous blood from the pericardial cavity to the glands of the papillæ. In *Oithona* it is certainly connected with the skin, and probably has some relationship to the vascular apparatus therein.

In this genus a renal organ probably exists, though we have failed to detect it. A distinct small orifice (Pl. IX. fig. 2 *b*, and Pl. X. fig. 1 *t*), however, opens externally immediately above the anus, and close to the posterior border of the heart. We traced this orifice through the skin, but could not observe its connexion with any internal organ; yet there can be little doubt that it is of the same nature as the minute opening by the side of the anus in *Doris*, and which in that genus leads into an extensive renal apparatus. We have not observed a similar orifice in any other species of the *Eolididæ*.

Nervous system.—The cerebral ganglia resemble those of *Doris* rather than of *Eolis*. They are placed at the commencement of the gullet; there are as usual four pairs of supra-œsophageal ganglions, though at first sight only three are apparent,—the cerebroid (Pl. X. fig. 4 *a, a*) and branchial (*b, b*) being completely fused. These latter form two oval central masses, resting upon the upper surface of the gullet, one on each side of the median

* Ann. Nat. Hist., 2nd Ser., vol. i. p. 101.

line, across which they are united at the anterior extremity by a short but distinct commissure: their posterior extremities diverge and are slightly bilobed, marking the boundaries of the two ganglia of which each mass is composed,—the anterior lobe indicating the cerebroid, the posterior the branchial. In *Doris bilamellata* and *D. aspera* these two ganglions are fused, much in the same manner, and have a strong general resemblance to those of *Oithona*. The pedial ganglions (*c, c*) are irregularly rounded, being equal in bulk to the cerebroid and branchial together. They lie against the sides of the gullet, and are united to the under surface of the central masses. The fourth pair of ganglions are the olfactory (*d, d*); they are well developed, though very much smaller than those just described, and are joined by a short pedicle or commissure to the upper surface of the anterior margins of the cerebroid ganglions. The close approximation of the olfactory ganglions to the central masses is a matter of some interest. In the *Dorides* they are sessile upon these masses. Thus we come to learn that these ganglions, which, in all the *Eolididæ* that we have examined, with the exception of this genus, are placed at the base of the dorsal tentacles, and consequently far removed from the central masses, are in truth cerebral ganglions, and like the olfactory of the higher animals, are placed in front of the brain.

The infra-œsophageal ganglions are placed in the usual situation on the buccal mass, below the gullet. The buccal ganglions (*e, e*) are scarcely larger than the olfactory, and are of an oval form, their inner extremities being connected across the median line by a short commissure; their outer extremities receive a cord of communication from each of the cerebroid ganglions. Two minute elliptical ganglions are almost sessile on the anterior border of the buccal ganglions; these are the gastro-œsophageal ganglions (*f, f*). Thus in all there are six pairs of ganglions; four above the gullet, and two below it.

The first pair of nerves come from the olfactory ganglions, and are large, but of no great length; they divide into several filaments as they enter the base of the dorsal tentacles. The second pair pass from the under surface of the anterior border of the cerebroid ganglions, not far from their union with the olfactory ganglions; these nerves go to supply the upper surface of the channel of the mouth. The third and fourth pairs of nerves issue from the same ganglions, but considerably behind the second pair; these also go to the channel of the mouth; the third probably sending a branch to the oral tentacles. A strong cord passes off close to the root of the fourth pair: these cords curve round the œsophagus and are united to the outer extremities of the buccal ganglions, forming the anterior collar (*g*). The fifth pair of nerves issue apparently from the outer border of the branchial ganglia, and go to the skin by the side of the head. The sixth pair are small, and come from the upper surface of the branchial ganglions; these nerves go to the skin of the sides of the back. The seventh, much larger than the sixth, emerge from the posterior margin of the same ganglions, and supply the dorsal skin, and apparently likewise the papillæ. These are the branchial nerves. The eighth and ninth pairs are large nerves; they issue from the outer border of the pedial ganglions and go to the foot. The posterior margins of these ganglions are united by a stout, shortish commissure, composed of two or three cords, which, passing below the gullet, form the great œsophageal collar (*i.*). The tenth pair of nerves are given off from the posterior margin of the buccal ganglions; these pass into the buccal mass and go to supply the tongue. The eleventh pair, issuing from the outer extremities of the buccal ganglions, are distributed to the muscles of the buccal mass. The twelfth pair come from the apex of the gastro-œsophageal ganglions, and being applied to the gullet, each divides into two branches, one of which supplies the upper portion of that tube, the other, passing down it, undoubtedly goes to the stomach as in the other Nudibranchs. The thirteenth pair are large; these are the hepatic nerves; they issue from the buccal mass in the same manner as similar nerves do in *Eolis,* and probably, as in that genus, are connected at their origin with ganglions, which must be looked upon as belonging to the sympathetic system. Immediately on emerging from the buccal mass, they are connected to the buccal ganglions at their point of union with the gastro-œsophageal, and then, arching outwards and upwards, pass from within the anterior œsophageal collar, and go to supply the glands of the papillæ.

These are all the pairs of nerves that we have traced: there is, however, a single nerve given off from a delicate collar (*h*), the ends of which are united to the under-surface of the central masses, just where they are connected to the pedial ganglions. This is the genital nerve (14), and similar to that which we have described in *Eolis.* We saw another nerve (15), which was apparently also distributed to the genitalia; this seemed to come from the right branchial ganglion, at its union with the pedial. These two nerves, which however require further examination, probably represent those that come from the visceral ganglion in *Doris,* and which in that genus are distributed to the sympathetic ganglions of the digestive, reproductive, respiratory, and circulatory organs.

EXPLANATION OF PLATES IX. AND X.

Plate IX.

Fig. 1. Side view of *Oithona nobilis* :—*a*, penis partially exserted; *b*, orifice leading to the female and androgynous parts.

Fig, 2. Dorsal view of the same, the papillæ of one side being removed :—*a*, anal tube; *b*, small orifice at the base of the same, supposed to lead to a renal organ; *c*, heart; *d*, great efferent or branchio-cardiac vessel, raised above the general surface; *e*, small efferent vessels, likewise raised above the surface, leading from the papillæ to the same.

Fig. 3. Two of the papillæ enlarged :—*a*, small efferent vessel leading to the great median trunk; *b*, puckered, membranous fringe with efferent vessel running up its margin.

Fig. 4. Upper view of the buccal organ :—*a*, anterior extremity leading to the channel of the mouth; *b*, gullet; *c*, *c*, horny jaws; *d*, *d*, muscles for advancing the whole apparatus.

Fig. 5. Side view of buccal organ :—*a*, anterior extremity; *b*, gullet; *c*, horny jaw; *d*, muscles for advancing the buccal organ.

Fig. 6. Side view of the tongue :—*a*, anterior extremity.

Fig. 7. Salivary glands; the buccal organ and all the viscera having been removed :—*a*, oral opening; *b*, walls of the channel leading to the buccal organ; *c*, *c*, salivary glands; *d*, *d*, ducts of the same passing into the wall of the channel of the mouth.

Plate X.

Fig. 1. General view of the viscera seen from above :—*a*, buccal organ; *b*, gullet; *c*, stomach; *d*, intestine; *e*, *e*, hepatic ducts leading from the great lateral hepatic channels within the skin; *f*, one of these channels laid open, exhibiting the canals from the papillæ opening into the same; *g*, *g*, folliculated glandular bodies in connexion with the anterior portions of the great hepatic channels; *h*, gland-like substance in connexion with the hepatic channels in the skin; *i*, some of these channels laid open; *j*, a portion of the right salivary gland; *k*, penis; *l*, testis; *m*, ovary; *n*, *n*, *n'*, mucous gland in connexion with the female channel; *o*, *o*, pericardial cavity seen in section; *o'*, *o'*, floor of the same; *p*, ventricle; *q*, auricle; *q'*, portion of the same attached to the great efferent vessel in the skin; *r*, *r*, the great efferent vessel seen in section; *s*, portal heart, opening through the floor of the pericardium; *t*, orifice supposed to be in connexion with a renal organ, and opening externally by the side of the anal tube; *u*, cerebral ganglions.

Fig. 2. Reproductive organs separated from the rest of the viscera and spread out :—*a*, intromittent organ retracted; *b*, testis; *c*, vas deferens; *d*, duct leading from the testis to the oviduct; *e*, ovary; *f*, duct leaving the same; *g*, dilated portion of the oviduct; *h*, constricted portion of the same; *i*, the point where it receives the duct from the testis; *j*, spermatheca; *k*, duct from the same leading to the oviduct; *l*, female channel leading to external orifice; *m*, vagina or copulatory channel leading from external orifice to oviduct and spermatheca; *n*, *n*, *n'*, mucus-gland in connexion with the female channel.

Fig. 3. View of the heart, the pericardium being laid open :—*a*, ventricle; *b*, aorta, passing from the front of the same; *c*, auricle; *d*, great median efferent or branchio-cardiac vessel laid open, showing its connexion with the auricle, and likewise with the efferent vessels from the papillæ; *e*, portal heart lying under the pericardium and opening through its floor; *f*, efferent vessels from the branchial papillæ.

Fig. 4. Central ganglions and their nerves:—*a, a*, cerebroid ganglions; *b, b*, branchial ditto; *c, c*, pedial ditto; *d, d*, olfactory ditto; *e, e*, buccal ditto; *f, f*, gastro-œsophageal ditto; *g*, nervous cord, connecting the infra-œsophageal to the supra-œsophageal ganglions, forming the anterior collar; *h*, small middle collar; *i*, great œsophageal collar; 1st pair of nerves go to the dorsal tentacles; 2nd pair to the upper portion of the channel of the mouth and lips; 3rd and 4th pairs go likewise to the channel of the mouth and lips; 5th pair supply the skin at the side of the head; 6th and 7th pairs pass to the skin at the side of the back, and supply the branchial papillæ; 8th and 9th pairs go to the foot; 10th pair are the lingual nerves; 11th pair supply the muscles of the buccal mass; 12th pair supply the gullet and stomach; 13th pair go to the glands of the papillæ; 14th is a single nerve going to the reproductive organs; 15th is likewise a single nerve, and probably also goes to the same organs.

Fig. 5. Interior view of one of the jaws:—*a*, cutting edge; *b*, point at which the two jaws are articulated; *c*, expanded lobe at the dorsal margin for muscular attachment.

Fig. 6. External view of the same:—*a*, cutting edge; *b*, expanded lobe at the dorsal margin.

Fig. 7. Two of the spinous plates from the tongue.

Fig. 8. Transverse section of a branchial papilla:—*a*, gland; *b*, afferent branchio-cardiac vessel; *c*, efferent ditto.

XXIV.—*On* Chantransia, *Desv.* By John Ralfs, Esq.*

CHANTRANSIA, *Desv.* TRENTEPOHLIA, *Agardh and British authors.*

Plant affixed, tufted; filaments branched, jointed, monosiphonous; fructification—capsules with granular contents and usually terminal and subcorymbose on proper branches.

Freshwater, minute, tufted Algæ of a red, purplish or inky colour. Filaments much branched, jointed; main branches elongated, mostly level-topped. Fructification capsular, usually on short, much divided proper branches; capsules generally crowded, subcorymbose, and terminal on short stalks, their contents simple.

The proper position of this genus is doubtful: in habit and appearance some of its species agree so closely with the minute, parasitic, irregularly branched species of *Callithamnion*, that Dr. Harvey in his 'Flora Hibernica' united it to that genus; and although, at Mrs. Griffiths' suggestion, he has, in his 'Manual of

* Read before the Botanical Society of Edinburgh, June 19, 1851.

British Algæ,' again separated them, yet he justly remarks, that deep-coloured specimens of *Trentepohlia pulchella* (*Chantransia Hermanni*) so much resemble *Callithamnion Daviesii* as scarcely to be distinguishable from it.

Whilst, however, the red colour of some species of *Chantransia* seems thus to indicate an affinity with the *Rhodospermeæ*, the inky-green of others appears to forbid us to rank the genus in that order. Dr. Montagne, a high authority, places it in *Ectocarpeæ*, a tribe belonging to the *Melanospermeæ*, and Kützing refers it to the *Conferveæ*. *Chantransia* has thus been associated by authors of distinguished merit with the three great primary divisions of the Algæ,—a proof how difficult it is to ascertain its proper position. As the contents of its capsules are simple and not divided into tetraspores, I believe its correct situation is with the *Chlorospermeæ*.

1. *C. Hermanni* (Roth). Tufts dense, reddish; joints of filaments three to five times longer than broad; fructiferous ramuli patent, capsules crowded. *Conferva Hermanni*, Roth, Cat. i. p. 164 (1797); Cat. iii. p. 180. *Conferva nana*, Dillwyn, Conf. t. 30 (1803); Smith, Eng. Bot. t. 2585. *Chantransia Hermanni*, Desv. (?); Kützing, Phycologia Germanica, p. 230. *Trentepohlia pulchella*, Agardh, Systema Alg. p. 37 (1824); Harvey in Hooker's Brit. Flora, p. 382; Manual of Brit. Algæ, p. 75; Hassall, Brit. Algæ, p. 75. t. 8. f. 2. *Auduinella Hermanni*, Duby, Botanicon Gallicum, p. 972 (1830).

On aquatic plants in streams.

The tufts of *Chantransia Hermanni* are dense, soft and woolly, not gelatinous, and adhere but imperfectly to paper; they are often confluent; their colour is reddish, becoming tawny by age and in drying. Filaments much branched, main branches elongated, somewhat level-topped; fructiferous branches lateral, numerous, short, patent, much divided. Capsules at first oval or clavate, finally orbicular, crowded in a corymbose manner, mostly stalked. Joints of stem three to five times as long as broad, those of fertile branches shorter.

Chantransia Hermanni differs from *C. chalybea* in colour and in its shorter joints and more patent ramuli.

2. *C. investiens* (Lenormand). Parasitic, rose-red, much branched; joints many times longer than broad; capsules solitary or in pairs, lateral and terminal, clavate or obovate. *Batrachospermum rubrum*, Hassall, Brit. Algæ, p. 113. t. 15. f. 2, 3 (1845). *Chantransia investiens*, Lenormand in Kützing's Species Algarum, p. 431 (1849); Ralfs, British Alg. no. 12.

Parasitic on *Batrachospermum moniliforme* and *B. atrum* in a stream, Penzance, *J. R.*

France, *Lenormand*!

Plant bright red, at first appearing as minute reddish stains, finally clothing the invested plant with a continuous downy covering. Filaments creeping and interlacing at base, and surrounding the plant on which it grows, much branched. Branches not attenuated, alternate, erect, elongated; joints very long, often twelve times as long as broad, and filled with a pink, slightly granular endochrome. Capsules clavate or obovate, alternate or opposite, sometimes, though rarely, opposite a branch; the terminal ones are more orbicular.

3. *C. chalybea* (Roth). Tufts rather lax, inky-green; joints of filaments five to six times longer than broad, those of fructiferous ramuli turgid; branches appressed. *Conferva chalybea,* Roth, Cat. iii. p. 286. t. 8. f. 2 (1806); Dillwyn, Brit. Conf. t. 91. *Conferva corymbifera,* Smith, E. Bot. t. 1996 (1809). *Ectocarpus chalybeus,* Lyngbye, Tent. Hydrophytologiæ Danicæ, p. 133. t. 44 (1819); Fl. Dan. t. 1666. fig. 1. *Trentepohlia pulchella, β. chalybea,* Agardh, System. p. 37 (1824); Harvey, Manual of Brit. Algæ, p. 118. *Auduinella chalybea,* Bory, Dict. cl. iii. p. 340. *Chantransia chalybea,* Fries; Kützing, Phyc. Germ. p. 229; Species Algarum, p. 429; Ralfs, British Algæ, no. 11.

β. *major.* Filaments longer with rather shorter joints, ramuli more distant.

α. Common. Rivulets, waterfalls, and on water-wheels.

β. Wells, Penzance, *J. R.*

Plant laxly tufted, of an inky colour, more or less tinged with green. Branches rather distant, level-topped, erect, their joints four to six times longer than broad. Fertile branches short, appressed, their joints shorter and usually turgid. Capsules orbicular, corymbose, less crowded than in *Chantransia Hermanni.*

Chantransia chalybea differs from *C. Hermanni* in its colour, penicillate tufts and its appressed fructiferous branches, the joints of which are more turgid. The dried plant is usually more or less glossy.

4. *C. compacta* (——). Plant minute, hemispherical, inky-green, firm; filaments much branched, joints twice as long as broad; branches erecto-patent.

On aquatic plants in a rivulet at Trengwainton near Penzance, *J. R.*

Chantransia compacta forms very minute hemispherical tufts or fronds of a dark colour, and very much resembles a *Rivularia* in appearance; the fronds are so firm as to require considerable pressure in order to separate the filaments for microscopic examination. Filaments comparatively stout, rigid, much branched, at the base horizontal and interlacing. Branches crowded, erecto-patent. Joints about twice as long as broad, but the lower ones frequently shorter. Capsules orbicular, numerous, lateral, arising from all parts of the plant and usually on short stalks.

Chantransia compacta differs from *C. chalybea* in its compact, firm habit, more crowded branches, shorter joints and more scattered capsules.

I am unacquainted with *C. violacea*, Kütz., and am consequently unable to decide with certainty that this plant is not a variety of that species; but its difference in colour has induced me to propose it as a distinct species.

Kützing in his 'Species Algarum' mentions two other British species: as I am unacquainted with them, I subjoin his descriptions:—

5. *C. scotica* (Kütz.). Cæspite cæruleo-chalybeo, majori, trichomatibus $\frac{1}{240}'''$ crassis, ramis ramulisque remotis patentibus elongatis; articulis diametro plerumque duplo longioribus. Kützing, *Phyc. Gener.* p. 285; *Species Alg.* p. 430.

   In Scotia legit cl. *Klotzsch.*

6. *C. violacea* (Kütz.). Cæspite minuto, violaceo, subgloboso; trichomatibus radiatim dispositis, rigidis, ramulis crebris approximatis, abbreviatis, patentibus, subsecundis; articulis inferioribus diametro fere æqualibus superioribus 2-3plo longioribus. Kützing, *Phyc. Germ.* p. 231; *Species Alg.* p. 431.

   In fluviis et rivulis montanis Germaniæ et Scotiæ ad Lemaniam fluviatilem.

XXV.—*A List of all the Mosses and Hepaticæ hitherto observed in Sussex.* By William Mitten, A.L.S.

Besides the species not before described as British, this list will be found to contain localities for others of rare occurrence or but little known, and will show the comparative rarity of the more common species.

With very few exceptions all the species enumerated have been gathered by the author himself; most of the previously known rarer species having been shown to him in their respective localities by Mr. Borrer, with whom he has examined many of the most productive parts of the county, and to access to whose collections he attributes chiefly whatever small amount of critical knowledge he may possess of these beautiful plants.

Tribe I. Andreæaceæ.

Genus 1. *Andreæa*, Ehrh.

A. rupestris, Hedw.

"On the High Rocks;" Forster, Fl. Tonbridgensis.

Nothing further is known respecting this moss, but it has been supposed that a small blackened state of *Jungermannia emarginata*, found on some of the High Rocks, might have been mistaken for it by Forster.

Tribe II. Dicranaceæ.

Genus 1. *Archidium*, Brid.

1. *A. phascoides*, Brid.
Phascum alternifolium, Eng. Fl., not of Dickson.

Not common. In wet places on Henfield Common, on Tilgate Forest, and by roadsides near Hurstpierpoint.

Genus 2. *Angstrœmia*, B. et S.

2. *A. subulata* (Linn.), Mitten.
Phascum subulatum, Linn. Eng. Fl.

Frequent on banks by roadsides; found more rarely on the Downs.

3. *A. alternifolia* (Linn.), Mitten.
Phascum alternifolium, Dicks.

Far less common than the preceding species, and almost confined to clayey soils: it occurs at Hurstpierpoint in several places, at Henfield, and on Tilgate Forest.

On this species Bridel founded his genus *Pleuridium*, "ob thecam lateralem aut talem visam," but he seems to have been not well satisfied about it, for he takes care to follow his assertions on that point with "aut talem visam," or "aut talis videtur." The authors of the 'Bryologia Europæa' in their last review of these species have adopted Bridel's name *Pleuridium*, which appears to be neither founded on a true idea of their mode of fruiting nor applicable to the species.

4. *A. nitida* (Hedw.), Mitten.
Phascum axillare, Dicks. Eng. Fl.

Frequent in ditches and places where water is dried up in summer.

5. *A. cerviculata* (Hedw.), C. Müller.
Dicranum cerviculatum, Hedw. Eng. Fl.

Not rare on peat, and sometimes on wet sandy banks; at Hurstpierpoint, Albourne, Henfield, Tilgate Forest, and Tunbridge Wells.

6. *A. heteromalla* (Hedw.), C. Müller.
Dicranum heteromallum, Hedw. Eng. Fl.

Frequent, particularly on sandy soils.

A. Hedwigii, Mitten, *Dicranum subulatum*, Hedw., is stated to grow near Littlehampton in the Appendix to Horsfield's 'History of Sussex,' but nothing further seems known respecting it.

7. *A. varia* (Hedw.), C. Müller.
Dicranum varium, Hedw. Eng. Fl.

Frequent on all kinds of soils.

8. *A. rufescens* (Turn.), C. Müller.
Dicranum varium, β. rufescens, Eng. Fl.

Not rare on moist sandy or clayey banks.

9. *A. Schreberi* (Hedw.), C. Müller.
Dicranum Schreberi, Hedw., not *D. Schreberianum,* Eng. Fl.

In very small quantity and rarely fruiting in many places about Hurstpierpoint and Henfield.

10. *A. crispa* (Hedw.), C. Müller.
Dicranum crispum, Hedw. Eng. Fl.

In small quantity at the High Rocks, Tunbridge Wells.

11. *A. cylindrica* (Hedw.), C. Müller.
Didymodon cylindricus, Hook. Eng. Fl.

In stubbles on St. Leonard's and Tilgate Forests, and on hedge-banks in several places about Hurstpierpoint, but always without fruit.

On the forests this species is very short and inconspicuous, but it grows much more luxuriantly on a shaded bank near Hurstpierpoint.

12. *A. pellucida* (Hedw.), C. Müller.
Dicranum pellucidum, Hedw. Eng. Fl.

Common about the sand rocks, and less frequent on wet ditch banks; very seldom in fruit.

The variety of this species, *Dicranum flavescens,* Smith, Eng. Fl., is found on the Hungershall Rocks near Tunbridge Wells, but it has not been observed in Sussex.

Genus 3. *Brachyodus,* Furnr.

13. *B. trichodes* (Web. et Mohr), Nees et Hsch.
Weissia trichodes, Hook. and Tayl. Eng. Fl.

On stones at Henley Hill, at Blackdown, and in the stone-pit at Henfield, the place where it was first observed in Britain by Mr. Borrer.

Genus 4. *Campylostelium,* B. et S.

14. *C. saxicola* (Web. et Mohr), B. et S.
Grimmia saxicola, Schw. Eng. Fl.

On stones at Blackdown, where it was first observed by Mr. Borrer; on rocks and stones at Henley Hill, on a stone wall at Tillington, on blocks of stone in a rivulet near Wych Cross, and in the same situation on Tilgate Forest near Balcombe.

Genus 5. *Seligeria,* B. et S.

15. *S. pusilla* (Hedw.), B. et S.

Weissia pusilla, Hedw. Eng. Fl.

Not uncommon on chalk-stones about the Downs; on stones at Henley Hill near Midhurst.

16. *S. calcarea* (Hedw.), B. et S.

Weissia calcarea, Hedw. Eng. Fl.

On chalk about Lewes.

The preceding species is very commonly mistaken for this, which happens the more easily, as the form of *S. pusilla* which grows on the chalk is shorter-leaved than usual.

Genus 6. *Leptotrichum,* Hampe.

17. *L. flexicaule* (Schw.), Hampe.

Didymodon longirostris?, Eng. Fl.

Abundant on the Downs, and rarely by roadsides; always sterile.

18. *L. homomallum* (Hedw.), Hampe.

Didymodon heteromallus, Hook. and Tayl. Eng. Fl.

Rare; it occurs at Blackdown, on Tilgate Forest, at the High Rocks, and in some other places about Tunbridge Wells.

19. *L. tortile* (Schrad.), Hampe.

Didymodon pusillus, Hedw. Eng. Fl.

In the stone-pit at Henfield in very small quantity, and on a sandy bank near Hurstpierpoint, where it was very plentiful for one season, 1847, but has scarcely been seen since.

Genus 7. *Dicranum,* Hedw., C. Müller.

20. *D. spurium,* Hedw.

On Waterdown and Broadwater Forests near Tunbridge Wells, but without fruit.

21. *D. scoparium,* Hedw.

Frequent in woods, and varying greatly; the leaves sometimes all straight, more commonly secund, and rarely, about the sand rocks, all falcate-secund.

22. *D. majus,* Turn.

D. scoparium, β. majus, Eng. Fl.

Not common: confined chiefly to the neighbourhood of the sand rocks, and St. Leonard's Forest.

23. *D. Bonjeani,* De Notaris; "dense cæspitosum fragile erec-

tum vel ascendens fastigiatim breviter ramosum robustum dense foliosum, apice substricto vel subcuspidato; folia caulina paulisper secunda vel erecto-patentia, e basi lata plana lanceolata latiusculo-acuminata dentibus acuta, apice subplano loriformi, superne argute serrata et leviter transversim undulata, nervo angustissimo evanido, omnino e cellulis longis robustis parietibus crassis valde interruptis flavidis præditis areolata, cellulis alaribus planiusculis paucis robustis brunneis dein marcescentibus; perichætialia in cylindrum convoluta late vaginantia superne sinuato-rotundata subito acuminata integra obsoletinervia; theca oblongo-cylindracea erecto-curvata subapophysata lævis exannulata fuscescens, operculo longi-subulato; perist. dentes angusti pallide purpurei bifidi."—*C. Müller, Synops.* p. 369.

D. palustre, B. et S. Bryol. Europ. Dicranum, p. 39. t. 31.

Frequent in bogs, but always barren.

This species has no doubt commonly been passed over as a state of *D. undulatum* or of *D. scoparium,* to which last in habit and appearance it has great resemblance, but it differs in having the upper part of its leaves broader and more strap-shaped and not subulate; the nerve vanishes below the point, in *D. scoparium* it is excurrent; the areolation of the leaves is much more lax than in *D. scoparium* or *D. Schraderi*; the capsules without opercula, sent by Mr. Spruce and Mr. Gardiner, resemble those of *D. scoparium.* As in *D. undulatum,* the leaves of this moss are prettily undulated, especially when dry.

24. *D. Scottianum,* Turn.

D. flagellare, β. Eng. Fl.

On all the sand rocks.

25. *D. Funkii,* C. Müller; "pulvinato-cæspitosum humile pallide viride fragile subsimplex strictum, inferne fusciduIo-tomentosum tenuius, superne crassius foliosum, parce fructificans; folia caulina erecto-patentia stricta e basi longa tenera laxissime et pellucide areolata lanceolato-acuminata latinervia, dorso scabra, apice denticulata, cellulis alaribus raro conspicuis, paucissimis tantum marginalibus hyalinis; folia ramorum sterilium apicis angustissime lanceolata linearia laxe quadrate et amœne pellucide areolata valde canaliculata strictissima laxinervia crassa; perichætialia vaginantia basi laxius sed superne ut in caulinis minute et incrassato-areolata; thecæ paucæ solitariæ in pedunculis valde cygneis ovales subpyriformes leviter sulcatæ olivaceæ, operculis conico-subulatis rubentibus obliquis; calyptra parce fimbriata; peristomium *D. turfacei.*"—*C. Müller, Synops.* p. 393.

Campylopus fragilis, Bryol. Europ. Campylopus, p. 4. t. 2.

On all the sand rocks, but seldom in fruit.

This pretty moss forms small dense tufts in cracks in the sand rocks. The upper parts are of a fresh or yellowish green colour, the lower pale brown; the leaves are all erecto-patent and subulate from a more elliptic pale base than in *D. flexuosum*; the large cells found at the base of the leaves of all *Dicrana* are scarcely visible in this species, being reduced to a single row of cells. In *D. flexuosum* this part is more developed and coloured of a deep red-brown, and the areolation of the leaves is closer and more dense, and the leaves are all much longer and often falcate. The capsules resemble those of *D. turfaceum.*

In the male plant the flowers are collected into capituli of four or five flowers each, at the summit of every innovation.

D. densum, Schleich., differs from the present species principally in its straighter and more appressed leaves; but whether it is not a form produced by growing "ad margines fossarum in paludosis prope Roche," as stated on the label of Mr. Borrer's authentic specimen, is questionable.

D. Funkii never grows on the ground in Sussex.

26. *D. turfaceum,* C. Müller; "dense cæspitosum humile inferne interdum divisum erectum haud tomentosum viride substrictum, inferne nudiusculum, superne longe comosum, haud falcatum; folia caulina erecto-patentia apice paulisper falcata, lanceolato-subulata longius capillacea canaliculata latinervia, dorso scabra, summo apice denticulata, cellulis alaribus minus conspicuis parvis laxis tenerrimis paucis planis prædita, e cellulis inferne quadratis pellucidis parvis superne minutissimis areolata; perichætialia intima cylindraceo-convoluta, e basi longe vaginante magis sensim subulata, inferne laxe pellucide superne minute areolata, longiora, apice denticulata; theca plerumque solitaria in pedunculo valde arcuato ovalis basi vix apophysata glabra sulcata pallida, operculo conico subulato obliquo longiori rubente; perist. dentes ad medium fissi, cruribus tenuissimis hyalinis rugulosis haud nodosis; calyptra ciliis albis inæqualibus flaccidis fimbriata."—*C. Müller, Synops.* p. 399.

> *Campylopus turfaceus,* Bryol. Europ. Campylopus, p. 4. t. 3.
> *Dicranum flexuosum,* Eng. Fl. in part.

Not rare in moist sandy places.

The most slender of all the British species, with longer and more subulate capillary leaves, which are often broken and strewed in abundance over the patches of the plant. As in *D. Funkii,* the enlarged cells at the base of the leaf are reduced to three or four in number, and not perceptible unless expressly looked for; but it appears distinct from that moss in its longer, more flexuose and loosely placed leaves.

27. *D. flexuosum,* Hedw.

About the sand rocks, and by the bog on Chailey North Common.

Tribe III. Pottiaceæ.

Genus 1. *Schistidium,* Brid.

28. *S. Floerkeanum* (Web. et Mohr), Mitten.
Acaulon Floerkeanum, C. Müller, Synops. p. 21.

Frequent in stubbles on chalky or clayey soils.

29. *S. muticum* (Schreb.), Mitten.
Acaulon muticum, C. Müller, Synops. p. 22.
Phascum muticum, Schreb. Eng. Fl.

On banks and in stubbles, not very common.

30. *S. triquetrum* (Spruce), Mitten.
Phascum triquetrum, Spruce in Eng. Bot. Suppl. 1901.
Acaulon triquetrum, C. Müller, Synops. p. 22.

On the cliffs between Brighton and Newhaven.

Genus 2. *Pottia,* Ehrh., C. Müller.

31. *P. cuspidata* (Schreb.), Mitten.
Phascum cuspidatum, Schreb. Eng. Fl.

Common in stubbles and on banks.

32. *P. curvicolla* (Hedw.), Mitten.
Phascum curvicollum, Hedw. Eng. Fl.

Not unfrequent about the Downs.

33. *P. recta* (With.), Mitten.
Phascum rectum, With. Eng. Fl.

More frequent than the preceding, and often growing with it, but seldom seen off the chalk.

34. *P. bryoides* (Dicks.), Mitten.
Phascum bryoides, Dicks. Eng. Fl.

On the coast at Aldrington near Brighton, and on the cliffs between Brighton and Newhaven ; it has also been met with by Mr. Borrer on the Downs at Piecombe and near Lewes, and near the Devil's Dyke.

35. *P. cavifolia,* Ehrh.
Gymnostomum ovatum, Hedw. Eng. Fl.

Cliffs and walls between Brighton and Newhaven, and about Hove, also at Hurstpierpoint, but almost confined to the coast.

36. *P. crinita,* Wils.

Rare : growing intermixed with *P. Heimii* amongst the shingle at Aldrington.

37. *P. Wilsoni,* B. et S.
Gymnostomum Wilsoni, Hook. Eng. Fl.

On a sandy bank at Barrow Hill, Henfield, where it has been known to Mr. Borrer for many years.

C. Müller refers hither with doubt the *Gymnostomum truncatulum,* *β. solivagum,* Brid. i. p. 69, sent by Green to Bridel from Hampstead and Plumstead Heaths. *P. eustoma* grows in both places, and so far as soil is concerned they are very likely to produce *P. Wilsoni*.

38. *P. eustoma,* Ehrh.

Gymnostomum truncatulum, Hedw. Eng. Fl.

Common on banks and in stubbles.

39. *P. Heimii,* Furn.

Gymnostomum Heimii, Hedw. Eng. Fl.

On the coast at Newhaven, Hove, Shoreham and Lancing.

40. *P. minutula* (Schw.), Hampe.

Gymnostomum conicum, Schw. Eng. Fl.

Very common in stubbles and waste places.

41. *P. Starkeana* (Hedw.), C. Müller.

Weissia Starkeana, Hedw. Eng. Fl.

At Hove, and on the cliffs between Brighton and Newhaven; not rare in stubbles, but most frequent near the coast.

42. *P. cæspitosa* (Bruch), C. Müller.

Anacalypta cæspitosa, B. et S. Bryol. Europ. Anacalypta, p. 3. t. 2.

"Cæspitulosa, parvula; caule subramoso vel ramoso; foliis patentibus, ovato- et oblongo-lanceolatis, concavis, margine haud revolutis, costa in mucronem brevem excedente, perichætialibus vaginantibus; capsula ovata, operculo longirostro, annulo unam cellularum seriem sistente, peristomii dentibus plus minus perfectis, in linea divisuriali obsoleta fissis vel pertusis."—*Bryol. Europ. l. c.*

Rare: on Woolsonbury Hill near Hurstpierpoint.

Intermediate between *P. Starkeana* and *P. lanceolata,* but agreeing more nearly with the first; it differs however in the form and never reflexed margins of its leaves; the three perichætial leaves are much widened and embrace the base of the yellow seta; the capsule is of a fine orange-brown when mature, ovate and not at all tapering downwards into the seta; just below the mouth it is a little constricted; the peristome is similar to that of *P. lanceolata* and equally variable; the calyptra is smooth and not scabrous as in *P. Starkeana*.

43. *P. lanceolata* (Hedw.), C. Müller.

Weissia lanceolata, Hook. and Tayl. Eng. Fl.

Not uncommon, particularly about the Downs.

Genus 3. *Trichostomum,* Hedw.

44. *T. cylindricum* (Bruch), C. Müller.

Weissia tenuirostris, Hook. and Tayl. Eng. Fl.

On all the sand rocks, but always sterile.

45. *T. mutabile,* Bruch.

Didymodon brachydontius, Wils. Eng. Fl.

Common on the Downs; and at Shoreham, growing plentifully on the scanty humus between the shingle, exposed to immersion at very high tides; always sterile.

46. *T. crispulum,* Bruch.

Didymodon crispulus, Wils. Eng. Fl.

Nearly as common as the last, but like it confined to the chalk and the sandy sea-shore, and barren.

47. *T. rubellum* (Hoffm.), Rabenh.

Weissia curvirostra, Hook. and Tayl. Eng. Fl.

Frequent on walls and roofs, and on the ground about the roots of trees.

48. *T. rigidulum,* Sm.

Didymodon rigidulus, Hedw. Eng. Fl.

Rare: in small quantity at Henley Hill and about Hurstpierpoint.

49. *T. trifarium,* Sm.

Didymodon trifarius, Sw. Eng. Fl.

Frequent on the Downs; growing on the earth in tufts about the roots of trees; it is also common on sandstone and on mortar in walls built of sandstone, but rarely fertile.

50. *T. tophaceum,* Brid.

On a wet sandy bank near Hurstpierpoint; at Hastings on and above the cliffs near the Dripping Well, and on walls at Midhurst.

51. *T. convolutum,* Brid.

Didymodon nervosus, Hook. and Tayl.

On the cliffs between Brighton and Beachy Head, and at Hastings.

Genus 4. *Barbula,* Hedw.

52. *B. aloides,* B. et S.

Tortula rigida, Eng. Fl.

Common about the Downs, and less frequently on clayey banks. This is the *T. rigida* of the Flora of Tunbridge Wells.

53. *B. ambigua,* B. et S.

On a sandy bank near Hurstpierpoint, where it grew very sparingly in 1849.

54. *B. rigida,* Schultz.

Tortula enervis, Eng. Fl.

In small quantity about a chalk-pit at Newtimber near Hurstpierpoint.

55. *B. revoluta,* Schw.
Tortula revoluta, Eng. Fl.

Not unfrequent on walls.

56. *B. Hornschuchiana,* Schultz; "dioica; laxe et late cæspitosa flavescens fragilis gracillima erecta parce breviter dichotoma; folia caulina sicca incumbentia, madefacta patentia, perfecte late lanceolata acutissima, nervo crasso excurrente vel in superioribus excedente, integerrima, inferiora minute sed dense areolata sublævia margine minus revoluto, superiora vel perichætialia parum majus areolata, margine erecto; theca oblongo-cylindrica, badia parva subcurvula, anguste annulata, operculo oblique subulato; perist. præcedentis." [*B. revoluta*] *C. Müller, Synops.* p. 608.

Probably not uncommon. At Aldrington near Brighton, growing on the sandy soil between the road and the sea; at Clayton on the chalk; on the Forest near Balcombe Tunnel; and Mr. Borrer has gathered it on Tunbridge Wells Common.

Similar as this species is to *B. revoluta* in size and appearance, yet when carefully compared, it presents many points of difference. The stems are about half an inch high, green, or more frequently dirty yellowish; leaves patent, when dry appressed to the stem, and slightly twisted, lanceolate, acute; the nerve excurrent into a sharp point; the margins revolute; the perichætial leaves are broader below and more subulate above, of a thinner and looser texture, and the margins are not reflexed; the capsules are subcylindrical; the peristome resembles that of *B. revoluta.* The plant does not form compact tufts like *B. revoluta,* but grows in loose patches on the ground: the leaves taper gradually to the point even when the margins are spread out. In *B. revoluta* the leaves are obtuse mucronate, and when the margins are spread out the point of the leaf is found to be broad and rounded. The perichætial leaves are six in both species: those of *B. Hornschuchiana* are subulate from an ovate base, but those of *B. revoluta* are broadly lanceolate and somewhat obtuse.

The description of *B. revoluta* in 'Eng. Fl.' corresponds better with *B. Hornschuchiana* than with the species intended, and it is possible that the *B. gracilis* of English authors may belong in part to *B. Hornschuchiana.*

57. *B. convoluta,* Hedw.
Tortula convoluta, Sw. Eng. Fl.

Frequent on chalky, gravelly, or sandy soils.

A variety with longer leaves, but always sterile, occurs on walls at Hurstpierpoint.

58. *B. unguiculata,* Hedw.
Tortula unguiculata, Hook. and Tayl. Eng. Fl.

Common everywhere.

59. *B. fallax.* Hedw.
Tortula fallax, Sw. Eng. Fl.

Frequent, but not so ubiquitous as *B. unguiculata.*

60. *B. vinealis,* Brid.

Common on walls, growing on the sides rather than on the tops; not often in fruit. The form *β. flaccida* is very common on hedge-banks, but always sterile.

61. *B. squarrosa,* Brid.

Tortula squarrosa, De Notaris, Spruce in Lond. Journ. Bot.

Beeding chalk-pit, Mr. Borrer. In small quantity on Woolsonbury Hill, and elsewhere on the Downs, but it is not rare on the cliffs between Brighton and Newhaven, and between Shoreham Harbour and the sea: always sterile.

62. *B. tortuosa,* Hedw.

Tortula tortuosa, Hedw. Eng. Fl.

Tottington Mount, Mr. Borrer; Slindon, Mr. Jenner.

63. *B. marginata,* B. et S.

Tortula marginata, Spruce in Lond. Journ. Bot.

Frequent on sandstone walls, and less commonly on bricks; it occurs also on the sand rocks.

64. *B. muralis,* Hedw.

Tortula muralis, Hedw. Eng. Fl.

Everywhere on walls and stones.

65. *B. canescens,* Bruch; "monoica, gregaria, cæspitosa, humilis, subsimplex; foliis obovatis et late ovalibus, costa elongata pilosis, margine revolutis, capsula erecta, symmetrica, oblonga, operculo conico, peristomii membrana basilari in tubum oblique tessellatum longe producta."—*Bryol. Europ. Barbula,* p. 34. t. 19.

Cliffs near the Lovers' Seat, Hastings, Mr. Jenner, 1844; it has since been gathered in the same place by Mr. Borrer.

Closely resembling *B. muralis,* but rather less in all its parts. The stems are short and almost buried in the fine loose sandy earth of the locality; the leaves in the lower parts of the stem are oblong or oblong-obovate, the upper ones are oval oblong and a little acuminate, concave, with the margins reflexed; the nerve is very stout for the size of the leaves, and excurrent into a diaphanous hair-like point, which in the lower leaves often equals the length of the whole leaf, in the upper it scarcely exceeds one-fifth; the setæ are yellow, and the oblong capsules orange-brown; the peristome is about half as long as the capsule, and tubular about half its own length; the operculum is conical, and the calyptra covers about half the capsule.

This moss may at all times be known from *B. muralis* by the long tubular base of the peristome, which corresponds with that of *B. cuneifolia, B. ruralis,* and *B. subulata*; besides this difference the leaves are broader, the upper ones rather acuminate, and all of a less firm and close texture than in *B. muralis,* and its habit is to grow on the earth, where *B. muralis* is rarely seen.

66. *B. cuneifolia* (Dicks.).

Tortula cuneifolia, Turn. Eng. Fl.

Tunbridge Wells, "on sandy banks and elsewhere," Forster. Bopeep, near Hastings, Mr. Jenner; also between Hastings and Winchelsea under the low cliffs; and on a moist sandy bank at Skeims Hill.

67. *B. subulata,* Hedw.

Tortula subulata, Hedw. Eng. Fl.

Common on banks.

68. *B. latifolia,* B. et S.

Frequent on trees and posts subject to inundation; not often producing fruit.

69. *B. papillosa,* Wils.

Tortula papillosa, Wils. MSS., Spruce in Lond. Journ. Bot.

Frequent on trees and fences, rarely on tiles.

The leaves of this species are not always gemmiferous, and its habit is altogether that of the *Syntrichiæ*: no trace of inflorescence has been seen.

70. *B. lævipila,* Schw.

Tortula ruralis, β. lævipila, Eng. Fl.

Abundant on trees.

71. *B. ruralis,* Hedw.

Tortula ruralis, Sw. Eng. Fl.

Very common on roofs; on the ground; rarely on trees. When growing on roofs this moss is usually of a brown colour, but when on the earth in sandy or chalky places it becomes of a fine yellow, and the lower portions ferruginous: this state is rarely fertile.

Genus 5. *Ceratodon,* Brid.

72. *C. purpureus* (L.), Brid.

Didymodon purpureus, Hook. and Tayl. Eng. Fl.

Genus 6. *Weissia.*

73. *W. crispa* (Hedw.), Mitten.

Phascum crispum, Hedw. Eng. Fl.
Astomum crispum, Bryol. Europ.

Common on the Downs.

When growing in tufts, as is most usual with this species, the leaves on the lower parts of the stems are not divergent; but when the plants grow singly, as sometimes they may be found amongst grass, the leaves are all divergent, and the plants have a very different look, and resemble very closely, except in colour, the next species.

74. *W. Mittenii* (Schimper), Mitten.

Astomum Mittenii, Bryol. Europ.

"Cæspitulosum; caule elatiore flexuoso erecto simplici et ramuloso; foliis inferioribus late lanceolatis, superioribus sensim majoribus utrisque solidis, sordide viridibus, costa crassa rufa cum apice evanido, perichætialibus tenuioribus, pallidioribus, costa tenuiore viridi, capsula in pedicello longiore subemersa ovata, rostello obtuso subobliquo; flore masculo terminali, perigonialibus ovato-lanceolatis."—*Bryol. Europ. l. c.*

On clayey soil in a stubble near Little-ease, and by a roadside near Hurstpierpoint; very rare in both situations, and growing intermixed with *W. mucronata, W. squarrosa,* and *W. multicapsularis.*

More robust than *W. crispa,* and with its capsules on longer setæ: the inflorescence is also somewhat different, being monoicous and polygamous; the flowers are terminal and sometimes hermaphrodite; the whole plant is brownish.

75. *W. multicapsularis* (Sm.), Mitten.

Astomum multicapsulare, Bryol. Europ.

"Cæspitulosum; caule procumbente, flexuoso-erecto, dichotome ramoso et ramuloso, unciali et longiore; foliis caulinis patulis, recurvis, flexuosis, flaccidis, perichætio polyphyllo, foliis perichætialibus erectis, lineari-lanceolatis; capsula in pedicello perbrevi, ovato-oblonga in rostellum subobliquum producta; calyptra ad mediam capsulam producta, longius persistente."—*Bryol. Europ. l. c.*

In very small quantity in several spots by a roadside on a clayey soil near Hurstpierpoint. A much larger moss than *W. crispa,* with broader and longer leaves, and with more stoutly rostrate capsules: the male flowers have not yet been observed.

[It corresponds very closely with the following, which may be noticed here, although it has no claims to be considered a Sussex moss.

W. convolutacea, Mitten; dioica? caulis breviusculus infra perichætium innovans, monocarpus; folia inferiora late lanceolata nervo excurrente cuspidata, marginibus inflexis, e basi cauli adpresso patenti-divergentia; perichætialia e basi subelliptica convolutacea subulato-attenuata, acuta, superne marginibus incurvis: theca in pedunculo brevissimo elliptica, operculo brevi apiculato.

Phascum crispum, Mougeot et Nestler, no. 703.

Bedfordshire, Mr. Turner in Hb. Borrer.

As in *W. multicapsularis,* the male flowers have not been seen in this moss; it also resembles that species in colour and appearance, but differs in the very convolute bases of the perichætial leaves, which quite cover the capsule, and have their margins incurved towards their apices.]

76. *W. longifolia,* Mitten; monoica; caulis breviusculus po-

lycarpus; folia inferiora lanceolata nervo excurrente mucronata, marginibus erectis, e basi cauli adpresso patentia; perichætialia longissima e basi lata convolutacea subulato-acuminata acuta apicibus arcuato incurvis; theca in pedunculo brevi, elliptica, operculo brevi apiculato; flos masculus in medio fertilium; folia perigonialia ovata acuta.

Gathered in 1836 by Mr. Borrer, near Goldstone Barn near Brighton, growing on a fence bank with *W. viridula.*

In appearance this moss differs greatly from all its allies; the perichætia are crowded together around the central male flower, and their leaves are remarkably long for the small size of the plant. The capsules appear to be slightly coloured, but are too young in all the specimens to ascertain if they may be coloured when mature like those of the *Phascum crispum* of Drummond's 'Musci Americani,' No. 9, which nearly resembles the present moss, and may belong to the same species.

77. *W. aciculata,* Mitten; monoica; caulis elongatus, ramulis fastigiatis polycarpis; folia inferiora e basi latiora erecta lanceolata divergentia nervo excurrente mucronata; marginibus erectis vel parum incurvis; perichætialia e basi lata sensim subulata angusta acutissima nervo excurrente; marginibus erectis; theca in pedunculo brevissimo vel fere sessilis, elliptica, operculo brevi apiculato; flos masculus ut in *W. crispa.*

On clayey soil by a roadside near Hurstpierpoint.

Nearly resembling *W. crispa,* but much more slender, with more attenuated and very acute perichætial leaves, which have the margins erect and not rolled in. The capsules are almost sessile and covered by the perichætial leaves, and the operculum and calyptra are shorter than those of *W. crispa.*

This and the last species present differences from each other, and from the other preceding species, amounting to the same value as those which distinguish *W. squarrosa, W. phascoides, W. rostellata,* and *W. microstoma*; and in all these mosses there is great difficulty in seizing upon any distinctive character which can be readily defined; yet they cannot well be considered varieties of a single species. *W. crispa* and *W. longifolia* are both found on the chalk, where as yet no intermediate state has been seen. *W. multicapsularis, W. Mittenii,* and *W. aciculata* are found on clay, and have but little the appearance of being varieties of each other: still it is possible that some of these at least may be only states of *W. crispa* modified by soil and situation. In all the species the leaves are patenti-divergent from an erect base appressed to the stem, and the apices are slightly hooded; the perichætial leaves have the margins more or less involute, and, like the cauline, are very papillose. The inflorescence in *W. multicapsularis* and *W. convolutacea* appears to be dioicous, but the male flowers are yet wanting to both species. The flowers of *W. Mittenii,* although sometimes hermaphrodite, do not essentially differ otherwise from those of *W. crispa,* which has the male flower sometimes terminal. In *W. longifolia* the male flower remains at the extremity of the axis, apparently from the simultaneous growth of innovations on all sides of the stem beneath it.

78. *W. phascoides* (Wils.), C. Müller.

Hymenostomum phascoides, Wils. Bryol. Europ. fasc. 42.

By the margin of the larger pond at Pondleigh near Hurstpierpoint. With the usual form of this species there sometimes occur stems which are hardly to be distinguished from *W. rostellata.*

79. *W. squarrosa* (Bruch), C. Müller; "monoica; laxe cæspitulosa, caule annosiore decumbente inæqualiter ramoso; folia squarrosa latiora, margine erecto, haud involuto; theca erecta ovata et elliptica æqualis, operculo anguste conico rostellato."—*C. Müller, Synops.* p. 663.

On clayey soil by a roadside near Hurstpierpoint, and in a stubble at Little-ease.

Very similar to *W. microstoma,* but more slender, with longer stems and shorter and broader squarrose leaves; its fruit too is ripened in November, whereas that of *W. microstoma* is scarcely mature before March or April.

80. *W. microstoma* (Hedw.), C. Müller.

Gymnostomum microstomum, Hedw. Eng. Fl.

Common on banks, by roadsides, and on the Downs.

81. *W. tortilis* (Schw.), C. Müller; "monoica; pulvinate cæspitosa dichotome et fastigiate ramosa fasciculate foliosa, viridissima inferne ferruginea parce radiculosa, robusta; folia caulina conferta, sicca valde incumbenti-tortilia, madefacta erecto-patula, inferiora minute ovata, superiora late oblongo-lanceolata, nervo excurrente breviter mucronata, margine integerrima incurva, carinata, subundulata, ubique e cellulis quadratis minutis firmis diaphanis apice folii opacis tenuissime papillosis areolata; perichætialia longiora, basi tenerius longius angustius pellucidius areolata; theca in ped. medio flavido turgide ovalis raro cylindracea æqualis vel gibba firma orificio majori rubro post operculi lapsum medio apertum, fuscescens simpliciter annulata, operculo longirostrato obliquo."—*C. Müller, Synops.* p. 661.

On the cliffs at Gin Gap near Newhaven.

Plants growing together in small patches amongst the short starved herbage on the edge of the cliff, exposed to the full influences of the sea breezes. The stems are from one to three-fourths of an inch high, fastigiately branched; the leaves are green or yellowish green in the upper parts, below ferruginous; the capsules are pale yellowish brown, erect or gibbous, the mouth red and the setæ yellow. It is readily known from *W. mucronata,* to which it is nearest allied, by its much greater size, thicker leaves, and coloured mouth of its capsules, which are ripened in March.

82. *W. mucronata,* Bruch.

Gymnostomum rutilans, Hedw. Sp. Musc. t. 3. f. 8–11.

Not very common on clayey banks about Hurstpierpoint. Doubtfully distinct from the following species.

83. *W. viridula* (Linn.), Brid.

W. controversa, Hedw. Eng. Fl.

Very common and variable in appearance.

84. *W. cirrhata,* Hedw.

Frequent on wooden fences; sometimes on thatch, on trees, and on the sand rocks.

85. *W. crispula,* Hedw.

Harrison's Rocks, Mr. Borrer, 1810, from whose specimens gathered there, the 'Eng. Bot.' figure was drawn.

86. *W. verticillata,* Brid.

On mortar between bricks round a spring near Hurstpierpoint; and about the Dripping Well at Hastings.

87. *W. tenuis* (Schrad.), C. Müller.

Gymnostomum tenue, Schrad. Eng. Fl.

In the stone-pit at Henfield, but barren.

Genus 7. *Grimmia,* Ehrh.

88. *G. apocarpa,* Hedw.

Not uncommon on walls and roofs; on exposed flints on the Downs, and on the sand rocks at Tunbridge Wells.

89. *G. pulvinata,* Hook. and Tayl.

Very common on walls and roofs.

90. *G. trichophylla,* Grev.

Rare: it has been gathered in small quantity by Mr. Borrer on some Druidical stones near Brighton, and on a roof at Henfield; it is also found on a stone wall at Henley Hill, and on rocks at Tunbridge Wells.

91. *G. acicularis* (Hedw.), C. Müller.

Trichostomum aciculare, Hedw. Eng. Fl.

On rocks about Tunbridge Wells, and on a wall at Henley Hill.

92. *G. lanuginosa* (Hedw.), C. Müller.

Trichostomum lanuginosum, Hedw. Eng. Fl.

On a rock at Henley Hill. It was formerly found on heaps of flints on the Downs near Patcham, by Mr. Borrer.

93. *G. canescens* (Hedw.), C. Müller.

Trichostomum canescens, Hedw. Eng. Fl.

In very small quantity on Woolsonbury Hill, and about Tunbridge

Wells; more abundant above Heyshot, and in several other places on the ridge of the Downs; on a tiled roof near Henfield, Mr. Borrer.

94. *G. heterosticha* (Hedw.), C. Müller.
Trichostomum heterostichum, Hedw. Eng. Fl.

On all the sand rocks, but fertile only at Tunbridge Wells.

95. *G. fascicularis* (Schrad.), C. Müller.
Trichostomum fasciculare, Hedw. Eng. Fl.

In very small quantity on a rock at Henley Hill.

Genus 8. *Zygodon*, Hook. and Tayl.

96. *Z. viridissimus*, Brid.
Gymnostomum viridissimum, Hook. and Tayl. Eng. Fl.

Very common on trees, more rare on walls: not rare in fruit, particularly on trunks of trees near the ground.

97. *Z. conoideus* (Dicks.), Hook. and Tayl. Eng. Fl. in part.
Z. Brebissoni, B. et S. Bryol. Europ. Zygodon, p. 8. t. 2.
Bryum conoideum, Dicks.

Rare: on a beech-tree on Newtimber Hill, and more plentifully on Sallows by the Mill Pond at Arundel. Mr. Borrer has gathered it in Charlton Forest, and Mr. Jenner in the Forest near Handcross.

Great as the confusion has been in the names of this and the next species, still it appears that the name *conoideus* is the proper one for this moss, it being the *Bryum conoideum* of Dickson; but if the name given to it by its discoverer is to be suppressed, it ought to take that of *Z. Dicksoni* rather than any other.

The peristome of this species is double, as described by Hooker and Taylor; not simple, as it is described and figured in 'Bryol. Europ.'

98. *Z. Forsteri* (Dicks.), Mitten; "monoicus; pulvinatus humilis breviter ramosus, inferne tomentosus viridissimus; folia caulina dense conferta, madefacta patula, e basi angustiore ampliuscule hexagone reticulata sensim late ovato-lanceolata s. subspathulato-acuminata, planiuscula nervo ante apicem evanido crassiusculo, integerrima, e cellulis ubique magnis perfecte hexagonis chlorophyllosis firmis areolata; perichætialia basi multo laxius reticulata; theca in ped. brevi flavido crassiusculo erecta, pyriformi-ovalis, fuscescens 8-striata, ore coarctata, operculo conico subulato obliquo; perist. dentes externi 8 bigeminati latiusculi subrugulosi pallide lutescentes sicci reflexi apice liberi, interni: cilia 8 cum dent. alternantia breviora anguste subulata hyalina subrecta."—*C. Müller, Synops.* p. 667.

Z. conoideus, Brid. i. p. 590; Bryol. Europ. p. 8. t. 2; C. Müller, Synops. p. 667.
Gymnostomum viridissimum, in part Eng. Fl.
Bryum Forsteri, Dicks.!

Near Hastings, Mr. Jenner.

No precise locality is known for this moss, but one small tuft was found amongst mosses collected by Mr. Jenner in the neighbourhood of Hastings.

Stems scarcely half an inch high, growing in dense tufts, the upper portions dark green, the lower pale and covered with whitish rootlets; the leaves are patent, subspathulate or widely lanceolate, shortly acuminate carinate; the nerve vanishes just below the apex; the texture of the leaves is composed of perfectly hexagonal cells in the upper part, and in the lower part they are elongated and colourless; the perichætial leaves are rather longer, but of the same shape as the cauline: the setæ are about a quarter of an inch long and yellowish; the capsules are erect pyriform-ovate, when dry ovate pyriform and eight-striate; the operculum conical subulate, oblique; the external peristome consists of eight bigeminate minutely rugose whitish teeth, the internal of eight subulate colourless cilia, alternating with the external teeth; the calyptra resembles that of *Z. viridissimus,* and covers about one-third of the capsule.

Although the confusion has been very great respecting the present species and *Z. conoideus,* still there seems no just reason why Dickson, who was the first to observe and describe these two mosses, should have his names set aside because others have confounded them and imposed names of their own.

In Mr. Borrer's herbarium is preserved a small portion of an original specimen gathered by Mr. Forster on a felled tree at Chapel-end, Walthamstow, and this being the source of Dickson's species places beyond doubt the fact that his *Bryum Forsteri,* "capsulis erectis denticulatis, setis adscendentibus surculis subacaulibus, foliis ovatis," is the same as the *Z. conoideus* of Bridel and continental authors, who have been altogether misled by the 'Muscologia Britannica.' This moss is still in want of a precise locality, Mr. Forster's specimens being from a felled tree in a timber-yard, and Mr. Jenner's gathered *somewhere* near Hastings.

Genus 9. *Orthotrichum,* Hedw.

99. *O. anomalum,* Hedw.

Not unfrequent on roofs and walls.

100. *O. diaphanum,* Schrad.

Common on trees and fences, rarely on roofs.

101. *O. stramineum,* Hsch.

Not very common, chiefly on beech-trees.

102. *O. rivulare,* Turn.

Rare: it occurs on bushes and roots by the stream at Little-ease near Hurstpierpoint, and on posts at Shermanbury. Mr. Borrer has found it at Henfield, and Mr. Jenner at Lugershall.

103. *O. Sprucei,* Mont.

Frequent on trees and fences by rivulets, always within the reach of occasional inundations.

104. *O. cupulatum*, Hoffm.

Rare: on tiles at Balcombe. Mr. Borrer has gathered it at Storrington, and Mr. Jenner at Lewes.

105. *O. tenellum*, Bruch.

Plentiful on trees about Hurstpierpoint and Henfield, but perhaps not generally common.

106. *O. affine*, Schrad.

Abundant on trees, more rarely on tiles.

107. *O. speciosum*, Nees ab E.

Very rare: one patch was gathered by Mr. Spruce in an orchard at Henfield; it has since been carefully sought for in the same place without success.

108. *O. rupestre*, Schleich.

O. rupincola, Funk. Eng. Fl.

In very small quantity on an ash-tree by a rivulet near New Close, near Hurstpierpoint.

109. *O. striatum*, Hedw.

O. leiocarpum, B. et S.

Frequent on trees.

Following C. Müller, the old name has been used for this moss, which, if it is the species so named by Hedwig, ought to retain his name, bad as it may be.

110. *O. Lyellii*, Hook. and Tayl.

Common on trees: unfrequent in fruit, which is mostly found in woods.

111. *O. pulchellum*, Smith.

Rare: in several places near Hurstpierpoint and in Tilgate Forest. On hazel at Midhurst, and on bushes on the beach near Shoreham, Mr. Borrer.

112. *O. crispum*, Hedw.

Not unfrequent, especially on beech-trees, in woods near the Downs.

A somewhat smaller state than usual is sometimes met with, and has been referred to *O. crispulum*, Bruch, but it does not quite correspond with continental specimens.

113. *O. Bruchii*, Hsch.

O. coarctatum, B. et S.

Common on trees in woods, particularly in the forests, where it abounds.

114. *O. Ludwigii*, Schw.

Very rare; on beech-trees on the north side of Woolsonbury Hill. Only three small tufts have been seen.

115. *O. jutlandicum*, Brid. i. p. 296.
O. phyllanthum, B. et S.
Common on trees.

Genus 10. *Encalypta*, Schreb.

116. *E. vulgaris*, Hedw.

On the Downs at Halnaker near Chichester, and on the north wall of St. Nicholas Church, Brighton, Mr. Borrer. On a wall at Storrington, and on a wall between Cocking and Midhurst.

117. *E. streptocarpa*, Hedw.

In many places on the Downs: at Newtimber; Arundel Park; Offham near Lewes; and on tiles near Hurstpierpoint: always barren.

[To be continued.]

XXVI.—*On the Development of the Cirripedia.* By C. Spence Bate.

[With three Plates.]

Few animals belonging to the European fauna, so very abundant on our shores as the Cirripedia, have had their nature so misunderstood, and so long veiled in mystery. The happy discovery of Mr. J. V. Thomson, so far back as 1826, approximated somewhat to a revelation of their real history; and the later researches of Burmeister, in his Beiträge zur Naturgeschichte der Rankenfüsser, together with those of Prof. Goodsir, in the Edinburgh New Phil. Journal, July 1843, have further elucidated this interesting inquiry. Although as yet the chain of development between the ovum and the perfect animal has not been successfully observed, the hiatus is not so great but that naturalists are enabled to identify the position of these creatures in the animal kingdom.

Feeling a little curiosity in relation to the subject, and wishing to verify for myself the observations of Mr. Thomson, I took advantage of my residing near the shore where two or three distinct species are common, and have occupied myself a little this summer in endeavouring to observe the animal, as well as the changes through which the larva passes until it assumes the form and characters of the parent. Being desirous to obtain the young, so as to identify it with the species which are the parent of each, I adopted the mode of breaking off the *Balanus* from the rocks and obtaining the embryo in a mature state before it had left the ovum, and of then hatching it; which was readily accomplished upon its being plunged into sea-water,—a mode which I found very successful, and which has enabled me to accompany this paper with sketches of the larva of five separate species :—

1. *Balanus balanoides,* Linn.
2. *B. porcatus,* Da Costa. B. sulcatus, *Brug.* B. Scoticus, *Wood.*
3. *B. perforatus,* Brug. B. communis, *Mont.* B. (var.) Cranchii, *Leach.*
4. *Chthamalus depressus* (?), Poli. Balanus punctatus, *Mont.*
5. *Clitia Strömia,* Müller. Balanus verruca, *Mont.*

Upon placing the young as soon as hatched under the microscope, I was interested to find that it differed as much from Mr. Thomson's figure as that given by him does from the adult animal*, thus showing that the larva must pass through more than one metamorphosis prior to its assuming the figure of the adult.

There is, on the first appearance of the larva of the *Balani,* a single black spot in the centre of what would be termed the head of the animal, appearing like the eye in *Cyclops, Canthocamptus,* &c.; but this it cannot be, since the form is not persistent in every individual even of the same species. With what agency this spot may be endowed I am not capable of stating, but it appears to me to be analogous to a similar spot in the larva of *Chirocephalus diaphanus*†, and which, by development, is shown to have no connection with the eyes; so also in an older stage in the larva of the *Balanus,* the eyes, which are absent in the young, become fully developed, but are found to exist distinct from this spot, which has been looked upon as an organ of vision by all previous observers. I think, however, that we are scarcely justified in assuming every black spot in a convenient position to be an eye: and in this instance, when the spot may be seen in the young of the same parent to put on almost every modification of form, I can scarcely bring myself to subscribe to the idea of its being an agent of sight. Moreover, in the pupa state, when the eyes are large and conspicuous, there may be observed a spot (Pl. VIII. fig. 15, 16 *b*) upon the shell, the same which Mr. Thomson presumes to be the "nucleus of the future attachment," so like to that to which we allude in the larva, that I am inclined to believe

* When this paper was first written, I was ignorant of the discoveries of either Burmeister or Goodsir; the researches of the former I have only seen since this has been in type; and to both of whom separately is due the merit of the discovery of the great fact of the complex metamorphosis of the Cirripedia; since Mr. J. V. Thomson, although the original discoverer of both stages, did not even conjecture that there was more than a single metamorphosis, although he was aware of the fact in the marine Decapoda, attributing the earlier form or larva to the pedunculated division, and the latter or pupa to the sessile division of the Cirripedia.

† Vide figures by Dr. Baird in the 'Hist. of British Entomostraca.'

them, particularly if the homologies as pointed out by Burmeister be correct, to be identical; an idea which receives support from the gradual receding of the spot from the anterior edge, near which it may be observed in the larva previous to the first moult; whereas in the next it is further back, and in the third, as given in Pl. VI. fig. 3 *b*, the only specimen of which I have had an opportunity of observing, it has considerably receded, being in a line with the extremity of the probosciform organ. Therefore, presuming such to be the case, I can scarcely appreciate the idea advanced by this latter author, that the two large eyes in the pupa are formed by the splitting into halves of this central spot; or, to translate his own words, "that the single eye is compounded of two halves, which, by degrees, separate more and more until in the following period they are divided by a considerable space."

In this description their development is not analogous to that of the eyes in the larva of the Entomostraca, which certainly in this stage must be considered as its nearest ally. For instance, in the larva of *Chirocephalus diaphanus* the two lateral organs of vision are apparent previous to the disappearance of the "central eye," plainly showing that the real eyes are not developed from the central spot, whatever it may be.

Among the more peculiar features of the larvæ of these animals is the presence of an elongated forked process of the abdomen, forming to all outward appearance a second caudal appendage, and which has been confounded with the tail in Prof. Goodsir's figure and description of the larva previous to the first moult, where he says, "the last segment is armed with three sharp strong spines which project backwards." After the first moult this appendage increases in length, greater or less in different species, by the addition of another ring proceeding from the extremity of the last, and like it terminating in a similarly forked extremity. Of its uses in the larva, or its homology in the adult animal, I have not been able to satisfy myself; but it is a feature in a more or less modified form (as far as I have observed) universally present in this early stage of their development.

In *Balanus perforatus, Clitia Strömia,* and *Chthamalus depressus,* the growth of the caudal appendages increases at the first moult to a length much greater in proportion than the same organs do in *Balanus balanoides.*

Another organ equally constant and peculiar to the early larval stage of these animals is, that which for convenience of communication I shall call a proboscis. This, the animal has the power of raising and lowering at pleasure, as its uses may require. At its extremity appears to be an oral-like aperture which is closed by a valve or upper lip. This organ, as far as my knowledge goes, has no analogous representation among Crustacea, it being a feature peculiar to this stage of the larva of the Cirripedia, among which it differs in length and size according to the species; like the caudal appendages, it increases in length, together with the natatory legs, with each of the earlier successive moults. At the base of this organ I have observed an irregular pulsation, and consequently presume it to be the seat of the heart.

At the shoulders of the anterior extremity extends right and left a small process, which under a one-fourth of an inch object-glass appears to terminate most commonly in a bifid extremity; but through the assistance of a higher power than I have used, I am informed by Mr. Darwin that this appearance is shown to be erroneous, it being seen to terminate always in a point: these are attached to the lower surface of the shield, and after the first moult appear to consist of two articulations; they may differ in dimensions in respective species, but, as far as I have had an opportunity of observing, are universally present in the sessile division of the Cirripedia; and judging from the figure given by Burmeister in his memoir upon the pedunculated Cirripedia, and those by Mr. Thomson upon the same division, they appear to be constant throughout the whole class, and probably are, as stated by Burmeister, homologous with the antennæ; and if so, they must represent the external or superior pair; but in watching the habits of these young creatures I have seen nothing which can induce me to accept the idea that they are made use of by the animal, as he presumes, for the purpose of climbing or holding itself in contact with any foreign body. In order to fulfill these conditions the more perfectly, they each terminate with a hook in Burmeister's figure; but this, not being represented in Thomson's, whose observations, in most essentials, coincide with those which opportunity has placed within my reach, induces me to receive the former author's drawing of these antennæ with caution, although it is probable that he may be correct when he presumes that they become the perambulatory feet in the pupa; and if so, we have an interesting exemplification of the assumed fact, that the antennæ among animals are but less modified in order to fulfill certain peculiar conditions; thus they represent in one stage organs of sense, whereas in the next they fulfill the conditions of true feet. Besides these horns or outer antennæ, the larva is endowed with a smaller pair of simple structure, more typical of those organs in Crustacea, and which, therefore, must represent the internal or inferior pair; but these I have not been able to observe previous to the shedding of the first exuviæ, though Mr. Darwin has been so kind as to inform me that he has seen them at that early period in the larva of *Scapellum vulgare*, and Prof. Goodsir has also figured them from the larva of *Balanus Tintinnabulum*; therefore from analogy it may be assumed, as most probable, that they exist in a more or less rudimentary form in all.

The natatory legs are at this period three on each side, the anterior pair being single and formed of three or four articulations, the terminating one being armed with three or four long spines, one of which also is generally attached to each of the two preceding joints. The two posterior pairs of legs become duplicates after the basal joint, which is large, and generally armed with a process covered with sharp spines pointing towards the animal: each of the joints of the larger division of the double extremities of both the posterior pairs is furnished with similar spines, some of which are in different species more or less fringed with fine ciliated processes. The spine upon the penultimate joint of the posterior pair of legs is in *Balanus perforatus, Chthamalus depressus* and *Clitia Strömia* curved inwards as well as ciliated; each of the extremities likewise is supplied with long spines or hair-like processes, similar to those which exist attached to the cirrhi in the adult.

It is since these observations have been made that I have become aware of Prof. Goodsir's paper in the 'Edin. New Phil. Journal,' by which I perceive that his observations do not exactly coincide with my own; but I think that much of the difference may depend upon the circumstance of his having viewed the animal from the dorsal surface only; since, if he had seen the animal from beneath, he would have observed that the anterior legs originate from a similar position with the rest, that is, near the centre of the animal. Of the "large segment which (he says) has originated at the anterior part of the body after the first moult," I have not been enabled to convince myself. That a line across may sometimes be seen in the *dead* animals, I am aware; but the fact of its position being not always persistent has induced me to attribute the appearance to an accidental fold in the tunic of the animal, originating in the roughness of manipulation in mounting the specimens.

Again, in Prof. Goodsir's figure the whole extremity of the leg consists of but a single articulation, whereas it has appeared to me to be, like the others, made up of several. The large basal process of the second pair of legs is not given in the same figure; this, together with his not having observed the abdominal process, is but the natural result of the drawing being made of the dorsal surface only.

Unfortunately, from the period of the larva having obtained its second form, which, according to my own experience, takes place on the second and not the eighth day, as stated by Prof. Goodsir,—and this I found invariably to be the case in every species which I have observed,—I have not been able, even with the greatest care and watchfulness, to preserve the young creature alive, so as to have the successive forms through which it passes, between the figure given as the earlier form with this paper, and that by Mr. J. V. Thomson in his 'Zoological Researches' upon Cirripedes; consequently there is a blank existing which imagination will scarcely venture to supply; so very unlike each other is the form in the earlier stage, to that which the larva or rather pupa assumes immediately prior to its adopting the character of a fixed animal.

I am aware that almost as great a difference exists between the very young larva of the decapod marine Crustacea and the one into which it is transformed, and that many moultings of the tunic must take place before the larva has arrived to the size to which it must, ere it can put on its more permanent form; so likewise it *may be* with the Cirripedia, that the larva shall so increase without change of form or undergoing a fresh metamorphosis prior to the one figured by Mr. Thomson and my own observation. That these animals sensibly increase in size during fifteen days (which is the longest period that I have been enabled to keep them alive) seems to lend assistance to this supposition; yet, notwithstanding, I can scarcely suppress the notion that some unrecognized form, possessing somewhat of the characters of each, will be found to be an intermediate stage of the creature's existence.

It was at the latter period of its existence as a free animal that it was observed by Mr. Thomson, from whose figure the one given with this paper in some slight detail differs, which probably has arisen from the greater or less transparency of the shells belonging to the respective specimens examined.

At this period the animal approximates much more nearly to its permanent character than it had done previously, as the natatory legs, which have increased to six pairs, together with the caudal appendage, form, with the soft parts of the animal, as seen through the transparent shell, a near resemblance to similar parts, only less developed, which belong to the adult animal: one slight exception exists in the natatory legs folding in the larva first anteriorly and then posteriorly, somewhat in the form of a compressed letter Z, from the last joint of which a strong spine projects which remains erect after the members are folded and at rest. Although six is the recognized normal number of pairs of legs in this stage of the young animal's existence, yet I was only capable of counting five pairs in the specimen from which this drawing is taken;—a circumstance, which might lend assistance to establish the truth of the intermediate stage given by Burmeister, which is figured and described as having only three pairs similar to that of the larva in its earliest period; and induces the idea that it adds a pair of legs with each successive moult; but this link in the history of the young creature's development is yet to be made clear.

At the anterior base of these organs an opake spot exists (fig. 15 *a*), which I presume to be the stomach.

Two larger and darker spots, situated a little higher and anterior, are pronounced to be organs of vision; near these are inserted two long slender members which are supplied with a sucker and hooks to each limb; with these the animal has the power of attaching itself to any object, and, by using them alternately, of perambulating on the surface of any hard substance; thus the young creature is in the middle stage endowed with the power of walking as well as swimming.

Here I cannot help remarking upon the gradually changing habits of the creature, which in its early state swims about at its own will and pleasure, using, as all aquatic creatures do, its long tail as a rudder, by which it is enabled to direct and control its own movements; whereas in the latter stage of its larval existence the tail is gone, and consequently the creature is most excentric in its movements through the water, apparently being unable to swim direct to any fixed point. Thus it appears that before it becomes a sedentary animal it has been partially rendered incapable of fully enjoying its existence as a swimming creature, and thus the path is softened in the change of habits from an active to a stationary existence; for an animal not having power to control its movements in its natural element could scarcely be supposed to enjoy its own existence: thus, under these circumstances, to become stationary is to become more happy.

It is I believe generally understood that at this stage the larva has two valves, one on either side, a right and left, united at their posterior margin by a hinge similar to that of a bivalve among Mollusks.

Of the correctness of this I was far from being able to convince myself, insomuch that I could neither observe the hinge nor the separation of the valves *beyond a certain point* at which the two appeared to me to unite; nor could I observe any opening or shutting, the two sides appearing to me to be continually the same, and the whole together formed a shelly cell such as I have endeavoured to figure (Pl. VIII. fig. 17).

At this period the larva may be presumed to represent the adult animal, and the shells of the operculum, but without the accessory valves.

Thus it is to be remarked, that this animal in its growth from embryo to adult puts on several distinct characters, all of which are indicative of the Crustacea in different forms.

First, it assimilates to the appearance of the larva of certain Entomostraca, being liberated from the ovum like them without eyes; after which it next approaches in character towards the adult Entomostraca, bearing an external resemblance to the bivalve Crustacea, and like these perfected animals possesses organs of sight, from which period they pass out of recognized tribes, and comprise a family peculiar to themselves. These observations tend to corroborate the now generally received opinion that they are true Crustacea, and among this class they appear to fill up a vacancy which alone was wanting throughout the whole range of the Invertebrata,—I mean a sedentary family, one or more of which exists among each successive race of animals.

The Polyp, from its analogy to the larva of the Medusa, may be looked upon as representing the sedentary family among the Acalephæ,—the fossil Encrinites and the larva of the Comatula as representing the same position among the Asteriæ. The Tunicata among Mollusks and the Serpulæ among Annelides appear to hold a similar relation, each to their separate class, as that which the Cirripedia occupy in relation to the Crustacea; and these last, by the different forms which they pass through in their individual development, may be said to represent the type of those separate forms in the sedentary character.

It would scarcely be just for me to close this paper without alluding to how much I am indebted to my friend Mr. Jeffreys both for specimens and a knowledge of the different species, his cabinet being as rich in this department of natural history as in that of British Mollusca; or without expressing my thanks to Mr. Darwin, but for whose kindness I should have been guilty of publishing more than a single error.

EXPLANATION OF PLATES VI. VII. VIII.

Fig. 1. *Balanus balanoides* as it appears when first liberated from the ovum.
— 2. The same after the first moult; 2 *a*, abdominal appendage.
— 3. The same after the second moult; 3 *a*, abdominal appendage.
— 4. The same, lateral view.
— 5. *Balanus perforatus* just liberated from the ovum; abdominal view.
— 6. The same after the first moult; abdominal view.

B. The (*so-called*) eye.
C. Abdominal appendage.
D. Caudal termination.
E. Proboscis.
F. Supposed oral aperture which is protected by the lip or valve G.
H. H. Horns or outer antennæ.
K. K. True or interior antennæ.
1. First pair of natatory legs.
2. Second ditto.
3. Third ditto.

These letters also refer to fig. 14.

Fig. 7. *Balanus porcatus,* abdominal view, just liberated from the ovum.
— 8. *Clitia Strömia,* do. do. do.
— 9. The same after the first moult; abdominal aspect.
— 10. The same after the first moult; dorsal aspect.
— 11. *Chthamalus depressus,* first form, abdominal view; 11 *a,* caudal extremity.
— 12. The same after first moult; dorsal aspect.
— 13. The same after first moult; abdominal view.
— 14. The same, lateral view.
— 15. *Balanus balanoides*: the pupa, or stage of the larva immediately previous to its becoming a fixed animal, in a state of activity.
— 16. The same at rest.
— 17. The same, viewed in front.
— 18. The same, anterior member with sucker and hooks.
— 19. The same, posterior natatory leg and caudal appendage.
— 20. The same, soon after its becoming fixed.
— 21. The same, do. seen from above.
— 22. The same, a little older.
— 23. *a,* Spermatozoa of *Balanus balanoides.*
b, do. do. *Balanus perforatus.*
c, do. do. *Clitia Strömia.*

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

[Continued from p. 102.]

77. *Agelena celans.*

Agelena celans, Blackw. Linn. Trans. vol. xviii. p. 624.
Argus celans, Walck. Hist. Nat. des Insect. Apt. t. iv. p. 504.

This scarce species may occasionally be met with running upon the ground or concealed under stones in woods about Llanrwst. The palpal organs of the male are developed in August. Though intimately allied to the *Agelenæ,* yet M. Walckenaer has included this spider in the genus *Argus.*

Genus Tegenaria, Walck.

78. *Tegenaria domestica.*

Tegenaria domestica, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 2. pl. 16. fig. 2; Koch, Die Arachn. B. viii. p. 25. tab. 260. fig. 607, 608; Blackw. Linn. Trans. vol. xix. p. 117.
—— *petrensis,* Koch, Die Arachn. B. viii. p. 27. tab. 260. fig. 609.
Aranea domestica, Latr. Gen. Crust. et Insect. tom. i. p. 96.
Agelena domestica, Sund. Vet. Acad. Handl. 1831, p. 125.
Philoica domestica, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 13.

I have received specimens of *Tegenaria domestica* from Cambridgeshire, Oxfordshire and Middlesex; but I have not observed it in the north of England and Wales. It inhabits old buildings, spinning an extensive horizontal sheet of web in the angles formed by the transverse junction of their walls, and in various other situations: connected with the web, which, in addition to its lateral points of contact, is supported by numerous fine lines attached to both surfaces and to adjacent objects above and below it, is a short tube, usually situated in the angle formed by the walls, which being open at its extremities not only affords a retreat to the spider, but a ready medium of communication also with every part of its snare. The sexes pair in May, and in the two following months the female constructs several lenticular cocoons of white silk of a fine texture, measuring about $\frac{5}{6}$ths of an inch in diameter, each of which contains from 130 to 150 spherical eggs of a yellowish white colour, not agglutinated together. All the cocoons are inclosed in separate sacs composed of compact white silk, having particles of plaster, whitewash, and other heterogeneous materials distributed upon their exterior surface.

The spider alluded to by Mr. Jesse in his 'Scenes and Tales of Country Life,' p. 339, as being peculiar to Hampton Court, and there named the "*Cardinal*," most probably is this species.

79. *Tegenaria atrica.*

Tegenaria atrica, Koch, Die Arachn. B. x. p. 105. tab. 353. fig. 825.
—— *sæva*, Blackw. Ann. and Mag. Nat. Hist. vol. xiii. p. 179.

In the autumn of 1843 Miss Gertrude Buller Elphinstone obligingly transmitted to me from Middlesex living specimens of this fine species, which ranks among our largest indigenous spiders; they were captured at East Lodge, Enfield, where Miss Elphinstone then resided, and in reply to some inquiries relative to their habits, she informed me that they were found in dwelling-houses and conservatories. Subsequently I have received specimens from Miss Ellen Clayton, who obtained them at Oxford.

The superior spinners of this species, like those of *Agelena labyrinthica*, are triarticulate, and have the spinning-tubes disposed on the inferior surface of their elongated terminal joint; when thus modified, the principal purpose subserved by these organs appears to be the binding down with transverse lines, distributed by means of an extensive lateral motion, of the filaments emitted from the inferior and intermediate spinners, by which process a compact tissue is speedily fabricated. When in captivity, *Tegenaria atrica* constructs a horizontal sheet of web, with a short tube at one of the margins, serving it for a retreat.

As the tenth volume of 'Die Arachniden' did not come into my possession until some months had elapsed after the publication of my description of this species in the 'Annals and Magazine of Natural History,' I was not aware that in announcing it as new to arachnologists I had been anticipated; however, such being the case, the specific name *atrica*, conferred upon it by M. Koch, must take precedence of that of *sæva*, which will follow as a synonym.

80. *Tegenaria civilis.*

Tegenaria civilis, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 7. pl. 16. fig. 1; Koch, Die Arachn. B. viii. p. 37. tab. 264. fig. 618, 619.
—— *domestica*, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 13.
Agelena civilis, Sund. Vet. Acad. Handl. 1831, p. 127.
Titulus 17, Lister, Hist. Animal. Angl. De Aran. p. 59. tab. 1. fig. 17.

The habits and œconomy of this common spider are very similar to those of *Tegenaria domestica*, for which it has frequently been mistaken, even naturalists of high authority having included references to Lister's description and figure of it among the synonyma of that species. During the summer and autumn the female constructs several lenticular cocoons of white silk of a fine texture, measuring about $\frac{3}{10}$ths of an inch in diameter, in each of which she deposits from fifty to sixty spherical eggs of a yellowish white colour, not adherent among themselves; these cocoons are attached to walls, or other objects in the vicinity of her web, and have generally particles of plaster, whitewash, or mortar disposed on their exterior surface.

I have ascertained the following remarkable physiological facts in connexion with *Tegenaria civilis* by observation and experiment; namely, that both sexes change their integument nine times before they arrive at maturity, once in the cocoon and eight times after quitting it; that a leg of a young individual detached at the coxa six times consecutively may be reproduced at each succeeding change of integument after the infliction of the injury; that the life of this species extends through a period of four years; that the sexual organs of the male are connected with the digital joint of the palpi; and that the female, after impregnation, is capable of producing nine sets of prolific eggs in succession without renewing her intercourse with the male, more than two years elapsing before all are deposited, and ten months nearly intervening sometimes between the deposition of two consecutive sets.

Genus Cælotes, Blackw.

81. *Cælotes saxatilis.*

Cælotes saxatilis, Blackw. Linn. Trans. vol. xviii. p. 618. tab. 39. fig. 6–8.

Clubiona saxatilis, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 436.
Drassus saxatilis, Blackw. Research. in Zool. p. 332.
Aranea terrestris, Wider, Mus. Senck. B. i. p. 215. taf. 14. fig. 10.
Amaurobius terrestris, Koch, Die Arachn. B. vi. p. 45. tab. 192. fig. 463, 464.
—— *subterraneus*, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 15.
—— *tigrinus*, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 16.

A description of this interesting spider, which I discovered in the spring of 1826 beneath loose fragments of rock on Snowdon, in Caernarvonshire, was originally given in the 'London and Edinburgh Philosophical Magazine,' under the name of *Clubiona saxatilis*. An examination of specimens procured afterwards in various parts of North Wales, Lancashire and Yorkshire induced me to remove it to the genus *Drassus*, on account of the curvature of its maxillæ (Researches in Zoology). Subsequent investigations however, made with great care, have served to convince me that it appertains to the *Agelenidæ*, as it possesses several marked characteristics in common with the spiders of that family; for example, the anterior part of its cephalo-thorax is compressed; the superior spinners are triarticulate, are longer than the rest, and have the spinning-tubes disposed on the under side of the terminal joint; each inferior tarsal claw is provided with two pairs of fine teeth near the base; and its web is of a compact texture, having a tube in connexion with it extending, usually, to the extremity of a cylindrical cavity in the earth, which is frequently excavated by the animal itself. These facts do not appear to have received that degree of consideration from M. Walckenaer which their importance demands, as he still seems disposed to retain *Cælotes saxatilis* in the genus *Clubiona* (Hist. Nat. des Insect. Apt. t. iv. pp. 441, 442). With regard to the genus *Amaurobius* of M. Koch, I may remark, that, as it includes spiders belonging to different families, which are easily distinguished by their organization, œconomy and habits, it must, as at present constituted, be rejected by systematic naturalists. The great defect of the genera attempted to be established by M. Koch is, that they are founded too exclusively on the disposition, form and relative size of the eyes; consequently, it sometimes happens that they comprise species in other respects decidedly incongruous.

Cælotes saxatilis pairs in April, and in May the female deposits about 120 spherical eggs of a yellowish white colour, not agglutinated together, in a lenticular cocoon composed of white silk of a fine but compact texture, measuring half an inch in diameter; it is generally attached to the inferior surface of stones by a small covering of web, on the outer side of which particles of indurated soil are frequently distributed.

Genus Textrix, Sund.

82. *Textrix lycosina.*

Textrix lycosina, Sund. Consp. Arachn. p. 19; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 14; Die Arachn. B. viii. p. 46. tab. 266. fig. 623, 624.
—— *agilis,* Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 109; Research. in Zool. p. 348. pl. 3. fig. 1, 2.
Agelena lycosina, Sund. Vet. Acad. Handl. 1831, p. 130.
Tegenaria lycosina, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 15.
Titulus 20, Lister, Hist. Animal. Angl. De Aran. p. 67. tab. 1. fig. 20.

Professor Sundevall was the first who proposed to institute with this species the genus *Textrix,* which he defined in his 'Conspectus Arachnidum,' published in 1833; a like proposition, made by myself in the autumn of the same year, was announced in the 'London and Edinburgh Philosophical Magazine;' and it is a remarkable circumstance, as the Professor justly observes in a private communication of great interest with which he favoured me, "that we have applied the generic name *Textrix* to the same animal without knowing anything of the coincidence."

I gladly avail myself of this opportunity to acknowledge the obligation I am under to the Rev. Morgan Morgan, Rector of Conway, for his great kindness in obtaining for me, through the medium of his friends in Sweden, important information on the subject of arachnology most liberally imparted by Professor Sundevall.

Textrix lycosina, which has a relation of analogy with the *Lycosidæ* by the disposition and relative size of its eyes, is widely distributed in Great Britain, most commonly occupying crevices in rocks, stone walls, and the bark of old trees; its superior spinners are triarticulate, having the spinning-tubes arranged on the under side of the elongated terminal joint, and are employed in the fabrication of its snare, which consists of a sheet of web supported both above and below by fine lines intersecting one another at various angles, and attached to it and to adjacent objects by their extremities; a cylindrical tube in connexion with the snare usually extends to the spider's retreat. The sexes pair in June, and in the following month the female deposits between 50 and 60 spherical eggs of a pale yellow colour, not adherent among themselves, in a lenticular cocoon of white silk of a fine but compact texture, measuring $\frac{1}{4}$th of an inch in diameter; it is attached to stones by a small covering of white web, on the exterior surface of which particles of soil and other materials are frequently distributed.

This spider, with a change of integument, is capable of reproducing the legs, palpi, and terminal joint of the superior spinners after they have been removed by amputation.

Family *Theridiidæ.*

Genus Theridion, Walck.

83. *Theridion lineatum.*

Theridion lineatum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 285.
—— *redimitum,* Latr. Gen. Crust. et Insect. tom. i. p. 97; Hahn, Die Arachn. B. i. p. 86. tab. 21. fig. 65.
—— *ovatum,* Sund. Vet. Acad. Handl. 1831, p. 113.
Theridium redimitum, Koch, Die Arachn. B. xii. p. 133. tab. 427. fig. 1053–1055.
Steatoda redimita, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 9.
Titulus 12, Lister, Hist. Animal. Angl. De Aran. p. 51.

This common spider, remarkable for its variation in colour, spins among coarse herbage and the stems of shrubs numerous fine glossy lines intersecting one another in different planes and at various angles, which constitute a snare similar in design to the toils constructed by the *Theridia* generally. It pairs in June, and in July the female deposits about 170 spherical eggs of a yellowish white colour, not agglutinated together, in a globular cocoon of bluish white, blue, or greenish blue silk of a looseish texture, measuring $\frac{1}{4}$th of an inch in diameter. The cocoon is inclosed in a slight tissue of white silk connected with the inferior surface of the leaves of trees and shrubs, the edges of which are convolved about it and are retained in that position by silken lines. The young remain a long time in this nidus with the female and are supplied by her with food.

M. Koch, in transferring that variety of *Theridion lineatum* named *redimitum* to the genus *Steatoda* of Prof. Sundevall (Conspectus Arachnidum, pp. 16, 17), lapsed into an inconsistency which M. Walckenaer has pointed out in his 'Hist. Nat. des Insect. Apt.' t. ii. p. 288, and which he himself has subsequently corrected.

84. *Theridion quadripunctatum.*

Theridion quadripunctatum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 290; Hahn, Die Arachn. B. i. p. 78. tab. 20. fig. 58; Sund. Vet. Acad. Handl. 1831, p. 118.
Steatoda quadripunctata, Sund. Consp. Arachn. p. 16, 17.
Eucharia bipunctata, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 7; Die Arachn. B. xii. p. 99. tab. 418. fig. 1027.
Phrurolithus ornatus, Koch, Die Arachn. B. vi. p. 114. t. 208. fig. 515.
Titulus 11, Lister, Hist. Animal. Angl. De Aran. p. 49. t. 1. fig. 11.

Crevices in walls and rocks, and interstices among stones are the haunts selected by this species, which occurs in many parts of England and Wales. It pairs in May, and in June the female constructs a globular cocoon of yellowish white silk of a loose texture, measuring $\frac{3}{20}$ths of an inch in diameter; it is usually attached to objects situated in the vicinity of her snare, and contains about 50 spherical eggs of a pinkish colour, not agglutinated together.

A female *Theridion quadripunctatum,* placed in a phial which was closely corked and locked up in a book-case, continued to exist without receiving any nutriment whatever from the 15th of October 1829 to the 30th of April 1831, when it died. That so voracious an animal should be capable of enduring abstinence from food for so long a period is certainly an extraordinary fact.

85. *Theridion sisyphum.*

Theridion sisyphum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 298; Latr. Gen. Crust. et Insect. tom. i. p. 97; Hahn, Die Arachn. B. ii. p. 47. tab. 58. fig. 132.
—— *lunatum,* Sund. Vet. Acad. Handl. 1831, p. 111.
Theridium lunatum, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 8; Die Arachn. B. viii. p. 74. tab. 273. fig. 645, and B. xii. p. 137. tab. 429. fig. 1060, 1061.
Steatoda lunata, Sund. Consp. Arachn. p. 16, 17.
Titulus 14, Lister, Hist. Animal. Angl. De Aran. p. 53. tab. 1. fig. 14.

Though I have never observed *Theridion sisyphum* in the open air, yet it is not uncommon in greenhouses, where it constructs an extensive complicated snare, somewhat of a pyramidal form, which consists of numerous fine glossy lines intersecting one another in different planes and at various angles. The sexes pair in June, and during the summer and autumn the female fabricates several balloon-shaped cocoons of different sizes, varying from $\frac{1}{5}$th to $\frac{1}{3}$rd of an inch in diameter, which she suspends in the upper part of her snare with their larger extremities downwards; they are composed of reddish brown silk of a fine but compact texture, and the largest of them sometimes comprises between 400 and 500 spherical eggs of a pale yellowish white colour, not adherent among themselves. Young spiders and cocoons containing eggs may frequently be seen in the snare at the same time.

86. *Theridion riparium.*

Theridion riparium, Blackw. Research. in Zool. p. 354.
—— *saxatile,* Walck. Hist. Nat. des Insect. Apt. t. ii. p. 328.
Theridium saxatile, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 8; Die Arachn. B. iv. p. 116. tab. 141. fig. 324, 325.

The œconomy of this species, which is evidently identical with the *Theridium saxatile* of M. Koch, is very remarkable. It spins under the projections of broken precipitous banks in the woods about Oakland a snare composed of fine glossy lines arranged after the manner of the *Theridia.* The union of the sexes takes place in July, and in August the female fabricates a slender conical tube of silk of a very slight texture, measuring from one and a half to two and a half inches in length, and about half an inch in diameter at its lower extremity; it is closed above, open below, thickly covered externally with particles of indurated earth, small stones, and withered leaves and flowers, which are incorporated with it, and is suspended perpendicularly in the snare by lines attached to its sides and apex. In the upper part of this singular domicile the female constructs several globular cocoons of yellowish white silk of a slight texture, having a mean diameter of about $\frac{1}{8}$th of an inch, in each of which she deposits from twenty to sixty small spherical eggs of a pale yellowish white colour, not agglutinated together. The young, after quitting the cocoons, remain a long time with the female and are provided by her with food, which consists chiefly of ants.

It would appear that M. Walckenaer, prior to the publication of the second volume of his 'Hist. Nat. des Insect. Apt.,' was not cognisant of my researches in this department of zoology, as in various instances he has adopted the names given by other arachnologists to spiders which I had previously described, without any reference to those assigned to them by me. I may refer to *Theridion riparium* as presenting a case in point.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 25, 1850.—Wm. Yarrell, Esq., Vice-President, in the Chair.

1. Catalogue of the Mammalia of Ceylon. Collected and observed by E. F. Kelaart, M.D., F.L.S.

[Having already published a list of the Mammalia of the Island in our Number for May 1851, we merely give the descriptions of the new species indicated by the author.—Ed. *Ann. Nat. Hist.*]

Golunda newera.

Fur soft, yellowish brown varied with black; chin and beneath yellowish grey; under-fur dark lead-colour; soft long hairs on the upper parts of the head and body, with longer black-tipped hairs having a subterminal yellowish band; fur of belly dark lead-colour tipped with yellowish grey; ears large, hairy on both sides, of a light rusty or ashy colour; whiskers slender, moderately long, some greyish, others blackish; tail shorter than the body, tapering to a point, scaly; upper surface of a black colour and covered with short semi-adpressed black hair; lower surface yellow or ashy colour, covered with short hair of the same yellow colour; feet having dark brown claws, purplish; four toes to the fore-feet, with a clawless rudimentary thumb; five hind-toes, three middle subequal; soles nearly bald, blackish; palma studded with four small tubercles; planta with six tubercles, the two foremost considerably larger; incisors yellow, superior ones grooved in the centre; molars flat, deeply 3-lobed, tubercles rising in three distinct lines, middle larger than those of the sides, and the front one extending beyond the two other lobes.

Length of body and head, $3\frac{1}{4}$ inches; tail, $2\frac{1}{2}$.

This rat is found in the black soil of Newera Ellia, and is a great destroyer of peas and potatoes. The only two specimens I had, lived for some days in a cage and played like mice.

Corsira newera ellia. (Or variety of *Corsira nigrescens.*)

Slaty or ashy black, very slightly washed with rufous on the upper parts; no trace of rufous beneath, which is paler slaty; whiskers long, very thin, greyish; legs from half way down the thighs covered with short adpressed hairs; feet fleshy grey; hair on the toes longer, and those of the hind-feet extending over the claws; claws white, those of the front feet elongated, compressed, acute; toes 5–5, all clawed; ears large, naked, partially hid in the fur; tail black, round, tapering, rather scaly, and thinly covered with short hair intermixed with much longer, glossy, shining, thin, stiff hairs, some of which are also seen in the upper parts and sides of the lower half of the body; teeth white throughout.

Length of body and head, $3\frac{1}{2}$ inches; tail, $2\frac{1}{2}$.

Found in Newera Ellia and even on Pedrotellgala, the highest mountain in Ceylon, which rises from the plains of Newera Ellia, and is 8020 feet above the sea's level. I had one quite docile in a box for some days, which fed ravenously on earth-worms; it used to run about the table and on my arms without attempting to get away; it died one frosty night.

This shrew differs from the *Sorex murinus* chiefly in the absence of all unpleasant smell. I could not trace any glands or lectæ in any part of the body. The elongated fore-claws is another good specific distinction. The *Sorex murinus* is also found here, and I am inclined to think that a very diminutive shrew, of which I have seen only one specimen, is another species, but which for the present I have considered as only the young of the above-described animal. It resembles in every point the *Sorex pygmæus* of Hodgson (Mag. Nat. Hist. vol. xv.). There are several characters in our *Corsira* which make me consider it not identical with the *C. nigrescens* of Gray, especially the greater length of its tail than in the animal found on the continent of India, which I know only from Mr. Gray's description.

2. On the blood-coloured exudation from the skin of the Hippopotamus. By John Tomes, F.R.S.

The exudation is composed of a transparent fluid in which float two kinds of corpuscles; one kind is tolerably abundant, and is both transparent and colourless; the other is comparatively rare and of a bright red colour. To the solution of these latter bodies the fluid owes its peculiar colour.

The colourless corpuscles are spherical in shape, and vary in diameter from the 3450th to the 2100th of an inch; the majority however measure about the 3000th of an inch. Their structure is granular, and in about the same degree as the colourless corpuscles of blood, and the ordinary exudation corpuscles, to which they present a strong resemblance.

Many of these bodies preserve their figure for a considerable time, while others become collected into clusters and form irregular broken masses.

The coloured corpuscles are irregular in size and shape, and are composed of an aggregation of minute elongated and sometimes triradiate bodies, many of which appear, from their irregular and obscure outline, as though partially dissolved. In the immediate neighbourhood of these, the fluid has a much deeper colour than elsewhere. From these circumstances I have been led to conclude that the general pink colour of the fluid is due to the solution of the coloured particles, and not simply to their presence. In this particular the fluid under consideration is strikingly different from blood, which owes its colour to the presence of coloured globules and not to their solution.

Whether the red colour of the exudation is a condition of youth, and of an imperfect condition of the skin, and has ceased in consequence of the increased age of the animal and the consequent more perfect development of the integument, or has ceased in consequence of the change of climate to which the animal has been lately subjected, is a question which, with the facts at present at our disposal, cannot be satisfactorily determined.

We have however sufficient evidence to warrant the conclusion, that the thick tenacious exudation, whether coloured or otherwise, is poured out only during the time the skin is immersed in water, and that it has an especial reference to the aquatic habits of the animal. It appears for the time to convert the surface of the body into a mucous membrane, and then, on the animal leaving the water, to furnish by its inspissation an epidermis.

Should further inquiry show that the thickness of the exudation arises from a solution of the colourless globules, its relation to mucus will be still further established, and a microscopic examination into the structure of the skin will become a subject of great physiological interest.

3. On six new species of Humming Birds. By John Gould, F.R.S. etc.

Although the Trochilidæ have lately received much attention both from our own and the continental naturalists, the subject is far from exhausted, as is shown by the circumstance of my being able to bring before the notice of the Society this evening no less than six species hitherto uncharacterized and unknown. These great accessions to the family are all from a state with which we have as yet had but little intercourse—that of Veragua in Central America; and we are indebted for a knowledge of them to the researches of an enterprising traveller and botanist, M. Warzewicz, who has just returned from that country, where he successfully explored many forests and other districts not previously trodden by the foot of civilized man. Unfortunately, both for myself and for science, he was not able, in consequence of the heavy rains which prevailed at the time, to procure or to preserve the examples in so fine a state as could be wished; although much mutilated and otherwise damaged, they are, however, sufficiently perfect to admit of my furnishing the following descriptions:—

1. Trochilus (Selosphorus) scintilla.

Male: upper surface bronzy green; on the throat a gorget of glittering fiery red, the feathers of which are much produced on either side; beneath the gorget a band of buffy white; wings purple-brown; central tail-feathers brownish black, margined with rusty red; lateral tail-feathers brownish black on their outer and rusty red on their inner webs; under surface reddish brown; bill black.

Female: upper surface as in the male, but not so bright; under surface white; throat-feathers less produced, and spotted with brown on a white ground; flanks buff; tail rufous, crossed by a crescentic bar of black near the tip.

Total length of the male, $2\frac{3}{4}$ inches; bill, $\frac{1}{2}$; wing, $1\frac{1}{4}$; tail, 1.

Hab. Volcano of Chiriqui, at an altitude of 9000 feet.

This is an extremely beautiful species, and forms a miniature representative of the *Trochilus rufus*, to which it is somewhat allied.

2. Trochilus (Thaumatias?) chionura.

Male: upper surface very dark grass-green; wings purplish brown; central tail-feathers bronzy green; lateral tail-feathers white, largely tipped with black; throat pale shining green; flanks greenish; centre of the abdomen and under tail-coverts white; upper mandible black, base of the lower mandible fleshy white.

Female: upper surface as in the male, but paler; lateral tail-feathers white, as in the male, but crossed near the extremity with an oblique band, instead of being tipped with black; throat and under surface generally white.

Total length, $3\frac{1}{2}$ inches; bill, $\frac{5}{8}$; wing, $2\frac{1}{8}$; tail, $1\frac{1}{4}$.

Hab. Chiriqui near David, province of Veragua, at an altitude of from 2000 to 3000 feet.

This is a remarkable species, differing, as it does, from all other Humming-Birds with which I am acquainted, in the large amount of white on the tail-feathers, which shows very conspicuously when that organ is spread. In form it is very similar to the *T. brevirostris* and *T. longirostris* of the Brazils.

3. Trochilus (Thalurania) venusta.

The entire crown, back of the neck, and upper part of the back, shoulders, abdomen, and under tail-coverts, beautiful shining ultramarine blue; throat and fore-part of the neck rich metallic green; wings purplish black; tail considerably forked, and of a blackish blue; bill black.

Total length, 4 inches; bill, $\frac{7}{8}$; wing, $2\frac{1}{8}$; tail, $1\frac{3}{4}$.

Hab. Volcano of Chiriqui in Veragua.

Remark.—Nearly allied to, and of the same form and size as, the *T. furcatus*, but a far finer bird.

4. Trochilus (——?) cœruleogularis.

Male: upper surface, shoulders, abdomen and under tail-coverts, shining grass-green; throat, sides of the neck and chest, rich violet-blue; wings purple-brown; tail rather forked; central feathers bronzy green; lateral feathers purplish black; upper mandible and tip of the lower black; basal portion of the latter fleshy white.

Female: upper surface shining grass-green, but of a paler hue than in the male; tail as in the opposite sex, except that the lateral feathers are tipped with white; centre of the throat, abdomen and under tail-coverts white.

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

Hab. Near David, on the north side of the Cordillera, Veragua.

I am also indebted to Dr. T. B. Wilson of Philadelphia for the loan of a specimen from Panama. This species is precisely of the same elegant form as the *T. Goudotii*, but is of a larger size, and is at once distinguished from that bird by its blue breast.

5. Trochilus (—— ?) castaneoventris.

Crown of the head metallic green; upper surface green; wings purplish brown; tail dark bronzy green, crossed near the tip by a broad band of black; the lateral feathers tipped with buff, which decreases in extent as the feathers approach the central ones; all the under surface reddish chestnut; bill black.

Total length, 4 inches; bill, $\frac{7}{8}$; wing, $2\frac{1}{4}$; tail, $1\frac{3}{8}$.

Hab. Cordillera of Chiriqui, at an altitude of 6000 feet.

Remark.—This is a moderately sized species, and is not allied to any other member of the family with which I am acquainted; I am therefore unable to assign it a place in any of the sections hitherto proposed; the specimens I possess appear to be immature, and are unfortunately in bad condition.

6. Trochilus (—— ?) niveoventer.

Crown of the head and back of the neck bronzy green; back rich coppery bronze; wings purple-brown; upper tail-coverts reddish purple; tail purple-black; throat resplendent green; abdomen snow-white; flanks green; under tail-coverts greenish brown, margined with white; bill black, except the basal three-fourths of the lower mandible, which are flesh colour.

Total length, $3\frac{3}{4}$ inches; bill, $\frac{7}{8}$; wing, $2\frac{1}{8}$; tail, $1\frac{1}{4}$.

Hab. Near David; warm countries of Veragua.

Remark.—Nearly allied to *T. Edwardi* and *T. erythronotus*; from the former, however, it differs in the colour of the tail, and from the latter in the white colouring of the breast.

BOTANICAL SOCIETY OF EDINBURGH.

Thursday, 19th June.—Professor Balfour, President, in the Chair.

A copy of the new edition of the Society's Catalogue of British Plants was laid on the table.

Mr. Henry Paul presented a specimen of *Codium Bursa*, collected in the neighbourhood of Brighton.

Dr. Balfour exhibited specimens of *Bryum Wahlenbergii* from Arniston, near Edinburgh, where they were collected by Mr. Veitch, gardener at Arniston; also of *Gottschea appendiculata* from New Zealand, collected by Mr. Sinclair.

Mr. Sibbald exhibited flowering plants of *Saxifraga hirta*, which he had received from Galtee More, in the county of Tipperary, one of the few stations recorded for this species. Mr. Sibbald agreed with Mr. Babington's views as to the distinctness of *S. hirta* from *S. hypnoides* and *S. affinis*, and referred to the figures in 'English Botany' as characteristic of the plants.

The following papers were read:—

1. "On the Government Teak Plantations of Mysore and Malabar." By Hugh Cleghorn, M.D., H.E.I.C.S.

The author exhibited specimens of teak from the plantations of Mysore and Malabar, and stated the glory of the Ghaut Forest was its teak, the vast importance of which was becoming daily more known and appreciated; the timber indeed had been long prized. Bontius described the tree under the name of *Quercus indica*, though, except as regards the timber, it has no resemblance to the oak. Rheede has given an accurate representation of *Tectona grandis*, and a good account of the teak forests of Malabar:—"Crescit ubique in Malabar, at præsertim in Provincia Calicolan (Calicut) ubi integræ sylvæ ingentium harum arborum reperiuntur. * * * Lignum vero hujus arboris, quercino ligno haud absimile, operi fabrili accommodum, atque Naupegis ad navium fabricam in usu est: sed in aquis (præsertim dulcibus) teredini facile obnoxium." Dr. Cleghorn stated that he had travelled in 1847 the route followed by Buchanan in 1801 (see Journal, vol. iii. p. 287), and that the teak forests therein mentioned had well nigh disappeared. Much attention is now given to this important article of trade by the government of India; plantations have been established in Malabar and Mysore, and their present thriving condition gives the prospect of eventual success.

2. "On *Chantransia*, Desv." By John Ralfs. This paper will be found at p. 302.

3. "Notice of *Belenia præalta* of Jacquemont." By Dr. Balfour. Dr. Balfour stated that the plant exhibited by him at the last meeting, as a species of *Hyoscyamus*, turns out to be the *Belenia præalta* of Jacquemont. The genus *Belenia* differs from *Hyoscyamus* in its corymbose inflorescence and more regular flowers. The plant is described and figured in Jacquemont's work. It grows on the Himalaya at great elevations, and towards the northern slope, abounding on the elevated flat plains. The plant in the Botanic Garden was raised from seeds sent by Major Madden to Mr. Moore of Glasnevin.

4. "Remarks on some Australian products." By Samuel Mossman. Mr. Mossman exhibited specimens of the following products brought by him from Australia:—

1. New Zealand Flax.

2. "Kauri Gum," of commerce.—"This is a very pure resin from the *Dammara australis* or Kauri Pine of New Zealand, and has been erroneously termed a *gum* by the settlers. The tree bears fertile and sterile cones, and sheds its bark like the *Eucalyptus* of Australia.

The timber is much valued in the navy for making large and durable spars. A remarkable circumstance connected with the collecting of this resin is, that it is principally found amongst sandy soil, on open fern-land, where not the vestige of a tree is to be found; a fact which indicates the existence at a recent date of extensive forests of this pine, having merely surface roots on the thin soil of these islands, deriving their nourishment mainly from the humid state of the atmosphere which characterizes that climate."

3. "Mimosa Bark," of commerce.—"This is the bark of *Acacia dealbata*, and contains a greater per-centage of *tannin* than any other bark. It is a handsome tree, from 15 to 30 feet high, forming luxuriant groves on the banks of streams, most abundant in Port Philip and Twofold Bay, between the parallels of lat. 34° and 38°. These groves, when in full blossom, send forth a fragrance which may be detected several miles distant, and on approaching them they present one of the most picturesque features in Australian forest scenery."

4. Seeds from the cone of *Araucaria Bidwillii.*

5. Fossil Ferns in Shale, from the Coal-measures of Australia. "Evidence has been found of the carboniferous strata running along the east coast of Australia, extending north and south a distance of 1000 miles."

Mr. Mossman also exhibited twenty new species of Australian plants, and remarked—"Since Brown's 'Prodromus' was published in 1810, very little has been done in illustrating the botany of Australia. Few genera have been added to the list given by this eminent botanist. Although Cunningham, Labillardière and others have added materially to our list of species, there is still a vast field open in this interesting region to future additions in botanical discovery, as is evident from the little I have done myself in that distant land; having brought home forty new species, some of which I now exhibit. In my herbarium of Ferns is one rather interesting to the student of this department of botany. No. 667 may be considered a variety of *Stegania* (*Lomaria*) *nuda*, R. Br.; it has the fructification of *Lomaria*, but the venation of *Blechnum* in parts of the frond, but not in all. Sir William Hooker and Mr. J. Smith have observed it before, and do not agree with Mr. Brown entirely in his discrimination of the two genera; for example, Mr. Smith considers the *Lomaria Spicant* of Mr. Brown as a *Blechnum*, and this variety of *Lomaria nuda*, Br., tends merely to show, according to him, that it too is truly a *Blechnum*, not a *Lomaria*."

6. Dr. Balfour made some remarks on the glandular stipules of Cinchonaceæ.—Mr. Weddell states that on the inner surface of the base of the stipules of *Cinchona* and allied genera, he had observed numerous small glands which secreted a gummy fluid. In *Cinchona* the secretion is transparent and fluid, while in several other genera it is solid and opake, and seems to glue the stipules to the bud which they embrace; this is particularly the case in *Pimentelia glomerata*. In *Rondeletia* the secretion is soft, like wax, and of a beautiful green colour. The inhabitants of Peru give it the name of Aceite-Maria, or Oil of Mary; they collect it carefully, and use it as an external application in various diseases. The stipular glands have an oval or

lanceolate form, and are somewhat pointed. The axis of the gland is in the form of an elongated cone; it is composed of elongated and dense cellular tissue. Dr. Balfour, with the aid of his pupil, Mr. Matthews, examined these glands in many Cinchonaceæ, and they detected them in fresh specimens of the following:—*Cinchona Calisaya, Burchellia capensis, Cephaëlis Ipecacuanha, Coffea arabica, Ixora javanica, Mussænda frondosa, Rondeletia speciosa, Pavetta indica, Luculia gratissima* and *Pinceana, Pentas carnea, Gardenia Stanleyana,* and other species. In some the secretion was beautifully coloured.

Dr. Balfour stated that he had recently received a letter from Dr. Walker-Arnott, in which he remarks, that in preparing spiral vessels to show them fresh, he finds the most easy plan is to take the petiole or peduncle of *Pinguicula vulgaris* and squeeze it between two glass slides, so that it may become thin and transparent. In this way a preparation is made, which, when put under the microscope, exhibits spiral vessels and annular ducts distinctly without any further trouble.

Dr. Balfour exhibited specimens of *Knappia agrostidea,* recently collected by Mr. Syme at Gullane Links, but which he had subsequently ascertained to have been sown there by several botanists at different times; as also *Ranunculus confusus,* Gr. et G., from a pond at the same place; and *R. trichophyllus,* from the pools at Gullane: the latter is considered by Mr. Babington and others as a variety of *R. aquatilis.* Dr. Balfour also exhibited from Mr. Syme dried specimens of *Narcissus poeticus,* retaining the beautiful colour of the flower; the specimens had been received in a fresh state from the Rev. Mr. Bree, Allesley Rectory.

MISCELLANEOUS.

ORTHAGORISCUS MOLA.

To the Editors of the Annals of Natural History.

Edinburgh, 7 West Maitland Street,
September 20, 1851.

Gentlemen,—Having had the opportunity this morning of examining a recent specimen of the *Short Sun-Fish, Orthagoriscus mola,* it occurred to me it might be of sufficient interest to justify my troubling you with a note of its capture. It was taken by some fishermen while swimming or rather floating near the surface of the sea, off the coast of Haddingtonshire, near Dunglass, on the 18th of this month. Its length was about 21 inches from the point of the nose to the extremity of the tail; and its breadth in front of the dorsal fin across to anus, immediately in front of anal fin, was 13 inches 6 lines; the length of the dorsal fin was 9 inches, and the anal 8 inches 6 lines, both being very moveable at their junction with the body; the length of the caudal fin, which unites these two other fins together, was 2 inches at its centre, the long "hinge-like" part connecting it to the body being 1 inch 9 lines in breadth at the same place; the rays of the different fins (pectoral, dorsal and anal) correspond to the numbers given in Yarrell's well-known 'History of British Fishes,' except that those of the thick caudal fin were so indistinct that I could not detect them by external examination. The fish was of a dingy bluish or dark leaden colour on the upper parts, mottled with a lighter colour on the sides, and of a light gray approaching to a silvery white on the abdomen, the "hinge-like" portion of the fins, especially of the caudal, having a reddish or dark flesh-coloured tinge; round the eye the colour was paler, and the eye itself was of a dark bluish-gray colour, with a bright "silvery ring round the pupil." The flesh felt soft and flabby, the fish being apparently in bad condition, and weighing only 11 lbs. avoird. The skin was slightly wrinkled, and was rough all over like a shark's.

I remain, Gentlemen, yours very respectfully,

John Alex. Smith, M.D.

P.S. I may mention that the skin of a specimen of this fish, much about the same size as the one I have described, was exhibited to the Royal Physical Society here last winter, having been captured by one of the members while dredging in Loch Ryan.

CARCHARIAS VULPES.

To the Editors of the Annals of Natural History.

Cork, September 20, 1851.

Gentlemen,—An example of the Fox Shark (*Carcharias Vulpes*) occurred in Ringabella Bay, close to the mouth of Cork Harbour, on the 31st of last month. It got entangled in a net and was secured by the fishermen. It was considerably smaller than the individual lately recorded in your Magazine by Mr. Thomson; the whole length of the animal being 7 feet 4 inches, and that of the upper segment of tail 3 feet 9 inches nearly. Owing to the ignorance of the person to whom the skinning was entrusted, the specimen has unfortunately not been saved. The fish was a male.

Yours respectfully,

J. (R.) Harvey, M.D.

On the Arrangement of Fossil Animal Remains in Collections. By J. E. Gray, Esq., F.R.S., V.P.Z.S. &c.

There appears to be considerable difference of opinion among geologists and fossil collectors respecting the manner in which fossil specimens of animals should be arranged. I have therefore been induced to put together the following notes:—

1. Some agree with Cuvier, Lamarck, Fleming, and other zoologists, that they should be arranged with and in the same series as similar specimens of the recent animals.

2. Others, that they should be first divided according to the strata in which they are found, and the specimens of each stratum arranged in a zoological method.

3. Others, that they should be simply arranged zoologically in a collection by themselves.

I have long been of opinion that no collection of zoology can be considered as complete, or worthy the name of a scientific collection, unless it contains the fossil animals and has them arranged on both the first and second of these plans.

The first is requisite to enable the zoologist to study the existing and the extinct animal, and without this advantage it is impossible that the natural method of animals, which is the true study of the scientific zoologist, can ever be discovered; on the other hand, it is only by the accurate comparison of the fossil remains of extinct animals with the skeletons and other hard parts of existing animals, that the proper characters of the fossil species can be discovered. It has always appeared to me that a zoological collection, not containing the fossil as well as the recent species, is as imperfect as a collection of recent vertebrated animals would be if it did not contain specimens of skulls and skeletons; and a collection of shells, sea-eggs and corals would be, if they were without examples of molluscous and radiated animals preserved in spirits.

The second plan, that of arranging a second series of the fossils when they have been well determined by comparison with the existing species, in series according to the strata in which they are found, is of the same importance to the zoologist as the geographical arrangement of the existing species, and of the utmost importance to the geologist, as affording him one of the best characters yet discovered for identifying the strata of the earth's surface. There are several private collections of fossils in this country where this system of arrangement has been carried out in a limited manner, that is to say, they are chiefly confined to the fossils of this country, or of some other special locality; but I have never seen any collection where it has been followed to a great extent; and I am convinced that the formation of such a collection, combining together the fossils of each stratum or bed from the various parts of the world, would have a most important effect on the progress of geological science, and at the same time bring together facts of the greatest value to the scientific zoologist who is studying the development and natural arrangement of organized beings. The third plan does not afford the facilities required by either the zoologist or the geologist, and is of as little use as a collection of the kind can be.

EARLY NOTICES OF THE ROYAL MENAGERIES IN LONDON.

THE interest which has been excited by the arrival of the Hippopotamus and his keepers induces us to give insertion to the following curious notice, from a record of the reign of Edw. III. in the year 1364; together with a note on the subject with which we have been favoured by Prof. Owen, and some notices of the Royal Menageries, and animals mentioned by our earlier historians.

"Les Archives de Guild-Hall offrent des renseignements si variés, que quelques-uns intéressent même les Sciences Naturelles; ainsi on y trouve, à la date du 4 Novembre 1364, un acte intitulé *Breve pro bestia de terra Egypti, vocata Oure.* Le roi écrivait au maire en faveur de son animal (*quemdam bestiam nostram*). Il avait appris que les habitants de Londres formaient le projet de maltraiter les deux citoyens auxquels la garde de cet animal extraordinaire avait été confiée, et de tuer la bête elle-même (*dictam bestiam atrociter interficiendam*). Il lui mandait en conséquence de prendre toutes les mesures nécessaires pour défendre la bête et ses gardiens, désormais sous sa protection spéciale*. Les rois d'Angleterre entretenaient dès lors une ménagerie à la Tour de Londres, ainsi qu'on en trouve la preuve dans les actes publiés par les soins de la commission des archives d'Angleterre; mais cet *oure*, dont le nom ne se rencontre point dans les nomenclatures des animaux connus aux moyen âge, était probablement une bête extraordinaire gardée à part dans la ville, et à l'existence de laquelle s'étaient attachées quelques idées superstitieuses†."

"Royal College of Surgeons, London, August 27, 1851.

"MY DEAR SIR,—From the circumstance of the 'Bestia de terra Egypti, vocata Oure,' requiring two keepers, and being so formidable as to alarm the citizens and lead to projects for destroying it, it must have been some large and formidable species. From Egypt might be derived the following Mammals suiting that description:—*2-horned Rhinoceros, Hippopotamus, Elephant, Giraffe, Lion, Syrian Bear.* The Elephant and Lion would be known and called by their proper names: the *Ursus Syriacus* is not a very large or formidable species: the Hippopotamus would require water in quantity sufficient for immersion. As to the Giraffe, this is so gentle a creature that one can hardly suppose it should have excited any enmity or alarm in the breasts of the citizens. Perhaps the Rhinoceros would be the most likely guess, if it is worth hazarding one on grounds so slender as those contained in the interesting extract published by M. Delpit. There is also the 'Crocodile.'

"Believe me, dear Sir, sincerely yours,

"RICHARD OWEN."

"*Richard Taylor, Esq., Sec. L.S.*"

The celebrated physician Johannes Caius, in the letter which he addressed to his intimate friend Gesner, in the reign of Elizabeth, gives several particulars relative to the royal menagerie of wild beasts in the Tower of London: "Leones cicurari possunt—in arce Londinensi leones custodum suorum oscula excipiunt, contactum admittunt et colludunt. Ipse vidi. Ista animalia [*Unciæ*] tam ferocia sunt, ut custos, cum primo vellet de loco in locum movere, cogebatur fuste in caput acto (ut aiunt) semimortua reddere, atque ita in capsam ligneam ad hoc factam, et respirationis gratia perforatam reponere, atque ita de loco in locum tuto transportare. Post horam reviviscebant tamen hæc, ut cati, non nisi extremis injuriis obnoxia morti. Itidem fecit custos cum è capsa exeruit. Jam vero novas rationes invenerunt reponendi et eximendi, trahendo ea in capsam fune, et capsam eis admovendo conto. Fœminam jamdudum ira sustulit: parvi canis

* Reg. G. fol. 140.

† Collection général des Documents Français qui se trouvent en Angleterre; par Jules Delpit, 1847. In publishing this extensive and very curious Collection, M. Delpit observes, "C'est certainement une grande gloire pour la commune de Londres de posséder des archives plus complètes que celles d'aucune autre ville."

consuetudine mansuescit mas, adeo ut resupinatus complectatur canem pedibus et colludat, ita ut nec dente lædat nec ungue."

Caius has a chapter *De Cornibus Cervi Palmati,* of which he had seen and figured a specimen in the monastery at Kenilworth in Warwickshire:—another chapter, also, on the Bonasus, whose skull and ribs were then preserved in the chapel of Guy of Warwick. In this he also mentions the Wild Cattle of our forests.

Notices of the Crocodile by the English Crusaders.

"*De Cocodrillis, &c.*—Cocodrillos apud *Damietam* invenimus et interfecimus: est autem bestia crudelis, homines et jumenta devorans, apertis oculis solo visu ova sua fovet: exclusi pulli statim fugiunt parentem quasi hostem, quos enim rapere potest in momento glutit et devorat."

"Ægyptii vero honoraverunt Prophetam, sepelientes eum juxta tumulum Regum, memores beneficiorum quæ præstiterat Ægypto, oratione enim sua fugaverat bestias aquarum, quas Græci *Cocodrillos* appellant."—*Historia Captionis Damietæ*: apud Gale, *Historiæ Anglicanæ Scriptores* XV. vol. ii. p. 452.

They are called *Cocodryll* in Trevisa's Chronicle.

RICHARD TAYLOR.

A Monograph of Macrochisma, *a genus of Gasteropodous Mollusca belonging to the family* Fissurellidæ. By ARTHUR ADAMS, R.N., F.L.S.

MACROCHISMA, Swainson.

Animal? Shell elongated, clypeiform, radiately ribbed, extremities elevated; foramen very large, elongated, placed near the hind part, with a groove posteriorly; the hind margin sinuated.

1. MACROCHISMA MAXIMA, A. Adams. *M. testâ oblongâ, costis parum elevatis subrugosis, striisque concentricis obsoletis ornatâ, fusco radiatim maculatâ, dorso elevatâ, lateribus planulatis, extremitate anticâ rotundatâ; posticâ elevatâ, subtruncatâ; foramen dilatatum, posticè excavatum.* *Hab.* ——?

2. MACROCHISMA DILATATA, A. Adams. *M. testâ ovato-oblongâ, radiatim costatâ, rubrâ, albo variegatâ, utrinque rotundatâ, lateribus dilatatis; foramen oblongum, in medio angustatum.* *Hab.* ——?

3. MACROCHISMA HIATULA, Swainson, Manual of Malacology, p. 356.

Fissurella macrochisma, *Sow.*

M. testâ ovato-oblongâ, radiatim costellatâ, fuscâ, subdepressâ, lateribus concavis, utrinque rotundatâ; foramen magnum, oblongum, posticè dilatatum, extremitate posticâ valdè elevatâ; margine vix sinuato. *Hab.* ——?

4. MACROCHISMA COMPRESSA, A. Adams. *M. testâ angustè oblongâ, albidâ, roseo radiatim pictâ, costellis granulosis striisque concentricis decussatâ, utrinque rotundatâ, dorso convexâ, lateribus compressis, in medio inflexis, extremitate posticâ valdè elevatâ; foramen magnum, lanceolatum, posticè dilatatum.* *Hab.* ——?

5. Macrochisma megatrema, A. Adams. *M. testâ ovato-oblongâ, albidâ, roseo radiatim pictâ, costellis rugosis striisque concentricis sculptâ, dorso subelevatâ, lateribus planulatis; foramen ovato-lanceolatum, permagnum.* *Hab.* —— ?

6. Macrochisma cuspidata, A. Adams. *M. testâ ovato-oblongâ, anticè angustatâ, productâ, acuminatâ, posticè elevatâ, rotundatâ, margine valdè undulatâ, fuscatâ, annulis fuscis concentricis ornatâ, lineis elevatis et concentricis cancellatâ, circa foramen pallidâ, extremitate posticâ valdè elevatâ; foramen magnum, cuspidatum, posticè dilatatum.*

Hab. Cagayan, in insulis Philippinis; *H. C.* (Mus. Cuming.)

7. Macrochisma producta, A. Adams. *M. testâ angusto-oblongâ, dorso elevatâ, convexâ, albidâ, fusco pallide variegatâ, lineis elevatis striisque concentricis obsoletè decussatâ, anticè angustâ, productâ, lateribus planulatis, extremitate posticâ rotundatâ, elevatâ; margine valdè sinuatâ; foramen perlongum, triangulare, posticè dilatatum.*

Hab. in littoribus Australiæ. (Mus. Cuming.)

8. Macrochisma angustata, A. Adams. *M. testâ angustâ, oblongâ, dorso elevatâ, utrinque rotundatâ, albidâ, lineis fuscis maculisque rufo-fuscis pictâ et tessellatâ, costellis obtusis subrugosis, lineisque depressis, concentricis, subdistantibus, sculptâ, extremitate posticâ elevatâ, margine sinuato; foramen magnum, elongatum, subtriangulare, posticè dilatatum, excavatum.* *Hab.* —— ?—*From the Proc. of the Zool. Soc.* July 23, 1850.

METEOROLOGICAL OBSERVATIONS FOR AUG. 1851.

Chiswick.—August 1. Cloudy and warm: slight rain. 2—5. Very fine. 6. Fine: densely clouded. 7. Overcast: fine: clear: lightning at night. 8. Very fine. 9. Overcast: cloudy. 10. Cloudy. 13. Sultry. 14. Fine: lightning at night. 15. Cloudy and fine. 16. Very fine. 17. Showery. 18. Cloudy and fine: clear. 19. Very fine: slight haze: clear. 20, 21. Very fine. 22. Very hot. 23. Overcast. 24. Heavy showers, with sunny intervals. 25. Very fine. 26. Slight rain. 27. Fine: constant and very heavy rain at night. 28. Fine: densely clouded. 29. Clear and cold: heavy showers, with hail in afternoon: overcast. 30, 31. Cloudy.

Mean temperature of the month	62°·84
Mean temperature of Aug. 1850	59 ·38
Mean temperature of Aug. for the last twenty-five years .	62 ·21
Average amount of rain in Aug.	2·41 inches.

Boston.—Aug. 1. Cloudy: rain p.m. 2—4. Fine. 5—7. Cloudy. 8. Fine. 9—11. Cloudy. 12. Fine. 13. Cloudy: rain early a.m., and lightning p.m. 14. Fine: rain, thunder and lightning p.m. 15. Fine. 16. Fine: rain p.m. 17. Fine. 18. Cloudy. 19. Fine. 20. Cloudy. 21, 22. Fine. 23. Cloudy: rain a.m. 24. Cloudy: rain p.m. 25. Fine. 26. Cloudy: rain p.m. 27. Cloudy. 28. Fine: rain early a.m. 29. Cloudy: rain a.m. and p.m. 30, 31. Cloudy.

Sandwick Manse, Orkney.—Aug. 1. Bright: showers. 2. Cloudy. 3. Bright: clear. 4. Bright: very clear: fine. 5. Clear: fine: very clear: fine. 6. Clear: fine: very clear: fine: aurora. 7. Clear: fine: haze. 8. Cloudy. 9, 10. Cloudy: bright. 11. Cloudy: drops. 12. Drizzle: damp. 13. Rain: damp. 14. Rain: drops: fine. 15. Drops: damp. 16. Clear: fine. 17. Cloudy: clear: fine. 18. Clear: cloudy. 19. Rain: cloudy. 20. Hazy: fine. 21. Rain. 22. Damp: cloudy. 23. Bright: cloudy: thunder. 24. Clear: cloudy. 25. Bright: clear. 26—28. Showers. 29. Showers: drizzle: showers. 30. Bright: clear: aurora. 31. Drizzle: clear: aurora.

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

Days of Month.	Barometer.							Thermometer.							Wind.				Rain.			
	Chiswick.		Boston.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. Aug.	Max.	Min.	8½ a.m.	9 a.m.	9 p.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8½ a.m.	Max.	Min.	9¼ a.m.	8½ p.m.	1 p.m.							
1.	29·847	29·830	29·30			29·56	29·60	78	62	68			55	52	nw.	w.		wsw.	.....	·23		·03
2.	30·020	29·989	29·50			29·76	29·77	79	60	59			54½	55	sw.	calm		sse.	·02	·40		·04
3.	30·066	30·063	29·47			29·67	29·85	78	54	69			57	53	sw.	sw.		w.	.....	.....		.....
☽ 4.	30·173	30·102	29·55			30·06	30·01	81	57	70			54	53	e.	sw.		calm	.....	.....		·03
5.	30·297	30·226	29·80			30·33	30·36	71	53	64			58	54	e.	e.		calm	.....	.....		.....
6.	30·234	30·173	29·80			30·35	30·36	67	53	63			61½	53	e.	e.		se.	.....	.....		.....
7.	30·056	30·014	29·68			30·34	30·30	75	55	63			59	53	ne.	e.		se.	.....	.....		.....
8.	30·018	29·988	29·60			30·24	30·22	80	52	67			56½	54½	ne.	ne.		calm	.....	.....		.....
9.	30·034	29·964	29·57			30·17	30·17	69	55	62·5			56½	52½	ne.	ne.		e.	.....	.....		.....
10.	30·085	30·075	29·62			30·20	30·20	71	53	59			56	50½	ne.	calm		ese.	.....	.....		.....
○ 11.	30·106	30·098	29·65			30·10	30·04	79	52	64			53	52	s.	calm		ese.	.....	.....		.....
12.	30·074	30·010	29·59			29·97	29·98	83	59	64			55	55½	s.	s.		calm	.....	.....		·06
13.	29·944	29·841	29·45			29·82	29·72	82	52	68			58	56	sw.	calm		w.	·02	·02		·10
14.	29·916	29·824	29·33			29·68	29·67	74	55	67			59	56½	sw.	s.		calm	.....	.....		·50
15.	29·933	29·893	29·33			29·72	29·88	79	48	64			57	52	w.	wnw.		nw.	.....	·25		.....
16.	29·999	29·931	29·48			29·97	30·02	77	58	62			52	48	sw.	w.		e.	·02	.....		.....
17.	29·893	29·882	29·30			30·02	30·10	76	54	66·5			52	46½	sw.	w.		calm	·28	·05		.....
18.	30·240	30·056	29·55			30·20	30·18	70	38	61			55½	50	n.	n.		se.	.....	.....		·06
19.	30·355	30·317	29·90			29·96	29·79	72	45	53			56½	52	e.	s.		ssw.	.....	.....		·41
☾ 20.	30·294	30·153	29·75			30·00	30·00	82	50	65			58	51½	sw.	wsw.		sw.	.....	.....		·09
21.	30·119	30·003	29·52			29·68	29·58	79	54	65			55	55	sw.	w.		w.	.....	.....		·07
22.	30·012	29·936	29·35			29·66	29·40	82	57	69			56	56	sw.	sw.		w.	·01	.....		·10
23.	29·878	29·849	29·29			29·47	29·44	76	59	66·5			58½	52	sw.	w.		sw.	.....	.....		·05
24.	29·879	29·781	29·30			29·52	29·64	72	46	63			55	52	sw.	sw.		nw.	·18	·03		·05
25.	30·160	30·044	29·50			29·78	29·86	71	41	58			54	52	nw.	nw.		wsw.	.....	·02		·04
● 26.	30·104	29·887	29·54			29·50	29·36	64	55	59			54	52½	sw.	s.		s.	·11	.....		·19
27.	29·993	29·889	29·42			29·41	29·49	68	52	60			55	51½	sw.	w.		w.	1·32	·26		·25
28.	29·739	29·669	29·20			29·52	29·57	64	44	57			51	48	nw.	nnw.		wnw.	.....	·24		·08
29.	29·902	29·707	29·22			29·80	30·06	59	45	51			48½	50½	n.	wnw.		n.	·07	·06		·06
30.	30·180	30·024	29·62			30·16	30·12	63	35	55			50	45	n.	nnw.		calm	.....	·08		.....
31.	30·240	30·178	29·78			29·91	30·02	68	51	53			56	51	w.	wnw.		w.	.....	.....		·02
Mean.	30·058	29·980	29·51			29·888	29·895	73·84	51·74	62·4			55·38	52·12					2·03	1·64		2·23

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 47. NOVEMBER 1851.

XXVIII.—*Notes on British Zoophytes, with descriptions of some new species.* By the Rev. Thomas Hincks, B.A.

[With a Plate.]

To the Editors of the Annals of Natural History.

Gentlemen,

The following miscellaneous notes relate to the British Bryozoa. I am not prepared to vouch for the novelty of all the observations which I here record. But in the course of a long and patient study of these interesting beings some facts have occurred to me, which I have not met with in the works of any of the English authors to which I have access, and which I venture to hope may prove of some value as a contribution to the history of the tribe. Even if I should repeat, in some cases, the observations of others, the testimony of one more independent witness may not be altogether worthless.

I have also been fortunate enough to obtain one or two species, which I believe to be new to the British fauna, and which I shall have the pleasure of introducing to the readers of the 'Annals' in the following pages:—

The Avicularium.

The "Birds'-head processes," with which some of the species of Bryozoa are furnished, have engaged the careful attention of naturalists, and their form and movements have been accurately described. But though we have many conjectures as to their precise function, and relation to the œconomy of the animal, few *facts* have as yet been recorded which throw light on the uses of this curious portion of structure. Such being the case, the following observation may have some interest.

The organ to which I refer bears a striking resemblance to a miniature bird's head, and is mounted on a short pedicle, furnished in most cases with a basal joint, by means of which it can be swayed backward and forward. These 'processes' are distributed in great numbers over the polypidom, one being generally placed on each cell.

The beaks are continually gaping and closing with much vehemence, and the entire organ is frequently swung to and fro. The movements, as it has often been noted, are quite independent of the polypes, and Mr. Darwin has well remarked, that in their functions these bodies "are related rather to the axis than to any of the polypi."

There is something very comical in the energy and earnestness with which these tiny jaws open and close, and throw themselves about, no cause being apparent in general for the outrageous gapings and eccentric jerks in which they indulge. They occur on several British species, as for example, *Flustra avicularis* and *Cellularia avicularis.*

While watching on one occasion a piece of the latter zoophyte through the microscope, a worm passed over it and amongst its branches. It was almost immediately firmly grasped by one of the *avicularia* and forcibly detained. In a short time, one end of it was seized by another, from which, however, by its violent contortions it extricated itself, but not without injury. The first assailant meanwhile kept fast hold, and soon two others caught the unfortunate at different points of the body. Thus it was held securely pinioned, and all its efforts to disengage itself, which were most vigorous, proved unavailing. The *avicularia* grasped the body of their victim most *viciously,* and nearly divided it. When I last observed the contest the worm seemed exhausted by its struggles and scarcely stirred, the *beaks* remaining firm and motionless. These strange police-officers were very systematic in their operations, and in capturing the intruder seemed to be discharging a very ordinary function.

There can be little doubt, I think, that it is the office of these organs to defend the Bryozoon from enemies—to arrest creatures or substances which might injure or annoy it. They are well placed for such a purpose, and their incessant gaping and swinging must enable them readily to detect the presence of trespassers. The *avicularia* then must be regarded as part of the machinery of the axis, charged with the special office of keeping the polypidom free from extraneous matters. An analogous contrivance occurs on others of the Bryozoa, consisting of long bristles attached to the cells by a joint, upon which they move backward and forward with considerable force. These clear away obnoxious matter from the neighbourhood of the cell, and keep the surface of the polypidom clean. I can confirm from personal observation the remarks which some authors have made respecting the *force* with which the movements of these hair-like appendages are executed.

Membranipora pilosa.

The polypes of this common species are furnished with a singular organ, which has been described by Dr. Farre in his admirable paper on the Ciliobrachiata. It consists of a small oblong body, which is placed between the base of two of the arms, and attached to the tentacular ring. It has a wide circular opening at the top, round which there is a play of cilia. The interior cavity is lined with cilia. The organ becomes narrow towards the base, and is closely united to the sides of the tentacles. Dr. Farre noticed a similar body on the polypes of *Alcyonidium gelatinosum* (Johnston). He states that he was unable to detect any flow of fluids through it, nor could he ascertain with what parts the cavity in its interior might communicate. I had long made this organ the subject of close investigation without gaining any clue to its history; but at length some light was thrown upon it by the following observations. Specimens of the zoophyte were procured in the spring, in which the *cercariæ* of Dr. Farre—filamentous bodies which are found swimming in the visceral cavity in many species of Bryozoa—were present in great abundance. They were also of larger size than any I had previously met with. In one of the polypes I observed a mass of these *cercariæ* wriggling upward from the lower part of the visceral cavity; and each filament, when it reached the base of the organ before referred to, was drawn into it and carried through it by the action of the cilia lining the interior, and then ejected and borne off by the tentacular currents. This expulsion went on for three or four minutes, during which time the filaments were streaming up incessantly from below. A great quantity was ejected. After a while a single filament only made its appearance occasionally, and at last none were to be seen.

Dr. Farre mentions that on one occasion he observed the *cercariæ* in a specimen of *Alcyonidium* "drifting rapidly to the upper part of the visceral cavity, and issuing from the centre of the tentacula," but from the sudden retraction of the polype he lost the opportunity of tracing their course. He adds, "it would appear from this that there is some external communication with the cavity of the body." My observations show that this communication is through the intertentacular organ, and that whatever purpose it may subserve beside in the œconomy of the Bryozoon, it is at certain seasons the channel through which *cercariæ* are ejected from the visceral cavity. The author before quoted conjectures that it may indicate a difference of sex, remarking that it is more frequently absent than present. I have not found this to be the case. The instances in which I was unable to detect its presence were very rare. Amongst a great number of polypes examined it occurred on all but a few.

The connexion, however, now proved to exist between the ciliated organ and the *cercariæ*—which must be regarded as spermatozoic bodies—may be accepted as conclusive evidence that it is subservient in some way or other to the function of generation. Professor Owen has pointed out "the analogy of these *cercariæ* with the spermatozoa discovered by Wagner in the tortuous generative tubes of the *Actinia*," and has noted their importance in the generative œconomy of the Bryozoa. I have observed them in *Bowerbankia* as well as in *Membranipora*, and Dr. Farre mentions them as occurring in *Valkeria*, *Alcyonidium*, and others. They are no doubt present in all the members of the tribe.

May not the intertentacular organ be also the channel through which the ova are expelled from the interior of the cell? They germinate, we know, from the inner surface of the lining of the cell, and falling into the visceral cavity are there fertilized by contact with the spermatozoa. It is probable that they find exit through the same passage by which the *cercariæ* were ejected, as before described.

In other species, Van Beneden asserts that he has discovered the termination of the oviduct under the roots of the tentacula.

I hope to be able ere long to report the results of further investigation into this interesting and obscure portion of the history of the Bryozoa.

Anguinaria spatulata.

The mechanism of the cell in this pretty species is interesting. The aperture, which is inferior, is large and oval. In the living state a membranous covering stretches over it of a dirty whitish colour.

At the upper end is a small *trap-door*, which falls when the polype is about to issue from its cell, and is drawn up and tightly closed after it when it retreats.

The polype does not protrude far from the cell. It has about twelve arms.

When retracted they may be seen folded together, and occupying the anterior portion of the cell. The internal structure is simple. There is a long œsophageal tube terminating in a dilated bag or stomach. The polype, when withdrawn, stretches down about two-thirds of the cell, and is not folded upon itself.

Filaments descend from the base of the body to the animal matter which pervades the creeping fibre. The polypes are very shy and wary, and will remain for a long time without issuing from their cells.

Eucratea chelata.

The polype of this species, which is closely related in structure to *Anguinaria*, is of extreme delicacy and beauty, and remarkable for the vivacity of its movements. In a moment it retracts itself, and the moment after darts from its little cell, bending its arms backward and forward with inconceivable quickness. The number of the tentacles is twelve.

Cellepora pumicosa.

The polypes are of a delicate orange colour, and singularly graceful in their form and movements. They are large, and protrude much beyond the cell when extended. The viscera are marked by dark spots.

Lepralia pediostoma.

Tentacles sixteen, long and slender. The aperture of the cell is covered by a horn-coloured operculum, which, when the polype extends itself, slides back, as it were, within the cell.

Flustra hispida.

The development of the ciliated gemmules has been described by Sir John Dalyell and others. I venture to add a few notes to their interesting observations. From a specimen procured in the month of May a large number of gemmules were excluded. They were found clustering about the surface of the fleshy mass. I was not fortunate enough to see any of them actually excluded, but there can be little doubt that they escape through the skin. The gemmule is a very beautiful object. It is of a semioval form, white, and thickly fringed with cilia round the border. It consists of a transparent case, inclosing an opake nucleus. The margin is broken into lobes, which bear a multitude of long and somewhat coarse cilia. At each extremity there is a tuft of very delicate hairs, which I have noticed in motion some time after the rest of the cilia have ceased to play. At the top of the back, between the nucleus and the outer case, is a small projection (Pl. XIV. fig. 1 *a*), or handle, which seems to disappear when the gemmule attaches itself. Towards one end of the nucleus I have repeatedly observed a curious movement quite independent of the cilia, such as might be produced by a number of *setæ* sweeping backward and forward. At the same point there was an appearance of structure, but I have not been able to arrive at any certain conclusions about it, and may very possibly have been deceived. I have observed very vigorous contractions of the mantle at one extremity of the body. The movements of the gemmule are irregular. Sometimes it creeps along, using its cilia as feet; at other times it swims pretty rapidly through the water; at others it tumbles over and over. Occasionally it floats on its back with its cilia upward, and in this state resembles a miniature boat. After a short time the cilia suddenly cease to play, the creature becomes attached, and is gradually developed into the cell and polype, which are to be the nucleus of an extensive colony.

In about twelve days from the time of attachment I have seen the polype issue from its cell, but the development probably proceeds more rapidly under favourable circumstances. Imperceptibly the body of the polype shapes itself within the mass. The tentacles are first visible. Soon violent convulsive movements are seen within. The front part of the cell is frequently pushed out with much apparent force, so as to form a neck of considerable length, and then suddenly retracted. There is no appearance of an opening at this time. The tentacles become very restless, and bend themselves about as if trying their powers and impatient of confinement. Gradually the parts become more defined; the elongation and retraction of the fore part of the cell continue, and at length the polype breaks from its captivity. The number of arms at first I have found to be twenty-four or twenty-five.

In the cases which came under my observation a narrow band of the granular matter, which composed the substance of the gemmule, remained round the body of the newly-formed polype. Some time before the development of the latter was complete a small swelling appeared on one side,—the rudiment of a second cell. A portion of the granular matter just referred to seemed to pass into it and fill it. This swelling gradually increased, extending down the side of the original cell. Before development had proceeded far, a third cell began to germinate from the second. A fourth was also in process of formation on the other side of the primitive cell (Pl. XIV. fig. 3).

The internal structure may be studied to great advantage in the newly-formed polype (Pl. XIV. fig. 4). The particles of food are borne down the œsophagus at once (there is no gizzard) into the stomach. There they are kept in constant agitation—whirling to and fro incessantly—and after a while are expelled and driven upward again by the sudden contraction of the walls of the stomach. This goes on *with much regularity*. The contractions of the stomach are very vigorous, the opposite sides almost meeting when the expulsion of the food takes place. A mass of undigested material gathers near the pyloric orifice, and is kept rotating by the action of cilia before escaping into the intestine. The intestinal tube shortly after leaving the stomach expands into a kind of sac.

New Species of Vesicularian Zoophyte.

The production which I am about to describe I believe to be quite new to the British fauna. Whether it be known or not to foreign authors I am unable to say.

It belongs to the family Vesiculariadæ of Dr. Johnston's work, and is much the most beautiful of its tribe. The peculiar structure of the cells renders necessary the formation of a new genus for its reception. In general character it is allied to *Vesicularia*.

Family Vesiculariadæ.

Genus *Mimosella* (Hincks).

***Polypidom** rooted, confervoid, horny, jointed and variously branched; cells ovate, biserial, opposite, with a basal joint, by means of which they can be moved to and fro, and folded together on the branches; polypes with eight tentacula.*

Species *Mimosella gracilis* (Hincks).

From a creeping fibre which spreads over the surface of *Fuci*, rise graceful, tapering stems, pinnate, much attenuated towards their extremities, and running out into filamentary, tendril-like prolongations. These stems are commonly from an inch to an inch and a half in height. They are jointed at intervals; and immediately below each joint spring two opposite pinnæ, also jointed, tapering and slightly curved.

The pairs of pinnæ do not all lie in the same plane. Along these are set the cells, which are ovate, elongate, biserial and opposite. Each cell is attached to a small prominence on the side of the pinna, which is perforated. A circular orifice on one side of the cell near the base fits over this, and a *joint* is thus secured, by means of which the polype can move its dwelling forward in one direction and back again. This is frequently done. The polypes are continually swaying their cells to and fro. Sometimes all the cells on the pinna are folded together on the upper side, just as the leaflets close on the leaf of the sensitive-plant (*Mimosa*), and hence the generic name. When specimens are dried or preserved in fluid, the cells are generally in this condition, and on slight inspection might be pronounced unilateral. Towards the base of each pinna the cells are long and oval; as they approach the apex they become short and globose, and at last are nothing more than little round excrescences.

The polypes have eight arms, and are furnished with a gizzard.

They are very vigorous in their movements. It is very interesting to watch the little creatures manœuvring their cells. Every now and then, as if some common impulse stirred them, all the polypes on a single pinna will move forward their cells, and the frond close, like the *Mimosa*-leaf when touched. More commonly they are independent in their movements. A single cell here and there will be seen in motion, while the rest remain quiet.

The mouth of the cell is furnished with the characteristic *setæ* of the family. When the cells are detached, the circular opening near the base may easily be detected.

The foregoing is a description of the simpler form of the zoophyte. Fine, proliferous specimens occur in which the polypidom is irregularly branched; the pinnæ are often trifid at their extremities, and are sometimes themselves pinnate and much prolonged.

This beautiful production was dredged in Salcombe Bay, Devon, profusely investing a bunch of sea-weed (Pl. XIV. figs. 5, 6, 7, 8).

Pedicellina.

Dr. Johnston records one species of *Pedicellina* (*P. echinata*) as British; stating at the same time that the *P. gracilis* of Sars and the *P. Belgica* of Van Beneden "may be expected to be found" on our coasts. The former has lately occurred to me at Fleetwood. Fine and abundant specimens were procured from a buoy that had been moored near that port. I am not aware that an *English* locality for this species has been published; but in a paper in the Number of the 'Annals' for June 1845, it is described by Mr. Goodsir and mentioned as occurring in Scotland. I have figured the *P. gracilis* (Pl. XIV. fig. 9). The most marked character is the expansion of the stem towards the base. The *Pedicellinæ* are amongst the most hardy of zoophytes. I transported specimens in a small bottle from the coast of Lancashire to Exeter, a distance of 300 miles, and though I was unable to renew the water, they lived with me after their long journey for two or three days. At the end of that time they showed signs of a disposition to get rid of their heads,—which is by no means a *suicidal* act in a *Pedicellina*,—and were therefore at once secured in Goadby's invaluable fluid!

I have also the pleasure of adding the *P. Belgica* to the list of British Bryozoa. Van Beneden's description is as follows:—"Tentacula twelve, equal in length, a little shorter than the body: stem and pedicle smooth." I have recently found this species at Exmouth on weed in rock-pools, near low-water mark. The small number of arms (eleven or twelve) and the freedom from spines are characteristic. The 'bulging' about the middle of the stem, as represented in Van Beneden's figure, was wanting in my specimens; but this can hardly be accounted an essential character.

FARRELLA.

The Fleetwood buoy which yielded the *Pedicellina gracilis* also supplied me with specimens of a zoophyte which must be referred to the genus *Farrella*, but which differs remarkably from the *F. repens* of Dr. Farre. I have not met with any description of it.

Species *F. producta* (Hincks).

Cells oblong, on a pedicle, as long as the cell or longer; tentacula twelve.

The cells, which are more slender than those of *F. repens*, are produced below into a long, gently tapering pedicle which connects them with the creeping fibre. This is equal to the cell in length or exceeds it; it becomes much attenuated towards the base. A thread of matter passes down from the bottom of the stomach through the pedicle. The cells are generally set a little obliquely on their stalks. The polypes have twelve arms, and exhibit a structure like that of the *F. repens* as described by Dr. Farre.

This is a very pretty species, and may be known at once by its long and tapering pedicle (Pl. XIV. fig. 10).

Apologizing for the length to which these notes have extended,

I remain, Gentlemen, your obedient servant,

THOMAS HINCKS.

Exeter.

P.S.—Since writing the foregoing pages I have had an opportunity of examining the *Cycloum papillosum* of Hassall in a living state, and of witnessing the escape of the gemmules from the ovarium. In this species the ovaries appear as yellowish *papillæ*, scattered irregularly over the surface of the polypidom. Within these the ova are arranged circularly. At the top of each ovarium is a slight depression marked by a small dark spot. At this point, when the gemmules are about to escape, an opening appears, and a little tube is gradually pushed forth to some distance. Through this tubular orifice the gemmules may be seen working their way by means of their *cilia*. As soon as they have effected their escape they begin to move with great activity through the water. I have seen seven pairs from a single ovary in the course of a few seconds, and very interesting it was to watch them struggling through the tubular passage, and launching themselves into their new sphere of being. As the sunlight falls upon the *cilia* they are tinted with a most lovely violet colour.

The gemmule is circular in form, white, opake, and bears a striking resemblance to *a low-crowned hat.* The margin is fringed with cilia. There is an orifice beneath opening on the edge of the disc, about which there are cilia, which play down into it.

Occasionally a cup-shaped organ is protruded near this aperture on which I have frequently observed a mass of fæcal matter.

There is great difficulty in examining these beings with the microscope, but I have been able to determine the above points with tolerable certainty.

The number of gemmules produced is immense. On a small specimen, incrusting both sides of a piece of weed, which did not exceed an inch and a quarter in length, and half an inch in breadth at the widest part, about 120 ovaries were reckoned. Each of these would contain about nine ova, so that more than a thousand altogether would be liberated from this inconsiderable fragment.

EXPLANATION OF PLATE XIV.

Fig. 1. The gemmule of *Flustra hispida.*
— 2. The same, as it appears shortly after having become attached.
— 3. A cluster of the cells of *F. hispida* in various stages of development.
— 4. Cell and polype recently developed from the gemmule.
— 5. *Mimosella gracilis* of the natural size—the cells folded together on the pinnæ.
— 6. A portion of a pinna magnified, showing the cells expanded.
— 7. A single cell, with the circular orifice near the base.
— 8. A cell just separated from the pinna.
— 9. *Pedicellina gracilis* of Sars.
— 10. *Farrella producta.*

XXIX.—*A List of all the Mosses and Hepaticæ hitherto observed in Sussex.* By William Mitten, A.L.S.

[Continued from p. 324.]

Tribe IV. Funariaceæ.

Genus 1. *Ephemerum,* Hampe.

118. *E. serratum* (Schreb.), Hampe.

Phascum serratum, Schreb. Eng. Fl.

Frequent in autumn and early spring.

119. *E. cohærens* (Hedw.), Hampe; "dioicum; basi filis protothalli instructum, subacaule; folia ovali-lanceolata serrata,

nervo evanescente [raro excurrenti] acuminata; theca globoso-ovalis recto-apiculata obtusa immersa superne brunneo-purpurea; calyptra tenerrima basi lacerata longi-apiculata."—*C. Müller, Synops.* p. 32; *Bryol. Europ.* fasc. 42. *Ephemerum,* t. 1.

On the exposed mud of the large pond at Pondleigh near Hurstpierpoint; more plentiful some seasons than others, according as the pond is more or less dried up; large quantities often remaining in the confervoid state without developing leaves or capsules.

Closely resembling *E. serratum* in size and habit, but readily distinguished under the microscope by its nerved leaves, which are also rather wider. The nerve is very variable, being sometimes prominent, at others requiring a transverse section to be made of the leaf before it is visible, and sometimes it appears more strongly defined in the upper part of the leaf than in the lower.

In the second review of the species of this genus in 'Bryologia Europæa,' *Ephemerum cohærens* is stated to be found in "Anglia occidentali," but it is not known to have been gathered in any other locality besides the one above given.

120. *E. sessile* (B. et S.), C. Müller; Bryol. Europ. fasc. 42. t. 2.
Phascum crassinervium, Bryol. Europ.
P. stenophyllum, Voit. Wils. in Eng. Bot. Suppt. t. 2829.

In small quantity on Henfield Common, and by the large pond at Pondleigh.

Genus 2. *Ephemerella,* C. Müller.

121. *E. pachycarpa* (Schw.), C. Müller.
Phascum crassinervium, Wils. in Eng. Bot. Suppl. t. 2932.

Frequent in stubbles.

Genus 3. *Physcomitrium,* Brid.

122. *P. patens* (Hedw.), Mitten.
Ephemerum patens, Hampe, C. Müller.
Physcomitrella patens, B. et S. Bryol. Europ. fasc. 42.
Phascum patens, Hedw. Eng. Fl.

Common on clayey soils in autumn.

123. *P. pyriforme* (Linn.), Brid.
Gymnostomum pyriforme, Hedw. Eng. Fl.

Frequent on moist ditch-banks.

Genus 4. *Entosthodon,* Schw.

124. *E. fasciculare* (Hedw.), C. Müller.
Physcomitrium fasciculare, Bryol. Europ. Physcomitrium, p. 13. t. 4.

Rare: it has been gathered at Hurstpierpoint, Henfield, Albourne, and Kingston near Lewes.

125. *E. ericetorum* (Bals. et De Not.), C. Müller.
Gymnostomum fasciculare, Eng. Fl.
Common on moist sandy banks, particularly in the forests.

Genus 5. *Funaria,* Schreb.

126. *F. hygrometrica,* Linn.
Frequent.

127. *F. Muhlenbergii,* Schw.
Rare: road-side bank by Offington, near Broadwater, Mr. Borrer. On the Downs near Stanmer, at Findon, and at Littlehampton, Mr. Jenner.

Genus 6. *Splachnum,* Linn.

128. *S. ampullaceum,* Linn.
On bogs on Ashdown Forest, Messrs. Woods, Jenner, and Reeves.

Tribe V. Bryaceæ.

Genus 1. *Schistostega,* Mohr.

129. *S. osmundacea,* Web. et Mohr.
S. pennata, Hook. and Taylor, Eng. Fl.
Very rare: in some holes in a bank at Bolney; barren.

Genus 2. *Orthodontium,* Schw.

130. *O. gracile* (Wils.), Schw.
Eridge Rocks, Mr. Borrer; High Rocks, Mr. Reeves; and Mr. Jenner has gathered it elsewhere in the neighbourhood of Tunbridge Wells.

Genus 3. *Bryum,* Dill. emend.

Section 1. Inflorescence dioicous.

131. *B. roseum,* Schreb.
"Frequent about Tunbridge Wells," Mr. Jenner, but not generally a common moss. It exists in small quantity at Hurstpierpoint and Henfield, and scattered plants may be found on the Downs often mixed up with *Dicranum scoparium* and *Leptotrichum flexicaule*: it is always sterile.

132. *B. Billardierii,* Schw. Suppt. t. 76; "dioicum; laxe cæspitosum veluti prolifero-ramosum; folia inferiora remota, superiora in rosulam densam siccitate gemmiformem congesta, erecto-patentia haud tortilia rigida, ovato-acuminata lata, margine revoluta, apice dentata, nervo in mucronem rigidiusculum producto, intense viridia concava, e cellulis densis firmis statu emolliendi mollioribus composita; theca obconico-pyriformis in pedunculo superne arcuato pendula fusca, operculo convexo breviter apicu-

lato pulcherrime aurantiaco vel purpureo nitido."—*C. Müller, Synops.* p. 253 [*sub B. canariense*].

B. Billardierii, Bryol. Europ. Bryum, t. 46.
B. canariense, Schw. Suppt. t. 204.
B. campylothecium, Tayl. Lond. Journ. Bot. 1846, p. 52.

On Woolsonbury Hill near Hurstpierpoint: very rare and sterile.

Stems in the specimens from the above locality about half an inch high, loosely cæspitose; leaves collected together at the tops of the stems, bright green, erecto-patent, ovate and ovate-acuminate, without a thickened margin, towards the apex dentate, the nerve excurrent, and above the apex of the leaf bent slightly backwards.

After a comparison of the specimens from Woolsonbury Hill with others from the Canaries, the Cape of Good Hope, New Zealand, Australia, and the Falkland Islands, it appears that there is no essential difference between *B. Billardierii, B. canariense,* and *B. campylothecium.* In the forms named *B. Billardierii* and *B. campylothecium,* the leaves are wider above than in the form named *B. canariense*; but the size and form of the cells, the reflexed lower margins, and denticulate apices are precisely the same in both. Schwaegrichen has figured and described the internal peristome of *B. canariense* with short and imperfect cilia, which might arise from immature specimens having been examined.

The *B. campylothecium* of Taylor, collected by Mr. J. Drummond at Swan River, differs from the usual forms of *B. Billardierii* only in having more boat-shaped leaves, and in this respect is analogous to similar forms of *B. capillare.*

Very similar as many species of *Bryum* are in a barren state to the unpractised eye, *B. Billardierii* however presents at once a character by which it may be readily known, in the denticulate apices of the leaves.

No dependence ought to be placed on the relative width of the margin as a distinctive character in species of this genus, for in some species, as *B. capillare,* it may be observed to vary from one that is almost imperceptible to one that almost equals that present in some *Mnia.*

133. *B. Donianum,* Greville, Transact. of the Linnæan Soc. xv. ii. p. 345. t. 3. f. 6; "habitus *B. capillaris*; folia caulina oblongo-ovata lata acuminata viridissima, margine crasse et flavo limbata remote denticulata, nervo crasso flavo excedente crasso-mucronata; perichætialia interna multo angustiora minora margine valde revoluta; theca in pedunculo longiusculo purpurascente apice arcuata elongato-cylindrica ore coarctata fusca, operculo conico acuto concolori nitido."—*C. Müller, Synops.* p. 282. sub nom. B. platylomatis, *Schw.*

B. platyloma, B. et S. Bryol. Europ. Bryum, t. 26.
B. Mülleri, Spruce in Musc. Pyren. No. 138.

Frequent on hedge-banks in sandy soils. The fruit was first gathered by Mr. Jenner by the roadside between Icklesham and Winchelsea, where it is very plentiful; it has also been met with in small quantity in several places about Hurstpierpoint.

[The plant in a barren state has been gathered at Reigate and Betchworth in Surrey by Mr. Borrer, and by Mr. Wilson near Warrington.]

In size and mode of growth this species closely resembles some of the larger forms of *B. capillare* found on moist sandy banks. The stems are seldom more than half an inch in height, densely covered below with brown radicles; the leaves are erecto-patent, not twisted nor spreading, oblong-ovate, and not so much inclining to a spathulate figure as those of *B. capillare*; the nerve is stout, and does not run into a hair-like point, but forms a stiff mucro at the apex of the leaf; the margin is thickened and towards the apex denticulate; the capsules are cylindrical, of a brown-red colour when mature, the operculum conical, acute, and shining.

Dr. Greville has given an excellent figure of this species in the place above quoted, and through his kindness the original specimens from the Ionian Islands have been compared with the Sussex moss.

B. Donianum may always be known by its erecto-patent, thickly margined, stoutly nerved leaves, with a short and rigid mucro.

134. *B. pseudo-triquetrum*, Hedw.

B. ventricosum, Dicks.

Frequent in bogs and wet places.

135. *B. alpinum*, Linn.

In small quantity on Henfield Common, and by the margin of Tilgate Pond in Tilgate Forest: sterile.

136. *B. pallens*, Sw.

B. turbinatum, Eng. Fl.

Common; but rare in fruit.

On the forest between Balcombe and Handcross a slender form of this species has been gathered with an imperfect internal peristome, the cilia being rudimentary and destitute of appendages; in other respects it corresponds with the usual state.

137. *B. capillare*, Hedw.

Abundant on roofs, walls, rocks, trees, and on the ground.

This common species offers a good subject in which to observe by analogy the variations to which allied species are subject. The margin of the leaves is liable to the greatest variation; and in those states in which it is most evident, it is always more prominent and thickened in the perichætial leaves.

The authors of the 'Bryologia Europæa' have taken as their typical form that in which the nerve of the leaf ceases just below the apex, and the hair-like point is composed of the united margins. This form is common on shaded banks and in woods. C. Müller, in his Synopsis, describes as the normal state that with an excurrent nerve; and as this is by far the most usual state, it has the greatest right to be considered the most perfectly developed form of the species.

Var. *rosulatum.*

B. rosulatum, Mitten MSS.

Cæspitulosum, humile, inferne tomentosum: folia ut plurimum in capitulis rosulatis congesta, ovalia vel spathulata, acuminata, acuta vel obtusata, integerrima, nervo infra vel paulo ultra medium evanescente apice sæpe torto et recurvo.

In very small quantity and sterile on Woolsonbury Hill.

Different as this moss appears at first sight from all other species of *Bryum,* it too nearly resembles some states of *B. capillare* to admit of its being considered distinct: the leaves are very variable in size, in form, and in the length of the nerve, as well as in the acumination or obtuseness of the apex; the same rosulate head producing some leaves that are elliptic, sometimes acute or sometimes obtuse, or spathulate with the apex twisted about half-way round, and obtuse, acute, or even sometimes bidentate. The nerve is sometimes very short, at others it extends to a little beyond the middle. The texture is similar to that of *B. capillare,* but it differs from all the common forms of the species in wanting the piliform acuminate point. The margin, if margin it may be called, consists only of a single row of narrower cells.

138. *B. cæspiticium,* Linn.

On walls and banks, but not very common.

139. *B. erythrocarpum,* Schw.

At Henfield and Hurstpierpoint in small quantity; not rare on the forests.

140. *B. atropurpureum,* Wahlenb.

Frequent on the earth in waste places and on walls.

141. *B. argenteum,* Linn.

Common on the ground, on walls and roofs. On a wet sand-bank near Hurstpierpoint, a state with pale yellow setæ and capsules occurs, but not otherwise different.

142. *B. albicans,* Wahlenb.

In the neighbourhood of Hurstpierpoint and Henfield; not unfrequent nor confined to any particular soil, but always barren.

143. *B. annotinum,* Hedw.

In fruit at Balcombe and Tunbridge Wells: plants without fruit are not uncommon.

144. *B. carneum,* Linn.

Frequent on wet ditch-banks.

145. *B. Tozeri,* Greville.

Not uncommon about Hurstpierpoint and Henfield, where it fruits occasionally in small quantity.

146. *B. crudum,* Schreb.

Gathered near Tunbridge Wells by Mr. Jenner; sterile. [Mr. Borrer has gathered this species in fruit at Betchworth in Surrey.]

Sect. 2. Inflorescence monoicous.

147. *B. nutans,* Schreb.

Widely distributed, but seldom fruiting.

Sect. 3. Inflorescence hermaphrodite.

148. *B. cernuum,* B. et S.

Common on walls and roofs, and on the ground.

A form with separate male flowers, but not presenting any further difference, is sometimes found; the fertile flowers are all hermaphrodite.

149. *B. inclinatum,* B. et S.

Frequent in sandy places, by roadsides and on walls. In moist sandy places the setæ are often much elongated.

150. *B. intermedium,* Brid.

Plentiful on wet sandy banks near Hurstpierpoint, at Hastings, and near Battle.

This species fruits chiefly in summer; but it is at all seasons more or less in fruit, which may be owing to the successive development and maturity of the antheridia, as observed in 'Bryologia Europæa.'

151. *B. bimum,* Schreb.

B. ventricosum, Eng. Fl. in part.

On the bog on Henfield Common. Mr. Borrer has gathered it at Amberley, and Mr. Jenner at Slindon.

152. *B. torquescens,* B. et S.

Under beech-trees on Woolsonbury and Newtimber Hills; on a stone wall at Henley Hill, and in the same situation near the Hungershall Rocks at Tunbridge Wells, where it has also been gathered by Mr. Jenner. [Mr. Borrer has gathered it on a wall at Hurtmoor near Godalming in Surrey.]

The state of this moss which has been gathered in the above localities corresponds with specimens received from M. Schimper, and is much larger than the slender form gathered at Gormire, Yorkshire, by Mr. Borrer, and described by Mr. Spruce.

So great a resemblance has this species to *B. capillare,* that, without examination, it might be readily passed over for that moss; but the capsules are more pendulous, and the seta is curved with a wider arc, so that the capsule hangs about its own length distant from the parallel seta: this peculiarity will often distinguish *B. torquescens* from *B. capillare* at first sight.

153. *B. pyriforme*, Hedw.

In the stone-pit at Henfield, and about Tunbridge Wells.

In his 'Synopsis,' p. 330, C. Müller says of this species: "Peristomii interni dentes maxime sulcati et hiantes valde serrati igitur veluti (sed non) appendiculati hyalini, ciliis solitariis brevibus non appendiculatis hyalinis interpositis. Formam peristomii hancce in speciminibus permultis examinatis invenimus et 'Bryol. Europ.' indolem non vidimus." The appearance above described is not the primary state of the peristome, which is correctly figured in 'Bryol. Europ.,' but is produced by the splitting of the processes down the carina as in *Acidodontium* and *Bartramia,* each half of the process bending over the intermediate cilia to meet at the apex the half of the next process: thus the two intermediate cilia with the two halves of the processes overlapping them, closely resemble a simple process, and the appendiculæ of the cilia sticking out here and there make it appear to be appendiculate.

Tribe VI. Bartramiaceæ.

Genus 1. *Bartramia*, Hedw.

154. *B. fontana* (L.), Schw.

Common in bogs and wet places; rarely fertile.

155. *B. pumila*, Mitten; dioica; dense cæspitosa tomentosa parum ramosa; folia caulina erecto-patentia homomalla ovato-lanceolata, nervo crasso superne dorso apiceque denticulato excurrente cuspidata, opaca, margine denticulato recurvo, e cellulis parvis ut plurimum rectangularibus viridibus densiusculis, papillis remotis scabridis instructis, areolata; perigonialia interna e basi lata concava patentia obtusiuscula minute denticulata, nervo crasso sub apice evanido: perichætialia longiora latiora et parum acuminata: theca in pedunculo elongato rigido undulato erecto subito inclinata globosa sulcata, operculo plano-conico obtuso; peristomium duplex normale.

In a wet place near Tilgate Pond, Tilgate Forest; the male plant only. Mr. Wilson has sent the barren female plant gathered by Mr. Croall in the Carse of Arderseir, Inverness-shire. The fruit is described from specimens gathered near Dollar, Perthshire, by Mr. M'Ivor.

The stems of this species in size and habit closely resemble those of *B. marchica,* and some small states of *B. fontana.* The figure of *B. uncinata,* Schwaegrichen, Suppt. t. 57 [*B. scabrida*], excepting the capsule and uncinate narrower leaves, very well represents *B. pumila*; but in this, as in *B. marchica,* the perigonial leaves are acuminate and acute, whilst those of *B. pumila* are obtuse like those of *B. fontana*; again, the cauline leaves of *B. pumila* are perfectly ovate-lanceolate, and not acuminate, nor so wide at the base as those of *B. fontana*. The fertile plants from Mr. M'Ivor are very different in appearance, being very much smaller; yet they appear to belong to the same species.

It seems impossible in the absence of authentic specimens to ascertain if this be the *B. fontana* β. *pumila*, "caule abbreviato simpliciusculo; foliis lanceolatis," of Turner, Musc. Hibern. p. 107. t. 10. f. 1. The only part of his description that points to *B. pumila* is "foliis intensius viridibus, nec acuminatis, nec cuspidatis," besides the observations that it is much more slender and shorter than α. The figure does not at all resemble the fertile *B. pumila* from Dollar, and that of the leaf represents it as described, "multo luculentius serratis;" from which it is just possible that the plant intended by Turner may be *B. rigida*, which has been gathered in Ireland.

156. *B. pomiformis*, Hedw.

On sandy banks: not very common.

Tribe VII. Mniaceæ.

Genus 1. *Fissidens*, Hedw.

157. *F. taxifolius* (Linn.), Hedw.

Very common.

Stems of this species may sometimes be found with the seta arising from just below the top.

[To be continued.]

XXX.—*On the Branchial Currents in* Pholas *and* Mya. By Joshua Alder and Albany Hancock.

[With a Plate.]

The existence of branchial currents in the Bivalve Mollusca, produced by the action of cilia, and admitted and discharged by different apertures, though denied by one or two authors, may be considered sufficiently established to allow of little further discussion. But though most naturalists admit the existence and action of these currents as a general law, yet exceptions have been claimed for some families and genera, whose anatomical structure is supposed to present an insuperable obstacle to the existence of inhalant and exhalant currents by different siphons; these siphons, as it is thought, having no communication internally. Among the families so placed are the *Myadæ* and *Pholadidæ*.

Mr. Garner in his excellent essay on the Anatomy of the *Lamellibranchiata*, published in the 'Transactions of the Zoological Society*,' and more in detail in Charlesworth's 'Magazine of Natural History †,' after describing the structure of those genera in which the water is acknowledged to flow in by the branchial siphon, and to be discharged by the anal one, goes on to say that "in the *Solen, Hiatella, Mya, Pholas, Teredo,* &c., a different disposition takes place. Here the branchiæ are prolonged into the inferior siphon, and as they are not separated from the base of the foot within, nor from the mantle without, the water drawn through the inferior orifice must make its exit by the same or by the anterior opening. But water is also drawn in by the other, and so gets access to the interior interlamellar spaces of the branchiæ; and by this superior siphon, ova, fæces, and secretions are discharged." From the statement here made it would appear that Mr. Garner draws his inferences from the anatomy of the animal alone, and not from actual observation of the currents, as he seems doubtful whether the water received by the branchial siphon is discharged by the same orifice or by the anterior opening.

Mr. Clark, however, has gone much further than Mr. Garner in an attempt to establish a somewhat similar view of the subject. By a series of experiments with mercurial injections, introduced principally through the anal siphon, he claims to have proved that no communication can exist between it and the branchial cavity; and by other experiments upon the living animal, that gentleman announces that he has made a most important discovery, namely:—that "nine-tenths, if not all, the water to bathe the branchiæ is admitted by the *pedal* gape, and ejected *only* by the branchial siphon; the anal one alone inhales water and discharges it;" and that "in the close-mantle *Solenidæ, Myadæ, Lutrariæ,* &c., as well as in the open-mantle *Veneres, Cardia,* &c., the water is only admitted into the branchial vault at the pedal or ventral aperture by the simple opening of the valves, and ejected, according to the structure of their respective sacs, either by the branchial issue alone, as in the *Pholades,* &c., or as in the *Veneres, Cardia,* &c., by the two confluent orifices, which are in fact but one branchial conduit."

This conclusion, so contrary to the experience of other naturalists, has been deduced from the following experiment. A *Pholas,* inflated with water, was lifted up and held in an inverted position with the siphons downwards, until all the water had run out. More water of course ran out of the branchial than the anal siphon, as might have been inferred from its larger aperture, the absence of a valve, and its more direct communication with the branchial cavity, in which the principal part of the water is con-

* Vol. ii. p. 91. † Vol. iii.

tained. On replacing the animal in water, a powerful column was observed to pass in through the pedal opening, while none was seen to enter by the siphons, these latter being probably closed by the animal in consequence of the unnatural usage it had been subjected to; but whether this be the case or not, it was to be expected that, by a known law of hydrostatics, the greater flow of water would be through the larger aperture until the equilibrium was restored. This, however, is a special case having nothing to do with the regular branchial currents, as has been before pointed out to Mr. Clark; yet this experiment is considered to have finally disposed of the complicated scheme, as it is called, of other authors, by which name is designated the simple observed fact, that water for branchial purposes is received and expelled by the action of cilia and by separate orifices.

Let us for a moment consider what would be the consequence of Mr. Clark's supposition that these animals obtain water only by the pedal gape. Nearly all of them pass their lives buried in sand or mud, or immured in solid stone, with only a small aperture externally, the pedal opening being beneath, and the siphonal tubes in communication with the open sea. Yet Mr. Clark would have these animals receive only the small quantity of water charged with sand and mud that finds its way to the bottom of the cavity, rather than draw their supply from the pure element on the surface, by means of their long siphons, which, it is generally supposed, nature has furnished them with for this very purpose.

It has long been known to us from actual observation that the *Pholades* and *Myadæ* do draw in a current of water by the branchial siphon, and that it is expelled by the anal one, as is the case with the other bivalves. To convince himself of this fact, it is only necessary for an observer to place a Pholas in a glass of sea-water and allow it to remain undisturbed for some time, in order that the animal may stretch out its tubes and recover its natural quiescent state. Then by gently adding a little fresh sea-water slightly charged with floating particles, a very decided current will generally be seen to set into the branchial siphon, and a counter-current to proceed from the anal one; the water round the pedal opening being at the same time undisturbed.

The same arrangements are readily recognised in *Mya*. We lately had an opportunity of observing *Mya arenaria* in its native haunts, and watched the play of its siphonal currents under very favourable circumstances. This species, at the mouth of the Tyne, buries itself to a depth of 6 or 8 inches in a stiffish clay, mixed with shingle; and, in shallow pools left by the tide, the siphonal tubes may be seen just level with the surface of the muddy bottom in full action. The mud lies closely packed against the walls of the tubes, so that nothing is to be seen but the internal surface of the expanded lips of the siphonal orifices fringed with numerous tentacles. When it happens that the surface of the water is only a little above these orifices, a strong current can be distinctly seen to boil up from the anal siphon, and another, with a constant, steady flow, to set into the branchial one. These currents were quite visible to the naked eye without the aid of a glass, so long as the mollusk remained undisturbed. We watched one individual for nearly a quarter of an hour, and no interruption of them took place; and it was not until the siphon was touched that the tubes were withdrawn and the currents ceased to play. But the siphon soon made its appearance again at the surface, and the orifices once more expanding, the currents commenced to play as strongly as ever. On examining the animal thus in its natural position, it is impossible to doubt that the currents are connected. If not, whence comes the water that is constantly pouring out of the anal orifice? None can pass down externally to the pedal opening while the tubes are in action, for at this time they completely fill the channel they occupy, their walls being in close contact with the sides of the burrow; and the mud, though it lay loosely about and against the siphons, was not in the least disturbed, as it must have been had a current passed down outside the tubes. Yet to satisfy Mr. Clark's theory such a current must have existed.

On removing these animals from their concealed abodes, and placing them in a vessel of fresh sea-water, the two siphonal currents were generally found in action when the individuals were undisturbed. And further, on placing the shell with its back downwards and the pedal gape raised above the surface of the water, these currents still continued to play; the excurrent and incurrent being as distinctly observed as before.

With *Pholas* we tried another experiment, which would seem conclusive with regard to the connexion of the siphonal currents. A specimen of *Pholas crispata* was placed in a shallow vessel of sea-water, and, as usual, the currents soon commenced to play. The nosle of a blowpipe charged with sea-water stained with indigo was then placed at the inhalant orifice, and immediately a considerable quantity of the coloured medium was drawn into the animal. Watching carefully the result, we had soon the satisfaction of beholding a blue-stained stream issue from the exhalant orifice. This experiment succeeded three or four times, notwithstanding the caution of the animal, which generally, on receiving the contents of the blowpipe, immediately closed the inhalant orifice, and then gradually contracting itself, with a convulsive action, squirted out the coloured matter by the same orifice by which it was received. It is worthy of remark, that, if we did not succeed in the first attempt, the second was almost sure to fail; the internal apparatus being apparently then adjusted to prevent the passage of the coloured particles: and it is likewise remarkable that the coloured fluid exhaled was deprived of all the coarser particles.

These experiments may be deemed conclusive of the fact that the inhalant and exhalant currents are really connected. The mode of their connexion, however, remains up to this time undiscovered. For the purpose of explaining this difficult point, we have found it necessary to make a careful examination of the anatomical structure of these animals. The result is very satisfactory. We certainly find no opening between the foot and the gills, nor between the gills and the mantle. The branchial or ventral chamber is so far completely isolated from the anal or dorsal chamber; and without a careful observation of the currents in the living animal, as above alluded to, here the matter might have been allowed to rest.

But a simple experiment will at once solve this difficulty. Having killed a specimen of *Pholas crispata* with the siphonal tubes contracted as little as possible, and having placed it in diluted spirit a few hours to render the tissues firm without hardening them too much, we had again recourse to the blowpipe, charged as formerly with coloured fluid. The specimen on this occasion was opened down the ventral margin, exposing to view the whole of the gills stretched along the roof of the branchial cavity. The nosle of the blowpipe was passed into the anal siphon, and on removing the finger from the top of the pipe, the contained fluid immediately filled the anal chamber behind the gills, and then passing at once down the tubes between the laminæ of the gills, issued through ten thousand pores, and dyed the water in the branchial chamber. Thus in an instant the secret was explained;—the currents communicate through minute openings in the laminæ of the gill-plates.

Having thus satisfied ourselves of this fact, we next directed our attention to the structure of the gills. Accordingly the anal chamber was laid open, and its ventral wall was seen to exhibit four longitudinal rows of large orifices. These four rows of orifices, already well known to anatomists, correspond to the attached margins of the four gill-plates, which hang from the roof or dorsal membrane of the branchial chamber; this membrane being the ventral wall of the anal chamber,—the membrane, in fact, which divides the chambers.

These orifices lead into wide tubes which pass between the two laminæ forming each gill-plate. These interbranchial tubes lie contiguous and parallel to each other, and extend the full width of the gill, being bifid within its free margin. Thus it is evident that the tubes within the gill-plates communicate freely with the anal chamber. The laminæ forming the walls of these tubes were now examined through the microscope, when the whole was observed to present a regularly reticulated structure composed of blood-vessels; those passing transversely being the stronger and more prominent. The longitudinal vessels, rather far apart from each other, form the meshes into parallelograms. These meshes are open spaces, fringed internally with a narrow membrane and active vibratile cilia. The two vascular laminæ forming the gill-plate are really sieves to separate suspended molecules from the surrounding medium on the passage of the water from the branchial to the anal chamber;—an apparatus of the most exquisite beauty and perfect adaptation to the desired end.

We cannot understand how this beautiful structure escaped detection by the mercurial injection of Mr. Clark. Had the anal chamber been completely filled with mercury as supposed, we conceive that it must necessarily have found its way into the interbranchial tubes, and probably thence into the ventral cavity. Indeed we think that so large a quantity of mercury as was required to fill the anal cavity would have caused a rupture of the very delicate membrane dividing this chamber from the branchial one, even without the external pressure which Mr. Clark says he applied to it. The interbranchial tubes have been described by several anatomists, but they do not seem to have carried their examinations so far as to have ascertained the subserviency of these tubes to the branchial currents. They have in a few genera been described to be for the purpose of receiving the immature ova after leaving the ovary.

Having carried our inquiries so far, we were anxious to observe this exquisitely constructed apparatus in action, and accordingly laid open the branchial chamber of a living animal, by dividing the mantle along the ventral margin, and thus completely exposing to view the gills. The specimen was then placed in a shallow vessel containing sea-water, and in a short time the excurrent siphon was in full play, pouring out a constant, steady current. As the branchial siphon was laid open from end to end, its action was stopped; the branchial chamber, however, being submerged was always filled with water. We now slightly coloured the fluid with indigo and carefully watched the gills through a rather powerful lens, which revealed a sight of extraordinary interest. The gills lay stretched, two along each side of the body, their posterior extremities passing some way up the branchial siphon, and appearing like delicate waved fringes, with their surfaces transversely fluted; the flutes being caused by the distribution of the channels within the laminæ. The free margins, down upon which we looked, were rather thick and distinctly longitudinally grooved. Along this marginal groove a minute cord or stream of blue particles of indigo was observed moving towards the mouth, following accurately all the sinuosities of the much-undulated gills. Minute streams of similar particles were also observed coming up from the base on both sides of the gills to join the stream that continued its progress along the margin. These lateral streams passed for the most part up the furrows of the laminæ, and becoming incorporated with that on the margin, augmented its volume as it approached the anterior extremity of the gill. All these streams were sharply defined, and the particles of which they were composed did not move amongst themselves, but were formed into cords or threads rather than streams, apparently bound together by some tenacious fluid. These streams or cords continued to be formed and moved on for hours; the action being only occasionally retarded when the animal was disturbed, and the whole time the water was continually passing out of the excurrent orifice or anal siphon.

Thus considerable quantities of indigo were accumulated in the vicinity of the mouth and oral tentacles. These accumulations were composed of ravelled threads spun as it were by the branchial apparatus, from the scattered, nearly invisible particles of indigo in the surrounding medium.

On reviewing this curious spectacle the question naturally arises—how is the matter, divided into such minute particles, thus collected on the surface of the gills? Having arrived at a clear understanding of the structure of these organs, we can give a correct answer to this question.

We have seen that the two laminæ forming the walls of the gill are in fact in structure like sieves, and that the tubes which pass between them communicate with the anal chamber leading directly to the excurrent siphon. When the water is flowing out of this siphon, there is consequently a tendency to form a vacuum in the chamber and in all the tubes between the gill-laminæ. By this means, combined with the action of the cilia lining the meshes, the water introduced into the branchial chamber by the inhalant tube will be drawn through the meshes of the laminæ, and all the suspended particles of matter retained on the surface of the gill. The water being filtered, as it were, allows the particles to accumulate, and then by the aid of other cilia, they are formed into the defined streams above described. This is certainly one of the most beautifully adapted organic mechanisms that can be looked upon. As a breathing organ it is very complete; as a prehensile organ for securing food it is surely unrivalled for the minuteness and beauty of its structure.

This examination of the gill in its living state throws some light upon the sustentation of the Lamellibranchiate Mollusks; for it would appear evident that all the minute particles of matter suspended in the water are collected and carried to the mouth without any apparent selection. The labial tentacles may possibly have the power of rejecting distasteful matters; but it is difficult to conceive how this can be, if the particles, as in the present case, always form a continuous cord, which would have to be severed before any part could be disengaged. And we may mention in proof of the minuteness of the particles extracted from the surrounding element by these animals, that on placing five or six individuals of *Pholas crispata* in a small vessel of water strongly coloured with indigo, they, in the course of twelve or fourteen hours, deprived the water of nearly all its colouring matter, leaving it scarcely tinged with blue, and the alimentary tube of several that were opened was crammed full of indigo, and that it was but little altered in appearance on passing in fæcal masses from the anal siphon.

The structure of the gills of *Mya arenaria* is similar to that of *Pholas*; those of *Pullastra perforans* are likewise formed much after the same plan, and in this latter species the sedimentary matters are collected on the surface of the gill in exactly the same manner as in *Pholas crispata*. In *Cardium edule* the gills are provided with interbranchial tubes, and they convey the food to the mouth along their free margins. The anal and branchial chambers of the oyster are as completely separated as in *Pholas*, and the gills procure food and take it to the mouth in the same manner as in that genus. In *Mytilus edulis* the branchiæ are a little modified. The four plates in this species are composed of two laminæ as usual, but only one of the laminæ of each gill is attached to the mantle behind; the outer lamina of the external gill, and the lamina next the foot of the internal gill being free: the interbranchial tubes are irregular and incomplete, extending scarcely halfway up from the free margin of the gill. The branchial plates of *Mytilus* are nevertheless efficient sieves, collecting all sedimentary matters on their surfaces, and conveying the same along their margins to the oral opening *.

These are all the species we have yet examined, but perhaps they may be considered sufficient to support a belief that the sieve-like character of the branchiæ, and the mode of action here described, predominate throughout the whole order of the *Lamellibranchiata*, as well as in that of *Tunicata*, whose branchiæ are known to have a similar structure.

* The gill-laminæ of *Pecten opercularis* are arranged in the same manner as in *Mytilus*. The outer lamina is free and much narrower than the inner, extending only about two-thirds up from the free margin.

EXPLANATION OF PLATE XV.

Fig. 1. General view of the interior of *Pholas crispata,* the mantle being laid open along the ventral margin :—*a,* incurrent siphonal orifice, with a piece of whalebone passed through it to show the direction of the current; *b,* excurrent siphonal orifice, with a piece of whalebone likewise passed through it into the anal chamber; *c,* the gills, exhibiting the indigo collecting on their surfaces in minute streams and passing along their free margins; *d,* anal chamber laid open, exhibiting the four rows of orifices leading into the tubes between the gill-laminæ; *e, e, e,* labial tentacles; *f,* accumulation of indigo on them, brought by the gills; *g,* oral orifice; *h,* foot.

Fig. 2. Section of the gill-plate, showing three of the tubes between the laminæ :—*a,* the tubes.

Fig. 3. A portion of the gill-laminæ highly magnified, showing the orifices in the meshes.

XXXI.—*Notice of a Barytic Deposit in certain Testacea from the London Clay.* By N. T. Wetherell, Esq., F.G.S., M.R.C.S.

During the examination of the Testacea of the London clay, I have observed in some univalves from a particular locality the occurrence of small concretionary bodies frequently filling the apertures and umbilici of the shells. These bodies are of an irregular form, but where they occur in the apertures of the *Naticæ,* especially *Natica glaucinoides,* they present at first sight somewhat the appearance of opercula*. In the other Testacea in which they occur, as some species of *Fusus, Pleurotoma* and *Cancellaria,* and a specimen of *Nautilus imperialis,* these bodies are more irregularly placed, and in a few instances they were found isolated in the clay surrounding the shells.

These bodies when broken have a fibro-radiate structure of an opake white, and readily yield to the knife; they are occasionally aggregated together, each one showing its centre of radiation. A slight effervescence was produced upon the application of muriatic acid, which ceased almost immediately without any apparent diminution of the size of the specimen.

A qualitative analysis kindly undertaken for me by Mr. James Field of Loughton, Essex, yielded the following substances :—

Silica, oxide of iron, alumina, carbonate of lime, sulphate of barytes.

Both oxide of iron and alumina were small in quantity, and there was a mere trace of silica, the sulphate of barytes forming by far the greater proportion of the concretions.

The specimens were obtained from the London clay, about two miles to the north of Highgate, at which place this formation lies under about 10 feet of diluvium or northern drift.

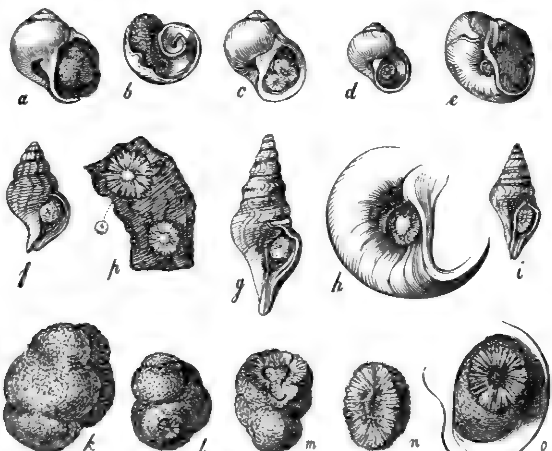
About three years since a small excavation was made through

* The barytic substance often fills up the umbilicus of the same species.

the drift bed into the London clay, the latter being penetrated to the depth of 8 or 9 feet; the shells being very abundantly disseminated throughout. Barytes is of rather rare occurrence in the London clay. In the list of the minerals of this formation given in the 'Outlines of the Geology of England and Wales,' it is not even mentioned.

Phillips, in his 'Introduction to Mineralogy,' states that the sulphate of barytes "occurs in crystals disposed in a radiated form on carbonate of lime, coating the divisions of the septaria, on the western side of the Isle of Sheppey."

In the numerous specimens of Testacea and other organic remains which I was so fortunate to obtain from the excavations in the London clay at Primrose Hill, and from the deep cuttings of the Great Northern Railway near Whetstone, I have not detected the trace of any similar barytic substance, and the occurrence of it in the locality previously mentioned may be probably due to the condition of the clay in its upper part at that spot, being more favourable to the decomposition and rearrangement of the chemical constituents of the matrix itself and of the contained organic bodies.



EXPLANATION OF THE FIGURES.

a, f, represent the deposit in an unbroken state within the apertures of a *Natica glaucinoides* and a *Fusus*; *b,* shows the space it generally occupies within the shell; *c,* the deposit broken, showing two centres of radiation; *d, g, i, Natica* and *Pleurotoma,* containing the deposit in a broken state, showing the fibro-radiate structure; *e, h,* umbilici of *Naticæ* filled with the deposit; *k, l, m, n, o,* magnified figures; *p,* magnified figure of the deposit in the clay. The natural size is represented in outline.

XXXII.—*An attempt to arrange the species of the family* Pholadidæ *into Natural Groups.* By John Edward Gray, Esq., F.R.S., Vice-President of the Zoological Society.

Several authors, as Lorenz Spengler (Skrivten af Naturh. Gebskabet, ii. 72. 1792; iv. 40. 1798), W. Wood in his work on Shells, and more lately G. B. Sowerby in his 'Thesaurus Conchyliorum' (x. 1849), have examined and described the species of this family, but very few attempts have been made to arrange them into natural groups, and this is the more important as the shells undergo great change in form and even in structure as they are developed by the growth of the animal.

I have therefore been induced to lay before the reader the following outline of an arrangement which has been some time lying in my portfolio, in the hope that I might find time to prepare a more complete description of the species.

Synopsis of the Genera.

A. *Dorsal muscle protected by one or two dorsal shelly valves. Cavity in which the animal lives not lined with a regular shelly tube inclosing the valves.* Pholadina.

a. *Siphons naked, front gape of shell open at all times.*

1. Pholas. Dorsal valves two, anterior single, central, lanceolate, hinder small, transverse; plate reflexed over the umbo, closely applied.
2. Barnia. Dorsal valve single, lanceolate; shell ovate; plate reflexed over the umbo, closely applied.
3. Dactylina. Dorsal valves two, lanceolate, placed side by side; the plate reflexed over the umbo, cellular beneath.
4. Xylophaga. Dorsal valves two, half ovate, diverging; umbonal process none.

b. *Siphons naked; front gape at length closed, with a callous plate.*

5. Jouannetia. Valves unequal, left largest, in front inclosing the other; dorsal valve single; umbonal process none.
6. Parapholas. Valves equal, regularly divided in front; dorsal valves two.
7. Martesia. Valves equal, regularly divided in front; dorsal valve single, lanceolate or peltate.

c. *Siphon with horny or shelly valves at their base.*

8. Pholadidæa. Front gape large, at length closed, with a callous plate; dorsal valves two, small.

9. Talona. Front gape small; dorsal valves two, moderate, diverging.

B. *Dorsal muscles only covered with a horny or coriaceous epidermis. The cavity in which they live not lined with a regular shelly tube inclosing the valves.* Zirfæina.

10. Zirfæa. Dorsal plate not reflexed over the umbo.

11. Navea. Dorsal plate produced and reflexed over the umbo.

C. *Dorsal muscles only covered with a coriaceous epidermis. Cavity in which they live lined with a regular shelly tube surrounding the valve.* Teredinina.

12. Teredo. Tube subcylindrical, hard, shelly; pallettes simple, oblong or transverse, entire.

13. Xylotrya. Tubes subcylindrical, hard, shelly; pallettes elongate, pennate.

14. Cuphus. Tube subcylindrical, thick, shelly; apex divided into two separate tubes; pallettes ——.

15. Guetera. Tube club-shaped, thicker, and closed beneath; pallettes ovate dentate.

A. *Dorsal muscle protected by one or two shelly dorsal valves. Cavity in which they live not lined with a regular shelly tube.* Pholadina.

The upper part of the cavity in which these animals reside is sometimes furnished with a calcareous deposit, which does not assume the regular form of a shell, but appears to be only an irregular exudation from the surface of the tubes, and never incloses the shelly valves, and it has only been observed in one or two genera, as *Martesia,* where it is formed of hard uniform calcareous matter (see Gray, Phil. Trans. 1833; Rang, Man. 345; Sow. Thes. Conch.), and *Xylotrya,* where it appears to be formed of agglutinated particles of sand: this latter was first shown to me by Mr. Edward Charlesworth.

a. *Siphons naked at the base; front gape of the shell more or less large and open, never closed with an additional shelly plate.*

1. Pholas, *Linn.*, part.; *Gray,* 1849.

1. P. costatus, *Linn., Sow. Thes.* t. 102. f. 8, 9.
2. P. crucifera, *Sow. Thes.* t. 104. f. 24, 26.
3. P. truncata, *Say, Sow. Thes.* f. 29, 30.
4. P. latissima, *Sow. Thes.* f. 15, 16?

2. Barnia. Barnia, *Leach MSS.* Barnea, *Risso.*

1. B. australasiæ. Ph. a., *Gray in Sow. Thes.* t. 107. f. 73.

2. B. Burmanica. Ph. B., *Philippi, Abbild.* t. 1. f. 1.
3. B. candida. Ph. c., *Sow. Thes.* f. 21–23. P. dactyloides, *Chiaje.* P. silicula, *Lamk.* P. papyracea, *Spengler.*
4. B. parva. Ph. p., *Sow. Thes.* f. 31, 32. Ph. crenulatus, *Solander in Spengler.* P. dactylus, var. *Desh.* P. ligamentina, *Desh.* P. dactyloides, *Lamk.*
5. B. similis. Ph. s., *Gray, Sow. Thes.* f. 12–14. Ph. antipodarum, *Philippi, Abbild.* t. 1. f. 3.
6. B. manillensis. Ph. m., *Philippi.* P. manillæ, *Sow. Thes.* f. 17, 18.
7. B. Erythræa, *Gray.* Shell ovate, elongate, radiately ribbed; the central ribs rather distant, with slight distant tubercles; hinder ribs nearly obliterated; the anterior ribs rather distant, with acute imbricate spines; the anterior gape broad, ovate, short.
   Hab. Red Sea.
8. B. fragilis. Ph. f., *Sow. Thes.* f. 92, 93.

3. DACTYLINA, *Gray, P. Z. S.* 1847, 187. Thoanoa or Thovana, *Leach MSS.*

* *Nucleus of dorsal valve anterior, gape narrow elongate.*

1. D. orientalis. Ph. o., *Gmelin.* Ph. Siamensis, *Spengler, Sow. Thes.* f. 3, 4. Ph. dactylus, *Solander MSS.*
2. D. Chiloensis. Ph. Ch., *Molina, Sow. Thes.* f. 1, 2. Ph. Campechensis, *Gmelin.*
   Var. P. laqueata, *Sow. Thes.* f. 19, 20.

** *Nucleus of dorsal valve posterior, gape broad.* Dactylina.

3. D. dactylus. Ph. d., *Linn., Sow. Thes.* f. 10, 11, 47. Ph. muricatus, *Da Costa.* Ph. hyans, *Pultney.* P. callosa, *Lamk.* Ph. tuberculata, *Turton.*

4. XYLOPHAGA, *Turton,* 1822.

1. X. dorsalis, *Turton, Sow. Thes.* f. 103, 104. Ph. Xilophaga, *Desh.*
2. X. globosa, *Sow. Thes.* f. 101, 102.

b. *Siphons naked at the base; front gape of the valves large, at length closed, with a callous plate.*

5. JOUANNETIA, *Desmoulin, Bull. Soc. Linn. Bord.* ii. 244; *Rang, Man.* 346. Pholadopsis, *Conrad, Bull. Acad. Philad.* 1849, 156. Triomphalia, *Sow. Thes.* 1850. Teredo, sp. *Deshayes.*

* *Valves with two impressed radiating grooves.*

1. J. globosa. Ph. glob., *Quoy.* T. globosa, *Sow. Thes.* f. 54, 55.
2. J. Cumingii. Triomph. C., *Sow. Thes.* f. 56, 57.

** *Valves with a subcentral impressed radiating groove.* Pholadopsis.

3. J. pectinata. Pholadopsis p., *Conrad,* t. 39. f. 3. Tr. pulcherrima, *Sow. Thes.* f. 58, 59.

6. Parapholas, *Gray.* Parapholas (part.), *Conrad, Proc. Acad. N. S. Philad.* 1848, 121; 1849, 156.

The anterior dorsal margin reflexed, and generally furnished with an internal elevated rib; umbo with a pair of vaulted cavities in front, connected with the anterior callous plate, and one or two behind umbo.

The periostraca (of this and the next genus) uniting the upper and lower edge of the valves often strengthened by a shelly plate forming additional elongate lanceolate posterior dorsal and ventral valves.

* *Valves with two sunken ribs; the hinder very convex, hinder dorsal cavity divided.*

1. Parapholas quadrizonalis. Ph. q., *Spengler, Sow. Thes.* f. 88, 89. Ph. striatus, *Chemn.* fig. 864–866. *Adult,* Ph. Incii, *Sow. Thes.* f. 45, 46.
2. P. Janellii. Ph. Janellii, *Desh.* Ph. Californica, *Conrad, Sow. Thes.* f. 5, 6, 7.

** *Valves with a single impressed rib; the hinder umbonal valve single.*

3. P. concamerata. Ph. c., *Desh., Sow. Thes.* f. 67, 68. Ph. cucullata, *Gray, B. M.* 1840.

7. Martesia, *Leach MSS., Blainv.* Mactesia, *Gray, misprint* "Mactresia, *Gray,*" *Agassiz.* Penitella, *Conrad,* 1849.

* *Valves with two impressed ribs, the hinder one oblique, the anterior dorsal marginal reflection adpressed.*

1. M. Calva. Ph. Calva, *Sow. Thes.* f. 51, 52, 53. Penitella Wilsonii, *Conrad,* t. 35. f. 5, bad? *Dorsal valve less developed.* Ph. acuminata, *Sow. Thes.* f. 48, 49; young, *Sow. Thes.* f. 50.

1*. M. branchiata. Ph. b., *Gould, Sow. Thes.* f. 82, 83.

** *Valves with a single subcentral impressed rib; the anterior dorsal reflection close pressed and furnished with an elevated internal rib.*

2. M. ovum. Ph. ovum, *Gray in Wood Supp.* f. 4. Ph. ovata, *Sow. Thes.* f. 71, 72; dorsal bad.
3. M. multistriata. Ph. m., *Sow. Thes.* f. 35, 36.

4. M. obtecta. Ph. o., *Sow. Thes.* f. 80, 81.
5. M. curta. Ph. curta, *Sow. Thes.* f. 33, 34 & 105.

*** *Valves with a single subcentral impressed rib; the anterior dorsal reflection erect, separate from the outer surface of the valve.*

6. M. striata, *Leach*. Ph. striata, *Linn.*, *Sow. Thes.* f. 40–44. Ph. lignorum, *Spengler*. Ph. nana, *Pultney*. Ph. pusilla, *Linn.* P. conoides, *Flem.* Ph. clavata, *Lamk.*
Jun. ? Ph. falcata, *Wood.*
Var. produced behind. Ph. semicostata, *Lea*, *Sow. Thes.* f. 84, 85. *Junior*, Ph. terediniformis, *Sow. Thes.* f. 97, 98.
7. M. australis, *Gray*. Shell elongate, front portion with rather distant waved concentric ridges (fewer than in *M. striata*), the hinder portion smooth, slightly concentrically waved; periostraca very thin, simple.
Hab. N.W. Australia, in hard stone and in resin.
8. M. rivicola. Ph. r., *Sow. Thes.* f. 90, 91.
9. M. aperta. *Junior*, Ph. aperta, *Sow. Thes.* f. 99, 100.
10. M. cuneiformis. Ph. cuneiformis, *Say*, *Sow. Thes.* f. 38, 39, f. 86, 87. Ph. corticaria, *Adams*, *Sow. Thes.* f. 94, 95. Ph. Edwardsii and Ph. rudis, *Gray*, *B. M.* 1820; junior, *Sow. Thes.* f. 96.

7*. TEREDINA, *Lamk.* Fistulana, sp. *Lamk.* Teredo, *J. Sow.*

This fossil genus appears only to differ from *Martesia* in being provided with a conical continuous entire tubular prolongation at the hinder end of the valves, in the place of the elongation of the valves, which is often to be observed in that genus, and in the absence of any supplementary posterior or ventral valves.

1. T. personata, *Lamk.* Teredo antenautæ, *J. Sow.*

c. *Siphons with shelly or rarely horny valves surrounding their base and forming a cup-like appendage on the hinder extremity of the valves.*

These appendages are not to be confounded with the extensions of the periostraca which are to be observed on the surface of the hinder part of some *Martesiæ*, as *M. obtecta* and *M. concamerata.*

8. PHOLADIDÆA, *Turton*, 1819. "Pholadidoidea, *Goodall*," *Blainv.* Pholidæ, *Swainson*. Parapholas, part., *Conrad.*

* *Siphonal valves without any tubular elongation, and not folded.*

1. Ph. papyracea. Ph. p., *Sow. Thes.* f. 66. *Junior*, Ph. lamellata, *Turton*. P. striata, *Blainv.* t. 80. f. 7.
2. Ph. spathulata. Ph. s., *Sow. Thes.* f. 69, 70.

** *Siphonal valves without any tubular prolongation, and with a longitudinal and transverse fold.* Talonella.

3. Ph. tridens. Ph. t., *Sow. Thes.* f. 60, 61. Talonella tridens, *Gray, B. M.*

*** *Siphonal valves with a tubular shelly prolongation.* Hatasia.

4. Ph. quadra. Ph. q., *Sow. Thes.* f. 62, 63.
5. Ph. melanura. Ph. m., *Sow. Thes.* f. 78, 79. Parapholas bisulcata, *Conrad*, t. 39. f. 4.
6. Ph. tubifer. Ph. t., *Sow. Thes.* f. 64, 65.

9. Talona, *Gray*, 1840; *P. Z. S.* 1848, 188.

1. T. explanata. Ph. explanata, *Spengler*. Ph. candidus, *Chemn.* f. 862. Ph. clausa, *Gray, Sow. Thes.* f. 74, 75.

B. *Dorsal muscle only covered with a horny skin or coriaceous epidermis. The cavity in which the animal lives is not lined with any regular shelly tube.* Zirfæana.

10. Zirfæa, *Leach MSS.*; *Gray*, 1840, *P. Z. S.* 1848.

1. Z. crispata. Ph. c., *Linn., Sow. Thes.* f. 37. Ph. bifrons, *Da Costa.* Solen crispus, *Gmelin.*
2. Z. constricta. Ph. c., *Sow. Thes.* f. 27, 28.
3. Z.? Darwinii. Ph. D., *Sow. Thes.* f. 76, 77.
4. Z.? julan, *Adans. Seneg.* t. 19. f. 1.
5. Z.? Vibonensis. Ph. V., *Philippi*, ii. t. 13. f. 5.

11. Navea.

Shell subglobose, closed behind; anterior gape very large, not closed up by age; edge reflexed, crenulated; valves with a sunken subcentral rib; anterior dorsal edge reflexed and closely adpressed to the outer surface of the valve; dorsal muscles covered with a coriaceous periostraca, and with a small transverse posterior valve placed behind the umbones; internal process simple, elongate, arched.

1. *N. subglobosa.* Shell subglobose, solid, truncated in front; anterior portion radiately ribbed and with a reflexed undulated edge, hinder portion regularly concentrically grooved.
   Hab. California, in a hole in a shell. Cab. Gray.

2. *N. tenuis.* Shell ovate, subglobose, thin; anterior portion obliquely truncated, finely and regularly concentrically striated, hinder portion smooth, very slightly concentrically wrinkled; subcentral rib indistinct externally, but with a distinct internal rib.
   Hab. —— ?, in a hole in a coral. Brit. Mus.

See also *Pholas nucivora*, Spengler, iv. 40. t. 10. f. 4, 9. Very like former, but according to the figure shorter in front, and longer and more rounded behind. Spengler, in his description and figure, appears to mistake the front for the hinder part of the shell.

C. *Dorsal muscle only covered with a coriaceous epidermis. The cavity which the animal inhabits lined with a regular shelly tube which surrounds the valves.* Teredinina.

12. Teredo, *Linn.* Teredo α, *Blainv.* Malleolus, *Gray.*

* *Tube concamerated near the external opening.*

1. T. Norvagicus, *Spengler.* T. nigra, *Blainv.* T. Bruguieri, *Chiaje.* T. Norvegicus, *Thompson.*
2. T. denticulata, *Gray.* T. navalis, *Moller, Moll. Grœn.* Greenland.

** *Tubes not chambered near the outer opening.*

3. T. batavus, *Spengler.* T. navalis, *Blainv.*
4. T. nana, *Turton.* T. navalis, *Milne-Edw.* T. megotara, *Forbes and Hanley.*
5. T. malleolus, *Turton.*

13. Xylotrya, *Leach MSS.*; *Gray, Ann. Phil.* 1825. Bankia, *Gray,* 1840. Teredo α, *Schum.* 1817. Teredo β, *Blainv.* Xylophaga, part., *Sow. Man.* !

1. X. bipalmulata. T. b., *Lamk. Syst.* T. palmulatus, *Lamk. Hist.* Taret de Pondicherry, *Adanson.*
2. X. Stutchburyi, *Leach, Blainv.* Tered. navalis, *Spengler.*
3. X. Philippii. Teredo palmulata, *Chiaje, Philippi.*
4. X. carinata. Teredo c., *Leach, Blainv.*
5. X. pennatifera. Ter. p., *Blainv.* T. palmulata, *Leach.* T. bipennata, *Turton.* T. navalis, *Home.*

14. Cuphus, *Guetard.* Kuphus, *Gray,* 1840. Kyphus, *Agassiz.* Furcella, *Oken.* Septaria, *Lamk.* Clausaria, *Menke.* Closonaria, *Férussac.*

1. C. arenarius. Solen a., *Rumph.* Leptana a., *Lamk.* Serpula polythalamia, *Linn.* S. gigantea, *Schrœt.* Teredo gigantea, *Home.*

15. Guetera, *Gray.* Fistulana, sp., *Lamk.* Teredo, sp., *Spengler, Megerle, Deshayes.*

1. G. corniformis, *Gray.* Fistulana c., *Lamk.*
2. G. clava. Teredo clava, *Gmelin.* Fistulana gregata, *Lamk.*
3. G.? lagenula. Fistulana l., *Lamk.*; perhaps same as preceding.

XXXIII.—*On some new Cambro-Silurian Fossils.* By FREDERICK M'COY, Professor of Geology and Mineralogy in Queen's College, Belfast.

Cytheropsis Aldensis (M'Coy).

Sp. Char. Arcuato-oblong, dorsal margin much arched, greatest convexity about the middle, sloping more towards the anterior, which is slightly smaller than the posterior end; posterior end broadly arched, anterior end obtusely pointed; a concave flattened sinus rather more than half the length of the shell in the ventral margin, rather nearer to the anterior than the posterior end; an obscure roughened spot slightly nearer to the anterior than the posterior end, and slightly nearer to the dorsal than the ventral margin; valves moderately and evenly gibbous; surface very minutely punctured under a strong lens. Length $1\frac{1}{2}$ millimetre, depth about $\frac{2}{3}$rds the length.

This little species is accompanied by a more elongate, oblong, less arched form of greater rarity, which may either be a distinct species or the male.

Extremely abundant in the dark earthy limestone of Aldens, Ayrshire.

(*Col.* University of Cambridge.)

Harpes parvulus (M'Coy).

Sp. Char. Cephalic shield semielliptical; flattened limb very wide (slightly exceeding the length of the glabella in front) with a thick margin; glabella narrow cylindrical, the slightly narrowed front about the width of its base, within the front margin of the cheeks; cheeks convex, one-third wider than the glabella at base; oculiform tubercles on a line with the anterior margin of the glabella, and slightly nearer to it than to the lateral margins; surface minutely granulated. Length of cephalic shield 3 lines, proportional length of front margin about $\frac{48}{100}$, length of glabella $\frac{46}{100}$.

This little *Harpes* is interesting as the first occurrence of the genus in Silurian rocks in Britain, although Col. Portlock has described two species which are common in Ireland. The species is remarkable for its small size and extremely wide marginal plate.

Limestone of Wrae quarry, Upper Tweed.

(*Col.* University of Cambridge.)

Pseudocrania (M'Coy), n. g.

Gen. Char. Shell slightly inequivalve, free, both valves regularly depressed, subconical, unattached; dorsal valve with or without a small cardinal area; internally, margin broad, flat, smooth or minutely striated concentrically, anterior pair of muscular impressions much larger and more strongly marked than the posterior pair; pallial impressions numerous, linear, not interrupted along the middle.

This palæozoic genus differs from the true *Crania* in the following points: 1st, *Crania* is attached by the substance of the dorsal valve, and exhibits thereon an irregular scar; both valves are free and regular in *Pseudocrania*; 2nd, in *Crania* the posterior or marginal pair of adductor muscles are always larger and deeper than the medial or anterior pair; the reverse is remarkably the case in the present genus, which also has a smooth or minutely striated margin, destitute of the strong granulation and punctures of most *Craniæ*. The *Crania antiquissima* as given by Verneuil may be taken as the type of the genus, as also the following species.

Pseudocrania divaricata (M'Coy).

Sp. Char. Longitudinally oblong, length and width almost equal, slightly narrowed posteriorly; hinge-line straight, a little shorter than the width of the shell; dorsal valve (analogue of the lower or attached valve) with a very low triangular cardinal area; external surface ornamented with sharp, prominent, narrow rugged lines divaricating from the beaks, those of the sides arched backwards towards the cardinal angles, about equally distant throughout from the intercalation of shorter striæ as the longer approach the margin, intervening spaces flat, about four ridges in the space of one line; internal casts show a broad, flat, defined rim with minute irregular concentric striæ, and the following parts in relief (depressions in the shell): 1st, a small oval mesial space originating near the hinge, and reaching to one-fourth of the length; 2nd, on each side of this, close to the hinge-margin, are two diverging oval muscular impressions; 3rd, at a little behind the middle of the shell are two ovate subtrigonal anterior muscular impressions considerably larger and deeper than the posterior pair; 4th, close in front of those a narrow semicircular impression (scar of visceral aponeurosis ?) with its extremities arching backwards round the muscular impressions; 5th, between this and the front and lateral margin, a series of from fifteen to twenty-two uninterrupted equidistant longitudinally narrow pitted (? pallial) marks, each dividing at its anterior half, separated by rather wider smoother spaces. Length 10 lines, greatest width (a little in front of the middle) 10$\frac{1}{2}$ lines, height of cardinal area three-fourths of a line.

In size and general character this agrees with the *Pseudocrania antiquissima* (Eichw. sp.) as given by M. de Verneuil (Geol. Russ. t. 1. fig. 12), but is easily distinguished externally by the beak being close to the posterior margin, and the remarkable divaricating sculpture of the valves, and internally by several minor points of detail obvious on comparison with the figure.

Common in the schists on the Bala limestone at Bryn Melyn quarry; schists of Pont y Glyn, Diffwys; and in the fine grits of Tan y Craig, Builth.

(*Col.* University of Cambridge.)

Siphonotreta micula (M'Coy).

Sp. Char. Longitudinally ovate. length and width about equal; sides and front broadly rounded, with a uniform curve, posterior extremity slightly acuminated; gently convex, perforated valve most so; greatest depth about one-fourth the length from the beak, which is near the posterior margin, and perforated by a round tubular opening; surface marked with a few concentric waves of growth, and sharp, flat, regular concentric linear striæ, about seventeen in the space of one millimetre; several short, slender, conical spines are rather irregularly scattered over the surface, the substance of the shell exhibiting under a high power an extremely minute reticular punctation. Average length (of rather large specimen) 2 lines, width usually rather less.

This small species varies from nearly orbicular to ovato-pentagonal in outline; in some specimens, particularly those from Wellfield, the depressions left by the spines of the surface are very obvious and rather crowded, producing a puckered irregularity of the surface, which is not to be seen in most of the specimens from Pen Cerrig; the concentric lineation is also more distinct in the former, between which the reticular punctation is so excessively minute, that it can only be traced with very fine and powerful glasses in favourable lights on the best-preserved portions of the shell, differing therefore very much from the most nearly allied fossil, the so-called *Terebratula hamifera* of Barrande. In nearly all the specimens the distinct and rather large circular opening at the apex of the beak is easily seen, and in many specimens an irregular fissure, apparently produced by crushing, extends a variable distance towards the front margin, either in the median line or more or less to one side or the other. The few rather large concentric waves or interruptions of growth are only seen in some specimens.

This species seems to agree in everything with the little *Terebratula hamifera* (Bar.) (Haidinger's Naturwissenschaftliche

Abhandlungen, vol. i. p. 418. t. 20. f. 9), but has the reticular punctation infinitely more minute than he describes that of his species to be (half a millimetre long, or four in a square millimetre). M. Barrande gives the geological place of his species in Bohemia as "gehört der Quartzitetage (D) an d. h. dem am höchsten gelegenen Theile des untern Silurischen Systems von Böhmen," and the schists in which ours occurs in such profusion in Britain seem to hold precisely the same place. Its gregarious habits are curiously shown by the circumstance of a fragment of shale four or five inches long and wide from Pen Cerrig having afforded upwards of 100 specimens now in the Cambridge collection, and another mass not much larger from Wellfield having yielded upwards of 70.

Very common in certain spots in the black shale of Pen Cerrig, Builth, Radnorshire; and not uncommon in the olive schists of Wellfield, Builth, Radnorshire; very rare in the olive schists of Pentre Llangynyw near Welchpool, Montgomeryshire.

(*Col.* University of Cambridge.)

Pentamerus microcamerus (M'Coy).

Ref. & Syn. *Spirifer? lævis,* Sow. S. S. t. 21. f. 12 (not *Pentamerus lævis,* Sow.).

Sp. Char. Transversely elliptical; receiving valve depressed, gently convex, greatest depth near the beak, which is elevated nearly at right angles, the height being one-eighth the width of the hinge; entering valve greatly convex; beaks small, rather prominent, reaching to the plane of the lateral margins, with which the low triangular area is nearly parallel, greatest depth slightly behind the middle; a broad, faintly marked, slightly convex, obsolete mesial ridge, and a few faint, broad, obsolete, irregular lateral radiations; hinge-line slightly less than the width of the shell, side margins elliptically rounded, front margins very wide, gently convex; cardinal area nearly sixteen times wider than high; surface apparently smooth, or with a very minute fibrous longitudinal striation: internal cast of receiving valve showing the broad triangular boss of the foramen, slightly keeled, the mesial septum formed by the junction of its bounding lateral lamellæ, only reaching one-third the length of the shell, or little more than equal to the width of the rostral chamber; cast of entering valve with a very narrow triangular area in the plane of the lateral margins; two very slightly diverging dental lamellæ, scarcely reaching twice the width of the area (or one-eighth the length of the shell), the exterior edges of which form two more diverging slits, resembling cardinal teeth; a slight indication of a mesial septum commencing a little in front of the ends of the diverging lamellæ, from between the ends of which project two long spatulate muscular impressions, not reaching quite to the middle of the shell. Width 2 inches 6 lines, proportional length $\frac{55}{100}$, depth of receiving valve $\frac{12}{100}$, of entering valve about the same.

I have recently examined such a great number of specimens from May Hill, that there can no longer be any doubt that it belongs, not to the genus *Spirifer* as suggested by Sowerby, nor to the genus *Orthis* as suggested by other palæontologists, but is a distinctly defined species of *Pentamerus*, distinguished by the very small size of the rostral chamber in the receiving valve, and the extreme shortness of the diverging lamellæ in the entering valve, which are not even indicated in Mr. Sowerby's figure thereof. As the species must be placed in the genus *Pentamerus*, and there is already a *Pentamerus lævis*, I am obliged to propose a new specific name. In very young specimens 3 lines long the mesial septum exceeds half the length of the shell.

In the fine sandstone of Mandinam, Caermarthenshire; very abundant in the sandstone of May Hill, Gloucestershire.

(*Col.* University of Cambridge.)

Hemithyris angustifrons (M'Coy).

Sp. Char. Elongate ovate; both valves very gibbous in the middle, gradually sloping to the margins, which are nearly level, or with a very slight elevation of the front towards the entering* valve; greatest width in most specimens rather behind the middle, from whence the width diminishes to the narrow obtusely rounded front; beak of the receiving valve large, pointed, with a very long triangular opening beneath it; substance of the shell coarsely fibrous, surface nearly smooth or with irregular transverse squamæ of growth; casts show in the entering valve two subparallel approximate longitudinal sulci marking the inner edge of the muscular impressions, and with a fainter sulcus between them left by the slight mesial septum; two pits near the beak, left by the apophyses, strong; receiving valve with two strong dental lamellæ, one on each side of the beak, and a slight indication of a mesial septum;

* As the terms "dorsal and ventral valves" have been almost invariably misapplied by conchological writers in describing Brachiopods, and as the confusion is very great when we use these terms in accordance with their anatomical position (but contrary to common use), I propose to use "receiving valve" for the perforated valve of *Terebratula*, &c. (called "dorsal valve" by conchologists and "ventral valve" by anatomists), and I use "entering valve" for the opposite one, of which the beak *enters* the cavity of the receiving valve.

few straight, once- or twice-branched impressions of the pallial vessels on each side. Length 9 lines, proportional length of entering valve $\frac{85}{100}$, width $\frac{75}{100}$, depth of both valves $\frac{50}{100}$.

The general ovate form of this species, with its narrow front, without mesial ridge or sinus, and its pointed beak, with large foramen, easily distinguish it from any of the other Lower Palæozoic forms. It varies considerably in depth, being sometimes rather less than the above dimensions, and having in one specimen the proportion of $\frac{70}{100}$, compared with the length; the width is sometimes a little more and sometimes a little less than the measurement given above. Some specimens seem to show projecting irregular transverse squamæ of growth.

Occurs in great number in the greenish sandstone of Mulock quarry, Dalquorhan, near Girvan, Ayrshire.

(*Col.* University of Cambridge.)

Hemithyris Davidsoni (M'Coy).

Ref. & Syn. *Terebratula sphærica* (David.), Bull. de la Soc. Géol. de France, 2nd S. vol. v. t. 3. f. 36 (not of Sow. S. S. nor Sow. Geol. Trans.).

Sp. Char. Globose or subcuboidal; entering valve deeper than the receiving one, moderately convex on the rostral half, abruptly and obtusely bent over towards the margin, nearly at right angles; beak of the receiving valve small, with a minute triangular opening beneath the apex, moderately convex, depressed towards the margin to form a broad, slightly defined sinus, the corresponding ridge to which in the entering valve is scarcely elevated; lateral margins nearly straight, front margin elevated into a quadrate sinus twice as wide as high; valves radiated with from eighteen to twenty very obtusely angular simple ridges, reaching distinctly to the beak, and sharply notching the margin, the four middle ones perceptibly larger than the rest. Length and width equal, and about 5 lines, depth of deflected front $\frac{55}{100}$, depth of both valves $\frac{88}{100}$.

This species differs from the *Terebratula sphærica* (Sow.), Sil. Syst., by having the elevation of the front towards the entering valve as in ordinary cases, instead of towards the receiving one as in that species, which in consequence of this Mr. Davidson suggests to be a variety of *H. deflexa*; and the Devonian *Atrypa sphærica* (Sow.), to which the present fossil is referred by Mr. Davidson, differs completely by having all the rostral portion smooth, while the ridges extend clearly to the beak in this Silurian type. The general form slightly recalls that of the *H. Wilsoni*, but there are much fewer ribs, and they are not divided by a medial sulcus on the deflected front.

Very rare in the Upper Ludlow rock of Burton and Brockton near Wenlock.

(*Col.* University of Cambridge.)

Hemithyris nasuta (M'Coy).

Sp. Char. Longitudinally ovate, longer than wide, gibbous, entering valve much deeper than the receiving one; receiving valve with a small obtuse beak, incurved nearly to touch the beak of the entering valve, with a small triangular perforation beneath; rostral portion tumid for about 5 lines from the beak, beyond which a wide flattened mesial depression is developed, gradually deepening towards the front, which in old specimens is very much produced into a flat tongue-shaped lobe, nearly as long as wide, gently sloping to the level of the most convex part of the entering valve; sides obtusely defined from the mesial furrow, gently convex, lateral margins slightly sigmoid, and bent upwards at the front, at a rounded angle of about 100°: entering valve with a slightly prominent beak; rostral portion and sides gently convex, after about 5 lines from the beak the middle is prolonged nearly in a straight line to the produced front margin, forming a large obtusely rounded mesial ridge: surface radiated with simple, close, obtusely rounded ribs, about four of which, rather larger than the rest, are raised with the mesial furrow, the broad sides of which are smooth, each side with about twelve slightly smaller ribs (seven in two lines at six lines from the beak near the side of the mesial furrow), leaving a rather broad smooth space at the rostral lateral margin on each side (a fine longitudinal striation is seen in some places). Length 1 inch 2 lines, proportional length of entering valve $\frac{90}{100}$, greatest width, about the middle of the length, $\frac{88}{100}$, greatest depth of both valves (one-third from the beak) $\frac{57}{100}$.

In form this species much resembles the *Terebratula promontorium* of Kutorga from the Lower Silurian limestones of Pulkowa (see Verhandlungen der Russ. Kais. Min. Gesellschaft zu St. Petersburg for 1845, t. 6. f. 3), but is distinguished by its ribbed surface.

Not uncommon in the schistose limestone of Craig Head near Girvan, Ayrshire.

(*Col.* University of Cambridge.)

Hemithyris sphæroidalis (M'Coy).

Sp. Char. Suborbicular, gibbous, nearly equivalve, margins very obtuse from the inflection of the edges; lateral margins nearly level, front margin abruptly raised into a quadrate sinus, about twice as wide as long; receiving valve with a very small pointed slightly incurved beak, with a minute triangular perforation beneath it, evenly gibbous except close to the sinus in the front margin, where there is a very slightly marked depression; entering valve evenly gibbous, with a very slightly marked, broad square ridge, extending a short way from the margin of the sinus; both valves radiated with from twenty to twenty-four very obtuse, rounded ribs, becoming gradually obsolete near the beaks, leaving the rostral portion nearly smooth, four of the ribs rather larger than the rest, slightly elevated with the mesial sinus; a short mesial septum in the entering valve; substance of the shell densely fibrous. Length 5 lines, proportional width $\frac{95}{100}$, proportional depth of both valves $\frac{70}{100}$.

The depressed spheroidal form and very obtusely rounded ribs becoming obsolete towards the beak, distinguish this species from the *H. nucula*, and the elevation of the mesial sinus being towards the entering instead of the receiving valve, as well as more depressed form, distinguish it from the *Terebratula sphærica* and *Terebratula deflexa* of the Wenlock rocks, to which it is otherwise very similar.

This seems to be the Upper Silurian species referred to by Mr. Davidson as identical with the Devonian *Atrypa sphærica* of Sowerby, to which it is very strongly allied, but is more depressed, has only four mesial ribs, and the beak is not adpressed. The obtuseness of the plaits and smooth rostral portion separate it from the *Terebratula pusilla* (Sow.) of the Lower Silurian rocks. The very obtuse margin, and smaller number of mesial plaits, and obtuse inflated form separate it from the *Terebratula famula* of Barrande (see Haidinger, Naturwissenschaftliche Abhandlungen, Band i. t. 17. f. 6).

Not uncommon in the Wenlock limestone of Dudley; Ireleth, Lancashire; Wenlock limestone of Ledbury, Herefordshire; and the limestone of the Hollies Church, Stretton.

(*Col.* University of Cambridge.)

Hemithyris subundata (M'Coy).

Sp. Char. Transversely broad, oval; valves gently and almost equally convex; beaks very small, apical angle 140° near the apex, lateral margins straight, front raised into a rounded wave, from which, in the large valve, a wide shallow mesial depression extends halfway to the beak, with a corresponding elevation in the small valve, in some specimens faintly extended to the beak: surface smooth. Average width 1 inch, proportional length $\frac{86}{100}$, length of entering valve $\frac{85}{100}$, depth of both valves $\frac{43}{100}$ to $\frac{50}{100}$.

This species is flatter and less wide than the *Atrypa* (*Pentamerus*) *undata* (Sow.), but less long than the *Atrypa* (*Pentamerus*) *lens*, being intermediate in form between the two. The casts show, however, in the small valve a rather strong slit in the beak for the short medial septum, and a transverse pit on each side for the origin of the apophyses or hinge-teeth. The receiving valve has two short diverging dental lamellæ, bordering its beak as in *Hemithyris* generally, with one or two small ridges between them; the sides of both valves show about three straight once- or twice-branched ridges of the pallial and ovarian vessels.

Very common in the schists and limestone of Mathyrafal S. of Meifod, Montgomeryshire; and in the schists of Pen y Craig, Llangynyw, Montgomeryshire; slate of Alt ffair ffynnon, Llanfyllin, North Wales.

(*Col.* University of Cambridge.)

Orthis Hirnantensis (M'Coy).

Sp. Char. Truncato-orbicular, depressed; cardinal area very low, triangular, nearly twelve times wider than high; hinge-line slightly less than the width of the shell; cardinal angles slightly obtuse, lateral and front margins horizontal, almost uniformly curved; entering valve perfectly flat, with a slight longitudinal mesial depression near the beak; receiving valve slightly and gently convex, most so along the middle, at about one-third the length from the beak; both valves with numerous slightly unequal, prominent, angular, strongly fasciculated striæ, each of the primary ridges branching near the middle into from five to seven smaller, forming in some specimens slightly angulated, divaricatingly arched groups, eight or ten striæ at the cardinal angles smaller and straighter than the rest, running nearly parallel with the hinge-line; separating sulci narrow, marked with very coarse punctures or little pits, and crossed by coarse obtuse transverse striæ; twelve to fourteen striæ in two lines at four lines from the beak; internal cast of receiving valve radiated with coarsely punctured impressions of the external striæ; cardinal teeth very short, thick, diverging at 80°. Width 1 inch, proportional length $\frac{70}{100}$, depth $\frac{16}{100}$.

This is an extremely beautiful species, remarkable for its flatness and broad divaricating bands of coarse, branched striæ, which are not at all arched along the hinge-line, as in the somewhat similar *O. retrorsistria* (in which the depth is greater, the striæ much more uniform, and the surface smoother, and the internal casts quite different).

Very abundant in the oolitic limestone and decomposing schists over the Bala limestone at Aber Hirnant E. of Bala, North Wales; and in the similar limestone of Cwm yr Aethen; oolitic limestone of Maes y fallen, Bala, Merionethshire: rare in the limestone of Cerrig y Druidion, Denbighshire.

(*Col.* University of Cambridge.)

Orthis retrorsistria (M'Coy).

Sp. Char. Rotundato-quadrate, depressed, no mesial ridge or furrow in either valve; hinge-line nearly or quite as wide as the shell; cardinal angles slightly obtuse; cardinal area flat, triangular, six or seven times wider than high in the receiving valve, and inclined backwards at about 120°, only one-third this height in the entering valve; rostral tooth of entering valve very large, triangular foramen of receiving valve with an internal, semiconical, hood-shaped extension of the dental lamellæ within it; receiving valve gently convex, greatest depth about the middle of the length; entering valve flat round the margins, gently concave in the middle; both valves with a few concentric wrinkles of growth, about a line apart, and radiated with slightly irregular obtuse striæ, which branch into two or three, at two or three intervals between the beak and margin, so that each of the strong primary ones form from seven to ten at the margin, separated by a rather deeper sulcus from the adjoining ones, so as to produce a flat, indistinctly marked, fasciculation; intervening sulci about the same size as the striæ (obscurely punctured in some specimens), which are straight in the middle, gradually assuming a divaricating curve on the sides, which is so great near the angles, that a large number of the lateral striæ curve backwards from the beaks to terminate along the distal half of each side of the hinge-line instead of the lateral margin, all the striæ crossed by indistinct transverse lines of growth; the size of the striæ does not vary much in the various parts of the shell, from fourteen to seventeen may be counted in two lines at four lines from the beak; cast of entering valve nearly smooth except at the margin, which, in the middle, is marked with close slightly dichotomous lines; the narrow triangular boss of the foramen is cleft by a deep, narrow, elliptical pit of the rostral tooth, flanked by the pits of two short cardinal teeth, diverging at 70°, between which and the hinge-line are the smaller but more diverging bosses left by the cardinal pits; a deep straight sulcus extends from the rostral tooth nearly to the anterior margin, marking a very long obtuse mesial ridge, on each side of the rostral part of which is a subquadrate pair of muscular impressions reaching less than half the length of the shell, the length and width of the pair being nearly equal; the lateral boundaries are formed by the deep impressions of a sigmoidal ridge, extending from the cardinal teeth on each side, each impression being slightly divided into two unequal lobes, anteriorly by the slight projection of an oblique narrow portion diverging from the anterior lateral angles; in fine specimens a faint transverse arched furrow separates the small posterior adductor impressions, which are longitudinally wrinkled, from the smoother and larger anterior portion; interior of receiving valve with two short cardinal teeth, diverging at 105°, from which two extremely long, narrow, elliptical muscular impressions extend more than half or nearly two-thirds the length of the shell, each lobe marked with faint radiating sulci, the pair being separated by a flat, acutely angular space, a little wider than one of the impressions at the anterior end, and extending to the point of the beak; a narrow space of the margin finely plicated, the rest of the surface nearly smooth or very faintly radiated. Width 10 lines, proportional length of receiving valve $\frac{90}{100}$, of entering valve $\frac{82}{100}$, depth $\frac{15}{100}$.

The backward curving of many of the lateral striæ to terminate on the hinge-line is more remarkable in this species than any other I know of, and suggests the specific name; something of the same sort may be seen in a less degree in the *O. subquadrata* (Hall), and one of the shells figured in the Mem. Geol. Surv. (vol. ii. pt. 1. t. 27. f. 9) as the *O. testudinaria*, from both of which the great general depression, the total absence of mesial fold, the concavity of the entering valve, great length of the narrow diverging muscular impressions in the receiving valve, &c., easily distinguish the present species. The same characters and backward curving of the lateral striæ separate it from the *O. protensa*.

Occurs in extraordinary profusion in the flags of S. end of Pen y gaer near Cerrig y Druidion, Holyhead Road, Denbighshire, closely covering extensive surfaces of the beds; flags at Hafod Evan, Penmachno, Caernarvonshire; schists of Cefn y coed, Llangedwyn, Montgomeryshire; schists W. side of Garn Brys, S.W. of Cernioge; abundant in the schists of Bwlch, Llandrillo, Corwen, N. Wales; schists of Llanwddyn E. of the Berwyn Mountains; schists of Das Eithin Ridge, Hirnant, Montgomeryshire; schists of Pen Cerrig Serth, Builth, Radnorshire; schists of Miltit Cerrig, Llangynnog, Montgomeryshire; schists of Bwlch y groes S. of Bala, Merionethshire; Alt yr Anker, Meifod, Montgomeryshire; schists of Tan y Bwlch y groes S. of Bala, Merionethshire; schists of Allt tre Ffynnon; limestone of Pentre cwm dda, S. of Glyn Diffwys, N. Wales; limestone of Llanfyllin, Montgomeryshire; common in the quartzite of Carn Goran, Cornwall.

(*Col.* University of Cambridge.)

Orthis sagittifera (M'Coy).

Sp. Char. Rotundato-quadrate or oblong, length usually a little greater than the width, depressed; hinge-line as wide as the shell; receiving valve obtusely subcarinate along the middle, most so near the beak, which is projecting, pointed, very slightly incurved, apical angle 140°, profile only slightly curved, lateral margins horizontal or with a slight mesial wave towards the receiving valve; cardinal area of receiving valve concave, triangular, four times wider than high, inclining backwards at 120°; triangular foramen narrow, open to the apex; entering valve gibbous, deeper than the greatest depth a little behind the middle, profile strongly arched; cardinal area very narrow, about one-third the height of the other, to which it is nearly at right angles, or in the plane of the margin; beak small, depressed, with a deep narrow mesial sulcus extending from it about halfway to the margin; surface of both valves radiated with very close, numerous, obtuse, subequal, irregular, branching striæ, separated by much narrower, deep, coarsely punctured sulci, about nine in two lines at six lines from the beak, straight in the middle, and along the hinge-line, slightly arched divaricatingly and most branched at the sides, no fasciculation; internal cast of receiving valve without mesial septum, two short dental lamellæ diverging from the beak at 80°, forming part of the lateral boundaries of a short, prominent, flattened, triangular pair of muscular impressions, slightly wider than long, scarcely one-third the length of the shell, usually tripartite by a pair of wide longitudinal sulci, rest of surface finely radiated by impressions of the external striæ; cast of entering valve with the triangular boss of the foramen, slit by a very slender rostral tooth, from which a narrow obtusely angular furrow (corresponding with the external one) extends about half the length of the shell; cardinal teeth forming long deep sulci, rather more than one-fourth the length of the shell, and diverging at 60°, resembling the mark of a broad arrow-head, of which the mesial sulcus was the shaft, surface impressed by the external radiating striæ. Width (of small specimen) 8 lines, proportional length of receiving valve $\frac{97}{100}$, of entering valve $\frac{85}{100}$, depth of receiving valve about $\frac{27}{100}$, depth of entering valve varying from $\frac{25}{100}$ to $\frac{30}{100}$. Length often upwards of 1 inch, the length and depth greater in proportion to the width in these old specimens.

This species is perhaps most nearly allied to the *O. turgida* (M'Coy), from which it is distinguished externally by its flatter receiving valve with nearly straight profile, and a cardinal area less than half the height, and a much more obtuse apical angle;

the striæ are thicker and coarser; internally the difference is still greater, the present species having much shorter and wider muscular impressions in the receiving valve, and the characteristic broad arrow-shaped impressions of the rostral portion of the entering valve, produced by the comparatively long diverging dental lamellæ, wholly separated from the mesial furrow. The gibbous entering valve with its deep narrow mesial sulcus near the beak, coarser striæ, and totally different internal characters separate it from the *O. retrorsistria* (M'Coy), with which it also frequently occurs.

Extremely abundant in the decomposing sandy schists of Aber Hirnant E. of Bala, N. Wales.

(*Col.* University of Cambridge.)

Orthis turgida (M'Coy).

Sp. Char. Longitudinally ovate, globose, margins very obtuse, greatest width slightly in front of the hinge-line, which is slightly less than the width of the shell; receiving valve very gibbous, profile much arched by the large beak, declining nearly to the level of the lateral margins, greatest depth about the middle of the length; in old specimens there is a faint wide shallow depression towards the front margin, which gradually changes into an obscure prominence towards the beak, or in the young; sides tumid; beak long, apical angle 100°, entering valve extremely gibbous, sometimes hemispherical, in some specimens more depressed, but remaining remarkably tumid towards the margins; a deep narrow sulcus extends from the beak almost halfway to the margin, becoming rapidly effaced by widening and flattening towards the front, which is depressed, with a narrow sinus in young specimens (from the mesial sulcus), and very slightly raised with a wide shallow wave (not affecting the surface) in old individuals (from the slight mesial depression of the old receiving valve); both valves covered with numerous fine, sharply defined, obtuse striæ, separated by flattened spaces, equalling them in width, bifurcating two or three times between the beak and margin, where, in old individuals, they are a little finer than in the middle of the shell, eight or ten in two lines at six lines from the beak, about ten to twelve at the front margin at ten lines from the beak; cardinal area in receiving valve very large, flat, nearly half as high as wide, inclining backwards at 130°; foramen narrow, triangular, entirely open; area of entering valve flat, triangular, about seven times wider than high: internal *cast* of receiving valve with strong dental lamellæ, diverging at 50°, forming the posterior lateral boundaries of a narrow ovate, strongly defined pair of muscular impressions, reaching half the length of the shell, not divided by any mesial septum, but having one or two strong sulci on each side; margin finely sulcated by the external striæ, faint extensions of which reach a variable distance towards the beak: cast of entering valve very tumid, nearly smooth, deeply slit towards the beak by the very deep narrow sulcus, left by a thick mesial septum, reaching half the length of the shell, and to which the lamellæ of the very short, thick, cardinal teeth seem to converge, forming the mesial septum by their union, the wide triangular boss of the foramen slit by a slender rostral tooth. Length of small specimen 9 lines, proportional length of entering valve $\frac{75}{100}$, width $\frac{85}{100}$, depth of receiving valve $\frac{35}{100}$ to $\frac{45}{100}$, depth of entering valve $\frac{25}{100}$ to $\frac{35}{100}$. (Length occasionally 1 inch.)

From the great variation in the proportional depth of the entering valve in different specimens, I am uncertain which of the valves is the deepest, although I have little doubt the entering one is so. I have seen small specimens confounded with *O. elegantula*, from which the characteristic turgid appearance from the tumidity of the sides, larger mesial striæ, &c. distinguish it; in the adult state the tumid form and deep short furrow in the rostral half of the entering valve distinguish it easily from all I know.

Extremely common in the schists of Craig y beri, Llanarmon fach, Denbighshire; schists of Coed Sion, Llangadoc, S. Wales; very common in the schists of Aber Hirnant E. of Bala, N. Wales; limestone and coarse schists of Golden Grove, Llandeilo; schists half a mile N. of Conway Falls; common in the limestone of Llandeilo, Caermarthenshire; limestone of Mathyrafal fridd, Meifod, Montgomeryshire.

(*Col.* University of Cambridge.)

Orthisina Scotica (M'Coy).

Sp. Char. Subquadrate, valves evenly convex, much depressed; hinge-line as wide as the shell, apical angle 120°, sides subparallel, front with an obsolete emargination in the middle; entering valve gently convex, with an obscure narrow mesial depression from the beak to the margin; receiving valve with projecting beak, not incurved, profile consequently nearly straight, very obscurely subcarinate along the middle, sides gradually sloping to the margins; cardinal area very narrow, parallel-sided in the entering valve, wide, flat, triangular, and inclining backwards at only 120° in the receiving valve; pseudodeltidium and deltidial pit concave, foramen oval, near the apex; surface radiated with twenty-eight thick, simple, subequal ridges, separated by deep sulci rather less than the ridges in width (three in two lines at six lines from the beak in the middle). Width 1 inch, proportional length of receiving valve $\frac{85}{100}$, length of entering valve $\frac{72}{100}$, greatest depth of both valves (about the middle) $\frac{45}{100}$.

There are two or three strong imbrications of growth at the margin, but I cannot distinguish any superficial striæ in the specimens at my command. In form it is intermediate between the *O. inflexa* and the *O. plana* (Pand. sp.), but is more depressed, the beak of the receiving valve not at all incurved, the pseudodeltidium concave outwardly, and is easily distinguished by its comparatively few, thick, simple ribs.

Very common in the concretionary limestone of Craig Head near Girvan, Ayrshire; calcareous shales of Colmonel on the Stincher.

(*Col.* University of Cambridge.)

Leptæna tenuicincta (M'Coy).

Sp. Char. Rotundato-quadrate; hinge-line as long as the shell is wide; cardinal angles forming nearly rectangular small flattened ears, sides subparallel, obtusely rounded, front wide; receiving valve subhemispherical, very gibbous, greatest depth a little behind the middle of the shell; beak large, prominent, obtuse, incurved to the level of the lateral margins; cardinal area nearly in the plane of the lateral margins, very broad, flat, triangular, height rather more than one-fourth the width; triangular foramen narrow, closed by a convex pseudodeltidium; entering valve very concave, with a mesial septum extending nearly to the margins; surface of both valves marked with very regular, minute, equal rounded concentric wrinkles, having a slight retral wave in the middle of the front, about twelve in the space of one line at the middle of the shell. Width about 5 lines, proportional length of receiving valve $\frac{90}{100}$, of entering valve $\frac{75}{100}$, depth $\frac{65}{100}$.

This beautiful species seems almost identical in size, shape and marking with the *Producta tenuicincta* (M'Coy) and *Leptæna enigma* (Vern.), but has a very wide distinctly marked cardinal area. Lest those species should prove to have areæ when more numerous and perfect specimens can be examined, I give my old specific name to this undoubted *Leptæna*.

Olive schists of Cefn Grugos W. of Llanfyllin, Montgomeryshire.

(*Col.* University of Cambridge.)

Strophomena spiriferoides (M'Coy).

Sp. Char. Subrhomboidal, sides rather depressed, only slightly convex; hinge-line as wide as the shell; cardinal angles square or slightly acute, sides subparallel, slightly rounded, front very abruptly raised into a quadrate sinus, one-third wider than high, from which a very prominent rotundato-quadrate mesial ridge extends sharply defined to the beak, and an almost equally deep and strongly defined flattened mesial hollow extends to the beak of the receiving valve, both valves radiated with subequal thread-like ridges, occasionally dichotomising (about fourteen in three lines at six lines from the beak): casts of the receiving valve show the closed, cicatized foramen, with a long slender cylindrical extension of matrix, half a line thick, arching from the apex of the beak into the back, at one-fourth the length from the beak, and two thick, short, slightly diverging cardinal teeth and lamellæ; casts of entering valve show two very short, thick, diverging pits of cardinal teeth, and a large double ovate pit left by the great bifid rostral tooth, and a trace of a slender mesial septum. Average width 1 inch, proportional length of receiving valve $\frac{85}{100}$, of entering valve $\frac{69}{100}$, depth $\frac{60}{100}$.

This is so extremely like the *Spirifera radiata* of the Wenlock limestone, that I have no doubt it has very often been confounded with it, and probably all the examples quoted by authors of *S. radiata* from the Caradoc and inferior strata will be found referable rather to the present shell, which abounds in these inferior rocks, where I have never seen the true *S. radiata* (nor does the present species occur to my knowledge in the Upper Silurian strata). Externally the present shell may be distinguished from the *S. radiata* by its longer hinge-line, flatter sides, and coarser striation, while the internal casts show the generic difference by demonstrating the pit for the great rostral tooth in the beak of the entering valve, and the slender tubular filling of the apical foramen as in the *Leptæna* (*Strophomena*) *sulcata* (Vern.), Bull. de la Soc. Géol. de France, 2nd S. vol. v. p. 31. f. 4, to which it is most nearly allied, but from which it differs by its greater gibbosity, and very prominent mesial ridge and hollow extending from the beak, giving it exactly the appearance of *Spirifera*. The *Orthis Vespertilio* when very finely sulcated might be mistaken for this species, but has the mesial depression in the entering and mesial elevation in the receiving valve, in which also the triangular foramen is open throughout.

Extremely common in the impure limestone of Moel y Garth, Welchpool, Montgomeryshire; very abundant in the limestone and schists of Bala, Merionethshire; very common in the Caradoc sandstone of Horderly; very abundant in the schists of Alt y Anker, Meifod, Montgomeryshire; schists of Tan y bwlch y groes S. of Bala, Merionethshire; schists of Bryn Melyn near Bala, Merionethshire; schists of Gelli Grin, Bala, Merionethshire; schists S.W. of Pwllheli, Caernarvonshire; schists of Pen y gaer, Cerrig y Druidion, N. Wales; schists of Beavers Grove, Bettws-y-coed, N. Wales; schists of Rhiwargor, &c.

(*Col.* University of Cambridge.)

Strophomena simulans (M'Coy).

Sp. Char. Truncato-elliptical; hinge-line slightly exceeding the width of the shell, forming short, rounded, semicylindrical ears, from a more or less pronounced indentation of the lateral margins; front wide, elliptically rounded; entering valve gently and slightly convex for about nine lines from the beak, and then more rapidly arched towards the receiving valve to a position sometimes nearly at right angles with the rostral portion; receiving valve nearly as concave as the entering valve is convex externally, except near the beak which is convex; cardinal area rather low, triangular, and nearly at right angles to the plane of the lateral margins; foramen broad, triangular, closed by the pseudodeltidium, except at the apex, where there is a tubular perforation (leaving a little columnar stem-like portion of matrix projecting from the apex of the cast); cardinal teeth very small, bifid, diverging at 115°, the dental lamellæ, originating from them, converge under the muscular impressions, so that their inner gently incurved edges, touching the shell, diverge at about 65°; muscular impressions undulato-orbicular, about a fifth wider than long, reaching rather less than half the length of the shell; surface sometimes with a few oblique concentric plicæ on the ears; surface regularly radiated with very fine slightly irregular striæ, about twenty-five to thirty in two lines at six lines from the beak, and at that distance usually every 5th, 7th or 9th of the striæ larger than the others, but near the beak they often seem simply alternate in size, the intervening delicate sulci closely punctured. Width 1 inch 10 lines, proportional length of rostral portion about $\frac{30}{100}$, more deflected front about $\frac{30}{100}$, depth at middle of length $\frac{20}{100}$.

This species in size, form, striation and tubular perforation of the apex of the beak almost exactly resembles the *Leptæna alternata*, Conrad, but differs in having the receiving or foraminated valve concave instead of being the convex one; the striation is also finer and flatter or more uniform, which, with the greater deflection or arching of the valves, also separate it from the *S. grandis*.

The specimens from Blain y cwm and Golden Grove are netted by a beautiful little species of *Vioa* branching frequently, nearly at right angles, forming straight, forking or angularly bending channels, one-fourth of a millimetre in diameter, the branches being at a little more or less than a line apart, and either in the plane of the valves or at right angles to it (leaving round perforations): it might be called *Vioa rectangularis*.

Not uncommon in the schists of Cefn Coch, Glyn Ceiriog, Denbighshire; in the olive schists of Golden Grove, Llandeilo, Caermarthenshire; schists of Blain y Cwm W. of Nantyre, Glyn Ceiriog, Denbighshire; and one doubtful specimen in the sandy schists of the Malverns, Worcestershire.

(*Col.* University of Cambridge.)

Leptæna (*Leptagonia*) *ungula* (M'Coy).

Sp. Char. Semioval; hinge-line as wide as the shell, forming short, rounded, slightly projecting ears; cardinal area low, triangular, with a large tubular foramen at the apex of the beak; receiving valve horse-hoof-shaped from the slope of the deflected front, being at a much more obtuse angle in the middle of the front than at the sides; visceral disk depressed, very slightly convex towards the beak, rendered rugged by seven or eight concentric wrinkles (only three or four at the margin commonly seen), angle between the disk and the deflected front obtusely rounded, the depth of the latter being rather less than the length of the disk; entering valve flat, concentrically wrinkled like the receiving one, but with a narrow margin, equally deflected all round, and only one-fifth or one-sixth the length of the disk; surface of both valves radiated with extremely fine close obtuse punctate striæ, about twenty-eight or thirty-two in two lines at four lines from the beak, every 3rd, 5th or 7th of which are usually considerably stronger than the others in all the middle portion; interior of both valves closely punctured and striate; the close, straight, pallial impressions resemble the external striæ on the deflected front, but are only eighteen in the space of two lines; interior of receiving valve with two rather long, very slightly incurved dental lamellæ diverging at 105°, including the rotundato-trigonal pair of muscular impressions which are one-third wider than long, and extend about half the length of the disk, being only separated by a slight indication of mesial septum at their anterior edge; apex of the triangular boss of the foramen with a small abrupt mucro from the entrance of the matrix into the small tubular opening at the apex of the beak; interior of entering valve with two very short diverging cardinal teeth, and a minute rostral tooth. Width 11 lines, proportional length $\frac{75}{100}$, length of disk in receiving valve $\frac{47}{100}$, length of disk in entering valve $\frac{65}{100}$, depth $\frac{25}{100}$.

This so exactly resembles some of the small varieties of *L. deltoidea* and the *L. camerata* (Conrad) as figured by Hall, that I should not have thought of separating them, were it not for the very much finer striæ, which very easily separate the species from our British specimens of *L. deltoidea*. The foramen of the apex of the beak is also larger, the dental lamellæ more divergent, and the muscular impressions much wider. I find the peculiar hoof-like form and other characters of this little shell (unlike *L. deltoidea*) to be extremely constant.

Gregarious, in extraordinary abundance, completely filling some beds of the limestone of Llansaintffraid, Glyn Ceiriog S. of Llangollen, Denbighshire; limestone of Selottyn Road S. of Llangollen, N. Wales.

(*Col.* University of Cambridge.)

Lingula Davisii (M'Coy).

Sp. Char. Ovato-pentagonal, or broadly subtrigonal, depressed, slightly and broadly convex near the beak, and about halfway to the margins, which become gradually compressed; greatest width at about the middle of the length; front slightly narrowed but very wide, subtruncate, and very slightly convex, obtusely rounded at the lateral angles to the subparallel slightly convex sides; posterior lateral margins rather long, forming an obtuse angle at the sides (usually nearly equalling half the length of the shell, nearly straight, and meeting at the beak at an angle of about 100° in the short and 95° in the long valve); surface with numerous, faint, concentric, rather wide subangular undulations of growth, accompanied by irregular concentric imbricating laminar striæ, ten in one line on the exterior of the shell; no trace of longitudinal external striæ, but on the internal cast a few faint obsolete flattened fibrous radiations observable with the lens. Length 7 lines, proportional width $\frac{77}{100}$, depth about $\frac{15}{100}$.

This curiously wide satchel-shaped *Lingula* is the species discovered by Mr. Davis in such profusion in the Lingula slates near Tremadoc in company with the large elongate *L. ovata* (M'Coy), and I have great pleasure in dedicating the species to him; at the same time I must remark, that except for a slightly greater width and perhaps less coarsely undulated surface, it seems scarcely to differ from the *L. lata* of Pander; as however this writer gives no description of his species, as his figure gives at least the differences noticed, and as Mr. Sowerby has unfortunately described a totally different Silurian species under the same name, I think (although this latter should not retain the name of *L. lata*) that it is better to give a distinct name to our very abundant and distinctly marked species. The British species most allied to this is the *L. attenuata* (Sow.), which however is easily distinguished by its much longer trigonal, retrally narrowed form, or rising from the gradual passage of the sides into the posterior lateral margins (without angulation), the very prominent narrow gibbosity from the beaks, &c. The substance of the shell is very thin, and the traces I have seen apparently of the mesial ridge extend little more than one-third the length of the shell.

Extremely abundant in the greenish slates of Penmorfa, Tremadoc, N. Wales; rare in the schists E. of Nant y Groes S. of Bala, N. Wales.

(*Col.* University of Cambridge.)

Lingula tenuigranulata (M'Coy).

Sp. Char. Shell black, semielliptical; sides parallel, abruptly rounded to the wide, nearly straight front, gradually rounding into the undefined arched posterior lateral margins, which unite elliptically in front of the beak, the curve being rather wider than a semicircle, in the small valve, but more elongate from the projection of the considerably longer beak in the opposite one; valves with a moderate, flattened, triangular gibbosity, widening from the beak to the front margin, from which the sides slope rather abruptly to the margins, the greatest depth being at about the middle of the length; surface with irregular, flattened, concentric laminar wrinkles, strongest on the sides, nearly obsolete in the middle; entire surface covered with extremely minute, close, regular, equal, sharply granular, longitudinal, slightly undulated striæ (about twenty-six in one line in the middle of the shell), the intervening spaces between the striæ about equalling the striæ in width. Length (of shorter valve) 1 inch 9 lines, proportional width $\frac{70}{100}$, depth $\frac{25}{100}$.

This species far exceeds the *Lingula quadrata* (Eichwald) in size, though that has hitherto been the largest species known; it is easily distinguished therefrom as well as from the *L. granulata* (Phill.), to both of which it bears some resemblance, by the extremely minute granular lineation of the surface (which is quite invisible to the naked eye, or with a lens of low power only giving a dullness to the surface) and the semielliptical regular arch formed by the union of the two posterior lateral margins of the shorter valve. In the *L. quadrata* also the front is much rounded and narrower, and the rather strong mesial lineation of the decorticated specimens does not occur in our species, in which, when the surface is removed, there are only seen traces of obsolete, broad, longitudinal fibrous bands, not at all confined to the middle of the shell, nor linear in character. As usual in fossil *Lingulæ*, it is the beak only of the smaller valve which is seen most commonly; but two of our specimens show the pointed beak of the larger valve, extending a quarter of an inch beyond the rostral margin of the other, the two being undisturbed from their original position.

Common in the sandy and calcareous schists of Alt yr Anker, Meifod, Montgomeryshire; sandy schists of Das Eithin ridge, Hirnant, Montgomeryshire.

(*Col.* University of Cambridge.)

Spondylobolus (M'Coy), n. g.

Gen. Char. Suborbicular, slightly narrowed towards the indistinct, short hinge-line, nearly equivalve, flattened; small valve with a slightly excentric apex, beneath which, on the interior, the substance of the valve is thickened into a wide undefined boss; opposite valve slightly longer, from the apex being perfectly marginal and slightly produced, channelled by a narrow triangular groove, the anterior end of which is flanked within by two very prominent thick conical shelly bosses, representing hinge-teeth: substance of the valves thick, testaceous, not glossy, minutely fibrous, but not distinctly punctured under a lens of moderate power, except by the ends of the fibres.

One species of this genus is indistinctly known already from the figures and descriptions of Mr. Davidson under the name *Crania Sedgwickii*, the prominent cardinal protuberance being taken for the posterior pair of muscular impressions; neither the tissue of the shell nor the internal impressions, however, are identical with those of *Crania*. The grooving of the beak of one valve, and the depressed orbicular form, show the strongest affinity to the Russian genus *Obolus*, which differs however by its glossy corneous substance, peculiar internal impressions (as figured by Kutorga), and want of the conical cardinal bosses. These latter, as well as the terminal beak of one valve and subcentral beak of the other, remind us of *Trematis* of Sharpe; but neither of the specimens I have examined of the small valve show the fissure of that genus, nor does Mr. Davidson allude to anything of the sort in his large species; and further, the coarse punctation of *Trematis* does not exist here. I think its zoological position very doubtful; the greatest affinity is probably with

Siphonotreta (which it resembles very much if the tube in the beak be viewed as modified into a groove by a cleft or division of the internal rostral pad, the walls of which would thus correspond to the cardinal bosses of the present genus, forming a passage thus to *Obolus*). I think a peculiar family should be formed to include those three genera, the family being placed between *Crania* and *Discina*.

Spondylobolus craniolaris (M'Coy).

Sp. Char. Suborbicular, depressed, slightly undulated, the width scarcely exceeding the length, front and sides broadly rounded, slightly acuminated behind; apex near the posterior margin; substance of the shell thick, calcareous, smooth, with very minute faint concentric striæ, very minutely fibrous, but the punctation (if it exists) indistinct; beak of small valve small, obtusely pointed at about one-fourth the length from the posterior margin; beneath the beak the shell is greatly thickened, forming an obtuse wide pad, internally reaching nearly to the margins; beak of larger valve terminal, slightly produced, apparently channelled below by a triangular groove, on each side of the base of which is a strong conical boss, projecting into the cavity of the opposite valve like cardinal teeth; surface dull, nearly smooth, or showing under very strong glasses an indistinct, very minute punctation (perhaps due to the fibrous tissue of the shell) and delicate concentric striæ. Length 4 lines, width $4\frac{1}{2}$ lines.

The specimens I have examined are chiefly internal impressions, showing two very deep small oval pits near the hinge-line, resembling the so-called *Crania Sedgwickii* of Davidson (Bull. de la Soc. Géol. de France for October 1848), from which it differs in the greater approximation of these impressions (which are clearly not analogous to the muscular impressions of *Crania*), smaller size, &c.

Five or six specimens have occurred in the shale of Builth Bridge, Radnorshire.

(*Col.* University of Cambridge.)

Holopella tenuicincta (M'Coy).

Sp. Char. Very elongate, spiral angle 20°, whorls probably eight or nine, but only five or six usually preserved, gently convex, sutures simple, deep, sutural angle 80°; surface girt with close, fine, sharp, subequal, spiral striæ (about thirty-five in the space of one line on the basal whorls), crossed by a few obsolete, sigmoidally arched lines of growth. Length about 8 lines, width at base 3 lines, length of last whorl 2 lines, length of penultimate whorl $1\frac{1}{2}$ line.

I imagine this may be the Scotch fossil referred by Mr. Salter (Quart. Geol. Journ. for August 1851) to the Upper Ludlow, *Turritella* (*Holopella*) *obsoleta* of Sowerby, as it has very much the same size and shape; and the distinctive spiral lineation requires a good cross light and some care to detect; but with these and a lens of low power it may be always seen, even in the sandstone casts, and the species thus easily distinguished from that of the newer rocks. The sutures are always more oblique than in the *H. obsoleta.* The slight inequality of size of the striæ seems in parts subalternate, in parts irregular.

Common in the sandstone of Mulock quarry, Dalquorhan.

(*Col.* University of Cambridge.)

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 9, 1851.—John Gould, Esq., F.R.S., in the Chair.

The following paper was read:—

On the generic subdivision of the Bovidæ, or Hollow-horned Ruminants. By H. N. Turner, Jun.

In the series of observations upon the Ungulate Mammalia, of which I attempted last winter to lay before the Society the more general results, my attention was also in some measure directed towards the detailed arrangement of those portions of the order which have generally proved subjects of difficulty. Of these, the classification of the *Bovidæ,* or hollow-horned Ruminants, has certainly been the greatest, since they form a well-marked natural group, including a great variety of forms, with but few remarkable differences of structure. I soon found, however, that even setting aside some of the more strikingly-modified genera, the distinctions afforded by the skull were much more decided than any that I could find among the *Cervidæ,* which, from their being less rich in number and variety, were always easier to subdivide correctly. Not having been able at that time to observe the skulls of certain of the more remarkable forms, I set the matter aside for better opportunities; and now that the large and interesting collection of hunters' spoils which Mr. Roualeyn Gordon Cumming has brought together, and is at present exhibiting in London, has given me the opportunity of supplying some of these desiderata, I venture, although there are yet a few points I could wish to ascertain, to lay this portion of my researches before the Society.

There cannot be a doubt that the horns present the best and most readily discernible characters, or that, when the genera are once correctly determined, they may be pretty easily defined by the variations of these parts alone; but it has long since been seen how the consideration only of the horns has led to very unnatural approximations. For example, Cuvier associates the Addax with the Indian Antelope; and Mr. Blyth, his translator, inserts his belief that it is more allied to the Coudou, which I think modern naturalists will allow to be equally wide of the truth. Again, the species forming the genera *Ægocerus* and *Nemorhædus* of Major Smith are placed together in the 'Règne Animal,' and Mr. Blyth hints that the Anoa may be allied to the Oryx.

It is certainly remarkable, that while the teeth have contributed so important a share in the characters by which the mammalia have been arranged by various authors, they should have been so entirely overlooked in the members of the present division; for notwithstanding the great uniformity and strongly-marked character pervading the Ruminant dentition, very decided characters may frequently be found in the form and direction of the incisors, and in the presence or absence of the supplemental lobe in the molars; and it is the more to be wondered at when we consider that the incisors, from their position, may often easily be seen in dried specimens, and that the character alluded to in the molars has been found of considerable value in the interpretation of fossil remains. The remaining characters I shall have to bring forward consist of certain little details of structure in the skull, which are very easy to be perceived, and which, as I have found them constant in those groups which I have characterized by their means, I trust may meet with due consideration from naturalists.

Of late years, while some zoologists have remained content to call all hollow-horned Ruminants that are neither oxen, sheep, nor goats, by the generic name *Antilope*, another class have run into the extreme of the modern fashion by using every trifling external difference visible in dried skins, or recorded in books (sometimes not even excepting size and colour), to divide them so extensively, that the characters of the genera become more difficult to remember than those of the species. Considering the difficulty of observing many of these characters in dry specimens, and of bearing such trivial details in the memory, it is not to be wondered at that many errors of observation have crept in, a few of which I will point out as I proceed, limiting myself in my own diagnoses to the characters of the skull and horns. There is no doubt that the suborbital sinus, improperly called "lacrymal sinus" (translated into "tear-pit" by some authors, "tear-bag" by Mr. Gray), will form a valuable means of distinction when its structure in all the genera has been sufficiently observed upon fresh individuals, or on the parts preserved in fluid, provided that we do not attach too much importance to its relative dimensions; but although its dried appearance may assist discrimination, we cannot venture to describe it. As to inguinal pores and interdigital pits, it must always be difficult, and frequently impossible to determine their presence or absence in specimens that are dried and mounted. Tufts upon the joints of the limbs, and the extent of bare space upon the muzzle, are certainly much too trivial to warrant generic distinction, and never mark out any particular natural group.

The last attempt to arrange this extensive family in subordinate groups is that of Mr. Gray, published in the eighteenth volume of the 'Annals and Magazine of Natural History.' His preliminary remarks, though brief, appear to me quite sufficient to dispose of the arrangements previously set forth, therefore I will content myself with the consideration of his own. The two primary divisions, which are founded only upon the horns, certainly do not indicate any very natural affinities, since, taking the whole structure into consideration, the *Antilopeæ* of Mr. Gray are not more closely allied to the *Boreæ* than they are to the members of the second primary division, nor do the *Strepsicereæ* ally themselves particularly to the Sheep and Goats. With regard to the subdivision of the *Antilopeæ*, he is certainly right in separating the "Antelopes of the Desert" as a group, although there is no doubt that some of the divisions of the "Antelopes of the Fields" are equally as distinct from each other as they are from the former. The division of the latter group into "True Antelopes," "Caprine Antelopes," and "Cervine Antelopes," also possesses some merit; but the genera *Capricornis* and *Nemorhædus* are very distinct from the other Caprine Antelopes, and the genus *Eleotragus* (*Redunca* of Major Smith) is very distinct from the other true Antelopes, and ought, as I am quite convinced, to include the genus *Kolus* of Dr. Andrew Smith, placed by Mr. Gray among his Cervine Antelopes, and consisting of species not known at the time Major Smith was engaged in these researches.

It will be universally admitted, that for the generic division of the Ruminants, zoology is most indebted to Major Smith, and in the course of my observations I have found reason to reject but few of the divisions proposed by him as subgenera, and few, if any, in my opinion, need be added. As I thus propose to curtail the list of genera adopted by Mr. Gray, and to separate certain of them from those with which he has associated them, several will stand alone; and of those which do ally themselves together, no group seems to manifest that particular relationship with other groups which should warrant us in separating the family, as Mr. Gray has done, into divisions of a primary, secondary, tertiary, and in some cases even a fourth and fifth degree of rank.

I will, therefore, while enumerating the characters which I have observed in the genera I propose to adopt, point out which of them appear to constitute groups, and mention those species which, from the inspection of entire specimens, skulls, or at least horns, I feel warranted in referring to the genera under which I place them. As I have seen nothing to guide me to a particular linear arrangement, any naturalist who may be pleased to adopt my divisions is at liberty to place the groups, and the genera contained in each, in whatever order he may think most convenient.

I will first proceed to the "true Antelopes" of Mr. Gray, excluding the genus *Eleotragus*. They all have the horns round, the middle incisors expanded at their summits, the others being bent outwards to make room for them, and the molars without supplemental lobes. The infraorbital depression when existing upon the skull is generally suddenly pressed in before the orbit. The genera are as follows :—

Antilope.

No suborbital fissure nor fossa*, but a wide opening on the side of the muzzle, between the maxillary and intermaxillary bones; the masseteric ridge rising before the orbit; the auditory bulla large and prominent, with only a small groove on its outer side to receive the attachment of the stylohyal bone; the occiput broad, somewhat produced downwards; its basal portion with the posterior pair of tubercles broad, the anterior ones small. Molars without the supplemental lobe.

Horns annulated, curving outward from the base, then bending backwards and towards the tip upwards.

Hab. South Africa.

A. Melampus.—Of this single species, to which modern zoologists have confined the old generic name, I have only seen skulls of the male, in Mr. Cumming's collection: the lower jaw, as in most of his skulls of Ruminants, being wanting in all of them, I could not ascertain the character of the incisive teeth.

Major Smith assigns a suborbital sinus to this genus, making the principal distinction from the next to consist in the absence of horns in the female, thus associating with it the *gutturosa* and *colus*, belonging properly to the next genus,—the *cervicapra*, which it seems most convenient to separate,—and the *adenota*, which I must now refer to the genus *Eleotragus*. With his *A. forfex* I am at present unacquainted. *Melampus* alone remains, to which Mr. Gray rightly assigns no "tear-bag;" this, together with the horns, must be the external character of the genus, if, indeed, it be essentially distinct from the Gazelles, for the horns might be considered as a distorted modification of the lyrate type, and some species of that genus seem to want the suborbital sinus.

Gazella.

A suborbital fissure, and a moderate, or very slight fossa, suddenly pressed in before the orbit; the masseteric ridge rising before the orbit; the auditory bulla large and prominent; the basioccipital bone having its tubercles moderately or but little developed; the median incisors expanded at their summits; the molars without supplemental lobes.

Horns annulated, more or less resembling an inverted lyre; that is, bending a little outwards soon after their origin, and again inwards towards the tip.

Hab. Eastern Europe, Asia and Africa.

* I here use these terms with reference only to the skull, the fissure being that opening existing in most Ruminants, filled up during life by membrane, between the nasal, frontal, lacrymal and maxillary bones; and the fossa, the depression upon the surface of the lacrymal bone immediately before the orbit, generally affording some indication as to the existence and structure of the suborbital sinus.

G. dorcas. *G. Bennettii.* *G. euchore.* *G. gutturosa.*	Of these species I have seen skulls.	*G. subgutturosa.* *G. Sœmmeringii.* *G. mhorr.* *G. colus.* *G. kemas.*

Several of the so-called species that are closely allied in size and colour to *G. dorcas*, appear to me to be merely varieties, as some of them have been considered by the older naturalists.

This genus seems prone to exhibit in certain species inhabiting more temperate regions, enlargements of, or appendages to, the respiratory passages; for example, the enlarged larynx of *G. gutturosa*, the elevated nose of *G. colus*, and the appendages to its sides in the Chiru (*G. kemas*); these seem to be physiological adaptations, in no case marking a group, and therefore insufficient to warrant generic distinction, which has been made in the two latter instances. However, not having as yet seen entire skulls of these species, I retain them provisionally in this genus, judging by the horns. I think few naturalists will set forth, with Mr. Gray, the colour of the horns of the Saiga as a generic character. Even in the *G. Bennettii*, so closely allied to *G. dorcas*, Mr. Hodgson states that the suborbital sinus is wanting, and he places the animal in a distinct genus, *Tragops* (afterwards altered to *Tragomma*), on account of this difference; while Colonel Sykes, the original describer of the species, affirms that it exists, though of very small size. Mr. Hodgson also denies it to the Chiru, which forms his genus *Panthelops*, and to which he assigns only five molars in each series.

CERVICAPRA.

A small suborbital fissure, and a very large fossa; the tubercles and median groove of the basioccipital bone well-developed. The other cranial characters as in *Gazella*.

Horns annulated, spirally twisted.

Hab. India.

C. bezoartica.

The remainder of this group, if we exclude the *Cephalophi* and the four-horned Antelopes of India, consists of a number of small species, apparently nearly allied, forming the subgenera *Tragulus* and *Neotragus* of Major Hamilton Smith. These are very distinguishable by the former having vertical, the latter recumbent horns; to the former, however, must be added the *Ourebi* (*A. scoparia*), from his subgenus *Redunca* (*Eleotragus*). Mr. Gray divides them into several genera, depending upon the presence or absence of inguinal pores and knee-tufts, the shape of the hoofs, the presence or absence and form of the "tear-bag," the condition of the fur; and one genus, founded upon two very young specimens, is characterized by the absence of the lateral rudimental hoofs. Most of these characters I must decidedly reject; and as I do not consider the evidence of dried skins quite satisfactory with regard to certain others, and have as yet seen skulls of only two species, I will content myself at present with adopting only the two genera of Major Smith; using however, for the first one, Mr. Gray's generic name *Oreotragus*, without at present wishing to enter into the question of its right to supersede that of *Tragulus*, because the latter name has been also used by Mr. Gray for a group of small Musk Deer, needlessly separated from the Meminna.

I do not see sufficient in the small horns contained in the Museum of the College of Surgeons to warrant the adoption, as a genus, of Major Smith's subgenus *Raphicerus*. I will not attempt to conjecture to what species they may belong: they show nothing to prevent their ranking among the *Oreotragi*; and their locality, said to be the East Indies, while all the members of this genus are African, is not known with certainty.

OREOTRAGUS.

A small suborbital fissure, with a large deep fossa suddenly pressed in before the orbit; the masseteric ridge rising a little before the orbit; the auditory bulla rather large and prominent; the basioccipital bone flat and smooth; the median incisors expanded at their summits, and the molars without supplemental lobes.

Horns small, placed forwards, vertical.

Hab. Africa.

O. saltatrix.
O. scoparius. } Of these two species I
O. tragulus. } have seen skulls.
O. melanotis.

NEOTRAGUS.

Horns recumbent.

Hab. Africa.

N. saltianus.—Of this animal I have seen no skull, but adopt for the present Major Smith's division, as the different direction of the horns is well-marked. It has the suborbital sinus, however, although its absence is assigned as a character by Major Smith. Of the other species included in the subgenus, I have seen but the two young specimens upon which Mr. Gray has founded his genus *Nanotragus*; they having no horns, I will not here venture to point out their location. The lateral rudimental hoofs are also wanting in at least one species of the last genus, the *Oreotragus Tragulus*, which Mr. Gray places in his genus *Calotragus*.

The skulls of the species of the two following genera are distinguished from those of the preceding ones by their having no suborbital fissure, and the fossa being large and not so suddenly pressed in in front of the orbit; and by the horns (or at least, in one case, the principal pair) being thrown back quite to the posterior edge of the frontal bone.

CEPHALOPHUS.

No suborbital fissure, a large fossa occupying the whole side of the cheek; the nasal bones expanded behind, reaching over a little way into the fossa. The other cranial characters as in *Oreotragus*.

Horns placed far back, inclined backwards.

Hab. Africa.

C. mergens.
C. coronatus.
C. silvicultrix.
C. Ogilbii.
C. Natalensis.
C. rufilatus.
C. Maxwellii.
C. monticola.
C. punctulatus.
C. grimmia.
C. Whitfieldii.

I have taken this list of species from Mr. Gray's paper on the genus, published in the same volume of the 'Annals and Magazine of Natural History,' omitting a few that seem to me likely to prove varieties, and adding two, which I find named in the Museum, and not included in his paper. I have only seen skulls of two or three species, but no one will dispute the limits of this very distinct genus.

Tetracerus.

The nasal bones not expanded; the other cranial characters the same as in *Cephalophus*, with the addition of a second pair of horns of small size, placed over the orbits.

Hab. India.

T. quadricornis.
T. subquadricornis

Eleotragus.

Nasal opening rather lengthened, the nasal processes of the intermaxillary bones long, yet not always reaching the nasal bones; a large infraorbital fissure, but no fossa; the masseteric ridge ascending rather high; the auditory bulla large and swollen; the basioccipital bone with its median groove and tubercles well-developed; the median incisors expanded at their summits; a well-developed supplemental lobe in the first true molar of each jaw, and usually more or less appearance of it in those behind.

Horns inclining backwards and outwards, transversely wrinkled, gently curving upwards, and a little inwards towards the tip.

Hab. Africa.

E. reduncus.
E. isabellinus.
E. capreolus.
E. arundinaceus.
E. adenota.
E. sing-sing.
E. ellipsiprymnus.
E. leché.

I have seen skulls of the four preceding the last-named.

It is quite evident, both from the structure of the skull and horns, and from the general external appearance and markings, that the *Antilope adenota* of Major Smith, and certain large species forming Dr. Andrew Smith's genus *Kolus*, belong truly to this form, and that in the latter case, at least, naturalists must have been deceived by mere dimensions. The similarity of character between the horns of the *Adenota* and those of the other species is very recognizable, although Major Smith, judging by these parts alone, supposed them to belong to the lyrate type. The species does not appear among those mentioned in Mr. Gray's paper in the 'Annals and Magazine of Natural History,' but from the name and place assigned to the specimen in the British Museum, he appears to have evaded the difficulty by constituting it a genus of itself, which is placed near the genus *Kolus*, the genus *Eleotragus* (as in his paper) being far removed. The skull in the Museum, although the occiput is lost, bears full evidence of its real affinity. Among the interesting additions to South African zoology discovered by those travellers who have visited the great lake recently discovered in that region, an undescribed species of Antelope*, of which a beautiful skin was recently brought before the Society, will perhaps assist the more sceptical in osteological characters in arriving at a just conclusion on this point, since, while it has the stature and lengthened horns of the *ellipsiprymnus*, it has the brilliant colour and the external marks (particularly the dark stripe down the fore-leg) which characterize the smaller species.

This genus does not seem to show any particular affinity to any of the rest, and forms a well-marked group, of which the species are scattered over various parts of Africa, and are mostly noted for their predilection for the vicinity of water.

I here again adopt Mr. Gray's generic name, to avoid the necessity of altering the name of one of the species, the *E. reduncus*.

STREPSICEROS.

The nasal opening of moderate size; a suborbital fissure, but no fossa; the masseteric ridge not extending high; the auditory bulla swollen and prominent; the basioccipital bone with its anterior and posterior pairs of tubercles well-developed, the former separated by a deep median groove; the median incisors expanded at their summits; the molars without supplemental lobes.

Horns inclined backwards from the base, twisted, with one or more longitudinal angular ridges.

Hab. Africa.

S. cudu.
S. euryceros.
S. Angasii.
S. oreas.
S. Derbianus.
S. scriptus.
S. silvaticus.
S. decula.

The general aspect of the skull in this group reminds one a little of that of the Deer. The species all agree very closely, both in structure of the skull, and in the direction, twisting, and ridges of the horns, the Coudou differing only in having the spiral wide and open, and in the horns being confined to the male, while the Eland is only a gigantic representation of the smaller species. *S. euryceros, S. Angasii,* and a species most probably distinct from the rest, of which Capt. Allen brought a skull from the Bight of Biafra, show an intermediate condition of the horns; and in *S. Angasii,* at least, they are known to be wanting in the female. Major Smith himself has here been deceived by size, and been led to place the subgenus *Tragelaphus* under his genus *Antilope,* and the others under his genus *Damalis*; even availing himself of stature, and in the case of the Coudou, of a white streak over the eyes, to help out the meagre distinctions. In associating the Nyl-Ghau with these animals, Mr. Gray has even allowed colour and marking to deceive him, for in this animal the horns are not even spiral; but in another respect the charac-

* Since named *Kolus leché* by Mr. Gray.

ters assigned to his *Strepsicereæ* agree with the Nyl-Ghau, and *not* with the others, which certainly have no suborbital sinus, nor have any of them an ovine muzzle, by which Mr. Gray distinguishes the larger genera from the *Tragelaphus*. In these latter points Major Smith is correct.

I will now proceed to the "Antelopes of the Desert" of Mr. Gray, a very well-marked, natural group, consisting of two distinct genera, which have usually been widely separated. Mr. Blyth, however, in the translation of Cuvier's 'Animal Kingdom,' hints at their affinity, and Mr. Waterhouse informs me that he has long held that opinion. Indeed he has placed the species next each other in the Catalogue of the Society's Museum.

Alcelaphus.

A large deep impression before the orbit, but no fissure; the masseteric ridge not extending high; the bones of the face lengthened downwards and forwards, and the occiput also prolonged and drawn downwards; the auditory bulla large and prominent, enclosing a large rounded space for the attachment of the stylohyal bone; the basioccipital tubercles high and sharp, the groove between them narrow in front, wide behind, with a flat space between the occipital condyles; the median incisors expanded at their summits; the molars rather small, narrow, and without supplemental lobes, showing, when somewhat worn, a pit in the middle.

Horns placed high, ringed at the base, with double flexures more or less marked.

Hab. Africa.

A. bubalis. *A. lunatus.*
A. Senegalensis. *A. pygargus.*
A. caama.

I have seen skulls of the three last-named.

Mr. Gray calls a portion of this genus "Boselaphus," doubtless intending *Alcelaphus* of De Blainville, which being antecedent to Major Smith's name *Acronotus*, should certainly be adopted. The genus is a very natural one, and the characters by which Mr. Gray proposes to divide it into two, are by no means sufficient. The last-mentioned species, *A. pygargus*, has usually been placed among the Gazelles, where it was left by Major Smith and by Mr. Blyth, who speaks of it as leading "through *A. Caama*, *Bubalis*, &c. to the Gnus." Mr. Waterhouse, who in the Catalogue of the Society's Museum uses the generic name *Antilope* throughout, places this species between the Gazelles and the others of its natural genus, to which the Gnu follows. Mr. Gray, who had left it with the Gazelles in the 'List of Mammalia' in the British Museum, has removed it to its true place in his paper in the 'Annals and Magazine.'

Catoblepas.

The general characters of the skull the same as in *Alcelaphus*; but the depression before the orbit less marked; the occiput rather less prolonged, and its base, together with the auditory bulla, broader.

Horns broad at the base, inclining more or less downwards and outwards, and then bent upwards.

Hab. Africa.

C. gnu. *C. taurina.*

The next genus is included by Mr. Gray among his "Caprine Antelopes," but differs from them in having a suborbital sinus or gland, of large size in some species, and of peculiar structure, opening externally by a single pore. Their nasal bones resemble those of the domestic Sheep, and their structure being altogether rather heavy, they might be called *Ovine Antelopes.*

NEMORHÆDUS.

No suborbital fissure; the fossa rounded, shallow, very variable in size, sometimes very minute; the nasal bones rather short and broad, joining the maxillaries only by the interposition of some imperfect ossification or separated from them altogether; the masseteric ridge extending high before the orbit; the auditory bulla very small; the basioccipital bone broad, with moderately developed eminences; the middle incisors slightly expanded at their summits; the molars without supplemental lobes.

Horns rising behind the orbits, annulated and wrinkled at the base, inclined and curved backwards.

Hab. India and its islands.

C. bubalina. *C. Sumatrensis.* *C. goral.*

This genus is too well-marked by nature to admit of subdivision. Although the "tear-bag" is said to be wanting in the *Goral,* there is certainly a slight depression upon the lacrymal bone, and the pore with which the gland opens may be so small in this species as to escape detection in dried specimens; but if it be really absent, the instances of the genera *Gazella* and *Ovis* must warn us against founding a genus solely on the want of this organ, while on the other hand, a difference in its structure seems to be of great zoological importance.

Since the foregoing observations were written, I have perused Mr. B. H. Hodgson's interesting account of the *Budorcas taxicolor,* in the 'Journal of the Asiatic Society of Bengal,' and a glance at the representations of the skull indicates very plainly that it is closely allied to *Nemorhædus,* to which Mr. Hodgson admits certain resemblances, and that it has no relationship with the Gnu, or the Musk Ox. The characters that I assigned to *Nemorhædus* would appear to serve as well for this new and singular genus, except that there seems to be no suborbital depression, and the masseteric ridge, as may be expected from the general elevation of the skull, does not rise before the orbit. The horns, whose peculiar twist must constitute the diagnosis of the genus BUDORCAS, appear, from the rough figures given, to have the wrinkling at the base very similar to that in *Nemorhædus.*

The following genera may be considered as in some degree allied, and deserve the name of Caprine Antelopes. They have no suborbital sinus, but have a fissure in the skull, and their incisors are not widened at the summits.

RUPICAPRA.

A minute suborbital fissure, but no fossa; the masseteric ridge ascending high before the orbit; the auditory bulla very small and compressed; the basioccipital bone flat; the incisors equal-sized, vertical; the molars without supplemental lobes.

Horns slender, round, vertical, and hooked backwards at the tip.

Hab. Europe.

R. tragus.

DICRANOCERUS.

No suborbital depression; the fissure lengthened; the nasal bones widest posteriorly; the orbit a little elevated above the line of the face, and the masseteric ridge not rising before it; the auditory bulla moderate, compressed and angular; the incisors equal-sized, sloping; the molars without supplemental lobes.

Horns vertical, compressed, with a process on their anterior side, and hooked backwards at the tip.

Hab. North America.

D. Americanus.

APLOCERUS.

Horns round, vertical, gently curved backwards.

Hab. North America.

A. Americanus.

I have seen no skull of this animal, but leave it for the present in this location.

I must forego all notice of the *Ixalus probaton* of Mr. Ogilby, as there is no skull to be seen, and the horns in the only specimen known are quite in a rudimentary condition.

The genera next to be considered are the "Cervine Antelopes" of Mr. Gray, exclusive of the genus *Kolus*, which I have rejected. With the exception of the Nyl-Ghau and some of the *Eleotragi*, they are the only members of the old genus *Antilope* that have well-developed supplemental lobes in all the true molars; they have always been placed near together.

ÆGOCERUS.

A small suborbital fissure, but no fossa; the masseteric ridge ascending high before the orbit; the auditory bulla moderate; the occipital portion of the skull much prolonged; the basioccipital portion widened, its two pairs of tubercles much developed, with a deep groove between them; the incisors gradually increasing in size to the median pair, which are not expanded at their summits; the molars with largely-developed supplemental lobes.

Horns rising immediately above the orbits, curved backwards, annulated.

Hab. Africa.

Æ. leucophæus. *Æ. niger.*

Oryx.

A suborbital fissure, but no fossa, the masseteric ridge not extending high; the auditory bulla large and compressed; the basioccipital bone with its tubercles well-developed; the molars with supplemental lobes.

Horns straight or gently curved, annulated, placed in a line with the face.

Hab. Africa.

O. gazella. *O. leucoryx.*

It is only in Mr. Cumming's collection that I have seen entire skulls of the Gemsbok, and the lower jaw being absent, I could not ascertain the character of the incisors. The skull of the *Leucoryx* I have not seen.

Addax.

A small suborbital fissure, but no fossa; the masseteric ridge ascending before the orbit; the auditory bulla large, prominent, and compressed; the basioccipital bone with its anterior pair of tubercles slightly, the posterior well, developed; the median incisors expanded at their summits; the molars with supplemental lobes.

Horns nearly in a line with the face, annulated, spirally twisted.

Hab. Africa.

A. naso-maculata. I have seen but one skull of this animal, and that is a young one, in the Society's collection, still retaining the whole of its milk dentition.

Before proceeding to the Sheep and Goats, the Nyl-Ghau requires to be introduced. It seems to stand alone, not having a decided affinity for any other genus.

Portax.

The nasal opening rather small, with the nasal bones small and narrow; a minute suborbital fissure; no fossa, but a smooth line upon the lacrymal bone; the masseteric ridge not extending high; the auditory bulla moderate, bulbous, compressed; the basioccipital bone with the posterior tubercles moderately developed, the anterior ones scarcely at all; the molars with supplemental lobes.

Horns short, round, vertical, slightly bent forwards.

Hab. India.

P. picta.—The only skull that I have seen (that in the British Museum) wants the incisor teeth, so that I could not ascertain their structure. The smooth line upon the lacrymal bone terminates in a small foramen, but on one side is continued for some distance forwards upon the maxillary bone, where it terminates in the same way; and it may even be faintly traced on the other side for some distance beyond the foramen.

Capra.

A small suborbital fissure, no fossa; the masseteric ridge ascending high before the orbit; the auditory bulla prominent and compressed;

the basioccipital flat, with its processes developed; the middle incisors not expanded; the molars without supplemental lobes.

Horns erect, compressed; curved backwards and a little outwards, or twisted; annulated or nodulous, and furnished with one or more longitudinal ridges.

Hab. The Northern portions of the Old World.

C. hircus.	*C. Falconeri.*
C. ibex.	*C. jemlaica.*

I do not see sufficient reason for separating the Jemlah Goat, as has been done, under the names of *Hemicapra* and *Hemitragus*.

Ovis.

A more or less marked, rounded, suborbital depression, but no fissure; the masseteric ridge ascending high before the orbit; the auditory bulla small; the basioccipital flat, more or less expanded anteriorly by the extension of the anterior pair of tubercles, the posterior ones small; the incisors nearly equal-sized, sloping; the molars without supplemental lobes.

Horns broad at the base, transversely wrinkled, bent outwards, with a more or less marked spiral curve in a direction contrary to that occurring among the Antelopes, and a longitudinal ridge or angle.

Hab. The Northern hemisphere.

O. ammon.	*O. nahura.*
O. Vignei.	*O. tragelaphus.*
O. aries.	

It is a matter of surprise to me that naturalists should almost universally have given *no* suborbital sinus, as characteristic of the genus *Ovis*, since it is very perceptible in the Domestic Sheep; and in some other species, especially the *O. ammon*, judging by the appearance of the stuffed specimens, and by the fossa upon the skull, it must be of very considerable size. I do not perceive it, however, in the *O. tragelaphus*, nor in the *O. nahura*. Although Mr. Gray maintains the long-established error, the observations of Mr. Ogilby and Mr. Hodgson agree with my own in this respect; the latter gentleman, who far exceeds Mr. Gray in the number of generic divisions, even separates *O. nahura* and *O. barhel* as a distinct genus under the name *Pseudovis*, on account of the absence of "eye-pits."

Ovibos.

A small depression in front of the orbit; no fissure; the masseteric ridge ascending before the orbit; the auditory bulla of moderate size; the basioccipital bone broad and flat, with a ridge and a fossa on each side; the anterior part of which is rough; the fossa at the side of the occipital condyle filled up and produced into a blunt process, upon which the articulating surface is continued; the molars without supplemental lobes.

Horns broad at the base, tapering, pressed downwards against the sides of the head, and the points bent upwards.

Hab. The North Polar Regions.

O. moschatus.—This animal, which derives its name from its general aspect being intermediate between that of the Ox and that of the Sheep, has generally been placed among the Bovine forms. Taking the aggregate of its characters, it appears to me to be at least as nearly, if not more, allied to the Sheep, but should most properly stand alone.

The remaining genera constitute the true Bovine type, and agree among themselves in most characters of the skull. I fear that Mr. Gray's distinctions, in the extent of the intermaxillary bones upon the sides of the nasal aperture, will not always hold good. Their general cranial character may be given first;—

No suborbital fissure, nor fossa; the masseteric ridge ascending rather high before the orbit; the auditory bulla moderate, compressed; the basioccipital bone with its tubercles well-developed, and a deep groove between them; the incisors nearly equal-sized, slightly bending outwards, and the molars with well-developed supplemental lobes.

Bos.

Horns placed upon the extremities of the ridge terminating the occipital plane, directed outwards.

Hab. Europe and Asia.

B. taurus.	*B. gaurus.*
B. frontalis.	*B. bantiger.*

Bison.

Horns round, situated in a plane anterior to that of the occiput, directed outwards and curved upwards.

Hab. The Northern Temperate regions.

B. urus.	*B. grunniens.*
B. Americanus.	

The last-named species is a true Bison, as the position of the horns, and the woolly fur, make apparent; the fur being generally more copious, may reasonably be expected to extend further upon the muzzle; and the generality of instances proves that the extent of naked surface may differ in very nearly allied species, and is not sufficient to warrant generic distinction. Therefore I do not think it advisable to adopt the genus *Poëphagus.*

Bubalus.

Horns attached in a plane anterior to that of the occiput, flattened or trigonal, inclined outwards and backwards, with the point bending upwards.

Hab. Southern Asia, its islands, and Africa.

B. buffelus.	*B. depressicornis.*
B. brachycerus.	*B. Caffer.*

Although Major Smith was deceived as to the affinities of the Anoa, later as well as earlier naturalists have assigned it to its true place, and a glance at the stuffed specimen in the British Museum leaves the matter beyond a doubt. I have examined the skull in the

Museum of the College of Surgeons, and cannot see that it has even a title to generic distinction. Naturalists seem at all times to have been prone to assign generic rank to whatever was mysterious or difficult to classify, and I can in no other way account for this species being made a genus.

It will be seen that my endeavour has been rather to ascertain and demonstrate whatever natural degrees of relationship exist among the species of this family, than to compose a system for mere convenience of reference; but so far from that being any hindrance to the practical adoption of my views, I think that in arranging the specimens in a museum, or the materials of a work, it will generally be found more convenient to be able to dispose the members of a natural group in whatever order may suit our immediate object, than to be compelled to place them in accordance with the stringent laws of a purely analytical method; and that for the purpose of referring a new species to its true location, when we have not the means of observing all characters that may be necessary for the determination of a series of natural affinities, the external characters which can be assigned to a group when its limits are well made out, will be found sufficient; while on the other hand, not only the external characters, but sometimes even those of anatomical structure, will, in a group which has not been previously subjected to a full and careful examination, be as the letters of an unknown language, often leading into error and confusion.

With regard to nomenclature, I have used such names as I find most generally adopted by later naturalists who have given attention to this subject, generally taking, where I had a choice, such as appeared to have been of earliest date; and as I only enumerate such species as I have seen, I must not be considered, although I have omitted a few which appear to be varieties, as rejecting all that are left out.

BOTANICAL SOCIETY OF EDINBURGH.

Thursday, 10th of July, 1851.

Dr. Balfour exhibited specimens of the following monstrosities :—

1. An *Arum* with a double spathe, the second spathe being alternate with the first. The spadix at the lower end showed the appearance of the adhesion of a second spadix. This specimen was from the garden of Dr. Neill, Cannonmills Cottage.

2. A monstrosity of *Antirrhinum majus*, presenting a regular flower formed by five personate petals with gibbous bases.

3. Monstrosity of white *Digitalis* showing the terminal floret composed of several united, and expanding before the other flowers in the raceme. There was thus a mixed inflorescence, partly definite and partly indefinite.

A letter was read from Mr. Wyville Thomson, Lecturer on Botany, King's College, Aberdeen, in which he states :—"A few days ago, walking along Dee-side about seven miles above Aberdeen, I was much surprised to see *Prunus spinosa* covered with large handsome fruit of a bright red colour, a pod very like the capsicum. The sloe-trees grow along the river-side, and are of that half-cultivated variety which attains the height of 20 or 30 feet, is straight and wants spines. The trees were closely tangled along the river-side for the distance of about 100 yards, all covered with this strange monstrosity. On examining the pods a little more closely they proved to be carpels disdaining their usual tardy progress into a drupe, and hurrying into a pseudo-legume. On cutting them open they exposed usually one, sometimes two abortive ovules, attached to a sutural placenta.

"A little further on I saw several trees of *Prunus Padus*, covered with long clusters of bright green unripe pods of a similar kind. We well know that the *Rosaceæ* are very prone to eccentricity with regard to their carpels, and to see one tree in that condition would not surprise me, but why all the individuals of *Prunus spinosa* in that neighbourhood should have gone wrong, and especially why the other species should have joined them, I am at a loss to conjecture."

Dr. Balfour suggested that these teratological appearances might be caused by the attacks of insects, and that they pointed out the connection between Rosaceæ and Leguminosæ, two orders which are chiefly distinguished by the position of the odd sepal.

A paper was read, "On the Plant Morphologically considered," by the Rev. Dr. M'Cosh. In this paper the author endeavours to show that the plant consists of three homotypal parts, the root and its subdivisions, the stem and its branches, and the leaf, with its veins. He dwelt in an especial manner on the venation of the leaf, which he considers as representing the mode in which the tree ramifies, as well as the angles at which the branches are given off. In the case of woody plants he conceived that the petiole of the leaf may in such cases represent the trunk. Thus the Beech, the Portugal Laurel, &c., which have little or no petiole, send off branches from near the root, while the Sycamore and Cherry, which have distinct petioles, have long unbranched trunks. He thought that this did not apply, however, to herbaceous plants, and he was not prepared to carry out his views in the case of Palms and other woody Monocotyledones, which he had not had an opportunity of examining in a normal state. The angles, also, at which the veins are given off, he considered as representing generally the angles of the branches.

Prof. Balfour was not prepared to enter into Dr. M'Cosh's views fully, although there were many plausible statements made by him. Dr. M'Cosh did not appear to apply his views on the same principle throughout. There could be no doubt that there were normal angles at which branches and veins were given off, but it was not an easy matter to get what might be called typical forms. He hoped that Dr. M'Cosh's remarks would lead to an investigation of the subject.

Prof. Fleming remarked that he was ill qualified to offer any remarks on the interesting paper which had been read, because he had long been in the habit of restraining his *imagination* in all scientific inquiries. This paper he considered an imaginative one—a hunting after resemblances and overlooking differences, so as to give results by no means to be depended upon. The leaves were organs differing in form, structure, and functions, from the stem and branches, and could not, homologically, be compared with them. The nerves of the leaves did not all diverge at the same angle, neither did the branches. These last were exposed to various influences during the life of a tree, and in consequence diverged from the stem at various angles in the different periods of growth. It was therefore a dream of the imagination to hope to determine a typical angle of divergence, when the plant was endowed with a considerable range of variation to fit it for its place in the œconomy of nature.

Prof. Goodsir had listened to Dr. M'Cosh's paper with much interest, on two accounts: first, because it appeared to him that its author had, in endeavouring to reach one of the objects he had in view, embodied another attempt to investigate the laws of organic form by that precise or geometrical method, which can alone ultimately elevate natural history to the platform of the perfect sciences; and secondly, because, although he could not admit all the conclusions at which its learned author had arrived, he yet believed the paper to involve a great truth. If he might be allowed to use the expression in reference to a plant, the specific physiognomy of a tree, as a mass, appeared to him to depend on the particular bulk, form, and grouping of its constituent masses. Now, if the form and grouping does not depend upon, it certainly involves, the mode of branching peculiar to the species. Dr. M'Cosh had restricted himself to the investigation of the law which regulated the latter; but he had, and would meet with, that apparently at present insuperable difficulty in all such researches, viz. the variation within certain limits of the form of parts, or of the whole of an organized body, according to the particular conditions under which that part or that individual has been developed. Prof. Goodsir suggested that Dr. M'Cosh might be more successful if he would limit his inquiry to the law of ramification of a single judiciously-selected species; and would endeavour to grow that species under such invariable conditions as might afford an approach at least to the typical form of the species. He also believed that before the law which regulates the arrangement of the primary and secondary ramifications of a leaf can be ascertained, attention must be directed to the law of form in the parenchyma itself.

MISCELLANEOUS.

On Parasitism. By M. Léon Dufour.

Parasitism seems to be a law of nature, so generally does it prevail throughout the living world. This existence imposed in the creation upon other existences is at once a law of antagonism, of repression, and of guarantee for the maintenance of the harmony of nature. The attentive study of the articulated animals, and particularly of insects, presents to us the prodigies of parasitism in profusion, whether the lens examines the integument of the animals, or the science of the scalpel steps in to sound the depths of their organism.

I have already had the honour to present to the Academy the history of a frail gnat,—a *Cecidomyia,* which, by pricking the floral envelopes of the birch, causes an irritation productive of tissue, a vegetable hypertrophy, in one word *a gall,* the cradle of its young. But by the law of parasitism their domicile is invaded by two usurpers whose mission it is to repress the too great multiplication of the *Cecidomyia.*

One of these usurpers is a Hymenopterous insect of the genus *Misocampus*;—it divines, in this hermetically closed gall, the presence of the quiet larva of the *Cecidomyia,* and by means of an invisible oviduct introduces an egg into its entrails. From this egg is hatched a gnawing worm, destined to take its nourishment from the living tissues of its victim. The latter, although bearing in its bosom this germ of destruction, continues to devour the substance secreted by the walls of its gall, and the work of assimilation becomes more active in consequence of the consumption of the parasite. But when the time of the metamorphosis arrives, the larva of the *Cecidomyia* wants the materials necessary for the completion of this great operation, whilst the larva of the *Misocampus* redoubles its nutritive energy in order to insure its transformation, which is accomplished on the corpse of its victim.

The second usurper of the gall belongs also to the Hymenoptera,—it is an *Eulophus*; this time, however, it is no longer a single worm, but a flock of ten or a dozen famished larvæ, which consume the food of the *Cecidomyia* and consequently that of its parasite the *Misocampus.*

Let us now exhibit another kind of parasitism, that of larvæ finding their nourishment in the bodies of living perfect insects; and see how, confined in a prison destitute of communication with the external air, they are enabled to breathe.

By dissection in water these parasitic larvæ are usually detached; all that can then be proved by the lens, through the transparent skin, is the existence of ramified tracheæ, and consequently the circulation of air through all the tissues. The problem to be solved therefore was the mode in which this air was inhaled, with the condition of a hermetically sealed prison. Dry vivisection has at last revealed to me this mystery.

In 1827 I published the history and iconography of the metamorphoses of a fly, the *Ocyptera bicolor,* the larva of which lives in the abdomen of a Hemipterous insect, the *Pentatoma punctipennis.* It is not within the viscera that it passes its larva state; it is always found outside the intestinal canal, and is nourished at the expense of the adipose and other tissues of the *Pentatoma.* I satisfied myself, that by means of a long, somewhat membranous, caudal tube, terminated by a double hook, it had appropriated one of the stigmata of its host. By this organic usurpation, it attained the easy and complete exercise of respiratory action.

Ten years later, I made known the larva of a Dipterous insect, the species of which is still undetermined, which lived as a parasite in the abdominal cavity of the *Andrena aterrima.* This larva had not, like the preceding, seized upon one of the stigmata of its host, but, such are the infinite resources of the Creator, it had grafted, by some mysterious operation, its own stigmata upon one of the two large trachean reservoirs, situated, in the *Andrena,* as in many other Hymenoptera, at the base of the abdomen. Thus, not only does the *Andrena* feed with the products of its own nutrition, this larva which an immutable decree has inflicted upon it, but it is compelled to respire for it,—to furnish it, in its own ample aëriferous reservoirs, with all the air necessary for its respiration.

Thus we pass, from wonder to wonder, to a recent example of parasitism, the circumstances of which seem fabulous.

In the summer of 1850, I had pinned in a box several living specimens of a weevil which lives on the tops of our pines,—the *Brachyderes lusitanicus.* The next day I found in the box some small chrysalids or *pupæ,* issuing without doubt from these weevils. I perceived without difficulty that these pupæ, which the unlearned would have taken for little red grains, were the cradles or swathes of a Dipterous insect belonging to the immense family of *Muscidæ.* After a few days I had the satisfaction, always new for my old experience, of witnessing the exclusion of a pretty little new fly, the colouring of which differed in the two sexes. I hastened to publish this double fact, and the fly was christened *Hyalomyia dispar.* But this was only two-thirds of the history of the metamorphoses of this fly ;—the initial phase, that of the larva, was wanting. The discovery of this I put off to the next year, and I have been able to realise my wishes. I am not going to describe this larva of an eighth of an inch in length ; I shall confine myself to exhibiting, in connexion with parasitism, one of the most interesting facts of organic usurpation. This larva, like that of the *Ocyptera* previously mentioned, lives outside the digestive viscera, in a cavity without air and without issue. In the vivisection of one of the weevils, I had the rare good fortune to find two larvæ of the *Hyalomyia.* One which was detached and free had two posterior, tubular stigmata, opening to the two lateral tracheæ ; this was sufficient to convince me that it had a complete respiratory apparatus. The other remained fixed, and I was able to prove, without the slightest doubt remaining on my mind, that one of the stigmata of the weevil had been usurped. There was not here, as in the *Ocyptera,* a supple caudal tube ; the larva was sessile, and its adhesion appeared to be the result of a graft by approach,—a sort of *organoplastia.* The two microscopic tubular stigmata of the larva corresponded exactly to the respiratory aperture of its host, and thus drew in the atmospheric air directly.

Figure the agitation, the patience, the active manœuvres of the *Hyalomyia,* when, urged on by a mature gestation, she flies to the tops of the pines to place her eggs in the stigmata of the *Brachyderes*! Judge of the difficulty of this egg-laying on the wing from the shielded structure of the beetle ! Although of a tolerably large size, it is apterous ; its elytra, soldered together and hard, are closely united by an imperceptible suture to the equally hard walls of the ventral segments. What sharpness of vision, what urgency of maternal inspiration, must drive the fly to seek the one defect in the armour, to profit by the fugitive moment when the stigma of the beetle is in exercise, to place an egg in it with the quickness of thought! But think you that this egg is merely laid in the usurped stigma? It must be fixed there, glued by a gummy liquor; and I have proved that a *sebific gland* exists for this purpose in the oviduct of the Diptera. Without this precaution the egg would be exposed to displacement during the constant action of the respiration of the beetle.

But this is not all that takes place. When the parasitic larva has completed its growth, it is called upon to undergo its metamorphosis to a pupa. No delay is allowed it; it detaches itself from the borrowed stigma,—its skin breaks its organic adhesions; its whiteness and transparency pass to a bright, opaque orange. It is nothing but a shell, the covering of a nymph, the swathed and mysterious image of the future fly.

I have said above that the living prison of the larva was without air and without issue; how then is the exit of these pupæ effected? Alas! this unnatural delivery costs the weevil its life. After its detachment, the larva, no doubt obeying an instinctive mission, tears the upper membranous coat of the apex of the beetle's abdomen. It fixes itself in this breach and there completes its transformation into a pupa. The maturity of this causes slight movements in the inclosed nymph, at the same time that by its titillation it provokes the expulsive efforts of the weevil. At last the pupa comes to light; it soon splits and opens at its thoracic region, and the active *Hyalomyia* darts into the air.—*Comptes Rendus,* 11 Août, 1851.

RARE IRISH MOLLUSCA.

To the Editors of the Annals of Natural History.

Shantalla, September 18th, 1851.

GENTLEMEN,—The following rare Mollusca were recently obtained by dredging round the South Isles of Aran, Galway Bay:—

Neæra cuspidata; in 60 fathoms, about twelve miles to the westward of the Great S. Isle.

Tellina balaustina; two specimens alive with numerous single valves, in 20 fathoms, South Sound of Aran, opposite the southern point of the Middle Isle.

Anomia striata; depth uncertain, South Sound.

Nassa pygmæa; range 10 to 60 fathoms.

Buccinum Humphreysianum; a single young specimen alive, in 60 fathoms, along with *Neæra cuspidata, Natica sordida,* &c.

I am, Gentlemen, your obedient servant,

ALEXANDER G. MELVILLE.

On the Umbrella Bird (Cephalopterus ornatus), "*Ueramimbé,*" L. G. By ALFRED R. WALLACE.

Having had the opportunity of observing this singular bird in its native country, a few remarks on its characters and habits may not perhaps be uninteresting, at a time when a consignment from me will have arrived in England.

The Umbrella Bird is about the size of a crow, averaging about 18 inches in length. Its colour is entirely black, but varied with metallic blue tints on the outer margin of the feathers. The colour of the iris is greyish white. It is a powerful bird, the bill being very large and strong, the feet short, and the claws acute.

Were it not for its crest and neck plume, it would appear to an ordinary observer nothing more than a short-legged crow.

The crest is perhaps the most fully developed and beautiful of any bird known. It is composed of long slender feathers, rising from a contractile skin on the top of the head. The shafts are white and the plume glossy blue, hair-like, and curved outward at the tip. When the crest is laid back the shafts form a compact white mass, sloping up from the top of the head, and surmounted by the dense hairy plumes. Even in this position it is not an inelegant crest, but it is when it is fully opened that its peculiar character is developed. The shafts then radiate on all sides from the tip of the head, reaching in front beyond and below the top of the beak, which is completely hid from view. The top then forms a perfect, slightly elongated dome, of a beautiful shining blue colour, having a point of divergence rather behind the centre, like that in the human head. The length of this dome from front to back is about 5 inches, the breadth 4 to $4\frac{1}{2}$ inches. The other singular appendage of this bird is the neck plume. This is a long cylindrical plume of feathers depending from the middle of the neck, and either carried close to the breast or puffed out and hanging down in front. The feathers lap over each other, scale-like, and are bordered with fine metallic blue.

On examining the structure of this plume, it is found not to be composed of feathers only, growing from the neck, as seems to have been hitherto supposed. The skin of the neck is very loose; looser and larger, in fact, than in any bird I know of. From the lower part grows a cylindrical fleshy process about as thick as a goose-quill and an inch and a half long. From this grow the feathers to the very point, thus producing the beautiful cylindrical plume quite detached from the breast, and forming an ornament as unique and elegant as the crest itself.

When in motion, either flying or feeding, the crest is laid back and the plume carried close to the breast, so as not to be conspicuous. When at rest in the daytime, the crest is fully expanded, and the plume is rather enlarged and hanging forward. At night, when asleep, all the feathers are puffed out to their fullest extent, and sometimes the head is turned so as to bring the dome of the crest on the middle of the back. It then presents a most singular appearance, the head and feet being quite invisible, the plume and crest alone being conspicuous amidst the mass of feathers.

These observations I was enabled to make by having a fine male alive for ten days. He had received a shot in the head, but appeared to suffer no ill effects from it, till on the tenth day he suddenly fell off his perch and died. I found, on skinning him, that the shot had broken his skull and entered the brain.

The Umbrella Bird inhabits the islands of the rivers, never having been seen on the main land. It is perfectly arboreal, never descending to the ground. Its food is fruit of various kinds, but when this is scarce it eats insects: my hunter saw one with a large hairy spider (*Mygale*) in his mouth. On seizing an insect or fruit, it strikes its beak against its perch several times, apparently to kill or soften it, or secure it more firmly in its beak, and then after two or three bites swallows it entire. Some of the fruits it eats are about the size of a damson, and have a stone, which it ejects through its mouth an hour or two after eating.

Its note is very loud and deep, and it is from this that it has received its Indian name " Ueramimbé," signifying the " Piper-bird." It utters its note early in the morning and in the afternoon. It frequents the very loftiest forest trees, but is said to build its nest rather lower. Its nest is said to be formed of sticks very roughly, and the young are very naked and ugly. The colour or size of the eggs I have not been able to ascertain.

In ascending the Amazon, it first occurs opposite the mouth of the Madeira, in some islands. In the Sohuives, as far as the boundaries of Brazil, it also occurs, and probably further. The Rio Negro, however, is its head-quarters; and there, in the numerous islands which fill that river, it is very abundant. It extends at least four hundred miles up the river, and very probably much further. I have not heard of its occurring in the Rio Branco, Madeira, or any of the other great tributaries of the Amazon. I have been informed by a hunter, that towards the sources of the Rio Negro another species is found, and this I hope soon to have the means of verifying. —*Proc. Zool. Soc. for July* 23, 1850.

Barra do Rio Negro, March 10th, 1850.

On the Genera Hexapus *and* Arges *of De Haan.* By J. D. Dana.

The genus *Hexapus* of De Haan, in his first publication of its characters (in Decade I. and II. of the Fauna Japonica, pp. 5 and 35) is arranged near *Pinnothera,* which it resembles in its short obese form and small size. But in his last Decade, published in 1849, which contains his final remarks on classification, at p. xiv., the genus is referred to the vicinity of *Pilumnus.* The outer maxillipeds are as in *Pilumnus.* The genus is peculiar in the fifth pair of legs being obsolete. The species is the *H. sexpes* (Jap. p. 63 and pl. 11. f. 6, *Cancer sexpes* of Fabricius, Ent. Syst. Suppl. p. 344. f. 37).

The genus *Arges* of De Haan (Faun. Japon. p. 21) includes only a fossil species. It is Cancroid in its outer maxillipeds, and near *Pilumnus* and also *Menippe.* The abdomen in both sexes is 7-jointed; in the male oblong-trigonal, in the female ovate. The lateral margins of the carapax are parallel and entire, and the general form is much like that of *Cyclograpsus Audouinii* and the allied. Distance between the eyes one-fifth the breadth of the thorax.—Sp. *A. parallelus* (F. Jap. p. 52, and pl. 5. f. 4) from Japan.—*Silliman's American Journal of Science and Arts for September* 1851.

Note on the Reproduction of Leeches. By M. Fremond.

In this memoir M. Fremond informs us what are the most favourable conditions for the preservation of leeches, but we must refer our readers to his paper for all particulars concerning the construction of reservoirs and the plants most proper to be put into them, merely giving here some of the details furnished by him on the development of these animals.

The reproduction of leeches is effected, according to circumstances, either by cocoons or compound eggs, which are usually hatched at the end of forty days. The egg is formed of a transparent membrane, full of a liquid, in which little globules soon begin to appear; these globules are in fact so many *germs* of leeches, and during development take the form of little worms, which soon leave the egg by an opercular hole at its extremity. The young leech is white when just hatched; it does not begin to acquire colour until some hours afterwards, and only arrives at its perfect colouring when two years old; its first food consists of the mucous matters which cover the leaves of aquatic plants; afterwards, when its mouth has attained a more complete development, it feeds on the larvæ of insects and other small animals.—*Comptes Rendus,* 12 Mai, 1851.

METEOROLOGICAL OBSERVATIONS FOR SEPT. 1851.

Chiswick.—September 1. Cloudy and fine: overcast. 2. Drizzly: cloudy and fine. 3. Hazy: very fine: clear. 4. Foggy: cloudy: fine. 5. Very fine: clear. 6. Fine: cloudy. 7. Clear: very fine. 8. Overcast: cloudy and fine. 9—13. Mornings foggy: days very fine: nights clear. 14. Slight fog: very fine. 15. Slight fog: cloudy and fine. 16. Light clouds and fine: overcast. 17. Overcast: fine: cloudy. 18, 19. Fine: clear. 20—22. Very fine. 23. Slight fog: very fine: rain. 24. Foggy: overcast: foggy at night. 25. Slightly overcast: rain. 26. Partially overcast: cloudy: clear. 27. Cloudy: drizzly. 28. Clear and fine. 29. Foggy: fine. 30. Rain: overcast.

Mean temperature of the month	55°·15
Mean temperature of Sept. 1850	54 ·23
Mean temperature of Sept. for the last twenty-five years	57 ·18
Average amount of rain in Sept.	2·61 inches.

Boston.—Sept. 1. Fine. 2. Cloudy: rain early A.M. and P.M. 3—5. Cloudy. 6. Fine. 7. Cloudy. 8—11. Fine. 12, 13. Foggy. 14. Fine. 15—17. Cloudy. 18, 19. Fine. 20. Cloudy. 21—23. Fine. 24. Cloudy. 25. Cloudy: rain P.M. 26. Cloudy: rain A.M. and P.M. 27. Cloudy. 28, 29. Fine. 30. Cloudy.

Sandwick Manse, Orkney.—Sept. 1. Drizzle: damp. 2. Cloudy: rain. 3. Drizzle: cloudy. 4. Clear: aurora. 5. Clear. 6. Bright: cloudy. 7. Cloudy: clear: aurora. 8. Clear. 9. Bright: hazy. 10. Cloudy: drops. 11. Cloudy: fine. 12, 13. Bright: fine: clear. 14. Bright: cloudy. 15. Cloudy: clear: aurora. 16. Bright: clear: aurora. 17. Bright: clear. 18, 19. Fog: cloudy. 20. Showers: clear. 21. Cloudy. 22. Drops: drizzle. 23. Bright: clear: aurora. 24. Clear: cloudy. 25. Showers: sleet showers. 26. Bright: showers. 27. Clear: showers: aurora. 28. Bright: showers: aurora. 29. Cloudy. 30. Cloudy: showers.

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

Days of Month.	Barometer.							Thermometer.							Wind.				Rain.			
	Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. Sept.	Max.	Min.		9 a.m.	9 p.m.	9¼ a.m.	8½ p.m.	Max.	Min.		Max.	Min.	9¼ a.m.	8½ p.m.								
1.	30·219	30·136	29·73			29·93	29·96	76	58	62·5			61	55	sw.	nw.		wsw.	·10	......		·03
☽ 2.	30·093	30·067	29·54			29·94	30·01	73	59	66			62	57	nw.	nw.		w.	......	·20		·05
3.	30·127	30·072	29·60			30·07	30·22	72	51	66			57	55	ne.	n.		w.	......	·03		·24
4.	30·049	30·029	29·52			30·21	30·21	69	46	64·5			50	51	n.	nw.		n.	·01	......		......
5.	30·209	30·151	29·70			30·39	30·48	67	49	58·5			53	47	n.	n.		n.	......	......		......
6.	30·373	30·296	29·89			30·52	30·52	63	44	57			54	51	ne.	nne.		n.	......	......		......
7.	30·448	30·430	30·02			30·57	30·58	66	48	58			55	47½	e.	n.		calm	......	......		......
8.	30·498	30·465	30·06			30·55	30·50	62	42	55			53	49½	ne.	ne.		se.	......	......		......
9.	30·465	30·449	30·05			30·42	30·36	67	31	56			55	49	e.	e.		calm	......	......		......
○ 10.	30·497	30·457	30·07			30·33	30·35	70	33	52			58½	56	se.	nw.		wsw.	......	......		......
11.	30·481	30·381	30·05			30·37	30·37	68	36	51			58	56	se.	nw.		w.	......	......		·05
12.	30·401	30·287	29·95			30·35	30·32	74	38	49			56½	52	nw.	nw.		w.	......	......		......
13.	30·319	30·301	29·90			30·31	30·32	72	33	52			55½	51	ne.	nw.		calm	......	......		......
14.	30·393	30·370	29·97			30·36	30·46	73	49	50			57	53½	se.	nw.		calm	......	......		......
15.	30·540	30·491	30·00			30·54	30·58	66	38	59			56	49	e.	ne.		calm	......	......		......
16.	30·572	30·460	30·06			30·57	30·56	66	52	58			57	49	ne.	n.		se.	......	......		......
17.	30·411	30·306	30·04			30·52	30·46	69	45	59			57	52	ne.	ne.		se.	......	......		......
☾ 18.	30·273	30·117	29·91			30·41	30·28	66	47	54			51½	47½	ne.	ne.		ese.	......	......		......
19.	30·063	30·025	29·70			30·14	30·04	66	45	56			57	52	ne.	ne.		sse.	......	......		......
20.	30·065	30·020	30·01			30·07	30·12	67	42	52			52	47	ne.	n.		e.	·02	......		·11
21.	30·026	29·993	29·66			30·07	30·03	65	49	53			57	54½	ne.	ne.		ese.	......	......		......
22.	30·055	30·005	29·63			29·82	29·91	67	39	56			55	56½	ne.	n.		wsw.	......	......		......
23.	30·114	30·106	29·68			30·12	30·15	73	54	59			55	51½	ne.	nw.		s.	·08	......		·13
24.	30·118	29·939	29·70			30·01	29·70	66	47	62			55	56	ne.	ne.		s.	......	......		......
● 25.	29·815	29·647	29·32			29·70	29·85	64	42	59			45	41	sw.	s.		n.	·06	·28		·08
26.	29·694	29·606	29·21			29·84	29·78	56	43	43			46	45	sw.	nw.		ne.	......	1·07		·05
27.	29·764	29·625	29·17			29·67	29·74	57	39	49			46½	44	w.	nw.		wnw.	·01	......		·11
28.	29·790	29·665	29·62			29·68	29·66	62	30	48			51	52	nw.	nw.		sw.	......	......		·04
29.	29·705	29·601	29·50			29·57	29·48	60	39	43			52½	51½	s.	s.		s.	......	......		·02
30.	29·443	29·340	29·12			29·32	29·04	62	46	53			52½	54	s.	s.		se.	·14	......		......
Mean.	30·167	30·094	29·74			30·145	30·134	66·80	43·50	55·3			52·71	51·10					0·42	1·58		0·91

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[SECOND SERIES.]

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XXXIV.—*Zoological Notes and Observations made on board H.M.S. Rattlesnake.* By Thomas H. Huxley, F.R.S., Assistant Surgeon R.N.

[With a Plate.]

III. *Upon* Thalassicolla, *a new Zoophyte.*

In all the seas, whether extra-tropical or tropical, through which the "Rattlesnake" sailed, I found floating at the surface the peculiar gelatinous bodies which are the subject of the present communication. They were the most constant of all the various products of the towing-net, which was rarely used without obtaining some of them, and which sometimes, for days, would contain hardly anything else.

The extreme simplicity of structure of these creatures was more puzzling to me than any amount of complexity would have been. The difficulty of perceiving their relations with those forms of animal life with which I was familiar, gave me rather a distaste to the study of them, and, as I now perceive, has rendered my account of their organization far less complete than I could wish it.

However, these forms seem completely to have escaped the notice of voyagers, and therefore I hope to do some service by directing the attention of future investigators to them, and by endeavouring to show what seem to me to be their relations in the scale of being.

It may not be out of place at the same time to examine what are the *positive* characters of those lowest classes of animal life of which this is a member.

The *Thalassicolla** is found in transparent, colourless, gelati-

* *Θάλασσα, the sea; κόλλα, jelly, glue.*

nous masses of very various form;—elliptically-elongated, hour-glass-shaped, contracted in several places, or spherical, varying in size from an inch in length downwards; showing no evidence of contractility nor any power of locomotion, but floating passively on the surface of the water.

Now of such bodies as these there were two very distinct kinds: the one kind, consisting of all the oval or constricted, and many spherical masses, is distinguished to the naked eye by possessing many darker dots scattered about in its substance; the smaller kind, always spherical, has no dots, but presents a very dark blackish centre, the periphery being more or less clear. I will adopt the provisional name of *Th. punctata* for the former kind, and that of *Th. nucleata* for the latter, as a mere matter of convenience, and without prejudging the question as to the existence of specific distinctions.

Th. punctata. (Pl. XVI. figs. 1, 2, 3.)

The mass consists of a thick gelatinous crust containing a large cavity. The crust is structureless, but towards its inner surface minute spherical, spheroidal or oval bodies are imbedded, from which the appearance of dots arises. These are held together merely by the gelatinous substance, and have no other connexion with one another. Each "spheroid" is a cell, with a thin but dense membrane, $\frac{1}{200}$th to $\frac{1}{250}$th of an inch in diameter, and contains a clear, fatty-looking nucleus $\frac{1}{1400}$th to $\frac{1}{800}$th of an inch in diameter, surrounded by a mass of granules which sometimes appeared cellæform.

This fundamental structure—a mass of cells united by jelly—like an animal *Palmella*, was subject to many and important varieties.

Very commonly the central part of each mass, instead of containing a single large cavity, consisted of an aggregation of clear, large, closely-appressed spaces, like the "vacuolæ" of Dujardin (figs. 2, 3, 2 *a*, 3 *a*).

Very frequently also each cell was surrounded by a zone of peculiar crystals somewhat like the stellate spicula of sponge, consisting of a short cylinder, from each end of which three or four conical spicula radiated, each of these again bearing small lateral processes (figs. 3 *a*, 2 *b*).

In another kind, much more rarely met with, the spherical cell contained a few prismatic crystals about $\frac{1}{1000}$th of an inch in length; it was of a bluish colour, and enveloped in a layer of densely packed minute granules not more than $\frac{1}{15000}$th of an inch in diameter. Outside these there was a number of spherical bright yellow cells $\frac{1}{1600}$th of an inch in diameter, and inclosing the whole a clear, transparent brittle shell perforated by numerous rounded apertures, so as to have a fenestrated appearance (fig. 6). There were no spicula in this kind.

In a single specimen I found a similar shell, but its apertures were prolonged into short tubules (fig. 5).

Frequently the connecting substance in which the cells were imbedded appeared to be quite structureless, but in some specimens delicate, branching, minutely granular fibrils were to be seen radiating from each cell into the connecting substance (fig. 2 *b*).

I have mentioned certain minute bright yellow spherical cells contained within the shell of the fenestrated kind; such coloured cells are contained in all kinds either diffused through the connecting substance or more or less concentrated round each large cell (figs. 3 *a*, 2 *b*).

Th. nucleata. (Pl. XVI. fig. 4.)

This form consists of a spherical mass of jelly as large as the middle-sized specimens of the last variety, with an irregular blackish central mass. Enveloping this and forming a zone about half the diameter of the sphere there is a number of clear spaces—vacuolæ—varying in size from $\frac{1}{62}$nd to $\frac{1}{2500}$th of an inch, the smallest being innermost. Scattered among the vacuolæ of the innermost layer, there were many of the yellow cells, and a multitude of very small dark granules. Delicate, flattened, branching fibrils radiated from the innermost layer, passing between the vacuolæ, and in one specimen these fibrils were thickly beset with excessively minute dark granules, like elementary molecules, which were in active motion, as if circulating along the fibrils, but without any definite direction. In this case the whole body looked like a moss agate, so distinct were the radiating fibrils (4 *a*). Left to itself for less than an hour, however, this appearance as well as the circulation of granules vanished, and only a few scattered radiating fibrils were to be observed, the rest seeming to have broken off and become retracted.

By rolling under the compressor the outer mass could be completely separated from the central dark body, which then appeared as a spherical vesicle $\frac{1}{65}$th of an inch in diameter (fig. 4 *b*), showing obscurely a granular included substance.

The membrane of the vesicle was very strong, resisting and elastic. When burst it wrinkled up into sharp folds (fig. 4 *c*), and gave exit to its contents (fig. 4 *d*). These were—

1. A very pale delicate vesicle (nucleus?) without any contents, and measuring (but when much compressed) about $\frac{1}{60}$th of an inch (fig. 4 *d*).

2. A heterogeneous mass consisting of (*a*) a finely granular base, (*b*) oil-globules of all sizes, (*c*) peculiar cells $\frac{1}{800}$th to $\frac{1}{1000}$th

of an inch in diameter (4 *e*). Some of these had a solid greenish red nucleus about $\frac{1}{3500}$th of an inch in diameter. Others resembled the nuclei in colour and appearance, but were larger ($\frac{1}{2500}$th of an inch), and had no cell-membrane:—were these granule cells?

Altogether the *Thalassicolla nucleata* might readily be imagined to be a much-enlarged condition of single cells of the *Th. punctata*; but I have no observations to show that it was so, nor can it be said from which of the varieties of *Th. punctata* the *Th. nucleata* arises.

The question may readily arise, Are these perfect forms? I can only say, as negative evidence, that I have never observed any trace of their further development, and that the spicula and 'shells,' and the capacity of fission, appear to afford positive grounds for believing that they are not mere transitional stages of any more highly organized animal. If, further, it can be shown that their structure is closely allied to that of known organisms, this probability will, I think, almost amount to a certainty.

What animals are there then which consist either of simple cells or of cells aggregated together, which hold the same rank among animals that the Diatomaceæ and Desmidiæ, the Protococci and Palmellæ hold among plants?

Ten years ago the general reply of zoologists would have been —none. The researches of the celebrated Berlin microscopist, Prof. Ehrenberg (wonderful monuments of intense and unremitting labour, but at least as wonderful illustrations of what zoological and physiological reasoning should *not* be), led to the belief that the minutest monads had an organization as complicated as that of a worm or a snail. In spite, however, of the great weight of Prof. Ehrenberg's authority, dissentient whispers very early made themselves heard, from Dujardin, Focke, Meyen, Rymer Jones, and Siebold. To these Kölliker, Stein and others —in fact, I think I may say *all* the later observers—have added themselves, until it really becomes a matter of duty on the part of those interested in the progress of zoology to pronounce decidedly against the statements contained in the 'Infusionsthierchen,' so far as regards anatomical or physiological facts*.

It has been shown in the first place, that a great mass of the so-called Polygastria are plants—at any rate are more nearly allied to the vegetable than to the animal kingdom. Such is the case

* That the above assertions will be considered by the majority of English readers to be unwarrantably severe, and considering the relative standing of the Professor and his critic, possibly impertinent, is no more than is to be expected.

I can only beg to disclaim all mere iconoclastic tendencies, and refer to a comparison of Prof. Ehrenberg's works with facts for my justification.

with the Diatomaceæ and Desmidiæ, the Volvocina, the Monadina, the Vibriones, and to these we must very probably add the Astasiæa.

So utter has been the want of critical discrimination in the construction of genera and species, that Cohn, in his admirable memoir upon *Protococcus pluvialis,* enumerates among the twenty-one forms (to which distinct names have been given by authors) assumed by the *Protococcus,* no less than *eight* of Prof. Ehrenberg's genera. The family "Polygastria," thus cut down to less than one-half its original dimensions, contains none but animals which are either simple nucleated cells, or such cells as have undergone a certain amount of change, not sufficient however to destroy their real homology with nucleated cells.

A nucleus has been found in *Euglena, Arcella, Amœba, Amphileptus, Trachelius, Bursaria, Paramœcium, Nassula, Chilodon, Oxytricha, Stylonichia, Stentor, Vorticella, Euplotes, Trichodina, Loxodes,* and other genera. It may be brought out by acetic acid just like any other nucleus in *Vorticella* and *Euglena.*

The animal is an unchanged cell in *Euglena,* in *Amœba* and in *Opalina.* In others, as the *Vorticellæ,* there is a more or less distinct permanent cavity in the interior of the cell which opens externally, an occurrence not without parallel among the secreting cells of insects. Certain genera, such as *Nassula,* have an armature of spines, but so have some of the Gregarinidæ which are unquestionably simple cells.

Contractile spaces,—cavities which appear and disappear in different parts of the Infusoria, and sometimes become filled with the ingesta,—are found no less commonly in the component cells of the tissues of many of the lower animals, and according to Cohn in the primordial cells of plants also.

The "Polygastria," then, may be justly considered to be simple cells, and to form a type perfectly comparable with *Thalassicolla.*

The researches of Henle, Stein, and Kölliker have made us acquainted with another form of cellular animals—the Gregarinidæ.

These are nucleated cells, without cilia, but with contractile walls, which lead an independent parasitic life in the intestines of many of the Invertebrata, principally insects.

The Gregarinidæ, like the Infusoria, are generally, if not invariably, single, solitary cells.

A third type is formed by the Foraminifera. The fate of these animals is somewhat singular. Considered to be Cephalopoda by D'Orbigny; Bryozoa by Ehrenberg; rudimentary Gasteropods by Agassiz; all careful observation tends to confirm the opinion of Dujardin, that the fabrication of their remarkable shells is essentially similar to *Amœba* and *Arcella,* both of which have been shown to be nucleated cells.

Lastly, we have the Sponges. That the tissue of the Sponges breaks up into masses, each of which is similar to an *Amœba,* has been pointed out by Dujardin, and confirmed by Carter and others. Dujardin, however, believing that a peculiar formless substance, "Sarcode," constitutes the tissues of the Sponges (as well as of the Infusoria and many other of the lower animals), fails to point out that they are mere aggregations of true cells.

This is not the place to discuss the important question, whether the great law developed by Schwann does or does not hold good among the whole of the lower animals. I believe that there is evidence to show that it does; that everywhere careful analysis will demonstrate the nucleated cell to be the ultimate histological element of the animal tissues; and that the "sarcode" of Dujardin, and the "formless contractile substance" of Ecker, are either cells or cell-contents, or the results of the metamorphosis of cells. Be this as it may, however, I can say positively, as the result of recent careful examination, that *Spongilla, Halichondria,* and *Grantia* are entirely composed of nucleated cells.

The Foraminifera and Sponges then, no less than the Infusoria and Gregarinidæ, are "unicellular" animals—animals, that is, which either consist of a single cell, or of definite aggregations of such cells, none of which possesses powers or functions different from the rest.

Using the word "unicellular" in this extended sense (as it has been used by Nägeli and others with regard to the Algæ), it may be said that there are four families of unicellular animals; in two of these, the Infusoria and Gregarinidæ, the cells are isolated; in two, the Foraminifera and Sponges, they are aggregated together.

From these considerations it appears to me that the zoological meaning and importance of the *Thalassicolla punctata* first become obvious. It is the connecting link between the Sponges and the Foraminifera. Allied to the former by its texture and by the peculiar spicula scattered through the substance of some of its varieties, it is equally connected with the latter by the perforated shell of other kinds. If it be supposed that a *Thalassicolla* becomes flattened out, and that a deposit takes place not only round the cells, but between the partitions of the central "vacuolæ," it becomes essentially an *Orbitoides**.

* Dr. Carpenter, to whom I communicated these observations, writes to me: "As far as I can understand them, the bodies described (if perfect non-embryonic forms) seem to constitute that kind of connecting link between Sponges and Foraminifera, which the relative position I have assigned to them would lead me to expect. It is interesting to remark that the cullen-

To come to a similar understanding of the nature of the *Thalassicolla nucleata,* it is necessary to recur again to certain general characteristics of the reproductive processes in the unicellular animals.

If we except *Tethya,* a sponge*, the ordinary reproductive elements have as yet been found in no unicellular animal.

Fission occurs in all except perhaps the Gregarinidæ. Gemmation appears to take place in the Foraminifera and Infusoria. In the Sponges the so-called ova or gemmules seem to be only a temporary locomotive condition of the cells, such as occurs in the *Vorticellæ* among the Infusoria, and the *Protococci* among plants.

But in all (except the Foraminifera) a process of multiplication by endogenous development occurs, and would seem in some cases to represent sexual propagation. Now the mode of this endogenous multiplication presents remarkable features of similarity in the Infusoria, the Gregarinidæ, and the Sponges.

There is a certain period in the existence of *Vaginicola crystallina,* when, gorged with food stored up in the shape of fat granules, &c., within the cavity of its cell-body, it becomes sluggish and eventually still. The body contracts and becomes rounded, and the transparent case closes in and seals up its inhabitant. Eventually long processes are developed from the body, and it takes on the form of the genus *Acineta* of Ehrenberg. After a while a new life stirs within this chrysalis-like form, and the contained mass gives rise successively (by a sort of fission) to young ciliated bodies, which leave the *Acineta* and become *Vaginicolæ.*

In a similar manner *Vorticella microstoma* becomes *Podophrya fixa*; but sometimes the changed *Vorticella* has no stalk, and then is the *Actinophrys* of some authors (not *A. Sol*). It is not known in what way the embryos are brought forth here, but it is a very significant fact that both the stalked and unstalked forms have been observed to conjugate.

Epistylis presents similar phænomena.

The *Actinophrys Sol,* to which more particular reference will be made by and by, has been observed to conjugate, but it is not absolutely known to arise by the metamorphosis of any *Vorticella,* though there is every probability in favour of the supposition that it does.

The Gregarinidæ pass through similar changes. Two forms

der-like skeleton of certain Foraminifera is extremely like in its appearance to a fragment of the shell of an Echinus, or to the plates contained in the integument of a Holothuria, and we know that these begin with a network of spicules. Consequently there is not by any means so great a distinction between the spicular skeleton of a sponge and the cullender-like skeleton of an Orbitolina as might at first sight appear."

* See Annals of Nat. History, S. 2. vol. vii. p. 370.

of these creatures are known; the one consisting of protean nucleated cells, the other of motionless spherical sacs, containing a vast number of minute bodies resembling *Naviculæ* in shape, and thence called "Navicella-sacs." Now, according to Stein, although the fact has been doubted by others, the "Navicella-sacs" result from the conjugation of two *Gregarinæ*, which have become motionless and filled with an accumulation of granules.

Certain it is that the Navicellæ are developed within the granular mass like embryo-cells within the yelk, and that when freed by the bursting of the Navicella-sac they become *Gregarinæ*.

Lastly, in the freshwater sponge (*Spongilla*), which consists of an aggregation of nucleated protean cells like a mass of *Gregarinæ*, a certain number of the cells at various points scattered through the substance of the *Spongilla* become motionless and distended with granules, and receiving first a membranous and then a siliceous investment, constitute the "seed-like bodies."

From Mr. Carter's account it would appear that when the "seed-like body" germinates its cells burst, and their granular contents become mixed. Subsequently protean cells, like the ordinary sponge-cells, make their appearance *pari passu* with the disappearance of the granules.

Supposing this account to be correct, the conjugation in *Spongilla* would be perfectly analogous to that of the Desmidiæ and Diatomaceæ, while in the Infusoria and Gregarinidæ it would resemble that of *Zygnema*.

Generalizing the above details (full authority for which may be found in the appended list of works), we may say that with the exception of the Foraminifera, about whose reproductive processes nothing is as yet known, the Protozoa all reproduce their kind by a process of endogenous development which is accompanied by greater or less changes in the structure and powers of the reproducing cell. We may add that in many cases these changed cells have been observed to conjugate, previous to the occurrence of the endogenous development.

Bearing all these facts in mind, let us return to *Thalassicolla nucleata*. If the *Th. punctata* answer to a mass of sponge-cells or an aggregation of *Gregarinæ*, is it not possible that the *Th. nucleata* may answer to the altered reproductive cell? I have shown that the *Th. nucleata* may very possibly be nothing more than a separated and enlarged cell of *Th. punctata*, and this possibility upon structural grounds becomes, I think, converted into probability, if *Th. nucleata* be compared with *Actinophrys Sol*, which there is every reason to believe is the reproductive stage of one of the Vorticellinæ.

Actinophrys Sol is a spherical gelatinous mass consisting of an internal dark granular portion and a clearer external zone from which many radiating threads are given off. Vacuolæ are scattered through the substance, larger in the external zone, smaller and more irregular in the interior.

If the animal is much compressed, nuclei and nucleated cells are forced out from its interior.

Finally, two specimens of *Actinophrys* have been observed to fuse together and become one.

It is unnecessary to point out the perfect analogy between *Actinophrys* and *Thalassicolla nucleata*, with one exception, that the large internal cell was not observed in *Actinophrys*—a circumstance which might readily occur if it were delicate, even though it existed.

The argument derived from this analogy becomes still more strengthened if we turn to the excellent account of *Noctiluca*—a marine phosphorescent body which has long been a zoological puzzle—by M. de Quatrefages. For the details I must refer to that observer's paper in the 'Annales des Sciences,' but I may state that its structure is essentially similar to that of *Thalassicolla nucleata*, supposing that the latter had given exit to its central cell by a depression at one point of its surface. *Noctiluca* however appears to feed after the manner of *Actinophrys*, and perhaps conjugates also, as M. de Quatrefages "has met with double individuals two or three times." This he considers an evidence of spontaneous fission; but further observation might have reversed this judgement, as it did that of Kölliker with regard to *Actinophrys*.

From the invariable adhesion of grains of sand to one part of the surface of *Noctiluca*, it would seem to be set free from some unknown fixed form which is probably analogous in its structure to *Thalassicolla punctata*.

To sum up the different lines of argument it may be said—

1. That the *Thalassicolla punctata* is not an exceptional form of animal life, but belongs to the same great division as the Sponges, Foraminifera, Infusoria, and Gregarinidæ,—the Protozoa or unicellular animals.

2. That the Protozoa have definite characters as a class, which are—

   a. That they are either simple nucleated cells or aggregations of such cells, which are not subordinated to a common life.

   b. That they have a mode of reproduction consisting in an endogenous development of cells, preceded by a process analogous to the conjugation of the lower plants.

3. That the *Thalassicolla nucleata* closely resembles *Actinophrys Sol*, which is known to conjugate, and which there is great reason to believe is the reproductive stage of one of the Vorticellinæ.

4. That as *Th. punctata* is one of the Protozoa, it most probably has a reproductive stage.

5. That *Th. nucleata* might readily be derived from such an alteration in one of the cells of *Th. punctata* as occurs in the sponge-cells when they go to form the seed-like body, or in the Gregarina-cells when they become "Navicella-sacs."

6. That *Thalassicolla nucleata* is essentially similar in structure to *Noctiluca.*

Finally, I may be permitted to say, that no one can be more fully conscious than myself of the slender and hypothetical grounds on which some of these conclusions rest. My chief purpose has been merely to show the tendency of the evidence now extant as clearly and broadly as possible;—rather to draw out a brief than to pronounce a judgment.

The following are the authorities referred to in the text:—

Von Siebold. Vergleichende Anatomie d. Wirbellosen Thiere, p. 7–25.

———. Ueber einzellige Pflanzen u. Thiere. *Siebold und Kölliker's Zeitschrift,* 1849.

Dujardin. Histoire naturelle des Zoophytes Infusoires.

Cohn. Nachträge zur Naturgeschichte des Protococcus fluviatilis. *Nova Acta Acad. Nat. Cur.* 1850.

Pineau. Sur le Développement des Infusoires. *Annales des Sciences,* 1845.

Stein. Untersuchungen über die Entwickelung d. Infusorien. *Wiegmann's Archiv,* 1849.

———. Ueber die Natur d. Gregarinen. *Müller's Archiv,* 1848.

Kölliker. Ueber die Gattung Gregarina. *Siebold und Kölliker's Zeitschrift,* 1848.

———. Das Sonnenthierchen. *Ditto.* 1849.

Quatrefages. Observations sur les Noctiluques. *Annales des Sciences,* 1851.

Hogg. Upon Spongilla. *Trans. Linn. Soc.* vol. xviii.

Carter. On Spongilla. *Annals of Nat. Hist.* 1849.

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

[Continued from p. 339.]

87. *Theridion nervosum.*

Theridion nervosum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 301; Hahn, Die Arachn. B. ii. p. 48. tab. 58. fig. 133.
—— *sisyphus,* Sund. Vet. Acad. Handl. 1831, p. 115.
Theridium sisyphus, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 8; Die Arachn. B. viii. p. 73. tab. 273. fig. 644.
Titulus 13, Lister, Hist. Animal. Angl. De Aran. p. 51. tab. 1. fig. 13.

A complex snare, having somewhat of a pyramidal form, is spun on trees, shrubs, gorse bushes and heath by this common spider, which is widely distributed in Great Britain. It pairs in June, and in July the female constructs a globular cocoon of dull green silk of a loose texture, measuring $\frac{1}{8}$th of an inch in diameter, which includes from 30 to 40 small, yellowish white, spherical eggs, not adherent among themselves. This cocoon is placed under a shallow dome-shaped canopy of silk, about which withered leaves, flowers, and the remains of insects are accumulated; it is situated among the foliage near the upper part of the snare, and in this nidus the young live amicably together with the female till they are capable of providing for themselves, when they separate.

Like its congeners, this species envelopes with lines drawn from the spinners by means of the posterior legs such insects as are too powerful for it to attack when first entangled in its toils.

88. *Theridion denticulatum.*

Theridion denticulatum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 305; Blackw. Linn. Trans. vol. xix. p. 124.

Branches of trees and shrubs trained against buildings, and crevices in rocks and walls are the situations usually occupied by this species. The female, in the month of June or July, attaches to objects near her retreat a globular cocoon of greenish brown silk of a very loose texture, measuring $\frac{1}{9}$th of an inch in diameter, in which she deposits from 30 to 60 spherical eggs of a brown colour, not agglutinated together.

89. *Theridion varians.*

Theridion varians, Hahn, Die Arachn. B. i. p. 93. tab. 22. fig. 71, 72; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 314.
Theridium varians, Koch, Die Arachn. B. xii. p. 134. tab. 428. fig. 1056–1058.

Theridion varians occurs in localities similar to those frequented by *Theridion denticulatum* and is a common British spider. It pairs in June, and in July the female constructs several globular cocoons of dull white silk of a very loose texture, the largest of which measures about $\frac{1}{7}$th of an inch in diameter; they are attached to objects situated near the upper part of the snare, and contain, according to their size, from 20 to 60 spherical eggs of a yellowish white colour, not adherent among themselves. Withered leaves, dried moss, and particles of indurated earth are generally disposed about the cocoons.

Of the three figures of *Theridion varians,* 1056, 1057 and 1058, given by M. Koch in the twelfth volume of 'Die Arachniden,' M. Walckenaer has placed the first and second among the synonyma of *Theridion denticulatum*, and the third among those of *Theridion tinctum*; he has also referred to fig. 1056 as a portrait of a female, whereas it most unequivocally represents a male. My own observations serve to confirm the accuracy of the view taken by M. Koch.

90. *Theridion pulchellum.*

Theridion pulchellum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 311.
—— *formosum*, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. x. p. 101.
Theridium vittatum, Koch, Die Arachn. B. iii. p. 65. tab. 94. fig. 217; Die Arachn. B. iv. p. 118. tab. 141. fig. 326.

This species is found in summer and autumn on rails and gates about Oakland. The plan of its snare is similar to that on which the snares of other *Theridia* are constructed. In June the female deposits about 29 spherical eggs of a yellowish white colour, not adherent among themselves, in a globular cocoon of white silk of a fine but compact texture, measuring $\frac{1}{8}$th of an inch in diameter. Near the cocoon, which is sometimes attached to the under side of a leaf by fine lines of silk, she takes her station, and on the approach of danger endeavours to secure her treasure by seizing it with her falces, palpi, and feet.

91. *Theridion carolinum.*

Theridion carolinum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 315.
—— *dorsiger*, Hahn, Die Arachn. B. i. p. 82. tab. 20. fig. 61 (misnumbered 60 in the plate).
Linyphia bimaculata, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 10.

I have taken this rare spider among grass near woods at Oakland. In June the female fabricates a globular cocoon of white silk of a slight texture, measuring $\frac{1}{10}$th of an inch in diameter, in which she deposits about 50 spherical eggs of a pale yellowish white colour, not agglutinated together. The cocoon is attached to the spinners by short silken lines, and is transported with her wherever she goes, in the manner of the *Lycosæ*.

92. *Theridion versutum.*

Theridion versutum, Blackw. Annals and Mag. of Nat. Hist. vol. xviii. p. 302.

The only specimen of this species which has come under my observation was a male; it was captured in the neighbourhood of Winchester in July 1846 by James Franklin Preston, Esq., and was comprised in a collection of *Araneidea* obligingly made for me by that gentleman in Hampshire and the Isle of Wight.

93. *Theridion pallens.*

Theridion pallens, Blackw. Research. in Zool. p. 357.
Epëira nubila, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. x. p. 101.

Bushes and coarse herbage growing in the vicinity of woods in Lancashire and Denbighshire are frequented by this minute species of *Theridion.* It pairs in May, and in June the female deposits about 20 spherical eggs of a pale yellowish colour in a small globular cocoon of white silk of a loose texture.

The female, both when adolescent and adult, has a design of a dark brown colour on the upper part of the abdomen, which almost disappears after she has deposited her eggs. The male differs from her so widely in structure and colour that I was induced to describe it in the 'London and Edinburgh Philosophical Magazine' as an *Epëira,* under the specific name of *nubila.* A knowledge of its habits and œconomy, subsequently acquired, has enabled me to correct this error.

94. *Theridion fuscum.*

Theridion fuscum, Blackw. Linn. Trans. vol. xviii. p. 626.

M. Walckenaer appears to regard *Theridion fuscum* as identical with *Argus formivorus* (Hist. Nat. des Insect. Apt. t. iv. p. 502), from which it differs in size, structure and colour, presenting all the essential characters of a *Theridion.*

Females of this species may be found towards the close of the year on rails and under stones in pastures near Llanrwst.

95. *Theridion albens.*

Theridion albens, Blackw. Linn. Trans. vol. xviii. p. 627; Walck. Hist. Nat. des Insect. Apt. t. iv. p. 492.

A female of this minute spider was discovered in July 1837 among strawberry plants in my father's garden at Hendre House, near Llanrwst.

96. *Theridion angulatum.*

Theridion angulatum, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. viii. p. 483.

A single specimen of this remarkable species was detected in a cleft of a rail at Oakland, in April 1835. It was a female, and, like *Tetragnatha extensa,* frequently extended the first and second pairs of legs forwards, and the fourth pair backwards, in a line with the body.

97. *Theridion variegatum.*

Theridion variegatum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 332.
—— *thoracicum,* Wider, Museum Senckenb. B. i. p. 218. taf. 14. fig. 11.
—— *callens,* Blackw. Linn. Trans. vol. xviii. p. 627.
Ero variegata, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 8.

In the fourth volume of his 'Hist. Nat. des Insect. Apt.' p. 496, M. Walckenaer has very properly added the name *Theridion callens,* conferred by me on a small spider described in the 'Transactions of the Linnæan Society,' to the synonyma of *Theridion variegatum,* a correction which I had previously made in my MS. catalogue of British spiders, having satisfied myself, by referring to Herrich Schäffer's 'Deutschlands Insecten,' Heft 138, fig. 5, 6, that the *Ero variegata* of M. Koch is identical with *Theridion callens,* and, like it, must become a synonym of *Theridion variegatum.*

This species occurs among grass growing in and near woods in the west of Denbighshire. The female fabricates a very remarkable balloon-shaped cocoon, about $\frac{1}{8}$th of an inch in diameter, which is composed of soft silk of a loose texture and pale brown colour, inclosed in an irregular network of coarse dark red-brown filaments; several of the lines composing this network unite near the smaller extremity of the cocoon, leaving intervals there through which the young pass when they quit it, and being cemented together throughout the remainder of their extent, form a slender stem, varying from $\frac{1}{10}$th to $\frac{1}{2}$ of an inch in length, by which the cocoon is attached to the surface of stones and fragments of rock, resembling in its figure and erect position some of the minute plants belonging to the class *Cryptogamia.* The eggs are large, considering the small size of the spider, five or six in number, spherical, not agglutinated together, and of a brown colour.

From a cocoon of *Theridion variegatum* transmitted to me in July 1851 by R. H. Meade, Esq., of Bradford, Yorkshire, in which locality it was found, eight young spiders had made their escape; they were included in the small box containing the cocoon.

98. *Theridion signatum.*

Theridion signatum, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 333; Blackw. Linn. Trans. vol. xix. p. 124.
—— *quadrisignatum,* Hahn, Die Arachn. B. i. p. 80. tab. 20. fig. 60 (misnumbered 59 in the plate).
Drassus phaleratus, Sund. Vet. Acad. Handl. 1831, p. 133.
Asagena phalerata, Sund. Consp. Arachn. p. 19, 20.
—— *serratipes,* Koch, Uebers. des Arachn. Syst. erstes Heft, p. 13; Die Arachn. B. vi. p. 98. tab. 204. fig. 502, 503.

Some difference of opinion has existed among arachnologists as to the position this spider should occupy in a systematic arrangement of the *Araneidea*; but I do not see any sufficient reason for removing it from the *Theridia*, to which it appears to be most nearly allied by its organization.

In Denbighshire this species is found among heath, but it is of rare occurrence. The radial and digital joints of the palpi are so closely connected in the male as scarcely to present any perceptible trace of their union; in short, as they appear to be incapable of separate motion, there seems to be an impropriety in regarding them as distinct joints.

99. *Theridion filipes.*

Theridion filipes, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. viii. p. 484.
Linyphia concolor, Wider, Museum Senckenb. B. i. p. 267. taf. 18. fig. 3 ; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 270.

Theridion filipes is allied to the spiders belonging to the genus *Neriëne* by the disposition and relative size of its eyes, and to those of the genus *Linyphia* by the length and delicacy of its limbs; indeed, on a superficial view, it bears a striking resemblance to *Linyphia tenuis*; but the structure of the maxillæ and the relative length of the legs have induced me to class it with the *Theridia*. It occurs under stones in woods in Denbighshire and Lancashire.

The first individual examined by me was a female, and it presented an anomaly in organization which I never before witnessed in this order of animals; it had a supernumerary eye situated between the two small ones constituting the anterior pair of the trapezoid.

M. Walckenaer has inadvertently placed the *Linyphia concolor* of M. Wider, which is identical with *Theridion filipes*, among the synonyma of *Argus graminicolis*, having previously described it as a distinct species under the name conferred upon it by M. Wider (Hist. Nat. des Insect. Apt. t. ii. pp. 270, 351).

Genus Pholcus, Walck.

100. *Pholcus phalangioides.*

Pholcus phalangioides, Walck. Hist. Nat. des Insect. Apt. t. i. p. 652; Latr. Gen. Crust. et Insect. tom. i. p. 99; Hahn, Die Arachn. B. ii. p. 34. tab. 50. fig. 119; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 20; Blackw. Linn. Trans. vol. xix. p. 125.
—— *opilionoides*, Koch, Die Arachn. B. iv. p. 95. tab. 135. fig. 311.

Living specimens of *Pholcus phalangioides* were brought to me from Barmouth, in Merionethshire, in the summer of 1835, by Richard Potter, Esq., M.A., of Queen's College, Cambridge, and Professor of Natural Philosophy in University College, London. In 1836 I received an adult male from Mr. T. Glover, which he had taken in Liverpool, and I have in my possession an immature individual from the Isle of Wight.

The spider referred to by Mr. Jesse in his 'Scenes and Tales of Country Life,' pp. 202, 203, as remarkable for the rapidity of its vibratory motions when disturbed, is, I have no doubt, *Pholcus phalangioides*, which frequents ancient buildings in the south of England, and like *Epëira diadema*, *Theridion quadripunctatum*, and some other species, has the habit of violently agitating itself when anything suddenly touches its lines. This vibratory motion, which in the case of *Pholcus phalangioides* appears to acquire its maximum velocity, is produced by the partial contraction and extension of the joints of the legs in quick succession, as I have ascertained by occasioning specimens of *Epëira diadema* to continue the action till it became so slow, in consequence of the fatigue experienced by the animals, that there was no difficulty in determining the manner in which it is effected. This singular proceeding is evidently intended by the spider to communicate motion to its snare and thus to cause the struggles of any insect entangled in it, by which means it is directed with certainty to its victim.

Family *Linyphiidæ*.

Genus LINYPHIA, Latr.

101. *Linyphia montana*.

Linyphia montana, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 233. pl. 16. fig. 4; Koch, Uebers. des Arachn. Syst. erstes Heft, p. 10; Die Arachn. B. xii. p. 113. tab. 422. fig. 1038, 1039.
—— *triangularis*, Latr. Gen. Crust. et Insect. tom. i. p. 100; Sund. Vet. Acad. Handl. 1829, p. 215.

This very common spider, which is frequently mistaken for *Linyphia triangularis*, constructs in hedges, bushes and rank herbage an extensive horizontal sheet of web of a fine texture, on the inferior surface of which it takes its station in an inverted position and watches for its prey. Connected with the web and with objects situated above and below it are numerous fine lines intersecting one another at various angles; those on the upper side are the most extensive, and not only serve to support the web, but also to precipitate such insects as strike against them with their wings upon the horizontal sheet, where they are quickly seized by the vigilant and active occupant.

102. *Linyphia triangularis.*

Linyphia triangularis, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 240.
—— *marginata,* Wider, Museum Senckenb. B. i. p. 253. taf. 17. fig. 5; Koch, Die Arachn. B. xii. p. 118. tab. 423. fig. 1041, 1042.

Linyphia triangularis occurs in the south-eastern counties of England, but I have not met with it in the northern counties, nor in Wales.

103. *Linyphia marginata.*

Linyphia marginata, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 346; Research. in Zool. p. 394.
—— *montana,* Sund. Vet. Acad. Handl. 1829, p. 217.
—— *resupina,* Wider, Museum Senckenb. B. i. p. 252. taf. 17. fig. 4; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 242; Koch, Die Arachn. B. xii. p. 109. tab. 421. fig. 1035, 1036.
Titulus 19, Lister, Hist. Animal. Angl. De Aran. p. 64. tab. 1. fig. 19.

In its habits and œconomy this species resembles *Linyphia montana,* fabricating in low bushes or among coarse herbage an extensive snare similar in design to the toils constructed by the *Linyphiæ* generally. It pairs in May, and in June the female spins one or two lenticular cocoons of white silk of a loose texture which are attached to withered leaves, or other objects situated near the snare; the larger of these cocoons measures $\frac{1}{2}$ an inch in diameter, and contains about 140 spherical eggs of a pale yellow colour, not agglutinated together.

104. *Linyphia pratensis.*

Linyphia pratensis, Wider, Museum Senckenb. B. i. p. 258. taf. 17. fig. 8; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 250; Koch, Die Arachn. B. xii. p. 121. tab. 423. fig. 1043.
—— *sylvatica,* Blackw. Linn. Trans. vol. xviii. p. 659.

Since the publication of my description of this spider, under the specific name of *sylvatica,* in the eighteenth volume of the 'Transactions of the Linnæan Society,' the suspicion of its identity with the *Linyphia pratensis* of M. Wider, there expressed, has been converted into absolute certainty by consulting M. Reuss's memoir entitled 'Arachniden,' contained in the first volume of the 'Museum Senckenbergianum;' consequently the appellation bestowed upon it by me must rank as a synonym. It will be seen that this opinion has been adopted by M. Walckenaer, on referring to his 'Hist. Nat. des Insect. Apt.' t. iv. p. 499.

This species is common in England and Wales, and in the spring of 1849 an immature male, which had not undergone its final change of integument, was forwarded to me by Mr. J. Hardy, who captured it in Berwickshire. Its snare is usually constructed among rank herbage growing in and near woods, and it pairs in May and June.

105. *Linyphia fuliginea.*

Linyphia fuliginea, Blackw. Lond. and Edinb. Phil. Mag. Third Series, vol. iii. p. 349; Research. in Zool. p. 401.

Linyphia fuliginea is found in various parts of North Wales and Lancashire; it pairs in June, and constructs a snare of moderate dimensions among the grass of meadows and pastures. The male closely resembles the male of *Linyphia pratensis,* but may be distinguished from it by its inferior size, and by the structure of its palpal organs.

106. *Linyphia rubea.*

Linyphia rubea, Blackw. Linn. Trans. vol. xviii. p. 661.

In the months of May and June this spider spins a web of moderate extent among bushes in woods and coppices in North Wales and Lancashire, where it is not uncommon. An immature female of this species was transmitted to me from Berwickshire by Mr. J. Hardy in December 1848.

XXXVI.—*Description of a new species of* Pterocyclos, *Benson, from Southern India.* By W. H. Benson, Esq.

Pterocyclos nanus, nobis, n. s.

Testa profunde perspective umbilicata, depressa, discoidea, albida, fascia media strigisque undulatis castaneis superne ornata; spira prominula, saturatiore; anfractibus $4\frac{1}{2}$ convexis, ultimo supra soluto; apertura obliqua, circulari; peristomate duplicata, marginibus sulco leviter impresso vix discretis, interno superne profunde recteque inciso, externo reflexiusculo, supra sinum alam angustam fornicatam, antice breviter descendentem, angulatam, formante.

Diam. major 10, minor 8, alt. 5 mill.

Hab. ad basin montium "Nilgherries," Indiæ Australis.

This interesting addition to the genus was sent to me by Dr. Jerdon with specimens of *Pterocyclos bilabiatus,* Sow. Possessing a similar deep umbilicus, narrower than in the other known species, it was overlooked as a young and imperfect specimen. On examination it proves to have arrived at its full growth, being allied in the characters of the aperture to *Pt. rupestris,* nobis, but differing from the smallest varieties of that shell not only in size and in the form of the umbilicus, but also in the less curvature of the incision under the wing, which is moreover less expanded, and does not touch nor cover any part of the preceding whorl. The operculum is unknown.

London, November 8th, 1851.

XXXVII.—*Note on the Genus* Lithostrotion. By William Lonsdale, F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen,

Should the following memoranda on the genus *Lithostrotion* be deemed admissible, I shall feel obliged by their publication in the 'Annals and Magazine of Natural History.'

I have the honour to be, Gentlemen,
Your most obedient servant,

Melksham, Nov. 1851. W. Lonsdale.

Lhwyd* is well known to have applied the definition, "Lithostrotion sive Basaltes minimus striatus et stellatus," to a coral represented in table 23 of his work on British Fossils; but no farther description of it is given in the chapter on coralline stones or in Letter Five (*op. cit.* p. 122). The rude delineation, just quoted, expresses fully an aggregate of polygonal columns longitudinally striated and transversely rugose; the upper surface presents also closely applied stellated areas variable in size as well as in the number of the facets, but uniformly traversed by many converging, fine rays. The limited amount of information thus communicated renders a satisfactory comparison with other basaltiform and lamelliferous Zoantharia hazardous; but Parkinson† identified a Welch coral with Lhwyd's *Lithostrotion*, and he describes it as composed "of polygonal columns, exactly adapted and closely concreted" (p. 43); but detachable from the general mass "by a moderate stroke" applied laterally (p. 44); the facets of the columns are moreover stated "to be finely and closely striated longitudinally, the striæ being intersected by very fine and closely set transverse ridges" (p. 44). Complete apices are also said to be "concave and to have a prominent star, one-third of the diameter of the concavity, arising out of the centre" (p. 44). A longitudinal section is further described as having "a striated plumose appearance" (*l. c.*); and allusion is made to "numerous, exceedingly slender longitudinal lamellæ, corresponding with the external striæ;" also to "equally delicate lamellæ perpendicularly disposed nearly in concentric circles; while others answering to the external transverse ridges," are stated to pass horizontally through both of the perpendicular sets (p. 44). Parkinson gives therefore a considerable amount

* Lithophylacii Britannici Ichnographia, edit. 1699.

† Organic Remains of a Former World, vol. ii. p. 43–44, pl. 5. figs. 3 and 6, 1808, reprinted 1833.

of detailed information, omitting among essentials simply the mode of developing additional corallites or columns. His figures and description, however, can be compared with Lhwyd's delineation only as regards the mode of aggregation, the form and exterior characters of the columns, and the many rays. It is also probable that Lhwyd's fossil possessed equally with that of Parkinson a facility in breaking into small masses or single corallites; but whether the original *Lithostrotion* had an internal structure similar to that of the coral identified with it, must be a conjecture. Following the literature of the genus as accurately as possible, the next authority, accompanied by a description *, which can be quoted is Dr. Flemimg †, and he is believed to be the first naturalist who assigned a place to *Lithostrotion* in a system of zoology. He describes four species: 1. *L. striatum*; 2. *L. floriforme*; 3. *L. oblongum*; and 4. *L. marginatum*. The first is identified with Lhwyd and Parkinson's delineations; but "the rays of the star" are stated to "unite with a small, solid, central axis" (*op. cit.* p. 508); the second species, *L. floriforme*, is founded on the Derbyshire fossil represented by Martin ‡, and designated *Erismatolithus Madreporites* (*floriformis*); and it is said by Dr. Fleming "to differ chiefly from *L. striatum* in its greater size, and the axis occupying a greater space;" he quotes also the following statement of Martin—"centres projecting, pointed and writhed or twisted like a rope §." The third species, *L. oblongum*, is the well-known oolitic Tisbury coral, figured by Parkinson ||, whose delineations are cited; and the fourth, *L. marginatum*, is a mountain limestone fossil of which Dr. Fleming had seen only "two detached columns" (p. 508). The present inquiry is necessarily limited to the first two species.

* In the 'Outlines of the Geology of England and Wales,' by the Rev. W. D. Conybeare and Mr. W. Phillips, Lhwyd's figure is quoted under the designation *Astrea basaltiformis* (p. 359, 1822), but no description or reason for a changed generic determination is given.

† History of British Animals, p. 508, 1828.

‡ Petrificata Derbiensia, tab. 43. figs. 3 & 4; also tab. 44. fig. 5? 1809.

§ The Derbyshire fossil figured by Guettard is probably this species, and the peculiar detached flower-like character of the terminations to the corallites is stated in an extract from a catalogue to be due to the decomposition of the cellular tissue—"la plupart sont évidés par la décomposition de leur tissu cellulaire, ce qui les rend semblables à des fleurs en entonnoir, garnies de leur pistil." (Mémoires, &c. t. iv. of the complete series, or t. i. Nouvelle Collection, p. 75. pl. 30, 1786.)

|| Org. Rem. t. ii. p. 56. tab. 6. figs. 12, 13. The fossil has been recently named *Isastrea oblonga* by M. Milne-Edwards and M. J. Haime, Archives du Mus. d'Hist. Nat. vol. v. p. 103, 1851; also volume of the Palæontographical Society for 1851, Description of British Fossil Corals, Part 2. p. 73–75.

Lithostrotion was regarded by De Blainville* as only a section (A) of *Columnaria*, characterized by "cellules avec un axe solide au centre des rayons;" and he included in it *Lith.* (*Column.*) *striatum* as well as *L.* (*Col.*) *floriforme*, referring in the former species to Fleming, Lhwyd, and Parkinson; and in the latter to Martin. The next authority, known to the compiler of this notice, is Mr. J. Phillips†, who represents and describes a Yorkshire and Welch coral under the term *Cyathophyllum basaltiforme*; and he identifies it with the *L. striatum* of Parkinson and Fleming. It is stated to be composed of adherent prismatic or pyramidal tubes, striated longitudinally and undulated transversely; to have thirty-six to fifty lamellæ, "the marginal lamellæ commencing within a thin crenulated vertical dissepiment." No mention is made of an axis great or little; on the contrary, an enlarged, transverse section (fig. 22) exhibits a direct centre of twisted lamellæ—a structure opposed to Dr. Fleming's "small, solid, central axis;" and nothing like Parkinson's "prominent star, one-third of the diameter of the (terminal) concavity arising out of its centre" (Org. Rem. ii. 44), is expressed in what appear to be tolerably preserved centres (Geol. Yorks. tab. 2. f. 21). Lieut.-Col. Portlock, in his 'Report on the Geology of the County of Londonderry,' &c. (1843), notices a carboniferous fossil to which is applied the designation *Astrea basaltiformis* (p. 333), and it is considered equivalent to *Cyath. basaltiforme* (Phillips), *Columnaria sulcata* (Goldfuss), and *Lithostr. striatum* (Fleming). The "mass" of which a specimen consists is stated to be readily fractured; and the long, slightly undulating prismatic tubes, resembling basaltic columns in miniature, are transversely undulated and longitudinally striated (*op. cit.* p. 333), and under *Ast. hexagona* it is said to have a conical, twisted umbo (p. 332). Prof. M'Coy also includes in Mr. Griffiths's‡ work on the Carboniferous Fossils of Ireland *Lithostr. striatum* (Parkinson), citing *Cyath. basaltiforme* of Mr. Phillips, whose characters are nearly adopted. The above particulars have been given to show that among the mountain limestone Zoantharia of England, three composed of basaltiform columns had been described by Parkinson, Dr. Fleming, and Mr. J. Phillips previously to 1845, but each so far as known distinguished by peculiarities of structure; and it is believed that a due consideration of their detailed characters will raise a doubt, whether any one of them can be truly referred to

* Manuel d'Actinologie, p. 350, Atlas, pl. 52. fig. 3, 1830–34; see also Lamarck's Anim. s. Vert. ed. 1836, t. ii. p. 343.

† Illustrations of the Geology of Yorkshire, Part 2. p. 202. pl. 2. figs. 21, 22, 1836.

‡ A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland, p. 188, 1844. Printed for private distribution.

Lhwyd's fossil, though all three have been identified with it. A similar impression induced the author of this notice, when he described the corals collected by Sir R. I. Murchison in Russia in Europe and the Ural Mountains*, to state that Lhwyd's coral "has probably been mistaken in some cases for other fossils of similar general aspect, yet of very different structure;" and as a subdivision of Dr. Fleming's genus appeared necessary, he adopted as the type of *Lithostrotion* that authority's second species, being "a well-known, strongly marked coral, and excellently figured by Martin in his 'Petrificata Derbiensia'" (*op. cit.* p. 603). In a subsequent portion of that Appendix (p. 619), the describer applied the term *Stylastrea* to certain corals, which he considered referable to Parkinson's fossil; and if he erred, as he feels he did, in positively identifying, on insufficient data, the latter with Lhwyd's delineation, the admission of the error only leaves still more doubtful the actual nature of that body. In retaining the term *Lithostrotion* for the second species of Dr. Fleming, who it must be remembered really established the genus, and in suggesting a new designation for corals which bear only a certain resemblance to the first species, the author believes he acted in conformity with one of the rules laid down by the Committee of the British Association appointed to prepare "A series of propositions for rendering the nomenclature of zoology uniform and permanent†." According to that rule, "When the evidence as to the original type of a genus is not perfectly clear and indisputable, then the person who first subdivides the genus may affix the original name to any portion of it at his discretion, and no later author has a right to transfer that name to any other part of the original genus" (*op. cit. infra*, p. 264. § 5).

Martin's delineation (Pet. Derb. t. 43. f. 3), though taken from a limited fragment, expresses so completely the general characters of the fossil, that in the examination of a collection of Derbyshire zoophytes no mistake could be made in identifying a specimen, should one occur. The essential characters given in the Appendix before mentioned are—"stems generally coadunated; interior of stems separable into three differently constructed areas: 1. a central axis; 2. an inner zone composed of vertical lamellæ; 3. an outer zone formed partly of lamellæ, but chiefly of variously arched or vesicular plates: the mode of reproduction" is further said to have been "by germs developed within the area of the parent stem, or without it by an occasional extension of the po-

* Geology of Russia in Europe and the Ural Mountains, by Sir R. I. Murchison, M. Ed. de Verneuil, and Count Alex. von Keyserling, vol. i. App. A. p. 602 *et seq.*, 1845.

† Annals and Magazine of Natural History, 1st Series, vol. xi. April 1843, p. 259 *et seq.* See also Report of the British Association for 1842, p. 105.

lype" (*op. cit.* p. 603). Martin's specimen was silicified (Pet. Derb. *l. c.*), apparently a prevalent mode of mineralization, and less favourable to the exhibition of minor structures than when the process has been effected by carbonate of lime; but his figures 3 and 4 (tab. 43) clearly express a triple composition; and many terminal cavities of the specimens examined displayed no greater amount of detailed composition than is given in those delineations, while others in the same mass exhibited fully the peculiarities of each area. The mode of reproduction is neither represented nor mentioned by Martin; but in a large, siliceous Derbyshire specimen of very irregular growth, obligingly lent to the author by Mr. Wilson of Lydstip House near Tenby, instances were detected of what appeared to be young germs developed within the area of the parent column; also of others based upon the united edges of two closely applied mature terminations; and they plainly could not therefore have sprung either from the side of the old corallites or from an interspace; while some could not be assigned to a definite position with respect to pre-existing stems. It is obvious, that where the growth was very irregular, and the vesicular or outer zone was squeezed into a vertical position or greatly compressed, germs and young columns may appear to occupy anomalous situations; and the difficulty in forming a right inference is increased when transverse sections cannot be consulted. Among the staple productions of the Clifton or Bristol dealers is however one, which possesses all the essential structures of the Derbyshire coral. It is apparently included by Mr. Phillips* under the designation *Cyathophyllum crenulare*; which is regarded as different from *Cyath. floriforme*, the term applied to Martin's fossil; but the distinction is only specific; and it remains to be ascertained, if under equally favourable opportunities for examination, any real variations exist. The Clifton specimens being calcareous are easily cut; and transverse sections containing illustrative examples of the mode of producing young corallites may usually be obtained. In an early state, the germ, situated in the vesicular zone and in general partly in contact with the wall of the parent, presents a small, round, oval or irregular area, defined by an opake white uneven line; and according to the degree of advancement, rudimentary lamellæ, everywhere equally imperfect, issue from the boundary: an incipient axis is also visible in the centre of the area. In the next stage, a second defining line appears, separated from the former by a narrow band, which is crossed generally by lamellæ, but is sometimes occupied in part by

* Geol. Yorkshire, Part 2. p. 202; *C. crenulare* and *C. floriforme*; and for delineations of the former consult pl. 2. figs. 27 & 28.

arched laminæ. At first, the line and band are limited to the free side of the young corallite, or that fronting the mature centre, and the line is united at each extremity with the wall of the parent. As however the offspring increased, the portion before stated to be in contact with the pre-existing mature boundary is separated; and an interspace is laid open, perfecting the range of the narrow band; while the second defining line is completed by an upward extension, on that side, of the old wall, or by an equivalent structure. In this state, the first-formed limit constitutes the partition between the lamelliferous and vesicular zones, and the second is the permanent wall of the added corallite. Remarks on further advanced conditions are unnecessary. Among the Russian polyparia before mentioned, four species of *Lithostrotion* are described*, three of which were believed to be new, and one to be identical with the *L. floriforme* of England. They all displayed fully the triple composition of the Derbyshire and Clifton fossils; and the first noticed species exhibited a sufficient number of young corallites within the boundary of the parent to prove that such was the essential mode of reproduction (p. 605); in the third species, *L. astroïdes*, a decided instance was also noticed (p. 608); and in the fourth, *L. floriforme*, cases were likewise believed to have been detected (p. 610); but in the second species, *L. mammillare*, "the young columns projected irregularly above the general surface, and in positions which rendered it difficult to imagine that they could have been in a young state included within the areas of the adjacent mature columns" (p. 607). The foregoing statements will, it is hoped, justify the conclusion drawn in 1845 respecting the prevalent mode of developing additional corallites in the fossils assigned to *Lithostrotion*. Many instances will occur to every collector in which it will be difficult to decide on the real mode; and if only such be accessible, they would lead to a different conclusion from that at which he has arrived. He begs to add, that he does not rest on the reproductive process alone for the establishment of *Lithostrotion* as defined in the Appendix before quoted.

It is now necessary, in order to show still further the uncertainty of the fossil originally termed *Lithostrotion*, to offer a few additional observations on carboniferous basaltiform corals. It has been already stated, that in the work on Russia by Sir R. I. Murchison, M. Ed. de Verneuil, and Count A. von Keyserling

* Count A. von Keyserling has united the four corals under one species, *Lith. floriforme*, but it is hoped that a careful consideration of the detailed characters will justify the original conclusions. He also includes *Stylastrea* in *Lithostrotion*; nevertheless the points of difference, noticed in a paragraph of this communication, are considered sufficient to justify a generic separation. (Reise in das Petschora-Land, pp. 152 & 154, 1846.)

(p. 619), the name *Stylastrea* was proposed for fossils considered as allied to the one described by Parkinson, and the following generic characters were given: "Columnar, lamellæ exceeding twelve; columns closely aggregated, easily separated; internal structure twofold—1st, a central area occupied by variously blended lamellæ or contorted laminæ, without a distinct persistent axis; 2nd, an outer zone, traversed by vertical, continuous, bi-plated lamellæ, not fasciculated; interstices occupied by numerous arched or vesicular laminæ; additional columns produced by subdivisions of the parent column" (*op. cit.* p. 621). The leading points of difference from *Lithostrotion* are a bi-areal instead of a tri-areal composition, and a fissiparous in lieu of a terminal gemmiferous mode of increase; but the subordinate distinctions must not be overlooked in estimating the value of the generic determinations. The agreements with Parkinson's fossil consist in the basaltiform configuration and the external characters of the aggregated columns, in the facility with which they may be separated; also in the plumose appearance of a longitudinal section*, and probably in the nature of the dissepiments between the lamellæ; but Parkinson does not allude to the composition of the centre, except that perfect terminations have a projecting star; leaving doubtful what would be the characters presented by a transverse section; and the comparison is still farther defective in no complete upper extremities of *Stylastrea* having been seen by the author; moreover the mode of increase is neither delineated nor described in the 'Organic Remains' (t. ii. p. 43, 44. tab. 5. figs. 3 & 6). Should the points of agreement be now considered insufficient to warrant a positive identification of any one of the fossils noticed in the remarks on *Stylastrea*† with Parkinson's coral, still they are deemed enough not to justify a decided generic separation. It is nevertheless fully admitted, that an absolute identification of that authority's coral, and consequently of those constituting *Stylastrea*, with Lhwyd's delineation was incorrect, the available points of comparison being too few. It must also be mentioned, that the proposed genus differs from Dr. Fleming's *Lithostrotion striatum* in wanting the "small, solid, central axis" (Brit. Anim. p. 508). Prof. M'Coy‡ has more recently described a new species of *Sty-*

* Parkinson, 'Org. Rem.' vol. ii. p. 44: compare the characters mentioned above with fig. 2 *a* of *Styl. inconferta*, App. A. pl. A; also with the description in p. 622, 'Geol. Russia,' &c. The Bristol or Welch coral noticed in pp. 619, 620, exhibits also in fractured vertical sections the plumose structure; and it is immaterial whether Parkinson alludes to the surface of separated lamellæ-plates, or to the interlamellæ-dissepiments, each structure when divided having a resemblance to a feather.

† Geol. Russia, &c. vol. i. p. 619.

‡ Annals and Magazine of Natural History, 2nd Series, vol. iii. p. 9, January 1849.

lastrea (*Styl. irregularis*); and he states that it "is remarkable for the nearly perfect transverse chambering of the central area;" a character delineated however to a certain extent in the Russian fossil *Styl. inconferta* (*op. cit.* pl. A. figs. 2, 2 *a*), but believed not to be persistent. Prof. M'Coy* has further described another carboniferous basaltiform genus, *Stylaxis,* also composed of adjacent, polygonal, easily separable tubes; and it is distinguished by having, "1st, a thin, flat, straight axis; 2nd, a broad inner area composed of numerous curved, vesicular plates in irregular rows converging upwards to the axis; 3rd, an outer area composed of smaller and more curved vesicular plates in rows inclining obliquely upwards and outwards." The mode of increase is likewise fissiparous (*op. cit.* woodcut, p. 119. fig. *a*). Two species are described, and one of them, *Stylaxis Flemingi,* is regarded by Prof. M'Coy as probably the *Lithostr. striatum* of Dr. Fleming; but he considers that authority to be wrong, in referring to Lhwyd and Parkinson's fossils as specifically identical with that noticed in the 'British Animals.' In the 'Archives du Muséum d'Histoire Naturelle' other species of *Stylaxis* are mentioned, and one of them, *Styl. Portlocki,* is stated to occur in the carboniferous series of Wales (Carbonifère, Galles, p. 453). *Nemaphyllum arachnoideum* of Prof. M'Coy is also transferred to the genus (*op. cit.* t. v. p. 454).

The reader has thus had brought under his attention the following basaltiform corals found in the carboniferous limestone of England, independent of the species of *Stylaxis* mentioned in the 'Archives':—

1. Lhwyd's *Lithostrotion sive Basaltes minimus striatus et stellatus.*
2. Parkinson's Welch fossil, identified by him, but on insufficient evidence, with Lhwyd's *Lithostrotion.*
3. Dr. Fleming's *Lithostr. striatum,* considered by that authority as equivalent to both the preceding fossils, a determination regarded as doubtful.
4. Mr. J. Phillips's *Cyathophyllum basaltiforme,* identified in the 'Geology of Yorkshire' with Parkinson and Fleming, but for the reasons before given believed to be distinct.
5. Prof. M'Coy's *Stylastrea irregularis.*
6. ——————— *Stylaxis major.*
7. ——————— ——— *Flemingi,* regarded by Mr. M'Coy as possibly the *Lithost. striatum* of Dr. Fleming.

Each of these fossils possesses the striated and stellated characters mentioned by Lhwyd in his definition, if such it can be considered; each of the latter six might therefore with equal

* Ann. and Mag. Nat. Hist., 2nd Series, vol. iii. p. 119 *et seq.*, February 1849.

propriety be assumed to be the fossil of that authority; and three of them (Nos. 2, 3 and 4) have been so identified. It would nevertheless, in the present state of knowledge, and the demand for detailed information, be altogether unjustifiable to refer any one of the series positively to Lhwyd's coral; and the author conceives that the subsequent investigations have fully supported the doubts which he entertained, when the Russian collection was under examination, as well as the correctness of the generic determinations then proposed.

In resuming the observations on *Lithostrotion,* it is necessary to state, that Prof. M'Coy in January 1849* considered the genus, as defined by the compiler of these memoranda, to be equivalent to the *Strombodes* of Schweigger †, adopting that naturalist's first division of the genus (Coni e centro proliferi) as its limits. It is not known whether the opinion is maintained; nevertheless should it be, the author feels assured that a reconsideration of the subject will afford grounds for doubting whether the known structures of *Lithostrotion* can exist in Fougt's ‡ *Madrepora composita,* confining the attention to figure 11 and diagram no. 4, to which alone Schweigger refers. The next known notice of *Lithostrotion* occurs in the Introduction to M. Milne-Edwards and M. Jules Haime's § first memoir on 'British Fossil Corals' (*op. cit. infra,* p. lxxii.). The genus is stated to consist of the *Lithostrotion* of Fleming in part; and the characters expressly mentioned are—"columella formed by a fasciculus of twisted bands, and the septa" (lamellæ) "subvesicular exteriorly and joining the columella along their inner edge." *Lith. floriforme* of Fleming is also given as the "typical species; but it is not known to what genus *Lith. striatum* was referred when the 'Introduction' was written. In the portions of volume v. of the 'Archives du Muséum d'Histoire Naturelle' published during the present year (1851) is a "Monographie des Polypiers Fossiles des Terrains Palæozoïques," also by M. Milne-Edwards and M. J. Haime; but *Lithostrotion* has different generic characters assigned to it; and in the General *Classification* of corals by which the monograph is preceded (p. 172), *L. striatum,* Fleming, is the "example" whereby the genus may be identified. The following are the generic equivalents and characters given in the body of the work (p. 432):—

Lithostrotion (pars), Fleming; *Lithodendron,* Phillips (non

* Ann. and Mag. Nat. Hist. 2nd Series, vol. iii. p. 10, January 1849.

† Beobachtungen auf Naturhistorischen Reisen. Systematic Table, 6, 1819.

‡ Dissertatio de Coralliis Balticis, 1745, apud Amœnitates Academicas, vol. i. p. 198, illustrative plate, fig. 11, and diagram no. 4.

§ Memoirs of the Palæontographical Society, first volume for 1850.

Schweigger)*; *Axinura,* Castelnau; *Stylastrea,* Lonsdale?; *Columnaria,* Dana (non Goldfuss); *Siphonodendron* et *Nemaphyllum,* M'Coy; *Acrocyathus* et *Lasmocyathus,* D'Orbigny.

"Polypier composé, se multipliant par gemmation latérale. Polypiérites entourés d'une épithèque complète, tantôt restant libres entre eux latéralement, tantôt complètement soudés par leurs murailles. Cloisons assez bien développées. Chambres viscérales présentant dans leurs parties extérieures des traverses vésiculaires, et dans leurs parties centrales des planchers bien développés, qui sont traversés par une columelle styliforme" (p. 432).

The first species described, *Lithostrotion Canadense* (p. 433, also explanation of plates, p. 483, with note [1]), is an American coral; but the remarks on the genus contain the accompanying observation:—"Fleming comprend dans ce groupe quatre espèces: la première avait déjà été anciennement nommée par Lhwyd, *Lithostrotion,* et c'est elle qu'on doit considérer comme le type du genre" (p. 432). In the following remarks therefore, those corals which possess the aggregated composition with the known structures of Lhwyd and Fleming's *Lith. striatum* will be regarded as the measure of generic comparison.

Respecting the genera of M. Castelnau and M. D'Orbigny the author can offer no remarks, not being able to consult their works; but *Lithodendron, Axinura, Siphonodendron* (M'Coy), and *Acrocyathus* are stated in the 'Archives' to be synonyms, and to have been separated from the species with laterally united corallites only on account of their free or lax habit of growth ("qui sont tous synonymes, et qui n'avaient pour but que de séparer les espèces à polypiérites libres latéralement de celles dont les individus sont prismatiques et soudés," p. 433). The comparison with *Lithostrotion* (Lhwyd and Fleming) will be confined therefore to *Lithodendron* (Phill.), the oldest of the branched genera, to *Stylastrea*?, *Columnaria* (Dana, not Goldf.), and *Nemaphyllum,* with remarks on one or two illustrative basaltiform fossils. Only the first of these genera possesses a prevailing branched mode of growth, the others having uniformly corallites which are closely aggregated. The corals forming the *Lithostrotion* of the 'Archives' are separable therefore into two portions, the first, or equivalents of *Lithodendron,* consisting of eleven species, and the second of eight; and they are arranged nearly in conformity with the prevailing habit of growth, though, in consequence of the views of the authors of the monograph, not in distinct sections.

* In the 'Introduction to the Memoirs on British Fossil Corals,' *Lithodendron* of Phillips is retained, but the *Lithodendron* of Schweigger is said not to be "an admissible genus," p. lxxi.; see also Appendix A. p. 597 *et seq.*, Geology of Russia, for earlier remarks, 1845.

With regard to the comprising in one genus of corals having free and united corallites, the 'Archives' contains the following remark:—"Nous nous sommes assurés, pour les polypiers présentant la même organisation que le *Lithostrotion striatum* de Fleming, que le dégré de rapprochement et de soudure des individus est très-variable dans une même espèce et par conséquent ne saurait avoir une importance générique" (p. 433). Reference is then made to *Lithodendron* and the other branched genera above enumerated; and in support of the opinion just given, *Lithostr. Canadense* may be quoted, though it is the only species in which a branched and massive composition is directly mentioned. It is however said to be "tantôt en touffe subdendroïde, tantôt moitié dendroïde, moitié astréiforme, ou tout à fait massif, suivant les divers dégrés de rapprochement des individus" (p. 433). From this statement it appears that that coral was liable to many variations of growth; and the corallites in the *Lithodendra* of Mr. Phillips are well known to be occasionally united with more or less flattened sides; but these conditions are only incidents of development. On the contrary, not one of the massive or asteriform species described in the monograph (p. 441 to p. 445) is shown to assume a partially branched habit. A variable growth marks moreover equally with an invariable one, important peculiarities in the polype, and may be rightly assumed as one valuable generic character. But it is not sufficient to state that corallites are partially or wholly united; the nature of the junction as well as the degree of structural blending should be detailed, so far as it can be ascertained; likewise the characters of lateral processes by which a connexion between more or less distant branches was effected. In *Lithostrotion Phillipsi* (Archives, the corallites are stated to be frequently united in little series by their sides, so as to call to mind somewhat the arrangement of *Halysites* (p. 439) or *Catenipora*; but Count Alex. von Keyserling *, who had described the coral, and referred it to *Lithod. fasciculatum* (Phillips), says they are united by short, often proliferous transverse tubes ("verbunden durch kurze, oft proliferirende Querröhren"); while in *Lithostr. Harmodites* (p. 440. pl. 15. figs. 1, 1 *a*) and *L. concameratum* (p. 441) connecting tubes are mentioned; similar in the former species to those of *Syringopora*; and in *L. Stokesi* the union is effected by expansions issuing from transverse ridges ("bourrelets," p. 440, pl. 20. f. 2). All the other species noticed in the 'Archives' are apparently destitute of such processes; and the junctions seem to have been accomplished either by simple contact or an extension of the cellular structure, which occurs immediately

* Reise in das Petschora-Land, pp. 170–171. tab. 3. fig. 2.

within the wall of the corallite. Sometimes contiguous branches in the *Lithodendra* of Mr. Phillips are not united, and can be separated without a fractured surface; but where a junction had taken place, the coalesced walls could not, in general, be severed without producing a scar on one or both of the stems. The corallites of *L. Canadense,* which had become prismatic by contact ("par rapprochement") are also stated to be often detachable by the hammer without breaking (p. 434). Mr. Phillips's fig. 14 (Geol. Yorks. pl. 2) of *Lithodendron irregulare* exhibits two instances of slightly distant branches being united by lateral developments; and polished transverse sections of apparently the same species gave many examples of the mode in which junctions had been formed among corallites very near each other, as well as in close contact. The latter showed along the line of junction a strong boundary-wall more or less flattened, and sometimes the adjacent cellular structure was slightly irregular. Where a small interval had existed, an outer extension of one of the corallites effected the union; and this elongation was wholly cellular, or similar to the portion of the stem from which it issued. The cells were as regularly formed and arranged as within the corallite; and there was no indication of a point, which might have become an axis, or the centre of an abdominal cavity. Moreover, no line of separation or partition-wall occurred between the extension and the body of the corallite; care being taken to guard against an inner circle of dissepiments; but at the junction with the other stem was a distinct wall, similar to that just noticed as existing in united contiguous surfaces. These lateral elongations were not regarded as incipient corallites, which had been impeded in their growth, for reasons given in the remarks on those productions. So far as observed, they, however, invariably issued from only one of the united branches, as if their development had depended upon some peculiar requirement in the polype: M. Milne-Edwards and M. J. Haime nevertheless state, that in *Lithostr.* (*Lithodendron*) *irregulare* the corallites, especially in the lower part, "portant des bourgeons dont beaucoup ont avorté et semblent s'être soudés aux polypiérites voisins" (Arch. p. 437). The nature of the processes above mentioned, and the conditions under which they were developed, as well as the extent to which their characters may have been influenced by direct contact in corallites, remain to be investigated and described. It is enough for the present inquiry to know, that they exist in certain species; and that in others, contiguous branches are often laterally united, and cannot under such circumstances be separated without fracture.

It is impossible from want of information to determine whether Lhwyd's fossil was separable with entire exteriors; and as Parkinson does not allude to the state of his coral when prisms were detached, it is equally difficult to arrive at a satisfactory inference respecting the amount of preservation in parted corallites of Dr. Fleming's *Lithostr. striatum*. The cabinet of Mr. D. Sharpe contains, however, specimens of a basaltiform fossil from the carboniferous limestone of Kendal, which resembles Parkinson's figures 3, 6 (Org. Rem. ii. pl. 5) in external configuration: rough transverse sections displayed also a "web-formed star" with traces of a central projection; and longitudinal sections exhibited "a plumose appearance" (consult *op. cit.* p. 44)—all of them farther points of agreement. The corallites separated easily, and the parted facets were entirely free from scars or other indications of fracture; while in one specimen they presented a continuous, opake white layer of a friable nature, but which, when viewed with a proper light, exhibited faintly longitudinal ribs, and more or less distinctly transverse rugosities; also minute thread-like transverse lines ranging the whole breadth of the facet and marking, it is believed, increments of growth; while not a vestige was visible of the minute cellular composition which occurs immediately within the wall, and is very conspicuous in purposely abraded or fractured surfaces. This opake, white layer evidently represented the original coral-matter, but in a friable state, probably from the abstraction of the animal portion; nevertheless as it occurred equally on each of the parted surfaces, it was inferred, that adjacent corallites are separable without fracture or the destruction of the minor structures. The detected characters moreover prevailed throughout the height ($2\frac{3}{4}$ inches) as well as breadth ($2\frac{1}{4}$ inches) of the specimen; and they therefore precluded, to that extent, the assumption of a local or periodical union. One specimen more completely occupied by calcareous spar had lost, to a great extent, the layer, but between the longitudinal striæ remnants of it existed, traversed by the supposed lines of increment; and where the wall had been nearly or entirely removed the internal or cellular composition was visible, but without the slightest indication of fracture. A basaltiform coral from Gower (South Wales), also in Mr. Sharpe's series of carboniferous fossils, presented characters similar to those of the last specimen; but some of the facets had been wholly deprived of their original investment, yet without fracture; and they displayed fully the cellular structure, or an irregular, white reticulation with meshes of dark carbonate of lime—the laminæ of the network agreeing in colour and substance with the walls above mentioned. It may be added, that the transverse lines of the reticulation had limited ranges, and that adjacent portions were on different levels; they were consequently quite dissimilar in character from the minute thread-like lines of the investing layer. The *Nemaphyllum* of Prof. M'Coy needs no remarks under this head, the corallites being described as inseparable (*op. cit.* p. 15). The author is unable from want of means to extend this portion of the inquiry into the characters of English basaltiform corals; but the Russian fossil to which he applied the term *Stylastrea inconferta* (Geol. Russia, App. A. p. 621–622) presented exteriors resembling those just mentioned; though he is not aware that *Styl. irregularis* (M'Coy, *op. cit.* p. 9) has similar minor structures. Lastly, as respects this character, Mr. Dana states, that his *Columnariæ* break into columns, without however mentioning the exterior condition of the parted corallites. A comparison of the limited materials thus brought under the reader's attention will afford the following points of difference as respects the connexion in branched and massive or asteriform species of *Lithostrotion* (Archives). In the former, juxtaposition, as before stated, is an occasional condition, and where a junction takes place, whether by processes or contact, a separation produces a fractured surface: on the contrary, in the massive species examined the corallites were uniformly contiguous; and when parted, they did not exhibit a disrupted, but a perfect exterior, as well as the minute lines of increment; while in specimens which had lost the coral matter during mineralization, or had been otherwise deprived of it, there was an equal absence of fracture—the exposed facets in the one case displaying casts of the original structures; and in the other, a smooth surface with an unbroken reticulation.

The precise mode in which additional corallites were produced in *Lithodendra* or branched species of *Lithostrotion*, the author believes, has not been described; and he is able to give but imperfect notices of early states in only two, referable he conceives to *Lithod. irregulare* and *L. sexdecimale* (Phillips). Polished transverse sections of the former afforded two examples of incipient branches. One of them, and probably the younger, presented a lateral semicircular projection, about half the diameter of the parent stem. The straight side, or that in contact with the old corallite, was situated within the substance of the latter, but was separated from it by a strong partition-wall—a fine, more opake line defining the boundary beyond the two bodies; while the curved portion protruded markedly beyond the periphery of the old branch, and had its own white wall. The minute area thus circumscribed was occupied principally by lamellæ-like plates, two or three of which ranged directly across it, or from the straight to the curved side; but the others had a more irregular outline, and were forked or connected by transverse laminæ. There was however no convergence to a centre; nor any medial point indicative of an axis; the plates bearing more the semblance of continued, previous lamellæ, than those which are originated in germs. It was impossible to consider this development, with its free semicircular outline and bold wall towards the parent stem, as a condition of the cellular extensions before mentioned, and in which, as already stated, no dividing structure exists: the composition also of the one differs wholly from that of the other. The second example of an addition in *L. irregulare* agreed in position, outline, and the existence of a perfectly environing layer with the first; but the structure within its area was not so distinct. Nevertheless, in the middle was a white spindle-shaped spot, possibly an incipient axis; and from the wall, on the straight side as well as the curved, issued rudimentary plates. No doubt was entertained that both these bodies were young corallites; and from the internal characters of the former, it was inferred that they were not strictly produced from germs, but contained within them partial extensions of structures which had entered into the composition of the parent. No instance was detected of a very early state in offshoots of *Lithol. sexdecimale,* but several of a more advanced stage. They were all smaller than the stems to which they were attached; and they had on that side a well-formed straight or curved wall, the concave outline of the latter being adapted to the convex exterior of the old corallite. They had more or less the contour of a horse-shoe, in consequence of oblique intersections; and around the wall were rudimentary lamellæ, the more prominent plates being generally on the side most distant from the parent stem. Other states farther advanced towards maturity were observed in both species; but they did not require special notice. A direct comparison between the reproductive process above imperfectly noticed, and that in the fossils of Lhwyd and Parkinson, or in the *Lithostrotion striatum* of Dr. Fleming and the *Cyathophyllum basaltiforme* of Mr. Phillips, cannot be established from want of information; nor was the mode detected in the basaltiform corals included in Mr. Sharpe's collection. The author is also unable to test the accuracy of his statement respecting the plan in *Stylastrea,* and regarding which the 'Archives' contains the following observation: "La prétendue multiplication par fissiparité signalée par M. Lonsdale, et qui a servi à cet auteur de caractère pour séparer cette espèce des *Lithostrotion,* nous semble être le résultat d'une mauvaise observation." (*Lith.*? *inconfertum,* p. 445.) He regrets that the grounds for correcting his error are not given; and he only conjectures, that what he believed to be a fissiparous operation, may be regarded by M. Milne-Edwards and M. Jules Haime as due to submarginal, gemmiferous developments. He ventures nevertheless to copy his account of what he noticed, and principally in the Russian coral to which he applied the term

*Styl. inconferta**, that the reader may form his own opinion respecting it, and be able to compare the statement with the characters assigned to young branches in *Lithod. irregulare* and *L. sexdecimale*. "The additional columns were produced by a subdivision parallel to one of the facets of the pre-existing column, and not by the development of a circular germ. Externally the partition was rendered visible by a line commencing in outer walls on opposite sides of a column, and ranging upwards, it almost immediately marked a clear boundary between two distinct columns." * * * * "In a section purposely made about half a line below the point where a subdivision was visible, the transverse under surface exhibited not the least sign of any irregularity in the lamellæ or in the interstitial plates. The young or offset column, which commenced immediately above the section (fig. 2 *b*), nearly subdivided the facets from which it sprung; but its area was much less than half that of the pre-existing column." * * * * "The structure exhibited in this uneven plane" (the obliquely fractured, upper surface of the young corallite, fig. 2 *b*, pl. A. *op. cit.*) "was much less regular than that in the section beneath, though not very different from the arrangement of the component laminæ near the sides of other columns in which no subdivisions existed: traces also of extensions upwards of the lamellæ of the undivided column were likewise detectable, indicating that the polype of the young column possessed, to a certain extent at least, the secreting membranes of the old."

From the foregoing statements respecting what had been observed in the reproductive processes of *Lithodendron* and *Stylastrea*, it is inferred, that additions were somewhat similarly effected in each case, or by an extension into the offspring of certain portions of the parent structures—that the operation was a modification of fissiparous productions—and that it should be carefully distinguished from purely gemmiferous developments.

The mode of increase in the *Columnaria* of Mr. Dana is not given in the description of the genus†. In *Nemaphyllum*, small circular buds were produced within the area of the parent star; and Prof. M'Coy's delineation exhibits the characters of a true germ. A marked difference therefore exists between the manner of effecting additions in that genus, and in *Lithodendron* or in *Stylastrea*.

As respects the internal composition of the fossils under consideration, the characters assigned in the 'Archives' to *Lithostrotion*, and before quoted, express very nearly the construction of the *Lithodendra* of Mr. Phillips, omitting the words "tantôt

* Geol. Russia, Appendix A. p. 620, commencing line 11, pl. A. fig. 2, 2 *a*–2 *c*.

† Exploring Expedition, Zoophytes, p. 362–363, 1846.

complètement soudés par leurs murailles" (Gen. Char. p. 432); provided the expression be rightly understood as applied to those species which are stated to be "massif" or "astréiforme." The existence of an axis is a point of agreement between the branched species (*Lithodendra,* Phillips) and certain of the massive. Mr. Phillips says, that his fossils have "a prominent central umbo or axis, generally oval in the section" (Geol. Yorks. ii. p. 202); while Dr. Fleming in his account of *Lithostr. striatum* mentions "a small, solid, central axis" (Brit. Anim. p. 508); and in the 'Archives' the only equivalent structure noticed among the generic characters is "une columelle styliforme" (p. 432). Whatever may be the intimate composition of these bodies,—and it may be stated, that in *Lithod. irregulare,* or in closely allied species, the axis is not solid, but formed of laminæ,—they apparently agree in presenting a small continuous structure, which to the unassisted eye is nearly uniform in dimensions and compactness. It is uncertain whether the *Cyathophyllum basaltiforme* of Mr. Phillips, and identified by that authority as well as in the 'Archives' (p. 442) with *Lithostr. striatum,* has an umbo or axis; and a similar doubt exists respecting Parkinson's *Lithostrotion,* likewise considered in the 'Archives' (p. 441) as equivalent to Dr. Fleming's species. Should however the "prominent star, one-third of the diameter of the" (terminal) "concavity" be regarded as an axis, still the structural composition is markedly different from what is detectable in the umbo of *Lithodendra.* Allusion is made in a former paragraph to a basaltiform coral from the mountain limestone of Kendal, and among other resemblances visible in transverse, fractured surfaces, to the characters mentioned by Parkinson, traces of a swelling in the centre of the corallite are noticed. The direct middle of these projections sometimes exhibited an irregular white spot, or a thickened line formed by the union of opposite lamellæ; and the two structures, in specimens purposely worn down, passed into each other, and often vanished entirely, the absence being evidently not due to decay, but to an altered mode of union in the lamellæ. A vertical section through the centre gave a very narrow area, occupied by a minute reticulation consisting apparently of the edges of lamellæ with transverse dissepiments, and not by a compact persistent body. Again, in the Russian fossil, *Stylastrea inconferta,* a styliform axis is manifestly wanting, not from decomposition, but from such a structure never having existed (consult Archives, p. 445, *Lithostrotion? inconfertum*). Prof. M'Coy in his description of a British species, *Stylast. irregularis,* also makes no allusion to an axis; on the contrary, he says, the centre of his fossil "is remarkable for the nearly perfect transverse chambering" (Ann. and Mag. of Nat. Hist. 2nd Ser. vol. iii. p. 9). The centre of the fossils composing the *Columnaria* of Mr. Dana "consists of oblique septa and cellules converging upwards into an axis;" and it is further said, that "this axis appears to be made by a convolution of the septa or their partial coalescence" (*op. cit.* p. 363; see also pl. 26. figs. 9*b* & 10). Between this structure and the solid axis of Dr. Fleming or of Mr. Phillips's *Lithodendra*, there is no resemblance. *Nemaphyllum* has however "a straight, thin, flat, fillet-like solid, or nearly solid axis" (*op. cit.* p. 15), which might readily be considered as only a modification of the structure in *Lithodendra* and *Lithostr. striatum*; but an agreement in this particular does not by itself warrant a generic union.

From these statements it appears, that among the fossils included in the *Lithostrotion* of the 'Archives,' some, as the species originally described by Mr. Phillips (*Lithodendra*), the *Lithostr. striatum* of Dr. Fleming, and the *Nemaphyllum* of Prof. M'Coy, have a "solid" or an apparently compact axis; while Parkinson's fossil and the supposed Kendal equivalent, also the *Columnaria* of Mr. Dana, have a large central projection of lax composition; and in *Stylastrea* as well as in *Cyathophyllum basaltiforme*, the existence of an axis cannot be affirmed. An agreement, as before mentioned, occurs therefore in certain branched and one massive or basaltiform species, omitting *Nemaphyllum* on account of its inseparable corallites; nevertheless the accordance does not constitute a generic identity even in the fossils in which it exists.

The next structure claiming attention is that which surrounds the axis. Mr. Phillips does not describe its composition; but his delineations of vertical sections (*op. cit.* pl. 2. fig. 17 & 19), possibly intended only as diagrams, exhibit simple laminæ inclined upwards and resting against the axis; though in the specimens examined they were often complex; occupying, however, as in the figures just quoted, a broad band on each side of the slender central body. In the 'Archives' the "visceral chambers" are stated to present "dans leurs parties centrales des planchers bien développés, qui sont traversés par une columelle styliforme" (p. 432). The transverse sections which were examined afforded diversity of character, according to their position with respect to the upturned laminæ. Sometimes the axis was surrounded by a clouded, ill-defined band, marking apparently a coincidence in the plane of cutting with the surface of one of those laminæ; occasionally an open zone occurred traversed by irregular, curved lines; and not unfrequently lamellæ ranged up to the axis. The equivalent portion of Lhwyd's coral is unknown; and Dr. Fleming in his account of *Lithostr. striatum* simply mentions the union of "the rays of the star" with a small solid axis—only one of the conditions in *Lithodendra*. The central projection in

Parkinson's *Lithostrotion* and in the Kendal fossil will possibly be regarded by most observers as an axis, in which case, as respects at least the latter, the zone under consideration will not exist. Regarding *Cyath. basaltiforme* no opinion can be hazarded whether it has a representative of this intermediate area; but in *Stylastrea,* if the transverse laminæ be considered an equivalent structure, then there is no axis. One of Mr. Dana's delineations of *Columnaria* indicates on each side of the central composition a narrow band (*op. cit.* pl. 26. fig. 9 *b*), which however becomes evanescent in the upper part of the figure; and his other vertical section (fig. 10) gives no analogous zone; while, according to the following extract from the generic description, he possibly did not consider that an intermediate band exists—"Corallum having the cells radiate, the middle within consisting of oblique septa and cellules converging upwards into an axis; texture exterior to the middle portion, cellular" (p. 363). *Nemaphyllum,* on the contrary, has an intermediate zone, or "a sharply defined cylinder of very minutely vesicular arched plates, the rows directed from the axis obliquely downwards and outwards;" and the illustrative woodcut expresses very nearly what is sometimes visible in the equivalent portion of *Lithodendra.* In that genus however, so far as is known, the zone is not "a sharply defined cylinder," and the circle occasionally shown in transversely cut corallites is an intersected upward-inclined plate; and not part of a continuous, vertical lamina as in Prof. M'Coy's figure (*op. cit.* p. 15). This will most probably be regarded by many palæontologists as an unimportant distinction, nor is it advanced as a valid generic difference by itself; but when taken in conjunction with the mode of reproduction, and the inseparable union of the stems, it forms one of a series of dissimilarities.

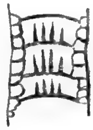
With reference to the agreements or otherwise in this portion of the *Lithostrotion* of the 'Archives,' it appears, that in the branched fossils referable to Mr. Phillips's *Lithodendra,* there is a large intermediate area of somewhat variable character, but essentially composed of curved laminæ inclined upwards and centrally—that in Lhwyd's fossil, Dr. Fleming's *Lithostr. striatum* and *Cyath. basaltiforme,* there is no authority for assuming its existence—that in Parkinson's *Lithostrotion,* also in the Kendal coral, and possibly in Mr. Dana's *Columnaria,* it is wanting, if the complicated central laminæ be regarded as an axis—and that in *Stylastrea* provided the transverse plates be an equivalent, there is no axis; while in *Nemaphyllum* an analogous zone is present, but in conjunction with other peculiar characters. Hence it may be inferred, that there is no prevalent agreement in this particular between branched and massive or asteriform species; and even in Lhwyd's *Lithostrotion* or Dr. Fleming's *L.*

striatum, the very existence of the most prominent part of *Lithodendra* remains to be ascertained.

The outer zone is simply stated in the 'Archives' to consist of "des traverses vésiculaires" (Gen. Char. p. 432); and Mr. Phillips's figures 12, 13, 15, 16 and 20, also 17 and 19, exhibit a narrow band similarly constituted, though each delineation varies somewhat in character. A specimen which afforded many transverse sections of a species probably referable to *L. fasciculatum* (Phill. pl. 2. figs. 16, 17) gave two conditions of this zone—one which presented simply alternations of very broad and very narrow lamellæ; while the other had equivalent plates connected by a more or less regular circle of arched plates, the narrow lamellæ projecting just beyond it, as in figure 16 (Phillips), or a series of somewhat quadrangular cells was interposed between the wall of the corallite and the circle. A polished slab thickly beset with transverse and oblique intersections of apparently *Lithod. sexdecimale* yielded a few examples almost as regularly constructed as in figures 12 and 13 (Phillips)—the characters being either a simple series of broad lamellæ united by a circle of diaphragms and forming a single circle of cells (fig. 12), or analogous cells indented by rudimentary lamellæ (fig. 13). The sections gave, however, very generally much less uniformity; and in oblique cuttings there was necessarily a total want of symmetry. The outer zone of the fossil which was believed to be *Lithod. irregulare* (Phill. figs. 14 and 15) had a similar composition, or a row of small cells adjacent to the boundary-wall, and a large inner series as shown in figure 15 just quoted; but in the specimens examined, care was necessary to reduce the exhibited structures to that type; and the arrangement was even then detectable only in the most directly transverse sections. The breadth of the zone was limited in all cases, but greatest in *L. irregulare*; and in some vertically cut corallites it was occasionally almost wanting. No opinion can be formed respecting the existence of a similar outer area in Lhwyd's fossil or in Dr. Fleming's *Lithostr. striatum*. Parkinson says that transverse sections of his coral resemble a spider's web, displaying "numerous and exceedingly slender longitudinal lamellæ corresponding with the external striæ," and "disposed perpendicularly from the circumference to the centre in a stellated form;" also "proportionally numerous and equally delicate lamellæ perpendicularly disposed nearly in concentric circles" (Org. Rem. ii. p. 44); and his figure 3 (pl. 5) displays exactly such a structure. No data however are given whereby the interior of the corallites can be separated into areas, except that the prominent star may constitute one, and all exterior to it another. Mr. Sharpe's Kendal fossil conjecturally associated with Parkinson's coral had also numerous delicate lamellæ, half of which, or every alternate plate, ranged to the centre, not in a straight line, but more or less waved; and the intermediate lamellæ stopt at what was supposed to have been the boundary of the central swelling. The dissepiments were likewise very numerous in the outer portion of the corallite, though not reducible to circles, being extremely irregular in position, distance and outline; while in the supposed axeal area they were much fewer. The breadth of the outer zone was about half that of the semidiameter of the corallite. In *Cyathophyllum basaltiforme* two portions probably exist, as "the marginal lamellæ" are said to "commence within a thin, crenulated, vertical dissepiment," and judging by the illustrative figures 21 and 22, the width of the areas is similar to that in the Kendal fossil. The outer part of *Columnaria* is "cellular," and its breadth bears to the inner the proportions just mentioned; equivalent characters as well as measurements occur also in *Nemaphyllum*. Lastly, in *Stylastrea* the outer zone is largely cellular, the lamellæ and dissepiments being distant, but the dimensions agree with those in the other basaltiform fossils.

A comparison of the characters just enumerated in the exterior area of branched and massive species of *Lithostrotion* (Archives), so far as they are known in the latter, and in apparently allied fossils, will give the following differences:—in Mr. Phillips's fossils the structures are reducible generally to one type—a series of small cells adjacent to the walls, and another within of larger dimensions, the two being separated more or less prominently by a circle of arched plates; and the breadth of the area is small, sometimes almost inconspicuous: on the contrary, in the massive corals the cells cannot be brought to a definite arrangement or shape, except in Parkinson's fossil, according to its description, and in that case there is no distinction between the cells next the wall and those situated elsewhere; the breadth of the area is also relatively great in every case, equalling almost uniformly half the semidiameter of the corallites.

Little can be said respecting the lamellæ, and that little is given chiefly to excite inquiry. In the 'Archives' they are stated to be pretty well developed—"cloisons assez bien développées;" and in the 'Geology of Yorkshire' to be "generally twisted or extinct near the centre." The latter characters were fully exhibited in the specimens examined during the present inquiry; but nothing is believed to have been published respecting the want of vertical persistence in the inner area; though such a condition is intimated in the remark, that the lamellæ are sometimes twisted near the centre, and sometimes extinct, as if the extension had depended on variations in growth. No evidence wholly satisfactory respecting this point has been obtained; nevertheless in longitudinal sections of the coral, believed to be *Lithod. fasciculatum*, some of the intervals between the inclined laminæ of the inner area were not wholly traversed by lamellæ, but presented a structure somewhat analogous to that given in the accompanying diagram. In the other species before mentioned no longitudinal sections were examined. Another particular in the lamellæ of *Lithodendra*, requiring investigation, is the composition. According to the specimens of *L. fasciculatum* and *L. irregulare* which were examined, the opake, white substance of the lamellæ was traversed along the middle, in transverse sections, by a fine translucent line, resembling in colour the calcareous spar which filled the cells and other lacunæ of the corallites. It was easily detected in the fossils considered identical with *Lithod. fasciculatum* and *L. irregulare*, occurring in the narrow plates as well as in the broad; but it was not discovered in *L. sexdecimale*. No lamellæ vertically divided, as in *Stylastrea*, were observed in a rough, partially fractured specimen of *L. irregulare*, though in polished, longitudinal sections of *L. fasciculatum* a translucent line often ranged down the middle of the vertical plates. The massive or basaltiform corals which were examined had in the inner area straight-edged lamellæ; and in Mr. Dana's *Columnaria*, Parkinson's *Lithostrotion, Cyathophyllum basaltiforme* and *Nemaphyllum* the structure is probably similar. How far any of the latter corals have lamellæ composed of two separable laminæ remains to be ascertained.



These defective observations afford no data for satisfactory comparison, as they do not rest on clear structural evidence. It is however probable that the membranes from which the lamellæ were produced had a periodical extension in one case, but not in the other; and in certain instances, as respects both branched and massive species, the lamellæ were apparently biplated.

A survey of the characters noticed in the preceding paragraphs of this article will afford the following conclusions regarding the fossils which have been the subjects of consideration: 1st, the habit of growth, mode of union, and external condition of parted stems are dissimilar in *Lithodendra* (Phill.) and the basaltiform corals which were examined—omitting *Nemaphyllum* from the summary, as it is believed not to be truly columnar, and to be otherwise essentially different from the Zoantharia with which it is associated in the 'Archives'; 2ndly, additional corallites seem to have been produced in branched as well as massive species by equivalent processes, or by modified fissiparous operations, and not by simple germs; 3rdly, the internal structures vary in the number of the component parts to the extent to which they could be ascertained; and in the characters of each part, or where an agreement exists in one particular, there are marked differences in others. Moreover not one of the massive species was so constituted, that it could be considered as possessing only specific modifications of the structures observed in the branched; while all the corals assigned to *Lithodendron* by Mr. Phillips have a unity of composition with subordinate differences; and among the massive Zoantharia some, at least, have also an aggregate of characters, but different from that of *Lithodendron*. Whatever value may be attached to these distinctions by some, the author conceives that they justify the retention of Mr. Phillips's genus—that as respects Lhwyd's fossil, there is a want of that amount of information which would warrant its being adopted as the basis of a genus—and that he was correct in limiting the term *Lithostrotion* to Dr. Fleming's second species, *L. floriforme*.

The author is unable to review each of the nineteen species described in the 'Archives'; but, that the reader may not have to rest on generic characters only, he begs to offer a few remarks on "*Lithostrotion basaltiforme*," which is identified with Lhwyd and Parkinson's fossils as well as with Dr. Fleming's *Lithostr. striatum*. The following are the assigned synonyms and characters (*op. cit.* p. 441–442).

1. *Lithostrotion*, Lhwyd, Lithophyl. Brit. Ichnog. tab. 23.

2. ————, Parkinson, Organic Remains, vol. ii. pl. 5. fig. 3, 6.

3. *Astrea basaltiformis*, W. D. Conybeare and W. Phillips, Outlines Geol. England and Wales.

4. *Astrea arachnoïdes*, De France, Dict. Sc. Nat. t. xlii.

5. *Lithostrotion striatum*, Fleming, British Animals.

6. *Columnaria striata*, De Blainville, Dict. Sc. Nat. t. lx.; Manuel d'Actinologie.

7. *Lithostrotion striatum*, S. Woodward, Synopt. Table, Brit. Org. Remains.

8. *Cyathophyllum basaltiforme*, Phillips, Geol. Yorkshire, t. ii. pl. 2. figs. 21, 22.

9. *Columnaria striata*, Milne-Edwards, Ann. de la 2e édit. de Lamarck, t. ii.

10. *Astrea hexagona*, Portlock, Report on the Geology of Londonderry, pl. 23. fig. 1.

11. *Astrea basaltiformis*, ibid.

12. *Lithostrotion striatum*, M'Coy, Synop. Carb. Foss. of Ireland.

13. *Lithostrotion microphyllum*? Keyserling, Reise in das Petschora-Land, tab. 1. fig. 2.

14. *Nemaphyllum minus*, M'Coy, Ann. and Mag. Nat. Hist. 2nd Ser. vol. iii.

" Polypier astréiforme. Polypiérites complètement soudés par leurs murailles et prismatiques; calices très-inégaux. Dans une coupe horizontale, on distingue des murailles extérieures, minces et très-nettes, et des murailles internes seulement indiquées par la limite des traverses vésiculaires qui emplissent les parties extérieures des loges; columelle petite, comprimée, mais un peu renflée au milieu; de 40 à 50 cloisons un peu serrées, extrêmement minces, très-finement flexueuses, alternativement un peu inégales; les grandes arrivant seules près de la columelle. Grande diagonale des grands calices 10, 12 ou même 15 millimètres (·39370, ·47244 and ·59055, or from more than $\frac{1}{3}$ to more than $\frac{1}{2}$ an inch); diamètre des murailles intérieures 5 ou 6 (·19685 and ·23622 of an inch)."

First as respects the altered specific name, adopted apparently from the 'Outlines.' The list of carboniferous corals, given in that work, includes the following announcement :—" *Astrea* basaltiformis. Lithostrotion. Luid. t. 23, and three undescribed species" (*op. cit.* p. 359). It is however a rule that "a name which has never been clearly defined in some published work should be changed for the earliest name by which the object shall have been so defined *;" yet in this case an undefined name has been substituted for one which had been defined, or *basaltiforme* for *striatum*. Moreover a reference in the 'Outlines' to Lhwyd cannot be regarded as a reference to a clear specific definition, or even to any definition, the terms employed being all applicable to more fossils than one and of different genera; and though Dr. Fleming's characters are not so precise as the present state of knowledge requires, still they give a limitation which enables the reader to separate Parkinson's fossil from *Lithostr. striatum.*

Before any general remarks are offered on the assigned specific characters and their amount of agreement with the generic, as well as with the fossils considered in the preceding list to be identical with Lhwyd and Fleming's corals, it is thought advisable to notice separately the *Astrea arachnoïdes* of De France † (No. 4 of the list). In the 'Archives' reference is made only to the 'Dictionnaire des Sciences Naturelles'; but De France in that work quotes Guettard's 'Memoirs' (t. iii. p. 510. pl. 52. f. 2) and Parkinson's 'Organic Remains' (vol. ii. pl. 5. f. 1. p. 40–41).

* Propositions for rendering the Nomenclature of Zoology uniform and permanent. Report British Association, 1842; also Annals and Mag. Nat. Hist. 1st Series, vol. xi. p. 266, 267, § 11 & 12.

† Not the *Astrea arachnoïdes* included in Lamarck, edit. 1836, t. ii. p. 420. No. † 43, a Maestricht fossil; nor the *A. arachnoïdes* of Fleming (Brit. Anim. p. 510), an oolite coral. (Parkinson, Org. Rem. vol. ii. p. 54, pl. 6. f. 4, quoted by Fleming.)

The figures there given have a general resemblance to each other, presenting an inner and an outer area; and they agree with Lhwyd's delineation in their numerous rays or lamellæ; but Guettard's fossil in the opinion of De France (*op. cit.* t. xlii. p. 384) had a centre or "axis *," which resisted the action of the weather, and gave rise to what Guettard terms "un couvercle" (Mem. t. iii. p. 510). This character would agree possibly with what Parkinson says respecting the centre of his *Lithostrotion* (Org. Rem. t. ii. p. 44), but not with Dr. Fleming's "small, solid, central axis" (Brit. Anim. p. 508), or with the "columelle styliforme" and "columelle petite" of the 'Archives' (Car. gén. p. 432; and Car. spec. p. 442); nor is such a structure exhibited in figure 2. pl. 52 (Mem.). In Parkinson's brief notice (Org. Rem. t. ii. p. 41) of the coral referred to by De France, no structural details are mentioned; but the figure (pl. 5. f. 1) was taken from a Swedish specimen, and the fossil is conjecturally identified with the Baltic fossil represented by Fougt †, and subsequently named by Linnæus ‡ *Madrepora ananas*—points which necessarily excite doubts respecting a specific agreement with Lhwyd's fossil. It is regretted that the data are not given for associating *Astrea arachnoïdes* with Lhwyd's *Lithostrotion* and Dr. Fleming's *L. striatum*; the remarks of De France and those of the authorities quoted by him being insufficient to satisfy an inquirer. Moreover the specimen from which the figure given in the 'Mémoires' and the accompanying explanation were derived, was obtained from Chaumont near Anvillers, three leagues from Verdun, a district believed to be geologically of the age of the oolites. It is possible however that the identification is with the smaller variety of Guettard's fossil mentioned only by De France, and found at Valogns (Manche) "dans les couches anciennes" (*op. cit.* p. 384). Nevertheless it would be satisfactory, had a note been given to fix the association with Guettard's original fossil or with De France's variety, as well as to define the locality and formation.

The chief distinction in the detailed specific and generic structures is the non-allusion in the former to central transverse laminæ or "planchers bien développés" (Car. gén. p. 432); and

* "Ce morceau, dont la surface paroit avoir été détruite, présente, ainsi que le dit Guettard, un couvercle au milieu de chacune des étoiles; mais ce couvercle n'est autre chose qu'un axe, qui, ayant présenté plus de solidité que les rayons, se trouve élevé un peu au dessus d'eux."—Dict. Sc. Nat. t. xlii. p. 384. "Ce morceau" alludes to a specimen in De France's possession.

† Dissertatio de Coralliis Balticis apud Amœn. Acad. t. i. p. 195, and illustrative plate, figs. 9, 8. Parkinson quotes only fig. 8 and the diagram No. 2.

‡ Systema Naturæ, edit. 10. t. i. p. 797, No. 35.

it is believed that their absence is a true distinction between the branched species or *Lithodendra* and the massive corals enumerated among the synonyms of the preceding list, so far as their composition is known, with the exception of *Lithostrotion microphyllum* (No. 13) given with a doubt, and *Nemaphyllum minus* (No. 14); in both of which an intermediate zone of arched laminæ exists similar to the plates in *Lithodendra*. It is also conceived, that the omission of the mode of increase in *Lithostr. basaltiforme* is correct, nothing being known respecting it in the fossils quoted as synonyms, except that in *L. microphyllum* (No. 13) new prisms were planted on the edges between the old corallites ("durch Einsenkung neuer Prismen in den Rändern zwischen den älteren"—Reise in das Petschora-Land, p. 156); and in the generic characters of *Nemaphyllum* (*N. minus*, No. 14), additions are stated to have been effected by "small circular buds developed within the area of the parent star" (Ann. and Mag. Nat. Hist. 2nd Ser. vol. iii. p. 15, and woodcut). The "columelle petite, comprimée, mais un peu renflée au milieu" (Archives, p. 442), agrees with the "columelle styliforme" of the generic characters (p. 432), and with the "small solid axis" of *Lithostr. striatum*; also to a certain extent with the central structure of *Nemaphyllum minus* (No. 14), and possibly with that of *Astrea hexagona* (No. 10); but there are no grounds for concluding that a similar axis occurs in Parkinson's *Lithostrotion* (No. 2), or in *Cyathophyllum basaltiforme* (No. 8), or perhaps in *Lithostr. microphyllum*? (No. 13). Again, the "polypiérites" are said to be "complètement soudés par leurs murailles" (p. 442), by which the author understands that they are so united as to be inseparable with smooth exteriors. In the remarks on the mode of union, given in an early part of this communication, a want of positive information on this point is mentioned as respects the original fossils of Lhwyd (No. 1) and Parkinson (No. 2); though, from the facility with which the corallites in No. 2 separated (Org. Rem. t. ii. pp. 43, 44), it may be inferred that an intimate union did not exist. On the contrary, in *Astrea hexagona* (No. 10), *Lithostrotion microphyllum* (No. 13), and *Nemaphyllum minus* (No. 14), a perfect union is apparently maintained. Not one of the fossils included under the head *L. basaltiforme*, so far as is known from descriptions or delineations, ever assumes the branched habit of growth of *Lithodendra*.

Very little remains to be said. The fourteen quotations contained in the foregoing list include *seven* distinct fossils, which are numbered 1, 2, 4, 8, 10, 13 and 14, the remaining seven, Nos. 3, 5, 6, 7, 9, 11 and 12, being only references to Lhwyd, Parkinson and Phillips, without any increase of structural details except in the case of No. 5, Dr. Fleming's *L. striatum*. Of the seven requiring notice, the first or Lhwyd's fossil has been shown to be almost wholly undefined; and it is as little qualified to be the basis of a species as it was before stated to be that of a genus. In the case of *L. striatum* the difficulties are increased by quoting Parkinson in addition to Lhwyd. No. 2 differs from the assigned characters of Dr. Fleming's fossil in the nature of the direct centre; and the comparison cannot be extended to the other internal structures. No. 4, *Astrea arachnoïdes,* is a doubtful coral, and does not admit of an identification with any one of those with which it is associated till full information is published; while No. 8, *Cyathophyllum basaltiforme,* also differs from *L. striatum* in the composition of its centre, and the comparison must be limited to that portion of the interior. Lastly, Nos. 11, 13 and 14 appear to have inseparable corallites; and it is not known if the published internal compositions exist in the *Lithostrotion* of Lhwyd and Dr. Fleming.

XXXVIII.—*Observations on the Genus* Rhizochilus *of Steenstrup.* By J. E. Gray, Esq., F.R.S., V.P.Z.S. &c.

[With a Plate.]

In the Proceedings of the Royal Danish Academy for May 1850, Professor Steenstrup has described a very interesting genus of univalve shells under the name of *Rhizochilus,* found attached to the axis of *Antipathes ericoides.*

Mr. Cuming, knowing the interest I take in the physiology of Mollusca, has most kindly allowed me to examine the three specimens which he has received from Dr. Steenstrup. The shell of this genus while the animal is growing is free, and would be considered in this state as belonging to the genus *Rapana,* nearly allied to *R. papyracea,* but of a more solid consistence; but when the animals have arrived at their full development, two or more congregate together in groups, each animal forming a more or less irregular, opake, white, solid shelly extension of the outer and inner lip, clasping the axis of the coral or the neighbouring shells, or both, and at length entirely closing the mouth of the shell, and firmly attaching the shells to the coral, or to one another, in such a manner that the animal is completely surrounded by a solid shelly case having no communication with the outer world but through the case of the anterior siphon of the mantle, which, by the contraction of the mouth of the shell, has been converted into a shelly tube. (See Pl. XVII. B. figs. 1, 2.)

This self-immurement of the animal within its shell has not been described in any other mollusk, and one is led to inquire if by so doing the animal commits voluntary suicide, or has a prolonged existence; if the latter, one should expect that it must be of a very torpid or lingering description, as the animal is entirely precluded from procuring its usual or indeed any other food for its subsistence, and the supply of water for respiration which can enter by the single siphon must be of a very limited quantity, there being only one aperture for its entrance and exit, in comparison with the continued current which usually circulates over the gills when the two apertures (one for entrance and the other for exit), which always exist in all Mollusca, are open for the purpose.

Many gill-bearing univalve mollusks are stationary; some, as the *Magilli* for example, live in holes like the bivalves in massive corals; and the *Vermeti* in tubes attached to the surface of marine bodies; but these animals keep themselves on a level with the surface of these bodies, even when enlarging like corals. The genera *Hipponyx* and *Calyptra* form a free cup-like base beneath their foot, and the genera *Pedicularia, Sabia, Tectura* and *Patella* sink pits into the surface of the shell or coral on which they happen to be attached; but all these animals retain the power, like the bivalve mollusks, of having two apertures for the water to their branchial cavity; but I cannot find in either of the two closed specimens of the genus *Rhizochilus* in Mr. Cuming's collection any trace of a second aperture.

Many of the lung-breathing Mollusca cover the mouth of their shell after the animal is withdrawn during the very dry, warm, or cold weather with a membranaceous or calcareous epiphragma, the animal during the time sinking into a torpid condition; but these animals have the power, at the first recurrence of damp weather, to remove this cover, which is not the case with the hard shelly secretions which cover up the mouth of the shell of *Rhizochilus*.

Many years ago I observed a somewhat similar phænomenon to that noticed by Dr. Steenstrup in a species of *Vermetus*, but I did not describe it, hoping to obtain more certain information, as I could not then assure myself that the contraction of the mouth of the tubular shell was the work of the animal which formed it, or of a parasite which adopted it as an habitation after the mollusk was dead.

These Worm-shells are of a dark brown colour, cancellated on the surface, much contorted together, with a free, erect end and a circular aperture. The mouth of many of these erect tubes are covered over with a thin, convex, shelly arch, with only a small hole in its centre not more than one-tenth part of the size of the mouth of the open tubes (Pl. XVII. B. figs. 4, 5, 6). They were brought from the African coast of the Mediterranean, and very much resemble the *Vermetus subcancellatus*, Philippi, Moll. Sicil. i. 172. t. 9. f. 20, who observes it is very frequent in Sicily; but Dr. Philippi does not describe the contraction of the mouth of the tubes, and hence it may be a different species. He refers to Chiaje's continuation of Poli, t. 57. f. 18, as giving a good figure of the animal of his species.

Chiaje, who gives no description to the plates, figures three specimens; two of them exhibit the animal of a *Vermetus* (given in more detail in fig. 19 of the same plate), and one which has a rather contracted mouth to the shell, with what appears to be an Annelide coming out of it. It was the knowledge of this figure that induced me to defer the account of this structure, but the interesting discovery of Professor Steenstrup leads me to believe that it is a peculiarity of the species, which has appeared to me to be most probably the case, as the shelly matter which covers up the mouth of the shell is of the same colour, texture, and structure as the rest of the shell, and only differs from it in being less strong and thick. These arched cases must as completely immure the animal as that of *Rhizochilus*.

Many species of *Ammonites* more or less completely contract and arch over the mouth of their shells when the animal has attained its full development; several specimens with the mouth so contracted are figured by D'Orbigny in his 'Paléontologie Française,' as *Ammonites Martinsii*, t. 125; *A. Braikenridgii*, t. 135 (copied Pl. XVII. B. fig. 3); *A. linguiferus*, t. 156; *A. Sauzei*, t. 139; *A. Bakeriæ*, t. 149; *A. bullatus* and *A. microstoma*, t. 142, &c. Mr. Owen, in his Lectures on Invertebrata (p. 332), mentions one with the mouth so closed which he observed in Mr. Pratt's collection. This species is from Normandy, and much resembles *A. Bakeriæ*. The mouths of the shells of the genera *Baculites* and *Scaphites* are also partially contracted.

It is to be observed that the *Vermeti* are attached the greater part of their life; the *Rhizochili* only become attached when the mouth is closed, but the *Ammonites* and *Baculites* and *Scaphites* remain free after the mouth is contracted or closed.

EXPLANATION OF PLATE XVII. B.

Figs. 1, 2. *Rhizochilus antipathicus*, from a drawing by Dr. Steenstrup, showing the shell with the mouth closed.
Fig. 3. *Ammonites Braikenridgii*, from D'Orbigny, Ter. Jurass. t. 135. fig. 5.
Fig. 4. *Vermetus subcancellatus* ?, natural size.
Figs. 5 & 6. The same, magnified, to show the arch over the mouth.

XXXIX.—*On the Germination of the Spore in the* Conjugatæ. By the Rev. William Smith, F.L.S.

To the Editors of the Annals of Natural History.

Gentlemen, Lewes, November 10, 1851.

Permit me briefly to record a circumstance of much interest as regards the germination of the reproductive body in the family of the *Conjugatæ,* and which may serve to vindicate the fidelity and discrimination of an eminent pioneer in the study of algology.

In examining the mud from a ditch in this neighbourhood, hoping to add to my list of local *Diatomaceæ,* I had the pleasure a few days since of discovering numerous "spores" of a *Tyndaridea* in every stage of germination. This phænomenon has hitherto been seen by but few observers, but among these few may be mentioned the honourable name of Vaucher; and so faithful are his observations, made nearly half a century since and with imperfect instruments, that his description will serve to record the precise facts I have observed, with the exception of the few words in italics, which are necessary to adapt his account to the species which has fallen under my notice. I quote from the passage as it is translated in the 'British Freshwater Algæ,' p. 22.

"Almost at the same instant and in the same day, or at least in the same week, all the grains of the *Tyndaridea cruciata,* of which I had many thousands, opened themselves by one of their extremities in the same manner as the two cotyledons of a seed whose embryo has become developed; and from the base of the aperture there issued a green sac, at first very small, but which soon extended itself in such a manner that it surpassed many times the length of the globule. In the interior of this sac appear soon *the twin masses of endochrome,* as in a *Tyndaridea* fully developed. The tube itself exhibits divisions, at first one, afterwards two, then a great number; at last the *Tyndaridea* detaches itself from its grain, and floats alone in the liquid, and then nearly in size, and with two extremities, which are *obtuse,* it resembles perfectly the plant which gave it birth."

This passage is immediately followed in Mr. Hassall's work by the following remark, upon which, with a multitude of specimens exactly according with Vaucher's description before me, I feel that it would be unnecessary to comment:—

"In this description Vaucher is doubtless altogether in error, and it is difficult to conceive in what way he could have been imposed upon; a careful microscopic examination of the 'spore' alone being quite sufficient to convince the observer that no such dehiscence as that represented by Vaucher could take place." (!)

I shall hope in a few weeks, when the Alga is in a more advanced state, and the process fully completed, to detail the circumstances attending it at greater length; in the mean time I hasten, not merely to record a fact of importance to the algologist, but to redeem from an undeserved censure the reputation of an observer, whose admirable writings were among the first to direct attention to a department of nature which had previously been treated with comparative neglect.

Yours respectfully,

WILLIAM SMITH.

XL.—*On some new Devonian Fossils.* By FREDERICK M'COY, Professor of Mineralogy and Geology, Queen's College, Belfast.

Steganodictyum (M'Coy), n. g.

Etym. *Στεγανὸς, covered,* and *δίκτυον, a network.*

Gen. Char. Polymorphous, forming either narrow, rounded, branch-like masses, or extended into thin, flat, foliaceous expansions; the interior of all the forms composed of rather large, irregular, polygonal or subhexagonal cells, the three dimensions of which are approximately equal (commonly about half a line in diameter), which become rapidly smaller towards the exterior, blending with the dense covering of the surface, which is variously sculptured with close waving lines, tubercles or costæ according to the species; surface dense, foraminated by the contracted, rather distant openings of the small cell-mouths.

These curious zoophytes abound in a particular layer of dark Devonian schist near Polperro on the coast of Cornwall, and are the bodies which have been taken for fossil fishes by all previous observers—the thick reticulated fragments being quoted as "bones of *Asterolepis*;" flat sculptured portions being taken for the scaly parts of various fishes, and the midribs of some of the fronds being supposed to be "Ichthyodorulites, as *Diplacanthus*, *Ctenacanthus*, and Upper Silurian species of *Onchus*." The supposed correctness of the latter identifications induced Sir R. Murchison to colour the part of the Cornish coast where these fossils occur as Upper Silurian, in his last map of that region. I first examined a good suite of these supposed Cornish fossil fishes at the Museum of Economic Geology, Jermyn Street, in company with Prof. Sedgwick last July, and at once demonstrated their true nature to Mr. Salter, who was kind enough to allow me to examine them closely. I subsequently examined the originally figured and described specimens at the Museums of Penzance and Truro, and finally visited the localities where they are found, and procured numerous specimens, now in the Geological Museum at Cambridge, as well as examined a great quantity not worth removing. The most remarkable character of these sponges is the thin, very dense, superficial covering to the coarse cellular internal network; which however might be almost paralleled by a slice of the common large cup-sponge of Ceylon. As so many authorities for whose opinions I entertain a high respect supposed the reticulation to be the cancellated structure of bone, I thought it due to them, that transparent microscopic sections should be prepared of some of the most bone-like portions and submitted to powerful microscopes, and for this purpose I trespassed on the kindness of my friend J. Carter, Esq., of Petty Cury, Cambridge, who possesses not only an extremely fine microscope, but admirable skill in the use of it and in the preparation of the objects. I have to thank him for not only putting slices of the present fossils under a high power, but making similar slices, for comparison, of fossil bones of various animals and of sponges—the results entirely confirming the opinion I had formed from an examination with my naked eye, namely, that there was no bone-structure whatever in the Cornish fossils; which indeed was obvious enough to any one reflecting on the way in which bones grow.

Steganodictyum Cornubicum (M'Coy).

Sp. Char. Fronds forming large, flat, slightly undulating expansions, about one line thick, and several inches long and wide, with irregular broad, transverse undulations or impressions; the middle supported by a thick, simple, gradually tapering, stem-like portion, which has a thickness and width of about three lines at 4 inches from the apex; surface of stem and frond, or lateral expansions, generally dark-coloured, dense, and uniformly marked with close, equal, broad, flat, longitudinal ridges, separated by deep sulci only one-fourth or one-third the width of the ridges (about eleven ridges in the space of two lines on all parts of the surface); the direction of the ridges is irregular, being sometimes over large spaces perfectly straight and parallel, but more usually much undulated; under a strong lens the ridges are seen to be punctured by numerous minute cell-openings, from one to three irregular rows to each ridge, rather more than their diameter apart; cell-structure of the interior, coarse, polygonal, averaging six cells in the space of two lines.

The midrib of this species is often found separated from the thin, foliaceous expansions, and has been then described as Ichthyodorulites of the genera *Onchus*, *Ctenacanthus* and *Diplacanthus*. I have however repeatedly noticed its contact with, and gradual passage on each side into, the flat, similarly striated frond.

Extremely abundant in a bed of blackish Devonian shale in Lantic and Lantivit Bays on the south coast of Cornwall near Polperro, and striking into Fowey Harbour, accompanied by occasional specimens of the *Bellerophon bisulcatus*, Röm. (the Devonian shell confounded with the Silurian *B. trilobatus* by those English geologists who have quoted that species from the British Devonian strata).

(*Col.* University of Cambridge.)

Steganodictyum Carteri (M'Coy).

Sp. Char. Flattened expansions, often less than one line thick; internal cellular structure rather finer than that of the *S. Cornubicum*: surface covered with subequal, elongate oval prominent tubercles, averaging twice as long as wide (half a line long), arranged sometimes in quincunx, sometimes in irregular lines, the rows from half a line to one line apart, but usually three to four tubercles in a space of two lines; flat spaces between the tubercles marked with a parallel striation, usually oblique to the tubercles, crossing those which are but slightly elevated, but obsolete on the more prominent ones (about nine sulci in a space of one line); both tubercles and oblique sulci punctured by the openings of the minute cell-mouths, which are about their diameter apart, and averaging eight to nine in a space of one line.

This species is very much rarer than the *S. Cornubicum*, from which it is easily distinguished by its tuberculated surface. I have great pleasure in dedicating it to my friend Mr. Carter.

Rare in the dark Devonian schists of Lantivit Bay, Cornwall. (*Col.* University of Cambridge.)

Uncites lævis (M'Coy).

Sp. Char. Longitudinally ovate, oblique; entering valve when young ovate, with the front and lateral margins broadly rounded, when old becoming very gibbous and subrhomboidal from the convergence of the sides to a narrow rounded front; receiving valve obtusely subcarinate along the middle when old by the nearly flat sloping of the sides, the front margin not perceptibly elevated, and the lateral margins nearly horizontal; beak very large, sharply pointed, and widely arched inwards obliquely to one side, the under part of the beak widely channelled with obtusely angular or rounded lateral margins; surface smooth, or only marked by the concentric lines or imbrications of growth towards the margin. Length of receiving valve $2\frac{1}{2}$ inches, proportional length of entering valve $\frac{75}{100}$, width $\frac{60}{100}$, depth of both valves $\frac{55}{100}$. Thickness of shell in beak of receiving valve 2 lines, above the beak of entering valve on one side 5 lines, on the other side 4 lines, diminishing the cavity to 2 lines in diameter; thickness of shell about the middle of the sides of receiving and entering valve 3 lines, diminishing to little more than 1 line along the middle, and gradually thinning to the margins; length of young specimens 9 lines, proportional length of entering valve $\frac{80}{100}$, width $\frac{80}{100}$, depth of both valves $\frac{45}{100}$.

The general narrow elongate form, and the oblique torsion of the long, narrow, claw-like beak in this species, exactly reminds us of the *Uncites gryphus* of Defrance, from which it is distinguished by the absence of the longitudinal sulcation. Having first ascertained the true internal characters of that curious Eifel fossil, it gave me great pleasure to recognise in our British rocks a second species of this remarkable genus. I should have imagined that the *smaller* of the two figures given in Sowerby's 'Mineral Conchology' under the name of *Terebratula porrecta* represented a young individual of this species, on account of the narrow produced front, but as Mr. Sowerby himself has since stated (G. T. 2 S. vol. v. expl. of t. 56) that those figures represented the *Strigocephalus Burtini*, and as all writers seem to coincide in that opinion, I have only to observe, that the present fossil, by the complete absence of internal septa, and the external characters above enumerated, has no affinity whatever therewith.

Not uncommon in the Devonian limestone of Newton Bushel, Devonshire.

(*Col.* University of Cambridge.)

Orthis persarmentosa (M'Coy).

Sp. Char. Transversely oblong, hinge-line nearly the length of the shell, ends obtusely subtruncate, slightly rounded; surface covered with thick, rugged, rounded, flexuous, radiating ridges, about half their thickness apart (about five in three lines in the middle of the shell at six lines from the beak), branching four or five times between the beak and margin, counting about 130 at the margin of a large specimen, those towards the sides straighter and finer than those in the middle. Average width 3 inches; length probably one-third of the width, but cannot be stated accurately, owing to the distortion of all the specimens.

This species very closely resembles the *O. sarmentosa* (M'Coy) of the older rocks in form, and the peculiar twig-like mode of branching of the ribs on the middle of the shell, and the straighter and finer one of the sides, but is distinguished by the very much greater number of the ridges. As in the case of that species the distortion is usually such, that I can make no probable approximation to the proportional length. The coarseness of the ridging separates the present species from the American *Strophomena nervosa* and *S. bifurcata* (Hall) of the Chemung group.

Common in the Devonian shale of Polruan, Cornwall; in the reddish Devonian schists of E. Looe; schists of Fowey.

(*Col.* University of Cambridge.)

Strophomena gigas (M'Coy).

Sp. Char. Rotundato-trigonal; hinge-line equal to the width of the shell; sides gently convex, converging to a narrow, much-rounded front; valves much flattened, slightly convex; surface radiated with very numerous fine, close, obtuse striæ, separated by narrower finely punctured impressed lines, every fifth, seventh, or ninth of which seem larger than the rest, about sixteen striæ in two lines at an inch from the beak, fifteen in the same space at the margin 3 inches from the beak; cardinal area broad: internal casts of receiving valve in adult specimens show the pair of muscular impressions, forming a slightly bilobed or subtrigonal mass, about one-third wider than long, and reaching rather more than one-third the length of the shell, each side marked with six or seven very coarse radiating ridges; mesial septum very small. Average length 3 inches 2 lines, proportional width $\frac{95}{100}$ to $\frac{100}{100}$, width of cardinal area nearly 2 lines.

This gigantic species in its elongate-elliptical or subtrigonal form, arising from the narrow rounded front, precisely agrees with *Orthis subarachnoidea* of MM. D'Archiac and De Verneuil (Geol. Trans. 2 S. vol. vi. t. 36. f. 3), but differs from it in the larger striæ at subregular intervals between the group of smaller, as well as its great size. I have seen and made drawings of a large number of specimens in the private collections of persons at or near Looe, although there is only one indifferent specimen in the University collection; I am therefore better prepared to decide on the characters of the species than I should otherwise have been.

Common in the Devonian shale of Looe, and of Polruan, Cornwall.

(*Col.* University of Cambridge.)

Strophomena nobilis (M'Coy).

Sp. Char. Semicylindrical; entering (?) valve very gibbous near the beaks, strongly arched downwards into a subcylindrical deflected front, the sides of which are slightly flattened to join the obscurely defined ears, which project from the gibbous beak, and are nearly rectangular; front rounded: surface radiated with narrow distinctly defined ridges, of about equal thickness throughout; about twenty originating from the beak, between each pair of which, after about the length of 1 inch, a new ridge equal to the primaries in size is developed, so that nearly over the whole shell the subequal ridges are little more or less than a line apart; the intervening spaces slightly concave, three times wider than the ridges, crossed by very deep, strong, irregularly curved concentric wrinkles, not crossing the ridges, scarcely four in a longitudinal space of three lines; entire surface, ridges and furrows marked with very fine slightly irregular longitudinal distant striæ, nine in the space of 1 line, strongly punctured when the outer layer of shell is removed. Width at hinge-line 2 inches 4 lines, proportional length about the same, depth (greatest at one-third from the beak) $\frac{65}{100}$.

This fine species is so completely unlike any other, that it is unnecessary to point out the distinctions; the nearest analogue apparently being the comparatively little, flat, few-ribbed *Orthis undulata* (M'Coy, Synopsis of the Silurian Fossils of Ireland, t. 3. f. 22. of the Silurian Series), with which however it has no specific affinity.

Devonian limestone of Torquay.

(*Col.* University of Cambridge.)

Leptodomus constrictus (M'Coy).

Sp. Char. Oblong, or subtrigonal from the projection of the very prominent beaks; valves very tumid towards the anterior side, greatest depth at about one-third from the beak, anterior end subtruncate, projecting but slightly towards the ventral portion beyond the line of the beaks; anterior lunette very large, ovate, deep, smooth; a deep narrow sulcus extends from the beak, slightly widening to the nearly straight ventral margin, which it meets at about 50°, forming a small sinus; posterior side much compressed, posterior slope not defined, posterior end obtusely subtruncate with a slight obliquity; hinge-line straight, rather shorter than the posterior side; anterior side and middle of the valves deeply marked with coarse concentric wrinkles, arising from the edge of the smooth anterior lunette, and most of them becoming abruptly obsolete on the posterior half of the shell; those near the margin of old specimens about one line wide, gradually diminishing towards the beak. Length 1 inch 2 lines, proportional width from beak to opposite ventral margin $\frac{77}{100}$, length of anterior lunette $\frac{37}{100}$, width of posterior end about $\frac{65}{100}$, depth of one valve about $\frac{40}{100}$.

This species in size, shape, subtruncate anterior end, and coarse concentric wrinkles of the anterior half becoming obsolete on the posterior portion, almost exactly resembles the *L. truncatus* (M'Coy) of the Upper Ludlow rock, but may be distinguished easily by the strong divisional sulcus from the beak. I suspect the fossil from Baggy Point, referred by Phillips (Pal. Foss.) to the Silurian so-called *Cypricardia impressa* of Sowerby, may be found to belong rather to the present species.

One young specimen, 5 lines long, of the left valve, and two large specimens in opposition of the right valve, have occurred in the "yellow sandstone" of Marwood, N. Devon.

(*Col.* University of Cambridge.)

Clymenia quadrifera (M'Coy).

Sp. Char. Discoid, compressed, nearly two-thirds of the whorls concealed; whorls about four and a half, crossed by very minute sigmoid striæ; periphery* narrow, obtusely rounded; septa with the middle portion crossing the periphery small; *first sinus* small, oblique, very obtusely rounded; first lobe nearly in the middle of the side, nearly square, slightly rhomboidal, length and width about equal, truncated at the broad extremity, the angle next the umbilicus rather more obtuse, and the other slightly more acute than a right angle, sides subparallel; second sinus slightly higher than the first, extending with scarcely any curvature to the umbilicus, its width double that of the lateral lobe, which is placed nearly in the middle of the side; dia-

* In descriptions of discoid Cephalopod shells, as Ammonites, &c., conchologists almost invariably use the terms "*back* or *dorsal*, and *ventral*," exactly in the opposite sense to what anatomy or the position of the animal would indicate. I therefore propose to use the term "*periphery*" for that part commonly called by describers of these shells the "back," or by anatomists the "ventral aspect," as the use, at this late period, of the latter term would bring much unnecessary confusion into the descriptions; for the opposite edge of the mouth I use the term "inner edge." In describing the septa of the same shells and for the same reason, instead of "*dorsal lobe*" I use the term "*mid-lobe*," or "*inner mid-lobe*," for the so-called "*ventral lobe*" of Von Buch and all other describers. Instead of "first lateral superior, first lateral inferior, and first, second, &c. auxiliary lobes," terms which are unnecessarily complex, I propose to number and describe the lobes simply as first lobe, second lobe, third lobe, &c., reckoning from the outer *mid-lobe*, or, as it has usually been called, the dorsal lobe. The word *sinus*, I think, may be used instead of saddle for the inflexion between each pair of lobes.

meter 1 inch 3 lines, proportional diameter of last whorl $\frac{54}{100}$, width of mouth at edge of umbilicus $\frac{31}{100}$, width of periphery about $\frac{17}{100}$.

This species is easily distinguished from all others by the remarkably defined, nearly square form of the lateral lobe. It is most allied to the *Clymenia striata*, Münster, from which it is easily distinguished by the very obtusely rounded, obscurely defined first sinus, and the regular, almost square-formed lobe and the scarcely curved margin of the second sinus; the cast of that species is also marked by sigmoid ridges, of which there is not the slightest trace on the second species. I have seen traces both of the *evanescent* thread-like middle and lateral keels occasionally noticed on the other species.

Very rare in the limestone of S. Petherwin.

(*Col.* University of Cambridge.)

Clymenia Pattisoni (M'Coy).

Sp. Char. Discoid, compressed, of about five whorls, rather more than one-third of each being concealed by the preceding turn; section of the whorls semielliptical, greatest thickness near the edge of the umbilicus, which is considerably wider than the whorl; sides very slightly convex, gradually converging to the obtusely rounded periphery, to which there is often superadded a very fine thread-like mesial keel and two lateral ones; surface finely striated transversely; siphon large, close to the inner margin; septa about one-third the width of the side apart, with the middle portion nearly transverse, no lateral lobe, but the edges after about the middle of the side arching backwards and then forwards again to the edge of the umbilicus, forming an obtusely rounded first sinus, which extends backwards about half the space between the septa farther than the middle portion. Diameter 9 lines, proportional diameter of umbilicus $\frac{48}{100}$, of last whorl $\frac{40}{100}$; width of mouth $\frac{25}{100}$.

This species belongs to that very restricted first group of *Clymenia* according to Münster, in which the edges of the septa are only slightly arched; it is most nearly allied to the *C. compressa*, Münster, from which however, on comparing with authentic specimens, I find it differs by the great size of the umbilicus, which in that species is much less than the last whorl, forming scarcely $\frac{30}{100}$ of the entire diameter. The septa differ from all of this group in the greater forward curvature of the umbilical end of the edge of the septa, thus forming a distinct rounded *sinus*, from which the edge passes with very little curvature across the outer half of the sides and periphery, forming no lateral lobe or medial saddle (*sinus*) as in the other allied forms; this flection forward to the umbilicus distinguishes this part very strongly from *C. lævigata*, which also has very much more numerous whorls and larger umbilicus. I have much pleasure in dedicating this species to Mr. Pattison of Launceston, to whose labours in collecting, I believe, are due the discovery of nearly all the British specimens of *Clymenia*.

Rare in the Devonian limestone of S. Petherwin.

(*Col.* University of Cambridge.)

Cyrtoceras subornatum (M'Coy).

Sp. Char. Gradually arched, involute; section of the whorls a regular transverse ellipse, the shortest axis in the plane of involution, tapering at the rate of 5 lines in 2 inches from a diameter of 1 inch 5 lines; periphery broadly arched, inner face rather more convex; sides elliptically rounded, with an obscure spiral ridge on each side along the most prominent part, bearing a row of large obtuse conical tubercles, nearly twice their diameter apart; on each side of this principal row of tubercles is a secondary obscure row, about half as far from the principal ridge as the tubercles of it are from each other, the outer of these rows most distinct, the inner nearly obsolete; these three sets of tubercles are connected by very obscure transverse wrinkles, which do not extend beyond them across the inner aspect, or the periphery; entire surface crossed by very minute, imbricating waving lines of growth having a very obtusely angular backward sinus in the middle of the periphery, all crossed by very faint longitudinal folds half a line apart, never assuming the prominence of striæ or ridges; siphon close to the outer margin. Proportional length of mouth as compared to the width $\frac{80}{100}$.

This beautiful species is most nearly allied in form, size, septa, siphon and striation to the *C. ornatum* (Goldf.), as figured by D'Archiac and De Verneuil in the 'Geol. Trans.' vol. vi. t. 28. f. 5, but is rather less rapidly curved, and is completely distinguished by the two or three rows of tubercles being very small, and entirely confined to the sides, leaving the broad periphery completely free of them.

One fragment in the Devonian limestone of Plymouth.

(*Col.* University of Cambridge.)

BIBLIOGRAPHICAL NOTICES.

Beiträge zur Naturgeschichte der Turbellarien. Von Dr. Max. Sigismund Schulze: Greifswald, 1851.

Contributions to the Natural History of the Turbellaria. By Dr. Max. S. Schulze.

This is an especially *German* book. To a considerable, and happily an increasing, number of English naturalists the meaning of this epithet is plain enough, but we fear that there is a still larger number to whom it will be very doubtful whether thereby we confer praise or blame.

To these the term "German" has a dire and mystical import, compounded of "Rumpel-Stiltskin," the writings of Mr. Carlyle, and Oken's 'Physiophilosophy,' the chief sources whence their knowledge of the literature and science of our Saxon fatherland is derived; the resulting impression being, for the most part, that the secret of German authorship consists in writing what is unintelligible in the greatest possible number of capital letters.

Doubtless there is something of truth in this popular impression, as in all popular impressions; but it may be worth while to look further into the matter.

The cloud of dust in the desert *may* be kicked up by a mere troop of wild asses; but the wise traveller will remember that it may also hide the strength of an army.

Dust enough about the tents of cur German sheiks there indubitably is, and good Mr. Bull, averse in his very nature to everything that is not neat, trim, close-shaven and well-brushed, will see nothing else, and passes by on the other side with coughs, curses, and a copious pouring forth of such adjectives as cloudy, mystical, metaphysical, and, if the worst come to the worst, perhaps pantheistical.

Yet, as we said before, it may be well not to sit down finally in this belief.

In the domain of literature and critical learning it is coming to be a very current opinion, that whatever be the practical results, in purpose and aim Germany is ahead of us. There is a laborious attention to details combined with a philosophic breadth of view and freedom of speculation;—there is an earnest piety in the search after truth, joined to the widest toleration for results, which, though not unknown, is far too little known on this side of the water.

It would be impossible for one branch of human activity to stand alone in these respects, and German science has not escaped the noble contagion of the example of German literature. It may be fearlessly asserted, that in no country does science as a whole stand on so high a footing as in Germany.

In no other country do the savans so clearly comprehend the great truth, that the man of science is also an artist—that he should strive to give a roundness, a symmetry, and a completeness to all his works, however small and seemingly insignificant, and that in proportion as he does so is he nearing the true goal, and freeing himself from the suspicion of wasting his time on elaborate trifles.

"Eh man! for Guid's sake leave off skinning slugs and be a man!" quoth a Professor of Greek to a Professor of Natural History; and though happily the reproach was much misplaced where it was applied, it might we fear be addressed with great justice to many of those who follow natural science in England.

We gloat over new species and gather together as many slides with "objects" on them as would roof in the Crystal Palace; we tax our mechanists and opticians to make us instruments whereby we may view these things; and all the while, the living, moving, feeling works of God, of which these are but shreds and fragments, are neglected, and the grand laws which rule their being, undiscovered. As if a foreigner wishing to become acquainted with the English in the 19th century were to go to Monmouth Street and study the old clothes, shutting his eyes to the men and women who elbow him.

It is as the antithesis of all this that we called Dr. Schulze's a peculiarly German book. The animals which he has investigated are nearly allied to the well-known *Planariæ,* and are found plentifully enough in both fresh and salt water. Now two methods of proceeding lay open to him:—either, following the approved Anglican mode (having first set up an elegant cabinet full of drawers, filled with neatly-made glass cells), he might have scoured the country, bored his friends, and caught his death of cold in seeking these worms, singing Io Pæan whenever they afforded a sufficient pretence for inventing a new dog-latin name (which is called discovering "a new species"), and finally have consigned his treasures to the cabinet aforesaid to be eventually "figured and described" in some exquisite and useless work;—

Or, as Dr. Schulze *has* fortunately preferred doing, he might have acquired a thorough knowledge of a few species, entering, with an insight which can only result from wide knowledge, into the details of anatomy, histology, development and chemical composition; comparing and, so far as possible, reconciling the discrepant statements of other observers, and therefore possessing a thorough acquaintance with the literature of his subject; in a word, fulfilling the Horatian rule in art, and making his work "totus, teres, atque rotundus." Such is the German method. If we were to find a fault in this case, it would be with a certain diffuseness and needless repetition.

We subjoin the chief results at which Dr. Schulze has arrived:—

1. The integument of the straight-intestined (*Rhabdocœla*) *Turbellaria* consists of a soft homogeneous finely granular base, which bears the cilia and contains many clear spaces in its interior. In this it resembles the substance of the body of the Infusoria and Hydræ (sarcode of Dujardin, formless contractile substance of Ecker); it is distinguished from it however by the fact, that on treating it with certain reagents, especially diluted ammonia, it becomes broken up into regular pieces, each of which consists of an aggregation of vacuolæ (Hohlräumen) and the appertaining connecting substance. This breaking up can only be explained on the supposition, that each re-

gular piece was originally a cell; the wall and contents of the original cells are metamorphosed into the sarcode-like substance, whose origin out of cells has not yet been demonstrated; the cells themselves however are not so fused together as to be inseparable by reagents.

2. The columnar bodies of the *Rhabdocœla* and freshwater *Dendrocœla* consist of a peculiar substance distinguished by its difficult solubility in alkalies and its ready disintegration by water and dilute acids. They differ widely from the urticating organs or "Thread-cells" of the Acalephæ and Polypes. In many kinds they have a peculiar relation to the nervous system, and may be probably regarded as subserving the development of the sense of touch.

3. The green colouring matter of *Vortex viridis* and *Mesostomum viridatum* is identical with the chlorophyll of plants; so is that of *Hydra viridis* and *Stentor polymorphus*.

4. The nervous system is developed in all families of *Rhabdocœla*, and consists of two ganglia united by a commissure, or of a double ganglion with the threads proceeding from it.

5. The organs of sense occur as eyes with or without lenses, and as auditory organs.

6. The hard parts of the male organ consist of a substance similar to chitin, distinguished from it however by its solubility in boiling solution of caustic potass.

7. The hard shell of the ova of *Rhabdocœla* and *Dendrocœla*, of *Clepsine*, *Nephelis*, and *Hydra viridis*, consists of chitin.

The polypidom of Sertularidæ and Campanularidæ consists of chitin.

8. In a new species of the Nemertidæ, *Tetrastemma obscurum*, living young were observed in the body of the parent, while hitherto the Nemertidæ were only known to be oviparous. The development of the young takes place without metamorphosis.

9. The development of the stylet of *Tetrastemma* goes on thus—the handle arises separately as the nucleus of a cell; the style, on the other hand, is taken from the preformed lateral style-sacs (Spitzentaschen); hence it may be concluded that the styles of the lateral sacs are afterwards to be regarded as really styles in reserve.

10. In the same Nemertid, as well as in *Prorhynchus stagnalis*, a new freshwater species, there exists a water vascular system whose existence in the Nemertidæ was not yet known.

We had intended to comment at some length upon some of these statements, but our space will allow of only a hasty reference to a few of the more important:—

1. The conclusion that the tissues of the Turbellaria are the result of cell-development; that therefore the law of Schwann prevails here no less than in the rest of the animal kingdom; and that thence the sarcode of Dujardin (the formless contractile substance of Ecker) has no right to be considered as a special histological element, will, we believe, be fully borne out in other cases. The substance of the Polypes (including *Hydra*), of the Medusæ, of the Sponges, may always, with proper precautions, be shown to be composed of true nucleated cells. These cells frequently manifest "protean" contractile

properties, but so does the white corpuscle of the human blood which is an indubitable cell.

2. It is interesting to observe that the similarity of the "columnar bodies" of the *Rhabdocœla* to the "thread-cells" of the Medusæ, Polypes, &c. is only superficial, and that therefore the value of the existence of the latter bodies, as a character, is not weakened.

We believe it to be very probable that further investigation will show that the existence of "thread-cells" in *Eolis* is only accidental, and that the genuine "thread-cell" is as characteristic of the Polypes and Acalephæ as the mammæ of the Mammifera.

3. In all probability, to this list of animals containing chlorophyll should be added *Spongilla fluviatilis*. Its occurrence in so highly organized animals as the Turbellaria is however very interesting, and removes one more of the supposed distinctions between plants and animals.

5. To this catalogue of organs of sense, we believe that the ciliated pits of the Nemertidæ might be added as either gustatory or olfactory organs; such ciliated pits in connection with the nervous centres, and very probably subserving one or other of these functions, are found in *Amphioxus*, the Tunicata, and the Rotifera.

7. The existence of chitin in the Turbellaria, in *Clepsine*, *Nephelis* (which confirms Grube's statement that it is found in the Annelida), and the Hydroid Polypes (to which, according to Grube, we must add the Nematoid worms), is a fact of great value, as its presence has been regarded as characteristic of the Arthropoda.

Finally, the demonstration with which Dr. Schulze furnishes us of the true structure of the Nemertidæ, gives a new proof, if any were wanted, of the extreme value of the microscope, as a means of checking the results of dissection among the Invertebrata. More would be done for the true knowledge of the structure of the Nematoid worms by the lucky discovery and careful examination of some very transparent species, than all the labours of the knife and forceps have hitherto effected.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 9, 1850.—John Gould, Esq., F.R.S., in the Chair.

Description of five new species of Anodontæ, collected by H. Cuming, Esq. in the East Indies. By Isaac Lea.

Anodonta gracilis. *A. testâ latâ, subcylindraceâ, inæquilaterali; valvulis tenuibus; natibus subprominentibus; epidermide luteâ; margaritâ vel albâ vel purpureâ.*

Hab. Dingle, Isle of Panay.

Diam. 1; length 1·7; breadth 3·4 inches.

Remarks.—This species is more cylindrical than is usual with the *Anodontæ*, and differs from the other species taken by Mr. Cuming in this character: it is rounded anteriorly, and is subangular posteriorly. The dorsal margin is nearly straight, the basal margin is slightly emarginate, the disc being disposed to be flattish. In the specimens under examination, the beaks are all more or less eroded, but in the youngest there are slight indications of undulations. The ligament is thin and long; the marks of growth are distant and rather dark, and the epidermis in the young is yellow or greenish, in the older it is darker and brown; the anterior cicatrices are distinct; the dorsal small, and placed in the cavity of the beaks.

The five species herein described are remarkable in the character of the dorsal line, which rises immediately under the margin into a dentoid line, somewhat lamellar, and approaching in its character the more distinct tooth of the genus *Dipsas* (Leach). In the younger specimens this is much more distinctly marked, and in the older it becomes obsolete. This group of *Anodontæ*, having this dentoid character, would seem to form a natural connexion on one side with the genus *Dipsas*, and on the other with the genus *Unio*, connecting with *U. Bengalensis*, brought by Dr. Burrough from India, and described by me in the 'Trans. Am. Phil. Soc.' vol. vi. pl. 2. fig. 3. This peculiar form of tooth, if it may so be called, is peculiar to that part of the world, so far as my observation extends; for among the numerous species examined by me from Europe, Africa and America, South as well as North, I have never met with this character developed as in those alluded to above.

ANODONTA CREPERA. *A. testâ ellipticâ, subcompressâ, inæquilaterali; valvulis tenuibus; natibus subprominentibus; epidermide tenebroso-fuscâ; margaritâ vel albâ vel purpureâ.*

Hab. Bongabon, Luzon, Philippines.

Diam. 1·1; length 1·8; breadth 3·3 inches.

Remarks.—Five of the six specimens under examination are purple, the sixth whitish. The outline is nearly oval. One of the specimens is obtusely biangular posteriorly; the substance of the shell is slightly thickened anteriorly; the beaks are too much eroded to observe any undulations; the ligament is rather short and thin; anterior cicatrices distinct; dorsal cicatrices small, and placed in the centre of the cavity of the beaks. The species is closely allied to *A. tenuis*, but is not quite so thin and is more transverse. Three specimens of the young have a well-defined anterior lamellar tooth and a distinct posterior raised line, which in the left valve is slightly divided. This is so marked in these young specimens, that one would scarcely hesitate to place them among the *Uniones* if we had not the adult, which have scarcely a vestige of the elevation on the dorsal line.

ANODONTA TENUIS. *A. testâ ellipticâ, compressâ, inæquilaterali; valvulis pertenuibus; natibus subprominentibus; epidermide tenebroso-fuscâ.*

Hab. Sual, Luzon, Philippines.

Diam. 1; length 1·7; breadth 3 inches.

Remarks.—This is very closely allied to *An. crepera* herein described, and may, perhaps, when more specimens of the old and young of both species are compared, prove only to be a variety. The specimens before me, however, differ in the *tenuis* being rather thinner and less elliptical, the outline inclining to oblong. The existence of teeth in the young, and the rudiments on the dorsal line in the adult, are very similar to the *crepera*. Of the four specimens before me, two have the nacre purple and two white. The beaks are too much eroded to observe any marks of undulations. The ligament is rather long and thin. Anterior cicatrices distinct; dorsal cicatrices small, and placed in the centre of the cavity of the beaks.

Anodonta subcrassa. *A. testá oblongá, subinflatá, subæquilaterali; valvulis subcrassis; natibus prominentibus undulatisque; epidermide luteo-fuscá; margaritá albidá, colore salmonis tinctâ et iridescente.*

Hab. Laguna de Bai, Luzon, Philippines.

Diam. 1·2; length 1·7; breadth 2·9 inches.

Remarks.—It is rare to meet with an *Anodonta* of the thickness of this species, but it still is not so ponderous as the *arcuata*, Fer., or as *lato-marginata* (Nobis). It cannot be confounded with either of these species, not being arcuate, and not having compressed beaks like the former, and being oblong and thinner than the latter, as well as also being destitute of the broad margin. The substance of the shell is slightly thickened anteriorly, and the basal margin is emarginate; the beaks are submedial, and when perfect are beautifully ornate with numerous small folds which form an acute angle from the point of the beaks, nearly parallel to the line of the umbonal slope; the ligament is short and rather thick; anterior cicatrices distinct; dorsal cicatrices large, and placed in the cavity of the beaks. The colour of a single young specimen before me is salmon inclining to purple, and the adults have the cavity of the beaks tinted in this manner. In the young specimen the lamellar line on the dorsal margin is very well defined, in the adults this character is nearly obliterated.

Anodonta Cumingii. *A. testá ellipticá, compressá, inæquilaterali; valvulis subcrassis; natibus vix prominentibus; epidermide atro-fuscá; margaritá albâ et iridescente.*

Hab. Malacca.

Diam. 1; length 1·9; breadth 3 inches.

Remarks.—This is an interesting species, and remarkable in the form of the dorsal line, which is thickened and raised immediately under the beak, where it is slightly incurved. This disposition to form a curve tooth reminds us of that group of *Naïades* which M. D'Orbigny discovered in the rivers of South America, and which comprise his genus *Monocondylæa*. In fact, this species forms a perfect link between the *Anodontæ* and his genus, and it is allied very closely to that species of this group which I described in the 'Trans. of the Am. Phil. Soc.' vol. viii. pl. 18. fig. 39, under the name of *Margaratina Vonderbuschiana*, from Java. The form of the tooth of the *M. Bonellii* also approaches to these. The anterior margin of the *Cumingii* is rounded, the posterior is somewhat biangular; the anterior cicatrices confluent; the dorsal cicatrices form a line across the cavity of the beaks. In all the four specimens under examination, the beaks are too much eroded to observe any undulations. An unusually dark line marks the course of the pallial impression.

Note on Tragelaphus Angasii. By Mr. Proudfoot.

The skins which I exhibit to the Society are those of an old ram and of a young female Antelope, which I shot on the banks of the Mapoota River, about sixty miles above its embouchure into Delagoa Bay. This river flows through the country of Mankazána, king of the Mathlengas (or Cutfaces), which people call this animal *Inyala*.

It is also found on another river called Umcoozi, running into St. Lucie Bay in the territory of Umpanda, king of the Zoolu, but very rarely.

On the Mapoota the Inyala are more numerous, and occur in small troops, composed of one ram and four or five females with their young. They are always found in the densest bush: they browse chiefly on shrubs, and resemble the Bush-buck in their general habits.

The average height of an adult male is within a third of an adult Koodoo, and very much above that of a Bush-buck.

The female has no horns, resembles a female Koodoo in form, and is rather smaller in size.

July 23.—W. Yarrell, Esq., V.P., in the Chair.

On new species of Birds from Australia. By J. Gould, F.R.S., F.Z.S. etc.

On the present occasion I propose to characterize seven more of the novelties sent home by Mr. MacGillivray, Naturalist to H.M.S. 'Rattlesnake.' *Vide* Ann. Nat. Hist. vol. vi. p. 137.

Tanysiptera Sylvia.

Bill and feet sealing-wax red; crown of the head, wings, and five lateral tail-feathers on each side blue; ear-coverts, back of the neck and mantle black; in the centre of the latter a triangular mark of white; rump and two middle tail-feathers pure white; all the under surface cinnamon-red.

Total length, 15 inches; bill, $1\frac{1}{2}$; wing, $3\frac{5}{8}$; lateral tail-feathers, 3; middle tail-feathers, $9\frac{1}{8}$; tarsi, $\frac{1}{2}$.

Hab. Cape York, Northern Australia.

Remark.—About the size of *T. Dea.* Fine specimens are contained in the British Museum collection.

Halcyon (Syma?) flavirostris.

Bill fine yellow, passing into brown at the tip; crown of the head, back of the neck, ear-coverts and flanks cinnamon-red; at the back of the neck a narrow, broken collar of black; throat and lower part of the abdomen tawny white; back and wings sordid green; rump and tail greenish blue.

Total length, 7 inches; bill, $1\frac{7}{8}$; wing, 3; tail, $2\frac{1}{2}$; tarsi, $\frac{1}{2}$.

Hab. Cape York, Northern Australia.

Remark.—Smaller, but nearly allied to the *Syma Tirotoro* of M.

Lesson. Some specimens have the crown of the head black. Fine specimens are contained in the collection at the British Museum.

Drymodes superciliaris.

Lores white; immediately above and below the eye a black mark, forming a conspicuous moustache; crown of the head and upper surface reddish brown, passing into chestnut-red on the rump and six middle tail-feathers; remainder of the tail-feathers black, tipped with white; wings black, with the base of the primaries and the tips of the coverts white, forming two bands across the wing; throat and centre of the abdomen fawn-white; chest and flanks washed with tawny; bill black; legs fleshy brown.

Total length, $8\frac{1}{4}$ inches; bill, $\frac{7}{8}$; wing, $3\frac{3}{4}$; tail, 4; tarsi, $1\frac{5}{8}$.

Hab. Cape York, Northern Australia.

Remark.—About the size of *D. brunneopygia.* Fine specimens in the British Museum collection.

Carpophaga assimilis.

Head, throat and ear-coverts grey; all the upper surface, wings and tail golden green; wing-coverts with a spot of rich yellow at the tip, forming an oblique band across the shoulder; line down the centre of the throat, chest and abdomen rich purple; under wing-coverts, vent, thighs and under tail-coverts rich orange-yellow; basal portion of the inner webs of the primaries and secondaries purplish cinnamon.

Total length, 14 inches; bill, 1; wing, 7; tail, 6; tarsi, $\frac{3}{4}$.

Hab. Cape York, Northern Australia.

Remark.—Very similar to *C. magnifica*, but considerably less in all its admeasurements. Specimens in the British Museum.

Chlamydera cerviniventris.

Upper surface brown, each feather narrowly margined, and marked at the tip with buffy white; throat striated with greyish brown and buff; under surface of the shoulder, abdomen, thighs and under tail-coverts light pure fawn colour.

Total length, $11\frac{1}{2}$ inches; bill, $1\frac{1}{4}$; wing, $5\frac{3}{4}$; tail, 5; tarsi, $1\frac{5}{8}$.

Hab. Cape York, Northern Australia.

Remark.—Intermediate in size between *C. nuchalis* and *C. maculata*, and distinguished from both by the fine fawn colouring of the under surface. A specimen in the British Museum of the male, apparently somewhat immature.

Nectarinia Australis.

Crown of the head and upper surface olive-green; over and under the eye two very indistinct marks of yellow; throat and chest steel-blue; remainder of the under surface fine yellow; bill and feet black.

Total length, $4\frac{3}{4}$ inches; bill, $\frac{7}{8}$; wing, $2\frac{1}{8}$; tail, $1\frac{1}{2}$; tarsi, $\frac{5}{8}$.

Hab. Eastern coast of Australia.

Remark.—Differs from *N. frænata* in its larger size, in its straighter bill, and in the stripe of yellow over the eye being almost obsolete. Specimens in the British Museum.

MONARCHA LEUCOTIS.

Crown of the head, back of the neck, back, primaries and six middle tail-feathers black; the three lateral tail-feathers on each side black with white tips; lores, a broad mark over the eye, ear-coverts, sides of the neck, scapularies and upper tail-coverts white; throat white, bounded below with black, the feathers lengthened and protuberant; chest and abdomen light grey; bill and feet lead-colour.

Total length, $5\frac{3}{4}$ inches; bill, $\frac{5}{8}$; wing, $2\frac{3}{4}$; tail, $2\frac{3}{4}$; tarsi, $\frac{5}{8}$.

Hab. Cape York, Northern Australia.

Remark.—About the size of *M. trivirgata.* Specimens in the British Museum.

A MONOGRAPH OF MODULUS, A GENUS OF GASTEROPODOUS MOLLUSCA, OF THE FAMILY LITTORINIDÆ. BY ARTHUR ADAMS, R.N., F.L.S.

MODULUS, Gray.

Animal with the head proboscidiform, the tentacles tapering, with the eyes near their distal ends. Foot small, the sides simple, without lobes or filaments. Operculum thin, horny, orbicular, paucispiral. Shell globose or conical, whorls nodulous; aperture round, or quadrangular, not pearly within; columella anteriorly with a prominent lamelliform tooth; umbilicus more or less open.

Modulus, *Gray.*—Turbo, sp. *Adanson*—Monodonta, sp. *Lamck.*—Monodonta, *Swains.*—Morulus, *Reeve.*

The aperture of the shell not being pearly within, and the animal being destitute of eye-peduncles, head- and foot-lobes or filaments, at once distinguishes this genus from *Monodonta,* and removes it from the family *Trochidæ.*

1. MODULUS LENTICULARIS, Chemnitz.

Trochus lenticularis, *Chem. Conch.* 5. t. 171. f. 1665.
Trochus modulus, *Linn. Gmel.*
Hab. Mexico. (Mus. Cuming.)

2. MODULUS TECTUM, Gmel.

Trochus tectum, *Gmel.* p. 3569. no. 16.
Monodonta retusa, *Lamck. Encyclop.*
Hab. Siquejar, Philippines; *H. C.* (Mus. Cuming.)

3. MODULUS CARCHEDONICUS, Lamck.

Monodonta carchedonicus, *Lamck. Hist. An.s.Vert.* tom. vii. p. 33; *Chem. Conch.* 10. t. 165. f. 1583, 1584.
Monodonta Sayii, *Nuttall.*
Hab. Atooi, California; *Nuttall.* (Mus. Cuming.)

4. MODULUS CIDARIS, Reeve.

Morulus cidaris, *Reeve, Elements of Conch.* p. 141. pl. 13. f. 63.
Hab. St. Estivan; *H. C.* (Mus. Cuming.)

5. MODULUS CERODES, A. Adams. *M. testâ turbinatâ, umbilicatâ, albidâ, fusco sparsim inquinatâ, lævigatâ; anfractibus*

rotundatis, supra planulatis, in medio cingulâ bituberculatâ, infernè cingulis nodulosis ornatis; aperturâ rotundâ; labio purpureo tincto, labro intus lævigato; umbilico profundo, callo columellari subobtecto.

Hab. ad Fretum Mosambicum. (Mus. Cuming.)

6. Modulus duplicatus, A. Adams. *M. testâ orbiculato-conicâ, umbilicatâ, cærulescenti, fusco variegatâ, spirâ prominulâ, acutâ; anfractibus planulatis, transversim sulcatis, ad peripheriam cingulis duabus tuberculorum compressorum ornatis, tuberculis rufo-fusco maculatis, infimâ fasciâ convexâ, concentricè sulcatâ; aperturâ intus violascenti; labro margine angulato, intus lirato; umbilico mediocri.*

Hab. ——? (Mus. Cuming.)

7. Modulus obliquus, A. Adams. *M. testâ orbiculato-conicâ, perobliquâ, albâ, umbilicatâ, spirâ depressâ; anfractibus subplanulatis, liris transversis, elevatis, supra radiatim nodoso-plicatis, ultimo in medio angulato, carinâ prominulâ instructo, infra cingulis transversis elevatis numerosis ornato; aperturâ rotundâ; columellâ roseo tinctâ; labro intus lirato.*

Hab. Mare Rubrum. (Mus. Cuming.)

Eglisia Cumingii, A. Adams. *E. testâ turritâ, solidâ, albidâ, longitudinaliter fusco-flammulatâ; anfractibus rotundatis, cingulis acutis, transversis (in anfractu ultimo sex), lineisque elevatis, transversis, interpositis, ornatis, interstitiis longitudinaliter tenuissimè striatis, varicibus tenuibus, longitudinalibus, inæquidistantibus, instructis; aperturâ rotundatâ, peristomate continuo, labio incrassato, anticè producto, calloso, et reflexo; labro simplici, acuto.*

Hab. Japònia. (Mus. Cuming.)

The obscure longitudinal varices show the true position of this genus to be between *Turritella* and *Scalaria*.

MISCELLANEOUS.

A Description of some of the Objects which cause the Luminosity of the Sea. By Charles William Peach, of Peterhead, N.B.*

[With a Plate.]

There is pleasure in knowing, even when far distant from a spot where so many bright days of our existence have been spent, and where so many valued friends reside, that institutions with which we are connected are still in existence, and to feel that a link of that chain which has so long held us together is still in our possession, and that the time is fast approaching when those kindred spirits will be assembled at one of their annual gatherings, to whom that link,

* Communicated by the Author; having been read at the last Annual Meeting of the Royal Institution of Cornwall in 1850.

though ever so small, will prove acceptable. Impressed with that belief and under such feelings, I have resolved to give you the last of the observations I was enabled to make, on the luminous objects which presented themselves to my notice before I left Fowey for this distant spot: I have only to regret that they are so few, still I trust they will not be altogether uninteresting. I shall first continue my journal-like form.

Date 1849.	Sea.	Animals, &c.	Weather, &c.
Nov. 8th & 14th.	Luminous. Very ditto.	Sagitta ——. Thaumantias octona. T. inconspicua. Mysis, and other crustaceans; very abundant indeed.	Very unsettled indeed; at times cold, then hot; now wet, then dry; in fact, very unstable. Herrings the whole time plentiful in the harbour.
Nov. 30th, 11 P.M.	Luminous.	Some few crustaceans which twinkled in the shade of the boat and vessels.	*Full Moon.* — Bright, clear, with occasional black clouds and showers. A most splendid lunar rainbow, colours bright. I never saw one so brilliant, although I have seen many, both from fog and rain, when I was a night-wanderer.

The objects figured in the accompanying sketches I observed at different times when the sea was luminous, and the whole of them added their twinkle to the illuminations. I am not aware that any have been noticed before as occurring in Cornwall.

Plate XVII. figs. 1–3.—A Sagitta, very glass-like and perfectly transparent, and consequently most difficult to see; it moves by jerks; the head has two fin-like appendages, one on each side; the eyes small, black and square, scolloped on the outer edges. I could distinctly see the working of the jaws.

Fig. 4.—One of the same kind. I obtained it in a small quantity of sea-water, which Mr. Forbes, artist, of Invernettie, near Peterhead, N.B., took up for the sake of the exuviæ of a Balanus. It was a trifle larger than the Cornish ones, and had two rounded pieces in front of the tail-fin, one on each side. As well, I was able to see the double circulation going on in the tail—(see the direction of the arrows in the sketch)—the circulating medium was granular, slightly coloured brown, and passed upwards in a narrow stream, on the outer sides of the tail, until reaching the body, then turned down again on each side of a line in the centre of the tail, until again joining the mass from whence it started. The granules left the lower part at first by one or two at a time, but soon got into a dense stream. I understand this animal has been fully described in the 'Magazine of Natural History.'

Figs. 5 & 6.—Has occurred to me twice, and is probably the early state of an Annelide; it was very active, nearly transparent, divided into eighteen segments, with a yellowish line down the centre of the whole and which was much darker towards the tail; on each segment were two dark spots; and long fine pointed hairs extended the whole length of the animal beyond the tail. The head had much the appearance of a cat, and my youngest boy, with child-like simplicity, called it "the little sea-cat," and would not let me rest until I had sketched it. The head was divided into three parts, the centre one being raised; on each side of this raised part were the crescent-shaped dark eyes, large in proportion to the animal; between the eyes three small dark spots; on each side of the snout were whisker-like appendages, spoon-shaped at the end; on each cheek a fan tipped with pointed hairs, which with the whiskers moved at times rapidly; at the hind part of the head two hoop-like ears—these also moved freely. It had, as well, short hairs on the tail, broadest at the outer end; these, as well as those on the head, were in rapid motion whenever the animal moved about, but quiet when it was at rest.

Figs. 7–9.—*Thaumantias lucifera,* which by some means had got into contact with a Sagitta. Whether it had employed the Sagitta to remove a bone which it had in its throat, after one of its delicate repasts, as the wolf did the crane, or not, I am unable to say: if so, he was not so honourable as the wolf; for despite of all the exertions of the Sagitta to free itself, and although the swallower's stomach was turned outwards in the struggle, he still refused to let him go; and the only difference that I could see was, the lips were pressed tighter round the head of his mouthful than before; for I frequently saw him, previously to the turn-out, smacking his lips, as if like the smoker of the present day he was enjoying his cigar: no doubt the dread of separation rendered this tight embrace necessary, having met with a very rough customer. This appears to me to be a proof positive that the Medusæ prey upon other animals, and hesitate not to attack those of large size, if they fall in their way; for I cannot believe this intrusion into the stomach of the Medusa arose from any Paul-Pry accident on the part of the Sagitta. It was a fearful struggle, maintained with great obstinacy on both sides, and which I watched for a quarter of an hour. I left them still locked, at 2 A.M., hoping at daylight to see the result of the affair, but found the vanquisher and the vanquished had vanished, and left only a very minute granular wreck behind. This rapid destruction is not uncommon among the minute objects which swarm in the sea; for as soon as the least weakness or sign of decay takes place, the still smaller scavengers fall upon them, and in a very short time all trace of them is lost—so abundant and so voracious are these sweepers.

TIME OF SPAWNING OF BRITISH CRUSTACEA.

To the Editors of the Annals of Natural History.

GENTLEMEN, Weymouth, Nov. 3, 1851.

I INCLOSE you a table of data which may probably assist in determining the times of spawning of twenty-four species of Crustacea taken at Weymouth. I have taken many other species, and many other specimens of the species of which I now inclose the list, but not one carried ova. I think it would be as well to make a list with all the data, and by this means we might, were the observations carried out at different parts of the coast, fill up a hiatus in the œconomy of the Crustacea, and that not the least interesting: the depth of water should also be recorded. The list I propose is of such as are taken not carrying ova, and this, with the table now sent you, will form a basis for further calculations.

Since my notice of *Achæus Cranchii*, in the July number of the 'Annals,' I have been fortunate enough to procure two more specimens; still they must not be considered as otherwise than rare on this coast.

I am, Gentlemen, yours very obediently,
WILLIAM THOMPSON.

Species.	Date when found carrying ova.	General Remarks.
Cancer Pagurus.........	March 8, 1850.	Caught in a crab-pot: ova orange colour: the carapace was 3 inches wide.
Carcinus Mænas	March 11, 1850. May 28, 1851.	Ova of an orange-brown.
Corystes Cassivelaunus.	March 16, 1850. April 27, 1850.	I found seven females thrown up March 16, 1850; of these only four carried spawn.
Crangon bispinosus ...	Feb. 11, 1851.	The ova is of a bright sea-green. Specimens taken Feb. 23 and May 24 had no spawn.
C. vulgaris	Jan. 29, Feb. 13, April 13, 1851.	
Galathea squamifera...	March 29, 1850.	
G. strigosa..............	Nov. 7, 1851.	Caught in a lobster-pot: the ova are very small, and of a beautiful garnet colour.
Hippolyte Cranchii ...	May 24, July 13, Aug. 2, 1851.	Ova of a reddish colour.
H. varians	May 24, 1851.	Ova of a reddish colour.
Homarus vulgaris	Feb. 20, 1851.	
Hyas araneus............	Jan. 18, 1851.	Ova of a dark brown.
H. coarctatus...........	Feb. 15, 20 & 27, 1851.	Ova of a rich orange colour and much developed.
Pagurus Bernhardus...	Jan. 7, 1850.	Out of eighteen specimens eleven carried ova, which are of a dark purple nearly approaching to black.
P. cuanensis	May 24, 1851.	Three out of ten carried spawn of a rich orange-brown colour.
P. Hyndmanni	July 13, 1851.	Ova black.
P. Prideauxii...........	Jan. 11, Feb. 21, 1851.	Ova orange.
Pilumnus hirtellus......	May 30, 1851.	Ova very small and of a bright orange colour.
Pinnotheres pisum......	April 27, July 23, 1850.	Ova of an orange colour.
Pisa tetraodon	May 27, 1851.	Ova small and of a bright red. Not sufficient in quantity to force back the abdomen.

Species.	Date when found carrying ova.	General Remarks.
Porcellana longicornis.	May 27, 1851.	Ova small and of a bright orange-brown; much more developed in some specimens than in others.
P. platycheles	May 30, 1850. May 30, 1851.	The ova are larger than in *Pilumnus hirtellus*, but of the same bright orange colour.
Portunus variegatus ...	July 23, 1850.	
P. arcuatus	*I believe* in January 1850.	Ova red. I have a specimen in spawn I obtained from the oyster-dredgers, who do not dredge beyond February, but unfortunately I omitted to make a note.
P. puber..................	Feb. 27, 1851.	The ova are of an orange colour: caught in a lobster-pot.
Stenorhynchus phalangium.	Feb. 27, May 24, 1851.	Ova of a dark orange colour. In the specimen of Feb. 27, and one of May 24, the ova were very much developed, but in a second of the latter date very little developed.

Geographical Distribution of Hymenoptera in Arctic North America. By Adam White, F.L.S.

"Otho Fabricius first, perhaps, recorded the names of any of the Hymenoptera of Arctic North America. Doubtless Baffin, Frobisher, and other manly navigators recognised humble bees and other bees during their summer voyages, and *may* have, in print or in manuscript, with sailor-like earnestness, made mention of every such occurrence in their journals. It is delightful to read the notices of flowers and verdure, in their accounts of the hurried spring, summer, and autumn of a Greenland year, of five-sixths winter. *Where* flowers and verdure abound, even for six weeks or a shorter time, *there* insects must be found;—*there* insects of the order Hymenoptera, the order to which this notice is limited, *must* occur. Flowers and Hymenoptera must be together.

"Otho Fabricius records two species of Hymenoptera as being brought by him from Greenland. His book, so admirable a model of a local fauna as to be even now one of the standards of excellence, was published in 1780. The next considerable accession to our acquaintance with the Hymenoptera of British America was made by Redman, who collected in Nova Scotia many fine species now in the British Museum. Some of these, such as *Pelecinus, Sirices, Ichneumonidæ*, &c., were very prominent species, and are now being worked out in the vast collections of the National Museum.

"Sir John Richardson and his brave comrades collected many species, which were lost during their disastrous journey. They still, however, brought many insects to England, and in the 'Fauna Boreali-Americana' these insects are described by the venerable Kirby. The species of Hymenoptera are very few; there are only *thirty-two altogether*, including those of Canada and Nova Scotia;

the circumstances attending the journey not admitting of their collection and preservation.

"An eminent man, reasoning on such data as he had, has recorded his belief that it will be found that Hymenoptera do not abound in British North America: now it may be remarked, in making generalizations on the distribution of animals, especially on those of the lower orders, 'that, before generalizing on a collection from any place not often visited or not often explored, attention be paid to the taste or tastes, or, in other words, to the bias or direction of the eye, hand, and mind of the person or persons who collect, supposing such reasoning is recorded as on authentic data.'

"Mr. George Barnston, to whose researches Sir John Richardson directed public attention in the 'Edinburgh New Philosophical Journal' for April 1841, has published a very admirable summary of the Progress of the Seasons as affecting Animals and Vegetables at Martin's Falls, Albany River, James's Bay, about lat. 51° 30′ N., and in long. 86° 20′ W. In this fresh and refreshing journal, there are *more than indications* that Hymenoptera, Diptera, and Neuroptera abound. In a year or two afterwards Mr. Barnston came to London and presented his collection to the British Museum.

"As one instance of his excellence as a collector, I may mention that Mr. Walker, who named and described the species of Diptera in the Cabinet of the British Museum, has alluded to or has described nearly 250 species of dipterous insects from the single station mentioned above; there being only 14 species of these insects recorded in the 'Fauna Boreali-Americana' of the Rev. Wm. Kirby. Mr. Barnston's researches, among the Neuroptera also, were considerable and very valuable. One insect brought by him, the *Pteronarcys regalis* (although previously found in Canada), afforded Mr. Newport a fit subject for his genius, as an accurate anatomist and recorder of facts and reasonings on the insect œconomy. This gentleman discovered persistent *branchiæ* in the *imago* or perfect state of the *Pteronarcys*, and has recorded his discovery and quoted some observations of Mr. Barnston's in a paper read at the Linnæan Society. As Mr. Gray's Catalogues of the collections in the British Museum (mines of information to the reasoner and writer on geographical distribution) are published, it will be seen how valuable are Mr. Barnston's and Sir John Richardson's collections to our acquaintance with the articulated animals of British North America, especially in its more northerly parts.

"I have mentioned that Kirby *describes* or alludes to only thirty-two species of Hymenoptera in his 'Insects of North America;' while Mr. Barnston *in one spot* found 192 distinct species, exclusive of *Chalcididæ*. I subjoin a comparative list of the families of Hymenoptera, the comparison being made with the British species existing in the Museum collection at the time of this record. Mr. Barnston and myself worked out the *Tenthredinidæ*; my friend and coadjutor Mr. Frederick Smith, an able hymenopterist, determined the other species; so the list may be deemed as correct as the circumstances will admit.

"It must be borne in mind that our British collection of Hymenoptera has been accumulating for at least thirty years, was a favourite part of Dr. Leach's collection, and has been made over a wide and variegated country; while Mr. Barnston's was formed in three months, on one spot, and under almost unheard-of disadvantages, counterbalanced, however, by an enthusiasm not easily deterred by difficulties.

	British Collection in British Museum.	Collected at Martin's Falls.
Cimbicidæ	10	4
Tenthredinidæ	157	76
Siricidæ, &c.	7	2
Ichneumonidæ	200	47
Chalcididæ	?	?
Chrysididæ	22	1
Formicidæ	11	7
Mutillidæ	5	0
Sapygidæ	2	0
Pompilidæ, &c.	38	2
Crabronidæ	57	16
Vespidæ	17	4
Apidæ	170	33

"A striking proof that the time has not yet come to reason correctly on the distribution of Hymenopterous insects,—at least in British North America."—*Arctic Searching Expedition, by Sir John Richardson*, vol. ii. p. 354.

Mr. Adam White desires to add, that the above paragraphs could be extended to other branches of articulated animals. When men like Kroyer go to Spitzbergen and Iceland, and Höllboll to Greenland, fish and crustacea "new to science" are found and described by them. Should his friend Harry Goodsir of the Erebus return to England, or should Captains Penny, Stewart, Lieutenant Osborne and MacClintock discover his papers; the scientific world will find that animal life is not so *rare* in these arctic seas as is generally supposed by many clever and enterprising men, whose researches do not *lie* in the direction of natural history. Captains Penny and Stewart and Dr. Sutherland saw walruses, narwhals, polar bears and seals in Wellington Channel. These creatures do not all *live* on one another. It is well to remember the rough but true lines so well known to every naturalist—

> "Large fleas and little fleas have smaller fleas to bite 'em;
> The smaller fleas have lesser fleas, and so *ad infinitum.*"

ACANTHUS MOLLIS (LINN.).

In the course of last summer I received from the Rev. John P. Mayne of St. Agnes, Isles of Scilly, some flowers of *Acanthus mollis*, with a request to be informed of its name, as he found it growing wild in that island. In answer to questions addressed to him, he has since informed me that it grows in a spot separated from some houses by a narrow field, on the south side of a hedge, upon some heaps of stones collected there on the destruction of an old lane that formerly passed the spot. An old man who rents the field tells him that he remembers having taken notice of the plant fifty years since; another man vouches for forty years.

The plant occupies a space of about 20 feet by 5 or 6, and is not found in any other part of St. Agnes, nor, as far as Mr. Mayne knows, in any of the other islands. Twenty years since St. Agnes, as he has ascertained, could not boast of even one garden, and therefore floral culture could hardly have caused its introduction more than fifty years since, when potatoes and rye and an occasional cabbage were the *only things* grown in the island by people who lived wholly by the sea.

Strange birds often visit the Isles during the south-easterly winds, and may, as Mr. Mayne justly suspects, have brought seeds from the continent. He adds, that "a brother clergyman, living at Marazion, near Penzance, has some plants of it growing in his garden. He has never seen the plant elsewhere, and is quite at a loss to account for their presence." Can this be Dr. Penneck's station noticed in 'Cybele Britannica,' vol. ii. p. 232?

I leave it to other botanists to discuss the curious question of the rank of this plant as "alien" or "colonist." I have no authority for supposing that it is found upon the Atlantic coasts of France, but it inhabits damp and stony or rocky places in the south of that country. The peculiarly mild winter climate of Scilly is not unfavourable to it, and it may therefore be an old if not "the oldest inhabitant."—CHARLES C. BABINGTON.

METEOROLOGICAL OBSERVATIONS FOR OCT. 1851.

Chiswick.—October 1. Densely clouded: rain. 2. Overcast: showery. 3. Fine: showery. 4. Rain: very fine: clear. 5. Fine. 6. Rain early: very fine. 7. Rain. 8. Very fine. 9. Foggy: drizzly: rain. 10. Cloudy. 11. Foggy: very fine. 12. Cloudy. 13. Very fine: rain. 14. Very fine. 15. Constant rain. 16, 17. Clear: very fine. 18. Fine: rain: cloudy. 19. Fine: overcast. 20. Slight drizzle: uniformly overcast. 21. Foggy: fine. 22. Slight fog: hazy. 23, 24, 25. Overcast. 26. Fine. 27. Overcast: exceedingly fine. 28. Overcast: rain. 29. Fine: clear. 30. Clear: fine. 31. Very fine.

Mean temperature of the month	51°·25
Mean temperature of Oct. 1850	44 ·32
Mean temperature of Oct. for the last twenty-five years .	50 ·50
Average amount of rain in Oct.	2·66 inches.

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

Sandwick Manse, Orkney.—Oct. 1. Bright: clear: aurora. 2. Rain: clear: aurora. 3. Bright: clear. 4. Rain: clear: large lunar halo. 5. Bright: showers. 6. Cloudy: showers. 7. Cloudy: rain. 8. Bright: lunar rainbow. 9. Bright: showers. 10. Showers: cloudy. 11. Clear: showers. 12. Cloudy: damp. 13. Cloudy: showers. 14. Bright: showers. 15. Rain: bright: showers. 16. Bright: clear. 17. Showers: drops. 18. Showers: rain: aurora. 19. Clear: showers: aurora. 20. Bright: cloudy: rain. 21. Bright: cloudy. 22. Bright: clear: aurora. 23. Damp: drops: aurora. 24. Fog: fine. 25. Fog: rain. 26. Drizzle: rain. 27. Fine: cloudy: rain. 28. Rain: showers: aurora. 29. Sleet-showers: aurora. 30. Cloudy. 31. Rain: showers: aurora.

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

Days of Month.	Barometer.							Thermometer.							Wind.				Rain.			
	Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Dumfries-shire.		Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Dumfries-shire.	Orkney, Sandwick.	Chiswick.	Boston.	Dumfries-shire.	Orkney, Sandwick.
1851. Oct.	Max.	Min.		9 a.m.	9 p.m.	9¼ a.m.	8¾ p.m.	Max.	Min.		Max.	Min.	9¼ a.m.	8¾ p.m.								
1.	29·290	29·012	28·94			29·13	29·11	60	44	55			53	54	s.	s.		ese.	·35	......		·05
☽ 2.	29·388	29·298	28·90			28·95	29·37	58	45	49			55	51	s.	s.		se.	·14	·44		·16
3.	29·577	29·440	29·12			29·39	29·34	61	49	52			53	51½	s.	s.		se.	·06	·04		......
4.	29·485	29·462	29·04			29·16	29·27	64	43	57			54	46	sw.	s.		se.	·25	·11		·09
5.	29·748	29·571	29·10			29·20	29·24	61	43	50			50½	50	nw.	s.		w.	·18	......		·21
6.	29·774	29·677	29·27			29·36	29·37	61	40	48			48	49	w.	w.		wsw.	......	·31		·17
7.	29·785	29·669	29·30			29·20	29·19	60	40	51			47½	47	sw.	ssw.		nw.	·09	......		·15
8.	29·955	29·833	29·43			29·42	29·61	59	32	47			50½	49	w.	w.		wnw.	......	......		·40
9.	29·924	29·802	29·54			29·68	29·54	60	56	42·5			49	50	s.	s.			·13	......		·03
○ 10.	30·168	29·535	29·54			29·60	29·86	68	46	59			53½	50	w.	wnw.		w.	......	·25		·09
11.	30·224	30·188	29·75			29·62	29·68	68	53	46			57½	52	s.	sw.		w.	......	......		·06
12.	30·283	30·274	29·78			29·89	29·84	68	54	57·5			50	52	s.	sw.		sw.	......	......		·06
13.	30·129	29·989	29·58			29·36	29·62	62	54	60			53½	49	sw.	sw.		sw.	·04	......		·05
14.	29·928	29·841	29·50			29·52	29·55	62	44	51·5			48½	46	w.	w.		calm	·03	·03		·47
15.	29·430	29·336	28·94			28·81	28·88	56	32	56·5			50	44	w.	w.		wnw.	·34	·20		·44
16.	29·606	29·502	29·10			29·11	29·36	57	28	41·5			46	43	sw.	w.		nw.	......	·06		·21
17.	29·894	29·802	29·43			29·53	29·58	57	30	39			46	45	w.	wnw.		s.	......	......		·07
☾ 18.	29·941	29·742	29·52			29·40	29·41	59	52	47			52	47	sw.	sw.		wnw.	·01	......		·09
19.	30·041	29·930	29·50			29·66	29·81	62	55	57			49½	45	sw.	wsw.		s.	·01	......		·13
20.	30·080	30·045	29·64			29·99	29·90	64	55	58			50	49	w.	ssw.		se.	......	......		·05
21.	30·076	29·993	29·62			29·84	29·83	62	52	58·5			55	51½	e.	se.		se.	......	......		·15
22.	30·137	29·986	29·56			29·94	30·10	56	59	56			50½	46	n.	calm		se.	......	......		·05
23.	30·255	30·219	29·83			30·22	30·30	57	50	47·5			47	50	se.	wnw.		s.	......	......		·01
● 24.	30·361	30·272	29·98			30·31	30·34	57	37	52			48½	51	ne.	calm		se.	......	......		·02
25.	30·386	30·348	30·00			30·30	30·09	55	49	50			51	54½	ne.	wnw.		wsw.	......	......		......
26.	30·214	30·099	29·79			29·90	29·83	57	42	44			53	53	e.	w.		w.	......	......		·05
27.	30·170	30·084	29·66			30·13	30·03	59	37	48			47	48½	nw.	wnw.		w.	......	......		·12
28.	30·100	29·576	29·65			29·56	29·28	54	39	47			47	44	sw.	wsw.		nw.	·33	......		·26
29.	29·419	29·305	29·04			29·46	29·71	48	30	38			42	42½	nw.	nw.		nne.	·02	·26		·10
30.	29·599	29·424	29·24			29·90	29·80	49	36	44			45	44	ne.	n.		w.	·01	·28		·08
☽ 31.	29·612	29·602	29·35			29·46	29·29	48	32	34			46	44	nw.	n.		wnw.	·02	·12		·14
Mean.	29·902	29·769	29·44			29·580	29·617	59·00	43·51	49·8			49·96	48·33					2·01	2·12		3·96

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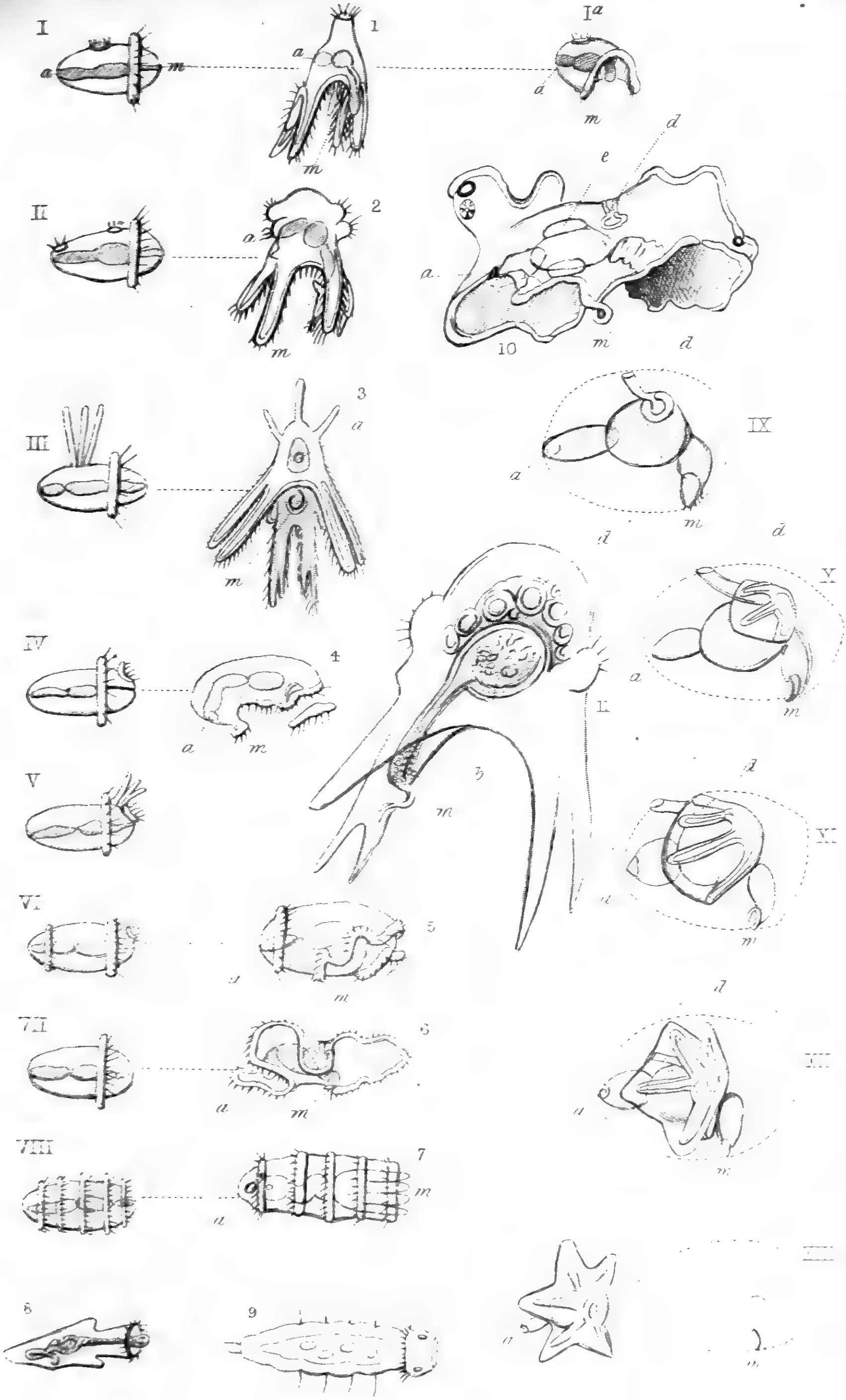

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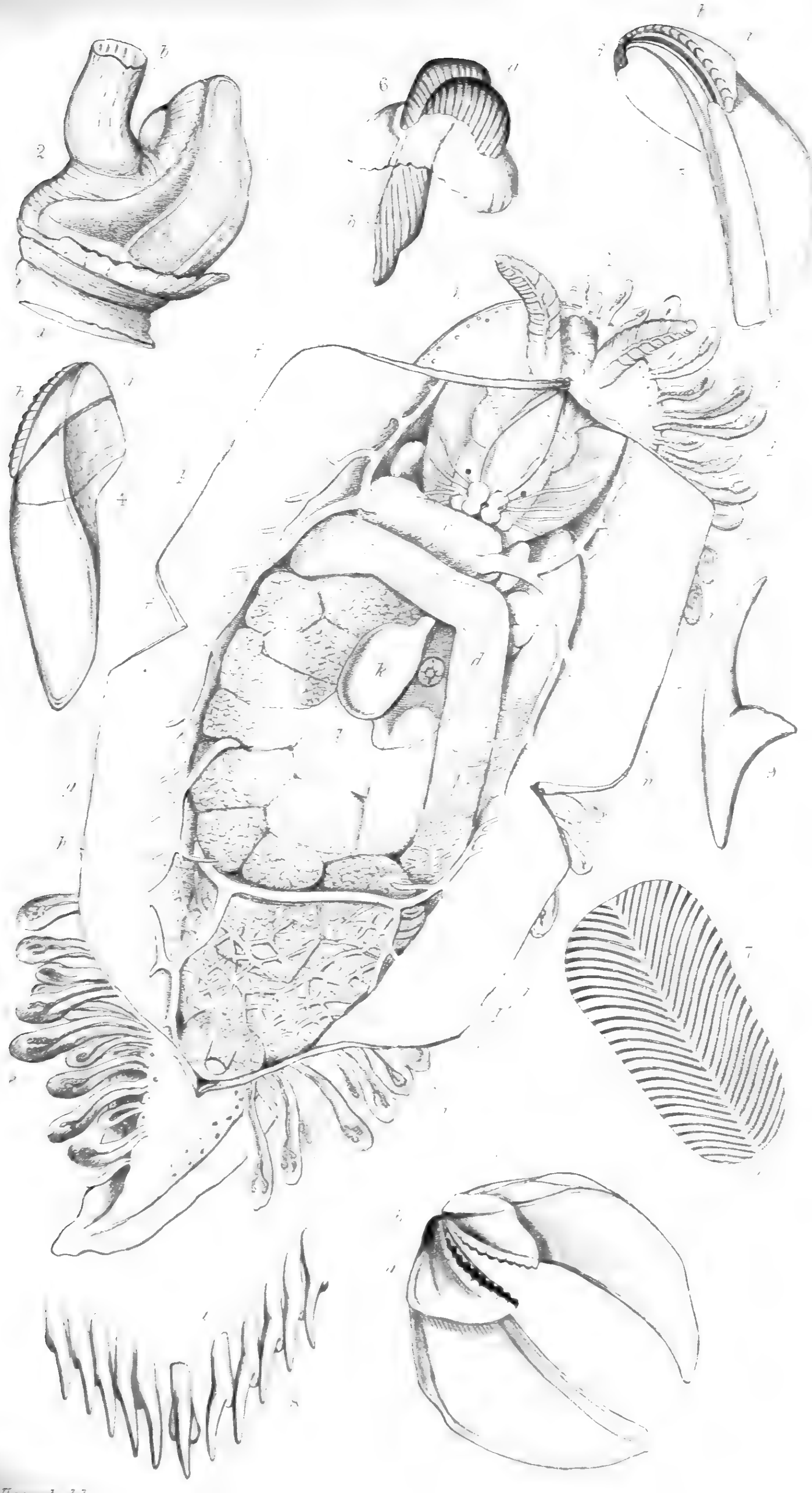
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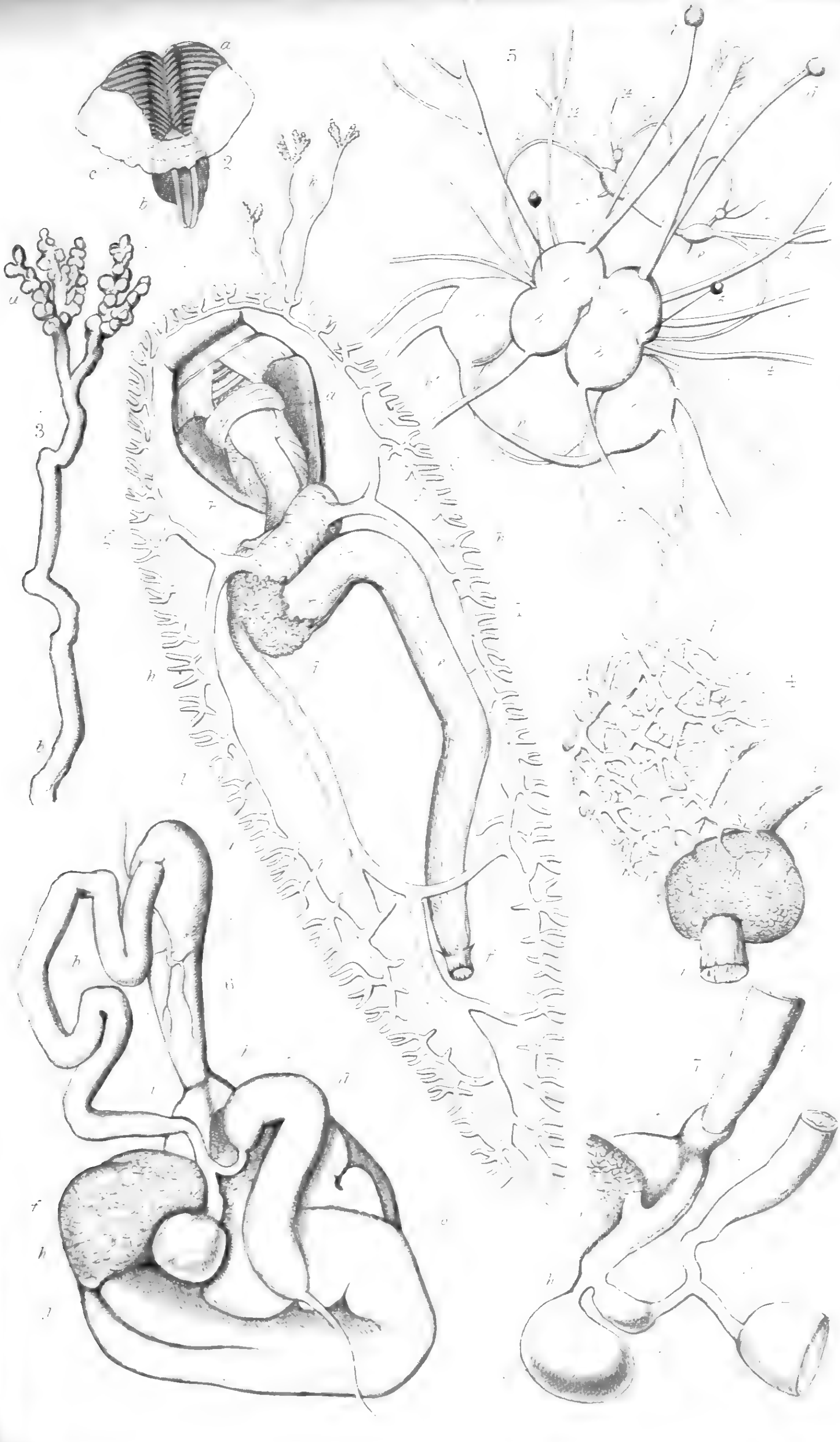

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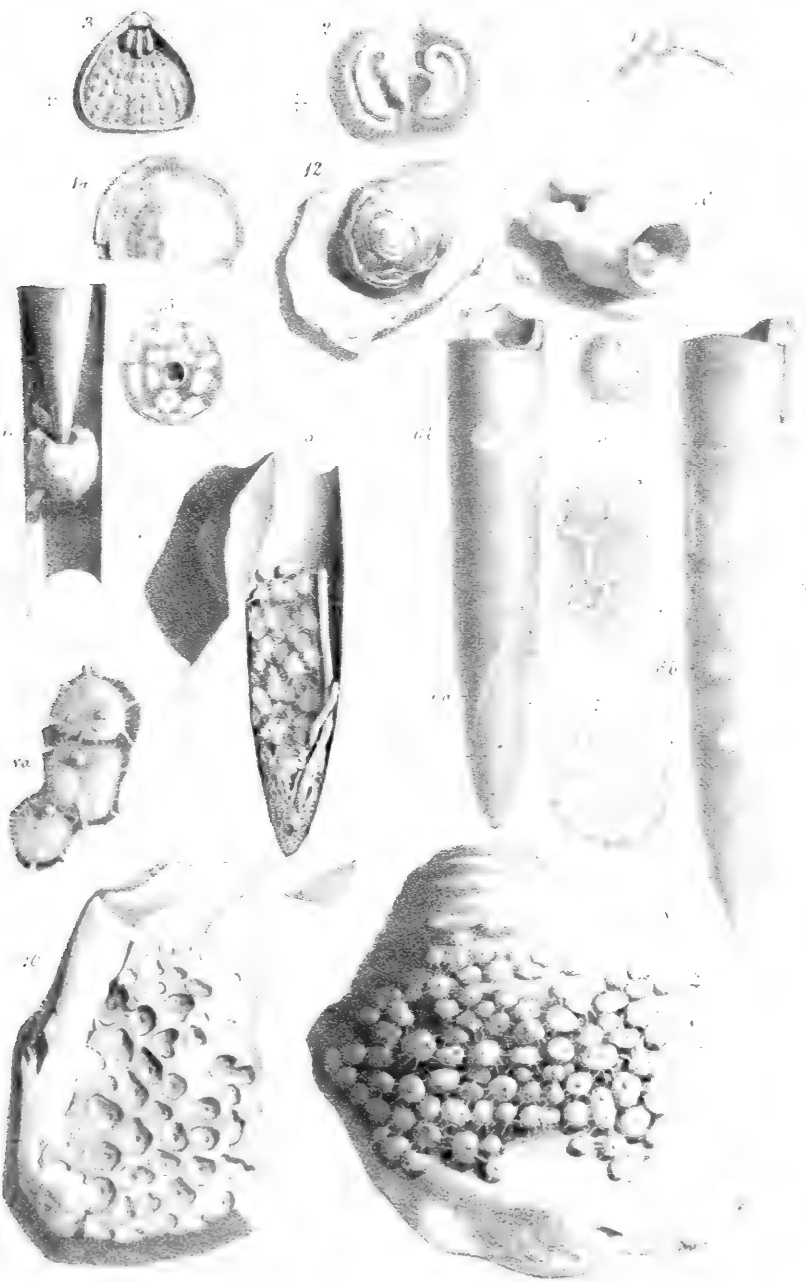

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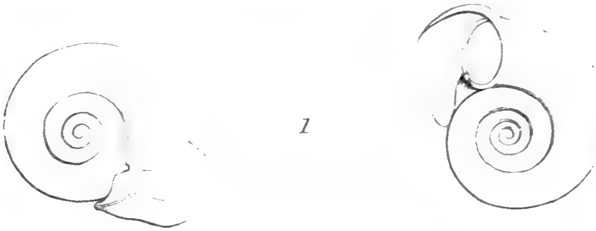

Pterocyclos Blandi

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P. or Myxostoma Troscheli

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Spirulina tenuissima

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Holostomum Cuticola

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Dickiea pinnata

J. De C. Sowerby sc.

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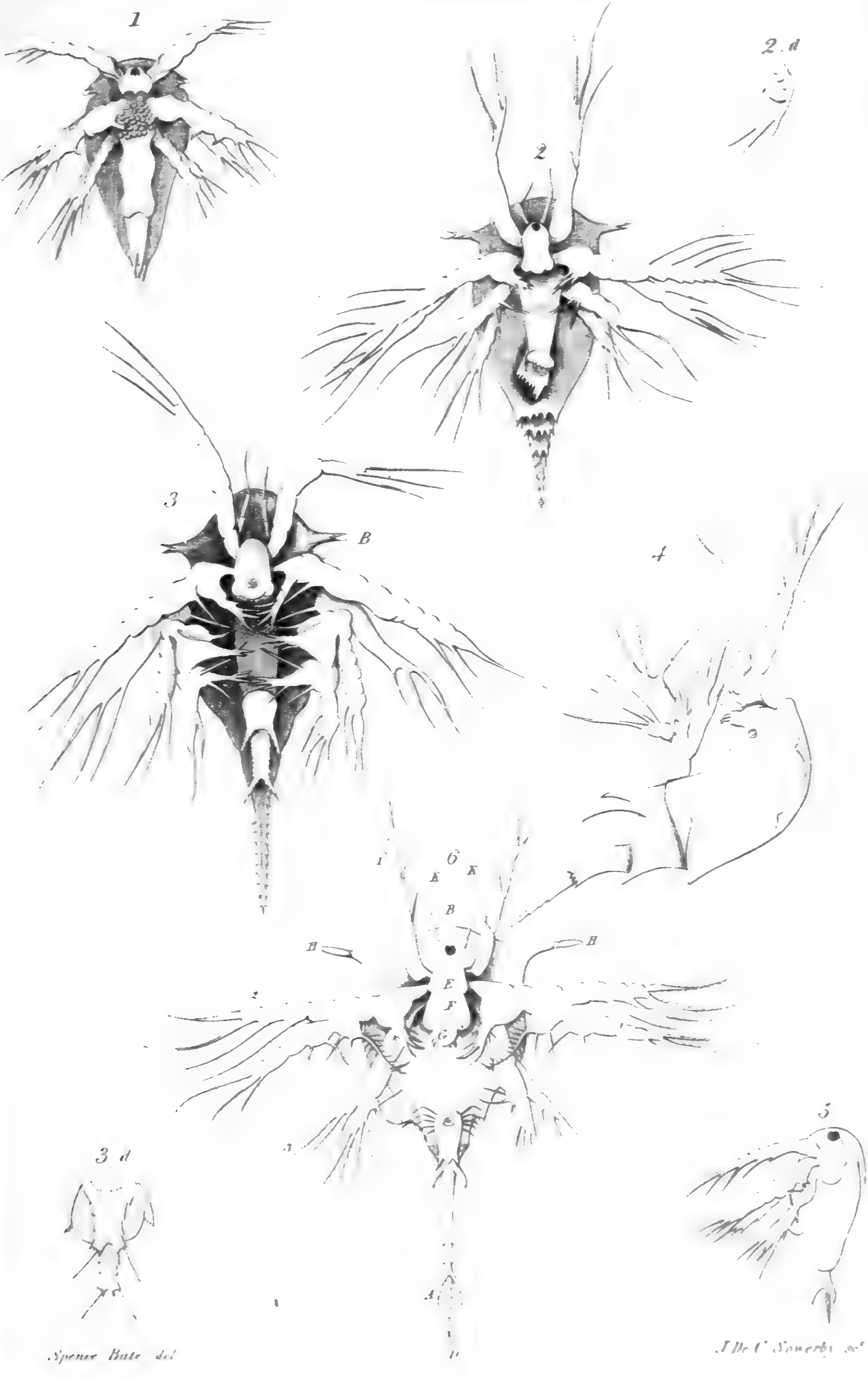

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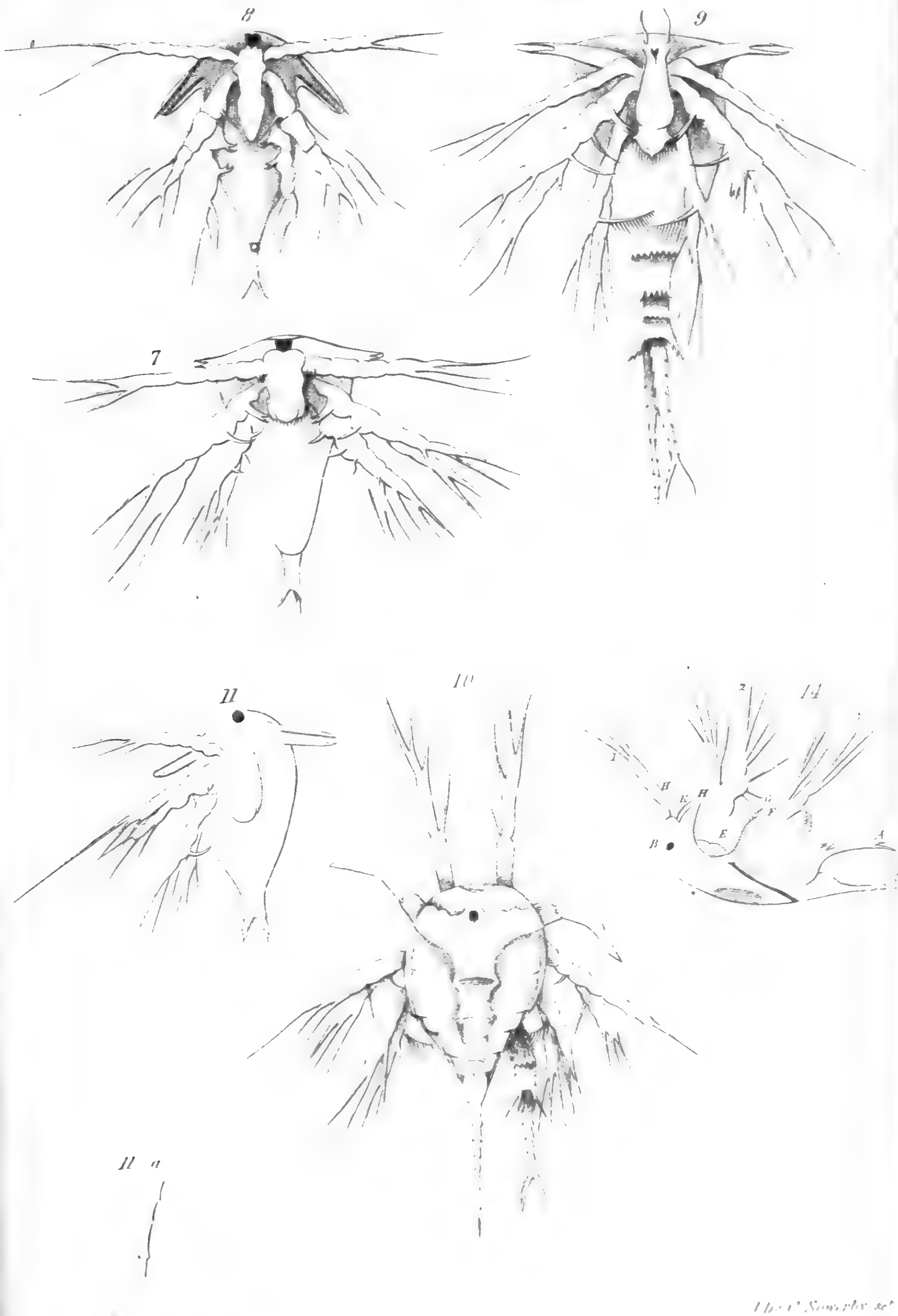

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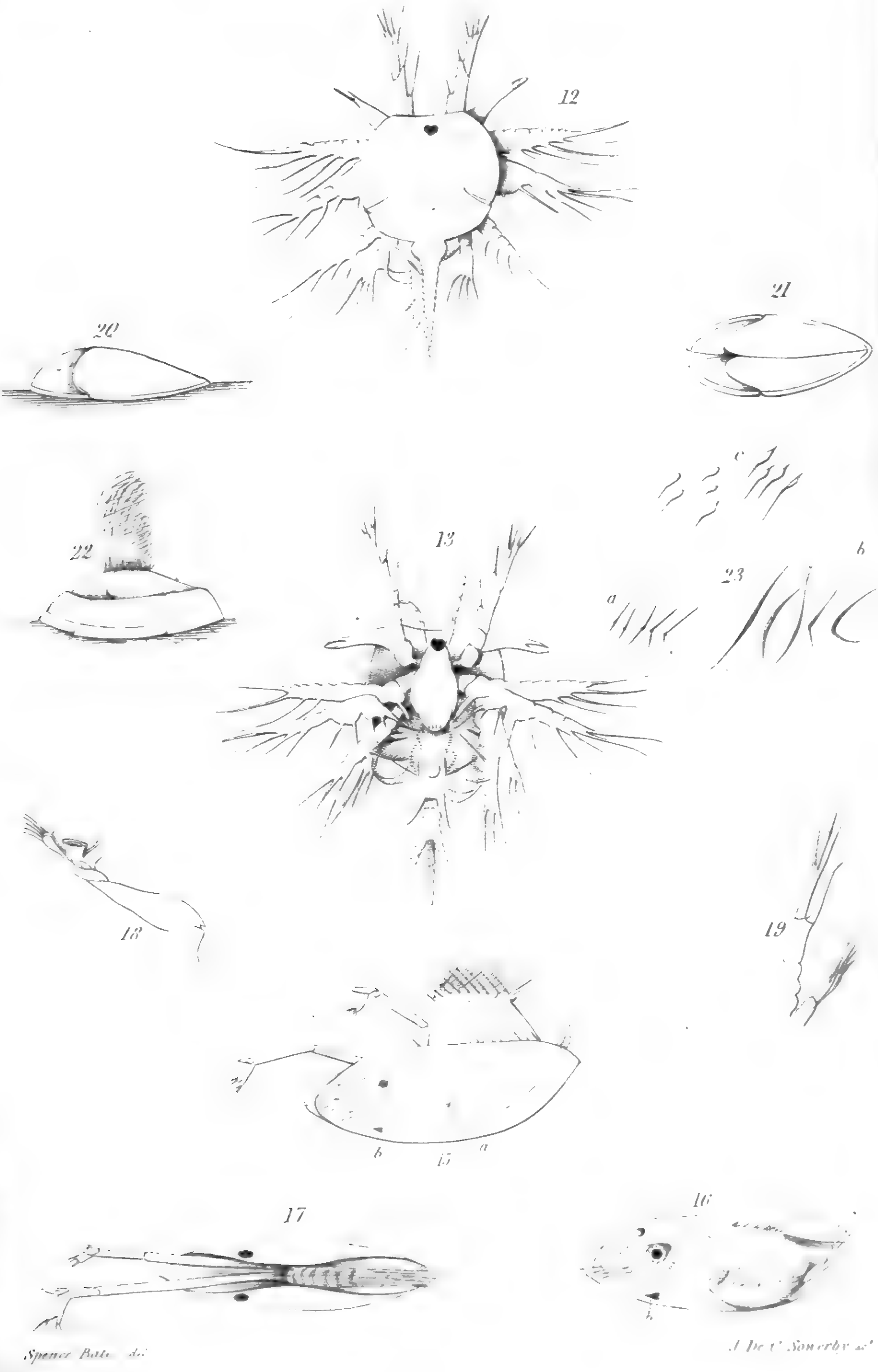

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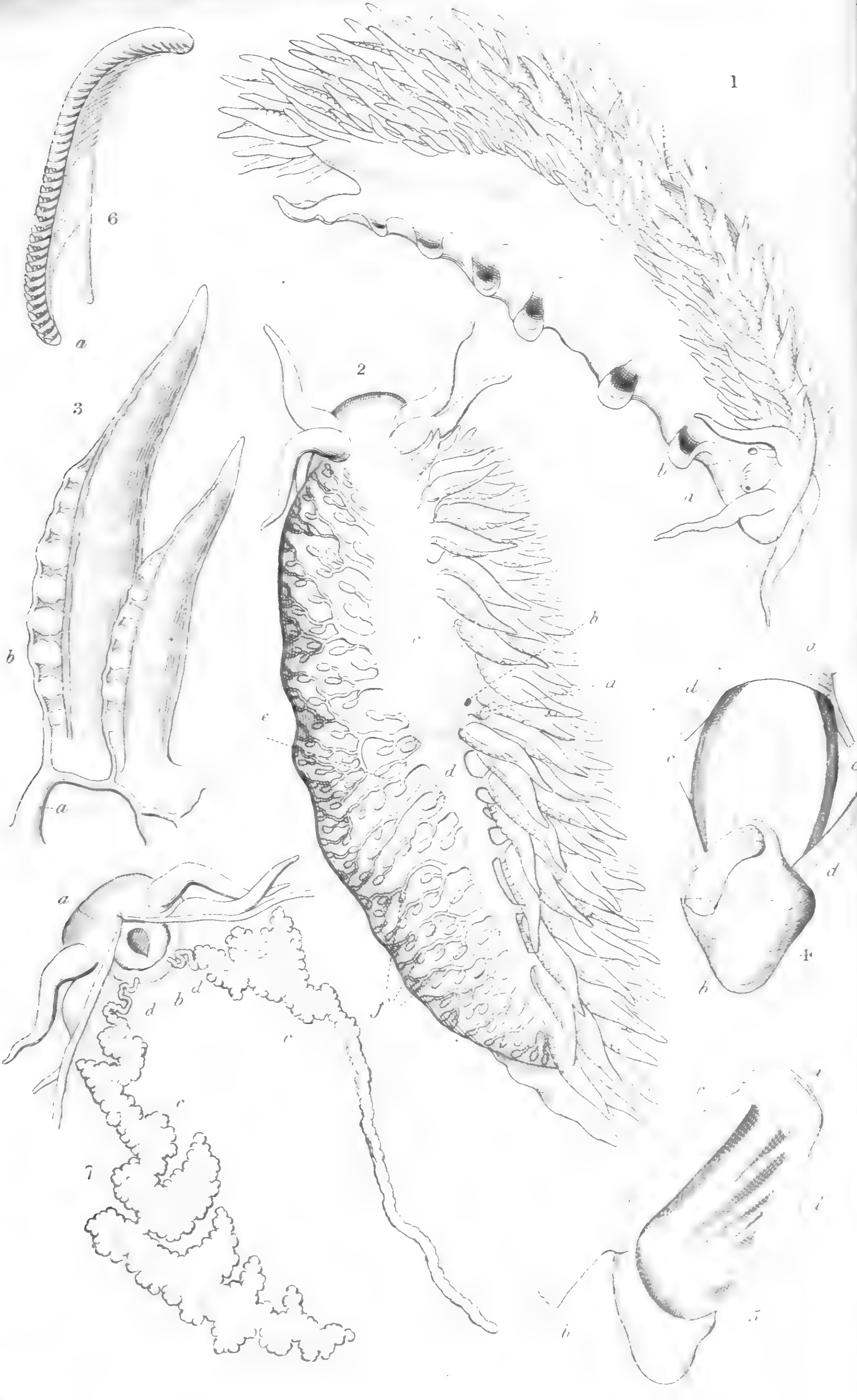
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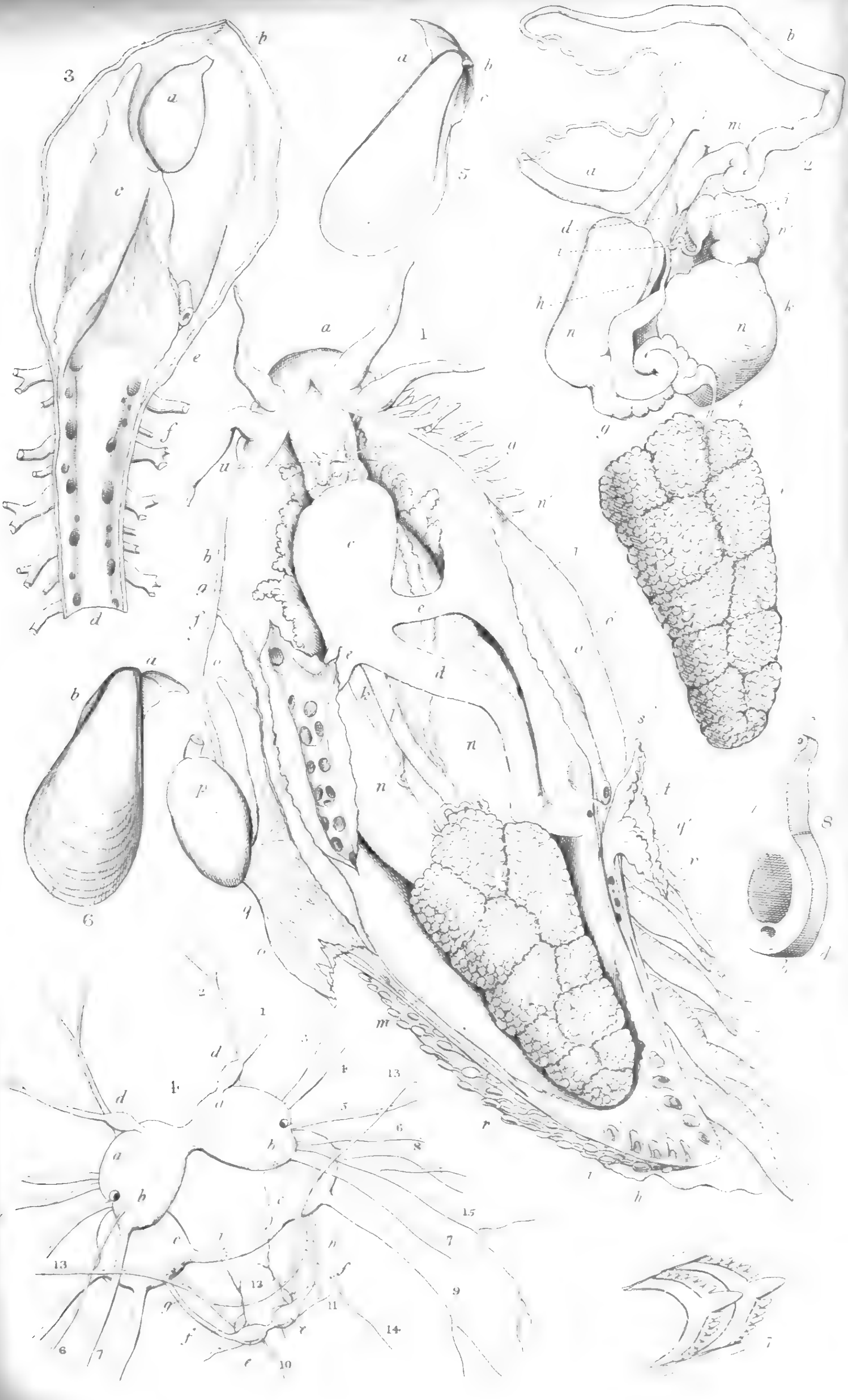
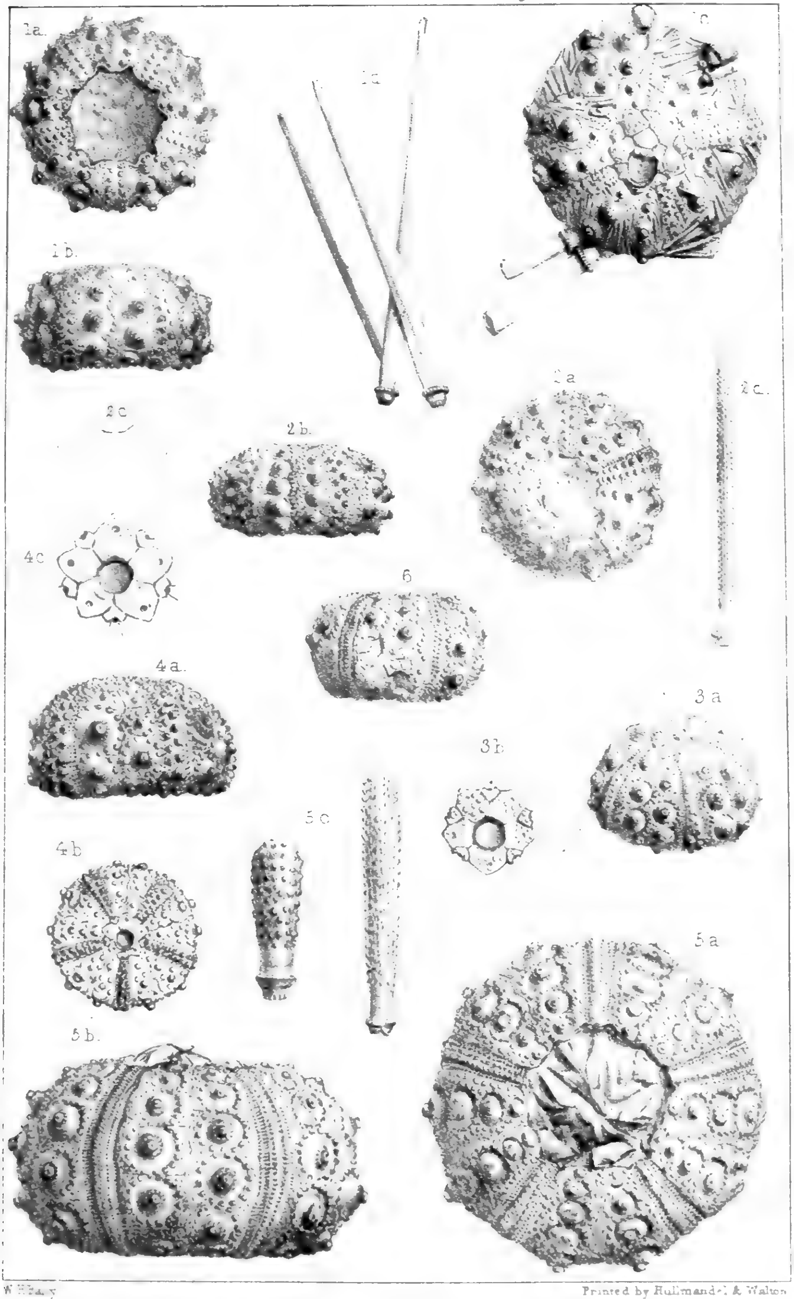
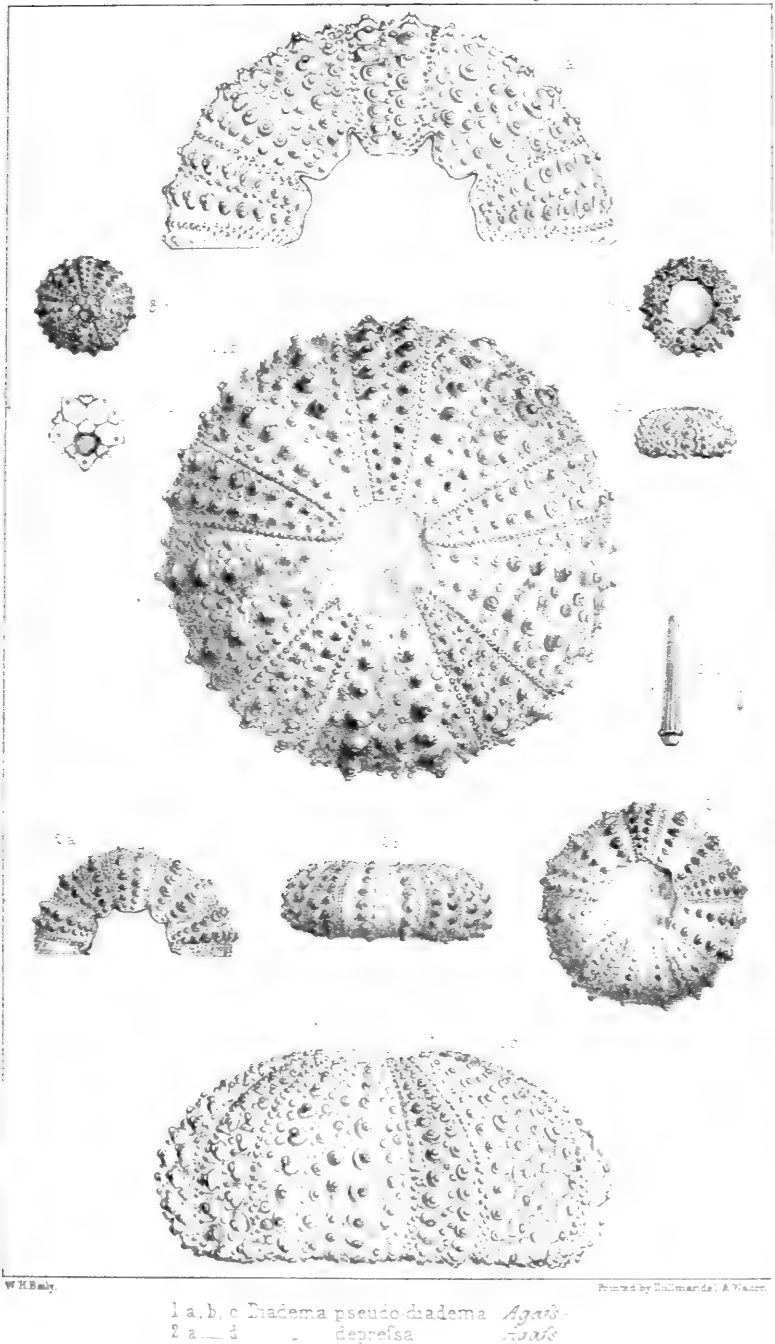




W. H. Baily. Printed by Hullmandel & Walton.

a c Acrosalenia hemicidaroides *Wright.*
a d „ Lycetti *Wright.*
a b Hemicidaris alpina *Agassiz.*
„ granulosa *Wright.*
Cidaris Fowleri *Wright.*
„ propinqua *Münster.*



W. H. Baily.

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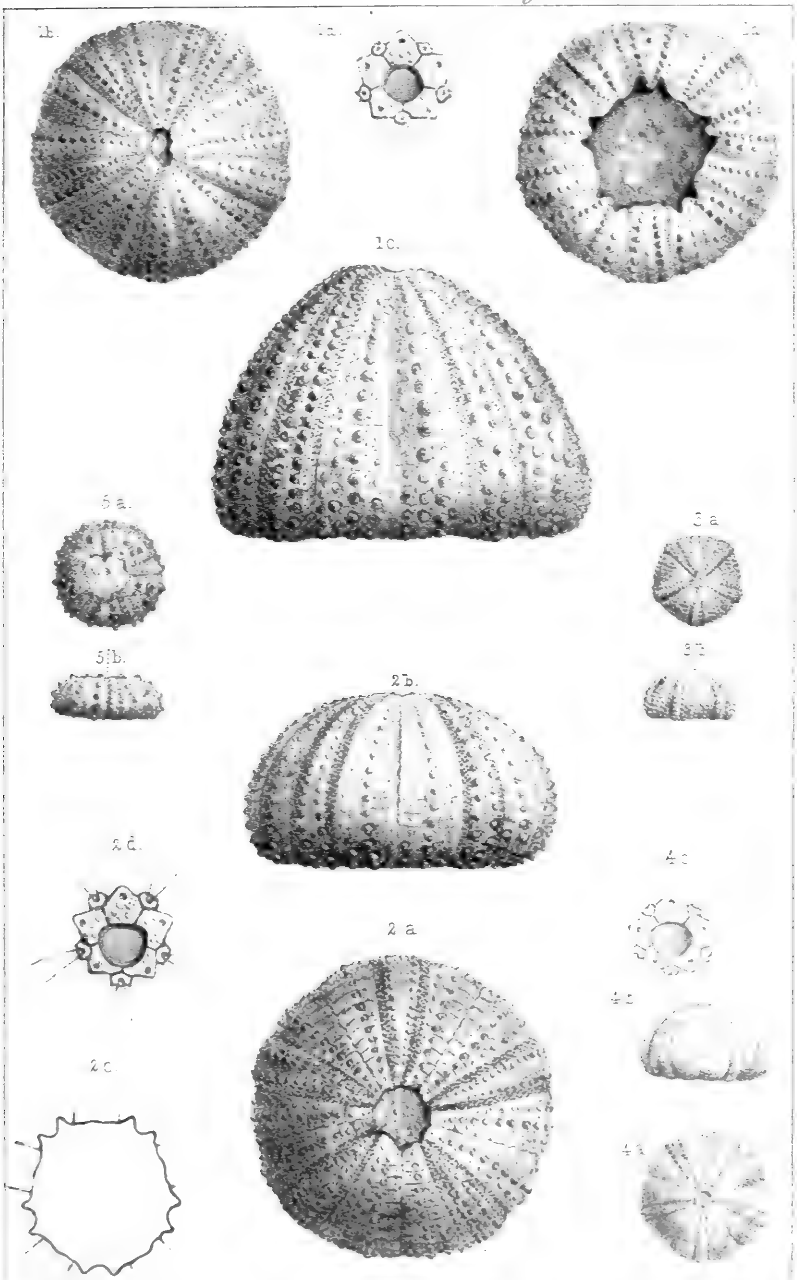
1 a. b. c. Diadema pseudo-diadema *Agass.*
2 a — d " depressa *Agass.*
3 a — d Acrosalenia spinosa *Agass.*



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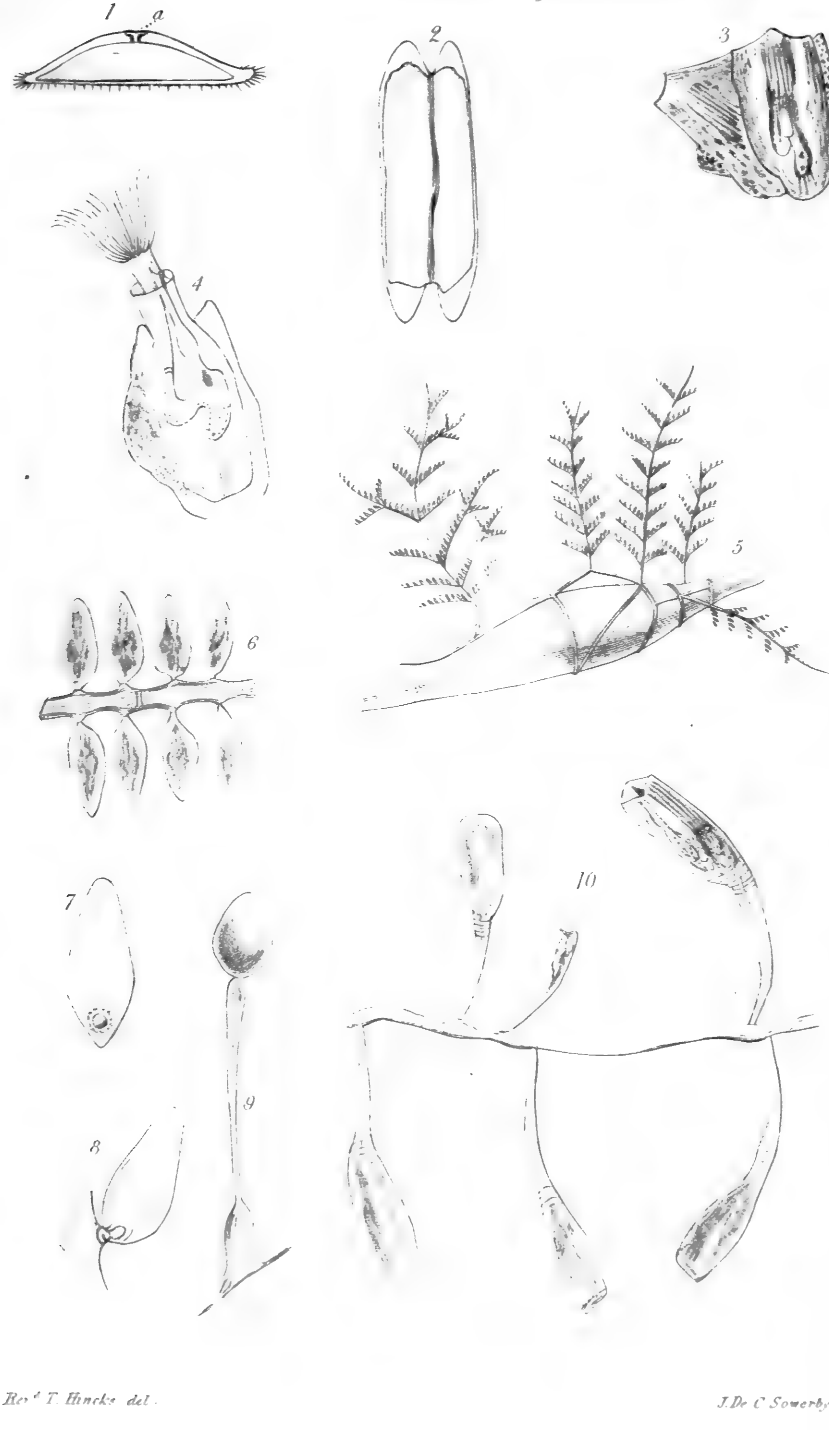
1 a–d. Echinus perlatus [illegible]
2 a–d. serialis [illegible]
3 a. b. Arbacea nodulosa Wright
4 a. b. c. Forbesii Wright
5 a. b. Goniopygus ? perforatus *Wright*



Rev^d T. Hincks del.

J. De C. Sowerby sc.

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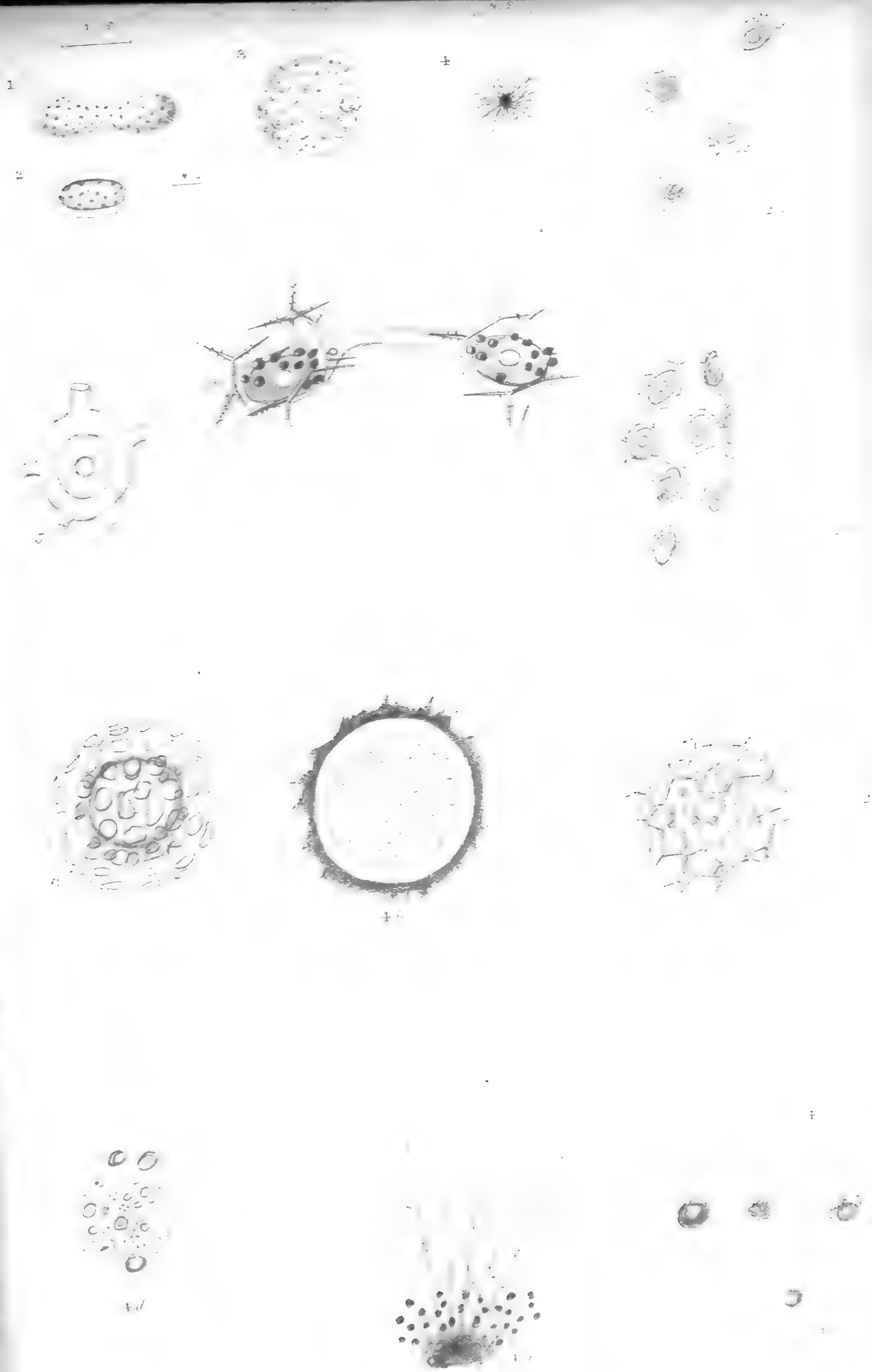

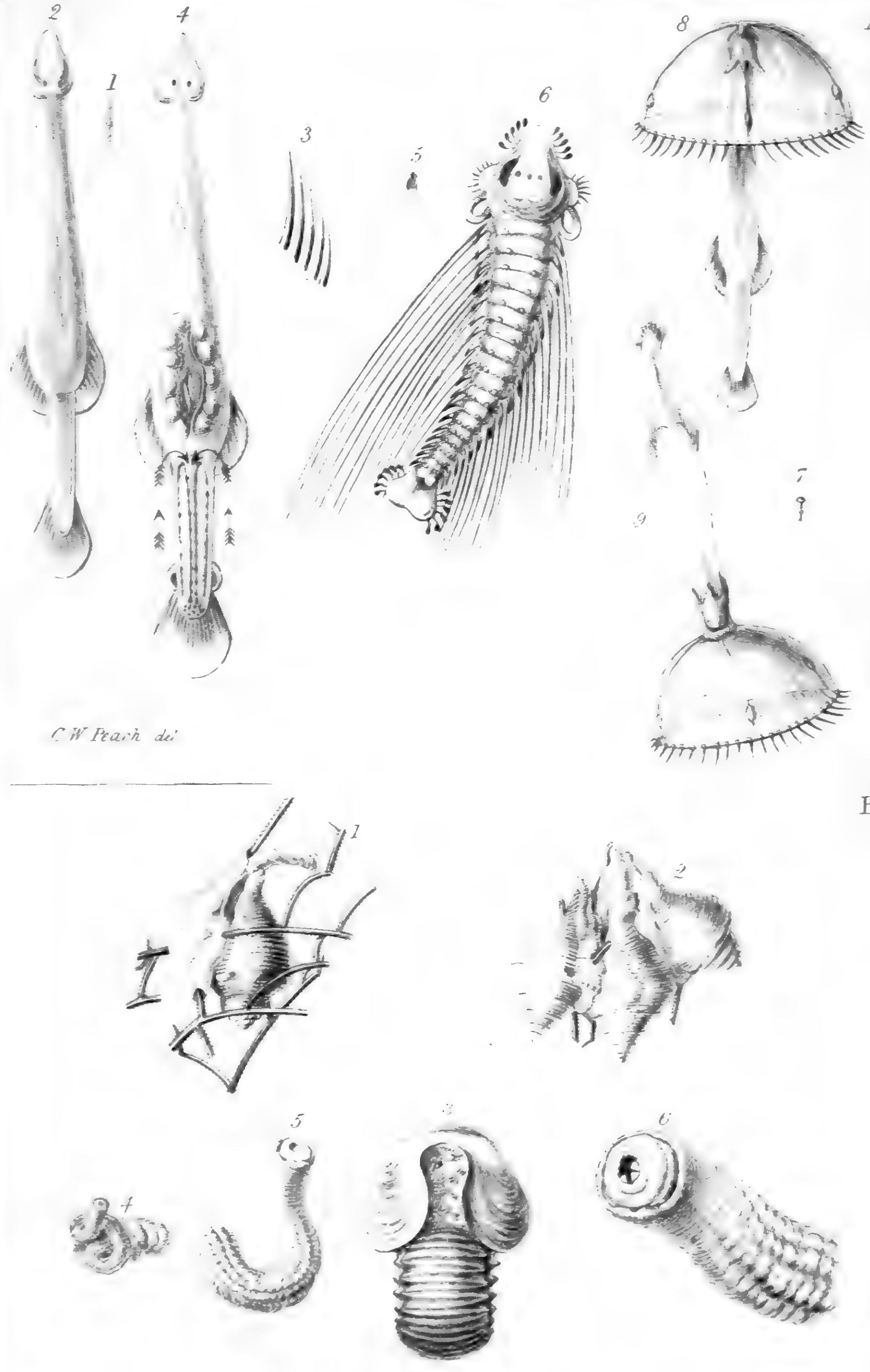
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C W Peach del
J De C Sowerby sc