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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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

"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. 115. JULY 1857.

I.—*Contributions to the Knowledge of the Terrestrial* Planariæ, *from communications from* Dr. Fritz Müller *of Brazil and personal investigations.* By Dr. Max Schultze *.

THE travels of the English naturalist, Charles Darwin †, have made us acquainted with a rich fauna of terrestrial *Planariæ* in the humid regions of primæval forest in South America, which merits the attention of zoologists in a high degree. If it was impossible to help being astonished, in the first place, at the remarkable circumstance that worms belonging to the order of the *Turbellaria*—which we are accustomed to find only in water in Europe, and which, in consequence of their extremely soft, delicate parenchyma, destitute of all supports, appear destined to live exclusively in that medium,—should occur on land, our interest would be no less attracted by the statements of the large size of these animals, the variegated colours with which they were adorned, and their Nemertoid form combined with the internal structure of the *Planariæ* of our fresh waters. The

* Translated by W. S. Dallas, F.L.S., from a copy of the paper in the 'Abhandlungen der Naturforschenden Gesellschaft in Halle,' vol. iv. 1857, kindly communicated by the author.

† Naturwissenschaftliche Reisen, deutsch von E. Dieffenbach, 1844, p. 28; Annals and Magazine of Natural History, first series, vol. xiv. p. 241, 1844.

demand for new and more detailed information upon the natural history of these inhabitants of the primæval forests has unfortunately been very sparingly satisfied since the date of the statements of the meritorious traveller. It therefore gave me peculiar pleasure to obtain such information from an approved observer, Dr. Fritz Müller, who has been settled for some years in the colony of Blumenau in the south of Brazil, and now in Desterro, on the island of Santa Catharina. Although his statements have been thrown off under unfavourable external circumstances, and without those optical aids which would have been desirable, I do not hesitate to publish them, as forming valuable additions to our previous knowledge. I at the same time take the opportunity to bring together what we know of these animals from Darwin and some others, and, lastly, add the results of some microscopic investigations into the intimate structure of these animals, which I made upon a specimen, well preserved in spirits, brought home by Dr. Burmeister, and handed over to me to be used as I pleased.

It is well known that O. F. Müller, the founder of our knowledge of the Turbellaria, discovered a species living upon the land, under stones in moist earth, to which he gave the name of *Planaria terrestris* (Vermium Terr. et Fluv. Hist. ii. p. 68). According to the short description of this animal given by the celebrated Danish zoologist, it possesses a nearly cylindrical body, only somewhat flattened on the ventral surface, 8 lines in length, and $\frac{2}{3}$rds of a line in breadth; it is blackish-grey above and white beneath, and exhibits two small black eye-spots at the anterior extremity. Dugès saw the same species in France (Ann. des Sci. Nat. 1 sér. xxi. p.82); and adds to Müller's statements, that the position of the buccal orifice, the form of the muscular œsophagus, the arborescent ramifications of the intestinal canal, the male copulative organ, and the seminal vessels, agree with the same parts in our freshwater species.

As far as I am aware, my friend Fritz Müller is the only person who has since this period met with the animal, which is certainly a rarity. It was in the neighbourhood of Grimmen, near Greifswald, that several specimens were discovered under stones; they were unfortunately only examined with the lens, but exhibited all the parts described by Dugès.

In the following, I have brought together F. Müller's statements regarding the *Terrestrial Planariæ of Brazil*, which have reached me in various letters:—

"Points of agreement with the *Planariæ* of fresh water are, the position of the buccal orifice towards the hinder third of the lower surface of the body, and also the dendrocœlar nature of the intestine; in the latter, there are the ordinary three branches, an anterior and two posterior, the ramifications of which are usually repeatedly divided. The proboscis, as it glimmers through the skin, appears as a long cylinder, in the middle of which the buccal orifice is visible as a transverse cleft. On a closer examination of the proboscis after removal, however, it is found that it may be dilated into a considerable flat cup or disk, which is sometimes elliptic, sometimes roundish, with its circumference sometimes nearly entire, sometimes more or less deeply lobed, and exhibits in its base, a little before the middle, a rather narrow œsophageal orifice, a structure which occurs in many of the larger marine *Planariæ,* but not in our freshwater species. In repose, the lateral margins are rolled in, and the whole organ folded together in such a way that it represents a cylinder with an anterior, undulated, longitudinal fissure.

"Points of difference from the genus *Planaria* are, the elongated form of the body, the slight depression, and the acute anterior extremity. The habit is thus often more that of a *Nemertoid* than of a *Planaria.* The eyes also, as far as they are known, are different; they are present in unusual number, not, as in *Planaria nigra,* forming a simple series, running regularly on the anterior margin, but compressed into dense streaks or spots near the anterior margin, and extending from thence in an irregular row, which constantly becomes less dense posteriorly along the lateral margins to the hinder extremity.

"These peculiarities, in conjunction with their dwelling-place, certainly justify their generic separation from the aquatic *Planariæ.* In accordance with the analogy of *Typhloplana* and *Leptoplana,* the name *Geoplana* might be formed for them. They like moderately moist places, under wood, bark, and stones, and between leaves of the Bromeliaceæ (but not in the water there accumulated). They appear to rest by day, and to crawl about during the night. Eggs somewhat larger than those of *Planaria Ulvæ,* and roundish, which could hardly belong to any other animal, were once found under wood.

"An important question is, whether the *Geoplanæ,* like their aquatic allies, bear cilia upon the surface of their bodies. Not possessing a microscope, and remembering an experiment in J. Müller's physiological course, I sprinkled a large specimen of *Geoplana rufiventris* with a little arrowroot, when I saw it move constantly forwards and sometimes a little outwards on the back, and backwards on the ventral surface, by which the existence of cilia seems to be placed beyond a doubt.

"The species hitherto observed are:—

"1. *Geoplana tristriata,* pale yellowish-green, with three narrow, dark, longitudinal lines on the back; belly paler. Greatest breadth about the second third part of the length, where the mouth is situated. It likes to bend the head upwards. At the point of curvature on each side there is a closely packed group of eye-spots, which are continued in an irregular series to the posterior extremity. The anterior margin of the head appears to be destitute of eyes. Length $1\frac{1}{2}$ inch; breadth $1\frac{1}{2}$ line. Abundant.

"2. *Geoplana octostriata*. Habit and eyes as in the preceding species; colour pale yellow; belly whitish; on each side of the back four dark brown, approximated, longitudinal streaks, far broader than the longitudinal lines of the preceding. Not rare.

"3. *Geoplana elegans*. Habit similar, but a little less attenuated in front. Length $2\frac{1}{2}$ in., with a breadth of 1 line. Eye-spots very small, forming a rather broad dense band anteriorly, becoming narrower and less dense posteriorly, and passing into a simple row. Colour yellow; belly paler; on the middle of the back a broad, deep black, longitudinal stripe, and between this and the lateral margin on each side a narrow, deep orange-coloured longitudinal stripe. Only found once.

"4. *Geoplana pallida*. Of a similar form to the preceding. Colour yellowish-white, with a single narrow, blackish, longitudinal stripe on the back. Several specimens between boards.

"5. *Geoplana atra*. Deep black, beneath grey; nearly cylindrical, but little attenuated before and behind. The eyes difficult of detection, although present. Proboscis more cylindrical than in the freshwater *Planariæ*, but always much wider at the buccal than at the œsophageal extremity. Length 9 lines; breadth $\frac{1}{2}$ a line. Found once under the bark of a rotten Figueira (*Ficus doliaria*?).

"6. *Geoplana marginata*. Back and belly deep blackish-brown, shining, with narrow, golden-yellow, longitudinal bands on the middle of the back, and broader dull yellow bands along the lateral margins; in the latter the eye-spots are very distinctly visible, closely approximated in front, posteriorly in a simple loose series. The animal, which was 3–4 inches in length, and some lines broad, much attenuated before and behind, was creeping in the house.

"7. *Geoplana rufiventris*. Back dark brown; belly tile-red; moderately attenuated before and behind. The eyes closely grouped in several rows, distinct on the margins of the anterior part of the body, not detected posteriorly. The animal, which was a few lines in breadth, and several inches long, was found on wood.

"8. *Geoplana olivacea*. Belly yellowish-grey; back greenish-brown with dark brown longitudinal bands margined with paler colour, darker towards the margins, paler towards the head.

Eyes along the entire margin of the body, closer in front, very much scattered behind. Not rare.

"9. *Geoplana Nephelis.* Resembling the preceding in form, but somewhat less elongated; in form and colour it reminds one of a *Nephelis.* Back uniform brown; belly paler. Not rare.

"10. *Geoplana Maximiliani.* Almost like the preceding; the back with a paler, yellowish, longitudinal band. This species, however, is further distinguished from the preceding one by its mouth and genital orifice being placed far more posteriorly, and its penis being almost globular, whilst in *G. Nephelis* this organ is long and cylindrical. In the latter, also, the orifice of the proboscis appeared to have entire margins, whilst in *G. Maximiliani* (when examined in a spirit specimen) it appeared deeply five-lobed.

"11. *Geoplana marmorata.* Length 4 inches, breadth 4 lines. The eye-spots present nothing remarkable. The dorsal surface is pale reddish-grey, with small black spots arranged in irregular, repeatedly-anastomosing, longitudinal rows; the ventral surface is pale grey. The proboscis is dilatable into a flat cup with an undulated margin (in a spirit specimen).

"12. *Geoplana pulchella.* The anterior third of the body above brownish tile-red, with oval whitish spots; beneath grey, with a whitish band in the middle. Eye-spots considerably approximated near the anterior margin; their series uninterrupted on the anterior margin, missing on the posterior two-thirds of the body. About an inch long, by fully 1 line in breadth, not very much attenuated anteriorly. Only once observed.

"13. *Geoplana subterranea.* This, even from its abode, is peculiarly interesting, as it again enlarges the circle of vital conditions under which this animal form is enabled to exist. After finding Flat-worms in the clear spring-water of the mountains, as well as in the lakes and fens of the plains, under the stones of the sea-coast, as on the floating sea-weeds in the midst of the ocean; after obtaining the prospect of a rich fauna of terrestrial *Planariæ* which conceal themselves in damp moss, under stones and bark, and rise to the summits of the primæval forest, where, between the spinous leaves of the *Bromeliæ,* they find a perpetually humid asylum,—*Earth-Planariæ* now make their appearance, companions of the Earth-worms and grubs. In characteristic opposition to its coloured congeners, so abundantly supplied with eyes, which live above the surface of the earth, this *Geoplana,* dwelling in darkness, is without both the adornment and the sense of colour,—milk-white and destitute of eyes. In its habit, this species is more removed than any other from the typical form of *Planaria.* Its uniformly narrow, very long body, rounded off at the extremities, which, with a length of

2–3 or even more than 4 inches, scarcely attains a thickness of ¾ths of a line, gives it exactly the appearance of a *Nemertina*. When the intestine is full, its contents, shining through the skin, give the milk-white colour a more or less vivid tinge of flesh-colour or rosy-red. The buccal orifice is removed unusually far backwards; the genital orifice is situated quite in the vicinity of the posterior extremity; the proboscis is bell-shaped; the intestine of the ordinary form, with its lateral branches simple or forked, placed close together.

"The animal lives especially in loose and sandy, but also in heavy and tenacious clay soils, in company with *Lumbricus corethrurus* *. It may seem strange that so soft an animal, which scarcely bears to be gently touched, should be able to exist and make its way through this medium. This difficulty is got over by the Earth-worms, which burrow through the soil in such a way, that it is penetrated in all directions, like a sponge, by smooth passages of various widths. As a reward for this, the Earth-worms are devoured, or rather sucked, by the Flat-worm. That this was the mode of nourishment, was easy to see, from the colour of the contents of the intestine. But I have also met with *Geoplanæ* which were holding a young *Lumbricus* with their protruded proboscis, and whose intestines were beginning to be filled with fresh blood.

"For the microscopic investigation of the internal structure, this species would be better adapted than any other, not only on account of its transparency, but also because, with a little patience, it may be dug out of the ground in any quantity. All the other *Geoplanæ* occur but rarely, as is certainly the case with the European *Planaria terrestris* of O. F. Müller."

So far the communications of my friend Fritz Müller.

I may be allowed to add to these specific descriptions, those which have been made known by others, which occur scattered in various Journals, and have never yet been brought together. As regards the generic name *Geoplana*, this appears to be so well chosen, that zoologists will certainly acquiesce in it. The necessity of the generic separation of the terrestrial *Planariæ* from the others was felt even by Darwin, who says: "The terrestrial *Planariæ* belong to the genus *Planaria*, Dugès, *Polycelis*, Ehrbg.; they may, however, form a distinct section of this genus, characterized by their more roundish narrow body, and the usual presence of longitudinal stripes of very brilliant colours." Nevertheless Darwin established no new name for them. Besides the English traveller, Blanchard and Leidy have described terres-

* The description of this new species of Earth-worm will follow this paper.

trial *Planariæ*. The former* received specimens preserved in spirits of a species observed in Chili by Claude Gay; these he made use of for anatomical investigations which will be hereafter referred to. Blanchard named the species *Polycladus Gayi*. The generic name cannot be extended to all terrestrial *Planariæ*, and remains attached provisionally only to this species. The same is the case with the name *Rhynchodemus*, given by Leidy† to a North American terrestrial *Planaria*.

Darwin's terrestrial *Planariæ* are as follow ‡:—

14. *Geoplana vaginuloides*.	19. *Geoplana pallida*.
15. *G. elegans*.	20. *G. elongata*.
16. *G. pulla*.	21. *G. semilineata*.
17. *G. bilinearis*.	22. *G. maculata*.
18. *G. nigrofusca*.	23. *G. Tasmaniana*.

Of these species described by Darwin, some, most probably, agree with those observed by F. Müller. Thus the *G. elegans* of the latter may sink in the *G. vaginuloides*, Darwin, and the *G. pulla*, Darwin, may be identical with *G. olivacea* or *Maximiliani*, Müller. A final decision could only be furnished by figures, which, however, are not given by Darwin, nor as yet by F. Müller. If the two first-mentioned species should prove to be distinct, Müller's *G. elegans* must receive another name, as this has already been given by Darwin to another species, referred to above under No. 15. In any case, however, Müller's name *pallida* must be changed, as Darwin's species of the same name has the right of priority. From its pure white colour the latter might remind us of the *G. subterranea*, if the strongly-marked absence of the eyes did not sufficiently show the right of the form living under ground to rank as a distinct species.

The two above-mentioned species, described by Blanchard and Leidy as coming in addition to the 23 already referred to, are:

24. *Geoplana* (*Polycladus*) *Gayi*, Blanchard. Blackish-green on the back, with a white median line; the margin with a broad orange border, which is bounded by two narrow black lines; ventral surface orange.

Length 85–90 millimetres; breadth about 30 millimetres.

Hab. Chili, in moist places on the ground.

* Historia de Chile p. Claude Gay, Vers, pl. 1. fig. 2 (which I have been unable to consult); Ann. des Sci. Nat. 3 sér. viii. p. 140.

† Proceedings of the Academy of Natural Sciences of Philadelphia, vol. v. 1850–1851, pp. 241 & 289.

‡ [The author has translated all Darwin's descriptions, which, however, we have omitted, as they were originally published in this Journal, *loc. cit. supra*. He has substituted Dr. Müller's generic name, *Geoplana*, for that of *Planaria*, under which Mr. Darwin described his species.—Ed.]

25. *Geoplana* (*Rhynchodemus*) *sylvatica*, Leidy. Body elongate, fusiform, attenuated in front, pointed behind; the ventral surface somewhat flattened. Colour on the back grey, with two brown stripes along the median line, and a transverse brown spot at or close behind the middle; belly whitish; head brown, bent upwards, exhibiting two black, lateral eyes. Length, 2–5 lines; breadth in the anterior fourth, $\frac{1}{8}$th line; in the posterior, $\frac{1}{4}$th line.

Lives between stones, flower-pots, &c., in the gardens of Philadelphia, and also under wood and fragments of bark in the woods of the neighbourhood.

As a twenty-sixth and last species this is followed by the *Geoplana* (*Planaria*) *terrestris*, O. F. Muller, the only species hitherto observed in Europe. This has been already referred to.

What Darwin and Leidy tell us with regard to the anatomy of the terrestrial *Planariæ*, refers solely to the parts recognizable with the naked eye, or with a low magnifying power, such as the alimentary apparatus, the efferent parts of the sexual apparatus, and the eyes; they are fully confirmed by the statements of F. Müller, communicated above. The form of the ramified intestine is the same in all as in our well-known freshwater species; this is also the case with the position of the buccal orifice. Only the form of the œsophageal tube differs essentially, as F. Müller particularly points out, in several species, by the cylindrical form becoming converted more into a trumpet-shape, with repeatedly folded margins to the outer orifice. The genital orifice is situated throughout behind the mouth, and is always simple, by which the terrestrial *Planariæ* are removed from the large marine forms, for a knowledge of which we are especially indebted to Quatrefages *, and some of which I have myself been able to examine †. The penis and seminal ducts have been detected in several species. Where eyes are present there are either *two*, as in *G. terrestris* and *sylvatica*, or *many*, and these are then always distributed on the margin of the animal in groups, at pretty uniform distances apart, or more singly. Darwin and Leidy state that they contain a refractive body.

The above statements regarding the position of the buccal and genital apertures do not agree with what Blanchard says of his genus *Polycladus*. In this the buccal orifice is said to be in the *anterior*, instead of the posterior third of the body, the genital orifice still farther forward. From the further description of the animal, however, it appears clearly that these

* Ann. des Sci. Nat. 3 sér. iv. p. 129.

† Verhandl. der phys. med. Gesellsch. in Würzburg, iv. 1854, p. 222.

statements are founded merely upon a confusion between the anterior and posterior extremities, which may be excusable, as Blanchard did not see the animal living *. With such a notion, however, Blanchard's statements upon the central nervous system in *Polycladus Gayi* of course lose all value. This is said to consist of two cerebral ganglia, situated over the seminal vesicle, and two cords running backwards (forwards) which are again interrupted by several (up to 14) small ganglia. What organ has been confounded here with the nervous system, it is hard to say; at any rate no cerebral ganglia can be situated above the seminal vesicle, but they must be sought at the opposite end of the body.

In this certainly imperfect state of our knowledge of the structure of the terrestrial *Planariæ*, I very opportunely obtained a specimen of such an animal. It was found by Dr. Burmeister, near Rio Janeiro, and put, whilst living, into spirits, in which it had been very well preserved, with the exception of an accidental injury in the middle of the body. The tissues, indeed, were only partially applicable to microscopic examination. Nevertheless, by the aid of glycerine, which is often exceedingly serviceable in the clearing up of spirit preparations for the microscope, I succeeded in obtaining an insight into the finer structure of several systems of organs. Unfortunately, the development of the generative organs was so backward in the animal, that nothing could be ascertained with regard to the sexual glands.

My specimen belongs to none of the 26 species above characterized, and I therefore introduce it into the system under the name of *Geoplana Burmeisteri*. Its length is $2\frac{1}{2}$ inches; its greatest breadth behind the middle of the body $\frac{1}{2}$ an inch; its thickness 1 line. The body is pointed before and behind; attenuated more rapidly posteriorly, and anteriorly very gradually and drawn out into a long point. The colour of the back is sepia-brown, blackish-brown at the anterior extremity; a pale brown streak runs along the middle of the back from the anterior to the posterior extremity, very distinctly and sharply bounded by nearly black margins in the anterior quarter of the animal, then obsolete, and only distinct again in the vicinity of the hinder extremity. On the back also a quan-

* I may, however, mention in passing, that this is not the first error of the kind into which this observer has fallen. He has slipped into the same mistake with the *Caryophyllæus*, which is so common in the intestine of *Cyprinus Brama* (Ann. des Sci. Nat. 3 sér. x. p. 323, pl. 12. figs. 1, 2). Here also the extremity furnished with the organs of generation is marked as the *anterior*, whilst it is really the *posterior*, as was rightly perceived by all the older observers.

tity of small, circular, whitish points are scattered; these can just be perceived with the naked eye, are smaller and closer together in the anterior half, and finally disappear entirely at the head. The lower surface is uniformly greyish-yellow, and exhibits close behind the middle the buccal orifice, from which, in my specimen, the repeatedly folded, funnel-shaped buccal extremity of the œsophagus projects, and 5 lines further back, the very small genital orifice. Eyes were discovered by the microscopic examination of the margin of the anterior half of the body; they form blackish-brown pigment-spots, usually of a crescent-shape, lying pretty close behind one another in a single row, in the concavity of which, directed outwards, there is a round transparent body, which does not refract light very strongly, and in this respect exactly resembles the similarly placed body, which must be regarded as a lens, of the eye of our freshwater *Planariæ*.

The microscopic examination of the skin in the first place confirmed the supposition expressed by F. Müller, that in this, as in the other Turbellaria, a ciliated epithelium exists, although, from his observation recorded above, this hardly required microscopic proof. Although the ciliary coat in general had suffered greatly by preservation in spirits, the epithelial cells with their crown of cilia could, nevertheless, be unmistakeably recognized in particular places. Whether this coat of cilia be general, or, as in many Mollusca, only present on particular parts of the body, could not be decided. Nevertheless, from analogy with the other Turbellaria, we are scarcely justified in doubting that this coat is uniformly diffused. The ciliary cells are colourless, and usually of a wedge-shape. In many of them the thickening of the anterior cilium-bearing cell-membrane was unmistakeable, and this appears to occur as universally in these epithelial structures as in the cylindrical cells of the intestine, according to the observations of Funke and Kölliker. Below them there is a layer of irregularly hexagonal pigment-cells, which are the seat of the true principal colour. *Bacillar bodies*, which, as is well known, occur so universally in marine and freshwater *Planariæ*, were entirely wanting in the skin of my *Geoplana*. These, as I have repeatedly observed, may be very well preserved in spirits, so that their absence could hardly be due to the mode of preservation.

As in the other Turbellaria, a cutaneous muscular network follows beneath the cells of the skin, and in the first place, indeed, a simple layer of closely approximated longitudinal fibres. Below these is a closer layer of *transversely placed* muscular elements. The former readily separate in connexion with the cells of the epidermis, in the form of a thin membrane, from the annular muscles, which on their part enter into an intimate union with the viscera, and especially with the finer terminal ramifications of the intestine, so that they cannot be removed without adherent portions of the latter. The condition of maceration of my *Geoplana*, caused by its preservation for several years in spirits, facilitated the separation of the above-mentioned layers, which could hardly have been effected in the fresh state.

The elements of these muscular layers are long fibres of 0·0006–0·002 line in breadth, homogeneous throughout, without any distinct envelope and contents, and without traces of transverse striæ, exactly resembling those which I have described and figured in the *Rhabdocœla* amongst the Turbellaria (Beitr. zur Naturgesch. der Turbellarien, 1850), and like those which occur in the larger aquatic *Dendrocœla*. Narrow and broad fibres are intermixed, the narrower ones greatly predominating in number; the broader fibres divide more frequently, and in certain cases penicillate radiations are seen upon them.

The space surrounded by the annular muscles was found to be entirely filled by the intestinal canal, whilst, as has already been stated, nothing could be detected, in my specimen, of the secreting portions of the generative organs, which in sexually mature animals will certainly push itself to a greater or less extent between the ramifications of the intestine. In the immediate vicinity of the genital orifice alone, the globular copulative organ occupied a comparatively considerable space. The commencement of the intestine was indicated by the externally projecting, folded, buccal orifice of the œsophagus, which was of a white colour, and formed of densely interlaced narrow muscular fibres. The œsophagus is continued forwards, concealed beneath the skin, and occupying nearly the whole thickness of the animal, in the form of a cylinder about 1 line in thickness, and 4 lines long. From it, at the extremity opposite to the buccal orifice, originate three branches of the intestine, one running forward in the direction of the œsophagus, gradually becoming attenuated, as it gives off numerous branches at right angles, and reaching nearly to the anterior extremity; and two passing backwards, which being bent upwards run along and above the œsophagus to the posterior extremity, and emit numerous branches outwards. These principal branches, and the larger secondary branches of the alimentary tube possess strongly muscular walls, and an internal epithelial coat of small cells. As the division of the lateral branches of the alimentary canal gradually becomes finer, the muscular layer grows proportionately thinner, whilst the epithelial cells become larger and more darkly granular, until the racemose extremities of the intestinal ramifications, which are attached to the inside of the annular cutaneous muscles, are formed exclusively of the epithelial cells, only surrounded by a delicate structureless membrane. These largely cellular extremities of the ramified alimentary tube may be compared to a liver in their function.

The muscular fibres of the alimentary canal are for the most part similar to those of the skin above described. Besides these, however, there are other muscular elements in the entire extent of this system of canals, and these are not dissimilar in form to the organic fibre-cells of the higher animals. They are usually fusiform, flattened bodies, with rounded or irregularly torn ends, of a similar size and form with the broad, short fibre-cells of arterial membranes, which I have figured in my Inaugural Dissertation "De arteriarum notione, structura," &c., 1849, tab. 3, figs. 2 & 4. They are transparent, pale, colourless, and not granular, but, on the other hand, are provided with an indication of longitudinal striation; they are homogeneous or exhibit a granular central streak, which either runs through the whole length of the fibre-cell-like body, or is only perceptible for a short space in the centre. This streak always possesses a swelling in the middle and is pointed at the ends; it has, however, no similarity to a sharply defined nucleus, but rather resembles the granular axial cords of the muscular filaments of the Mollusca which C. Semper has recently described (Siebold and Kölliker's Zeitschr. viii. p. 345. tab. 7. fig. 10). The form of the bodies described varies in many ways. Although the spindle-shape is the most usual, a few clavate bodies occur, which are drawn out at one extremity into a long filament; others resemble fragments of fibres, and others again represent actual long fibres, but at the same time, in their refractive power and the indication of the longitudinal striation, perfectly resemble the fusiform bodies, although their breadth is less, so that a transition of the one form into the other cannot be mistaken. All these elements occur in the walls of the alimentary tube mixed with narrow muscular fibres, such as I have described as situated in the skin, and to these again they exhibit distinct transitions, so that, for this reason especially, I do not hesitate to draw a conclusion as to the muscular nature of the fusiform bodies. It appears, therefore, as though the broadest of the muscular bands in the body of my *Geoplana* were composed of single elements similar to the fibre-cells of the higher animals, which after maceration may be easily isolated, or readily break away where they were previously firmly united, whilst the narrower ones form long, continuous filaments in which a coalescence of several cells is no longer to be perceived, or has never existed.

Enclosed in the œsophagus of the animal I found a morsel of food, consisting of the grinding-plate and jaws of a snail with adherent muscular parts. This observation, like the statements of F. Müller as to the war of destruction waged by *Geoplana subterranea* against the Earth-worms, is opposed to Darwin's supposition that the terrestrial *Planariæ* only feed upon vegetable food, and indeed upon rotten wood, on which they are principally found. Darwin certainly kept some specimens in confinement for 21 days, without giving them any other nourishment than rotten wood, and during this period the animals grew considerably. Nevertheless this observation could not be decisive, as the contents of the intestine were not examined. The intestine of my specimen did not contain a single vegetable cell.

Of the nervous system nothing could be ascertained by preparation; and of the sexual organs I have only to mention the seminal vesicle, and the penis, which may be easily isolated at the genital orifice in the form of a globular body of $\frac{1}{2}$ a line in diameter. The seminal vesicle contained no spermatozoids. The true form of these contractile organs, which are composed of very fine muscular fibres, can only be ascertained by the examination of fresh specimens. The same applies to the sexual glands, the water-vascular system, &c. But for the purpose of subsequent histological investigation, a solution of 1–2 grains of bichromate of potash in the ounce of water will always be far preferable to spirits for the preservation of these extremely delicate animals, and I warmly recommend this solution to all collectors.

II.—*Description of a new species of Earth-worm* (Lumbricus corethrurus). By Dr. F. Müller *.

Lumbricus corethrurus, Brush-tail, the commonest of the Earth-worms of this country (Brazil), and which may be found in almost every clod of arable land, is rather slender, soft, and readily torn; the skin is nearly colourless, translucent, so that the colour of the body is principally caused by the intestine and blood-vessels, and therefore it appears more reddish towards the anterior extremity, grey in the middle, and pale reddish-white posteriorly. The measurement of nine animals all bearing clitelli (and killed in spirit of wine, because the length is constantly varying during life) gave on the average 28‴ in length, of which the clitellus measured 3‴, and the space in front of it 4‴. The body is cylindrical, attenuated anteriorly from the clitellus, and of

* This description is given by Schultze, and is referred to in the preceding paper, at p. 6.

a tolerably uniform thickness posteriorly. The number of segments is about 200–250, of which 13 are in front of the clitellus; the latter, which is often wanting, includes 8 segments. The foremost segment is grooved longitudinally, like the three anterior segments in *Geoscolex maximus*, Leuck. When the animal, feeling about, extends the head, one or two similar segments, together with a clavate head-lobe with a long peduncle, make their appearance from the first segment. On the foremost segments the bristles exhibit the usual position, the four bristles of each side being approximated in pairs; the upper pair is continued as far as the clitellus, whilst the two bristles of the lower pair gradually become more distant; from the clitellus backwards we see on each side only two rows of separate bristles: these are the first and third rows counting from below upwards; the latter runs about the middle, between the belly and the back; the insertion of the second and fourth bristles varies in height on each segment, but without any definite law being perceptible; sometimes, for example, they are placed alternately higher and lower, so that those of the 1st, 3rd and 5th, and again those of the 2nd, 4th and 6th segments lie in the same longitudinal line; sometimes three are elevated and two again depressed, so that those on the 1st and 5th segments stand at an equal height, those on the 2nd and 4th higher, and those on the 3rd still higher; sometimes also they maintain the same height on several consecutive segments, &c. After a greater or less number of segments (*e.g.* 20–30), the two rows of bristles still existing also cease their regularity: first the lower row, and then the upper one which runs along the middle of the side; these bristles also then vary in the height of their insertion from segment to segment. This apparently perfectly chaotic arrangement of the bristles becomes regular again in the vicinity of the hinder margin, by each segment bearing 8 bristles standing nearly at an equal distance apart, which alternate with those of the contiguous segments, by which 16 longitudinal rows (or also 3 spiral lines) of bristles are produced. It is remarkable that this singular arrangement of the bristles does not occur in young animals; these have two rows of pairs of bristles at the anterior extremity, which further back separate into four rows of isolated bristles.

The bristles on the anterior part of the body are more delicate, and appear to be slightly hooked; those on the hindermost part are very strong, straight and amber-coloured, stand upon distinct tubercles, and appear to be incapable of being entirely retracted. From these 16 rows of strong bristles, the whole tail acquires a brush-like appearance. The stomach is strongly muscular. The egg-capsules are almost globular, colourless and opalescent; I never found more than one embryo in them.

This short description will suffice to give a pretty good idea of our Earth-worm, and at least allow it to be easily distinguished from the other species hitherto described. Although the arrangement and form of the bristles are usually regarded as essential generic characters of the Earth-worms, and the present worm, which is so peculiar in this respect, appears imperiously to demand the formation of a new genus, I have been unable, especially on account of the regularly bristled young, to determine upon taking this course, the rather as there is no material anatomical or physiological peculiarity to justify this separation, as is the case for example in *Euaxes* and *Criodulus*, the latter of which is so deserving of a minute investigation. Perhaps some such point may appear to exist on the further investigation of a peculiarity, which has induced me to bring this insignificant animal before the zoological public. In almost all the larger specimens, one is struck immediately by a small spot about the end of the third quarter of the body, which appears of a more vivid red and as if inflamed; on the dorsal surface at this point the delicate skin often appears to be inflated, and as it were to form a small sac (*Bruchsack*). In specimens killed in spirits this spot looks like a second but much smaller clitellus, as it is sharply separated and rises a little above the segments before and behind it, probably because in the contraction of the body the weaker skin and muscular layer present less resistance here. If this spot, which I have not missed on any of the very numerous adult animals which I have examined for it, be examined with the lens, it is found to be composed of from 5 to 10, more or less distinctly separated, narrow segments, without bristles, and according to all appearance newly formed.

My first thought on seeing this new formation, was of the commencement of a transverse division; but, then, specimens produced by such a transverse division should have occurred, and these would have been destitute either of a proper anterior extremity or of the brush-like tail; for these, however, I have sought in vain. On counting the segments in nine specimens there proved to be nearly the same number of segments (namely 110) between the clitellus and this spot; the inconsiderable differences may be due to mistakes in counting. On the other hand, the number of segments behind the spot varied from 60 to nearly double that number. This spot might therefore possibly be a place for the formation of new caudal segments. Observations continued through all seasons may perhaps give us certainty even without a microscope.

Itajähy, June, 1856.

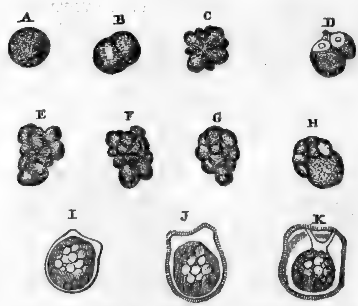
III.—*Remarks on MM. Koren and Danielssen's Researches on the Development of* Purpura lapillus. By Wm. B. Carpenter, M.D., F.R.S., F.G.S., F.L.S.

Although I have for some time had in my possession the Second Part of the 'Fauna littoralis Norvegiæ,' containing the second memoir of MM. Koren and Danielssen on the development of *Purpura lapillus,* yet it was not my intention to take any notice of their criticisms upon my observations, until I should have had the opportunity of again working through the subject. As the views of those gentlemen, however, have recently been brought prominently before the readers of the 'Annals' (see vol. xix. p. 433), and as my own have not been presented in its pages, I take the liberty of drawing attention to the following concise summary of them; referring such as desire a more detailed statement to the original memoir in the 'Transactions of the Microscopical Society,' new series, vol. iii.

It will be remembered that, according to MM. Koren and Danielssen, all the 500 or 600 egg-like bodies contained in any one capsule are of similar character: all undergoing coalescence into a conglomerate mass; and this mass subdividing itself into ovoidal bodies of larger or smaller size, each of which becomes converted into an embryo.

My view of the case is very different. Of these 500 or 600 egg-like bodies, I regard a small number only—usually from 12 to 30—as true *ova,* the remainder being only *yolk-spherules,* which are destined to serve for the nutrition of the embryos. The distinction between them manifests itself at a very early period, even in the first segmentation; for while the yolk-spherules divide into two equal hemispheres (fig. 1, B), the real ova divide into a larger and a smaller segment (D); in the cleft between these are seen the minute 'directive vesicles,' which appear to be always double or even triple, although, from being seen 'end-on,' only one may be visible; and near these is generally to be seen a clear space in each segment. The difference is still more strongly marked in the subsequent divisions; for whilst the cleavage of the yolk-spherules goes on irregularly, so as to divide each

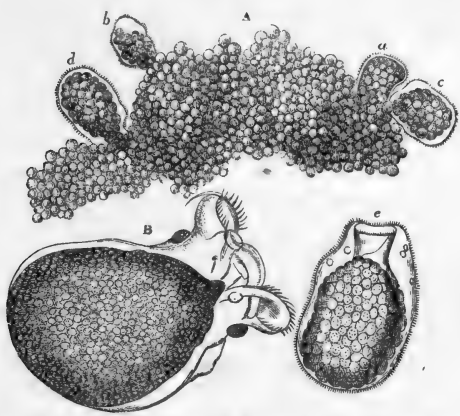
Fig. 1.



Early stages of embryonic development of *Purpura lapillus*: A, egg-like spherule; B, C, E, F, G, successive stages of segmentation of yolk-spherules; D, H, I, J, K, successive stages of development of early embryos.

into from 14 to 20 segments having no definiteness of arrangement (C, E, F, G), that of the ova takes place in such a manner as to mark out the distinction, first noticed by Vogt (in his memoir on the development of *Actæon*), between the cephalic and the visceral portions of the mass (H); and the evolution of the former into distinct organs very speedily commences. In the first instance, a narrow transparent border is seen around the whole embryonic mass, which is broader at the cephalic portion (I); next, this border is fringed with short cilia, and the cephalic extension into two lobes begins to show itself; and then between the lobes a large mouth is formed, opening through a short, wide œsophagus, the interior of which is ciliated, into the visceral cavity, occupied as yet only by the yolk-segments originally belonging to the ovum (K).—Whilst these developmental changes are taking place in the embryo, the whole aggregate of segments formed by the subdivision of the yolk-spherules coalesces into one mass, as shown at A, fig. 2; and the embryos are often, in the first instance,

Fig. 2.



Later stages of embryonic development of *Purpura lapillus*: A, conglomerate mass of vitelline segments, to which were attached the embryos, *a, b, c, d, e*; B, full-sized embryo, in more advanced stage of development.

so completely buried within this, as only to be discoverable by tearing its portions asunder; but some of them may generally be found upon its exterior; and those contained in one capsule very commonly exhibit the different stages of development represented in fig. 1, H—K. After a short time, however, it becomes apparent that the most advanced embryos are beginning to *swallow* the yolk-segments of the conglomerate mass; and capsules will not unfrequently be met with, in which embryos of various sizes, as *a, b, c, d, e* (fig. 2, A), are projecting from its surface, their difference of size not being accompanied by advance in development, but merely depending upon the amount of this 'supplemental' yolk which the individuals have respectively gulped down. For during the time in which they are engaged in appropriating this additional supply of nutriment, although they increase in size, yet they scarcely exhibit any other change; so that the large embryo, fig. 2 *e*, is not apparently more advanced as regards the formation of its organs, than the small embryo, fig. 1, K. So soon as this operation has been completed, however, and the embryo has attained its full bulk, the evolution of its organs takes place very rapidly; the ciliated lobes are much more highly developed, being extended in a long sinuous margin, so as almost to remind the observer of the 'wheels' of Rotifera, and furnished with very long cilia (fig. 2, B); the auditory vesicles, the tentacula, the eyes, and the foot, successively make their appearance; a curious rhythmically-contractile vesicle is seen just beneath the edge of the shell in the region of the neck; a little later, the heart may be seen pulsating beneath the dorsal part of the shell; and the mass of yolk-segments of which the body is made up gradually shapes itself into the various organs of digestion, respiration, &c., during the evolution of which (and while they are as yet far from complete) the capsule thins away at its summit, and the embryos make their escape from it. It happens not unfrequently that one of the embryos which a capsule contains, does not acquire its supplemental yolk in the manner now described, and can only proceed in its development as far as its original yolk will afford it material; and thus, at the time when the other embryos have attained their full size and maturity, a strange-looking creature, consisting of two large ciliated lobes with scarcely the rudiment of a body, may be seen in active motion among them. This may happen, indeed, not only to one but to several embryos within the same capsule, especially if their number should be considerable; for it sometimes appears as if there were not food enough for all, so that whilst some attain their full dimensions and complete development, others remain of unusually small size, without being deficient in any of their organs, and others again are more or less completely abortive,—the supply of supplemental yolk which they have obtained having been too small for the development of their viscera, although it may have afforded what was needed for that of the ciliated lobes, eyes, tentacles, auditory vesicles, and even the foot,—or, on the other hand, no additional supply whatever having been acquired by them, so that their development has been arrested at a still earlier stage.

Now, in defence of the foregoing explanation of the process, and in reply to the criticisms of MM. Koren and Danielssen, I beg to make the following remarks; premising that I speak not only for myself, but for Mr. G. Busk, whose independent observations (made for the purpose of testing the value of mine) led him to the complete adoption of the same view of the case.

1. The absence of any definite membranous envelope around the egg-like bodies, was, both to Mr. Busk and myself, a matter of certainty.

2. The existence, in certain of these bodies, of the 'directive vesicles,' which MM. Koren and Danielssen now concur with me in affirming, was most pointedly denied by them in their former memoir. They bring no new observations to invalidate my statement, that in the cases in which these bodies present themselves, the segmentation follows a regular plan, tending to the production of an embryo according to the ordinary Gasteropod type; but content themselves with affirming that the distinction which I have drawn between the segmentation of the true ova and that of the vitelline spheres is nugatory.

3. Although MM. Koren and Danielssen spoke in their first memoir of having only *occasionally* met with *one* of the embryos developed from a single ovum, they now admit that *several* such embryos are *usually* to be found in the capsule before the act of conglomeration has commenced; thus again confirming my statement as to a fact of fundamental importance. They do not offer any explanation of the ordinary presence of these small embryos, which is altogether meaningless, if (as affirmed by them) they speedily perish, but which is fully explained (on my view of the case) by their subsequent expansion into large embryos through the ingestion of the supplemental yolk. I have nowhere said, as is imputed to me, that all the bodies enclosed in the capsules are "anatomically and physiologically alike;" on the contrary, I contend that although there is originally no perceptible structural difference between the true ova and the vitelline spheres, a definite physiological difference manifests itself from the very commencement of the process of segmentation.

4. MM. Koren and Danielssen impute to me that I have (under the influence, as they assume, of a preconceived hypothesis) affirmed the existence of a mouth and a ciliated œsophagus in the small embryos, and have given delineations of these organs, without any other foundation than my own imagination, having mistaken for the œsophagus the foot in an incipient stage of development. It is not a little strange that if *I* have been deceived in this matter, so accurate and cautious an observer as Mr. Busk should have not only followed me in this error, but should have actually made the very drawings whose truthfulness is challenged. That my eyes should have deceived

me, when I saw, during the prolonged observation of the same individuals, yolk-segments actually pass down this œsophagus, and their bodies augment in bulk, does not strike me as very probable.

5. It is not a little significant that, putting aside the foregoing difference, the figures given by MM. Koren and Danielssen to illustrate their *second* memoir bear far more resemblance to mine, than they do to those by which their *first* memoir was illustrated. This fact, of which any one who compares the three sets of figures may readily satisfy himself, cannot but throw some doubt over the trustworthiness of the figures and descriptions originally given by those authors.

6. The contractile vesicle which was described and figured by MM. Koren and Danielssen in their first memoir as the heart, and which is distinguished by its projection from beneath the mantle during the middle period of development, I again affirm (and this without the slightest hesitation) *not* to be the heart. With the aid of the achromatic condenser, I was able to recognize what the presence of a distinct auricle and ventricle showed to be unmistakeably the heart, much deeper in the cavity of the mantle; and that these observers should *not* have recognized it, may be due to their not having transmitted a sufficiently strong light through the semi-opake body of the embryo. Although the reference they make in their second memoir to some other contractile vesicle (kidney ?) would seem to imply that they had recognized (as I have done) two distinct contractile organs, they have given no evidence of having done so.

I will not take upon myself to affirm that I have made no errors in my description of the process. Those who may take the trouble to consult my original memoir, will find that there are certain parts which I do not consider myself to have fully made out. But I cannot at present entertain any doubt as to the general facts of the case; and I submit that the admissions now made by MM. Koren and Danielssen go to strengthen my view of it. It is obvious that the main point to be decided by further observation is, whether I am right in affirming that in embryos developed from single ova, a ciliated mouth and œsophagus exist, down which yolk-spherules can pass; or whether, as MM. Koren and Danielssen assert, I have mistaken for the œsophagus the incipient foot. I would suggest to any observers who, during the present season, may have the opportunity of studying the development of *Purpura* (at Tenby the egg-capsules are so abundant that they may be gathered by the handful), that they give their special attention to this point, and that they endeavour so to place the embryos under the microscope, as to be able to look at the mouth from the front, as well as from the side, and thus to see down into the short wide œsophagus. Such a view was obtained both by Mr. Busk and myself, and is represented in fig. 9 *b* of my memoir; but MM. Koren and Danielssen seem only to have examined these parts from the side.—I shall of course take the first opportunity of again applying myself to the investigation; and if I find that I have been in error, I shall lose no time in making public my retractation.

P.S. Since writing the above, I have been informed by Dr. Dyster of Tenby, that he has repeatedly verified the most important parts of my observations; viz. the development of embryos, possessing a mouth and ciliated œsophagus, from single ova, which are distinguished as such from the very commencement, by the mode of segmentation and the presence of the directive vesicles.

IV.—*On the Ultimate Structure of* Spongilla, *and Additional Notes on Freshwater Infusoria.* By H. J. Carter, Esq., Assistant Surgeon H. C. S., Bombay.

[With a Plate.]

In the "Postscript" to my notes on the organization of Infusoria, dated 10th June last*, it is stated that apertures exist in the investing membrane of *Spongilla*, and that the particles of carmine taken in through them pass into the substance of the sponge-cells. This was added chiefly to correct an assertion made in the body of the paper, that *Spongilla* lived by endosmosis. I also stated that I should recur to these facts more particularly hereafter; but since then, up to within the last month, I have not had an opportunity of again pursuing the subject. I have, however, during this time, succeeded in ascertaining the ultimate structure of *Spongilla*, by following its development from the seed-like body, and this I will now relate.

Those who are acquainted with *Spongilla* are aware, that it is charged towards the base with a number of seed-like bodies of a globular shape, each of which consists of a coriaceous membrane enclosing a number of delicate, transparent, spherical cells, more or less filled with ovules and granular matter, while an incrustation of gelatinous matter, charged with small spicules peculiar to the species, surrounds the exterior of the coriaceous membrane. It has also been shown that at an early period

* Annals, vol. xviii. p. 242.

of development the spherical, which we shall henceforth call "ovi-bearing," cells are polymorphic—identical, but for the ovules, with the ordinary sponge-cell,—and surrounded by a layer of peculiar cells equally polymorphic, which I have conjectured to be the chief agents engaged in constructing the capsule*. It is desirable also to remember that there are these two kinds of cells in the composition of the seed-like body, because we shall find by and bye that they appear in corresponding parts of the newly developed *Spongilla*. Lastly, the seed-like body presents a hole, which we shall call the "hilum."

Having thus briefly alluded to the constituent parts of the seed-like body, let us now pursue the development of *Spongilla* from it. This takes place in the following order: viz. 1st. The contents issue through the hilum under the form of a gelatinous mass, in which the ovi-bearing cells and their contents appear to be imbedded *entire*. 2ndly. The spicules begin to be developed, and with them is formed a delicate pellicle, which not only encloses the new *Spongilla*, but also the seed-like body: to this pellicle we shall give the name of "investing membrane;" this becomes separated by an interval (which we shall designate the "cavity" of the investing membrane) from the gelatinous mass containing the ovi-bearing cells, which we shall term the "parenchyma." 3rdly. Apertures are developed in the investing membrane, and a system of afferent and efferent canals in the parenchyma; the afferent canals commencing in many large apertures and afterwards communicating with each other, and the efferent canals commencing in *ramusculi* which end in a single tubular vent. In this period also the spicular structure is formed and arranged. 4thly. The ovi-bearing cells are developed into spherical ampullaceous sacs, communicating with the afferent canals; and the afferent and efferent currents are established. We will now follow this more in detail.

First Period.—Three or four days after the seed-like body (which has never been allowed to get dry †) has been placed in clear water, a white substance like cotton is seen to have issued from the lower part of it. This, when examined, is found to present a flat, transparent border, so abounding in (indolently contracting) vesicles of different sizes, that it looks like an areolar structure. I wish particularly to call attention to this point,

* Annals, vol. xviii. pl. 6. figs. 41, 42.

† For this purpose it is best to place a piece of *Spongilla*, charged with the seed-like bodies, in a basin of water, where it will soon get putrid; but this does not matter: the seed-like bodies still retain their vitality, and will throw out the young *Spongilla* much more quickly than if taken fresh from the living mass. Those which I have used for these experiments belong to *Spongilla alba*, H. J. C., which was taken from the tank a year since.

because it resembles the vacuolar state of the protoplasm in the early development of the cell of the Characeæ, and probably of vegetable structures generally. The margin of this border is more or less irregular and digitated, from the polymorphic substance of which it is composed; while further in may be seen the ovi-bearing cells in the denser gelatinous matter, with their ovules already somewhat diminished in size. The spicules have also begun to appear.

Second Period.—We may commence with the formation of the spicules, which is so rapid, that they come into view almost simultaneously with the issue of the substance of the seed-like body.

Spicules.—These appear to be formed in sponge-cells of a peculiar kind, one of which is confined to the parenchyma, viz. that which forms the large smooth spicule, and the other to the seed-like bodies and the investing membrane, viz. that which forms the small spiniferous spicule characteristic of the species. Of the former I can state nothing, except that it appears to be filled with ovules like the ovi-bearing cell, while the latter is characterized by the absence of ovules, a uniform granular composition, and the presence of a nucleus (Pl. I. fig. 7).

At the earliest period that a spicule becomes visible it appears under a hair-like form of immeasurable thinness, and enclosed in a sponge-cell of a spindle-shape, which has assumed this figure to accommodate it. The nucleus of the cell is now seen in its centre, and the spicule, about $\frac{1}{400}$th of an inch in length, lying across it (fig. 8 *a*′). After a few hours the spicule becomes much larger and longer, and the sponge-cell still more extended to retain it within its substance; it also presents a glairy, ovate globule in its centre, through which its shaft passes, not in the line of the longitudinal axis, but on one side of it, so that the globule looks as if it were appended to it (fig. 8 *a, b, c*). When, however, the spicule is arrested at this stage of its development and denuded of the sponge-substance, that part which in the sponge-cell appeared to be a glairy, refractive globule, is found to be merely an inflation of the outer wall of the spicule, for the shaft of the spicule, slightly diminished in size, may then plainly be seen to pass through it in the manner before mentioned, and to present the longitudinal canal in its inside. In this state neither undiluted nitric acid nor a saturated solution of caustic potash produces any change in it, so that it may fairly be assumed to be of the same composition as the rest of the spicule.

By degrees, as the spicule is enlarged, the inflation is also proportionally increased in size, and disappears only when the spicule is fully formed (fig. 8 *d*). The normal state of the inflation appears to be single and in the centre of the spicule, but it may be situated on any part of the shaft, or present in variable plurality (*e*, *f*, *g*).

In my notes on the organization of the Infusoria I have stated* that the spicule grows from a hair-like extension projecting from either side of a glairy globule, which now is found to be nothing but an inflation, probably filled with refractive fluid. However, as we see that the spicule grows by layers deposited on the original one, which, therefore, forms the longitudinal canal, and that, when it is fully formed, the inflation is no longer visible, at the same time that the inflated portion is continuous with the outermost layer of the spicule while the latter is growing, it does not seem improbable that the first layer does arise from the linear extension of a globule, and that every succeeding layer is formed in the same way; (hence, as there will be more layers in the centre than at the circumference, the spicule assumes a pointed form at each extremity); the inflation subsiding with the extension of each layer, until the final one leaves no inflation at all, and the spicule assumes its ultimate form. The original form of the spicule, therefore, appears to determine its ultimate one, and the spiniferous character of this will therefore depend on the greater or less tendency in all the layers to assume this figure, whatever it may be (fig. 8 *h*). Whether the spicule is developed throughout by the same sponge-cell, or whether, after it very much exceeds in area any of the sponge-cells, which is always the case with the large spicule, a plurality are engaged in its ultimate development, or whether it continues to grow in the intercellular substance until it has reached its largest size, I am ignorant; but I have ascertained, by a series of observations and measurements, that it does not grow after having become denuded of the sponge-substance.

Again, I am not certain that the inflation, though extremely common, is always concomitant, or even necessary in the formation of the spicule, for many present no trace of it in any stage of their development, from the time they are first visible to that in which they have attained their largest size.

Long before the spicules are formed, however, they are transported from place to place by the sponge-cells individually, and when too large for this, are twisted and turned and grouped together by the general mass, to meet the requirements of the case, with as much instinct as that which characterizes the arrangement of the bits of stick in an ant-hill; while they appear never to become finally fixed until the substance in which they may be imbedded has altogether lost its vitality.

Investing Membrane.—As the sponge-substance accumulates vertically, the flat transparent border seems to disappear by

* Annals, vol. xviii. p. 118.

being raised with the pellicular covering of the *Spongilla* generally, until it presents a considerable angle of elevation at the circumference; while the parenchyma, either by contraction within, or by forcing outwards bundles of its large smooth spicules, here and there separates itself from the pellicular covering, and thus both the investing membrane and its cavity are formed (Pl. I. fig. 1 *b, b, b*). The investing membrane, now supported in its position by these bundles of spicules (*d, d, d*), and kept on the stretch by the small spiniferous spicules which are scattered through its substance, presents two objects well worthy of description, viz. the peculiar cell to which I have before alluded, and a number of apertures (*f, f*).

The cells of the investing membrane are characterized by their uniformly granular composition and colourless appearance. They are nucleated, possess the contracting vesicle singly or in plurality, and are spread over the membrane in such numbers, that it seems to be almost entirely composed of them; while they are of such extreme thinness, and drawn out into such long digitated forms, that they present a foliated arrangement not unlike a compressed layer of multifidous leaves, ever moving and changing their shapes (figs. 6 *d* & 7). This is, as I have before stated, the same kind of cell as that which forms the cortical layer of the seed-like body at a very early period; and, as will be seen hereafter, is further characterized by not enclosing any carmine when the other cells become charged with it.

The apertures, on the other hand, are circular or elliptical holes in the investing membrane among (in ?) these cells. They seldom exceed $\frac{1}{700}$th of an inch in diameter, have a clean, thin margin, which in one part presents a slight tubercular enlargement, and are generally surrounded by some minute colourless granules; while they have the remarkable property of closing or dilating like the pupil of the eye, but generally with extreme tardiness instead of the velocity observed in the latter (fig. 6 *a*). The tubercle looks very like the nucleus of a sponge-cell, and, when the aperture is contracted, the granules may be seen to be enclosed in a circumscribed form, which, together with the presence of one or more contracting vesicles, gives the whole very much the appearance of one of the sponge-cells peculiar to the investing membrane. Through the apertures the particles of food and other substances suspended in the surrounding water are admitted into the cavity of the investing membrane, preparatory to passing into the parenchyma, in the manner which will be presently mentioned*.

* These are the apertures to which I alluded in the postscript mentioned. Mr. Bowerbank also discovered them about the same time in

Independently of all these structures, together with an innumerable number of minute contracting vesicles, the investing membrane is so transparent, that every part of its cavity can be seen as clearly as if there were no membrane at all.

Parenchyma.—This consists of a mass of gelatinous substance (Pl. I. fig. 1 *c, c*), in which are imbedded the smooth spicules and ovi-bearing cells, and through which pass the afferent and efferent canals.

Ovi-bearing cells.—The ovi-bearing cells do not burst and allow their contents to become indiscriminately scattered through the gelatinous mass in which they are imbedded, but each becomes developed separately and entire in the following way, viz. the ovules and granules of the ovi-bearing cell subside into a granular mass by the former losing their defined shape and passing into small monociliated and unciliated sponge-cells; this mass then becomes spread over the interior surface of the ovi-bearing cell, leaving a cavity in the centre, into which the cilia of the monociliated sponge-cells dip and keep up an undulating motion; meanwhile an aperture becomes developed in one part of the cell which communicates with the adjoining afferent canal, and thus the ovi-bearing cell passes into an ampullaceous, spherical sac. The cilia may be now seen undulating in the interior; and if the *Spongilla* is fed with carmine, this colouring matter will not only be observed to be entirely confined to the ampullaceous sacs, but when the *Spongilla* is torn to pieces and placed under a microscope, particles of the carmine will be found in the interior of the monociliated as well as in that of the unciliated sponge-cells (figs. 2, 3, 4, 5); proving that of such cells the ampullaceous sac is partly composed.

This sac then must be regarded as the animal of *Spongilla*, as much as the Polype-cell is regarded as the animal of the *Polype*, and the whole mass of *Spongilla* as analogous to a Polypidom.

Sometimes an isolated ovi-bearing sponge-cell which has escaped from the general mass, may be seen to have undergone the same development by itself in the watch-glass; but in this case there appears to be no aperture, for particles of carmine brought into contact with it indicate no currents about its exterior, while, within, the cilia may be undulating as actively and as evidently as if it were *in situ*. Another proof also of the absence of an aperture is, that under this condition the ampullaceous sac encloses the particles of carmine which are in contact with its exterior, after the manner of *Amœba*.

England, and mentioned the fact at the British Association (Athenæum, 30th August, 1856). His paper in the Quart. Journ. Microscop. Science I have not yet seen.

I have stated that the contents of the ovi-bearing cell during development become spread over its inner surface, but at the same time I think it questionable whether this cell becomes revivified, or whether it is not ultimately cast off after a new one has been formed.

In proportion as the ampullaceous sac experiences a want of nourishment after it has been fully developed in the watch-glass, so it gets thin, and, becoming more translucent, not only allows its aperture to be better seen, but presents an indistinct meridional lineation, which, radiating from around the aperture, meets at the opposite pole of the sac, thus giving the former an appearance not unlike the pupil of the eye (fig. 3 *a*); but though at one time it is larger and at another smaller, and not unfrequently of an irregular circular form, yet its changes are so gradual, that I have seldom, except when carmine has been added and taken into this sac, been able to see any alteration in its size or form for an hour together. When the aperture is in focus, the opposite point of the sac is invisible.

Afferent Canals.—The afferent canals consist of a number of channels which open by large apertures into the parenchyma from the cavity of the investing membrane, and then, freely anastomosing, form an areolated cavernous structure, throughout which the particles admitted into the cavity of the investing membrane subsequently circulate, and are finally received into the ampullaceous sacs which open into them (fig. 1 *e, e*).

Efferent Canals.—The efferent canals, on the other hand, begin by radicles in the interstices of the cavernous structure, among the ampullaceous sponge-cells (with the cavities of which, however, they do not communicate, nor with the afferent canals, as will be seen hereafter), and, growing into large branches, at length terminate in a single tube. This tube extends beyond the periphery of the *Spongilla*, and ends in a mammilliform point, in the centre of which is a single contracted aperture (Pl. I. fig. 1 *g*).

Thus we have the structure and composition of the portion of *Spongilla* developed from the seed-like body. Let us now direct our attention to its functions, which are easily elicited by placing a little carmine in the water, and watching the particles as they pass through its substance.

No sooner has the carmine reached the exterior of the investing membrane, than its particles are rapidly drawn in through its apertures, not vortically but directly, and, traversing its cavity, or the interval which exists between the investing membrane and parenchyma, in different directions, are thence drawn in through the apertures of the latter, and finally into the ampullaceous sacs, where they remain a quarter of an hour or more, until they are thrown off and find their exit through the efferent system of canals.

During their course we observe, that on arriving near the ampullaceous sacs, they are rapidly drawn aside, and for the most part pass into their cavities; and by seeking for those favourably situated for such observations, that is, at the circumference of the parenchyma, we not only see that this takes place at one point only, but also, frequently, that at this part of the sac there is the circular aperture mentioned, and that they pass in through this aperture; further, after a certain time, we observe, that the particles of carmine which have accumulated round the inner surface of the sac, are gradually thrown off from its circumference, and, falling into the efferent system of canals, are thus carried away and finally ejected.

It would have been satisfactory to have seen the particles pass in through the aperture while the latter was uppermost or undermost, and in the focus of the microscope (Pl. I. fig. 3 *a*)*, but this I could never do, perhaps from the rapidity with which they are whirled into the interior; but when the aperture happens to be on one side of the sac, the particles may be seen to pass through it into the interior, and generally to adhere to the first part with which they come into contact, when they are instantly enclosed by the sponge-cell on which they impinge. Again, the aperture would not appear to be the only part of the exterior of the ampullaceous sac which is in communication with the afferent canal, but a much larger portion is bathed by the afferent fluid, for particles of carmine may be seen to adhere to the external surface of this sac as well as to be carried into it; and the latter seems to be more the case as the sac becomes altered from want of nourishment, after having reached its maximum of development under the circumstances mentioned.

If now we clear the watch-glass of all superfluous carmine by dipping it in clean water, and again place it under the microscope, the facts to which I have before alluded will become perfectly evident, viz. that the colouring matter is wholly confined to the ampullaceous sacs, and that the sponge-cells of the investing membrane do not contain a single particle; while, by tearing the *Spongilla* to pieces, it will be found as much in the bodies of the monociliated as in those of the unciliated sponge-cells. Thus the component parts of the ampullaceous sac are easily demonstrated. One point, however, remains to be proved,

* This aperture corresponds in every respect, except the presence of the tubercle, with the aperture of the investing membrane; but I never could entirely satisfy myself that the latter was not a contracting vesicle, until I saw the particles of carmine pass in through it.

namely, that there is no direct communication between the afferent canals, or the ampullaceous sacs, and the efferent canals. This is easily effected by placing a little carmine in the water, and observing the moment of its entry through the apertures of the investing membrane and that of its exit through the efferent tube, when the interval will be found to vary; but as it is seldom less than a quarter of an hour, this is quite sufficient to show that there is no direct communication between these cavities; while the mode of enclosing the particles by the small sponge-cells being known to be like that of the *Amœba,* their having been seen to throw them off at the circumference of the ampullaceous sac, when they are immediately carried away by a current passing through the canal into which they are thrown, is still further corroborative of the fact; but, indeed, it requires no corroboration, for when the sacs are only one layer deep, it can be seen.

We have now to consider by what power the particles are drawn into the ampullaceous sacs, and how a constant current through the *Spongilla* is maintained—questions which we can only hope to answer by a study of the organs of *Spongilla* individually; and fortunately, as far as the first inquiry goes, this is much aided by the change which takes place in the new *Spongilla* a few days after it has been developed.

The same difficulty which exists in maintaining life in the Infusoria, viz. the want of proper nourishment, is experienced with respect to the young *Spongilla,* and hence, sooner or later, it becomes starved; but frequently, just before this takes place, the whole community of sponge-cells, more or less, separate, dissolve partnership, so to speak, leave their habitation, and issue forth into the watch-glass to seek independent existences respectively for themselves. At this time the ampullaceous sac may be seen entire, but reduced to an actinophorous form (Pl. I. fig. 9), and presenting a single nucleus, while in other instances the community of this sac have separated, and its monociliated and unciliated sponge-cells are also seen spread about the watch-glass; also groups of much smaller monociliated cells like those called *Uvella* by Ehrenberg; and lastly, the characteristic sponge-cell of the investing membrane.

The one, however, which interests us most here, is the monociliated sponge-cell of the ampullaceous sac (that which I once supposed to be the *androspore*), and this may be seen attached by a pedicular elongation of its substance to the watch-glass on one side, and with its single cilium undulating on the other (fig. 10). We have it now, then, exactly in the position for ascertaining the direction of the currents of the latter, and these, when a little carmine is added, are found to be towards the body on either side of the cilium, by which the particles may be seen to be thrown almost point-blank on its surface, and at the same time caught up (by apparently adhering to it, or by a process thrown out by it as in *Actinophrys Sol* (*b*)) and rapidly passed into the interior. Hence we may easily conceive the united effort of all the ciliated sponge-cells in the ampullaceous sac being sufficient to produce a considerable current into its interior, and thus to catch the particles which are passing through the afferent canals.

The other question, viz. that of the afferent and efferent currents, is not so easily solved, but still the monociliated sponge-cell supplies data for at least speculation on that point. I have already shown, in my notes on the organization of the Infusoria, that the vesicula or contracting vesicle is an excretory organ, and that it discharges itself from the surface in many Infusoria, especially in the naked Rhizopoda, to which the sponge-cell is most intimately allied; and it so happens, that not only do these monociliated sponge-cells present the contracting vesicle in great activity, but also in variable plurality, so that with those of the other sponge-cells lining the cavity of the ampullaceous sac, a continual and rapid discharge of water must be kept up; which, when we remember that it is the character of this organ to discharge itself from the surface, and find that when the ampullaceous sac leaves the parenchyma it becomes nothing more than a large sponge-cell, gives us, I think, pretty good reason to infer that these organs discharge their watery contents into the efferent system of canals; and, when we consider the powerful organ which the contracting vesicles of all the ampullaceous cells together must form for effecting this function, it does not seem unreasonable, in connexion with the following facts, to conclude that the currents, both afferent and efferent, of the sponge may be produced in this way.

It might be supposed, from what has been stated respecting the course of the particles of carmine through *Spongilla*, that the afferent and efferent currents never cease as long as it is alive; but such is not the case under some circumstances, for although no difference is appreciable when only a small quantity of carmine has been taken in, yet when there is an abundance in the water, and the ampullaceous sacs become apparently filled with it, not only do these sacs one after another seem to close their apertures and refuse admittance to any more, but the whole investing membrane becomes drawn towards the parenchyma, its apertures all become closed, and the tubular vent of the efferent system retracted, and its aperture also closed, so that there is a total cessation of all active motion in the *Spongilla*; and this may continue for more than an hour, when the vent is seen to project itself as gradually as it became contracted, the investing membrane to resume its original position, and the apertures in both to open and admit and emit their currents respectively as before; but now, the latter brings away the refuse of the carmine which has been and is still being thrown off into the efferent canals. In fact, the *Spongilla*, having been fed to satiety, appears thus to shut itself up for a time for the purpose of digestion, and then to open to throw off the refuse.

Again, it sometimes happens that one of the large branches of the efferent system bursts and gives rise to an efferent current before the tubular vent resumes its original dimensions and opens its aperture, by which two efferent currents are subsequently established, for the abnormal one does not close when the normal one becomes opened. Hence we have a further indication of pressure on the contents of this system, which will hardly derive explanation from anything but a force exerted by the contracting vesicles in the way mentioned; the conditions of the fluid in the afferent and efferent canals hardly holding out a sufficient difference in composition or density to account for this by endosmosis.

Thus we find *Spongilla* (for I have ascertained that the same structure exists in the large masses as in the small ones) composed of a number of stomachal sacs imbedded in a gelatinous substance permeated with spicules for its support, and an apparatus for bringing them food, as well as one for conveying away the refuse, while the nutriment which is abstracted by the process of digestion common to Rhizopodous cells (*e.g. Amœba*) no doubt passes through the intercellular gelatinous substance into the general development of the mass; and if right in comparing the ampullaceous sacs to the stomachal cavities of the simplest Polypes, are we not further justified in drawing a resemblance also between the ciliated sponge-cells and those which line the stomach of *Cordylophora**, of *Otostoma*†, and many of Ehrenberg's *Allotreta* together with those in the stomach of the *Rotatoria* and *Planariæ*‡, which are evidently biliary organs, also having cilia floating in the cavity which receives the food?

Lastly, it is perfectly evident that each monociliated sponge-cell possesses a large granule (Pl. I. fig. 10 *c*), which is of a greenish colour, and that the assemblage of these cells in the interior of the ampullaceous sac produces the assemblage of granules which are seen in it; also that these granules, when the ampullaceous sac becomes individualized and assumes an actinophorous form, represent the "granules" which I have described as a part of the internal contents of the Rhizopoda (fig. 9).

* See Prof. Allman in Phil. Trans. 1853, p. 370.

† Annals, vol. xvii. p. 117.

‡ *Idem*, vol. xviii. pl. 7. fig. 92.

May we not infer from this that these indicate the presence of similar cells in the interior of *Amœba*, &c.? If this should be the case, and that they are homologous with the liver-cells of the *Planariæ*, then I shall have been right in my original conjecture that the "granules" are the homologues of the "spherical cells*."

It is proper to notice here, also, the affinities which *Spongilla* has to the vegetable kingdom. I have already alluded to the resemblance between it and the cell of the Characeæ at an early period, when both are filled with vacuoles; nor is the plurality of the contracting vesicle in the Rhizopoda generally, when matured, a less striking instance of the transition of the vesicula or contracting vesicle in the more animal Infusoria, into the passive vacuoles of the vegetable protoplasm. The nucleus of the Rhizopoda is typical of that which exists in the vegetable cell. Similar "granules" are also seen in motion at the extremity of the root-cell of *Chara*, in the "fixed protoplasm†;" and at present no difference can be shown between the molecular protoplasm in each; while as regards the production of starch, that is so common in every specimen of *Spongilla* that is met with, more particularly at the end of the season, that its presence is no novelty whatever. The mode of taking nourishment is different, but I have already stated that when the protoplasm leaves the cell of *Spirogyra*‡, and even before its exit, it encloses nutrient matter after the manner of *Amœba*. For the last year, some plants of *Chara*, which I reared from the nucules, and have grown in a glass jar, have only been kept vigorous by dead grasshoppers, which every now and then, when the *Chara* begins to grow lighter in colour and meagre in appearance, have, by being thrown into the water, restored it to its former condition§. So that the same elements, under different circumstances, are thus made subservient to the same purposes. Hence the sponge-cell appears to be but a naked condition of the vegetable cell, and thus to become the first, or among the first, of animal organisms.

I would here also recur to the forms which the substance of *Spongilla* assumes when, under the dread of starvation, it leaves

* Annals, vol. xviii. p. 125. † *Idem*, vol. xix. pl. 3. fig. 2 *f*.

‡ *Idem*, vol. xix. p. 259.

§ In this instance I have noticed, that the moment the plants become robust, they cease to bear fruit; while, when they become impoverished, they throw forth nucules,—the physiology of which appears to be evident: viz. so long as there is plenty of nourishment to build up more structure for ultimately making more propagative germs, this alone occupies the instinct of the plant; but the moment the nourishment ceases, the instinctive fear of failing in the propagative department causes the plant to turn its attention to preserve itself by forming seeds.

its habitation; not more to particularize these forms than to show how closely they resemble those of the protoplasm of *Spirogyra,* when under similar circumstances it also leaves its natural habitation or cell-wall and seeks for food elsewhere. The smallest is that which resembles *Uvella,* Ehr. This consists of a number of minute, monociliated, flask-shaped cells, which adhere by their pointed extremities respectively to a common centre point, whence the whole assumes a globular form (Pl. I. fig. 11 *a, b*). They are about $\frac{1}{3733}$rd of an inch in diameter, polymorphic, and present the granule and contracting vesicles like the monociliated sponge-cell of the ampullaceous sac; they also enclose particles of food, and on separating from each other, attach themselves by a prolongation of the body to the watch-glass (*b*), so that they are but a miniature type of the ciliated sponge-cell. The latter, again, which I have already described, loses its cilium a day or two after it has come out into the watch-glass, and assumes an actinophorous form, becoming at last encapsuled; previous, however, to losing the cilium, it progresses with the latter in front, and not behind, as when it is set free by tearing up a piece of the *Spongilla.* The ampullaceous sac, whilst remaining entire, also assumes an actinophorous form, loses all appearance of cilia internally, and encloses food after the manner of *Amœba.* All these figures are so like those assumed by the protoplasm of *Spirogyra** when it breaks up and undergoes the changes to which I have alluded, that no doubt can be entertained of both organisms being Rhizopoda at this period.

Of the sense of feeling in *Spongilla,* I have had no manifestations beyond the instinctive acts to which I have alluded, and that wonderful power of opening an aperture through itself, which the sponge-cell of the investing membrane apparently possesses; but in *Amœba Princeps,* which is a closely allied organism, I once saw the surface contract and become puckered several times successively, on being pinched by a rotatory animalcule (*Diglena*), an experiment which this animalcule performed for me so satisfactorily, that I have no longer any doubt about the matter.

The "swarm-spore" described by M. N. Lieberkuhn†, which appears to me to be a ciliated form of the seed-like body, and the same as the "gemmule" described by Dr. Grant, I have not yet been able to see; nor have I been able to see his "spermatozoa-like bodies," unless the *Uvella*-form just mentioned be them.

The formation of the seed-like body, however, now that we

* Annals, vol. xix. p. 259. † *Idem,* vol. xvii. p. 407, 1856.

know the structure of the ampullaceous sacs, seems very intelligible; for we have only to conceive an enlargement of the small sponge-cells lining its interior, with the addition of ovules to them respectively, and the spicule-bearing sponge-cells of the cortical substance supplying the spicular crust to the exterior, to have a globular capsule thus composed, with a hilum precisely like the seed-like body; a conjecture which seems to derive support from the fact, that in some instances, when *Spongilla* is beginning to experience the want of nourishment, these sacs, small as they are, assume a defined, rigid, spherical form, from their pellicle becoming hardened and encrusted with extremely minute spicules.

Additional Notes on the Freshwater Infusoria in the Island of Bombay.

As there are some parts of my "Notes" on the organization of the Infusoria* which require correction, alteration, and further explanation respectively, I take this opportunity of communicating the observations necessary for this purpose, and at the same time of supplying additional matter, which will render them more complete.

Vesicula.—At p. 129 it was stated that the existence of the vesicula "in *Astasia, Anisonema* (Duj.), and *Euglena* can only be determined by inference." Since then I have seen the hyaline vesicle, supposed to be the vesicula, empty itself in all three of these organisms, but more particularly in *Euglena viridis*, and a description of the process, which is peculiar, in this species will serve for all the rest. (Pl. I. fig. 14.) It has been already stated, that in *Anisonema* the vesicula seemed to alter in size and shape without completely contracting, which is more or less the case with all this class of animalcules, and appears to arise from the presence of a single sinus in connexion with the vesicula, as will be seen by the following description of the mode in which this function is performed.

In *Euglena viridis* the single sinus, which is attached to the side of the vesicula, after having become filled, pours its contents into the latter; the vesicula, thus distended, is now pressed upon by the gradual refilling of the sinus, and thus its contents also become evacuated. Hence we never witness that sudden contraction of the vesicula which is so common in other Infusoria, at the same time that it often appears double in *Astasia* and *Anisonema* (where it is more evident than in *Euglena*, owing to the absence of colouring matter), from both sinus and vesicula being more or less distended together (fig. 15).

* Annals, vol. xviii. p. 115, 1856.

The only way in which this process can be well seen is, by getting specimens of *Euglena viridis* which are turning red, filled with ovules and about to become capsuled, or which have been just burst from their capsules. These, which at this time are spherical, if placed in water under a light piece of glass, and the water partly abstracted by bibulous paper, will, by the pressure of the glass, assume a compressed circular form, in the centre of which the vesicula and its sinus may be observed in full operation, and be deliberately watched for some time, or until the infusorium dies (fig. 14).

Besides *Polytoma Uvella,* and *Chlamidomonas,* as before mentioned (*loc. cit.*), the vesicula has been seen and described by Mr. G. Busk in *Volvox Globator**, and having myself also seen it in the *Thecamonads,* besides several species of *Euglenæ,* while it would appear that Cohn has observed it in the swarm-cells of *Confervæ,* its existence throughout this class of Infusoria seems thus to be established.

At p. 128 it is stated respecting the vesicula—"in *Euglypha* I have not been able to recognize it;" but since then I have seen it frequently; it is situated in plurality just in front of the nucleus, as in *Euglypha pleurostoma,* H. J. C. (fig. 19 *c*).

Ovules.—At p. 224 I have stated, respecting the "ovules" of Infusoria, that "they occur in *Euglypha alveolata,* Duj., congregated round the hyaline capsule of the nucleus, from forty to fifty in number," &c. I have also observed this in another species, viz. the one just mentioned, for which I propose the name "*E. pleurostoma*"; and the same kind of development described in the "larger variety" of *E. alveolata,* p. 227, figs. 32, 33, as well (fig. 19, *e, i*). *E. pleurostoma* is very like Ehrenberg's *Difflugia Enchelys* and Dujardin's *Trinema acinus,* but not being identical with the figure given of the former, and though often presenting three radiated prolongations of the diaphane like the latter, but by no means constantly, it becomes necessary to give it a name. It is just possible hereafter that all three may be found to be the same, but even then it would be well to retain the term "*Euglypha,*" because *E. pleurostoma* is essentially of this genus; the only differences between it and *E. alveolata* being the lateral position of the mouth and the circular figure of the scales in the former.

At p. 231, figs. 39, &c., under the head of "Impregnation," it is stated that many of the ovules of *Spongilla,* when pressed out from the seed-like body, have a small granule or cell "in different degrees of connexion with them, from simple approximation to almost undistinguishable incorporation;" the same is the case with the ovules of *Euglena viridis* (fig. 16).

* Quart. Journal Microscop. Science, vol. i. p. 35.

At p. 234, under the head of "Development of the ovules," it is stated that the same process as that which takes place in the development of the ovule of *Spongilla* "appears to take place in the ovules of *Euglena*," and this, to a certain extent, may be really the case; but as the ultimate forms of the two organisms are different, so there must be a point at which their developmental appearances begin to differ. This, in the ovule of *Euglena viridis*, consists in the evolution of a spiral structure, which, when fully formed, appears to spring out in opposite directions, and thus, with the diaphane, afford that means of vermicular progression which *Euglena* always presents when void of, or with only an injured or imperfect cilium (fig. 17 *a*, *b*, *c*).

I infer this from the following circumstances: first, that in a watch-glass, where a number of the ovules of *Euglena viridis* had been placed for observation, about a hundred small *Euglenæ virides*, closely corresponding in size with the largest ovules, made their appearance, elongating and contracting themselves incessantly for several days, without moving far from the place in which they appeared to have been developed (on account of the imperfect state of their cilium), and, being without chlorophyll, presenting exactly the same appearances as fully-developed individuals in the same condition (fig. 18). Secondly, from the ovules which remained on the sides of the basin from which those in the watch-glass were taken, presenting, after a while, a spiral line on both the flat sides of the compressed ovule, which apparently, from its resiliency, caused these sides to become prominent and obtusely conical; thus indicating an advance of development in these also as well as in most of those in the watch-glass, which was arrested, probably, from want of proper nourishment (fig. 17).

Now when we consider that the cells of *Euglenæ*, which we have called ovules, do not present any signs of an amyloid composition when treated with iodine, that the existence of the spiral line proves them not to be mere oil-globules, while the cell of *Euglena* ultimately developes a spiral structure in its substance, as I have particularly pointed out in *Crumenula texta*, Duj.*, and a number of minute *Euglenæ virides* made their appearance among a group of ovules of this organism, carefully set apart in a vessel for development; there can, I think, be very little doubt that these cells, which are common in all the family, are in reality their ovules.

In the same page it is stated, that "instances however do occur where the ovules gain a cilium within the cell," &c. I doubt now if these are developments of the *ovules*, but rather products of the other development which I have shown to take

* Annals, vol. xviii. pl. 6. fig. 60 *a*, *b*, *c*.

place in *Euglena**, and consider analogous to, if not the same as, that described in the Characeæ and in *Spirogyra* (*loc. cit.*).

It should be remembered that in obtaining the ovules of *Euglena viridis* for development, they should not be forced out of the organism, but swept off the sides of the vessel an hour or two after the *Euglenæ*, together with some of the water in which they have been living, have been collected and set aside for settlement.

I have also met with another species of *Amœba* undergoing ovular development, viz. *A. verrucosa*, Ehr. (fig. 12), precisely like that which I have already described; the *Amœba* perishing as the ovules are developed, and ending in becoming a mere ovisac (fig. 13).

When first formed, the ovules, which are spherical, consist of a hyaline capsule enclosing a sphere of glairy, refractive fluid, like that of the ovules of *Spongilla* and *Euglena* (fig. 13 *a*); but as they begin to develope, this glairy matter becomes transformed into a granuliferous mucus which is spread over the inner surface of the capsule (fig. 13 *b*); and finally the granules present motion, whether of themselves or by aid of the mucus in which they are imbedded, I am ignorant, for thus far only have I seen the development; but I am inclined to think the next stage consists in the whole ovule becoming polymorphic, like the ovule of *Spongilla*. This *Amœba* appears to me—for I have watched the development of a group for many months together—to be the adult of my *A. quadrilineata*, and therefore the latter is not a new species. The formation and development of the ovules took place in April, and the organism appears to require at least nine months to come to maturity.

At p. 236 I have stated that I had observed "*Vorticellæ* developed singly from *Acineta*." This was from inference. I have since been able to follow the gemmules thrown off from the *Acineta*-form of *Vorticellæ* through their subsequent development, and in no case have seen them take on any other form than that of *Acineta*. The young gemmule at the moment of its exit is, as Stein has stated, exactly like the bud on *Vorticella*, but when pursued to its resting-place, I have always found it end in becoming an *Acineta*; so that this is not a true instance of alternation of generation. Others, viz. Drs. Lachmann † and Cienkowski ‡, have arrived at the same facts; and these gentlemen also doubt the transformation of *Vorticella* into *Acineta*. Time will prove whether they or Professor Stein are right in this also; in the meanwhile I incline to side with the latter.

* Annals, vol. xvii. pl. 9. figs. 11–14. † *Idem*, vol. xix. p. 235, 1857.
‡ Quart. Journal Microscop. Science, No. 18. p. 96, 1857.

In the same page it is also stated, that the sudden contractile movement "of *Glenodinum* unites *Euglenæ* indirectly to *Vorticellæ*." I now find that this is not the case, as the "movement" is not one of the whole body, or of the body at all, but of the cilium, which, floating posteriorly, like that of *Anisonema sulcata* and *Heteromita ovata* (Duj.), &c., every now and then fixes itself by its sucker-like extremity, and thus suddenly checks the progression of the organism. Whether the long cilium is also used for progression, or whether this is performed by the aid of the "minute vibratile cilia" noticed and figured by Dr. Allman*, I am ignorant; but there does not appear to be a second large cilium for this purpose, as in the animalcules just mentioned.

Chara.—At p. 237, pl. 7. figs. 93–98, in the additional matter which I have given respecting the development of monads from the cell-contents of the Characeæ, it is stated that they are derived from the nuclei which are found free in the protoplasm and in the rhizopodous or polymorphic cells which exist in it (fig. 93 *a*); the nuclei becoming granular (94 *d*, 96 *b*), and the granules finally passing into monads; and this may still take place; but for the most part it now appears to me that it is the old protoplasm which becomes divided up into monads, after having first abstracted the starch from the dead chlorophyll and converted it into oil, the oil then appearing in a granular form enclosed within the monads; hence the origin of the "granules" (94 *d*, 96 *b*, 98 *a*) mentioned at p. 238.

In the same page I have alluded to the "mulberry-shape of the plasma," which we must now consider as the protoplasm (96 *a*, 97 *a*, 98 *b*). This derives explanation, I think, from the tendency of the protoplasm to assume an actinophorous form, and the radii at the time the pellicula covering them is about to become hardened, not being entirely retracted, but remaining in the pouch-like form which produces the mammillated or mulberry-surface mentioned. That this does take place is frequently evidenced by the whole surface remaining actinophorous; and indeed it is only an instance of the way in which the peculiar forms of many structures are produced, viz. by the hardening of the pellicula upon the shape assumed by the protoplasm. It is therefore not difficult to conceive, when the protoplasm and oil are subdivided into monads inside this mulberry-shaped capsule, how the "granules," which are in fact oil-globules surrounded by protoplasm, should get into these pouches (98 *a*).

As regards, therefore, impregnation or ovular development being connected with this process, we now see that both are out of the question; but still we have to account for the disappear-

* Quart. Journal Microscop Science, vol. iii. p. 24. pl. 3. fig. 9, &c.

ance of the "nuclei." These, however, might also secrete a pellicula round themselves, and undergo the same kind of division as the protoplasm, for they are endowed with a considerable degree of contractile power, though not so active as that of the protoplasm. Certain it is, that cells containing no nucleus, as well as a cell containing one or more, will each produce a litter of monads.

These additional observations on the development of monads from the cell-contents of the Characeæ will be better understood after perusing the abstract of my paper entitled "Transformation of the Vegetable Protoplasm into *Actinophrys*," to which I have already alluded*.

EXPLANATION OF PLATE I.

Fig. 1. *Spongilla alba,* growing from the seed-like body: *a,* seed-like body; *b, b, b, b,* investing membrane charged with small spiniferous spicules; *c, c,* parenchyma, consisting chiefly of globular, ampullaceous sacs (8 to 10-5600ths of an inch in diameter), and large, smooth spicules; *d, d, d,* bundles of smooth spicules supporting the investing membrane; *e, e,* openings of the afferent canals; *f, f,* dark points representing the apertures of the investing membrane; *g,* tubular vent of the efferent system of canals.

N.B.—All the parts of this figure have been drawn upon the same scale, in order that their relative proportions might be preserved as much as possible.

Fig. 2. Fundus of ampullaceous sac, representing the arrangement of the sponge-cells in its substance; the white or transparent lines indicating the intercellular substance; the central circle, which cannot be seen in the same focus, pointing out the position of the aperture on the opposite side. Sac $\frac{1}{360}$th of an inch in diameter; aperture or mouth $\frac{1}{1400}$th of an inch in diameter. This figure is too elaborate: the sponge-cells should have been a little fewer and larger.

Fig. 3. Aperture or mouth of ampullaceous sac, showing the faint radiating lines which appear when the sac is beginning to waste from want of nourishment.

Fig. 4. Sponge-cells of the ampullaceous sac, as seen after the *Spongilla* has been torn to pieces: *a,* unciliated, *b,* monociliated forms (active or secondary); *a′, b′,* passive, spherical or primary, forms of ditto. Unciliated cell from 2 to 3-5600ths of an inch; monociliated cell from 1 to 2-5600ths of an inch in diameter.

Fig. 5. Ideal section of an ampullaceous sac: *a,* diaphane, or cortical layer (the existence of which is inferred, partly from the isolated sac, fig. 9, presenting something of the kind); *b,* monociliated sponge-cells with their cilia projecting into the interior; *c,* aperture. In this state this sac may sometimes be seen isolated, but with the aperture closed, though the cilia are still undulating interiorly.

Fig. 6. Portion of investing membrane illustrative of its apertures: *a,* aperture fully dilated, showing the tubercle in its margin (nucleus of

* Annals, vol. xix. p. 259, 1857.

the cell in which the aperture is situated?); *b*, aperture half-closed; *c*, wholly closed; *d*, characteristic sponge-cell of investing membrane; *e*, portion of a spiniferous spicule.

Fig. 7. Group of sponge-cells of the investing membrane illustrating their arrangement *in situ*.

Fig. 8. Figures illustrative of the development of the spicule: *a*, nucleated sponge-cell bearing a spicule $\frac{1}{400}$th of an inch in length, and of extreme thinness; *a'*, sponge-cell bearing a still younger spicule, $\frac{1}{1400}$th of an inch in length, on which is seen the inflation; *b*, ditto, with the spicule more advanced; *c*, spicule still more advanced, showing the passage of the shaft through the inflation, thus proving that the latter is the outer layer of the spicule, and that the spicule is formed of layers deposited from within outwards; *d*, fully-developed smooth spicule; *e, f, g*, varieties in the position and number of the inflations, and in the development of the shaft, which are endless; *h*, central portion of a spiniferous spicule, showing two spines projecting from the inflation.

Fig. 9. Isolated ampullaceous sac ($\frac{1}{700}$th of an inch in diameter), which, having left the parent mass of *Spongilla*, has become amœbous and actinophorous, presenting a cortical transparent portion (the diaphane) externally, and the sarcode charged with granules internally.

Fig. 10. Monociliated sponge-cell, after the constituent cells of the mass of *Spongilla* have separated to seek an independent existence for themselves: *a, a*, dotted lines showing the movement of the surrounding particles of carmine in the direction of the arrows; *b*, a particle caught up and enclosed by a projection of the cell, as in *Actinophrys Sol*; *c*, "granule;" *d*, contracting vesicles; *e*, pedicle of attachment, which can be withdrawn at will. Cell from 2 to 4-5600ths of an inch in diameter.

Fig. 11. Section of a spherical group of the *Uvella*-form of sponge-cells seen under similar circumstances (group $\frac{1}{700}$th of an inch in diameter): *a*, isolated group of three polymorphic cells; *b*, fixed isolated on eproducing the same kind of currents with its cilium, &c., as fig. 10 ($\frac{1}{3733}$rd of an inch in diameter).

Fig. 12. *Amœba verrucosa*, Ehr., $\frac{1}{224}$th of an inch in diameter: *a*, vesicula; *b*, nucleus. This Rhizopod generally contains a large portion of *Oscillatoria* or a rotiferous animalcule for food, which has been left out here for clearness. One of its characteristic features is the elliptical form of the capsule of the nucleus or "nuclear utricle," while the nucleus ("nucleolus") is spherical, and frequently presents vacuoles.

Fig. 13. The same, transformed into an ovisac partly filled with spherical ovules in the granuliferous stage of development. Ovisac or effete animal $\frac{1}{136}$th of an inch in length; ovule $\frac{1}{1366}$th of an inch in diameter: *a*, early or nucleated form of the ovule; *b*, in granuliferous stage of development.

Fig. 14. *Euglena viridis*, filled with ovules; compressed vertically; presenting the granular, capsuled nucleus, and the vesicula with its sinus.

Fig. 15. Three figures to show how the fluid is expelled from the vesicula: *a*, undistended state of sinus after it has just filled *b*, the vesicula; *a'*, sinus again becoming distended, and pressing out the contents of *b'*, the vesicula; *a''*, fully-distended state of the sinus which has thus nearly emptied *b''*, the vesicula, preparatory to again discharging its contents into the latter.

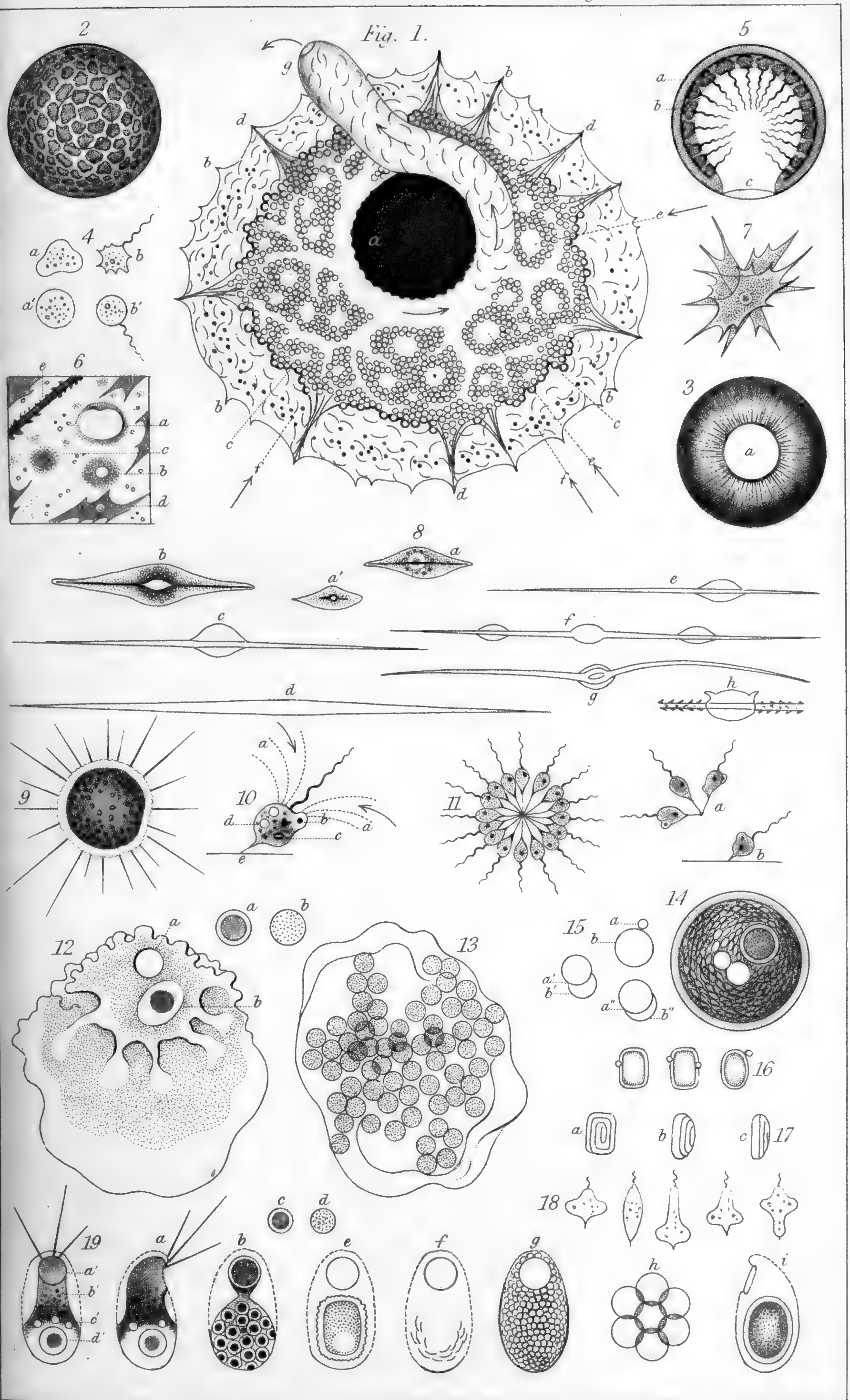


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Fig. 16. Ovules of *Euglena viridis* (2 to 2·5-5600ths of an inch long), presenting the "granule" on their circumference, like those of *Spongilla*. (See 'Annals,' vol. xviii. pl. 6. fig. 39, &c.)

Fig. 17. Ditto in supposed process of development, presenting a spiral line: *a*, view of flat surface; *b*, half-view of ditto; *c*, marginal view, showing the projection of the ovule in the direction of the axis of the spire.

Fig. 18. Young colourless specimens of *Euglena* (2 to 3-5600ths of an inch in diameter, which made their appearance in the watch-glass wherein the ovules of *E. viridis* had been placed for development.

Fig. 19. *Euglypha pleurostoma*, H. J. C. (*nov. sp.*?), $\frac{1}{500}$th of an inch long: *a'*, mouth with projection of tentaculiform prolongations of the body; *b'*, body; *c'*, vesiculæ or contracting vesicles; *d'*, nucleus. *a*, lateral view of ditto; *b*, ditto partly filled with ovules; *c*, early state of ovule, $\frac{1}{2800}$th inch in diameter; *d*, subsequent or granuliferous stage of development of ditto; *e*, development similar to that described and figured in *Euglypha alveolata*, in which there appears to be a secondary test developed round a capsule containing granules (see Annals, vol. xviii. pl. 5. figs. 32, 33); *f*, empty test containing supernumerary scales; *g*, ditto, covered with scales *in situ* (scale $\frac{1}{5600}$th inch in diameter); *h*, form and arrangement of the scales; *i*, lateral view of figure *e*, but with secondary test more elliptical.

V.—*Notice of the Animal of* Turbo Sarmaticus *and other Mollusca from the Cape.* By Arthur Adams, F.L.S. &c.

To the Editors of the Annals of Natural History.

Cape of Good Hope, April 11, 1857.

Gentlemen,

Dr. Gray having formed a genus out of the *Turbo Sarmaticus*, on account chiefly of its singular operculum, I was particularly anxious to observe the animal. Making a little excursion therefore to Millar's Point, a wild and rocky spot, I succeeded, after long search, in discovering the haunts of the animal. At low-water, and in fissures in the far-out rocks abounding with green sea-weed, and adhering to the sides of the granite masses where the sea breaks, the *Turbo Sarmaticus* may be found. It is timid, slow-moving, and difficult to observe. The colour is green, spotted and marbled with white, and finely reticulate with dark green. The margin of the mantle is thickened, and just within the edge a dark-green band reposes on the dark-coloured zone on the inside of the outer lip. The rachis of the lingual membrane (a specimen of which I have submitted to the examination of Dr. Gray) has a series of five nearly equal, square teeth, outside of which is a quadridentate, lateral tooth flanked by numerous slender uncini. The upper jaw, composed of two long, cartilaginous pieces, is protected at the tip by a horny lamina. The head-lobes are very large and rounded, with the front edge crenulate; the eye-pedicel is large, thick, and triangular, with a small, simple eye placed on the outer side near (but not on) the tip; the neck-lappet is very large, occupying two-thirds of the length of the lateral membrane, the free edge deeply divided and pectinate, some of the divisions again divided at the end, or compound, as seen in *Livona pica*, the others smaller and simple. The edge of the lateral membrane is pectinate, and there is a single, long, stout, white, tentacular filament at the extreme hinder part. The opercular mantle, as in this instance it may appropriately be called, is furnished with three very short conical processes on each side, while the front edge is capable of being extended backwards over the entire rough outer surface of the operculum, with the exception of a small portion posteriorly, which is free from the foot below.

The animals of three species of *Oxystele* which I have observed here, namely *O. tigrina*, *O. merula*, and *O. tabularis*, do not differ from each other in any essential respect. They are black, with the head transversely lineated with white; the head-lobes are simple and triangular; the long filiform tentacles are barred with white; the neck-lappets are moderate; the lateral membrane is finely crenulated, and is furnished with three equal filaments on each side, marked, like the tentacles, with white and black, and the sides of the foot are speckled with white.

In my excursions among the rocks I was much struck with the rich variety of *Patellae*, and seized the opportunity of examining the animal of *Helcion pectinatus*, which has the gills arranged round the groove between the mantle and foot exactly as in *Patella*, the animal of which it resembles in every respect. *Helcion* will therefore form a section of *Patella*, as Dr. Gray suggests, and not a genus of *Tecturidæ*, as supposed by my brother and myself in our 'Genera of Recent Mollusca,' p. 460. The animal of the Cape *Nacella* does not differ from that of the British *N. cærulea*. The smooth, thin shell is only found on smooth, rounded stones. The *Patella cochlearis* has the head and neck very elongated, and resting in the gutter of the narrow fore part of the shell; the mantle is also produced in front over the head. This species forms the subgenus *Olana*, H. & A. Adams. The stellate forms of *Patella* forming the subgenus *Scutellastra*, H. & A. Adams, have the margin of the mantle extended into the radiating processes of the shell. The *Patella compressa* is also found here, but I have not succeeded in taking it alive.

I remain, Gentlemen,

Yours very truly,

Arthur Adams.

VI.—*List of the* Echinodermata *dredged between Drontheim and the North Cape.* By R. M'Andrew, Esq., F.R.S., and L. Barrett, F.G.S.

Echinodermata.

Holothuriadæ.—In Duben and Koren's list of the Norwegian Echinodermata, thirteen species of this order are described. In our own researches we only procured six species, of which one is new; it belongs to the genus *Eupyrgus*; this same genus is represented on the coast of Greenland by another small species (*E. scaber*). The *Holothuriadæ* are not common Radiata on the Norwegian coast, only one species (*Cucumaria frondosa*) being dredged abundantly.

Echinidæ.—The species of this order procured by dredging are few, but this deficiency is quite made up by the abundance of individuals. The *Echinus miliaris* is common among the Laminaria. *Echinus esculentus* is seen in great abundance at low-water in the south; in the north its place is taken by *Echinus neglectus.* The three species above mentioned being found in great plenty, form a very characteristic feature of the Laminarian zone. *Echinus neglectus* is a very variable species: specimens differ principally in the length of the spines, some being covered with short ones of equal length, others with long purple spines, or long primary and short secondary ones; possibly these may be two species. *Echinocyamus angulosus,* of Leske, was very common in the south among Nullipora and sand. *Schizaster fragilis* was met with several times on a muddy bottom, generally in deep water. In Drontheim Fiord we dredged some specimens in thirty fathoms, but in the north it lives in much deeper water, being brought up from 100 to 150 fathoms. *Spatangus purpureus* occurred but sparingly, in shallow water, as far north as Hammerfest, but it was very small: on one occasion *Montacuta* was found attached to its spines. The two species of *Amphidetus* were taken: *Amphidetus cordatus* is common in the south, and *A. roseus* in the north.

Asteriadæ.—Eighteen species of *Asteriadæ* are included in Duben and Koren's list of the Scandinavian Echinodermata; only ten of these were dredged by us on the northern coast. Some of the species included in the above-mentioned list were procured from the southern part of the western coast; but as our researches were confined to the shore between Drontheim and the North Cape, it could not be expected that we should collect as many species. One species of *Astropecten* was often dredged in deep water between Omnoeöe and Hammerfest, which has not been described; and in deep water off the coast of Finmark we procured two new species of *Astrogonium*. A single specimen of the only species of this genus previously known to live on the coast was dredged in 100 fathoms near Hammerfest. *Ctenodiscus crispatus* was not rare on a muddy bottom in 20 to 50 fathoms: *Ctenodiscus pygmæus* is probably the young of this species: several small specimens were procured. The two species of *Solaster* occurred only very young, $\frac{3}{4}$ of an inch in diameter; great numbers of these small star-fish were found among Nullipora in shallow water. *Uraster rubens* and *Uraster glacialis* were found in great numbers at low-water; the former species attains a large size in the south. Twice it was found feeding on the Periwinkle: it clasps the shell with its five rays, and protrudes its stomach into the shell, even as far as the apex: the operculum is not eaten. It also feeds on Chitons.

Ophiuridæ.—Only seven species of this order were collected during our cruise, all of which are included in a MS. list of the Norwegian Echinodermata furnished us by M. Lutken of the University Zoological Museum, Copenhagen. Three species only occurred abundantly. *Ophiolepis filiformis* is very common in the south, on a muddy bottom. *O. bellis,* Forbes, is very common, from Drontheim to the North Cape, on stony and rocky ground, from low-water to about 30 fathoms; this species, like *O. rosula,* varies much in colour; scarcely two specimens can be found alike. *O. texturata,* though not so common as the last two species, was generally distributed along the whole coast, and, like most species having a wide geographical range, had a great range in depth, from 20 to 200 fathoms.

Crinoidea.—The two small species of *Crinoidea* living on the coast were not seen; they are quite distinct from the two species found in Scotland, the largest of which was named *Comatula Woodwardii,* in the Annals for January 1857. We had overlooked the little *Comatula* of that name from the Crag, described by Prof. E. Forbes; and as there are now two species called *C. Woodwardii,* we must change the specific name of the species last described. We propose to call it *Comatula celtica.*

Echinodermata.

Note.—The figures in the following table indicate the greatest and least depths at which each species was dredged alive. In the third column the kind of sea-bottom is named; in the fourth, the letters express the degree of frequency of occurrence:—*a,* abundant, generally distributed and plentiful; *f,* frequent; *l,* local, more or less plentiful in a few localities; *r,* rare; and *v. r.* very rare, when but few examples occurred. In the fifth column the Northern Scandinavian distribution is given, the coast being divided into three unequal provinces: North Drontheim (Dront.); Nordland (Nord.); and Finmark (Fin.).

Species.	Found living.	Ground.	Freq.	Norwegian Distribution.
Holothuriadæ.				
Cucumaria, *Blainv.*				
—— pentactes, *Müller* ..	20	gravel	r.	Nordland.
—— frondosa, *Gunner* ..	lit.–25	rock, weed	c.	Dront., Nord., Fin.
Thyonidium, *D. & K.*				
—— commune, *Forbes*, sp.	15–30	mud	r.	Nordland.
Eupyrgus, *Lutken.*				
—— hispidus, n. sp.*....	70	mud	r.	Nordland.
Psolus, *Oken.*				
—— phantopus, *Linn.* ..	20–40	gravel	..	Dront., Nord.
—— squamatus, *Müller*..	......	....	..	Nord., Fin.
Echinidæ.				
Amphidetus, *Agass.*				
—— cordatus, *Penn.*....	15	sand	l.	Dront., Nord.
—— ovatus, *Leske*.....	20–40	mud	a.	Dront., Nord., Fin.
Spatangus, *Klein.*				
—— purpureus, *Müller*..	20–30	sand, mud	r.	Dront., Nord., Fin.
Schizaster, *Agass.*				
—— fragilis, *D. & K.* ..	30–150	mud	r.	Dront., Nord., Fin.
Echinocyamus, *Van Phels.*				
—— angulosus, *Leske* ..	15–25	nullipora	a.	Dront., Nord., Fin.
Echinus, *L.*				
—— esculentus, *L.*	lit.–15	rock, lamin.	a.	Dront., Nord.
—— miliaris, *Leske*	8	laminaria	a.	Drontheim.
—— neglectus, *Forbes* ..	lit.–30	rock, gravel	a.	Nord., Fin.
Asteriadæ.				
Uraster, *Agass.*				
—— rubens, *Linn.* sp. ..	lit.–20	rock	a.	Dront., Nord., Fin.
—— glacialis, *Linn.* sp...	lit.–40	rock	c.	Dront., Nord., Fin.
Cribella, *Agass.*				
—— oculata, *Penn.* sp...	lit.–130	sand, gravel	c.	Dront., Nord., Fin.
Solaster, *Forbes.*				
—— papposa, *Linn.* sp...	4–8	nullipora	r.	Nord., Fin.
—— endeca, *Linn.* sp. ..	20–70	gravel	r.	
Astropecten, *Link.*				
—— arcticus, *Sars*	150	sand	v.r.	Nordland.
—— Mulleri, *M. & T.* ..	10–50	sand	c.	Nordland.
—— Lutkeni, n. sp.	20–100	sand	c.	Nord., Fin.
Astrogonium, *M. & T.*				
—— granulare, *Müller* ..	100	gravel	v.r.	Finmark.
—— aculeatum, n. sp. ..	100	gravel	v.r.	Finmark.
—— boreale, n. sp.	150	gravel	v.r.	Finmark.
Pteraster, *M. & T.*				
—— militaris, *M. & T.* ..	100–150	gravel, sand	r.	Finmark.

* The new species are described in the following article.

Species.	Found living.	Ground.	Freq.	Norwegian Distribution.
Ophiuridæ.				
Ophiolepis, *M. & T.*				
—— filiformis, *Müller*, sp.	20–40	mud	a.	Drontheim.
—— texturata, *Forbes* ..	20–150	gravel, sand	c.	Dront., Nord., Fin.
—— carnea, *Lutken*	50–200	sand	c.	Finmark.
—— squamosa, *Lutken* ..	4–8	nullipora	r.	Nordland.
—— bellis, *Forbes*	lit.–30	rock, nullip.	a.	Dront., Nord., Fin.
Ophiacantha, *M. & T.*				
—— spinulosa, *M. & T.*..	50–70	sand	r.	Nordland.
Ophioscolex, *M. & T.*				
—— glacialis, *M. & T.* ..	130–150	sand	1 sp.	Finmark.

VII.—*Descriptions of four new species of* Echinodermata. By Lucas Barrett, F.G.S.

[With a Plate.]

Eupyrgus hispidus, nob. Pl. IV. fig. 1 *a, b.*

Specific character.—Body covered with perforated, ovate plates, each of which bears a single spine; extremities more or less produced, ascidiform. Suckers alternating, placed in three double distinct rows on the under surface, reaching from mouth to anus. Spines attached to the extremities of the plates by four roots.

This little species resembles in shape *E. scaber*, Lutken, from the west coast of Greenland, which is of about the same size, but differs in the shape of the plates bearing the spines; for while those in *E. scaber* are cruciform, the plates in the species now described are ovate or irregular. (Fig. 2.)

The genus *Eupyrgus*, which was made for the reception of these two species, resembles *Psolus* in being covered with calcareous plates, and in having only three rows of suckers, but differs in the absence of a naked disk, on which the suckers are placed in that genus.

Astropecten Lutkeni. Pl. IV. fig. 3 *a, b, c.*

Specific character.—Disk pentagonal; rays produced, pointed; each side formed of two rows of plates, about forty in each row; those in the upper row are nearly as long as broad. The plates forming the lower row are oblong. The apex of the ray is formed of a single excavated plate. The marginal plates are covered with numerous spines, and the whole of the upper surface between the lateral plates is covered with tubercles crowned by groups of minute spines smaller than those which cover the plates. The ambulacral grooves are partly concealed by two rows of small bundles of long spines. The triangular spaces between the ambulacra and the margin are covered by numerous oblong tubercles, which bear numerous spines, similar to those which cover the marginal plates. We have dedicated this species to M. Lutken of Copenhagen, who has described many of the northern Echinodermata.

Common in deep water off the coasts of Nordland and Finmark.

Astrogonium aculeatum. Pl. IV. fig. 4 *a, b.*

Specific character.—Disk pentagonal; rays somewhat produced; each side made up of two rows of eight intermediate lateral plates, which are largest at the junction of two rays; the upper surface of these plates is naked, but on the sides and under surface they bear numerous unequal granules; those on the sides are largest at the apex of the ray, and form two rows; those on the under surface are small, and are placed in a single row around the margins of the plates. The upper surface between the lateral plates is formed of numerous nearly circular plates, each of which is surrounded by a circle of globular granules. Ambulacra protected by two rows of long and two rows of short spines. The other part of the under surface is composed of rows of oblong plates, each of which bears about six globular granules.

Only one specimen was dredged in 100 fathoms water off the coast of Finmark.

Astrogonium boreale. Pl. IV. fig. 5 *a, b.*

Specific character.—Disk pentagonal, bordered by two rows of large marginal plates; each side is made up of two rows of eight intermediate lateral plates. Apex of the ray formed of a single triangular plate; the exterior edges of lateral plates covered with compressed granules. The upper surface of the disk composed of numerous hexagonal plates covered by compressed granules, except those near the centre, which bear granules only on their margins; near the middle of the disk are five smooth plates arranged in a circle round the centre. The marginal plates, on their under surface, have a single row of small granules round their margins. The ambulacral groove is bordered by two rows of long and four rows of short spines; the other part of the under surface is covered with numerous plates bearing granules.

One specimen occurred off the coast of Finmark in 150 fms. water.

EXPLANATION OF PLATE IV.

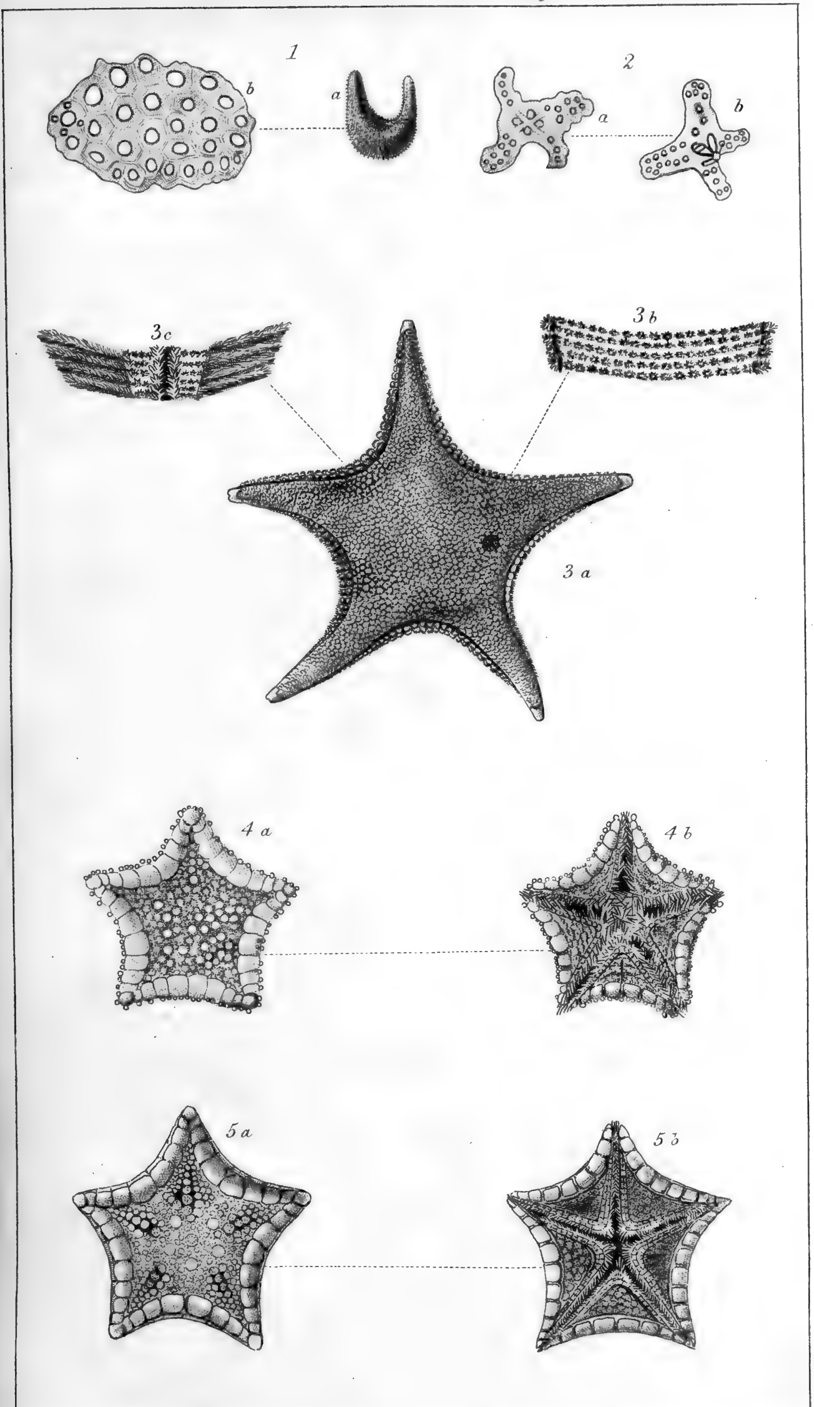
Fig. 1. *Eupyrgus hispidus*: *a*, natural size; *b*, × 66.
Fig. 2. *Eupyrgus scaber*, Lutken: *a* & *b*, × 66.
Fig. 3. *Astropecten Lutkeni*: *a*, twice the natural size; *b* & *c*, magnified portions of the upper and lower surface of a ray.
Fig. 4. *Astrogonium aculeatum*: *a*, upper, and *b*, lower side, twice the natural size.
Fig. 5. *Astrogonium boreale*: *a*, upper, and *b*, lower side, magnified twice.

BIBLIOGRAPHICAL NOTICES.

On a True Parthenogenesis in Moths and Bees; a Contribution to the History of Reproduction in Animals. By C. T. E. Von Siebold. Translated by W. S. Dallas. 8vo. London: Van Voorst, 1857.

In this remarkable little work, the learned Professor of Zoology at Munich has called the attention of physiologists to a series of phænomena which threaten to produce a considerable disturbance, at all events for a time, in the generally received opinions regarding the laws of generation. It is usually supposed that in order to the production of fertile eggs the concourse of male and female elements is necessary, but it appears from the observations of Von Siebold, as here recorded, that in some cases the eggs of virgin female insects are capable of giving birth to a progeny which passes through all its stages of development in the same way as if it had been produced from fecundated eggs. To this phænomenon, occurring in some species as a regular condition of specific existence, in others under exceptional and at present inexplicable circumstances, our author gives the name of *Parthenogenesis,* originally made use of by Professor Owen to indicate the alternation of generations.

Although numerous instances of a *lucina sine concubitu* in insects and spiders had already been described by different authors, and some curious questions were started by the constant occurrence of females only in certain Crustacea, all these cases were looked upon by physiologists in general as of a very doubtful nature, and no one certainly anticipated that such apparently exceptional phænomena would have led to the development of a theory of the constitution of the societies of social insects, such as is given by Von Siebold in the work before us. In fact, most of the recorded cases of the production of fertile eggs by virgin moths are so destitute of all those elements of exactitude which alone could render them conclusive, that our author, after a careful critical examination, rejects them all as untenable, at all events on the evidence furnished by their describers. The views put forward by Von Siebold himself are, however, so heterodox, according to the present physiological faith, that we have no doubt they will be received with considerable incredulity by many, and although we must confess that we cannot see any flaw in the evidence, one distinguished authority at least has already stated that he con-



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siders the case "not proven," although without giving any reasons whatever for such an opinion, and indeed leaving some of the most important elements in the argument out of the question altogether.

One of these important points consists in the occurrence of Parthenogenesis, in Siebold's sense, amongst the Lepidoptera, not only as an exceptional case in the Silk-worm moth, but also regularly in some small moths belonging to the genera *Psyche* and *Solenobia*, in which the larva lives in a case or sac, and the female is quite destitute of wings. It will be unnecessary to enter at length into the history of these moths—suffice it to say that they have been bred year after year without a single male making its appearance, although large numbers of individuals were repeatedly reared. The females in both these genera, although very imperfect in external appearance, possess regularly-developed sexual organs; those of *Psyche* fill their pupa-case with eggs before quitting the sac which served as their habitation in the larva state, whilst those of *Solenobia* emerge from their cases, and, clinging to the outside, stuff the interior with eggs.

Very wisely has the author placed this incontestable case of the regular occurrence of Parthenogenesis as the introduction to that which is undoubtedly the great object of his publication, namely the establishment of a theory to account for the phænomena of sex in the bee-hive, which will of course be applicable to the other social Hymenoptera. The theory here put forward does not, however, originate with Von Siebold, but with a Silesian clergyman named Dzierzon, who also appears to have rendered great service to the apiarians by the invention of a new form of hive with sliding supports for the combs, a description of which will be found in the work now under consideration. According to this theory of Dzierzon, which has been further elaborated by Von Siebold, and most enthusiastically supported by a great bee-keeper, the Baron von Berlepsch, the queen-bee, which, like all other female insects, receives the seminal fluid of the male in a peculiar receptacle, there to be retained until it comes in contact with the egg during its passage through the oviduct, possesses the power of permitting or preventing this contact, so that the eggs may be deposited in the cells, either fecundated or unfecundated, at the pleasure of the mother. The theory goes on to say, that from the fecundated eggs female larvæ are produced, which become developed either into queens or workers, whilst the unfecundated eggs furnish the larvæ of the drones or males. The queen is supposed to be incited to the fecundation or non-fecundation of the eggs by the size of the cells in which she is about to deposit them, the worker cells being considerably smaller than those destined to be the cradles of drones, whilst the nature of the royal cells is so peculiar, that we may easily believe it to have some influence on the egg-laying female.

Without dwelling upon the many interesting facts in bee-life which are treated of in the pages of this important work, we may briefly refer to a few of the principal points of evidence adduced in support of this remarkable theory. It is now generally admitted, even by bee-keepers, that the queen only copulates once, and that the supply of seminal fluid received at this time, and stored up in the seminal receptacle, serves for the fecundation of the immense number of eggs which she deposits during the period of her fertility, extending over several years. Sometimes, however, the stock of spermatozoids appears to be exhausted before the life of the queen comes to a close, and when this is the case she lays nothing but drone-eggs, introducing confusion into the wonderfully harmonious arrangements of the hive. This was found to be the case also with a queen which had been exposed to severe cold, with the view of destroying the vitality of the spermatozoids; of three queens thus treated, only one survived, and this afterwards laid nothing but drone-eggs. Another queen, whose abdomen had been injured so as *probably* to displace the seminal receptacle, also produced drone-eggs exclusively. Added to this, certain workers, which, as is well known, are merely abortive females, destitute of copulative organs and of the seminal receptacle, and therefore incapable of fecundation, are found to possess imperfectly developed ovaries, which produce a very small number of eggs, and these, when deposited in the cells, are said always to produce drones. For most of these facts Von Siebold appears to have been indebted to the apiarians Dzierzon and Von Berlepsch; but perhaps the most remarkable observations are those made by himself, in the microscopic examination of a considerable number of newly-deposited eggs. In the majority of the eggs deposited in worker-cells examined by him, he found spermatozoids; sometimes as many as four. In some instances these singular filaments still retained the power of motion. On examining twenty-seven drone-eggs laid by the same queen which had furnished a portion of the female eggs, Von Siebold did not discover a single spermatozoid.

Such is the outline of the results at which the distinguished author has arrived; and although many will perhaps be disinclined to give an unhesitating adhesion to his views, there can be no doubt that his work is one of the most important that has appeared for a long time, one well worthy of being carefully studied by all physiologists, and one that must in the end greatly advance the cause of science, if only by calling the attention of observers to this singular and much-neglected subject.

Eenige Vergelijkend-Ontleedkundige Aanteekeningen over den Otolicnus Peli. Eene Academische Proeve, door P. Hoekema Kingma. Leyden, 1855.

Some Observations on the Comparative Anatomy of the Otolicnus Peli. An Academical Essay. By P. Hoekema Kingma. Leyden, 1855. Pp. 55 and 2 Plates.

Dr. Kingma tells us, in a short preface, that at the time when it became necessary for him to select a subject for his Academical Dissertation for the Degree of Medicine at Leyden, he found some difficulty in making his choice. He says he would gladly have taken one having a direct relation to medicine, if his experience in that science had been more ample and satisfactory. He considered himself more fortunate, when, desiring to take up some theme of comparative anatomy not previously much treated upon, the distinguished Professor J. V. d. Hoeven offered him a specimen of a quadrumanous mammal for dissection and description. We believe the course adopted by the author is unusual, and not likely to be extensively followed. Those who are only able to appeal to a few years' personal observation will continue, and be expected to continue, to treat in their theses upon diseases which, after the amplest and most devoted attention, still remain imperfectly known and obscure.

The genus *Otolicnus* is one of the five into which succeeding naturalists have divided Linnæus's quadrumanous genus *Lemur*, and was so named by Illiger. It corresponds with Geoffroy's genus *Galago*. All the known species belonged to Africa, until Temminck obtained another from New Guinea, which he named *Peli* in commemoration of Pel, an investigator of nature who visited the coast of that large island*. It is this rare animal of which Dr. Kingma obtained a specimen for dissection, the first which has been submitted to that process. From having been preserved in spirits for some time, it was not in all respects perfectly adapted for the purpose, but the author's researches afford a very complete view of the structure of almost every organic system. In these he was further assisted by receiving another example from the hands of Temminck himself, which likewise was not uninjured, and was also of the male sex. Dr. Kingma's observations embrace careful and somewhat minute descriptions of the animal externally (including a microscopical examination of the hairs of its body and measurements of the skeleton), of the muscular system, of the intestinal canal, of the vascular system, of the respiratory organs, of the sexual and urinary organs, of the brain, and of the organs of the senses. The work is illustrated by a delicate and carefully-executed lithograph, containing eleven figures of the more remarkable organs and structures met with in the dissection. For this beautiful plate, and the duplicate in outline, the author acknowledges himself indebted to M. J. V. d. Hoeven, *Candidatus Medicinæ.*

This specimen, measuring from the tip of the nose to the end of the long bushy tail, was very nearly 14 English inches in length, the tail itself occupying more than half of this space, or $7\frac{3}{4}$ inches. The *Galago* (*Otolicnus*) *Moholi*, figured and described by Dr. Andrew Smith in his fine work illustrative of the zoology of Southern Africa, was 16 inches long.

The teeth greatly resemble those of the Insectivora. In the upper jaw there are on each side two small incisors, a canine, two premolars and four molars. In the lower, three long incisors, a canine, two premolars, the first of which is furnished with an acute cusp, and three molars (by an error of the press stated to be four (*vier*), p. 17).

The animal has soft, woolly hair, thickest on the back, of a grey colour in the most exposed parts, passing into brown on the neck

* "Galago de Pel." Esquisses Zoologiques sur la Côte de Guiné, par C. J. Temminck. Vol. i. Les Mammifères. Leyden, 1853.

and belly, and in some parts into orange. A narrow white stripe ascends from the tip of the nose to between the eyebrows. The black ears described by M. Temminck are not alluded to by our author. There are two large, thick, tactile hairs (*gevoelsharen*), above the internal angles of the eyes, and two others at some distance above the outer angles, besides some at the sides of the nose and on the lower lip. At first view these hairs appear to differ in structure from those of the pelt, yet they are possessed of the same elements.

The following is Dr. Kingma's account of the microscopical examination of the hair. By a glass of moderate power, the hair is seen to be clear and transparent at the root. At some distance, transverse striæ are seen, following one another regularly. At a greater distance from the root, these transverse striations are more perceptible, and give the hair a jointed appearance, like that of a tape-worm. These joints are so formed that the upper part of each is somewhat broader than the lower part of the ensuing one. By this regular succession of broader and narrower portions, the edges of the hair acquire an undulated appearance. The wavings are the strongest in the lowest third of the hair; further towards the point, they become merely perceptible. In each joint is a cavity, shorter than the joint itself. The lowest portion of this cavity is hollow and clearly diaphanous, whilst the upper part, defined by a right line, is filled with a black pigment. These pigment-spots are about 0·01 (0·001 ?) of a millimètre broad, and 0·005 mm. long. The cavities are completely separated from one another. In the first third of the hair, like the joints themselves, they are more developed lengthwise, and the pigment is much darker; further on, they appear more compressed from above downwards, and fit closer to one another. At some distance from the tip of the hair, the cavities disappear altogether, yet the articulations remain clearly perceptible nearly to the point.

The four hands are entirely devoid of hairs on their palmar surfaces. The head is of an oval form, with a prominent snout, the lower jaw receding behind this part at an oblique angle. Its most remarkable appearance, however, arises fromthe spacious orbits; they nearly join each other above the nose, and by a slender projection of the outer angle of the frontal bone, corresponding with a similar construction of the malar bone, bulge out at the sides, so as to render this part of the skull, when seen from below, wider than any other. This is best seen in Dr. A. Smith's figure of the cranium of the *Galago Moholi*, which he has given of double the natural size. Near the large eyes rise up the still larger, thin, elongated, external ears of the animal. In the hollow of the auricle there are three or four grooves, divided by corresponding folds. The hind limbs are longest and most developed. The palmar surface of the hands is furnished with a number of callosities, that form elastic cushions, upon which the animal alights in its noiseless bounds. All these peculiarities of organization have a strict and intimate bearing upon the functions and habits of the animal—upon its nocturnal and insectivorous characters.

The small lachrymal canal is situated without the orbit, just below its inner angle. This latter cavity communicates by a large opening with the temporal fossa. The outer margin of the orbit forms a perfect ring. The humerus has an opening in a prolongation on the inside of its lower extremity (foramen supra-condyloideum), for the passage of the median nerve and radial artery. The thumb of the fore-hand is small. The muscular system presents many peculiarities in origins and insertions. A plantar muscle was not met with. The palate is furnished with six transverse folds. Below the tongue is a small tendinous plate, with its anterior extremity free, and the other strongly attached to the muscular tissue of the tongue*. The length of the intestinal canal from the mouth downwards is 24·3 English inches. Its proportionate length to that of the body is as 4·9 : 1. The contents of the canal were for the most part the remains of insects. The cæcum was filled with intestinal worms, most probably, Dr. Kingma considers, belonging to a species of *Oxyuris*.

The arterial system presents some peculiarities deserving of notice. At the arch of the aorta two branches are given off, the *innominata* and the left subclavian. The former gives off in succession the left and right carotids, and is continued into the right subclavian. The brachial artery divides in the middle of the arm into two branches, one of which is a continuation of the trunk, and passes, with the median nerve, through the *foramen supra-condyloideum,* to become the radial artery; the other branch goes to the superficial muscles of the fore-arm. Both these branches of the brachial artery consist of a plexus of small vessels, six to eight in number, which are of equal diameter. The first branch continues in the divided state through the foramen, and could not be traced further; the other, as we have said, loses itself in the muscles.

After the abdominal aorta has given off the two internal spermatic arteries, it is suddenly greatly dilated, so that its *lumen* acquires more than double its previous area. The dilatation is not limited to the aorta, but is perceptible in its branches, the crural having a greater circumference than the aorta itself before it gives off the renal artery. The *arteria sacralis media* is large, and arises from the aorta just above its division into the two iliacs. It proceeds at first undivided towards the posterior part of the pelvic cavity, and then separates into from 6 to 8 small branches of equal size running near each other, whilst a larger undivided branch is continued as the main vessel. The first branch of the common iliac forms the crural artery. This very soon gives off a plexus of about 8 branches of equal magnitude, besides some muscular branches, whilst the main trunk pursues its course. This plexus of vessels proceeds to the popliteal space, and is again united into one trunk. This disintegration and redintegration, if we may so term it, of the crural artery is beautifully exhibited in one of M. J. V. d. Hoeven's delicate lithographic figures (fig. 8). In the femoral and sacral plexuses, therefore, there remains a continuation of the primary trunk; but in

* This peculiar organ is described in Mr. Baird's interesting history of his specimen of the *Lemur tardigradus,* Loudon's Mag. Nat. Hist. i. 208.

the brachial our author has not perceived this disposition. Such an arrangement of the arteries is observed in the *Bradypus*, an animal of strictly arboreal habits. When the muscles of the extremities are engaged in climbing and in supporting the weight of the body, by strong and continuous contractions, thus requiring a large supply of blood, under circumstances, as to gravity and compression of the vessels, highly unfavourable to its transmission, this admirable plexiform disposition of the arteries overcomes every impediment. In agreement with this structure, Dr. Andrew Smith, and other observers of different species of *Galago* in their natural state, speak of them as active denizens of the trees. Dr. A. Smith says he first met with the *Moholi* near the Limpopo river, seated upon trees. "They were very active, springing from branch to branch and from tree to tree with extraordinary facility, and always seized the branch on which they intended to rest. In their manners they considerably resembled the monkeys, particularly in their grimaces and gesticulations."

Dr. Kingma tells us the *prostate* is of moderate size. It is situated behind against the neck of the bladder. Posteriorly and inferiorly it bears two papillary appendages, which are 8 mm. long and 3 to 4 mm. thick. Apparently they do not appertain to the tissue of the prostate, yet they are very closely connected with it. In M. J. V. d. Hoeven's plate these appendages are, we conclude, somewhat more accurately exhibited as situated at a little distance in front of the prostate, in fact separated from it by the prostatic portion of the urethra. It seems that these appendages are hollow, and are internally furnished with folds, so that the internal superficies has a reticulate appearance. Both cavities stand in connexion with each other by means of a duct, which joins its fellow anteriorly. On the opening of these appendages, a turbid fluid came to light. In this the microscope revealed vesicles of a spherical or oval form, composed of a capsule filled with transparent fluid.

The surface of the hemispheres of the brain exhibits no convolutions whatever, in this respect presenting a dissimilarity to the higher quadrumanous animals. All the organs of the senses exhibit structures of high development, which we must not further dwell upon. The pupil is round. The large eyes render it apparent that the *Otolicnus Peli* seeks its prey by night, and hides itself by day,—facts which we have alluded to before.

We have now given a sufficient account of some of the peculiarities of structure brought to light by our author, so carefully described by him, and many of them so accurately delineated by the pencil of his friend and coadjutor. This brings us to remark, that the prefatory portions of Dr. Kingma's "Specimen Inaugurale" present a most pleasing indication of its author's right feeling. To whom could he so properly dedicate this first result of his researches as to his father, and in what simpler and more touching words than these, "Aan mijn' Vader"? He pours out his grateful thanks to the excellent Professor J. Van der Hoeven in affectionate language, which we know is as just as it is cordial,—to the learned Halbertsma, Professor of Anatomy, and mentions his vivid recollection of the pleasant and instructive hours passed in the hospitable residence of this gentleman,—to Temminck, Director of the Rijks Museum of Natural History,—and to the other Professors of the Medical Faculty at Leyden.

The author makes frequent references to the writings of naturalists and comparative anatomists who have preceded him; to Fischer, Meckel, Burdach, W. Vrolik, Burmeister, Lattke, J. V. d. Hoeven, Temminck, Duvernoy, Schroeder V. d. Kolk, and others, and evinces that he has not come unprepared to his task. The elaborate dissection of the *Moholi* by Dr. A. Smith appears not to be known to him.

In conclusion, we may remark that we have read Dr. Hoekema Kingma's dissertation with care, and can unhesitatingly announce it as a valuable contribution to comparative anatomy, elaborated with much pains and knowledge, creditable alike to the skill and attainments of its author. In expressing a parting wish for his success, to whatever department of science he may devote himself, we may add, that we are greatly mistaken if this be his last contribution to its progress.

Introduction to Cryptogamic Botany. By the Rev. M. J. Berkeley, M.A., F.L.S. With 127 Illustrations on wood, drawn by the author. London, Baillière, 1857.

Prior to the appearance of the present work, there was nothing in the English language which could be recommended as a satisfactory introduction to the study of the lower tribes of plants. No special treatise since the translation of Sprengel's 'Introduction to the study of Cryptogamic Plants,' the last edition of which came out in 1819, has to our knowledge been published in Great Britain. It was therefore high time that a summary introduction should be written by a native botanist, embodying the very numerous additions which have been made to our knowledge by various Cryptogamists at home and abroad. Such an introduction now lies before us, upon which an immense amount of care and trouble has been expended by the most eminent of all our Cryptogamists. Mr. Berkeley has consulted pamphlets, transactions, published collections of specimens, and papers innumerable scattered in English and continental Annals and Magazines, as well as most of the more important treatises on the different branches of his large subject. Although we think we could point out here and there works which he has passed over in silence, which it would have been well to have mentioned, even if he was unacquainted with them (for example, the works of Nylander and Massalongo on Lichens are not so much as alluded to), yet certainly, on the whole, a want of learning will not be laid to Mr. Berkeley's account. But after all, the greater value of the book consists, not in the useful and laborious epitome of other men's labours, but in the care and accuracy with which his own observations are put together, and accompanied with original figures. By far the greater part of the plates are made from his own dissections: some few are from Thuret, Harvey, and others; but in every case the authority for the figure is added to it. In so large a field as Cryptogamic Botany, it was hardly to be expected that even Mr. Berkeley's learning should suffice for all points. Accordingly he has consulted various friends (named in the introduction and in several parts of the body of the work) on those subjects which they have specially studied. At the end is added a very useful catalogue, but (as we have intimated already) not quite so perfect as could be wished, of the principal works on Cryptogamic plants, both generally and specially.

We have now the less pleasing task of pointing out a somewhat serious, though very remediable defect in the book. It is entirely destitute of anything like a synopsis of its contents; it consists of one long chapter without any summary prefixed; and it is broken into 645 articles, without any marginal or other indication of the contents of each. The running title, "Introduction to Cryptogamic Botany," occurs 579 times without variation at the top of the pages. The reader consequently, especially the inexperienced reader, finds himself, on opening the book, in the midst of an intricate wood without star or compass. It is only by putting together the indications given at pp. 69, 81, and 424, that any person, unacquainted with the subject, can gain a faint knowledge of the subjects discussed.

We have drawn out, partly for our own profit, partly for that of the reader, a kind of syllabus of the arrangement. It will also show what proportions of the work are occupied by particular tribes. A general introduction is prefixed to the whole work, and there is a special introduction (systematic, physiological, and geographical) to each alliance.

Class I. *Thallogens.*

Alliance I. Algales, pp. 84–234.

The Algæ are divided into three groups. See p. 108.

Alliance II. Mycetales, pp. 235–420.

a. Fungales, pp. 235–372.

For the divisions of the Fungi, see p. 269.

b. Lichenales, pp. 372–420.

For the divisions of the Lichens, see p. 389.

Class II. *Acrogens.*

Alliance III. Characeæ, pp. 425–430.

Alliance IV. Muscales, pp. 430–507.

Includes Ricciaceæ, Marchantiaceæ, Jungermanniaceæ, as well as Musci. For the divisions of the last, see p. 469.

Alliance V. Filicales, pp. 507–564.

Includes Ophioglosseæ, Equisetaceæ, Marsileaceæ, and Lycopoliaceæ, as well as Ferns proper. For the divisions of the last, see p. 522.

We have said that the defect is remediable; and even with respect to the present edition (for we trust that such a book as this will go through more than one edition), nothing would be more easy than to prefix a table of contents, giving the substance of each of the 645 articles.

In conclusion, we earnestly recommend the work to all our scientific friends: it is suitable to every botanical reader, besides being quite indispensable to the Cryptogamic student. Nay more, the zoologist and geologist will find not a little to interest them on the subject of their special studies.

Synopsis Plantarum Glumacearum. Auctore E. G. Steudel. Royal 8vo. Stutgard, 1855.

This book will be of considerable use to botanists, from its containing full generic and specific characters of the plants known to its author, which are included in the orders Gramineæ, Cyperaceæ, Restiaceæ, Eriocaulaceæ, Xyridaceæ, Desvauxiaceæ, and Juncaceæ. Although Dr. Steudel has apparently done his best to accumulate all that is known concerning the plants of these orders, he has not been altogether successful; for much which has been written in England and also in France seems unknown to him.

It is greatly to be feared that the number of species is multiplied to far greater extent than nature will acknowledge; but in such a work as that before us, this does not seem an unpardonable fault, for each reader is furnished with the means of judging for himself.

Previously to the issue of this book, we were obliged to content ourselves with the very imperfect account of the Gramineæ afforded by Kunth in his 'Enumeratio,' and have therefore much cause for thanking Dr. Steudel for this Synopsis.

Work in the Press.

Mr. P. H. Gosse has in the press a work on Geology, in which he endeavours to set aside the conclusions of geologists as to the antiquity of the earth, by the application of a principle *wholly scientific*, which, though hitherto apparently quite overlooked, he believes to be impregnable.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

January 27, 1857.—Dr. Gray, F.R.S., in the Chair.

On the true Nautilus umbilicatus of Lister. By Augustus A. Gould, M.D.

In looking over the shells of a dealer in Boston (U. S. A.), I observed three specimens of an umbilicated Nautilus, which struck me as differing essentially from the shell commonly known as *Nautilus umbilicatus*. A more careful examination satisfied me that they were quite distinct; and I made out a comparative description of them, intending to designate the newly observed one by the name *texturatus*, on account of its finely reticulated surface. But on referring to the several figures of *N. umbilicatus*, I found that the figure of Lister, which represents the shell originally named *umbilicatus*, presented all the characteristics of the reticulated shell, while all other figures represented the smooth, shining shell ordinarily bearing that name. From both the figures and descriptions of authors, I am led to believe that the shell originally observed by Lister has not been recognized by conchologists since his day. Every writer except Favanne expressly speaks of his shell as smooth (lævis, glatte), and his figure clearly refers to the common shell. On the supposition, then, that these are two distinct species, it is proper to restrict the term applied by Lister to the shell represented by him, and to substitute another for the shell ordinarily named *umbilicatus*. The term *scrobiculatus* indicated in manuscript by Solander, and adopted by Dillwyn, and which has been placed by others as a synonym, may be appropriately restored to this species.

The principal differences between the two shells are as follow. Taking the common shell, so well represented in Sowerby's 'Thesaurus,' as a standard, the other shell, which we take to be the genuine *umbilicatus* of Lister, is more ventricose, the sides being nearly parallel, and the periphery broadly rounded; the aperture is nearly quadrate rather than oval, the posterior angles being nearly right angles; the umbilicus is rather larger, its walls nearly perpendicular, in no degree cup-shaped; its marginal angle very slightly rounded, the edges of each whorl broadly spreading over the preceding whorl, and it is in all cases clearly pervious; the surface, instead of appearing smooth and shining, with only some distinct traces of revolving striæ near the aperture, has a dead, unpolished aspect, and is everywhere conspicuously reticulated with numerous, crowded, well-impressed, revolving lines; the colouring, instead of a lively ochreous, has a dusky smoky hue, and the chestnut-coloured flammules are numerous and delicate, numbering as many as five to the inch in place of three in the *scrobiculatus*. In all the specimens of the latter which have come under my observation, the sides are conspicuously undulated by a series of distinct waves, in the direction of the lines of growth, which are wholly wanting in *umbilicatus*. The most obvious distinctive marks then are, in the former, the shining surface and waved sides; and in the latter, the numerous small flammules, dead surface, and well-marked revolving striæ. These revolving striæ are plainly indicated on the figure of Lister; and that they are not merely a style of the engraver's art, but are intended to indicate something in nature, may be inferred by comparing the figure with that of *N. Pompilius*, in immediate proximity, the surface of which is really like that of *scrobiculatus*. The best of the three specimens examined by me, is now in the possession of Hugh Cuming, Esq., and an inspection of it will fully confirm the above views.

The synonymy of the two species will then be as follows:—

N. UMBILICATUS. *Testa suborbicularis, ventricosa, striis confertis volventibus insculpta, utrinque late umbilicata; marginibus umbilicorum vix rotundatis; umbilico pervio, infundibuliformi, nigro, margine externo vix rotundato; rufescens, postice radiatim ferrugineo strigata, strigis angustis, confertis.*

N. umbilicatus, Lister, Conch. t. 552. f. 4.

N. SCROBICULATUS. *Testa suborbicularis, subdepressa, lævis, nitida, lateribus radiatim fluctuatis, utrinque late umbilicata, umbilico crateriformi, margine externo rotundato, late flavescens, postice radiatim ferrugineo strigata, strigis latis, remotis.*

N. scrobiculatus, Soland. MS. Portland Catal. 169. no. 3653; Dillwyn, Catal. i. 339.

N. Pompilius, var. β., Gmelin, no. 3369.

N. crassus umbilicatus, Chemn. Conch. x. t. 137. f. 1274, 1275.

Le grand Nautile ombiliqué, Favanne, Conch. i. 726. t. 7. f. B 3, t. 69. f. D 2.

N. umbilicatus, Knorr, Vergn. iv. pl. 22. f. 4; Lamarck, Anim. s. Vert. xi. 322; Blainville, Malac. pl. 8. f. 2; Crouch, Conch. pl. 20. f. 16; Sowerby, Thes. Conch. pl. 98. f. 7.

February 10, 1857.—J. Gould, Esq., F.R.S., V.P., in the Chair.

ON THE ANATOMY OF THE GREAT ANTEATER (MYRMECOPHAGA JUBATA, LINN.). PART II. BY PROFESSOR OWEN, F.R.S., F.Z.S., ETC.*

In my former communication on the Anatomy of the Great Anteater, the position of the stomach and its relations to adjoining viscera were briefly pointed out. In the present paper I propose to describe the form and structure of this very remarkable organ in the *Myrmecophaga jubata*.

Moderately distended the stomach presents a subglobular form, of about 8 inches diameter, with a smaller subglobular appendage, as it seems, of about 3 inches diameter, intervening between the main cavity and the intestine.

The œsophagus terminates near the middle of the upper surface of the main portion, of which about 4 inches extends to the left of the cardiac orifice to form what Haller called the 'saccus cæcus.'

On the middle of both the anterior and posterior surfaces of the stomach is a sheet of tendon, of an irregular triangular form, 6 inches in longest diameter, which is in the direction of the length of the stomach, and in which the tendon extends from the large to the small division of the organ, and acquires upon the latter its greatest thickness and whitest colour.

* This paper will be reprinted in the Transactions, and there illustrated with 4to plates.

Upon bisecting the stomach lengthwise, the part described as the main cavity is seen to correspond with the cardiac division, and the seeming appendage, with the pyloric division, of the stomach in *Rodentia*: but they are much more distinct in structure and functions in the *Myrmecophaga* than in any other mammal with a stomach similarly divided externally. The cardiac cavity has a vascular secreting surface, the lining membrane being disposed in very numerous small rugæ; at the parts where the parietes have yielded most to the distending force, these rugæ are nearly effaced: other larger and more permanent folds are nearly straight, are confined to the vicinity of the communication with the pyloric cavity, and converge towards the aperture.

The cardiac orifice, in the inverted stomach, presents the form of a narrow, slightly bent crescentic slit. It is situated about $3\frac{1}{2}$ inches from the similarly shaped aperture of communication between the cardiac and the pyloric cavities: but the margin of this latter aperture is indented as it were by the ends of the converging folds of the lining membrane, about ten in number, which are continued into the pyloric cavity. The length of the cardiac slit is 1 inch; that of the intercommunicating aperture is 1 inch 3 lines.

The pyloric division of the Anteater's stomach is remarkable for the thickness of its muscular tunic and the density of its epithelial lining, which convert it into a veritable gizzard.

The muscular coat varies from one inch to half an inch in thickness; at the middle of the cavity it is separated from the lining membrane by an unusual accumulation of the elastic submucous cellular tissue, which is most accumulated in the upper wall of the cavity. A very small proportion, only, of food can enter at one time into this cavity, to be subjected to the triturating force of its parietes, operating with the aid of swallowed particles of sand in the comminution of the unmasticated or imperfectly masticated termites.

The area of the pyloric cavity, as exposed by a vertical longitudinal section, appears a mere linear, slightly sinuous tract, with a dilatation near the pylorus, due to a kind of valvular protuberance of the upper wall projecting towards that aperture. But, when the pyloric cavity is bisected transversely, its area then presents a crescentic figure, owing to the protuberance formed by the thicker muscular tunic and the more abundant submucous elastic tissue in the upper parietes. The lower longitudinal plicæ, which commenced on the cardiac side of the intercommunicating aperture, give a longitudinally ridged character to the inner surface of the cavity.

This character is changed, near the pylorus, for a reticular rugosity: the pylorus, when viewed from the duodenal side, presents a crescentic form, with the horns of the crescent directed upwards. The lining membrane of the duodenum soon becomes smooth.

Mr. Gould communicated the following letter, lately received by him from M. Elsey, Esq., the Surgeon and Naturalist attached to the Expedition under the command of A. C. Gregory, Esq., now engaged in exploring the north-western and northern portions of

Australia. Mr. Gould considered this communication to be of great value, inasmuch, as, besides mentioning that the writer had acquired an extensive collection of birds, it contains numerous very interesting observations respecting the various species which had been met with in the neignbourhood of the Victoria River Depôt, N.W. Australia, lat. south 17° 34′ 30″; their interest being much enhanced by the circumstance of many of them referring to several forms not previously known to occur in that part of the country.

Victoria River Depôt, N.W. Australia,
S. Lat. 17° 34′ 30″.
June 1856.

My dear Sir,

I am sorry I cannot send you any account of large collections or extensive ornithological notes. Circumstances over which I could have no control have kept me a close prisoner at this camp since last October. My collection of birds comprises up to the present time 103 species, some of which are, I think, new. Of Hawks I have five kinds, including two species of *Milvus*. The latter feed entirely on grasshoppers, are most cowardly birds, and utter a peculiar shrill wailing cry. The first I procured was of a very uniform dark, dirty brown colour. It was common on our first arrival here, but disappeared about December, and was sóon replaced by *Milvus affinis*, which has latterly become very numerous, and now perches in hundreds on the trees around the camp. These birds are excellent eating, and certainly exceed any other game we have here in flavour and tenderness. There are also three Eagles, neither of which I have been able to get, for though knocked down with our largest shot, they have got away; one has a dark-slate upper surface and wings, and white breast and belly. It frequents Sandy Island, the Stony Spit, and other parts of the river where sandbanks afford good fishing ground. The second is smaller, and of a pure white. I have only seen it once, when passing some dangerous rapids in the boat. The third is brown, with a very light-coloured and small head and neck, while the wings have an immense expanse. I should mention that one of our men found the black and white Eagle nesting in April. The nest was of immense size, and contained a single purely white egg of an almost globular form.

I have three Owls. The Barking Owl of these parts is a fine bird, the upper surface of which is beautifully mottled with dark-red and cinnamon-browns; while the under surface is white, with a central streak of brown in the feathers of the breast. It builds in the hollows of the huge Gouty-stem tree (*Adansonia*) of this coast, and incubates in March and April. Another is a large dirty slate-brown bird, with rough, dull yellow beak and legs. I procured one specimen only early in November, most likely a stray bird. The third was an *Athene*, rather smaller, of a mottled brown. The stomachs of all the specimens of the *Athene* were crammed with Orthoptera.

There is one true *Caprimulgus* here, of a beautiful warm mottled brown and black, and with white on the wings. It lays a dull white or greyish egg, marked with dirty green, at the foot of a tree, on the bare uneven ground. I have two species of *Ægotheles*, both of which I flushed from the holes of trees; and I have seen a large *Podargus*, with huge cellular mandibles, which was shot by the mate of the schooner, and spoilt by insects when I saw it.

About the middle of December a large flight of Swallows arrived from the south, high in the air and out of shot. They remained about us one afternoon, wheeling in the air, but did not pitch, and were gone next morning. A little Martin common here just now (May and June), is equally shy, and I cannot find its place of resort. Two *Dacelos* are frequently seen: one entirely coloured with shades of blue and grey, and with a crest of lengthened feathers on the back of the head; the other blue and warm red-brown, with finer and stronger tints than the other, and without a crest. A dull-coloured *Halcyon* (?) *sanctus* is common; and I have shot a single pair of the beautiful *Alcyone pulchra*, which I have only seen once. My men, some of whom take great interest in my collection, mention another, which I have not seen. According to their account, it is a lovely bird, the under surface fine purple, &c. Of *Artamus* I have several species, but have no means of determining them. They usually frequent stumps and dead logs in open flats, in twos and threes, and are very active. One species only, a dusky little fellow, lives on the tops of the ranges. I have seen a number of this species sitting round the top of a lofty Palm (*Levistona*), whose head had been struck off by storm or whirlwind; it was more than 80 feet high, and swayed in the breeze, and the circle of birds, with their heads directed inwards and their tails turned outwards, had an absurd effect. Of Shrikes I have two or three, including *Graucalus melanops*. I do not know *Grallina Australis*, nor have I heard its cry, so often alluded to by Leichardt, unless indeed a black and white bird with whitish very long tarsi, and white, rather blunt and soft beak, which builds a mud nest in the branches of trees near the water, be it. It has a peculiar shrill cry as it rises from the water, and is called the "Water Magpie" by our stockmen.

Of Fly-catchers and Robins, so called, I have seven or eight species. One robin has a slate-grey back, black head and wings, and chestnut flanks, with a white stripe over the eye; it lives in the mangroves, and may be recognized at all times by its pretty little piping note. I found it nesting in November and again in February and March; the nest is an open, shallow, slightly constructed one; the eggs two in number, dull greenish-grey, speckled with brown mostly at the larger end.

There are three or four Wrens; one a brilliant glossy black, with scarlet back and rump; this is the male bird, which does not attain this plumage till the second moulting. The young birds are uniform dull wren colour. After the first moulting they have a darker tint, and a few feathers between the shoulders tipped with red, and perhaps a single black feather in the tail. At the second moulting they acquire all their gloss, and may then be seen surrounded by a group of newly fledged birds. The female is dull wren-brown, with a lighter under surface. There is another beautiful Wren much larger and longer in the body; it has a beautiful purple top to the head, with oval spot of glossy black in the centre, and black zone outside it; the body is greyish-brown; the tail is long, of a blue tint, and having a sort of water-mark, if I may so call it, on the surface, which gives various shades to the colour. There is also another Wren of the same size and form and with a similar tail, but with a plain grey head and a chestnut spot over the ear-coverts. This is a female, the other a male; of each I have only a single specimen. All these build a dome-shaped nest of grass, in a low bush or tuft of grass, and lay about February and March four white eggs, quite translucent: the yolk shining through gives them a rose tint. I have shot lately (May) a bird allied to *Cinclorhamphus*, but to what genus it belongs I do not exactly know. Of two specimens one had in its stomach large green seeds, the other bark, bugs and various insects.

The Finches are very numerous and very beautiful. I have ten or twelve species, including *Estrelda annulosa* and *Poëphila personata*, of which there are two or three varieties, similar in size, habits and body colour, but differing in the glossy black of the face and chin, and in the colour of the beak and legs. The beautiful *Poëphila Gouldiæ* is tolerably numerous; of this also there are two varieties or species: one with a black face, surrounded by a line of bright blue; the other has the anterior half of the face scarlet, the rest black, edged with blue. Of both the breast is bright purplish-lilac; the belly canary-yellow; the back a mixture of bright green and dark brown, with light blue mixed over the rump.

There are two *Donacolas*: *flaviprymna*, and a crimson and brown one, of which there are one or two varieties. The *Donacolas* build in some parts in low tea-trees overhanging water, making a large spouted nest with a small cavity, of dry bark of tea-trees, and *Pandanus*. The *Poëphilæ* generally have large nests of grass on the ground or in low tufts of grass; one species builds in the small bushes of *Calliotrix* and *Melaleuca*, and composes its nest of minute dry twigs, often so slenderly that it appears to have a double opening. The *Estreldæ* build smaller and stouter nests in young *Eucalypti* and small trees, from 15 to 20 feet high. They all lay six white eggs.

I have met with two or three nests of the bower-bird, *Chlamydera nuchalis*, but no one of my party has seen the birds.

The Crow of this part of the country is a large bird, generally solitary, with a small eye and hazel-brown iris; it is very wary, and with difficulty shot.

The *Meliphagidæ* are not numerous, at least the more common species; the *Tropidorhynchus* is feathered all over the head, and does not merit its vulgar name. There is another somewhat resembling it here, but without its singular voice, and with a stouter beak. It is much like *Anthochæra*. A true *Merops* is also met with.

I have been unable to learn anything of the habits or nidification of the *Meliphagidæ* at present.

I have not observed any true Cuckoo here, and have failed to discover the *Cuculus dumetorum* of this coast; but I have seen two Cuckoo Pheasants (*Centropus*), one much lighter-coloured than the Moreton Bay species; the other with an almost black under surface, and the general plumage of a dark tint.

A *Climacteris* of dusty-brown plumage, with a brownish-yellow spot on the wings, looks very handsome when sailing with outspread wings and tail from tree to tree, or when hopping round the trunk and branches of the gum-trees, where it feeds much on the pupæ contained in the small tough cylindrical cocoons suspended in hundreds in the cracks of the bark. It loses all its beauty when prepared as a museum specimen.

Of Cockatoos: *Cacatua galerita, sanguinea,* and *Eos,* are abundant here, the two latter especially. Leadbeater's Cockatoo, with the fine red crest, was also seen on the southern slope of the dividing range south of lat. 18° S., and extending to the margin of the desert in lat. 20° S. It is common in the northern districts of West Australia, north of the Murchison. I have been hitherto most unfortunate in my attempts to get a Black Cockatoo. Several, however, have been shot and their tail-feathers, &c. brought in. I met with *Aprosmictus erythropterus* for the first time in January; on dissection, I found the os furcatorium very small, and buried in the substance of the pectorals.

I have not found a single *Platycercus* or *Euphema,* and only two Honey Parrots, *Trichoglossus versicolor* and *T. rubritorquis*; *Nymphicus Novæ-Hollandiæ* appeared suddenly in the beginning of April, and was followed in about a fortnight by *Melopsittacus undulatus*; both became very numerous, feeding about the burnt patches of ground; they are now (June) becoming scarce.

Pigeons are not very numerous. I found *Ptilonopus Swainsoni* at Quail Island on the coast near Port Paterson, and the fine *Carpophaga leucomela* at Point Pearce, near a swamp at which we were encamped in October; I was unable to preserve it, and have not seen it again.

Phaps histrionica, or a pigeon very similar to it, has been found lately in May, and another Bronze-wing smaller, and of a uniform greyish brown with white tip to the tail, red cere, and silver-grey iris, has been common during our stay. I have been disappointed in not getting *Geophaps plumifera.* It was often seen on the route from Point Pearce, and was very numerous, with another and larger-crested Pigeon at the second depôt, established on a branch of the Upper Victoria in lat. 17° 3′ S.

The *Petrophassa albipennis* is common among the sandstone cliffs of the ranges. Of two *Geopeliæ,* one is speckled, and has a silver-grey iris; the other has a beautiful lavender-coloured breast, and pink iris, with broad bright red orbits. Both are elegant, timid birds, and their liquid voices can be heard during the heat of the day, when all else is still. Neither of these Pigeons has the peculiar vocal powers noticed in *Geop. tranquilla* by Captain Sturt. The speckled one makes a very slight flattish nest of sticks on the horizontal fork of a branch, in which it deposits two white eggs.

One *Megapodius* was shot at Point Pearce, where in the hurry and confusion I could not preserve it; it was of compact form, of a uniform olive-brown plumage, with a stout beak, red iris, and strong tarsi and toes, the hinder especially. No mounds were seen during our short stay there.

A small Quail is common among the grass, but I have not yet obtained it.

Both *Dromaius* and *Otis* are of the same size, and in every way similar to those of the south; we have nowhere confirmed the observations of Leichardt and his black fellow as to their smaller size. Indeed Mr. Gregory believes, and I think most justly, that the *Emu* may cross the entire continent from east to west, or north to south, its habits being strictly wandering. It has no regular feeding ground or drinking place; its tracks are everywhere, and it is for ever on the move.

Of Waders I have a considerable number, but am unable to determine many of the species, as I am entirely without books of reference. I have found the beautiful *Lobivanellus lobatus* common during March and April on the sand-banks of the fresh water; it was usually associated with a small white *Himantopus*, with black wings and head. A long and pointed winged bird resembling *Glareola* is also frequent; it feeds on the wing, on grasshoppers, &c. about the *Polygonum* and other bushes fringing the banks.

I have seen *Falcinellus*, but could not get it. I have also one white *Platalea*, the *Jabiru* or *Mycteria*, and two or three Herons. The Night Heron, *Nycticorax*, is common, frequenting the dense mangroves, where it remains during the day, but flies at the most distant noise. I have also single specimens of *Tribonyx* and *Fulica*.

I have not had much opportunity of procuring *Natatores*. The Whistling Duck is very common, and was frequently shot on lagoons in the interior, but is very wary on the river. Large V-shaped flights of them passed over our camp during March from S.E. to N.W., in which direction they appear to have a favourite resort. I have also another Duck, similar to it, but smaller, with a soft dull-brown plumage.

I have seen *Nettapus pulchellus*, but could not get it. Indeed my opportunities of examining the river have been so much more limited than those Captain Stokes enjoyed, that many of his birds I have not even seen. And owing to our small number I have generally on these excursions been obliged to take an oar myself, and could not therefore keep a very bright look-out.

The *Plotus* is common here, and excellent eating. During February and March it was incubating. It chooses large trees that hang over the water above or through the mangroves, and in these a number of them build a colony of large coarse flattish nests of dead sticks and twigs, which appear, from the quantity of dirt about them and their stained appearance, to be used year after year. Each season they place in the centre a few fresh green leaves, and on these lay three or four white eggs, with a very earthy opaque, but brittle shell; the lining membrane is of a blue-grey colour; they are rather smaller and more elongated than a hen's egg. We have enjoyed many fine meals of these eggs, sometimes getting from forty to fifty in a single tree. Both birds sit. The male is of a glossy greenish-black, with a little brownish-grey on the wings and wing-coverts. The female has a white under surface, but is otherwise similar.

The Pelican is white, with black wings, and a very fine blue and purple margin round the pouch. It is, I presume, *Pelecanus conspicillatus*. Its breeding season is March and April.

I have thus endeavoured to give you a rough abstract of my collections hitherto; I am now about to begin work really, as I start with the party in a few days for the Albert River, and from thence, if all 's well, to Moreton Bay. I shall have much pleasure in writing to you from the Gulf of Carpentaria, should I have anything of interest to communicate.

I remain,
My dear Sir,
Your obedient Servant,

John Gould, Esq. M. Elsey.

February 24, 1857.—Dr. Gray, F.R.S., in the Chair.

On the Skull of a Manatus from Western Africa. By Dr. Balfour Baikie, F.R.Geog.S.

Until very recently but two species of the somewhat scarce genus *Manatus* have been acknowledged by naturalists, viz. *M. australis* (the *M. Americanus* of some writers) and *M. Senegalensis*. Of these the former inhabits chiefly the mouths of the great rivers of the north-eastern coast of South America, and the West Indies, while the latter is confined to the tropical portions of the western coast of Africa. Some writers, as Hernandes, mention a species found along the coasts of Peru, but, if so, little or nothing is known of it or its habits. Wyman has described as *M. nasutus* what is probably a variety of *M. Senegalensis*, and Harlan as *M. latirostris* another Manatee from the Gulf of Mexico, which, however, seems to be a good species.

Individual specimens of *Manati* have rarely been met with along our own shores, as that recorded by Prof. Fleming* as having occurred in the Shetland Islands in 1823; and I am in possession of tolerable evidence, which I intend shortly to publish, that a similar animal has made its appearance from time to time in Orkney, where it is not unknown to fishermen. These are most probably stray members of *M. australis* which have crossed the Atlantic, which belief is, to some extent, supported by the fact that in Orkney they have always been seen on the western or Atlantic side of the islands.

The *M. Senegalensis* has been found in the Senegal, the Gambia, and some rivers of Western Africa; and *Manati* have also been known to occur in various rivers opening into the Bight of Biafra,

* *Vide* Fleming in Edin. New Phil. Journal, and Baikie and Heddle's 'Historia Naturalis Orcadensis.

which have hitherto been referred to the same species, partly because no specimens had hitherto been critically examined, and partly because it seemed unlikely that two species of a genus so unprolific, even in individuals, should exist in localities so very near to each other. All probability from previous knowledge, or in the absence of more precise or more extended information, merely justified a belief in the existence of two species, one inhabiting the New World, the other peculiar to some tropical portions of the Old World.

The differences between *M. australis* and *M. Senegalensis* are quite evident. The former seems to grow to a greater size, and the shape of the skull at once distinguishes it, being altogether larger, with a more lengthened nasal opening, and more elongated intermaxillary bones, giving it a large mouth. The lower jaw, also, is less massive and angular, and its inferior margin less curved. It would seem to approach more to the fragmentary extinct forms described by Cuvier in his 'Ossemens Fossiles.' In *M. Senegalensis* again the skull is more compact, the snout shorter, the lower jaw more angular with its lower border more curved, and the zygomatic process of the temporal is less elevated.

In 1851, while Dr. Barth was journeying towards the country of Adamáwa in Central Africa, he heard from the natives, accounts of an animal said to frequent the rivers and marshes, named by them Ayú (erroneously written Ajúh). He heard of the same animal, under the same name, also up the river Kwóra or Niger below Timbúktu, and he believes that it also exists in the river Shári, which runs into the marshy Lake Tsád. Dr. Barth not having been able to satisfy himself about this creature, directed Dr. Vogel's attention to it, and the latter gentleman fortunately met with a specimen in September 1855 in the upper part of the Binuë or Tsádda. An account of this Ayú having been sent by him to England, and read at the British Association Meeting at Cheltenham, Prof. Owen thought that it presented sufficient peculiarities to distinguish it as a species, which he indicated as *M. Vogelii*; but his remarks partly applied to a *Manatus* skull, which was exhibited at the time, and which by some misconception persons present had been led to consider as belonging to the very individual described by Vogel.

During the months of September and October 1854 I ascended the same river; but though this was the period when they ought to have been most abundant, yet I neither saw nor heard of any such animal; and though I always carefully examined the hunting relics in the various villages, yet I never met with its remains. From this I am led to confirm Dr. Vogel's statement, that it is a rare and scarce creature. But on the 13th July previous, just after I had entered the mouth of the Kwóra and Niger from the sea, I had spent the day in examining some of the interminable dreary creeks, which are there so apt to perplex the voyager. While returning in the afternoon I saw under some palms and mangroves a collection of miserable huts, hardly entitled to the appellation of a village, towards which I pulled and presently landed. The inhabitants in great alarm all fled into the bush, and could not be induced to come out, so I walked through their habitations, looking around me, but finding nothing but heaps of nuts of the oil-palm. But just before embarking, my eye caught a heap of dry bones, placed evidently by the negroes as their dju-dju, or sacred heap, remains of their hunting achievements, and now dedicated to their deity. I eagerly examined the mass, but found to my grief that it was composed mostly of fragments, among which were portions of skulls of goats, of a bullock, and of a crocodile; but on turning these over I saw a more complete relic, one which struck me as being peculiar, and as something I had not previously seen. This I carried off, and it turned out to be the nearly complete skull of a *Manatus*, which was the skull exhibited at Cheltenham. Having had time lately to examine it, I found it to exhibit the peculiarities remarked by Prof. Owen, and the result is as follows :—

General Measurements.

	inches.
Extreme length	$12\frac{1}{2}$
Greatest depth	8
Length of nasal orifice	$4\frac{1}{4}$
Breadth of nasal orifice	2
From edge of orbit to extremity of snout	$3\frac{5}{8}$
From anterior molar socket to extremity of snout	$3\frac{3}{8}$
From anterior edge of infraorbital foramen to ditto	$3\frac{1}{4}$
From maxillary and intermaxillary suture to ditto	$1\frac{3}{4}$
Greatest depth of zygomatic arch	$2\frac{1}{2}$

The proportions of the skull are more elongate than those of *M. Senegalensis*, but less so than those of *M. australis*. Top of skull oblong, bounded by two almost completely parallel ridges on the frontal and parietal bones. Frontal suture remaining, parietal bones united. Breadth of orbits nearly one-half of their length; orbits directed outwards, nearly in a plane with the snout at an angle of about 40°; lower edge of orbits circular, smooth, and not tuberculated. Intermaxillaries more lengthened than in Cuvier's figure of *M. Senegalensis*, but much less deep, and not nearly so elevated along the anterior angle of the nasal cavity. Cavities for nine upper molars, the anterior being but a single socket, the others adapted for three dental fangs, one internal, and two external and lateral. Fangs flattened and slightly expanded at extremity; the two external directed immediately upwards; the internal one, rather the longest, directed upwards and inwards, especially the more anterior ones. Two posterior molars still undeveloped. Molars multicuspid, with two transverse irregularly tri-tubercular ridges, the posterior one being generally partially divided into two by a small groove. The ridges on the remaining anterior molars (third and fourth) much rubbed down and worn, exposing the dentine. Remains of one incisive socket at extremity of each intermaxillary near the suture. Incisive foramen pyriform, the base anteriorly.

Lower jaw less massive than in *M. Senegalensis*, with posterior angle less marked, and lower border much less curved; opposite sides completely anchylosed, a deep hollow under upper and inner edge. Cavities existing for eight molars, the socket of the anterior one being simple; two posterior molars but partially developed. Lower molars more distinctly three-ridged than the upper ones, but the ridges less evidently tri-tubercular. Molars with two fangs, anterior and posterior, resembling the two external fangs of the upper molars, directed downwards, flattened and expanding, especially the posterior one. Molars deciduous from before backwards, seemingly forced out by the gradual advance forwards of the posterior ones.

The temporal bones being both wanting, I am unable to speak of the zygomatic processes, which differ in shape in the two previously known species.

Dr. Vogel's measurements being from an entire head, while mine are from the dried skull, the size of the respective animals will nearly approach each other, mine being rather the smaller. In the distance between the orbit and the snout, on which Prof. Owen lays stress, they will be found so fairly to agree that they may be presumed to belong to the same species. Let us now therefore see whether the other measurements and proportions of the one we have been considering differ sufficiently from others to favour the presumption of its being a species. In *M. Senegalensis*, the contour, looking at the skull from above downwards, is nearly that of an isosceles triangle, closely approaching an equilateral triangle, while that of *M. australis* more resembles the outline of a violoncello. In the Niger specimen again, the form, though more nearly resembling the former, is certainly of an intermediate character, the base of the triangle being shorter in proportion. The profile view of *M. australis* shows a lengthened, rather narrow beak, while *M. Senegalensis* has one shorter and remarkably deep; and here again we have an intermediate form, the shape in this case certainly more resembling *M. australis*. The inferior border of the lower jaw of *M. australis* is long and straightened, while that of *M. Senegalensis* is short and curved, its posterior angle, also, being more massive and decided, and approximating to that of the Dugong. Here again the Niger Manatee intervenes, the angle being more obtuse, and the curve less than in the Senegal species. The proportion of the length of the nasal opening in *M. australis* is to the breadth as 3 to 1, in *M. Senegalensis* as 1 to $\frac{2}{3}$, but in my specimen as 2 to 1. The coronal suture, sharply angular in the South American and almost semicircular in the Senegal species, is in the Niger one acutely arched. The temporal ridges irregularly converge posteriorly in *M. australis*, in *M. Senegalensis* they gently diverge, while here they run antero-posteriorly almost entirely parallel. The temporal bones being, as I have remarked, absent, I cannot speak of the temporal zygomatic apophyses; but the malar portions which remain would seem to indicate a continuance of the same intermediate character.

But in a few points the Niger skull is peculiar, and differs entirely from the others. Thus the superior and anterior angle of the parietal bone extends much further forward than in either of the others, reaching to within less than an inch of the posterior angles of the nasal opening. The anterior edge of the post-orbital apophysis and the lower margins of the orbits are plain and smooth, not irregular. The vomerine sheath is not nearly so prolonged anteriorly, and does not reach to within an inch of the anterior incisive foramen. The maxillary and inter-maxillary do not unite by a bevelled surface, but by a suture forming a right angle.

On one point we can draw a tabular view of the whole of the skulls, viz. as to the comparative distance of the orbit from the end of the beak, which, compared with the total length of the skulls, is as follows :—

In Dr. Vogel's entire head of the Ayú as 7 to 36, or about 1 to 5.

In the skull from the mouth of the Kwóra as 27 to 100, or more than 1 to 4.

In the skull of *M. Senegalensis* as 1 to 3 nearly.

In the skull of *M. australis* as 5 to 14, or less than 1 to 3.

From what I have drawn out we may, I believe, make the following deductions: 1st, That in the Kwóra or Niger, and its tributary the Tsádda or Binuë, is found a *Manatus* intermediate in many of its characters between *M. australis* and *M. Senegalensis*; and 2ndly, That if these differences are, as Prof. Owen suggests, too marked for a mere variety, then there is no alternative but to allow it as a species. I do not mean to affirm its positive existence, but merely following up the idea thrown out by Prof. Owen, in examining the skull I brought home, I think the *probability* of its distinctness is considerably increased. Being about to revisit the river Kwóra I shall make a point of searching more closely after this animal, with a view to settling the question. If established, the genus will stand as follows :—

MANATUS, Rondel.

1. MANATUS AUSTRALIS, Tiles.

Hab. West Indies and north-east coast of South America.

2. MANATUS SENEGALENSIS, Desm.

Hab. African rivers, Senegal to the Gambia.

3. MANATUS VOGELII, Owen.

Hab. Rivers opening into the Bight of Biafra.

Whether *M. nasutus* of Wyman and *M. latirostris* of Harlan are species, varieties, or synonyms, I have not the means of ascertaining.

M. australis is, as I have mentioned, more allied to the extinct fossil forms; and *M. Senegalensis*, again, more approaches in form of skull to the Dugong.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 15, 1857.—The Lord Wensleydale, Vice-President, in the Chair.

"On the present state of Knowledge as to the Structure and Functions of Nerve." By Thomas H. Huxley, F.R.S., Fullerian Professor of Physiology, Royal Institution.

The speaker commenced by directing the attention of the audience to an index, connected with a little apparatus upon the table, and vibrating backwards and forwards with great regularity. The cause of this motion was the heart of a frog (deprived of sensation, though not of life) which had been carefully exposed by opening the pericardium, and into whose apex the point of a needle connected with the index had been thrust. Under these circumstances the heart would go on beating, with perfect regularity and full force, for hours; and as every pulsation caused the index to travel through a certain arc, the effect of any influences brought to bear upon the heart could be made perfectly obvious to every one present.

The frog's heart is a great hollow mass of muscle, consisting of three chambers, a ventricle and two auricles, the latter being separated from one another by a partition or septum. By the successive contraction of these chambers, the blood is propelled in a certain direction; the auricles contracting, force the blood into the ventricle; the ventricle then contracting, drives the blood into the aortic bulb; and it is essential to the full efficiency of the heart as a circulatory organ, that all the muscular fibres of the auricles should contract together, and that all the muscular fibres of the ventricle should contract together; but that the latter should follow the former action after a certain interval.

The contractions of the muscles of the heart thus occur in a definite order, and exhibit a combination towards a certain end. They are rhythmical and purposive; and it becomes a question of extreme interest to ascertain, where lies the regulative power which governs their rhythm.

If we examine into the various structures of which the heart is composed, we find that the bulk of the organ is made up of striped muscular fibres, bound together as it were by connective tissue, and coated internally and externally with epithelium. Now it is certain that the regulative power is not to be found in any of these tissues. The two latter may, for the present purpose, be regarded as unimportant, as they certainly take no share either in producing or guiding the movements of the heart. The muscular tissue, on the other hand, though the seat of the contractility of the organ, requires some influence from without, some stimulus, in order to contract at all, and having once contracted, it remains still until another stimulus excites it. There is, therefore, nothing in its muscular substance which can account for the constantly recurring rhythmical pulsations of the heart.

Experiments have been made, however, which clearly show that the regulative power is seated, not only in the heart itself, but in definite regions of the organ. Remove the heart from the body, and it still goes on beating; the source of the rhythm is therefore to be sought in itself. If the heart be halved by a longitudinal section, each half goes on beating; but if it be divided transversely, between the line of junction of the auricles with the ventricle and the apex of the latter, the detached apex pulsates no longer, while the other segment goes on beating as before. If the section be carried transversely through the auricles, both segments go on beating; and if the heart be cut into three portions by two transverse sections, one above the junction of the auricles and ventricle, and one below it, then the basal and middle segments will go on pulsating, while the apical segment is still. Clearly then, the source of the rhythmical action, the regulative power, is to be sought somewhere about the base of the auricles, and somewhere about the junction of the auricles and ventricles.

Now there is in the frog's heart, besides the three tissues which have been mentioned, a fourth, the nervous tissue. A ganglion is placed at the base of the heart, where the great veins enter the auricles—from this two cords can be traced traversing the auricular septum, and entering two other ganglia placed close to the junction of the auricles with the ventricles. From these ganglia nerves are distributed to the muscular substance. Now we know, from evidence afforded by other striped muscles and nerves, that the contraction of the former is the result of the excitement of the latter; in like manner, we know that the ganglia are centres whence that excitement originates. We are therefore justified, analogically, in seeking for the sources of the contractions of the cardiac muscles, in the cardiac ganglia; and the experiments which have been detailed—by showing that the rhythmical contractions continue in any part of the heart which remains connected with these ganglia, while it ceases in any part cut off from them—prove that they really are the seats of the regulative power.

The speaker then exhibited another very remarkable experiment (first devised by Weber) which leads indirectly to the same conclusion. An electro-magnetic apparatus was so connected with the frog upon the table, that a series of shocks could be transmitted through the pneumogastric nerves. When this was done, it was seen that the index almost instantly stopped, and remained still, so long as the shocks were continued; on breaking contact, the heart remained at rest for a little time, then gave a feeble pulsation or two, and then resumed its full action. This experiment could be repeated at will, with invariably the same results; and it was most important to observe, that during the stoppage of the heart, the index remained at the lowest point of its arc, a circumstance which, taken together with the distended state of the organ, showed that its stoppage was the result, not of tetanic contraction, but of complete relaxation.

Filaments of the pneumogastric nerve can be traced down to the heart, and whenever these fibres are irritated, the rhythmical action ceases. The pneumogastric nerves must act either directly upon the muscles of the heart, or indirectly through the ganglia, into which they can be traced. If the former alternative be adopted, then we must conceive the action of the pneumogastric nerve upon muscle to be the reverse of that of all other nerves—for irritation of every other muscular nerve causes activity and not paralysis of the muscle. Not only is this in the highest degree improbable, but it can be demonstrated to be untrue; for on irritating, mechanically, the surface of the heart brought to a standstill by irritation of the pneumogastrics, it at once contracts. The paralysing influence, therefore, is not exerted on the muscles, and as a consequence, we can only suppose that this "negative innervation," as it might be conveniently termed, is the result of the action of the pneumogastric on the ganglia.

It results from all these experiments, first, that nerve-substance possesses the power of exciting and coordinating muscular actions; and secondly, that one portion of nervous matter is capable of controlling the action of another portion. In the case of the heart it is perfectly clear that consciousness and volition are entirely excluded from any influence upon the action of the nervous matter, which must be regarded as a substance exhibiting certain phænomena, whose laws are as much a branch of physical inquiry as those presented by a magnet.

Now, (still carefully excluding the phænomena of consciousness,) we shall find on careful examination, that all the properties of Nerve are of the same order as those exhibited by the nervous substance of the heart. Every action is a muscular action, whose proximate cause is the activity of a nerve, and as the muscles of the heart are related to its ganglia, so are the muscles of the whole body related to that great ganglionic mass which constitutes the spinal marrow, and its continuation the medulla oblongata. This cranio-spinal nervous centre originates and coordinates the contractions of all the muscles of the body independently of consciousness, and there is every reason to believe that the organ of consciousness stands related to it as the pneumogastric is related to the cardiac ganglia; that volition, whether it originates, or whether it controls action, exerts its influence not directly on the muscles, but indirectly upon the cranio-spinal ganglia. A volition is a conscious conception, a desire; an act is the result of the automatic, unconscious origination and coordination, by the cranio-spinal ganglia, of the nervous influences required to produce certain muscular contractions.

Whatever may be the ultimate cause of our actions then, the proximate cause lies in nerve-substance. The nervous system is a great piece of mechanism placed between the external world and our consciousness; through it objects affect us; through it we affect them; and it therefore becomes a matter of the highest interest to ascertain how far the properties and laws of action of nerve-substance have been ascertained by the physiological philosopher.

Nerve-substance has long been known to consist of two elements, fibres and ganglionic corpuscles. Nerve-fibres are either sensory or motor, and the activity of any one fibre does not influence another. But when nerve-fibres come into relation with ganglionic corpuscles, the excitement of a sensory nerve gives rise to that of a motor nerve, the ganglionic corpuscles acting in some way as the medium of communication. The "grey matter" which occupies the middle of the spinal marrow has long been known to be the locality in which the posterior roots, or sensory fibres, of the nerves of the body, and the anterior roots, or motor fibres, come into relation with ganglionic corpuscles; and as the channel by which, in what are called reflex actions, the activity of the sensory nerves is converted into excitement of corresponding motor nerves. The precise *modus operandi* of the grey matter has been much disputed, but the recent researches of Wagner, Bidder, Kupfer, and Owsjannikow, throw a great light upon, and vastly simplify the whole problem. It would appear that all nerve-fibres are processes of ganglionic corpuscles; that, in the spinal cord, the great mass of the grey matter is nothing but connective tissue, the true ganglionic corpuscles being comparatively few, and situated in the anterior horns of the grey substance; finally, it would seem that no ganglionic corpuscle has more than five processes: one, which becomes a sensory fibre and enters the posterior roots of the nerves; one, a motor fibre which enters the anterior roots; one, which passes upward to the brain; one, which crosses over to a ganglionic corpuscle in the other half of the cord; and perhaps one establishing a connexion with a ganglionic corpuscle on the same side.

It is impossible to overrate the value of these discoveries; for if they are truths, the problem of nervous action is limited to these inquiries: (*a*) What are the properties of ganglionic corpuscles? (*b*) What are the properties of their two, or three, commissural processes? For we are already pretty well acquainted with the properties of the sensory and motor processes.

A short account was next given of the physical and physiological phænomena exhibited by active and inactive nerve; and the phænomena exhibited by active nerve were shown to be so peculiar as to justify the application of the title of "nerve-force" to this form of material energy.

It was next pointed out that this force must be regarded as of the same order with other physical forces. The beautiful methods by which Helmholtz has determined the velocity (not more than about 80 feet in a second in the frog) with which the nervous force is propagated were explained. It was shown that nerve-force is not electricity, but two important facts were cited to prove that the nerve-force is a correlate of electricity, in the same sense as heat and magnetism are said to be correlates of that force. These facts were, first, the "negative deflection" of Du Bois Raymond, which demonstrates that the activity of nerve affects the electrical relations of its particles; and secondly, the remarkable experiments of Eckhard (some of which the speaker had exhibited in his Fullerian course), which proved that the transmission of a constant current along a portion of a motor nerve so alters the molecular state of that nerve as to render it incapable of exciting contraction when irritated.

These facts, even without those equally important though less thoroughly understood experiments of Ludwig and Bernard, which appear to indicate a direct relation between nerve-force and chemical change, seem sufficient to prove that nerve-force must henceforward take its place among the other physical forces.

This then is the present state of our knowledge of the structure and functions of nerve. We have reason to believe in the existence of a nervous force, which is as much the property of nerve as magnetism is of certain ores of iron; the velocity of that force is measured; its laws are, to a certain extent, elucidated; the structure of the apparatus through which it works promises soon to be unravelled; the directions for future inquiry are limited and marked out; thus the solution of all problems connected with it is only a question of time.

Science may be congratulated on these results. Time was, when the attempt to reduce vital phænomena to law and order was regarded as little less than blasphemous: but the mechanician has proved that the living body obeys the mechanical laws of ordinary matter; the chemist has demonstrated that the component atoms of living beings are governed by affinities, of one nature with those which obtain in the rest of the universe; and now, the physiologist, aided by the physicist, has attacked the problem of nervous action—the most especially vital of all vital phænomena—with what result has been seen. And thus from the region of disorderly mystery, which is the domain of ignorance, another vast province has been added to science, the realm of orderly mystery.

MISCELLANEOUS.

On the Saliva of Dolium galea. By Professor Troschel.

Statements have recently been made tending to prove that the boring Mollusca penetrate stones by a purely mechanical action. The following observations of Professor Troschel seem to show that in some cases the perforating action of Mollusca may be due to a chemical cause.

In the 'Voyage of the Astrolabe,' Quoy and Gaimard state that the *Dolium galea*, a Ctenobranchous mollusk nearly allied to the *Buccini*, possesses salivary glands of extraordinary development. They are composed of two lobes, of which the anterior alone is glandular; the posterior forming a sort of pouch which attains the size of a pigeon's egg, and contains an aqueous liquid mixed with bubbles of air. The efferent canal of the gland passes through the nervous ring which surrounds the œsophagus and opens into the buccal cavity in front of the tongue.

Whilst staying at Messina in the autumn of 1853, Troschel purchased two specimens of *Dolium* from the fishermen, and on returning to his residence he prepared to put them in spirits. For this purpose he broke the shell of one of them in the region of the spire, when the animal elongated itself outwards, pushing out its proboscis as far as it could, and moving it about in all directions with a threatening aspect. Troschel then wished to seize the extremity of this proboscis, which was dilated into a trumpet, in order to examine it more closely, when the animal suddenly projected a large stream of a transparent liquid, which fell upon the floor at a distance of several feet. A moment afterwards the calcareous slabs with which the floor was paved were covered with froth, the liquid evidently containing an acid which produced effervescence with carbonate of lime. J. Müller, who was then at Messina, was a witness of this phænomenon.

The experiment was repeated with the second *Dolium*, but this time the fluid was received in a glass. It was colourless and not frothy, but dissolved carbonate of lime rapidly with effervescence. Troschel afterwards collected a great number of specimens, which enabled him to obtain the acid liquid in great abundance. A single individual furnished as much as three ounces. The pressure of the finger upon the region corresponding with the salivary glands was sufficient to cause the expulsion of the saliva.

In April 1854, after his return to Bonn, Troschel forwarded a bottle of this singular saliva to Dr. Boedeker at Göttingen, for analysis. The liquid did not present the least trace of decomposition or fermentation, and had not given rise to any formation of mould, although it had been collected six months before. It was as clear as water, possessed a very acid taste, and boiling did not produce any precipitate in it, even when the free acid had previously been neutralized by soda. Consequently it did not contain any albumen. The quantity of organic substances contained in this liquid was found to be excessively minute. No trace of urea, or of sugar, was found in it; on the other hand, the analysis proved the existence in it of an abundance of muriatic and sulphuric acids, and of sulphates of magnesia, potash, and soda. It gave the following results:—

Free anhydrous muriatic acid (HCl)	0·4
Free hydrated sulphuric acid (HO, SO^3) (corresponding to 2·2 per cent. of anhydrous sulphuric acid)	2·7
Anhydrous sulphuric acid combined with bases (neutral salts).	1·4
Magnesia, potash, soda, a little ammonia, very little lime, and organic matters, forming in all	1·6
Water	93·9
	100·0

The existence of such a liquid in the body of an animal is of high interest. The zoologist and the physiologist must inquire what can be the object of such a secretion, if it be not a purely excretory substance. The chemist must join the physiologist in attempting to explain how such powerful mineral acids can be secreted in a free state in the perfectly healthy organism of a living animal.

The first of these questions is to a certain extent answered by Troschel. He has seen the stream of liquid projected by the animal issue from the mouth and attain a length of several feet. This is an indication which the physiologist must not allow to pass unappreciated. It appears rational to conclude therefrom, that at least a great part of the salivary liquid is not employed in digestion. On the other hand, it is very probable that the *Dolium* makes use of it as a defensive weapon. The shell of *Dolium* has a very wide opening, and is destitute of a protective operculum, so that the animal is exposed to every kind of attack. It is probable that it defends itself against its enemies by means of the sulphuric and muriatic acids of its saliva. We must not forget, however, that as the animal lives in water, its saliva cannot act at any great distance. We might suppose that the saliva is employed for two different purposes, on the one hand for defence, and on the other for digestion. This latter function, however, appears to be contradicted by an observation of Troschel's. In the stomach of many specimens of *Dolium* he found the *débris* of *Fuci* bearing small animals with calcareous shells, such as Polypes, *Serpulæ*, &c. When exposed to the action of the saliva, these fragments of calcareous shells were dissolved, with a strong effervescence, in less than a minute. We may therefore conclude that the *Fuci* had not been in contact with the saliva either before, or during, deglutition. The saliva, consequently, has probably no relation to digestion.

It is curious that the membranes of the animal itself which are in contact with the acid are not attacked thereby. This liquid also has no effect upon the shell of the *Dolium*, especially upon its inner surface, which is covered by a delicate polished varnish, unalterable by acids.

The *Dolia* are not endowed with the faculty of perforating stones; but the mere fact of the secretion of a free acid in these Mollusca, shows that it is not impossible that perforating animals may secrete a substance capable of chemically acting upon calcareous rocks. It is true that the perforating Lamellibranchiate mollusks are destitute of salivary glands, but it is not impossible that some other part of the body may assume the secretion of an acid liquid.—*Monatsber. der Akad. der Wiss. zu Berlin*, August 1854, p. 486.—From the abstract by E. Claparède in *Bibl. Univ. de Genève*, February 1857, p. 161.

Note on the occurrence of the Harvest Mouse in Cornwall. By Charles William Peach.

In the 'Zoologist' for the present month, at page 5592, I observe a communication from Mr. E. H. Rodd, mentioning the occurrence of the *Mus messorius* at Penzance, and of its not having been noticed in Cornwall before. I find in Couch's Cornish Fauna, part 1, page 7, that it is common, and so it occurred to me, for during my residence at Goran Haven, this beautiful little creature was well known to me, from having seen it and its nest on the stems of corn in the fields, and in winter—at times by dozens—in the corn-stacks, where other mice were more abundant, when the farmers were taking their corn into the barns; for at such times, either myself or children were often requested to attend with my old and favourite dog Hassan, who, though a large fellow, was exceedingly quick, and very fond of catching mice and rats, and few could escape him: the red mouse (harvest mouse) was a delicate and dainty morsel; these he immediately swallowed, the other mice and rats he merely killed. My children on one occasion took home some of the harvest mice; for these I made a small cage; they lived with us some time, drank milk freely, fed on any sort of grain or bread, and it was interesting to watch their gambols and see them suspend themselves by their prehensile tails from the wires of the cage; unfortunately, these wires were so flexible that one by one they got out, and no doubt fell a prey to pussey.

As I have introduced my dog, I may as well mention a trait in his character, proving that he was as "rigidly faithful and honest," as the dog mentioned at page 5590 of the same publication; he differed, however, from this tailless one in having a splendid black "tail wi' upward curl," tipped with white. A butcher visited the Cove every Friday; the dog most certainly knew the day and was invariably on the look-out, and immediately took possession of the shop, and, when the butcher was absent, full charge of the meat,—was frequently shut up with it, all lying around him, even on the low block on which it was chopped, and woe betide the cat that attempted to steal.

He however claimed as his perquisite the small pieces that dropped when chopping, but should a large piece fall, he did not interfere. Hassan had not been trained to keep shop, for I had him when only a month old, nor did I tell him to attend the butcher; he carried his character in his look, and so gained the situation—

"His honest, sonsie*, baws'nt face,
Aye gat him friends in ilka place,"

and greatly respected he was by all my neighbours, for his honest and quiet good-nature. With the children he was an especial favourite, and constant attendant in their walks. A more intelligent "faithful tyke" there could not be; he lived with me fifteen years; since his death I dare not keep another—I cannot bear these partings.

I could tell very many things about him, showing a something which throws *mere instinct into the shade*, but must not trouble you farther, beyond mentioning that, however good a character he had, his name (Hassan†) got one of my little sons, for a time, a bad one. On removing to Fowey, a lady inquired of him the dog's name; he said, "Hassan, madam." She mistook it for "ask him, madam," and thought him impertinent; a friend to whom she mentioned it explained. From that time both dog and boy became favourites with her—the dog soon learned to lift the latch of the door leading to her kitchen, and many a piece he got by it.

Wick, Caithness, N.B., May 24th, 1856.

* He had, like Burns's dog, "a white stripe down the face."
† 'Camel-driver."

A Notice of the Baradla Cavern, near Agtelek, in Hungary. By Dr. Schmidl*.

This is the most extensive of the caverns at present known in the Austrian empire. Its principal gallery has a length of more than $\frac{4}{5}$ of an Austrian mile (about 4 English miles). The limestone-mountains containing this natural excavation bear some resemblance to the Karst Mountain of Illyria, and may be considered to absorb the atmospheric waters, as their interior contains three rivulets, two in the principal and one in a lateral cavern. These subterranean currents come to day near Josafö, N.E. of Agtelek, with sufficient water to work several mills. Most of the larger caverns examined by Dr. Schmidl have before their mouth a heap of rolled fragments, rising from the bottom of the valley. The heap, or talus, is somewhat depressed at its top; it then slopes rather steeply towards the mouth, and continues within the interior of the cave, before the commencement of the real cave-soil, lying somewhat beneath the level of the external valley-bottom. The mouth itself is most frequently situated on a high, steep, sometimes nearly vertical cliff. It is generally a fissure, increasing in breadth downwards, with its lower extremity concealed by the heap of detritus. This fissure has been evidently obstructed by falling rocks, so as to prevent the high-water penetrating to the interior: the rocks, corroded by the action of the waters, broke further down, and produced the heaps of detritus; until, at last, the external waters found another way into the interior of the mountains.

Like the caverns of Carniolia, the Baradla Cavern is composed of a series of isolated chambers and narrow channels; but a greater number of separations being broken through, its longitudinal extent has become more considerable. The terminations of the cavern are no more than 180 to 200 fathoms distant from the outside of the mountain, opposite to its mouth.

The inner portions of the Agtelek Cavern are warmer than the exterior, and the dry portions have a higher temperature than those traversed by running water. The thermometer indicated 8°·3 R. in the first large hall, and 10°·4 R. in the last one.

The fauna of the Baradla Cavern is rather rich, especially in insects; among them are genuine cavicolous forms; namely, two species of *Acarina* (*Hæmalastor gracilipes* and *Eschatocephalus gracilipes*, Frauenf.). Tritons are not unfrequent. The Frogs found in the cavern are probably but accidental tenants. A genus of *Hirudinidæ* (*Typhlobdella*, Kov.) is peculiar to this cavern. A lateral cave is called the "Bat-cave," on account of the enormous number of these animals found inhabiting it; so much so, indeed, that experiments have been made to use their excrement as a substitute for guano. No *Proteus* has hitherto been found in the Hungarian cavern in question. Dr. Schmidl was the first who discovered, in the soil of one of the lateral branches of the Baradla Cave, the fossil remains of *Ursus spelæus*.

* From the Proceedings of the Imperial Academy of Sciences at Vienna, October 2, 1856. Communicated by Count Marschall.

On the Australian Dugong (Halicore australis). By Mr. FAIRHOLME.

Moreton Bay, on the east coast of Australia (lat. 27° S.), is a region of great interest to the zoologist. The southern end of it is formed by two long islands, extending together about sixty miles, within which the Bay is studded with a number of beautiful islets. On the small island of St. Helena, one of those vast congregations of flying foxes takes place, which I have endeavoured to describe in a former paper.

The Dugong (*Halicore australis*) is still found there in considerable numbers, though I fear it is rapidly decreasing, as the chase of it in whale-boats manned by natives forms one of the great attractions of the Bay.

The blacks prefer the flesh and blubber to any other food, and the white people have found in its oil qualities similar to those of cod-liver oil, having used it successfully in some cases of consumption or debility. The native name for the Dugong is "Yungan." It is about 9 or 10 feet long when full-grown, and contains from five to eight gallons of oil. It feeds on a grass-like sea-weed growing on the large flats of the Bay, some parts of which are exposed at low water. As the tide recedes, the Dugongs retire into deeper water from the feeding-grounds. The natives tell us, that before white people came amongst them, and introduced boats and harpoons, they used to catch "yungan" by placing large nets across the channels through which they knew the animals would pass from the feeding-grounds. Since the establishment of a Pilot Station at Moreton Bay, the blacks have acquired great dexterity in the use of the whale-boat and harpoon, and are now constantly employed in the pursuit, either for themselves as food, or for Europeans, who collect the oil for sale. The chase is conducted with great caution and silence. The harpooner stands in the bow, and directs the steersman by the movement of the hand. As the Dugong must rise at intervals to blow, he endeavours to calculate the exact spot of rising, and launches the harpoon as it reaches the surface. Having only a short rope to the harpoon, the Dugong often drags the boat with considerable velocity, but is very soon exhausted.

The blacks have a grand feast over one, stripping off the whole of the flesh and blubber in one large sheet, leaving the carcass entire. Thus anyone wishing to procure skeletons entire could do so by going amongst the natives with a supply of tobacco and a little flour, as the Moreton Bay tribe has always been very friendly with the whites.

I regret to say that some entire skeletons which were being sent to England by a friend of mine, were placed with a large collection of shells in a vessel which was unfortunately burnt.

I have no doubt that the Dugong abounds in the bays and straits north of lat. 27°; but in none of these will the same facility be offered of procuring specimens as at Moreton Bay, where the blacks are so friendly, and are so well acquainted with the habits of this animal.—*Proc. Zool. Soc.* Nov. 11, 1856.

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VIII.—Hectocotylus-*formation in* Argonauta *and* Tremoctopus *explained by Observations on similar Formations in the Cephalopoda in general.* By Professor JAPETUS STEENSTRUP*.

[With two Plates.]

THIS memoir is to be regarded essentially only as a somewhat detailed explanation of the figures on the two accompanying plates.

The principal object of these figures is to induce naturalists to examine the animals themselves for the peculiarities to which they draw attention in a general way, rather than by their means to give an exhaustive picture of the details; it would be better to reserve the latter for such figures as might be taken from living animals or freshly-caught individuals; the present figures are therefore for the most part in outline, and only the particular parts, of which a clearer representation was desirable, have been executed more in detail.

The subject which they represent is an essential deviation from the symmetrical structure, otherwise so highly characteristic of the Cuttle-fishes, which has hitherto scarcely been observed, or, if observed, not sufficiently noticed, as we shall find that in *all male individuals* of that entire great group, one of the eight (four pairs) arms surrounding the head, on *one side* of the animal, *is not only formed differently from that on the opposite side, but is even developed in such a peculiar manner for a longer or shorter space of its*

* Kongelige Danske Videnskabernes Selskabs Skrifter, 5 Räkke, naturv. og math. Afdeling, 4 Bind. 1856. Translated from the German of Professor Troschel, in Wiegmann's Archiv, 1856, p. 211, by W. S. Dallas, F.L.S.

length on this side, that it is impossible to doubt that the arm is thereby adapted to some particular purpose, of which we cannot suppose that it is of subordinate importance to the animal, because its transformation occurs in so great a number of species of the class, and bears its peculiar characters in each natural genus.

When the metamorphosis is traced from form to form, we may see distinctly, in my opinion, that the arm with its peculiar structure enters entirely or partially into the service of reproduction, and in the first case even becomes wholly unfitted for the part which it otherwise has to play, namely to act as an organ of motion (swimming or creeping) or in the prehension of food. This metamorphosed arm consequently betrays its close alliance with the Hectocotylus-formation in the two Octopod genera *Argonauta* and *Tremoctopus*, Delle Chiaje, as the recent investigations of Filippi, Verany, Vogt, and H. Müller have placed it beyond a doubt that the *Hectocotylus* or parasitic creature found so frequently upon female Argonauts and sometimes upon female *Tremoctopodes*,—which was first regarded, in accordance with the views of Delle Chiaje, as a parasitic animal or Entozoon, but subsequently, in accordance with the sagacious combinations of Kölliker, as a metamorphosed male Cephalopod destined to lead a parasitic life upon its female,—is by no means a complete organism, but only an arm of the male Cephalopod, which, being filled with semen, separates from it and adheres to the female for the purpose of fecundation. In order to understand this Hectocotylus-formation, which during the last three or four years has attracted so much of the attention of naturalists, more correctly, and in its connexions, the observations which I here bring forward will furnish an important key; but with the interest which they possess in this respect, they also unite, as it seems to me, no small importance in a systematic point of view. The peculiarity here referred to furnishes an additional hint for the comprehension of what does and what does not belong to this class, and in many cases it gives good specific characters for the distinction of nearly allied species, without considering the value which it possesses as an external [sexual] character in individuals of the same species, especially as such characters have hitherto been missed; and these are at the same time so readily intelligible and so striking to the eye, that one can hardly help wondering that they have not previously been observed and brought into use.

After these few introductory words I pass immediately to the description of the most essential differences of form in this metamorphosis represented in the figures upon the accompanying plates, merely remarking, preliminarily, that in the order in which I state them, I have allowed myself to be guided in part by the succession in which they have occurred to me.

This, therefore, is the original reason for my commencing with the genus *Loligo,* Lamk., as I first became aware of this peculiarity by my comparative investigations of our northern species; the continuation of my investigations has, however, shown me that I may naturally start from this genus.

In the restricted genus *Loligo,* Lamk. (and therefore without the species upon which D'Orbigny subsequently founded the genus *Ommatostrephes*), all the species which I have had the opportunity of examining* have the extreme portion of the fourth left arm (ventral arm) so metamorphosed, that the acetabula or suckers, which in the opposite arm are continued quite to the apex, constantly diminishing in size, here gradually disappear; whilst the peduncles on which they are seated, on the contrary, increase in size, and become converted into long papillæ, giving the extreme part of the arm a peculiar, pectinate appearance. These papillæ always appear to be most strongly developed on the external margin of the arm, whilst those belonging to the series of acetabula on the inner† margin of the arm retain a trace of sucking-disks for a longer distance.

In the largest species of the genus *Loligo,* the so-called Atlantic form of *Loligo vulgaris,* Lamk., but which is really a distinct species, for which I have, in another memoir, proposed the name of *L. Forbesii,* Stp., the fourth left arm of the male has twenty-three pairs of acetabula regularly developed and corresponding with the suckers on the same space of the right arm; from the twenty-third pair onwards the size of the sucking-disks suddenly diminishes; and even the twenty-seventh and twenty-eighth pairs have them so small that they can only be distinctly recognized with the aid of a lens; after this the sucking-disks disappear entirely, whilst the muscular root of the peduncle becomes elevated to three or four times its ordinary height, and converted into a conical, elongated papilla. There are about forty pairs of papillæ, and therefore the same number

* Besides the Cuttle-fishes in the two museums of which I have the superintendence, or in which I am interested, namely the Zoological Museum of the University [of Copenhagen], and the Royal Museum of Natural History, I have also been enabled, by the kindness of my colleague, Professor Eschricht, to make unlimited use of the materials possessed by the Zootomical Museum of the University.

† Under the terms "inner" and "outer" margins of the dorsal and ventral arms, those will always be understood here which lie nearest to or furthest from the median plane of the animal: in the two lateral pairs of arms I employ the terms "upper" and "lower" to indicate the two corresponding margins of the arms, or the series of acetabula standing upon them.

of pairs of acetabula have been metamorphosed; they diminish in length in both rows towards the apex, but those which are placed along the outer margin of the arm are at the commencement more elongated in proportion, whilst the subsequent ones, in a certain space of the metamorphosed part of the arm, are abbreviated, and seated on its margin like small serrations (*vide* Pl. II. fig. 2*).

* The specific distinctions between *Loligo vulgaris*, Lamk., and *Loligo Forbesii*, Stp., are best derived from the size and form of the suckers on the tentacles: in *L. vulgaris* of the Mediterranean, as described and figured by D'Orbigny and Verany, and also in a form of our coasts, which may certainly be regarded as *L. vulgaris*, these are very large in the two central rows, and very small in the lateral rows, so that a transverse section of the latter is only one-half of that of the former, and their height only one-third; whilst in *L. Forbesii*, Stp., the suckers of the central rows scarcely exceed those of the lateral rows, either in transverse section or in height; and, on the whole, it appears as if the club of the tentacle had four series of suckers of equal size. In comparison with the suckers of the arms, the disks of the central rows of the tentacles in *Loligo vulgaris* are 2–3 times as large as the largest disks on the third arm, whilst in *L. Forbesii* they are scarcely one-third larger. The horny ring in the central rows of suckers in *L. vulgaris* has only one-half of its circumference finely toothed, whilst the other half is toothless, or only bears a group of 4–5 small blunt teeth (in our northern form these are indeed the only teeth on the horny ring): in *Loligo Forbesii* the ring bears numerous pointed teeth all round, and these are usually larger and smaller alternately. In this species, also, the suckers of the lateral series have the horny ring completely set with teeth of equal size, whilst in *L. vulgaris* their horny ring has high pointed teeth in the upper half, and the lower half almost toothless. In colour also, *L. Forbesii* is characterized by having the colour-sacs united into linear spots on the anterior part of the sides, and also down the ventral surface. These long, dark markings, and the nearly uniform size of the tentacular suckers, consequently distinguish this species from *L. vulgaris* at the first glance. Of both species I have only been able to examine the males on our coasts; with us, *L. Forbesii* is the largest and most common. The ordinary specimens are at least 2 feet long with the tentacles, 20 inches to the tips of the arms, 15 inches to the roots of the arms, and the mantle = 1 foot.

The figures which certainly represent *L. Forbesii* are—

Forbes and Hanley, British Mollusca, vol. i. pl. L.L.L.
Adams (H. and A.), The Genera of Recent Mollusca, pl. 4. fig. 3:

in the former place under the name of *L. vulgaris*, Lamk.; in the latter, under that of *L. magna*, Rondel.

It is also this species that I have figured in a woodcut in my memoir upon the "Sea-monk" (Sömunken); and, to judge from the suckers, it is also possibly the species represented by Borlase (Natural History of Cornwall).

As Rondelet's name "*Loligo magna*" is no systematic denomination in the Linnæan sense, this name, adopted by Leach, Gray, and others, cannot be justly regarded as prior to *L. vulgaris*, even if it cannot be abandoned for the reason adduced by D'Orbigny, because there are other *large* species; but least of all can this name be transferred to the new species, which, in the opinion of the malacologists of Southern Europe, is an Atlantic spe-

In the male of another Danish species of *Loligo*, which I regard as the *L. vulgaris* of Lamarck and the succeeding South European authors, although in particular points it does not *perfectly* agree with the more detailed descriptions, I find an accordance between the right and left arms of the fourth pair as far as the eighteenth or nineteenth pair of suckers, where a perceptible elongation of the peduncle commences. This then increases more and more towards the apex of the arm, the suckers disappearing gradually, and the peduncle remaining as a long conical papilla. The papillæ are, on the whole, rather longer and more powerful than in the preceding species, from which it also differs in having the extremely small, ringless sucking-disks visible for a somewhat longer distance, and also in that the papillæ of the inner series are the smallest at the commencement, but afterwards become the longest, especially towards the apex, where they bend inwards towards the median line of the arm, or, as it were, stretch over towards the series of the opposite side, on which the papillæ have become shorter and thicker exactly in the same proportion, and, as in the preceding species, lie along the margin of the arm like the teeth of a saw. In this species, also, about forty pairs of acetabula appear to be metamorphosed as above described.

Of *Loligo Pleii*, D'Orb., from the Antilles, the Museum unfortunately possesses only a single specimen, which has formerly been completely dried; but it is still easy to discern that in this species the transformation commences with the nineteenth pair, and becomes quite as striking as in the two preceding species.

cies, which does not occur in the Mediterranean, and could therefore hardly have been intended by Rondelet as his *L. magna*. It even appears to me on the whole very doubtful whether this was a *Loligo* at all, both when we consider the figure (*e.g.* the long tentacles), and the statement regarding the fins: "pinnulæ latiores sunt quam in Sepia, non totam alvum ambientes, et in angulum acutum in lateribus desinentes," words which are subsequently more exactly explained by the statement regarding the fins of *Sepiola*, as to which he says: "nec figura nec situ pinnis Sepiarum et Loliginum similis, neque enim angusta longaque totam alvum ambit, ut in Sepiis, neque lata et in acutum angulum terminatur, ut in Loliginibus, sed rotunda, parva, utrinque veluti adnata modicam alvi partem occupat, neque ad extremum usque corporis protensa" (p. 250). All this is indicative of *Ommatostrephes*, to which the words "corpore in acutum desinente" are also more suitable than to *Loligo*, even when they are employed in opposition to the body of *Sepia*.

To this, the largest species of our European seas, and also the species upon which I first observed the remarkable metamorphosis of the arm in the male, I have given the name of *Loligo Forbesii*, after Professor Edward Forbes. By this I have wished to keep in remembrance not only that this species is represented in his excellent work above mentioned, but also the services done by this extraordinarily endowed man to natural history in general and to the knowledge of marine animals in particular.

In other species of *Loligo* both series of acetabula at the apex of the arm are not so uniformly subjected to this metamorphosis, but only one series furnishes the above-mentioned papillæ. Amongst the species which I have had the opportunity of examining, this is the case especially in two from the coast of Brazil, namely *L. brasiliensis*, Bl. and *L. brevis*, Bl., together with a species which agrees well with D'Orbigny's description of his *L. gahi*, and which is therefore probably derived from the Pacific Ocean.

Of the last-mentioned species the arm is represented in fig. 3. The left arm is normally constructed as far as the fourteenth acetabulum, after which the peduncles in the outer row of suckers begin to be disproportionately elongated, but still bear small sucking-disks, provided with horny rings, as far as the twenty-second pair, at which the peduncle is quite papilliform, as are all the other peduncles (about twenty-six) which follow it up to the apex; under a strong magnifying power, however, we may still discern a small puncture at the tip of each papilla,—the last indication of the sucking-disk. In the inner row the sucking-disks are continued, with distinct horny rings, nearly to the apex of the arm (at least they may be traced almost to this with a lens), but they are elevated upon peduncles, which constantly rise higher and higher, so that they completely overtop the papillæ of the opposite side. It may also be remarked, that on the inside of each papilla a membranous comb or lobe runs down to the median line of the arm, and thence extends in an oblique direction (for it is well known that the suckers are placed alternately in the two rows) in the form of a similar membranous comb towards the inside of each acetabular peduncle on the opposite side. The development of these membranous lobes commences as early as the fourteenth pair*.

In *Loligo brevis*, Bl., things are essentially the same; the differences appear to me to be that the sucking-disks which persist as far as the apex in the inner series, are not borne upon quite such long peduncles; that the papillæ, which are very long, especially at their commencement, only make their appearance at the twentieth pair; and that the membranous comb is less developed, although always perceptible.

Loligo brasiliensis, Bl., of which the Museum possesses two male specimens from Rio, has both series of acetabula on the left ventral arm regularly developed as far as the fourteenth pair, and the inner row continues essentially in the same way up to the apex (with thirty-five pairs); in the outer series the acetabula diminish rapidly in size, four still exhibiting the sucking-disk

* From their minuteness, no representation of these membranous lobes could be given.

distinctly, and with a slightly developed horny ring; from this point papillæ, which are very low, but tolerably thick at the root, follow to the apex.

In the above-mentioned six species no striking difference exists between the left and right ventral arms below that part of the arm which has entered into this remarkable metamorphosis; but in *Loligo media*, Linn., which is destitute of acetabula on the oral lobes (*Mundfligene*), and which has therefore been raised by Gray to the rank of a distinct genus under the scarcely admissible name of *Teuthis**, this is, on the contrary, the case (fig.1); the left arm below this part, which in other respects does not differ remarkably from that described in *L. Forbesii* and *L. vulgaris*, being completely armed with very small suckers, whilst the right arm bears large ones. The external sexual distinction between males and females is consequently even greater here than in any of the other species, and we may therefore the more easily settle the dispute between D'Orbigny and Verany with regard to the relation of this species to the *L. Marmoræ* established by the last-mentioned writer. Both in his great work on the Cephalopoda, published in conjunction with Férussac, and in his 'Mollusques vivants et fossiles,' D'Orbigny asserts that the females of our species are the short-finned forms which Verany has called *L. Marmoræ*, and the males, on the other hand, the long-finned forms named *L. subulata* by Lamarck; but this assertion is proved to be quite incorrect by the above-mentioned sexual distinctions, as males and females occur of both these forms, and of all intermediate steps between them. Consequently, I cannot give my adhesion to D'Orbigny's opinion; but neither can I, with Verany, regard these two forms as distinct species, as, in a series of thirteen individuals, I not only find all the intermediate forms, but also a determinate proportion between the prolongation of the abdomen and the fins and the entire bulk of the animal; for which reason I cannot but incline to regard these external differences of form as indications of a more or less complete growth, and therefore the above-mentioned species as forms differing in age.

As the seven species above mentioned represent the genus *Loligo*, not only in all its essential forms, but also in all its different ranges of distribution, I do not think that it can be regarded as an unfounded assumption, that the fourth left arm (ventral arm) will be found metamorphosed in a similar way,

* Gray and Adams, who adduce Aristotle as the authority for the genus (*loc. cit.*), must certainly have forgotten, both that it is difficult, and one might almost say, impossible, at this moment to decide what Aristotle meant by his *Teuthis*, and also that Linnæus has long since applied the generic name of *Teuthis* to a fish.

and furnished with papillæ for a part of its length, in all the species of the genus.

The genus *Sepioteuthis*, Bl., stands so close to *Loligo* in every respect, that, with many naturalists, it can hardly establish its right to subsist as a distinct genus; it was therefore to be expected that it would also approach the species of *Loligo* in the form of the reproductive organs. This, indeed, it appears to do, so far as can be judged from the single species of which I have had the opportunity of examining a great many specimens, namely *Sepioteuthis sepioidea*, Bl., from the Antilles*. As shown by fig. 4, the left ventral arm is actually metamorphosed analogously to that of the *Loligines*, but still with its peculiar character, the peduncles in the outer row of suckers being transformed into compressed leaf-like papillæ, united by a membranous bridge with the roots of the peduncles in the opposite row, which are transformed into blunt elevations. The metamorphosis commences at about the thirtieth sucker, and embraces about twenty-eight pairs of acetabula. It must also be indicated that the right ventral arm of the male *Sepioteuthis* differs remarkably from that of the female, as its extreme third is covered with acetabula so small as to be scarcely visible, and it is therefore to be supposed that in the genus *Sepioteuthis* the right arm assists the left in the part which it has to play.

With the genera *Loligo* and *Sepioteuthis*, which, according to D'Orbigny, form a group by themselves, I associate another genus, established upon two small Cephalopoda, which so strongly resemble certain small *Loligines* (e. g. *L. brevipinna*, Les.) in form, that I should not be surprised if they were nearly allied forms which have been described under this name. They nevertheless form a very characteristic small genus, which, in my opinion, must be placed close to *Loligo*, although it is destitute of one of the characters hitherto regarded as essential to the *Loligo*-group, namely muscular cords on the funnel; and in this respect the species approach the group of *Sepiola* and *Rossia*, as also in the structure of the acetabula, as these have not the small elevated band all round the horny ring, which always occurs in *Loligo* and *Sepioteuthis*. But in all other respects they appear to me to be true *Loligines*. To keep this near relationship in mind, I have formerly named this genus *Loliolus*; this name being a diminutive of "Lolius," from which, according to Gaza, *Loligo* is derived. In both the species of *Loliolus*, the

* Of the other species of the genus, which are all derived from the Indian Ocean and its large gulfs, I have been unable to examine any males. I may take this opportunity to remark, that I have not yet made use of any of the material obtained by the expedition of the 'Galathea' in this investigation.

males of which are represented in figs. 5 & 6, and which are easily distinguished from each other by the different size of the acetabula on the second and third arms, the left ventral arm is also metamorphosed, but in a far higher degree than in the two preceding genera, as throughout its whole length it has not the least trace of a sucker, the surface on which the suckers should be situated being even converted into a compressed, obtusely-toothed edge; we find that all the teeth of this edge are produced from the fused bases of the peduncles of the inner series of acetabula, whilst of those of the other row scarcely the smallest trace is left. Fig. 5' represents the left ventral arm of *Loliolus typus*, Stp., seen from the outer side, and somewhat enlarged; the small projecting points are the only traces of the suckers and peduncles of the outer series. Fig. 6' represents the same arm of *Loliolus affinis*, Stp., also magnified; on this I have been quite unable to find any such points, but cannot assert that they are entirely wanting, as the specimen is unfortunately rather flabby. The number of metamorphosed suckers may have been about twenty-six in the former and twenty in the latter, to judge from the number of the teeth*.

With D'Orbigny, as is well known, the genus *Sepia* belongs to quite a different group from the preceding genera; but still, in this genus, it is the same pair of arms which presents the want of symmetry in the male individuals, and the arm of the same side which is metamorphosed, but instead of the apex or apical half of the arm being the seat of the transformation, it is here the basal part or the lower half.

Thus, if we compare the right and left ventral arms in a male *Sepia officinalis*, Linn., we shall see at once, that the lowest fourth part of the left arm (as shown in fig. 7) has a peculiar appearance. Whilst the right arm has large and perfect acetabula, which follow each other in four complete rows, and increase in size from the apex of the arm inwards towards its base, the above-mentioned part of the left arm has only the two or three lowermost suckers in each row normally developed, whilst the seven or eight following suckers in each row have either become

* For the more exact determination of the species, I may also state that both have a broad, free, internal gladius, which has the greatest resemblance in form to those of *Loligo brevis* and *L. brevipinna*, figured by D'Orbigny, tab. 13. fig. 6, and tab. 15. fig. 3. In the species of *Loliolus*, however, the lamina is perhaps rather broader in proportion to the shaft; the shaft has a sharp keel in *L. typus*, whilst both males and females of *L. affinis* have the shaft rather broader, and with a more rounded back. I have no indication of locality for my *Loliolus typus*; *Loliolus affinis* occurred in a glass marked "Captured by Governor Christensen on the voyage from the Cape to Tranquebar," so that it is an inhabitant of the Indian Ocean. There were two specimens, male and female.

very small or almost entirely evanescent. The former is the case with the two innermost rows, in which the acetabula are extremely low, being scarcely one-sixth of the usual height of the suckers, whilst they are still about a third of their diameter, so that they sit like small depressed saucers fixed on a short thin stalk of the inner surface of the arm; the latter, on the contrary, occurs in the two upper rows placed towards the back of the animal, the suckers of which are so small that they may be easily overlooked, when we have not large individuals to examine. On a Cuttle-fish of 11 inches in length they are scarcely more than 0·5 millim. in diameter, and their height is far less. The transformation of the arm, however, does not consist only in the retrogression of these acetabula; this, in reality, only becomes very striking by the coincidence of two other modifications. Thus the arm becomes much broader at the above-mentioned part, not only by the space between the three upper series of acetabula becoming larger, by which these, so extremely small in themselves, being removed to a greater distance apart, must appear even still more inconsiderable, but also by the membranous border, which runs along the outer row of acetabula, and which is rather narrow on the rest of the arm, being considerably developed here, and becoming nearly as broad as the surface of the arm. Then the muscular parts, which, as it were, constitute the roots of the peduncles of the suckers, or from which these peduncles, as it were, originate, have been developed in a peculiar way, becoming elevated, lying like oblique beams across the arm, and partially crossing amongst themselves, by which means a quantity of pits are produced, which are particularly deep towards the upper margin. Lastly, in these pits and on the partitions which separate them, the skin has everywhere folded itself into elevated, thin, membranous laminæ, which run together into a reticulated form, and give the whole surface of this part of the arm a certain resemblance to the inside of a calf's stomach. This pitted and reticulated structure of the surface, which particularly assists the suckers in escaping from the eye, does not confine itself entirely to the true upper surface of the arm, where it is strongest between the two outer rows of suckers, but also extends itself over the corresponding portion of the lateral margin of the arm. It can hardly be doubted that this peculiar structure has for its object a considerable secretion of mucus; but the elucidation of the particular way in which the transference of the seminal mass to the female can thereby be assisted, must be left for future investigations. The tenth or eleventh sucker in each of the four rows makes its appearance suddenly, with its proper size and shape, and from thence to the apex there is no perceptible difference between this arm and that of the opposite side, or between the arms of the male and female.

In *Sepia inermis,* Van Hasselt, from the Indian Ocean, of which the Museum only possesses one male specimen, and this a small one, of hardly 4 inches in length, I find this peculiarity still more remarkably developed. The lower half of the arm (see Pl. II. fig. 8) possesses no suckers at all, but its whole breadth is metamorphosed in the same way as the outer side of the corresponding portion of the arm in *Sepia officinalis,* a number of pits being arranged distinctly enough in rows by more prominent folds of skin, which pass transversely across the arm. The strongest transverse folds appear to indicate the position of the muscular parts, to which the peduncles of the acetabula are attached; and from their number, we may suppose that about twenty transverse rows of suckers have disappeared. Both margins of the arm have a tendency to fold together, and thus, as it were, to form a very long sucking or grasping plate. The specimen referred to, from which fig. 8 is drawn, was unfortunately somewhat flabby, and not very well preserved; a better-preserved specimen may perhaps exhibit a trace of the suckers, the existence of which I have thought myself compelled to deny. At any rate, this structure, in an Indian species of *Sepia,* renders it probable that the peculiarities above described in *Sepia officinalis* do not occur in this species alone, but that we have in this case to do with a phænomenon occurring in the whole genus *Sepia.*

Of three other species of this genus I only possess female specimens; and in these, as in the females of the two preceding species, the four series of suckers pass up to the base of the arm, constantly increasing in size.

With the genus *Sepia,* D'Orbigny groups the two principal genera of the small shore Cuttle-fish,—*Sepiola,* Leach, and *Rossia,* Owen; but, as regards the peculiarities of the arms, which we are investigating here, they are widely separated from each other, as the following will show at once.

In a male *Sepiola Rondeletii,* D'Orb., I found the following peculiarities. Of the first, or dorsal pair of arms, that of the right side bore very small suckers in two rows up to the apex; and these, which became smaller quite regularly upwards, did not attain one-fourth of the size of the large globular acetabula which are found on the second and fourth pairs of arms, especially on their middle portion; in this they agreed with the suckers of the third pair. In this unequal development of the acetabula this male *Sepiola* of mine also agrees with fig. 5 of the first plate of *Sepiola* in the great work of Férussac and D'Orbigny. The arm on the left side, however, differed not only from that opposite to it, but also from all the other arms of the animal, as it was, so to speak, inflated in a peculiar way through its whole length, as shown in my fig. 9. On a closer examination, it appeared that the cause of this inflated state was, that the otherwise spherical peduncles of the suckers had become much elongated and cylindrical, and amalgamated together; with the obtuse apices of these cylinders, the suckers are united by such thin and short filaments, that they almost appear as if they were sessile; their diameter is the same as that of their cylinders, so that they nearly touch each other with their outer margins. This applies especially to the inner row of suckers, which exceed those of the outer row in size, and project beyond them, as is shown more distinctly by fig. 9″, which represents this arm seen from the ventral side, and fig. 9‴, which exhibits two of the suckers in both rows more strongly magnified. The first-mentioned figure also shows a remarkable dilatation of the skin developed at the base of the inner surface of the arm, strongly provided with muscles, and thus rendered capable of dilating itself towards the sides and folding itself together, so that it appears able to act as a prehensile apparatus or forceps. It is here represented with the margins rolled together in the nozzle-like form which it had in the spirit specimen. Below this nozzle (*Dille*) there are seated four small suckers of the size and form of those situated at the base of the other arms, from which we see that this dilatation of the skin occupies the same position on the arm as the dilatation on the arm of the *Sepiæ*; and that this apparatus has essentially the same import as the above-described part in the genus *Sepia*, I cannot doubt. I have already mentioned that fig. 5 on the first plate in Férussac and D'Orbigny best represents my male *Sepiola* as regards the general habit and the strong spherical acetabula on the second and fourth pairs of arms. I will now request that this figure may be compared with mine in regard to the structure of the left dorsal arm, and it will certainly be admitted that it is probable that the peculiar form which this arm has received in the figure must be founded upon such a structure as that which I have here described. As all my females had small suckers where the male possessed the large ones, and had the right and left dorsal arms equally developed, so as to correspond with the other figures which D'Orbigny has given of the species, I naturally regard the often-mentioned fig. 5 as representing a *male*, and not an individual with a morbid or monstrous development, as D'Orbigny explains this figure of his*. I also possess another male *Sepiola*

* At p. 237 of his continuation of Férussac's great work on the Cephalopoda (Histoire naturelle et particulière des Mollusques), D'Orbigny says of *Sepiola atlantica*:—"Cette espèce, de même que la *Sepiola Rondeletii*,

from the Mediterranean, which belongs to the same group as *S. Rondeletii*, as it has only two rows of acetabula on each arm; its second and fourth arms also bear large and spherical suckers, and its left dorsal arm is metamorphosed in an exactly analogous manner with that of the preceding, from which, however, it is distinguished by the suckers being larger in proportion at the lower part of this arm, and diminishing more suddenly towards the end of the arm; they are at the same time rather more pedunculate, and the basal parts of these peduncles are not so strongly amalgamated. The peculiar prehensile part at the root is also less developed.

In the genus *Rossia*, so nearly allied to *Sepiola*, it was to be expected that the behaviour of the arm would be the same. I find that this is actually the case as regards the *pair* to which the metamorphosed arm belongs, but the metamorphosis itself is very different. Unfortunately I possess no male of the true European species, but, on the other hand, I have examined five male individuals of the genus *Rossia* from the coast of Greenland. These five individuals decidedly belong to two different species, but they all agree with each other, and differ from the female individuals, both of the European and Greenland species, which I have been able to examine, in that the three lower pairs of arms, the second, third and fourth pairs, bear considerably larger suckers than the first pair, or the dorsal arms, whilst in the females this pair does not bear perceptibly smaller suckers than the rest; and also that the same first pair, *the right and left arms*, has the outer row of these suckers, for nearly two-thirds of the length of the arm, standing upon high peduncles, the roots of which are uncommonly strongly developed, compressed, and, in the soft state, almost leaf-like; between these peculiar peduncles we see folds of skin insert themselves, and other similar folds of skin issue from the roots of the peduncles. (Pl. III. fig. 1.) These remarkable folds of skin, on closer examination, prove to be only luxuriant developments of the ridges of skin which in the *Rossiæ* surround the base or the peduncle of the individual acetabula like cups, as is the case also partially in *Sepiola*,—cutaneous formations to which sufficient attention has perhaps not been paid hitherto, but which possibly correspond

est assez sujette à une maladie qui consiste en une durcissement et une croissance beaucoup plus grande des cupules des bras sessiles, qui deviennent quatre fois aussi gros que les autres, sans que leur cercle corné suive la même proportion. Cette affection allonge les bras, les fait gonfler, ou les rend souvent difformes." Of *Sepiola Rondeletii*, also, he says, in the explanation of figures, p. 233, and indeed with reference to the very figures (5 & 6) which I have mentioned above as unmistakeably resembling my figure:—"Fig. 5, Individu malade; ses cupules devenues plus grosses et plus durs. Fig. 6, Portion de bras affecté de la maladie indiquée."

with those which D'Orbigny has described after Tilesius in *Sepiola japonica,* Til. About eleven acetabula are thus strongly elevated on the outer side of the right and left arms, whilst the remaining suckers are borne upon lower peduncles, which, however, agree essentially with the others. As the so-called "covering membrane" (*Deckhaut*) of the acetabula, which I have called the lateral border of the arm in the preceding, is very strong and broad on the outer side of the arm *before* these eleven suckers, and the above-mentioned folds of skin are continued upon it, some similarity is produced between this development and that which we met with in *Sepia,* just as we have here the metamorphosis in the lower part of the arm, or principally in it. Lastly, it must also be observed, that in all the five individuals both arms are so obliquely twisted inwards, that it is evident a cooperation between the outer side of both arms is facilitated thereby. These two species are probably amongst the largest in the genus, as they are of equal size with *R. palpebrosa,* Owen, with which one must, in my opinion, be identical*, but there is scarcely sufficient reason for supposing that the smaller species would not exhibit peculiarities agreeing with these†.

* The two species are easily distinguished from each other, as one has extremely small suckers on the clubs of the tentacles, as is the case, according to Owen's description and figure, in *Rossia palpebrosa* ♀, whilst both males and females of the other species have very large suckers on the clubs; the middle row of these considerably exceeds the large spherical suckers of the arms in size, by which peculiarity this species also differs notably from all other described species. To this remarkable form I have given the name of *Rossia Mölleri,* Stp., after our late countryman, H. C. Möller, who has done such service to the Molluscan fauna of Greenland. The two dorsal arms, Pl. III. fig. 1, are drawn from the male of this *R. Mölleri.*

Induced by this and several other additions to the fauna of Greenland, which will be referred to in this memoir, I seize the opportunity of reminding the reader, that both the original collection which served Möller as the foundation for his "Index Molluscorum Grœnlandiæ," and also his subsequent collections for a more complete elaboration of this work, have been presented to the Zoological Museum of the University by his father, and that an enlarged and more complete edition of Möller's Index, with original figures, is being prepared by M. O. Mörch, principally with the aid of the above-mentioned material.

† I make this remark with reference to a peculiarity in the remarkable *Rossia dispar,* Rüpp., noticed incidentally in Verany's work on the Cephalopoda of the Mediterranean. In this small species, which was first recognized by its disproportionately large suckers on the uppermost lateral arms (see Verany, *l. c.* tab. 23 *d, f, g, h*), for which Gray also has formed a separate genus under the name of *Heteroteuthis,* according to a letter to the author from Dr. Krohn, all the individuals furnished with these large suckers have proved to be females; whilst of another form, agreeing with this in other respects, but destitute of the large acetabula, and for which the name of *Rossia affinis* was thought of, only males have been met with.

The genus *Ommatostrephes,* D'Orb., formed of those species of the older genus *Loligo,* in which the eyes are uncovered by the general integument, and the structure differs in many other respects from that of the species of *Loligo* in the narrower sense; the genus *Onychoteuthis,* Lichtst., with its subgenus *Gonatus,* Gray; and the genus *Loligopsis* as it was peculiarly understood by Férussac and D'Orbigny, which does not appear to stand in connexion with the Cephalopoda upon which Lamarck originally founded his genus *Loligopsis,*—do not present the same differences in the structure of a single pair of arms in the male individuals. Nevertheless, important external differences between the males and females are not wanting, as appears even from Verany's description and figure of the two sexes of *Omm. sagittatus,* Lamk., and as I can confirm from the examination of both sexes from the Mediterranean. It is, however, not only the comparatively much shorter body and the much longer and stronger arms which distinguish the males from the females, but there is also the remarkable difference, which Verany has overlooked, that in the male both the lateral arms bear suckers several times larger than those of the ventral and dorsal arms, whilst in the females the suckers of the lateral arms do not greatly exceed these in size. In these forms, therefore, I by no means doubt the existence of external sexual distinctions, but only that of a less symmetrical development of one of the pairs of arms with reference to reproduction. In connexion with this, however, I must expressly observe, that although I have had the opportunity of seeing a considerable number of species,—and namely no less than six* of the so-called "*Loligopsides,*" which as a group I

Under the supposition that this observation is correct (?), it remains a question whether these males do not exhibit the dorsal pair, in the first place, with smaller suckers than the other three pairs of arms, and in the second, analogous to the arms in the above-mentioned three species. It requires a closer investigation to determine whether the two *Rossiæ* from the Irish coast, described by Ball, *R. Owenii* and *R. Jacobii,* of which the latter is referred to *R. macrosoma* by Forbes and Hanley, are not in the relation to each other of males and females of the same species; at least the former agrees, in the characters of the suckers, with my males, and the latter with my females. See the figures of these two species in Forbes and Hanley, plates N. N. N. and S. S. S.

* As this group still contains so few species in the system, and as these Cuttle-fishes are very rare in general in museums, it will hardly be superfluous to refer to this number. The six species above mentioned are all Atlantic; two of them are very small species of the genus *Chiroteuthis,* D'Orbigny, with much resemblance to the *Lol. zygæna,* Ver., described in Verany's work, and figured on pl. 40, and to *Lol. vermicularis,* Rüpp.; two others are also small species, but belong to the genus *Leachia,* Les., one of which is the *Cranchia* (*Owenia*) *megalops,* described by Prosch in the Memoirs of this Society; and a second remarkable species, to which I have given the name of *L. Reinhardtii,* and which is distinguished from all

would prefer naming *Hyaloteuthiæ* or *Medusoteuthiæ*; of the *Onychoteuthis* group, two, and of the genus *Ommatostrephes*, five species,—yet I have only had a considerable number of individuals of each sex for examination in very few species, namely in one of each of the last-mentioned genera; so that it is not impossible that an observer more fortunately situated in this respect, and especially one residing on the Mediterranean, might ascertain what I have been unable to discover. In this case, however, the metamorphosis will certainly be confined to an extremely small part of the arm*.

From the remarkable forms which, as we have seen, are acquired by a particular arm in most of the male Cephalopoda of the order *Decapoda*, this being peculiarly developed for a particular object, let us now turn to the *Octopoda*. If we have been unable to repress the feeling that this remarkable development very closely represents the Hectocotylus-formation in the genera *Argonauta* and *Tremoctopus* among the latter, it is natural that we should seek to discover a trace of the same formation in the other genera of the Octopod Cephalopoda, in order, in this way, by closer transitions, to give greater probability to this idea.

When we investigate the series of the species of the genus *Octopus* itself, and at the same time compare their external structure, we find that the arm, which is "hectocotylized" in the two genera above mentioned—which, as is well known, is the

the previously described species by its strong armature of cartilaginous bands on the mantle. Besides a toothed cartilaginous band down the median line of the back, it has on each side of the body two other toothed cartilaginous bands or ribs, which meet at an acute angle exactly at the points where the mantle is united with the funnel on each side; the proportions of the arms are 3, 2, 4, 1, and they only bear two series of suckers; the tentacles have four rows of suckers on the outer third, which are continued in a scattered arrangement over the middle third; the fins are terminal, small and roundish. Lastly, I have a large and very important species of the same genus from North Greenland, *Leachia hyperborea*, Stp., which is distinguished from *L. pavo*, Les., with which it appears to be most nearly allied, by the length of the fins, which are very narrow, follow the sides of the body for half their length, and together form a lanceolate figure; by the different comparative lengths of the arms, which are 3, 2, 1, 4; and by the considerable size of the acetabula and the shortness of the tentacles, which are only twice as long as the true arms. These new species, with several other Cuttle-fishes of the Atlantic, are destined to form the subject of a future memoir. The sixth species is an imperfect *Histioteuthis*, D'Orb.

* In my two male *Ommatostrephes*, Lamk., one of the ventral arms does, indeed, exhibit a peculiar form at the apex, which might indicate such a metamorphosis; but as in one individual it is the left and in the other the right arm, and as both appear to have been slightly injured at this place during life, I could not regard this as normal, especially as I could find nothing similar in male *Ommatostrephes* of other species.

third arm on the right (*Tremoctopus*) or left (*Argonauta*) side of the animal,—is also formed differently to the other arms in the genus *Octopus*, and in this case it is always the arm on the right side which has become transformed. This arm is always shorter than the left one, even to a considerable extent, as its length in different species is only one-half to three-fourths of that of the latter; and as, besides this, it not only often retains the same thickness, but is even more muscular in its outer half, it has frequently a more powerful appearance. It bears far fewer acetabula than the left arm, and is furnished externally at the apex with a peculiar, usually longish plate, which is provided, in most species, with a greater or less number of transverse wrinkles or ribs with intervening pits. This plate is also connected with the swimming-membrane at the base of the arm by the agency of a muscular border of skin, which runs down along the dorsal margin of the arm, and this border is very often found with its free margin rolled up towards the inner side of the arm, by which a more or less closed canal is formed, which is undoubtedly destined to conduct the spermatophora to the apical plate of the arm. As this canal or semicanal is destitute of chromatophora on the inside, and perfectly white in most species, I conclude that in the living animal this membranous margin will in general be bent towards the side of the arm, as was seen in most of the spirit specimens.

This is the case at least in *Octopus grœnlandicus*, Dewhurst (= *O. arcticus*, Prosch), in five males of which I find only 41–43 acetabula on the right arm of the third pair (whilst on the corresponding left arm I find 74–79), a spoon-shaped prehensile plate furnished with 13–17 transverse ribs at its apex, and a cutaneous margin which extends from the latter to the middle of the connecting membrane between the third and fourth arms, where the semicanal or groove, formed by this margin, also suddenly ceases. Fig. 2, on Pl. III., which is of the natural size, is intended to assist the comprehension of this peculiarity: *a* is the grasping-plate, as I have called it, separated from the sucker-bearing part of the arm by a high angular fold of skin (*d*); *b*, *b* is the membranous border; and *c*, the place where it commences or terminates at the margin of the swimming-membrane*. In one specimen, a seminal capsule or spermatophore projected from the funnel, and was probably on the way towards this membranous border, to which it is most likely conveyed by the upper extremity of the funnel simply laying itself against the commencement of the fold of skin.

* The sucking-disks on all the true arms are of about the same size; their appearing larger on the first pair in the figure is owing to the direction in which they were seen by the artist.

In a male specimen of *Octopus macropus*, Risso, or *O. Cuvieri*, D'Orb., collected by Professor Eschricht near Cette, and now handed over to the Zoological Museum of the University, I find the characters so far in agreement with those of *O. Grœnlandicus*, that here also the right arm of the third pair is much shorter than the left one,—the former being not quite 10 inches, whilst the latter is nearly 20 inches in length; and the right arm is at the same time dilated at the apex into a muscular plate of 13 mill. in length, but narrow, which bears no suckers, and is separated from the sucker-bearing part of the arm by an elevated fold. Although the specimen was somewhat flaccid, a tendency of the margins of the terminal plate to bend together like a grasping apparatus was recognized; but no transverse elevations were to be seen, perhaps only in consequence of the above-mentioned state of preservation. Below this grasping-plate the arm was of the regular construction, with the exception of its stronger muscularity and greater thickness, and the muscular border down the side of the arm.

Another species of *Octopus*, also a native of the Mediterranean, but which I can by no means regard as a small *O. vulgaris*, exhibits essentially the same character: the arm is represented of half the natural size, with the border unfolded, in Plate III. fig. 3. The number of transverse ribs in the grasping-plate is 17.

Besides several species of *Octopus*, the determination of which I have found impossible from the want of materials for comparison, I have also examined several male individuals of *O. rugosus*, Bosc, from the West Indies, likewise a great number of males of *O. vulgaris*, Lamk., from the Mediterranean, and a male *Octopus* from the coast of Chili, which, from the considerable size of some particular pairs of suckers on the lateral arms, appears to be the well-known *O. Fontanianus*, D'Orb., of that coast. In all of these I have found that this right arm has a muscular fold of skin along its inner or lower side, destined to form a canal or semicanal for the passage of spermatophora, and that it is furnished at the extremity with a small sucker-like dilatation, which, however, is so inconsiderable that it may easily escape observation, whilst the arm itself is sufficiently distinguished from the opposite one by the above-mentioned rolled-up fold of skin, and by its abbreviation, although it is not thicker, as in the other forms, but appears thinner and more pointed in its outer half than the other arms. I must therefore assume, that in all species of *Octopus*, without exception, this third arm on the right side is destined for the conveyance of spermatophora.

I must add, particularly, with regard to *Octopus vulgaris*, Lamk., that five uncommonly large male individuals examined by me all have the fourteenth, fifteenth, or sixteenth sucker on their lateral arms, of a very disproportionate size, and that the uppermost pair of these lateral arms also usually had the suckers in the neighbourhood of this large sucker of nearly the same size, whilst in only one of these specimens there was a tendency to develope two such sucking-disks on the lowest lateral pair, or the so-called third pair of arms. At the same time the third right arm was about a foot shorter than the left one, but also distinctly thinner in its outer half, and it had the pointed terminal surface at the extremity; the fold of skin, which is very white on the surface turned inwards, gives the arm an appearance as if the side of the arm were divided into two parts by a longitudinal cleft*. In no female, although even here the

* The characters which I have here indicated, namely the pointed form of the arm, the strong cutaneous fold along the dorsal part of the arm, the distinct white colour of the inside of this fold, its rolling towards the side of the arm, from which it only appears to be separated by a deep crack or furrow, and indeed from the very apex, and lastly, the above-mentioned large sucking-disks on the two lateral pairs of arms, and even on the arm which assists in reproduction, enable us to understand three passages in Aristotle, which have not hitherto been perfectly intelligible to philologists and zoologists. These passages show us, that in the common *Octopus* of the Mediterranean, his *Polypus*, Aristotle not only knew of this peculiar form in the one arm, but was also aware that it stood in connexion with reproduction, although he distinctly asserted that the semen was not conducted through the arm.

In one place, Aristotle says very briefly, regarding his *Polypus*: *Διαφέρει δὲ ὁ ἄῤῥην τῆς θηλείας τῷ τε τὴν κεφαλὴν ἔχειν προμηκεστέραν, καὶ τὸ καλούμενον ὑπὸ τῶν ἁλιέων αἰδοῖον ἐν τῇ πλεκτάνῃ λευκόν* (lib. v. c. 10. 1, edit. Schneider, p. 196), which must be translated: "differt mas a fœmina eo, quod habet caput (*i. e.* abdomen) oblongius, et *genitale*, quod a piscatoribus vocatur, *in brachio album.*" This expression refers, in the first place, to that employed in another passage in the same book (lib. v. c. 6. 1. p. 188), wherein it is stated more in detail—*Φασί δέ τινες καὶ τὸν ἄῤῥενα ἔχειν αἰδοιῶδές τι ἐν μιᾷ τῶν πλεκτανῶν, ἐν ᾗ δύο αἱ μέγισται κοτυληδόνες εἰσίν· εἶναι δὲ τὸ τοιοῦτον ὥσπερ νευρῶδες μέχρι εἰς μέσην τὴν πλεκτάνην προσπεφυκὸς, ἅπαν τε (εἰσαφιέναι) εἰς τὸν μυκτῆρα θηλείας*—that is to say, "aiunt nonnulli, marem in uno brachiorum, in quo sunt duo maxima acetabula, quoddam genitali simile habere, idem esse quasi nervosum, usque ad medium brachium adnatum, et totum in narem (fistulam) fœminæ inseri." It also refers, as we now certainly find, to the more exact description of the arm in the fourth book: *Ὁ μὲν οὖν πολύπους καὶ ὡς ποσὶ καὶ ὡς χερσὶ χρῆται ταῖς πλεκτάναις· προσάγεται δὲ ταῖς δυσὶ ταῖς ὑπὲρ τοῦ στόματος, τῇ δ' ἐσχάτῃ τῶν πλεκτανῶν, ἥ ἐστιν ὀξυτάτη τε καὶ μόνη παράλευκος αὐτῶν καὶ ἐξ ἄκρου δικρόα (ἔστι δὲ αὕτη ἐπὶ τῇ ῥάχει· καλεῖται δὲ ῥάχις τὸ λεῖον, οὗ πρόσω αἱ κοτυληδόνες εἰσί·) ταύτῃ δὲ τῇ πλεκτάνῃ χρῆται ἐν ταῖς ὀχείαις* (lib. iv. 1. 6. p. 131)—that is, "polypus vero brachiis et ut pedibus et ut manibus utitur, nam duobus, quæ supra os habet, admovet ori cibum, extremo autem brachiorum, quod est acutissimum et solum eorum ex parte candidum et cui ab apice fissura (est autem hæc in spina: spina vero vocatur pars lævis brachii, e cujus latere anteriore acetabula sunt)—hoc brachio in coitu utitur."

That in the above words Aristotle referred to such a formation as I have lateral arms were unmistakeably the largest, did I find such large suckers.

This equipment of the males of *Octopus vulgaris* with isolated suckers of remarkable size on certain arms, induces me not to quit the genus *Octopus* without calling attention to the fact that the above-mentioned *O. Fontanianus*, D'Orb., which, according to D'Orbigny, is the only species hitherto observed on the coast

described above in *Octopus*, and especially in *O. vulgaris*, hardly requires to be more exactly indicated, and it is nothing but a want of acquaintance therewith that has led naturalists astray, when they have asserted that Aristotle had some knowledge of the remarkable peculiarities discovered within the last few years in *Argonauta* and *Tremoctopus* (see Von Siebold, Zeitschr. für wiss. Zool. 1853, p. 122-124; Roulin, Ann. Sc. Nat. 1852, xvii. p. 191; Owen, Lectures on Comp. Anat. 1855, p. 634†). Aristotle's sources of information were evidently the fishermen of the Mediterranean; these perhaps still know the mode of reproduction of the Octopods, although it is certainly very remarkable that the naturalists who have occupied themselves so much with the Cuttle-fishes of the Mediterranean, especially of late years, should have learnt nothing about it. Pliny appears to me only to have known the traditions of the celebrated Greek philosopher and naturalist; he calls the arms of the Cephalopoda, pediculi, cirri, crines, brachia, and has the following passage regarding their employment in the service of reproduction in the *Polypus* or *Octopus*: "Omnes brachiis, ut pedibus ac manibus, utuntur; cauda vero, quæ est bisulca et acuta, in coitu" (lib. ix. 46); and "polypi (coeunt) crine uno fœminæ naribus annexo" (lib. x. 74).

Rondelet, with whom, as with his contemporary, Gesner, Aristotle is a principal source of information, and with whom the interpretation of the Greek text is an important matter, expresses himself as follows upon the above-mentioned statements of Aristotle: "Sed hæc somnia esse, anatome certo demonstrat. Mihi sæpius polypos dissecanti nunquam visa sunt acetabula ista majora in uno brachio quam in alio, præterquam in primo et maximo polyporum genere, *in quo non duo in uno brachio sed quatuor in quatuor brachiis acetabula præ ceteris omnibus maxima comperias*, in aliis generibus minima. Quod si semen hac emitteretur, necesse foret, meatum aliquem ab internis partibus huc deductum, fœminam quoque eodem meatu semen excipere ovaque edere, quæ fieri non posse, fatebuntur omnes qui polypos viderunt, et ovorum in inferiori alvi loco situs necessario convincit, alio quam brachii acetabulo ova edi." (De Piscibus, Lugduni, 1554, lib. xvii. pp. 511, 512.) Rondelet has therefore correctly observed the four large suckers on the lateral arms of the male, but we cannot exactly see whether he has regarded them as a sexual character; in this respect, however, he is somewhat in advance of the more modern observers, who have overlooked both these and the *brachius copulator*. In D'Orbigny I find no observations upon this organ; Verany has regarded the large size of the suckers as something accidental, stating, correctly enough, that "the suckers increase imperceptibly up to the fifteenth, which is usually the largest," but afterwards adding, "and often very disproportionate to those which touch it, especially on the arms of the third pair." (*l. c.* p. 17.)

† The author last cited states (p. 634), "It would seem, also, that the modified arm of the male in certain Octopods had not escaped the notice" of Aristotle: citing the passage in question.

of Chili, and which is principally distinguished from the other species of *Octopus* by the character which I have found to occur, and indeed in a remarkable degree, in all male individuals of our commonest species, is probably established only upon males, and is perhaps also a collective species, consisting of males of several distinct species. At all events, two male Octopods from the coast of Chili which I possess, present, together with the common character of these large suckers on a particular part of the arm, such great differences, that they can hardly be regarded as belonging to a natural species: one of them, a very large specimen, of the size of an ordinary *O. vulgaris*, has 90 pairs of suckers on the third right arm; the other, which was brought from Valparaiso by Professor Kroyer, is much smaller, and has only 40 pairs of suckers on the same arm; the large one has the terminal plate but slightly developed, whilst the hectocotylized arm of the smaller specimen bears an elongated, lanceolate, terminal plate with faint transverse wrinkles, and the angle of the fold of skin previously mentioned is drawn out into a papilliform point (fig. 4); the small male also has the isolated, disproportionately large suckers on the dorsal and ventral as well as on the lateral arms, and the latter are not thicker than the uppermost and lowest pairs, whilst the large male has these large suckers only on the lateral arms, which preponderate considerably over the other arms. Now, as I am also in possession of a female Cephalopod which approaches the smaller male, but is destitute of those suckers, I believe I am justified in expressing my above-mentioned suspicion against *O. Fontanianus*; but I must reserve myself for a final decision by more abundant material. At present I must advise naturalists to be cautious about admitting the whole group of Octopods which Gray wishes to bring together by a character which at least partially coincides with the most essential specific character hitherto given for *O. Fontanianus*; according to Gray, the males of *Octopus vulgaris* would come in this, his third group, whilst the females would remain in his first*.

A male individual of the genus *Eledone*, Leach, which is derived from the Mediterranean, and which, as it has a cirrus over the eye, would most probably be the common *E. moschata*, Leach, shows that this nearly allied genus possesses a similar structure of the arms, as is shown more exactly in Pl. III. fig. 5. As in the genus *Octopus*, the third right arm is shorter and somewhat stronger than the left one; it bears only 64 acetabula, whilst

* Gray, Catalogue of the Mollusca in the Collection of the British Museum, Part 1. London, 1849, p. 14. With regard to the *O. oculatus*, D'Orb., which also stands in Gray's third group, I can at least certify that only the males possess the very large sucker on the lateral arms.

the opposite one has 93, so that the deficiency is about one-third. A strong cutaneous border commences in the middle of the margin of the membrane stretched between the third and fourth arms, and thence runs along the arm to its apex, where there is a peculiarly developed terminal portion, destitute of suckers, which evidently represents the spoon-shaped plate of the Octopods, but which is furnished with several elevated longitudinal folds. The individual figured also deserves notice, because the seven other arms are not provided with acetabula at the extremities, but with two rows of cutaneous laminæ, a peculiarity which I do not find described in any *Eledone*, and which therefore made me doubt for some time whether I had not a new and undescribed species before me. As, however, two male specimens* afterwards examined, of which one at all events was from the Mediterranean, were also destitute of acetabula at the apex of the arms, and bore similar laminæ in their place, whilst I could not find the least trace of anything of the kind in numerous females of *Eledone* from the Mediterranean, I assume that this peculiar development of the extremities of the arms only occurs in the males, so that it is a sexual character (see fig. 5″).

In this opinion I am the more strengthened as I find exactly corresponding cutaneous formations at the extreme ends of the arms in a large male *Eledone* from Bergen, which is certainly *E. cirrosa*, Lamk., whilst several females, partly from the same locality, and partly from other places on the Norwegian coast and from Faerö, exhibit no trace of it. Nevertheless, in the last-mentioned species these cutaneous lobes differ from those occurring in *E. moschata*, in being less foliaceous or plate-like, but more elongated and thin, almost like cirri or filaments. Fig. 6 represents a small portion of them from one of the arms, but certainly from a specimen which was in a rather flabby state.

In opposition to the great uncertainty which prevails in this genus in the recognition of the species in consequence of the want of definite external characters†, these observations upon the different development of the apices of the arms in the two sexes and in different species, may conduct us to the right way, when they are extended to all described species.

* In these individuals the third right arm had respectively 62 and 65 developed acetabula.

† A want which is so great, that the species which have been regarded as far removed from each other, are essentially distinguished, in that some have a cirrus over the eye, the others not (although this cirrus appears always to be more or less distinctly present), whilst the more nearly related species are not to be distinguished even from spirit specimens. See Verany, Mollusques Méditerranéens, p. 15 : "car, je l'ai déjà dit, après la mort les deux espèces sont, si je peux m'exprimer ainsi, indéchiffrables."

Guided by this remarkable form and metamorphosis, in the males of *Octopus* and *Eledone*, of exactly the same arm which, in the male individuals of the genera *Argonauta* and *Tremoctopus*, becomes developed into a separable and deciduous transferer of semen, and by the unmistakeable concordance which occurs again between the development of the arm in *Octopus* and *Eledone*, and the peculiarity which I have above described in the male Decapoda*, I no longer regard it as doubtful that all these developments belong to one category, and all have essentially the same object, namely the transference of the spermatophora, or of the seminal masses contained in these peculiar capsules, to the female, or perhaps to the eggs. Nor do I doubt that, provided this supposition be correct, the peculiar transitions presented by each genus have their determinate purpose, and give rise to many different modes of fecundation; but what the details of these may be, must be left to be decided by observations on the animals in a state of nature. For the guidance of subsequent investigators, I shall take leave at a future meeting of the Society to bring forward the indications which have been furnished to me by spirit specimens, as in these we certainly see that the transfer of the spermatophora takes place in very different ways, and that the actual fecundation of the ova must be effected in many cases in an unexpected and very remarkable fashion.

Before passing to some general remarks to which these observations lead, I shall give an exact description of a very perfect *Hectocotylus*, or of an arm which is destined not merely to transfer the semen, but also to become detached and to fasten itself with the entire mass of semen upon the female; and I do this the rather, as hitherto the formation of *Hectocotyli* is only known in the larger species of *Tremoctopus* (*T. violaceus* and *T. Carenæ*) which live in deep water, but not in the smaller oceanic species of the genus living nearer the surface, for which we may perhaps provisionally retain D'Orbigny's name of *Philonexis*; and it is exactly one of these small oceanic species, namely *P. Quoyanus*, D'Orb.†, of which I have had the opportunity of examining the *Hectocotylus*.

In *Philonexis Quoyanus* the development of the *Hectocotylus* differs from the well-known process in *T. Carenæ*, in that it is not formed in a pedunculated membranous bladder, but in a

* In one of my males of *Rossia* I found two soft envelopes of seminal capsules between the cutaneous folds of the arm.

† Should it turn out hereafter that *P. semipalmatus*, Owen, is not synonymous with D'Orbigny's species, my species will probably be nearest to *semipalmatus*, according to Owen's figures. A male was captured with three females, by Professor Reinhardt, under 22° 4′ N. lat. and 24° 40′ W. long.

large and spacious cutaneous sac, which lies deeper than the root of the arm, and occupies essentially the same place as the large folds in the genera *Sepia, Rossia,* &c., into which the tentacles may be more or less retracted and received. Figure 7, which represents a male specimen of this species three times the natural size, shows at once that the male has only seven arms, which are all regularly developed, and that the absent arm is actually the right arm of the third pair. On closer examination, however, it is seen that the place where this right arm should be situated is as it were swelled up, and that by this swelling both the fourth pair of arms and the funnel are not a little displaced towards the left side. Under a lens it is easy to perceive that the cause of this displacement is a very long, rolled-up arm, which occupies the space between the funnel, the eye, and the root of the arm, and which is covered only by a skin so thin and transparent, that the eye may easily trace the curves of the arm, and distinguish their finely fringed margins and the individual acetabula which are turned towards the skin, which, however, in consequence of the mode in which the arm is rolled up, are but very few. In the enveloping membrane I have been unable with the lens to detect either an actual opening through which the arm might issue forth, or a line or impression, to indicate where a division might subsequently occur, as is known to be the case in *T. Carenæ;* but perhaps this would have been more distinct on the fresh specimen. After opening the cutaneous sac by an incision with a sharp knife, it was easy to draw forth the remarkable *Hectocotylus*-arm. This is represented, when thus extracted, in fig. 8. It was quite colourless throughout its whole extent, like the previously observed *Hectocotyli* of *Argonauta* and *Tremoctopus,* but individual chromatophora existed in the membrane covering it. Its length is several times that of the corresponding arm on the opposite side of the animal, although this is longer than the very long first and second pairs (by which, indeed, this species is characterized), and bears no less than 33 pairs of acetabula; therefore a greater number than is supported by any of the other arms. These acetabula are of nearly equal size throughout the entire length of the arm, and the arm itself is also nearly uniform in breadth throughout. At the apex the arm swells into a nearly pyriform part, which is destitute of suckers; and along one side of this swelling there is a slight furrow and fold of skin, of which the latter appears to be traceable down the arm for a short distance. At the base of the swelling and close to the extreme sucker of the arm, is the origin of a long lash or filament of 55 mill. in length, the basal portion of which appears as if surrounded by a thin sheath. It is still to be remarked, that along each lateral margin this *Hectocotylus* bears fine cutaneous papillæ in a longitudinal furrow; these papillæ, which are placed close together, and stand here and there in several close series, gave the fringed margin to the arm in its coiled-up state, and they must also be what were regarded as branchiæ when the *Hectocotylus* was considered to be an independent male organism. In this specimen I was unable to find any trace of a dorsal cavity with an external orifice; but this would be formed essentially by the covering membrane when the arm was naturally and spontaneously rolled up,—a mode of development which presents no difficulty for the species hitherto observed, but of which it is difficult to form a clear notion here, on account of the form and position of the enveloping sac. In reference to this it must be mentioned, that the only known *Hectocotylus* which resembles my form in the want of the dorsal cavity and the presence of "branchiæ," is that found and described by Kölliker on the female of *Tremoctopus violaceus*, the development of which, however, is still unknown, as the males of this Cephalopod have not yet been discovered*.

It seems probable to me, that the vesicular or pyriform, swelled, terminal portion of the *Hectocotylus* represents the apical plate in *Octopus* and *Eledone*, which has already been repeatedly mentioned, and also that the long filament or "flagellum," which occurs in all *Hectocotyli*, and originates in all at the same spot, namely where the angle of the fold of skin described in *Octopus* and *Eledone* is situated, may be the apex of this angle which has been more developed and elongated (see fig. 4 *d*); only then it cannot be an axial portion. It also appears probable to me, that the muscular membranous border which forms the above-described furrow or semicanal in the hectocotylized arm in *Octopus* and *Eledone*, which, however, is only a peculiar development of the membrane which runs for a greater or less distance along the arms in all Cephalopoda, may be exactly the same membrane which, in *Argonauta* and *Tremoctopus Carenæ*, envelopes the entire *Hectocotylus* in its rolled-up state, and which, when the arm is subsequently stripped off, according to the observations of Verany and Vogt, at the same time forms a dorsal cavity at the base of the arm; whilst, as regards its import, this furrow rather corresponds with the internal canal on the dorsal surface of the *Hectocotylus*, which is destined for the re-

* The agreement between the *Hectocotyli* of the two species which have the swimming-membrane between the two uppermost pairs of arms so strongly developed, may serve provisionally as a support for a different distribution of the species under the two generic names *Tremoctopus* and *Philonexis*, somewhat as has been attempted by Gray, Mollusca of the British Museum, pp. 24–27.

ception or transfer of the seminal mass*. But in all this we have nothing but indications. I must content myself with having pointed out generally all the formations and agreements here described, and leaving it to those who possess richer materials, and especially to naturalists living on the sea-coasts, particularly that of the Mediterranean, who are fortunate enough to observe these animals daily in a state of nature, to carry out the comparison in all its details, I will only append to the above series of observations the general remarks to which they appear to lead me at the moment.

In the first place, it follows clearly, from these observations, that the *Hectocotylus*-formation in *Argonauta* and *Tremoctopus* is a far less paradoxical phænomenon than it was supposed to be by naturalists, nor does it occur so suddenly and without transitions, as appeared at first, and as has hitherto been stated. We see rather that the peculiarity, so strange and anomalous at the first glance, is here, as throughout Nature, prepared and brought about by a series of transitions. It appears that it is only a stronger expression, in particular spots, for that which is expressed more or less distinctly in numerous other points in the vicinity†.

In the consideration of the *Hectocotylus*-formation in *Argonauta*, the modification and transformation taking place here of an organ originally connected with motion and nutrition, into an organ of reproduction, has frequently been compared with the alteration in form and function which the palpi undergo in the male Spiders, by certain parts of them becoming transformed into spoon-shaped organs, which are employed for the reception

* I may, however, refer to the abundant and interesting literature of the last few years upon the three known species of *Hectocotylus*, and especially to—

Kölliker, Berichte von der königl. zootomischen Anstalt zu Würzburg, 1849.

Verany, Mollusques Méditerranéens, 1851, P. 41. p. 126-128.

H. Müller, Zeitschr. für Wiss. Zool. 1853, p. 1–35, & p. 346–358. taf. 1. (See also Verhandl. der physikalisch-medicinischen Gesellsch. zu Würzburg, 1851; Annales des Sciences Naturelles, tom. xvi. 1851, and Scientific Memoirs, new series.)

Verany and Vogt, Annales des Sciences Naturelles, tom. xvii. 1852, p. 148–185. pl. 6–9 (and Scientific Memoirs, new series).

Leuckart, Zoologische Untersuchungen, iii. 1854, p. 91–109. taf. 2. fig. 19–22. (See H. Müller, Verhandl. der phys.-med. Gesellsch. zu Würzburg, 1854, p. 332.)

† The entire developmental series in this respect in the Cuttle-fishes is similar to that which I have indicated with regard to the breeding of the Frogs and Toads, in which the care of the male of *Alytes obstetricans* for the eggs, evidently originates from, or is in relation with, the obstetric assistance which all the species render to their females.

of the semen and its transference to the female*. It appears to me, however, that an analogy as close, or perhaps closer than this, which has already been made use of by Leuckart, Owen, Von Siebold, and others, is that which occurs in so many males amongst the Decapod Crustacea, in which a pair of abdominal limbs is converted into more or less complete tubes; or in the males of the Rays and Sharks, in which it is the ventral fins, and therefore an active motory apparatus, that become converted on one side into large conducting-tubes for the semen. In both cases the organs very nearly represent the structure in *Octopus* and *Eledone*. If we imagine these long hollow tubes formed for the transfer of the semen, remaining, in copulation, attached to the female, we have the condition of the parts as in *Argonauta*. That parts of the male member which are destined to the actual insemination or introduction of the semen into the female sexual organs, may be detached during this introduction, and remain in the female, is perhaps not unexampled; the circumstances described as occurring in many insects at least offer a distant analogy herewith; but in the males of insects, whose life is closed with the first and only copulation, there can be no question of a new growth or reproduction of the lost parts.

Moreover, that it is in genera of Octopods that we have an example of a regeneration of the arm lost in copulation, is deserving of attention, inasmuch as by this we are reminded of a difference between the Octopoda and Decapoda, which is not unessential, but has not hitherto been rendered sufficiently prominent. *Thus all the Decapoda appear to be incapable of replacing accidental injuries of the arms, or the loss of parts of them, by a new growth, whilst the Octopoda possess this power in the highest degree,* and reproduce their arms, which are exposed to so many enemies, with the same facility and rapidity as, for example, the Star-fishes.

Amongst numerous Octopoda I have never seen a single one with the arms injured or bitten off, without a reproduction being commenced, more or less advanced, or even completed; and this sometimes on most of the arms†. In more than a hundred Decapoda which I have at present examined, I have, on the contrary, never found a trace of a reproduction, although

* A still closer analogy seems to exist with some of the Myriapoda, such as *Polydesmus*, in which, according to M. Fabre (see Annals, Feb. 1857, p. 162), the semen is transferred to the female by the first pair of feet of the seventh segment.—W. S. D.

† I have seen female individuals in which all the eight arms had been lost, but in which they were more or less completely reproduced; and I have seen a male in which the same was the case on the seven arms, whilst the hectocotylized arm alone was uninjured: whether this was something accidental, or whether the Octopods do not place this peculiar arm of theirs in so much danger as the others, I must leave unanswered; but it de-

I now and then found both large and small portions of a single arm lost, and the wounded surfaces healed.

From the different forms of the pair of arms metamorphosed for the purpose of reproduction, it appears that there is an unmistakeable connexion between the position and extent occupied by the metamorphosed part of the arm, and the natural group to which the particular Cephalopod belongs. This appears with peculiar distinctness when the above-described peculiarities are placed in apposition with D'Orbigny's classification of the Cephalopoda.

OCTOPODA*.

Philonexidæ	*Argonauta* (Philonexis) *Tremoctopus*	third left / right	arm a Hectocotylus† (feminæ polyandræ !).
Octopidæ	*Octopus* *Eledone*	third right arm hectocotylized‡	(feminæ monandræ?).

DECAPODA.

Myopsidæ	*Rossia*	first left arm hectocotylized	(with the right one, only in the middle).
	Sepiola		(alone, in its whole length).
	Sepia	fourth left arm hectocotylized	(at the base).
	Sepioteuthis		(at the apex).
	Loligo		(at the apex).
	Loliolus		(in its whole length).
Oigopsidæ	*Ommatostrephes* *Onychoteuthis* *Loligopsis*	No hectocotylized arm hitherto observed.	

* I have not referred here to the *Sciadephorus Mülleri*, Eschr. (*Cirroteuthis*), a form differing completely from the rest of the Cephalopoda. I have certainly examined four males, and found no trace of the formation of the arm indicated in *Octopus* and *Eledone*, but I cannot assert with certainty that it would not be found on living examples. The peculiar texture of this genus causes all its parts to alter greatly in spirits. As something very remarkable, I must observe, that my four male specimens had, as it were, stripped off a portion of the small acetabula on the lower third of the arm, thus forming small plate-like surfaces,—an appearance which none of my females presented. Whether this might be a sexual character, I am unable to say. The genus appears to form a peculiar family of the Octopoda, although it will be seen, from my present investigations, that it approaches *Eledone* not only by the single series of acetabula, but also by the cirri which I have indicated at the apex of the arm in *Eledone*, and which in *Sciadephorus* appear to represent the greater part of the arm.

† Deciduous, colourless, developed in a sac.

‡ Permanently attached, coloured, developed in a free state.

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serves to be remarked, that whilst as a rule every Octopod has one or two arms reproduced, none of the numerous males which I have examined presented this arm in an injured or reproduced state.

The reproduction takes place with much ease, not only in the direction

This summary furnishes a very striking evidence that there must be something natural in D'Orbigny's division of the Decapod Cephalopoda into the two principal groups, "*Myopsides*" and "*Oigopsides,*" although no great inclination to adopt them has hitherto been shown. The difference in the conditions of reproduction shows especially that the genus *Ommatostrephes*, D'Orb., is still more entitled to be removed far from the genus *Loligo*, with which even modern malacologists, such as Verany and Troschel, persist in placing it. D'Orbigny repeatedly points out that his genus *Philonexis* or *Tremoctopus* is essentially distinct from *Octopus*, under which genus its species were formerly arranged, and closely approaches *Argonauta*; and the above-mentioned conditions of reproduction also show this completely; and in reference to this, it is very interesting to observe that the supposed *Octopus*, in which Verany has described the complete *Hectocotylus*-development, namely *O. Carenæ*, Ver., has proved to be a *Philonexis* or *Tremoctopus*. If, therefore, D'Orbigny's division into great groups finds much confirmation in the above-described peculiarities, these should also furnish many hints for a probably more natural limitation of the particular families, and this applies especially to the collocation of the genus *Sepia* with *Rossia* and *Sepiola*, which, however, has appeared less natural to many. The negative characters which united these three genera in opposition to the other *Myopsidæ*, have already lost something of their strength, as the want of the muscular cords on the funnel has been detected in the small

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of the axis of the arm; but even a single sucker or a group of suckers, which their enemies may have bitten from the sides or the base of the arm, is reproduced with the greatest facility.

I have already called attention to the misinterpretations of Aristotle, where he has been understood as if, in his representations of the circumstances of reproduction in his Polypus, he had in his eye a *Hectocotylus*-formation, such as we are now acquainted with in *Argonauta* and *Tremoctopus*. This appears to me to be the place to clear up, as far as possible, another misconception which stands in connexion with the preceding. Roulin (Ann. des Sc. Nat. xvii. p. 189), namely, supposes that it is the observation of male *Octopods* from which the *Hectocotylus* had separated, and which therefore had lost one arm, that gave rise to the story referred to by Aristotle, that at certain times, especially in winter, when the *Octopus* retracts itself more into its cavities, it bites off its own arms, and to Aristotle's view—by which he endeavours to explain the origin of the story—that it is the voracious eels that bite off the arms of the animal. The foundation of both the story and its explanation is of course neither more nor less than the frequent and striking injuries and renovations in the common *Octopus*, and Aristotle's explanation is correct, as the stomachs of the *Murænæ* are found filled with fragments of the arms. "Ego vero," says the excellent Belon, "cum apud Epidaurum semel Murænas secarem, earum ventriculos cirrhis polyporum refertos comperi." (P. Bellonii de Aquatilibus, libri duo. Paris, 1553, p. 331.)

genus *Loliolus* in the *Loligo*-family. The justification of the mode here adopted of employing the hectocotylized arm as a rule for the natural collocation of the forms, lies in its importance for the entire reproduction. It would be inconceivable that the various occurrence of this metamorphosis, sometimes in one, sometimes in the other pair of arms, sometimes on the right and sometimes on the left side, sometimes at the apex and sometimes at the base of the arm, &c., should not give rise to the same number of differences in the mode of fecundation, and in the position and manner in which the seminal mass is placed upon the female; inasmuch as it appears that the semen is hardly involuntarily or mechanically emitted or poured out upon the eggs, but that this is effected by conscious movements. What is furnished us in this respect by simple reflection, is also confirmed by observation. The seminal mass is actually attached to very different parts, and under very different conditions, which I propose to describe shortly in another memoir, of which I shall here only give the general result, that in the genera *Sepia*, *Sepioteuthis*, and *Loligo*, and therefore in all those which have the left arm metamorphosed, the seminal mass is attached to the lips of the female (*membrane buccale*, D'Orb.), which therefore appear peculiarly equipped for this purpose, whilst I have never found the semen attached to this spot in any other Decapod, but on various parts of the mantle or of the viscera; for example, in *Ommatostrephes*, deep in the cavity of the mantle in the median line of the back. For comparison with what has here been stated with regard to *Sepia* and the *Loligines*, it must be remembered that the anatomical examination of the two male specimens of *Nautilus** has shown a great difference in the development of the peculiar labial portions on the two sides of the animal, whilst nothing of the kind occurs in female individuals.

Although the external sexual distinctions above referred to have proved to be distinct and important, they have not hitherto been perceived by naturalists; most of them will at least agree with me in regarding them as such, after reading the preceding. To show more distinctly this deficiency in our present knowledge of the Cephalopoda, it will hardly be superfluous, although I trust that it may be considered quite sufficient for this purpose, to quote two of the most modern assertions relating to this subject; they are dated in the last and in the present year, and will, in my opinion, completely prove the position of science for the time at which they were written. In the new edition of his

* Vide Van der Hoeven in Tijdschrift voor de Wis- en Natuurk. Wetenschappen, I. Deel, 1848, p. 67–75. pl. 1. fig. 1–3, and Transactions of the Zoological Society, 1850, p. 21–29. pl. 5–8.

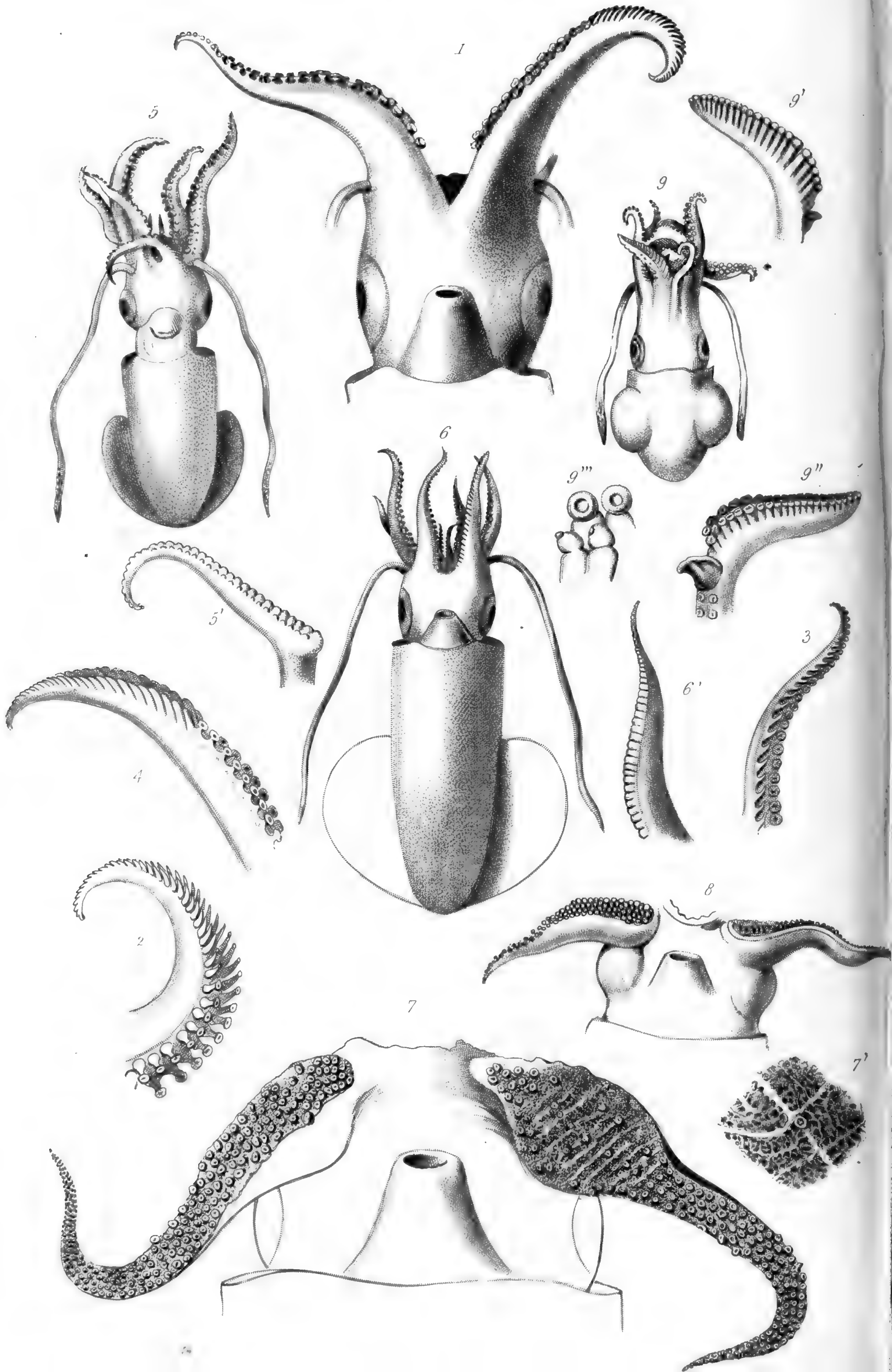
"Lectures on Comparative Anatomy and Physiology, London, 1855," the celebrated English anatomist, Professor Owen, has no peculiarity in the Octopoda and Decapoda to place beside the sexual distinctions so often referred to in *Argonauta* and *Tremoctopus*, except the following :—" In the Calamary (*Loligo vulgaris*) the gladius of the male is one-fourth shorter, but is broader than that of the female. The sepium of the Cuttle (*Sepia*) shows a similar, but not so much, sexual difference in its proportions," p. 628; so that of such characters he is only acquainted with the greater or less breadth of the gladius, according to the sexes. Still less has Professor Leuckart to place beside this sexual peculiarity in *Argonauta* and *Tremoctopus*. In his "Nachträge und Berichtigungen zu dem ersten Bande von J. Van der Hoeven's Handbuch der Zoologie, Leipzig, 1856," which have just appeared, I find that this author, so well known by his observations upon the sexes and reproduction of the sea animals, says, in connexion with the above-mentioned two genera: "Amongst the other Mollusca no instances of a sexual dimorphism have yet been observed, for the difference in the formation of the labial tentacles in the male *Nautilus*, pointed out by Van der Hoeven, and recently confirmed (according to his letters) ...... can scarcely be placed beside the remarkable peculiarities of those Cephalopoda."

But the more these peculiarities have been overlooked, the more does the question arise, how can they have escaped observation? and, as the answer to this, I must state that I suppose that they must really have been frequently noticed by naturalists, but that they must have regarded them as *morbid developments* or *accidental mutilations*, of which the traces had not been effaced by regeneration. I have already stated that D'Orbigny has indicated as a disease, what in my opinion is a character of the reproductive males in the genus *Sepiola*; and that the short, hectocotylized arm of *Octopus* and *Eledone* has been regarded as an injured or mutilated arm, the lost terminal portion of which had not yet grown, appears to me to follow distinctly enough, although indirectly, from the numerous figures of these animals possessed by science. I have been unable to find a single one of these with a male arm of this description; and as it is inconceivable that, especially amongst so many Octopods figured in such different places and at such different periods, there should not have been a single male (although these appear to me to be at least as abundant as the females), the artists or naturalists must, in order to complete the animal, have given it the symmetry which they supposed to belong to it. This applies also to the form of the left arm in the male *Loligines* and *Sepiæ*, and the more so as, according to the text and the lettering of the plates, many of these figures represent males, whilst the arms are given as symmetrical. Amongst the Decapoda, however, a case often occurs, which may have led to an erroneous conception of the symmetrical development, namely that considerable portions of the suckers of the arms, and especially towards their apices, appear as if bitten off during the powerful movements and exertions of the animal when it finds itself captured or in great danger; and that the metamorphosed, papilliferous part of the arm in a *Loligo* or a *Sepioteuthis* might easily be confounded with such parts deprived of their suckers, at least on a rather superficial examination*.

The preceding assertions must only be understood in reference to the existence of this peculiarity, and it must be borne in mind that it was much better known at a period of high antiquity. That Aristotle, and perhaps Pliny, were better informed by the fishermen of the Mediterranean, as to a peculiar arm in the genus *Octopus,* I have already pointed out under that genus, and at the same time called attention to the fact that Aristotle knew for what purpose this arm was employed.

As the question so easily arises, how early in the life of the animal this transfer of the arm into the service of reproduction occurs, and how far it remains constantly in the same condition, or perhaps undergoes changes at the season of propagation, I must add in conclusion, that the numerous specimens which I have examined with this view have given me no inducement to suppose that any alteration takes place according to the season of the year or the age of the animal. Even my smallest specimens of a species exhibit the same characters as the largest, and I find myself compelled to assume that the male young of the different genera and species quit the egg already furnished with *the* hectocotylized arm which belongs to them by virtue of their genus or species. As an adherent of the theory that the sex is not subsequently developed, but that it is present originally from the first movements in the egg, I should have preferred being able to ascertain by direct observations that the young of the Cephalopoda quit the egg with their external sexual characters; but I have only had the opportunity of examining the

* In *Loligo,* as well as in *Ommatostrephes* and *Onychoteuthis,* I have found the cavity of the mouth and the œsophagus filled with acetabula and horny rings or hooks, evidently belonging to the same animal, and the place of which on the arms could still be determined. From this we see that we must be very cautious in stating that the Cephalopoda serve as the food of these animals because single horny rings or hooks of this kind are found in their stomachs; but if fragments of the beak, of the gladius, and the lenses of the eyes are found, as has often been done by me in certain forms, no such misinterpretation can take place.


1
5
9'
9
6
9'''
9''
5'
3
6'
4
8
2
7
7'

young of one species (a *Rossia*) in the egg, and all these, which belonged to one and the same brood, appeared to me to be of the same sex, namely females.

EXPLANATION OF PLATES II. & III.

Plate II. illustrates the position and form of the hectocotylized arm (*brachium copulator*) in the Decapod Cephalopoda.

Fig. 1. *Loligo media*, Linn. ♂. Head with the two ventral arms, to show that the fourth left arm is papilliferous, and that it has small acetabula in comparison with the right arm. Somewhat enlarged.

Fig. 2. *Loligo Forbesii*, Stp. ♂. The papilliferous apex of the fourth left arm. Natural size.

Fig. 3. *Loligo gahi*, D'Orb. ♂. The apex of the fourth left arm; the acetabula are only metamorphosed into papillæ on one side. Double the natural size.

Fig. 4. *Sepioteuthis sepioïdes*, Blainv. ♂. The apex of the fourth left arm.

Fig. 5. *Loliolus typus*, Stp. ♂.
Fig. 6. *Loliolus affinis*, ♂.
} Of the natural size, to show the general appearance of this new genus, and the remarkable form of the fourth left arm, on which all the acetabula are deficient.

Fig. 5'.
Fig. 6'.
} This arm double the natural size.

Fig. 7. *Sepia officinalis*, Linn. ♂. Ventral arms, to show the peculiar metamorphosis of the fourth left arm, and its difference from the right one. Two-thirds of the natural size.

Fig. 7'. A small portion of the cutaneous pits on the metamorphosed part, magnified three times.

Fig. 8. *Sepia inermis*, Van Hass. A similar portion, to show the peculiarity of the fourth left arm here also.

Fig. 9. *Sepiola Rondeletii*, D'Orb. ♂. The animal of the natural size, to show this and the preponderance of the first left arm over the rest.

Fig. 9'. This arm seen from the dorsal surface.

Fig. 9''. The same arm seen from the ventral surface, showing the peculiar cutaneous lobe. Magnified three times.

Fig. 9'''. A pair of acetabula from both series on this arm, to show their position. Strongly magnified.

Plate III. illustrates the position and form of the hectocotylized arm (*brachium copulator*), partly in the Decapod genus *Rossia*, partly in the Octopod Cephalopoda.

Fig. 1. *Rossia Mölleri*, Stp. ♂. The dorsal arms, or the first pair, to show the peculiar elongation of the peduncles of the acetabula on the central parts of the right and left arms, and the strong expansion of the arm-border on the same part. Natural size.

Fig. 1'. A pair of acetabula, considerably enlarged.

Fig. 2. *Octopus grœnlandicus*, Dewh. (= *O. arcticus*, Prosch.) ♂. Of the natural size, to show the position of the hectocotylized third arm in the Octopoda. The four pairs of arms are marked ', '', ''', ''''; the letters *a*, *b*, *c*, *d*, in this and the following figures, always indicate the same parts of the arm, namely *a*, the apical plate; *b*, *b*, the muscular cutaneous border, which is white internally, and which, by being rolled up against the side of the arm, forms a furrow or canal; *c*, the commencement of this furrow; *d*, an angular fold of skin, which separates the acetabuliferous portion from the apical plate.

Fig. 3. *Octopus*, sp. indeterm. ♂. Third right arm, with a portion of the fourth right arm. Half the natural size.

Fig. 4. *Octopus*, sp. nov. ♂. The apex of the third right arm. Natural size.

Fig. 5. *Eledone moschata*, Leach. ♂. Third right arm, half the natural size.

Fig. 5′. Its apex, somewhat enlarged.

Fig. 5″. The apex of one of the seven other arms of the male, slightly enlarged.

Fig. 6. *Eledone cirrosa*, Lamk. ♂. A piece of the apex of an arm of the male.

Fig. 7. *Philonexis Quoyanus*, D'Orb., ♂, to show that only seven arms are present, which are not hectocotylized, and that the eighth, which is converted into a *Hectocotylus*, lies concealed in a sac between the eye and funnel. Magnified three times.

Fig. 8. Its *Hectocotylus* more strongly magnified: *a*, vesicular apical portion; *d*, flagellum; *e*, portions of "branchiæ."

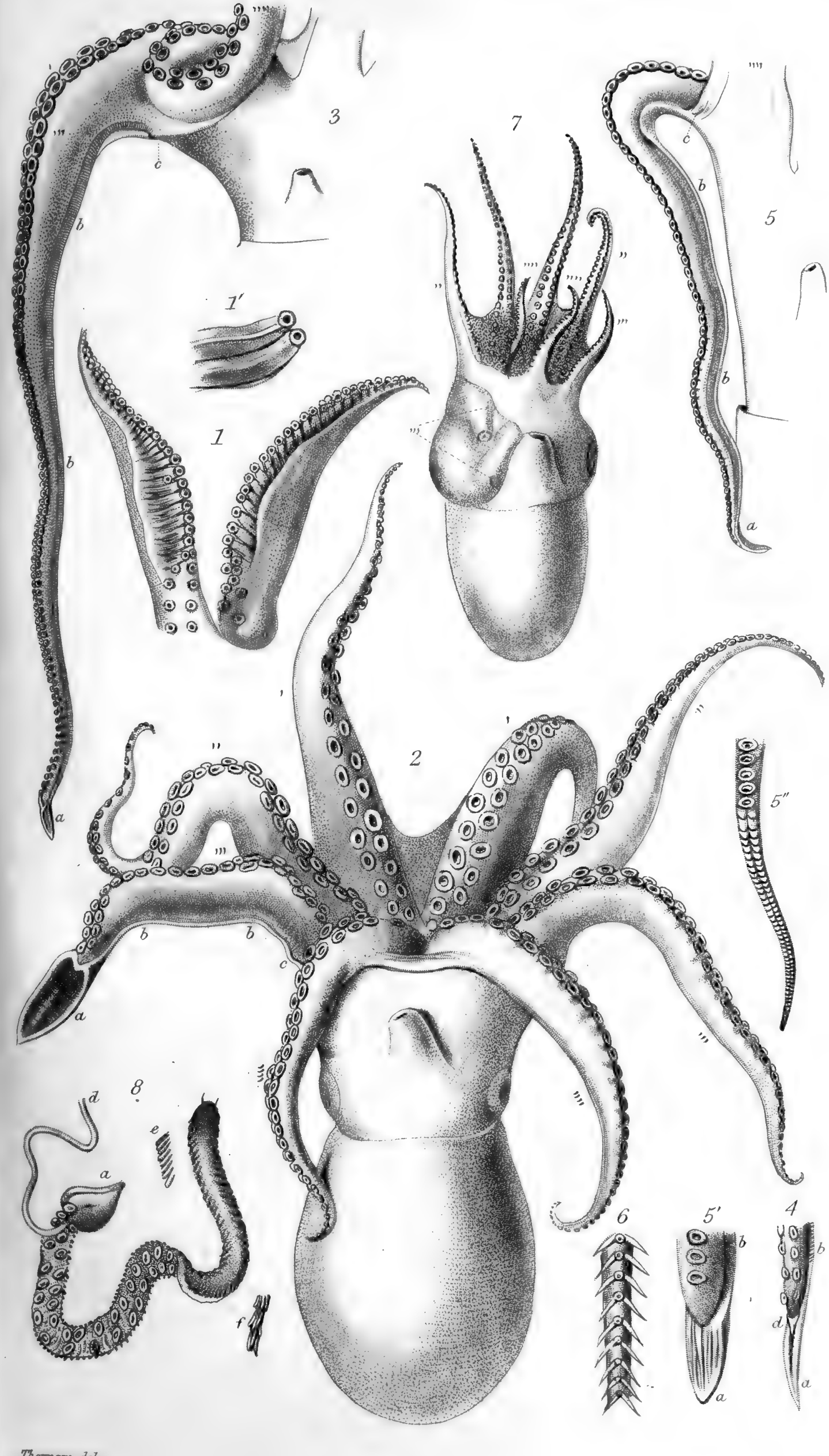
IX.—*On the Occurrence of the genus* Cryptoceras *in Silurian Rocks.* By E. J. Chapman, Professor of Mineralogy and Geology in University College, Toronto.

But one living genus of the chamber-shelled Cephalopods being known, the classification of the numerous fossil types met with more particularly in the Palæozoic and Secondary rocks, is of necessity based on characters derived immediately from the shell itself. For the purpose of classification, four characters, of more or less value, are especially available. These comprise—(1) the character of the aperture; (2) the form of the septa; (3) the position and character of the siphuncle; and (4) the form and mode of growth of the shell.

The aperture may be—(*a*) open; (*b*) contracted. The septa: (*a*) simple; (*b*) angular or lobed. The position of the siphuncle: (*a*) central or sub-central; (*b*) internal or "ventral;" (*c*) external or "dorsal." The siphuncle itself: (*a*) simple; (*b*) complicated. The form of the shell: (*a*) straight or conical; (*b*) arched or "horned" in various ways; (*c*) discoidal, with or without contiguous volutions; and (*d*) spiral.

By means of these characters, all the trustworthy genera of the chambered Cephalopods may be arranged, conveniently at least, if not naturally, in ten sections or families*, as shown in the following tabular view:

* Many palæontologists will, no doubt, think an extended subdivision of this kind very unnecessary, and prefer to group these forms in two, or at the most, in three families; but in adopting this plan, the characters of



Thornam del.

J. Basire sc.

1. Gomphoceratidæ:—Aperture contracted. *Gomphoceras* (including Hall's *Orthoceras fusiforme*); *Phragmoceras; Oncoceras; Lituites* (?).

2. Heterosiphonidæ:—Aperture unknown, perhaps contracted. Siphuncle more or less complicated, or otherwise marginal, with conical Orthoceras-like shell. Septa simple or slightly wavy. (See remarks below.) *Endoceras; Cameroceras* (?); *Gonioceras; Ormoceras; Ascoceras.*

3. Nautilidæ:—Aperture open. Septa simple. Siphuncle central or sub-central. *Orthoceras; Nautilus; Lituites* (?); *Hortolus; Aploceras* (including Hall's *Cyrtoceras annulatum* ?); *Nautiloceras; Trochoceras.*

4. Trocholitidæ:—Aperture open. Septa simple. Siphuncle internal or "ventral." *Trocholites.*

5. Cyrtoceratidæ:—Aperture open. Septa simple. Siphuncle external or "dorsal." *Cyrtoceras; Gyroceras; Cryptoceras.*

6. Clymenidæ:—Aperture open. Septa lobed. Siphuncle internal. *Clymenia; Subclymenia.*

7. Aturidæ:—Aperture open. Septa lobed. Siphuncle internal or nearly so, and very large. *Aturia* (*Megasiphonia*)—a Tertiary form.

8. Goniatidæ:—Aperture open. Septa with angular lobes. Siphuncle external. *Goniatites* (*Aganides*); *Bactrites.*

9. Ceratidæ:—Aperture open. Septa with denticulated lobes. Siphuncle external. *Ceratites; Baculina.*

10. Ammonitidæ:—Aperture open. Septa foliated. Siphuncle external. *Ammonites; Crioceras; Scaphites; Ancyloceras; Toxoceras* ?; *Hamites; Ptychoceras; Baculites; Turrilites; Helicoceras; Heteroceras.*

Under the name of Heterosiphonidæ, we have separated from the Nautilidæ, all of those more or less imperfectly known forms (commonly classed with *Orthoceras*) which possess a large complicated siphon, or in which, with other related characters, the siphon is marginal. We are fully aware that many objections may be urged against this view; but until a true *Nautilus* be discovered with the peculiar character of siphuncle exhibited by *Ormoceras,* for example, we feel justified in holding to the sepa-

the respective families become ill-defined, and the appreciation of transition groups much weakened; whilst, at the same time, a necessity is occasioned for the creation of sub-families or tribes. A classification which does not show upon its face a greater distinction between *Goniatites, Ceratites,* and *Ammonites,* than between the last-named genus and *Hamites* or *Baculites,* for example, assuredly has no claim to be considered a natural grouping. In the arrangement given in the text, the second family is merely a provisional one, rendered necessary by our still imperfect knowledge of its included forms.—E. J. C.

ration of this latter form, with *Endoceras*, &c., from the normal Orthoceratites. The external ridges on the siphuncle of *Endoceras*, although so distinctly pointed out by Hall, appear to be forgotten altogether in the descriptions of many European palæontologists. *Ormoceras*, notwithstanding the central position of its siphuncle, is evidently closely related to *Gonioceras*, and through that genus, though less closely, to *Endoceras*.

If the separation of the *Goniatites* and *Ceratites* from the Ammonitidæ be disapproved of, they may be placed in that family as separate tribes. Our present object, however, is not to discuss the classification of the chambered Cephalopods, but to point out the occurrence in our Silurian rocks of a type hitherto unannounced, below the Devonian formation.

In the fifth of the above families, that of the Cyrtoceratidæ, characterized by the presence of simple septa, with external or so-called "dorsal" siphuncle, we have three genera: *Cyrtoceras*, a simply "horned" form, exceedingly abundant; *Gyroceras*, a discoidal or "rolled-up" *Cyrtoceras*, but without contiguous volutions; and *Cryptoceras*, likewise a discoidal form, but with contiguous whorls. Of the last-named genus, founded by D'Orbigny, but two species appear to have been hitherto recognized, the *C. subtuberculatus* (*Nautilus subtuberculatus*) from the Devonian beds of Nassau, and the *C. dorsalis* (*Nautilus dorsalis*, Phil.) from the carboniferous limestone of Yorkshire. Quite recently, however, in a specimen from the Black River limestone of Lorette, in Eastern Canada, submitted to us by Mr. Head, the son of His Excellency the Governor-General of Canada, we have remarked the *Cryptoceras* type of structure, viz. simple septa and an unmistakeably "dorsal" siphuncle, combined with a Nautiloidal form of shell. Hall, in the first volume of his 'Palæontology of the State of New York,' figures and describes, under the name of *Lituites undatus*, a fossil that may perhaps be identical with the one now under review; but if so, the generic term "*Lituites*" should certainly give place to that of "*Cryptoceras*." The siphuncle is said to be *dorsal*; and Professor Hall describes the only examples known to him, as occurring in the Black River limestone of Watertown, in Jefferson County. This same *Lituites undatus* is quoted by D'Orbigny in his 'Prodrome,' and also by Pictet in the last edition of his 'Traité de Paléontologie;' but these palæontologists appear to ignore completely the dorsal position of the siphuncle as described by Hall. D'Orbigny, indeed, places it immediately under the following generic definition: "Lituites, Breynius: coquille spirale, à tours contigus, siphon central;" and this central position of the siphuncle as an essential characteristic of *Lituites* is also recognized by M'Coy in his recent work on the British Palæozoic Fossils of the Cambridge Museum, as well as by all modern palæontologists. One thing therefore is certain, that whether or not our specimen be identical with that of Professor Hall, it has evidently no claims to be considered a *Lituites.* In the present note, however, we are unable to do more than announce the occurrence of the genus *Cryptoceras* in our Canadian rocks, the characters of the solitary specimen before us being too imperfect to warrant the bestowal of a specific name.

Since the above was written, we have learned that several examples of this fossil type, under the name of *Lituites undatus,* have been obtained by the Geological Survey of Canada from the Black River limestone of Lorette. It is very probable that many of the Silurian *Lituites* will prove, when more closely examined, to belong to *Cryptoceras,* or to Barrande's new genus *Nothoceras,* a notice of which (Bulletin de la Société Géol. de France, t. xiii. p. 380) has only just reached us. Although stated to have been read before the Society on the 3rd of March 1856, the Bulletin containing the notice was not issued until March in the present year. In *Nothoceras,* the bent edges of the septa (the *goulot* of the French palæontologists) protecting the siphuncle, instead of being deflected backwards as in *Nautilus, Cyrtoceras,* &c., are deflected forwards or towards the opening of the shell, as in the *Ammonites.*

Toronto, Canada West, July 1, 1857.

X.—*List of* Coleoptera *received from Old Calabar, on the West Coast of Africa.* By Andrew Murray, Edinburgh.

[Continued from vol. xix. p. 461.]

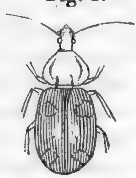
Panagæidæ.

Craspedophorus, Hope.

Isotarsus, Laferté.

1. *Cr. conicus,* mihi.

Fig. 1.



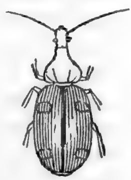
Niger, pilosus; thorace antice angustiore, postice latiore et ad basin truncato, punctato, lateribus rotundatis et postice elevatis; elytris magnis, punctato-striatis, maculis duabus flavis, altera antica transversa interstitia sex tegente, altera postica transversa interstitia quinque tegente.

Long. 8–9½ lin., lat. 4 lin.

Black, pilose. Head narrow, polished, margined, with an elongate deeply-punctured fovea on each side from the eyes forward, a few scattered punctures on the raised vertex between these foveæ, behind which there is a transverse series of fainter punctures; a deep oblique puncture or line at the anterior angles. Labrum emarginate and pitchy-black. Palpi pitchy-black, with the terminal joints pilose; antennæ as long as half the body, black and pilose, slightly thicker in the middle than at either extremity; neck smooth and impunctate. Thorax narrowed in front, broadest behind the middle, truncate at the base, anterior angles meeting the neck, anterior margin between them nearly straight, very coarsely punctate, sparsely pilose; narrowly margined, and with a raised space within the margin, narrow in front, wider behind, on which the punctuation is fainter; an elongate fovea on each side at the base, and a minute tooth at the posterior angles, which are rounded and obtuse; no dorsal line. Scutellum minute. Elytra rather convex, broad, black, with two fulvous spots on each, one near the base, the other near the apex, both transverse; the coloured spaces not raised, nor of a different texture from the rest of the elytra; deeply punctate-striate, the punctures on the striæ transverse; interstices convex and punctured, pilose, the hairs black on the black parts of the elytra, fulvous on the fulvous spots; the anterior of these spots commences on the 3rd interstice, and is continued on the 4th, 5th, 6th, 7th and 8th interstices, the extent and form of the fulvous marking varying in different individuals; the posterior marking is confined to the 4th, 5th, 6th, 7th and 8th interstices; the 9th interstice and marginal space are not encroached on by the fulvous spots; the marginal space is marked by a series of cross-wrinkles rather than punctures; the apex is slightly emarginate, but not truncate. Underside black, pilose, hairs piceous; prosternum sparsely and deeply punctate; inferior margin of thorax impunctate; sides of mesothorax and metathorax coarsely punctate; segments of abdomen finely and acicularly punctured, with some large, coarse punctures or foveæ on their sides; inflexed margin of elytra finely punctate. Legs black and pilose.

This species should be placed near the *Panagæus festivus* of Dejean. At first I supposed it to be the *Panagæus tropicus* of Hope, and I have distributed it among my correspondents under that name, but I am afraid I have been hasty in doing so. I have not seen Hope's species in nature; but Mr. Westwood's recent appointment to the curatorship of the Entomological Collection at Oxford (an appointment on which all entomologists must felicitate themselves) having rendered Mr. Hope's collection again useful to science, I have availed myself of his kindness to ascertain (so far as can be done without actual inspection of the insect itself) whether any of my species of *Craspedophorus* correspond with Hope's. Mr. Westwood's report confirms my doubt as to this species, although he observes that it is of the same general form, and, coupled with Hope's description, leads me to consider the two species distinct. His description is as follows:—"Long. lin. 8, lat. lin. $3\frac{1}{2}$. Niger; antennis atris, thorace semicirculari haud excavato, subdepresso et crebrissime punctulato. Elytris sulcato-punctatis quatuor maculis subquadratis flavis pedibusque nigris. *Hab.* In Sierra Leone. This species has the two anterior spots covering six interstitial spaces, while the posterior cover only five*." This description, so far as it goes, corresponds with my species, except that in mine the thorax cannot be called semicircular, or not excavated; it should rather be called conical, and it certainly is excavated, especially posteriorly. Mr. Westwood has furnished me with a sketch of the thorax of *tropicus*, which shows that it is more semicircular and shorter than in *conicus*. Hope's species also is somewhat smaller. The number of interstices over which the yellow spots extend (a particular which Mr. Hope gives as a good specific character throughout the genus) corresponds with that in his *tropicus*, excepting that the anterior marking sometimes covers the whole of the third interstice, at other times scarcely impinges on it at all; thus leaving it not quite clear whether it covers five or six interstitial spaces.

Fig. 2.



2. *Cr. strangulatus*, mihi.

Valde affinis præcedenti, sed thorace antice fortiter constricto; elytris punctato-striatis, maculis duabus flavis, singulis interstitia quinque tegentibus.

Long. $7\frac{1}{2}$–$8\frac{1}{2}$ lin., lat. $3\frac{3}{4}$ lin.

Very closely allied to the preceding species, and the same description will answer for both, with the following exceptions.

This species is rather smaller. Its head is somewhat narrower. Its thorax is quite differently shaped, being narrow, constricted in front, and rather rapidly expanded behind; the posterior angles are obtuse, and not so much rounded as in *conicus*. The elytra are shorter, not quite so convex, and the interstices also are less convex; the fulvous markings are narrower, particularly the posterior spot, and the colour of the anterior spots does not encroach on the third interstice, and is thus confined to five instead of six interstices. The punctures

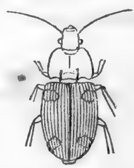
* Annals of Nat. Hist. vol. x. (1842–3) p. 94.

on the interstices are somewhat coarser and less numerous, and seem to be rather more transverse.

In other respects the characters of the two species correspond. Their extreme similarity, except in the form of the thorax, suggests the idea that they may possibly be sexes of the same species. As the tarsi in this genus furnish no indication of the sex, I endeavoured to satisfy myself on this point by detaching the abdomen and dissecting out the sexual organs, which I found, although not very decipherable, to be at least exactly the same in both species. They would appear therefore not to be sexes of the same species. Neither do I think they can be varieties, the difference of form in the thorax being too great to allow of such a supposition. I should also mention that I have received specimens of *conicus* in several consignments, but *strangulatus* came only upon one occasion, and then in small numbers.

3. *Cr. arcuato-collis*, mihi.

Fig. 3.



Niger, pilosus, depressiusculus; capite latiore; thorace depresso, lateribus rotundatis, ad basin una et altera parte arcuato, profunde punctato, lateribus posticis lævioribus; elytris punctato-striatis, maculis duabus flavis, singulis interstitia quinque tegentibus, altera antica recte transversa, altera postica oblique transversa. Long. 7½ lin., lat. 3½ lin.

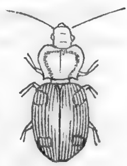
Black, pilose. Head broad, polished, margined on each side in front of the eyes, very coarsely punctured over the whole surface of the head, except upon the clypeus, which is large, semicircular, and straight in front; it is less closely punctate on the neck; there are two not very deep depressions more closely punctate on each side in front. Labrum pitchy. Palpi ferruginous, terminal joints pilose. Antennæ not so long as half the body, filiform. Thorax somewhat quadrate, depressed, coarsely punctured, narrowest in front, sides rounded and margined, anterior angles rounded and projecting, posterior angles rounded-in, with a minute tooth caused by a small excision at the angle; basal margin arched on each side towards the angles, middle space nearly straight, projecting backwards in consequence of the arch on each side; dorsal line well marked; an inner depression a short distance within the lateral margin, following somewhat its line, nearest to it in front, diverging from it behind, more deeply punctate than the rest of the surface, behind joining a deep basal depression about half-way between the middle and the exterior angle, the basal depression not separated from the margin by any raised space, very coarsely punctured. Scutellum small and smooth. Elytra rather depressed, not a great deal broader than thorax, punctate-striate; sides somewhat parallel and margined, black, with two rather transverse fulvous spots, the one near the base extending transversely across the 4th, 5th, 6th, 7th and 8th interstitial spaces, the other near the apex extending obliquely and transversely backwards over the same interstices; the spots pretty regular, but the colour on the 5th and 7th interstices most extended, particularly in the anterior spot; the coloured spaces not raised, nor of a different texture from the rest of the elytra; the interstices finely punctate, somewhat flattened on the disk, but very convex towards the sides; the marginal space marked with cross-punctures. Under-side black, pilose, hairs piceous; prosternum and breast deeply punctured, inferior margin of thorax impunctate; segments of abdomen finely acicularly punctured, with one or two deep foveæ or large punctures on the sides of the basal segments; inflexed margin of elytra almost impunctate. Legs black and pilose.

This species is allied to the *Cr. selenoderus* of Laferté, but may be at once known by its much greater size, it being fully a third larger.

4. *Cr. Lafertei*, mihi.

Niger; thorace obcordato, ad basin truncato, angulis anticis rotundatis et projicientibus; elytris curtis, maculis duabus rufis, altera antica fere ad humerum posita et ad marginem attingente, interstitia quinque tegente; altera postica transversa, interstitia quatuor tegente.

Fig. 4.



Long. $7\frac{1}{2}$–8 lin., lat. $3\frac{3}{4}$ lin.

Black. Head rather broad, closely covered with small punctures, which become confluent here and there, particularly in two foveæ on each side of the head; space in front (clypeus) impunctate, smooth and shining, with one large puncture on each side. Antennæ piceous, darkest at base. Palpi ferruginous. Thorax obcordate, very uniformly covered with punctures smaller than those in any of the preceding species, which become faint and disappear towards the margin near the posterior angles; the margins are expanded and very slightly reflexed, and at the anterior portion they have a narrow edging or border; anterior angles projecting and rounded-in to the neck, truncate at the base; posterior angles slightly projecting backwards, and with a slight exterior excision at the point; middle portion of base also very slightly projecting backwards; the dorsal line is distinct, except behind, and there is an elongate straight depression at the base on each side. Scutellum triangular, with the sides slightly sinuate, smooth and impunctate. Elytra sparingly pilose, short, convex, and looking somewhat as if curtailed, punctate-striate, the striæ deep, particularly towards the apex, and with the interstices convex and punctate; marginal space with a distinct row of transverse punctures; two clear red or ferruginous spots on each elytron, the anterior reaching to the margin, and extending over the 5th, 6th, 7th, 8th and 9th interstitial spaces; this spot runs obliquely from the shoulder in the direction of the suture, is rounded opposite to it, and then returns in a slightly rounded line to the margin; the posterior spot is short and nearly transverse, and is confined to four interstitial spaces, the 5th, 6th, 7th and 8th, and is most prolonged on the 7th; the spots are of the same texture as the rest of the elytra, and are not raised above their surface; apex emarginate. Under-side with the prosternum and breast deeply punctured, the prosternum more sparsely than the breast; inferior margin of thorax shining, and with faint traces of punctures; inflexed margin of elytra finely punctate; sides of segments of abdomen coarsely punctate, less so towards the apex, middle portion finely aciculated. Legs pitchy-black, with tibiæ piceous and tarsi dark ferruginous.

I have named this species in honour of the Marquis de Laferté Senectère, who has published an able revision of the group on which we are at present occupied, and has been kind enough to give me the benefit of his information as to my new species.

5. *Cr. grossus*, Hope. Pl. XIII. fig. 8, in vol. xix. [June] of Annals.

Panagæus grossus, Hope, Ann. Nat. Hist. x. (1842) 94.
Panagæus grandis, Imh. Verhandl. d. Nat. Gesellsch. in Basel, v. p. 166.

"Niger; antennis atris; thorace fere hexagono, angulis anticis rotundatis, posticis abrupte truncatis, disco subconvexo punctato, lateribus parum depressis et marginatis; elytris sulcato-punctatis, quatuor maculis rubro-miniatis insignitis, corpore pedibusque nigris*."

Long. 11 lin., lat. $4\frac{1}{2}$ lin.

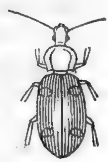
I believe this species to be, as above stated, the *grossus* of Hope. His description, as is usual with him, is more concise than we could have wished; and I shall therefore add a somewhat more detailed description, although the admirable figure by M. Migneaux, which the reader will find in my last plate of Old Calabar species, renders any additional description scarcely necessary.

* Hope in *loc. cit.*

Black. The head is impunctate, but finely rugose between the antennæ, with an elongate fovea on each side, in which the rugosities almost take the appearance of punctures. The antennæ are black and piceous towards the apex. The clypeus is smooth and elevated in the middle. The thorax may rather be described as truncate-cordate than as hexagonal, but as both the anterior and posterior portions of the lateral margins are somewhat straight, either expression may be used without being inconsistent with the truth; it is faintly and not very closely punctured, sparingly pilose, the margins reflexed, the dorsal line distinct, but reaching neither to the front nor the base; a deep longitudinal fovea is on each side of it at the base; the base is truncate, a broad space in the middle projecting very slightly backwards; the anterior angles are narrow, and project a little, and are rounded; the posterior angles are right-angled, and have the usual excised tooth. The scutellum is small and impunctate, and has the sides gently curved. The elytra are convex and obovate, pilose or pubescent, deeply punctate-striate, the punctures faint; the interstices are convex and finely punctate; the spots are red, with a tinge of vermilion; the anterior occupies four interstitial spaces (the 5th, 6th, 7th and 8th), and also the marginal space; but the raised margin itself (which is prominent) is not coloured; the posterior spot occupies the same striæ, but not the marginal space; the spots are of the same texture as the rest of the elytra, and are not raised. The marginal space might be called the last interstitial space, as it is broad and raised like the rest, but in addition to the fine punctuation found in the interstitial spaces, it has a series of larger pits of various sizes, with a raised point in their middle. The hairs are piceous, except on the red spots, where they also are red; they are red on the under side of the body, which is sparsely punctured on the prosternum, breast, and sides of the segments of the abdomen (their middle portion being slightly aciculated). The tarsi are piceous.

6. *Cr. Erichsoni*, Hope.

Fig. 5.



Niger, rugose punctatus; thorace fere circulari, ad basin truncato et in medio retro projiciente, lateribus reflexis, rugose punctato; elytris punctato-striatis, maculis duabus parvis fulvis elevatis, singulis interstitia quatuor tegentibus.

Long. 8 lin., lat. $3\frac{1}{4}$ lin.

Black. Head moderate rugosely punctate, with a longitudinal fovea on each side in front, and a smooth rounded elevation between them, margined on each side in front of the eyes. Palpi nearly smooth. Thorax small, very deeply and coarsely punctate, on a hasty inspection appearing nearly circular, the anterior angles being rounded-in to the anterior margin, which is almost straight; the sides behind the middle sloping more rapidly to the posterior angles, which are obtuse and have a slight excision; base truncate at the sides, with the middle space (which is also truncate) abruptly projecting backwards, as in *Lebia*; margins broadly reflexed, more narrowly in front, the depression ending in a deep fovea on each side behind; the reflexed margins are punctate in the same way as the rest of the thorax, but the basal foveæ are nearly free from punctures; dorsal line almost imperceptible. Scutellum elongate triangular, impunctate. Elytra elongate, somewhat parallel, sparingly pilose, deeply punctate-striate; interstices convex, finely and sparsely punctate, the punctures both on the striæ and on the interstices are transverse, becoming towards the sides and on the marginal space almost transversely strigose; two yellow spots on each elytron, the anterior transverse, and about a fourth of the length of the elytra from the base, the posterior obliquely transverse and about a fourth from the apex: the spots are of a different texture from the rest of the surface, somewhat raised, glossy and lustrous, and nearly impunctate, and are placed on the 5th, 6th, 7th and 8th interstitial spaces; on the 6th projecting most forward, on the 7th most backward; apex slightly emarginate. Under-side with the prosternum and sides of breast coarsely punctate; inferior margins of thorax impunctate; sides of the segments of abdomen coarsely punctate, middle smooth, with aciculations; inflexed margin of elytra somewhat rugose. Coxæ punctured. Legs slender.

I learn from Mr. Westwood that this is Hope's *Erichsoni*, although, from his description, I should not have found it out. It is interesting from its approaching the New Holland species, *australis*, Dej., to which it bears considerable resemblance.

7. *Cr. Symei*, mihi.

Niger vel brunneo-niger, pilosus; antennis ferrugineis; capite parum punctato; thorace fere hexagono, pone medium latiore, fortiter punctato, lateribus posterioribus testaceis et translucentibus, foveis elongatis duabus ad basin; elytris crenato-striatis, interstitiis leviter punctatis, maculis duabus testaceis, altera antica interstitia sex et marginem tegente, ad humerum ascendente, altera postica interstitia quinque tegente; pedibus testaceis.

Long. 3¼ lin., lat. 1¼ lin.

Of the form and facies of *Panagæus crux-major*, but smaller.

Black, or fuscous black, pilose; the pubescence or hairs testaceous. Antennæ and palpi ferruginous. Head punctate between the eyes; the clypeus smooth. Thorax somewhat hexagonal, truncate at base, the greatest breadth a little behind the middle, uniformly coarsely punctate, the margins a little expanded and reflexed posteriorly, and where expanded testaceous and semitransparent; dorsal line faint, and on each side of it an elongate basal fovea; the middle of the base very slightly and abruptly projecting backwards. Scutellum small, smooth. Elytra somewhat elongate and parallel, crenate-striate, the interstices faintly punctate; two testaceous spots on each elytron, the anterior covering the whole interstitial spaces from the 4th to the raised and inflexed margin inclusive, anteriorly gradually ascending from the 4th till it reaches the 7th interstice, on which and the remaining portion of the side of the elytron the colour runs up to the base, where it turns in again upon the 6th and 5th, and posteriorly runs down a short space upon the 7th or 8th and the remaining lateral space; the posterior spot is narrower, and confined to the 4th, 5th, 6th, 7th and 8th interstices, being curved obliquely backwards. Under-side black; prosternum and breast coarsely punctate, and segments of the abdomen finely punctured, with a few coarser punctures on the sides. Legs testaceous.

I have dedicated this species to my friend Mr. John T. Syme, Lecturer on Botany in St. George's Hospital, London, a very able and zealous entomologist.

It is not without doubt that I have placed it in the genus *Craspedophorus* instead of in *Panagæus*. It has much more the appearance of *Panagæus crux-major*, *P. fasciatus*, &c., than of any of the *Craspedophori* with which I am acquainted, but none of the three specimens which I possess have the anterior tarsi dilated. It may be that they are all females, or it may be that the tarsi of the males are not dilated. In the absence of proof that they are dilated, I have kept this and the following species in this genus (of which the non-dilatation in the males is the essential character), notwithstanding that I cannot help thinking they more properly belong to *Panagæus*.

8. *Cr. vicinus*, mihi.

Valde affinis præcedenti, et differt præcipue in macula antica non attingente marginem elytrorum.

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

Very closely allied to the preceding species—possibly only a variety. It is rather larger, has the foveæ at the base of the thorax rather deeper and broader, and the testaceous or yellow markings on the elytra differently disposed. The anterior spot does not reach the margin, being confined to the 4th, 5th, 6th, 7th and 8th interstitial spaces, the colour being shortest on the 5th and longest on the three last; the posterior spot is confined to the same interstices, almost disappearing on the last; it is more transverse and not so much curved obliquely backwards and outwards as in *Symei*.

[To be continued.]

XI.—*Notes on the Indian species of* Lycium. By T. Anderson, Esq., M.D., Oude Contingent*.

In October 1855, when passing through the Doab between the Ravee and Beas, I gathered a specimen of *Lycium Edgeworthii* of Dunal, a species founded on a plant sent to Dunal by Mr. Edgeworth, from near Sirhind. The plant in my herbarium is evidently the same as that which Dunal has described; but after most careful and repeated examination of a considerable number of specimens in my possession, I am convinced that Dunal's *L. Edgeworthii* is only a variety of his *L. mediterraneum*, the *L. europæum* of Linnæus. In order that his species *L. mediterraneum* and *L. Edgeworthii* may be distinguished, he has refined their specific characters so much, that they appear to be the descriptions rather of trivial varieties than of permanent and well-marked species. The differences between the specific characters of the species consist of a line or two in the length of the calyx—a mark of no importance, of minute differences in the length of the pedicels and peduncles, and of inconstant characters taken from the existence of minute hairs at the insertion of the filaments in *Lycium Edgeworthii*. In my specimens I found several flowers entirely glabrous. In *Lycium europæum* the character is "filamentis basi puberulis." Characters are also taken from the branches and spines, but the latter, in both species, are of all shapes and sizes, from a simple thorn $\frac{1}{4}$ of an inch long to a spine 3 inches long, bearing leaves and flowers. Dunal supposes the colour of the corolla of *L. Edgeworthii* to be yellow; in my specimens it is pale rose-coloured, as in *L. europæum*.

Dunal has proposed to change the name of the Linnæan *L. europæum* to *L. mediterraneum*, a change by no means applicable to a plant widely diffused in India. I therefore retain the Linnæan name, and propose the following specific character, which seems applicable to both the Indian and Western plants.

L. europæum, fruticosum, cortice albido, ramis spinescentibus, spinis teretibus, foliis 2–5 ad basin spinarum fasciculatis, obovato-

* From the Journal of the Asiatic Society of Bengal, No. I. 1857.

oblongis vel oblongo-cuneatis, pedicellis calyce longioribus, interdum geminis, plerumque unifloris, calyce breviter 5-dentato glabro vel puberulo, corolla calyce duplo longiore anguste infundibuliformi, staminibus inclusis.—*L. europæum*, Linn. et auct.; Royle, Ill.; *L. mediterraneum*, Dun. in DC. Prod. xiii. 523 (cum omnibus variet.); *L. Edgeworthii*, Dun. in DC. Prod. xiii. 525; *L. indicum*, Wight, Icones, t. 1403.

Hab. in India prope Delhi, *Royle*; Guzerat, *Wight*; Sirhind, *Edgeworth*; Panjab ad Umritsir, *T. Anderson*.

Folia glabra vel punctulata $\frac{1}{2}$–1 unciam longa. Spinæ axillares nudæ vel foliosæ $\frac{1}{4}$–1 unciam longæ. Flores gemini vel sæpius solitarii e fasciculis foliorum. Calyx 5-dentatus cyathiformis 1–2 lineas longus, glaber. Corolla calyce longior infundibuliformis 4–6 lineas longa, roseo-alba. Filamenta filiformia inclusa inæqualia, uno cæteris breviore. Antheræ parvæ ovatæ, basi bifidæ. Stylus cylindricus, staminibus longior. Stigma orbiculare, capitatum. Pollen in aqua globosum. Ovarium ovatum. Bacca globosa parva.

In India, special care is required to guard against the undue increase of species, since in this country, besides difficulties arising from want of books of reference, natural causes make the determination of species more difficult than in Europe. One of the most powerful of these is the sudden and complete change of climate in many parts of the Peninsula of India, arising from the periodical recurrence of the rainy season, which often alters the flora from that of an arid plain to one consisting entirely of a large number of tropical annuals. This climatic change also temporarily affects the appearance or "habit" of the perennial plants, causing a wonderful luxuriance of growth and alteration of the foliage. To these changes *Lycium europæum* is fully exposed. It is a native of dry sandy plains, where, before the rains, it is stunted in all its parts; but when the air and soil become charged with moisture, an expansion of all its parts takes place, fully accounting for the multiform characters of its leaves, and the diversity in the length of the spines, &c.

XII.—*On the Development of* Purpura. By Wm. B. Carpenter, M.D., F.R.S., F.G.S., F.L.S.

To the Editors of the Annals of Natural History.

July 20, 1857.

Gentlemen,

My friend Dr. Dyster of Tenby (whose competency as an accurate and well-informed microscopist is well known to every naturalist who has visited that place) having applied himself afresh, at my request, to the question of the development of *Purpura*, has just sent me the following notes, which I will thank you to publish in your next Number:—

"1. The egg-like bodies in the recently-separated egg-capsules are *destitute of any investing membrane.*

"2. In those possessing a 'directive vesicle,' an envelope appears very quickly; and in such as are thus distinguished, *the segmentation is regular*, and never in such sort as to give them the lump-of-different-sized-cannon-shot-look (excuse my terminology) which the vitelline spheres assume. The latter segmentate frequently before the true ova,—I mean before those possessing the 'directive vesicles.'

"3. *I have distinctly seen vitelline spheres from the agglomerated mass pass through the œsophagus, and become united to the mass within the embryo.* I have made several drawings of the œsophagus of embryos at different periods; and I took care not to look at yours first. They are so like as not to be worth sending up, except that the aperture (when seen in front) appears more nearly circular than in your figure. I could see right down to the mass below. On subjecting a full embryo to pressure (under the compressor) applied *a tergo*, the vitelline mass issues through the œsophagus."

I venture to hope that I am now sufficiently exculpated from the imputation thrown upon me by MM. Koren and Danielssen, of having mistaken for an œsophagus the incipient foot. But if further justification be necessary, I would beg to refer to the memoir of M. Claparède (Müller's Archiv, April 1857) on the development of *Neritina fluviatilis*, in which all my most important statements are borne out (express reference to them being made) by the analogy of another species, and the coexistence of a mouth and ciliated œsophagus with the rudimentary foot is placed beyond all question*. It is not a little remarkable that, according to M. Claparède, the observations of M. Lindström, which have been cited by Messrs. Koren and Danielssen as confirmatory of *their* views, are really coincident with *his*, and therefore with *mine*.

I am, Gentlemen,
Your obedient Servant,
WILLIAM B. CARPENTER.

* An abstract of M. Claparède's memoir will appear in the next Number of this Journal.

XIII.—*Observations on the Larvæ of the Trematode Worms.* By Dr. P. de Filippi*.

Having this summer pursued my investigations upon the Trematode worms in the larva state, I have succeeded in finding some new forms, and in adding to the results of my previous observations some details as to the mode of life of these creatures.

The *Paludina impura*, of which I have captured many individuals in different localities in the vicinity of Turin, has furnished me with three new species of these parasites:—

1. Some *Rediæ* producing Cercariæ of *Distomum*, very distinctly characterized by a tubercular body, and by the small ventral disk situated at the posterior third of the body, but especially by the bifurcate excretory organ, forming two large, lateral, twisted vessels, which ascend to the sides of the anterior sucking-disk. This species becomes encysted with the greatest facility, even on the stage of the microscope. It has shown me that in the formation of the cyst, after the concentric layers of mucosity exuded by the *Cercaria*, the skin of the latter assists, becoming detached, and forming the inner wall of the cyst itself.

2. A very fine Cercaria of *Monostomum*, furnished with large eyes in the form of two semi-lunar spots, with a tolerably strong pharyngeal bulb, and with a tail provided with a membranous crest. This species is produced from a very elongated Redia, without lateral appendages.

3. Some very peculiar nurses, almost identical in their organization, vital properties, and the form of the Cercariæ produced by them, with those found by M. Moulinié in the *Limaces*†. This is decidedly a third kind of nurse, very different from the two known up to this time, and for which I have reserved the names of *Sporocystis* and *Redia*. They present the form of a cylindrical sheath, with pretty thick walls, of which the narrowed anterior extremity forms a button or a head. This sheath is contractile; the head especially moves, and elongates and shortens itself, issuing from and re-entering a sort of collar. Notwithstanding this vitality which they enjoy, these sheaths did not present any vessels or intestines, or even a mouth. The cavity of the body is filled with Cercariæ, which, like those described and figured by M. Moulinié, are characterized by a very short tail, by a rounded excretory organ of

* Translated by W. S. Dallas, F.L.S., from the Annales des Sciences Naturelles, 4me série, tome vi. p. 83.

† Mémoires de l'Institut Génèvois, tome iii.

on the parasites of the marine Mollusca. The locality beaten by the waves was by no means favourable, and I was only once able to find in the *Conus Mediterraneus* a fine flask-shaped Redia with a long, but usually retracted neck, a very large pharyngeal bulb, a short intestine, and a well-developed vascular system. I am compelled to confine myself to this mere indication, because the offspring which it contained was only in the state of germs.

XIV.—*Observations on the Development of the Star-fishes.* By J. Koren and D. C. Danielssen*.

Sars was the first to make known to us the history of the development of the Star-fishes, in Wiegmann's Archiv, x. p. 169. Subsequently, in the 'Fauna Littoralis Norvegiæ,' p. 47, he furnished complete observations upon the *Echinaster sanguinolentus*, Müller, and the *Asteracanthion Mülleri*, Sars. Here he described minutely the external changes passed through by the embryo until it acquires the radiate form. Unfortunately, he did not succeed in explaining the internal organization. The Star-fishes observed by Sars belong to the section in which the development takes place without any peculiar larval apparatus.

A short time afterwards, Desor† published the history of the development of a Star-fish, which took place nearly in the same way as that described by Sars, except that in place of four clavate prehensile arms, there was only one, which was always ventral, and placed near the middle of the Star-fish. With regard to this organ, Sars and Desor are at variance. Sars supposed that the four prehensile arms left a cicatrix, which became the madreporic plate. Desor, on the contrary, regarded the claviform prehensile arm as a vitellary sac, which diminished in proportion as the little Star-fish increased in size, until at last it disappeared altogether.

Subsequently, Agassiz‡ published his observations, which for the most part agree with those of Desor, although he does not say that the claviform stem becomes an appendage of the digestive organs. Agassiz says that he has seen the contents of the stem turn upon themselves. W. Busch§ observed and

* Translated from the Fauna Littoralis Norvegiæ, Part ii. p. 55. By W. S. Dallas, F.L.S.

† Proc. Boston Soc. Nat. Hist. Feb. 15, 1848; Müller's Archiv, 1849, p. 79.

‡ American Traveller, Dec. 22, 1848; Müller's Archiv, 1851, p. 122.

§ Beobachtungen über Anatomie und Entwickelung einiger wirbellosen Seethiere, p. 77. Berlin, 1851.

ducts which terminate at the spine originate from a very pretty bunch of secretory cells. This characteristic apparatus of the armed Cercariæ is not so well developed in any other species.

Amongst the Cercariæ which I have already made known in my previous works, and which I have again frequently seen in the course of this year, I shall mention particularly the *Cercaria virgula*, of which I have indicated the analogy with the *C. microcotyla*, parasitic on *Paludina vivipara**. I must now add, that in the form and dimensions of its Sporocysts, the *C. virgula* presents the same differences that I have found in the other allied species.

In some individuals of *P. impura*, the Sporocysts of *C. virgula* are large and elongated, and contain a considerable number of Cercariæ; in others, on the contrary, we only find small Sporocysts, usually of a rounded form, upon which we can see a sort of more or less apparent umbilicus, and which only contain a very small number of Cercariæ (3–4). These Cercariæ are exactly identical, both in form and organization, with those produced by the large Sporocysts; but their dimensions are much less, being reduced nearly to half. On examining a great many of these little Sporocysts, we soon see that they are the result of a scission of other larger ones; so that what I have just called an *umbilicus* really merits that name, because it corresponds with the spot at which the separation has taken place. The same difference between large and small Sporocysts exists in the *C. microcotyla* of *Paludina vivipara*, as I have pointed out elsewhere†, and this difference now receives its explanation. It is not impossible that these small Sporocysts and Cercariæ belong to different species from the analogous large Sporocysts and Cercariæ.

I have been struck this summer by the frequency (although the individuals were always few in number) of a Cercaria, which was first indicated by M. de la Valette under the name of *C. cristata*‡, and which never occurred to me in my previous researches. This singular creature, which I have met with in different species of Mollusca (*Valvata piscinalis, Paludina impura, Planorbis submarginatus, Lymnæus stagnalis, L. palustris*), is still the subject of a problem with me. If it be really a Cercaria, it can only be referred to a *Monostomum*.

In the month of August I passed a few days on the shore of the Mediterranean, with the view of making some investigations

* Second Mémoire pour servir à l'histoire génétique des Trématodes, p. 6. Turin, 1855.

† Mémoire, &c., p. 9. figs. 5, 6 (1854).

‡ Symbolæ ad Trematodum evolutionis historiam. Berlin, 1854.

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figured larvæ exactly resembling those of Sars, and according to his observations the prehensile arms would disappear at last upon the ventral portion. Neither Sars, Desor, nor Agassiz speak of the mouth of the larva; Busch, however, asserted that he had seen one, between the four prehensile arms; but this he has given up, since Sars, who has had the opportunity of observing a multitude of larvæ, did not see the mouth.

J. Müller* has minutely observed the larvæ of *Echinaster sanguinolentus*; but, unfortunately, this celebrated naturalist had only spirit-specimens, so that with regard to this point he could obtain no information. Having been unable to procure these larvæ, we are also compelled to pass over this question. According to J. Müller's observations, the prehensile organs are hollow, and have no relation to the digestive organs. In the interior of the body, at the side opposite to the prehensile organs, the stomach makes its appearance as a round body with a central cavity. It advances by degrees towards the middle of the body, in proportion as the larvæ acquire the radiate form. When the stomach is completely formed, the mouth opens at the point where it occurs in the adult Star-fish. After these remarks, we shall speak of the development of *Pteraster militaris*.

On the 9th of August 1852, we found this Star-fish with young in various stages of development. We know, from the observations of Sars, that the young of *E. sanguinolentus* and *A. Mülleri* are developed in a cavity situated in the vicinity of the mouth, and which is formed by the Star-fish drawing up its disk, collecting together the widest parts of its rays, and adhering by their tips. In *Pteraster militaris* there is a large hollow space between the skin, which bears the calcareous network and the spines, and the delicate soft membrane, which is supported and sustained by the spines, like a roof with numerous rows of pillars. At the middle of the back, this membrane has a large opening, which is pushed out like the neck of a bottle and surrounded by five small bundles of perfectly straight bristles. At the bottom, just at the middle of this, the anus opens. In the cavity above described the eggs are developed, and the young remain there until they have acquired the radiate form. It is only then that they pierce through the membrane above mentioned.

The number of young found in the cavity varies: in some specimens we have only found 8–10, in others 20, or even more. Most of the young occur along the arms, and only a few at the middle of the disk. The colour was usually yellowish, and most

* Ueber den Allgemeinen Plan in der Entwickelung der Echinodermen. Berlin, 1853.

of the young had already acquired the radiate form, and were provided with eyes, which could be seen through the above-mentioned membrane. Unfortunately, we found none in the state of embryos, but we succeeded in finding some in the larval state. In these the body was of an oval form, a little waved in the middle, and at its upper part a buccal opening was perceived, which descended towards an extremely delicate intestinal canal. The larvæ being perfectly opake, we were obliged to employ a careful pressure to show the internal organs. By this compression we saw that the skin was furnished here and there with calcareous particles; in other respects, the body was composed of a dark, granular mass. The buccal orifice appeared in the form of a funnel; it led to a delicate and narrow intestinal tube, of the same width throughout, except at its upper part, which was a little widened in the form of a funnel towards the buccal orifice.

The intestinal canal, after passing towards the posterior part of the body, made a curve to the right, and was then lost in the dark vitelline mass. In the interior of the body, and nearly in the middle, a mass of dark, closely-packed granules was observed (the commencement of the stomach of the Star-fish). This dark spot was already surrounded by a circular aquiferous canal. A hollow tube arose from the back of the larva (the commencement of the sand-canal), and terminated in the interior of the circular canal. We could not observe whether this tube had an external opening.

Another larva which we examined had five rounded rays at the margin. On the dorsal surface, towards the margin of one ray, there was a small, projecting, buccal orifice, which led to the delicate intestinal canal. When this larva was compressed, the buccal orifice and the intestinal canal appeared more distinctly, and although the latter was extremely delicate, it could nevertheless be traced to its opposite extremity, where it described a curve to the right, and opened upon the back of one of the rays. In the middle of the Star-fish a dark, round body (the stomach) was distinctly seen, with the aquiferous canal and the sand-canal which opened into it. No trace of ambulacra could be discovered, but, on the other hand, several irregular calcareous pieces were seen in the mass of the body.

The third young animal was much larger, and had five obtuse rays distinctly developed. At the middle of the extremity of each ray there was an eye, composed of three pigmentary agglomerations, formed by dull orange-coloured pigment-granules. The larval mouth, which was slightly prominent, was situated to the left between two rays. The intestinal canal and the anal orifice could still be seen distinctly. Calcareous spines had been formed in the skin. At the middle of the back there was an opening, just at the spot where the prominent orifice, in the form of the neck of a bottle, occurs in the adult animal. In the middle of the ventral plane the buccal orifice was observed, surrounded by five calcareous pieces, and closed by a pretty strong membrane. The stomach was distinctly formed, and surrounding it the aquiferous canal already mentioned was observed, from which five canals passed to the five rays. From each canal lateral canals issued, which terminated in the pedal vesicles. In this specimen there were three pairs of ambulacra.

On the 12th of August we again examined some specimens. The larval mouth still existed, but a portion of the intestinal canal of the larva had already begun to disappear. On the back, which was tolerably convex, the madreporic plate was found in an interradial space. Four pairs of ambulacra were formed. The skeleton was then pretty well developed. The membrane which closed the buccal aperture still existed; it does not disappear until afterwards, so that the true mouth is only formed after the young animal has quitted its mother.

If we glance at the observations which we have made upon the development of *Pteraster militaris*, we shall see that the embryo passes through three stages,—the embryonic state, that of the larva, and that of the Echinoderm, all of which are passed through whilst the embryo is enclosed in the maternal cavity. On comparing this, in the first place, with the Star-fishes whose larvæ are furnished with claviform prehensile organs, but nevertheless, as regards the development of the other internal organs, are still in the embryonic state, and then with those which have special larval organs which subsequently disappear, we shall find that the development of *Pteraster militaris* differs in several points from that of those larvæ. In *Pteraster*, the form of the larva is oval, without prehensile arms, and it is furnished with a buccal orifice, and with a long and narrow intestinal canal, which terminates by an anal orifice. Both the mouth and the remainder of the intestinal canal disappear by absorption, but only some time after the true Echinoderm has made its appearance. Even in the larva the rudiment of the stomach of the future Star-fish is perceived; this, however, does not arrive at its perfect development until the radiate form has made its appearance. For some time the larval mouth and the intestinal canal and anal opening are still observed; for it is only at a later period of development that all these attributes disappear, after the formation of a mouth in the centre of the ventral surface and an anal orifice on the back.

In *Bipinnaria asterigera* the œsophagus of the larva enters into the back of the Star-fish excentrically and interradially.

Near to it, and a little to the left, the anal tube is situated, at a considerable distance from the centre of the Star-fish.

In *Pteraster militaris* the larval mouth only presents itself upon the back near the margin of two arms, in the most advanced larval state; and the anal orifice is situated here, as in *Bipinnaria asterigera,* excentrically. In *Bipinnaria asterigera,* in which the Star-fish only communicates with the larva by the œsophagus and the skin which passes from the larva to the Star-fish, the larva detaches itself from the latter by the œsophagus becoming constricted with strong contractions, whilst the detached larva dies in six or eight days. We have also observed that the whole intestinal canal disappears, and that a new anal orifice is formed; it is only the stomach that remains of the larva. This takes place somewhat differently in *Pteraster militaris,* for the entire larva passes into the Star-fish, although the latter receives a new mouth, intestinal canal, and anus. J. Müller has indicated that *Bipinnaria asterigera* is perhaps a stage in the development of *Solaster furcifer.* It is now some years since we expressed the same opinion on this subject to MM. Sars and Bockdaleck.

BIBLIOGRAPHICAL NOTICES.

System der Ornithologie West Afrika's von Dr. G. Hartlaub. Bremen, 1857, 1 vol. 8vo.

Until the local faunæ of the different parts of the earth's surface have been worked out to a much greater extent than has as yet been accomplished, it is almost hopeless to attempt with any certainty to enunciate general laws on the geographical distribution of animal life, one of the most interesting and by no means one of the least important subjects of natural science. It is with great pleasure, therefore, that we welcome every successive attempt to form an accurate account of the whole or any part of the animated nature of particular countries. Africa is a zoological kingdom to which the naturalists of Germany have of late years devoted no small degree of attention. Since Dr. Rüppell completed his great contributions towards our knowledge of the zoology of North-eastern Africa, Vierthaler, A. Brehm, Von Müller, and Prince Paul of Wurtemburg, have made further explorations into more remote portions of the same country, and have reaped a rich harvest of results; and Dr. Peters, returned from the little-known region of the Mozambique, has commenced the publication of his numerous discoveries in every branch of zoology. To the ornithology of Africa, Dr. G. Hartlaub of Bremen has for several years devoted much of his attention; many papers in the Transactions of the Natural History Society of Hamburg, and in Cabanis' 'Journal für Ornithologie,' bearing witness to his untiring application to this subject. In Dr. Hartlaub's most recent publication, the 'System der Ornithologie West-Afrika's,' we have in a connected form a complete summary of all that is known concerning West African ornithology up to the latest date, and this given in a manner that may well serve as a model for naturalists who are desirous of writing similar essays upon any branch of natural history.

A very interesting and copious introduction (in which a complete review of African ornithology generally is given, together with many remarkable facts concerning the geographic extension of the different forms, and a summary of all that is known about the nidification and propagation of the species) leads us to the main part of the volume, which consists of an enumeration of all the birds which are known to occur in Western Africa. Concise specific characters in Latin are assigned to every species; the more important synonyms and numerous references to the works in which each has been noticed by former writers are given, and, what is also important, as being a point much too generally neglected by naturalists, the exact localities in which each species has been found, together with the authority for such locality. The amount of labour which it must have cost to accomplish this result cannot be easily estimated. It is no light task to draw up specific characters for seven or eight hundred animals when they are all ready before one's eyes; but, when many of the types are scattered about in the different museums of Leyden, Paris, Basle, London, and Philadelphia, all of which must be formally visited, or seen by the eyes of correspondents (who have to be kept up to their work of replying to numerous interrogatories by thrice the corresponding number of applications), it is no small praise to say, that the whole has been finished in a manner which must be highly satisfactory to every one who takes an interest in the progress of natural history.

The portion of the African continent which Dr. Hartlaub has embraced in his present treatise consists of the whole country lying along the coast from Senegal southwards to Benguela, a distance of nearly 30 degrees of latitude. But in very few points within this region have explorers penetrated far into the mainland, and the number of species, therefore (758), included in Dr. Hartlaub's catalogue, indicates an *Avifauna* of no ordinary richness. The discoveries also which have lately been made by P. B. Du Chaillu and other collectors in Gabon (who have made some advances towards the unexplored interior), give promise of many interesting accessions to the list as time progresses.

Western Africa, as Dr. Hartlaub observes, in its general zoological aspect, shows a rich originality. The productiveness and peculiarity of the African fauna are here continually discovering new and unexpected treasures to the investigator. This is the realm of the giant *Gorilla*,—here are the haunts of the most colossal of all serpents,—this is the country whence marvellous *Goliathi* delight the vision of the entomologist,—and where amongst the birds, the peculiar African forms are met with in the greatest abundance and most characteristic species.

Of the 758 species of birds which Dr. Hartlaub includes in the

Zoology of Western Africa, no less than 400 appear to be peculiar to this part of the continent; 150 occur also in North-east Africa; 64 are also found in South Africa; the remaining 140 appear to be pretty well dispersed over the continent, since they are met with in North-eastern, Western, and Southern Africa. Of the 124 *Accipitres* which are known to occur on the African continent, 56 are met with in Western Africa; but, singularly enough, no examples of the genera *Gypogeranus, Polyboroides,* or *Helotarsus,* which are the three most characteristic African types of this order.

Of *Passeres* we have notice of no less than 450 species, among which are members of many remarkable genera—such as *Meropiscus, Parinia, Ixonotus, Striphrornis, Pæoptera, Hypergerus, Bias, Megabias, Elminia, Artomyias, Erythrocercus, Lobotos, Chaunonotus, Picathartes,* and *Onychognathus,* which, as far as is hitherto known, are all peculiar to Western Africa. Of *Columbæ* 17 species; of *Gallinæ* 19, including members of the peculiar African genera *Numida, Agelastus,* and *Phasidus.* The two latter forms are restricted to Western Africa. The order *Struthiones* is worthily represented by the Ostrich.

Among the 99 species of *Grallæ* contained in Dr. Hartlaub's list, the most eccentric form is perhaps Temminck's Ralline genus *Himantornis,* discovered by Pel in Ashantee. Lastly, 42 species of *Anseres* conclude the series of West African birds.

Popular History of the Aquarium of Marine and Freshwater Animals and Plants. By George Brettingham Sowerby, F.L.S. 12mo. London, Reeve, 1857.

If we may apply to some of our writers on science the old rule that "by their fruits ye shall know them," it would almost appear that they consider one of the great beauties of a popular work to consist in its resemblance to those complicated pieces of patchwork in which our grandmothers used to take so much pride. The prescription which they adopt in the manufacture of a book would seem to be somewhat as follows:—Take all the standard works on the subject to be treated of; transfer the choicest passages to a notebook; select those which suit you best; tack them together with as much of your own material as may be absolutely necessary; sprinkle in a few fragments of poetry (which you may easily pick up along with your other plunder); print and publish. The less trouble you take, the better, as you will the sooner be done and get your money: if the book sells, the publisher is satisfied; and as for the public, your conscience may be perfectly easy, for the matter you appropriate is far better than anything your own brains are capable of furnishing; so what right has anybody to complain? The only answer to the last question that we can think of at the moment, is that the authors of the works subjected to this shameless system of robbery may perhaps be foolishly inclined to think that it would be more to their advantage if the public would read their works in the original form, rather than in pirated extracts; but this we must leave to their consideration.

As far as we can judge from the results, it would appear that some very similar rule must have guided our author in his literary labours; and at all events, we may safely say that he is one of the greatest proficients in the art of scissors and paste. Of the little work whose title stands at the head of this article, nearly a third consists of acknowledged quotations from the works of Gosse, Johnston, Forbes, Bell, Dalyell, Baird, &c.; fully another third is abstracted, with more or less verbal alteration, from the same authorities, and the remainder is——twaddle.

In his preface Mr. Sowerby apologizes for his limited acquaintance with the "*Hydroid Zoophytes*," as well as with some other "animal organisms." If he had included the whole range of Zoology in this avowal of ignorance, he would have been nearer the mark. An utter want of knowledge is observable in almost every page: names are continually misspelt (as, for example, *Acephala* for *Acalepha*, which occurs in two or three places); Johnston's definition of Zoophytes, which applies to both the Polypes and Polyzoa, is given as belonging to the former only; and as if to make up for this, the four species of Polyzoa to which the author refers are placed, three of them with the Hydroid Zoophytes, and the fourth (*Alcyonidium*) with *Alcyonium*, amongst the Asteroida. Circumstances such as the presence of thread-cells in the Polypes, are also referred to repeatedly as if peculiar to certain species, simply because they are mentioned in some quotation, although the author informs his readers at the outset (in a passage borrowed from Gosse) that this is the case in all Polypes. There are some curious confessions of ignorance in different parts of the work, as, for instance, at p. 209, where we find that the author's "only opportunity of observing a living specimen of the Entomostracous division of Crustacea was that afforded me by the attendant at the Zoological Society's Fish-house, who had just taken from a pike a specimen of *Argulus foliaceus*."

This primitive ignorance, of which there is abundant proof, would perhaps have been of less importance had the author taken the trouble to study his subject as he went on; but the idea that there was any necessity for such an exertion as this appears never to have entered his mind. Even the portions copied with modifications from other works are often disfigured by considerable blunders, as, for example, in the following beautifully intelligible passage (p. 164), which is evidently derived from Forbes's Star-fishes. After speaking of the oral and anal openings of the Echinodermata, our author tells us that "whatever relative positions these two openings take, the intestinal canal leading from one to the other is winding, and is attached to the inside of the shelly case by means of what is called an integument (!), as well as all the internal lining, with vibratile cilia, and which is connected with the function of respiration. They are believed to possess also a muscular apparatus, which has pulsations and branching veins connected with it, like the heart in more advanced animals." We need not dwell on the elegance and perspicuity of these passages, but the muscular apparatus which has "pulsations connected with it" would be a curiosity to see.

We find in the preface that to make up for the numerous quotations on those branches of science of which the author confesses himself to possess an imperfect knowledge, "other parts of the work contain more original observations and opinions, many of which will be new to the reader." We do not know whether the statement at p. 288, that the author has "seen the heads of common Mackerel shining brightly in a dark cellar," is one of these new observations; but his application of the fact to the establishment of the luminosity of fish in the sea, is certainly novel, as is also the implied statement that *Pyrosoma* is a fish, given on the same page. One of the "original" opinions is undoubtedly that expressed at p. 241, which attempts to account for the production of Hermit-crabs by the accidental introduction of the larval form of some common Crab into empty shells. Mr. Sowerby has not yet made the necessary experiments for the establishment of this theory, and "in the meanwhile we must," as he advises us, "be content to take the obvious facts as we find them."

Some of the animals referred to appear to us to be very absurdly introduced into a book on the Aquarium. Such are especially the freshwater Tortoises, Turtles, and Alligators, none of which are within the reach of the ordinary possessors of aquaria. Still more ridiculous is the introduction of an account, two pages in length, of Professor Owen's *Euplectella*, a sponge from the Philippine Islands, which Mr. Sowerby seems to hope may yet be seen "living and flourishing in our tanks." What interest Mr. Sowerby can possibly have in the matter we cannot tell; he would certainly know no more about *Euplectella* after seeing it, than he does now by simply reading about it.

We might without much trouble extend our list of Mr. Sowerby's errors, but such a treatment of such a work would be almost like breaking a fly upon the wheel, an operation which we have no desire to imitate. We have, indeed, already devoted to it far more space than it deserves on any consideration, except as it furnishes such a striking example of that wholesale and disgraceful pillage of standard works on science, by ignorant and careless compilers, which now threatens to become so much the fashion. Considering the number of works of all prices already existing upon the same subject, we cannot think that the present book was necessary on public grounds; and if the necessities of his series compelled Mr. Reeve to bring out a work on the "Aquarium," he ought at least to have taken care that the workman to whom he confided its production was rather more a master of his craft than the one whose literary offspring we have just been examining. We must add, that the volume, which is one of Mr. Reeve's popular series, is as usual illustrated by twenty coloured plates. These are drawn on stone by the author, and most of the figures are tolerably effective. One or two, however, are bad, especially that representing the Newts and Water-beetle, which is positively a ridiculous caricature.

A Popular History of British Crustacea; comprising a familiar account of their classification and habits. By ADAM WHITE, Assistant, Zoological Department, British Museum. Sq. 12mo. London, Reeve, 1857.

Mr. Reeve probably admires a good contrast; at least this is the only motive to which one can attribute his publishing consecutively two such opposite books as this and the one to which we have just called attention. In Mr. White's 'Popular History of the Crustacea' we have the carefully and conscientiously executed work of one who is well acquainted with his subject; and although we meet here and there with tolerably lengthy quotations relating to the habits of the animals described, it would be a hard-hearted critic indeed who would object to this, when the portion of the work evidently due to the author's own labour so greatly preponderates.

By this, we do not mean to say that any great amount of originality is displayed in its pages, and Mr. White himself is as ready as any one to acknowledge that in treating popularly of a subject upon which so much has been done, there is but little chance of striking into any new path; for he has evidently aimed solely at furnishing the young naturalist with a sketch of the characters and habits of the numerous Crustacea inhabiting the waters of our Islands, and it is not too much to say that he has been eminently successful. His little book is an extremely interesting and valuable addition to our popular literature of Natural History, especially as no work with the same scope was previously in existence, and the plates with which it is illustrated are, it seems to us, superior to most of those which have hitherto appeared in Mr. Reeve's series.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

May 14, 1857.—General Sabine, R.A., Treas. and V.P., in the Chair.

"On the Organization of the Brachiopoda." By Albany Hancock, Esq.

In the present memoir the author states at length, and fully illustrates by figures, the conclusions to which he has been led by a long series of researches into the anatomy of the Brachiopoda; investigations which have been conducted with a special reference to the discrepant opinions maintained by Prof. Owen and the older writers on the one hand, and by Prof. Huxley and himself on the other. Some of the points in dispute have already been discussed in a paper read before the British Association at Cheltenham, and in the present memoir the author not merely reiterates the statements which he then made, but gives a detailed account of the whole organization of the Brachiopoda based upon his dissections of the following species:—*Wald-*

heimia australis, *W. Cranium*, *Terebratulina caput-serpentis*, *Rhynchonella psittacea*, *Lingula anatina*, and another species of *Lingula*.

The Brachiopoda are divisible into two groups, according as the valves of their shells are articulated or not. *Waldheimia* is the type of the former group, *Lingula* of the latter.

In the articulated forms there are usually three apertures opening into the pallial chamber; of these, one is the mouth,—the other two are situated at the apices of the organs which have been described as "hearts." In *Rhynchonella*, where there are four such "pseudo-hearts," there are of course five apertures instead of three. In *Lingula*, which possesses a distinct anus, opening on the right side of the pallial cavity, the apertures into the cavity are four, viz. one oral, one anal, and two appertaining to the pseudo-hearts.

After a description of the general arrangement of the organs in the articulated and non-articulated Brachiopoda, an elaborate account of the various systems of organs is given.

The muscles of the Terebratulidæ are divisible according to their functions into two groups,—the adductors of the valves, and those which adjust the shell upon the pedicle. Of the former, or "valvular" muscles, there are three pairs,—the adductors, cardinals, and accessory cardinals of previous writers; which the author prefers to term *occlusors, divaricators*, and *accessory divaricators*. Of the latter there are likewise three pairs, the so-called dorsal and ventral pedicle muscles and the capsular muscle; these the author terms the *dorsal and ventral adjustors*, and the *peduncular* muscle. The attachment of the muscles in *Waldheimia australis* and their actions are particularly described. The peduncular (capsular) muscle is shown to be the continuation of the muscular fibres contained within the peduncle. In the other articulated Brachiopoda examined, the arrangement of the muscles is essentially the same, but interesting differences are observable even in closely allied species.

Names in use.	Names proposed.	Names of homologous muscles of articulate Brachiopoda.
Anterior retractors ...	Anterior occlusors	Anterior occlusors.
Anterior adductors......	Posterior occlusors.........	Posterior occlusors.
Posterior adductors	Divaricators	Accessory divaricators.
Central protractors......	Central adjustors	Ventral adjustors.
External protractors ...	External adjustors	
Posterior retractors ...	Posterior adjustors.........	Dorsal adjustors.
Capsular	Peduncular	Peduncular.
	Anterior parietals.	
	Posterior parietals.	

Thus, in a species differing but little from *Waldheimia australis*, and in *W. Cranium*, the divaricators and accessory divaricators are united. In *Waldheimia Cranium* and *Terebratulina caput-serpentis* the dorsal adjustor muscles are not attached to a hinge-plate, but are inserted into the valve itself. In *Rhynchonella psittacea* there is a pair of peduncular muscles. In *Lingula* there are six pairs of muscles, all of which have both extremities attached to the valves. They have been divided into adductors and sliding muscles, the latter again being subdivided into protractors and retractors; but the author, considering that no sliding motion takes place, regards the latter terms as improper, and gives a set of new names, of which a concordance with the older denominations is given on the preceding page.

The author conceives that the valves are separated by the action of the divaricators, combined with that of the parietals; these muscles compressing the visceral cavity posteriorly, and thus driving its contents into the anterior portion. The antagonists of these are the occlusors; while the office of the adjustors appears rather to be to supply the place of a hinge, and to prevent anything like sliding of the valves one over the other.

The muscular fibres of *Lingula* are smooth and unstriated. In *Waldheimia* those of the posterior occlusors are strongly striated, but the rest of the muscles have smooth fibres. The arms, their attachment and minute structure are next fully described.

In *Waldheimia* the canals of the attached portions of the arms coalesce into a single wide tube, which lies externally between the produced and reflected crura of the calcareous loop, and is separated by a partition from a canal of corresponding size—the "brachial sinus,"—which also extends throughout the whole length of the produced and reflected crura, and is in fact a prolongation of the perivisceral chamber. The cirri are arranged in this and all the other Brachiopoda examined, in a double alternating series—not in a single row, as has hitherto been stated to be the case. The walls of the brachial canal are tolerably well supplied with delicate muscular fibres, which run diagonally round the tube, and are most strongly developed towards the sides, near the grooved ridge which supports the cirri. An indistinct band of exceedingly delicate longitudinal fibres may also be observed nearly opposite to it. The author has however completely failed to discover, either here or in *Rhynchonella*, anything like the double spiral arrangements of fibres described by Prof. Owen, and believes that the latter observer has mistaken the blood-sinuses for muscles.

The author doubts whether the spiral coil can be unwound, and conceives that the muscular fibres described, are chiefly for the purpose of giving firm support to the grooved ridge on which the cirri and brachial fold are seated, and thus affording the complex muscular fibres which the ridge contains a better fulcrum whence to act upon the cirri.

In *Terebratulina caput-serpentis*, which possesses no calcareous loop, the pallial lobe connecting the produced and reflected portions of the arms is strengthened by calcareous spicula, which are so numerous as to preserve the shape of the part even when the animal basis is removed.

In *Lingula* the arms contain two canals; one, the anterior, being the equivalent of the single canal in *Rhynchonella*, and, like it, terminating at the side of the œsophagus in a blind sac. The posterior brachial canal probably communicates with the perivisceral cavity and exhibits a peculiar arrangement of muscles, by whose action perhaps the arm can be exserted.

In addition to those parts of the alimentary canal and its appendages which are already known in the articulated Brachiopoda, the author describes a short median gastro-parietal band arising from the upper surface of the stomach and passing upwards and backwards to the dorsal parietes a little in advance of the hinge-plate. With regard to the existence or absence of an anal aperture in the articulated Brachiopoda, the writer states: "I have made numerous dissections under a powerful doublet, and have removed the part and examined it with a microscope: I have filled the tube with fluid as the fingers of a glove with air, and by pressure have attempted to force a passage: I have tried injections; but have equally, on all occasions, failed to discover an outlet, and have only succeeded in demonstrating more and more clearly the cæcal nature of the terminal extremity of the alimentary canal. Therefore, how much soever it may be opposed to analogy and to authority, the fact must be recorded—there is no anal orifice in *Waldheimia*, *Terebratulina*, or in *Rhynchonella*."

In *Lingula*, as in the articulated Brachiopoda, the first inflection of the intestine is towards the ventral surface, but the alimentary canal eventually ends in the easily observable anus placed nearer the dorsal than the ventral surface, on the right side of the body. The rudimentary mesentery, and the lateral gastro-parietal and ilio-parietal bands of *Lingula* are described. There is no median gastro-parietal band. Fæcal matter rolled into round pellets is commonly observable in the intestine of *Lingula*, while no fæces are ever found in that of the articulated Brachiopoda.

The genitalia in the articulate Brachiopoda are developed between the two membranes of which the inner wall of the pallial sinuses in which they are contained is composed, and, thrusting the inner of the two membranes from the outer, form a prominent mass connected by a band with the inferior wall of the sinus. The genital artery runs along the upper or outer edge of the band, and the genitalia are developed round it.

In *Lingula* the reproductive organs are withdrawn from the mantle and lodged within the visceral chamber, forming four irregularly lobulated or branched masses, two above and two below the alimentary canal, so that they may be distinguished as dorsal and ventral genital masses. The dorsal ovaries are suspended by the ilio-parietal bands, and the ventral by the continuation of these bands along the free margins of the pseudo-hearts. In both cases the attachment is along the margins of the bands, which are related to the genitalia much in the same manner as the suspending membrane is to the genital bands in *Waldheimia*; and it would seem that in *Lingula* the reproductive organs are really developed between the two layers composing the ilio-parietal bands. The author adduces arguments to show that the *Lingulæ* are hermaphrodite, the testis being a reddish mass, which ramifies over the true ovary.

The ova probably make their way out by the so-called "hearts," which open by their apices into the pallial cavity, and by their patulous bases (the so-called auricles) into the perivisceral chamber, and are hence capable of performing the functions of oviducts. The author has assured himself of the constant presence of the apical aperture of the pseudo-heart in all Brachiopoda. As pointed out by Prof. Huxley, there are four of these pseudo-hearts in *Rhynchonella*, but only two were found in the other Brachiopoda examined.

The pseudo-hearts have nothing to do with the propulsion of the blood, a function which is performed chiefly by the pyriform vesicle discovered by Prof. Huxley in *Waldheimia* and *Rhynchonella*, and which was found attached to the stomach in all the Brachiopoda examined. It is composed of two layers, the inner distinctly muscular, the outer transparent and homogeneous. Connected with this heart are vessels or blood-channels (particularly described in the Memoirs); the "venous canals," which open into it anteriorly, returning the blood conveyed by the posterior arterial channels into the system of peripheral sinuses originally described by Prof. Huxley.

Accessory "hearts" or pulsatile vesicles have been found in some of the articulated Brachiopoda; the mantle and the walls of the body are essentially composed of a plate of substance traversed by reticulated lacunæ, and lined upon each side with epithelium. After explaining at length the distribution of the lacunæ throughout the mantle, the sheath of the intestine, its bands, the genital folds, the arms, &c., the author proceeds to give the following sketch of the course of the circulation:—

"Having now gone over all that I have been able to ascertain with respect to the central and peripheral portions of the circulatory apparatus, and having also examined the lacunes and blood-canals of the brachial organs, it will not be difficult to follow the flow of the blood throughout its entire course in *Waldheimia*; and as it is in it, so will it be in all probability in all other Brachiopods.

"It has been shown that the heart is a simple, unilocular, pyriform vesicle, suspended from the dorsal aspect of the stomach, and projecting freely into the perivisceral chamber; that there is neither auricle nor pericardium,—unless the membrane which closely invests it can be so called,—that it is hardly more complex in structure than the pulsating vessel of the Tunicata; and that in *Lingula*, indeed, it scarcely at all differs from the heart of these lowly organized mollusks. This vesicle, or heart, propels the blood through four arterial trunks or channels, to the reproductive organs and mantle, and probably also to the alimentary tube, and is apparently assisted by four or more pulsating vesicles in connexion with these principal trunks. The blood thus conveyed by the genital or pallial arteries will escape by the lacunes in the membranes suspending the genitalia, into the plexus in the floor of the great pallial sinuses. Thence it will find its way into the outer lacunary system of the pallial lobes, and into that of the dorsal and ventral walls of the body, as well as into the lacunes of the anterior parietes. Having saturated all these parts of the peripheral system, it will divide itself into two currents, one of which will set backwards in the direction of the membranous bands connecting the alimentary tube to the parietes, and will flow through their channels into the system of visceral lacunes, which encircle the alimentary canal within the sheath, and which probably carry blood to the liver. This current will also supply blood to the lacunes nourishing the muscles. The blood thus directed will reach the branchio-systemic vein, either by the great œsophageal lacunes, or through the foramina which penetrate the sides of the channel as it runs along the dorsal ridge of the stomach.

"The other blood-current will set forward in the direction of the base of the arms, and some of it will pass into these organs through their general system of lacunes; but the principal portion will be carried by the afferent brachial canal to the extensive plexus of lacunes in those parts, and will circulate, in the manner before pointed out, within the walls of the great brachial canal. The blood will then be drawn up one side of the cirri through the vessels—the afferent brachial arteries—originating in the great brachial plexus, and returning down the other, will be poured into the efferent brachial canal, and thus reach the lateral efferent sinuses at the root of the œsophagus. Thence it will enter the great œsophageal lacunes, and there meeting with the other current of returning blood from the visceral lacunes, will be carried to the heart by the branchio-systemic vein along the dorsal side of the stomach.

"Thus it is perceived that the blood finds its way back to the central organ in a mixed condition. That which is conveyed by the gastro-parietal and other bands will be imperfectly aërated, having only flowed through the pallial membranes, which must be looked upon as but accessory oxygenating agents. The arms undoubtedly perform the office of gills, and are true respiratory organs. The blood which circulates through them will consequently be returned in a perfectly aërated condition, to be mixed, however, with that in a less pure state from the visceral lacunes before it enters the heart. This mixed state of the blood is not by any means peculiar to these animals, for it obtains in many of even the higher mollusks."

The perivisceral cavity and the great pallial sinuses have no communication with the proper blood-vascular system, but are to be compared to the atrium of the Ascidianida, and the water-chambers of the Cephalopoda and other mollusca. The pseudo-hearts enable the perivisceral cavity to communicate with the exterior, and convey away the genital, and probably the renal products. On this head the author says:—

"From the foregoing account of the circulatory apparatus, it would appear that the perivisceral chamber, and its various so-called vascular ramifications in the mantle, are not connected with the blood-system. This is no doubt a startling fact. I commenced the present investigation fully imbued with the opinion that these parts were blood reservoirs and channels, and I only relinquished it when it became no longer tenable. Step by step the points relied on had to be abandoned, until at length the full conviction was arrived at that I had been seeking to establish a fallacy. I have been unable to discover any communication between the true blood-system and the pseudo-vascular ramifications in the mantle or the perivisceral chamber. Injections were thrown into this chamber, but none of the fluid found its way into any part of the lacunary system. The pallial lobes were removed, and the great pallial sinuses distended to their fullest capacity, with exactly the same result; and it was not until the tissues were ruptured on applying great pressure, that a little of the injected matter was extravasated into the peripheral lacunes. The perivisceral chamber, then, and all its various ramifications, are in no way connected with the true blood-system."

The nervous system of the articulated Brachiopoda is described at length. Besides the principal subœsophageal ganglion, two minute enlargements are shown to exist upon the anterior part of the œsophageal commissure, and two small pyriform ganglia are described in connexion with the under part of the principal ganglion. The peripheral nerves are minutely traced out, and two peduncular nerves, not hitherto known to exist, are described. The author denies the existence of the so-called "circumpallial" nerves. He has been unable to detect the nervous centres in *Lingula*, and he is inclined to regard the cords, described as nerves in that genus by Prof. Owen, as blood-sinuses.

The author next makes some remarks on the structure of the shell, pointing out that in *Terebratulina caput-serpentis* there are two distinct layers, an external and an internal; and he then draws attention to the important anatomical characters which separate the articulated Brachiopoda as a group from the inarticulate division.

In conclusion, the author draws a parallel between the Brachiopoda and the Polyzoa, demonstrating the close structural conformity between these two groups.

"On the Placenta of the Elephant." By Professor Richard Owen, F.R.S., &c.

In this paper the author gives a description of the fœtal membranes and placenta of the Indian Elephant. The chorion forms a transversely oblong sac about 2 feet 6 inches in long diameter, encompassed at its middle part by a placenta of an annular form, 2 feet 6 inches in circumference, from 3 inches to 5 inches in breadth, and from 1 inch to 2 inches in thickness; in structure resembling that of the annular or zonular placenta of the Hyrax and Cat. The part of this placenta which had been detached from the maternal portion occupied a narrow annular tract near the middle line of the outer surface. A thin brown deciduous layer was continued from the borders of the placenta for a distance varying from 1 to 3 inches upon the outer surface of the chorion. Flattened folds of a similar layer of substance, or false membrane, could be raised from some parts of the surface of the placenta; at other parts the substance formed irregular fibrous bands,—the fibres extending in the direction of the circumference of the placental ring. The outer surface of the chorion is for the most part smooth and even shining, but at each of the obtuse extremities of the sac there was a villous subcircular patch, between 2 and 3 inches in diameter, the villi being short and graniform, $\frac{1}{6}$th of a line in diameter or less. Thus the chief points of attachment of the chorion to the uterus are, at the equator by the annular placenta, and at each pole of the elongated sac by the subcircular villous patch. The umbilical cord was short and rather flattened: it was formed by two arterial and one venous trunks, and by the slender neck of the allantois, with the connecting cellular tissue and the covering of amnios: it measured about 6 inches in length, before the division of the vascular trunks, and about 3 inches in circumference. The inner surface of the amnios is roughened by brownish hemispherical granules, from 1 line to $\frac{1}{10}$th of a line in size—commonly about $\frac{1}{2}$ a line; the outer surface is finely wrinkled, but smooth; the amnios is continued from the base of the umbilical cord upon the allantois, which is of considerable size, and is so interposed between the chorion and amnios as to prevent any part of the amnios attaining the inner surface of the placenta. The amnios consists of two layers: one is the granular layer, continued upon the inner or fœtal surface of the allantois, and thence upon the umbilical cord; the other is the smooth outer layer, continued upon the outer or chorional surface of the allantois, and thence upon the inner surface of the chorion. The allantois divides where the amnios begins to be reflected upon it into three sacculi; the disposition of these sacculi is described in detail. The chief peculiarity was the presence, upon the inner layer of the allantois, and chiefly upon the endochorionic vessels, of numerous flattened oval or subcircular bodies, varying in diameter from an inch to half a line: their tissue was compact, structureless, and of a grey colour. On dissecting some of the vessels over which these bodies were placed, the vessel was found to pass on the chorionic side of the body without undergoing any apparent change, the body being developed from the allantois, and from that part which forms the allantoic side of the sheath of the vessel. These bodies were most numerous near the placenta: their free surface was smooth, not villous like the cotyledons of the Ruminantia, from which they likewise differed in projecting inwards towards the cavity of the allantois. The most important modification of the vascular structures connecting the chorion with the uterus, in the Elephant, is their combination of two forms of the placenta, viz. the 'annular' and the 'diffused,' which have hitherto been supposed to characterize respectively distinct groups of the class Mammalia.

The author concludes by a comparison of the different known forms of the placenta, including those of the *Pteropus* or large frugivorous Bat, and of the Chimpanzee; and by remarks on the value of placentary characters in the classification of the Mammalia.

June 15, 1857.—The Lord Wrottesley, President, in the Chair.

"On the Causes and Phænomena of the Repulsion of Water from the Feathers of Water-fowl and the Leaves of Plants." By George Buist, D.C.L. of Bombay, F.R.S.

Happening to reside in Bombay, in the neighbourhood of a number of small tanks or ponds abounding with the Lotus or sacred bean of India, and with four different varieties of Water Lily, I was struck with the different appearances presented by these when immersed in water, or when water was sprinkled on them. The leaves of the lily, like those of the Lotus, floated with considerable buoyancy on the surface, but never, like the Lotus, rose above it, on a tall independent stem. The lily leaf is full of holes about the size of a pin's head, and serrated at the edges. Through these, when the leaf is pressed down, the water perforates freely. The upper surface of the leaf is smooth and shining, and water runs off it without wetting it, as it does off a piece of glass or greased surface. When placed under the water at an angle of about 45°, the leaf of the lily seems to change colour; the dark purple leaf of the red lily appears of a bright rich pink, the dark green or bluish-green of the white, pink, and blue lilies seem to become of a bright emerald-green; the intensity of these hues varying with the angle at which the immersed leaf is seen.

When the Lotus leaf is placed under water it reflects light like a mirror, so that the image of any object, if presented to it at a proper angle, is seen by the spectator as distinctly as if the surface were one of polished metal. When water is thrown on the surface of a floating leaf, it flows off like a pool of quicksilver, reflecting light from the whole of its lower surface; and this holds good on all occasions. The repellent property of the leaf is on the upper side only, for the lower side is always wet, being only destroyed by severe rubbing. These peculiarities seem long to have been familiar to the natives, and have given rise to the Mahratta lines in reference to the virtuous man, which may be thus translated:—

> "He is not enslaved by any lust whatever;
> By the stain of passion he is not soiled,—
> As in the water, yet unwet by the water,
> Is the Lotus leaf."

On examining carefully into the cause of this, I found the Lotus leaf covered with short microscopic papillæ, which entangle the air and establish an air-plate over the whole surface, with which in reality the water never comes in contact at all. Another peculiarity connected, but not necessarily so, so far as I could discover, with this, was the singular respiratory pores of the Lotus. The leaves of the Lotus, when full-sized, are from a foot to 16 inches in diameter; on cutting off a leaf 6 inches broad, the stalk of which was less than the third of an inch in diameter, I was able to collect 33 cubic inches of air in an hour, when the vital energies of the plant must have been injured by its mutilation; at this rate a tank covered with Lotus leaves would produce daily an atmosphere 4 feet in depth throughout its whole surface. When the leaf is pushed slightly under water, a constant succession of air-bubbles seem to arise from it, at the rate of two or three a minute at each spiracle. The air-bubble diffuses itself as it is extricated, presenting a very broad base to the leaf and blunt low-crowned apex, and seems detached with difficulty. The air-plate all over the surface must thus become continually renewed and the arrangement kept perfect.

Sensible respiration is not at all essential to the repelling power of leaves; the most beautiful manifestation of it I have met with is in the *Pestia*, a little floating water-plant abounding in our shallow tanks, and resembling common endive. When pushed under the surface, it looks like a little mass of burning silver. The same appearance is presented on cabbages, young clover, and a vast variety of other leaves; it is the cause of the bright pearl-lustre of dew. The same phenomenon is manifested on the wings and backs of divers when they dash into the water. In this case it has been ascribed, most erroneously as I believe, to the presence of grease or oil in the feathers, and is, I have no doubt, due to the presence of an air-plate repelling the water, so that it never comes in contact with the feathers at all. The trimming process, so carefully performed by Water Fowl, is probably an application of oil or grease, with the object of separating or dressing the little fibres of the feathers so as to produce an arrangement fitted to entangle the air. The reflexion of light from the lower surface of the water is the proof of want of contact. A piece of polished marble or of glass, a waxed, oiled or greased surface, readily throws off the water without remaining wetted; but no reflexion is in this case observable.

Might not the manufacturers of waterproof cloth or clothes take a hint on this point from the economy of nature? Could they manage to produce a surface such as would entangle and retain a film of air, no india-rubber varnish or other water-tight material would be required, while the texture would permit the free transmission of respiration or moisture from the body, which Mackintosh's and other similar contrivances obstruct.

BOTANICAL SOCIETY OF EDINBURGH.

May 14, 1857.—Professor Balfour, Vice-President, in the Chair.

The following papers were read:—

1. "Notice of two cases of Poisoning with the seeds of *Thevetia nereifolia*," communicated, with remarks, by Dr. Douglas Maclagan.

The history of these cases, which occurred in India, was furnished by Dr. John Balfour, H.E.I.C.S. The symptoms were narcotico-irritant, the irritant character predominating, and the somnolence and other cerebral phænomena being, in Dr. Maclagan's opinion, probably as much those of exhaustion as of true narcotism. There was vomiting of a peculiar character. *Thevetia nereifolia*, Juss. (*Cerbera Thevetia*, L.), now naturalized in India, appears to have been introduced probably from South America.

2. "Account of the Insect which infests the seeds of *Picea nobilis*," by Andrew Murray, Esq., F.R.S.E.

The *Picea nobilis* was first introduced into this country from the north-west of America by Douglas in 1831. No second importation of seed was made in any quantity till Jeffrey sent home some packages in 1852. These proved all bad, and apparently had suffered from the ravages of an insect. Mr. Beardsley and my brother next sent a quantity in 1854, and I noticed the fact that in almost every cone of *P. nobilis*, the seeds were being eaten by a small caterpillar. My brother had found these caterpillars in the green as well as in the mature cone, their eggs evidently having been deposited in the kernel while the cone was yet soft and easily penetrated. One or two subsequent importations of seed proved to be also to a greater or less extent infested by an insect. I have bred the insect, and find that it belongs to the genus *Megastigmus*, one of the Chalcidites. Out of hundreds of insects which I have seen developed from the cones of *Picea nobilis*, I never saw any other species, except one small moth. In the April Number of the 'Zoologist,' Mr. Parfitt has named the insect *Megastigmus Pini*. He has described only the female, not having seen the male. I obtained specimens of both, which I have placed in the British Museum. The male is smaller than the female, and differs in having its upper surface entirely black. The immense quantities in which the insect has been found in the cones, at least in all the later importations, and the fact that the early stage in which the cone is attacked renders protection or prevention by man nearly impossible, are likely, I fear, to keep this pine always comparatively scarce.

3. "On the supposed influence of the Moon on Vegetation, in Peru," by Archibald Smith, M.D.

The author thought it not unreasonable that the lunar ray might have a peculiar chemical agency on the functions of plants and animals, as it appears to have on dead animal matter. It must be borne in mind that the light afforded both by the sun and moon in Peru is much greater than in the British Islands,—so that, although we may reasonably repudiate any marked effect from the moonlight in these islands, the more intense lunar light of Peru may exercise a sensible power on plants. The author alluded particularly to the surprisingly rapid growth of lucern, which is extensively cultivated in Peru, and is evidently much favoured by light, whether of sun, or sun and moon together. During the prevailing misty season on the coast (which is the time when the low and maritime sand-hills are garnished with grass and flowers to their summits) the growth of lucern in the plains and valleys is greatly stinted. In these wet months, as they are called, though the rain very rarely forms into a light shower, or exceeds the limits of a dripping mist, the clover or lucern does not attain to a flowering maturity; but no sooner do the vapours of the coast begin to break up, and the sun show itself in a brightening sky, than this useful plant receives a fresh impulse, yielding two or three luxuriant crops in succession. This remarkable vigour of vegetation under the influence of a returning sun, argues on behalf of light, more than of heat. Besides, in the temperate valleys of the Sierra, where the summer temperature of the air does not exceed the winter temperature of the coast, the lucern grows luxuriantly under a bright clear sky during the dry season, though there also its growth is checked in the cloudy and rainy months; and yet the sunny season of the mountains is subject to night chills, or even frost at certain elevations, whereas the wet months are not so. Light, therefore, seems the essential condition to the recurrence of the more luxuriant vegetation, as observed in the successive climates of the Andes.

4. "On some of the leading Plants of the lowest zone in Teneriffe," by Professor J. Piazzi Smyth.

The author described the manner and characteristics of growth of the chief plants as met with advancing from the sea-coast inland, and found both the indigenous and cultivated plants to exhibit a poverty of growth as compared with many other lands in the same latitude (28°). The cause of this, he thought, was owing to the special predominance of the trade-wind throughout the archipelago of the Canaries during the whole of the summer season, and to the want of rain, and the low temperature which that wind produces, both primarily and secondarily. The author treated at length on the *Dracæna Draco* as being, *par excellence*, the characteristic plant of the lowest zone of Teneriffe.

June 11, 1857.—Professor Fleming, President, in the Chair.

The following papers were read:—

1. "On the Identity of *Achorion Schönleini*, and other vegetable parasites, with *Aspergillus glaucus*," by Mr. John Lowe.

The object of this communication was to show the relation which exists between the parasitic growth in *Porrigo favosa* and other skin-diseases, and a common species of fungus, *Aspergillus glaucus*, and to establish the identity of a number of these forms which have hitherto been regarded as specifically distinct. A quantity of favus crust having been procured from a case of *Porrigo lupinosa*, a portion was immersed in pure glycerine, another was placed on cheese, and a third in a solution of raw sugar. The first did not germinate, but became disintegrated after about ten days. This was probably owing to the temperature of the fluid not being sufficiently high, as it is well known that the yeast-plant grows with facility in the same medium, at an elevated temperature, during the manufacture of butyric acid. The cells placed on cheese also failed to germinate, and died in about the same time as those put into glycerine. Those immersed in the saccharine solution gave a different result. At the end of forty-eight hours the cells had become swollen and more oval than at first; on the day following, they began to unite into moniliform chains forming a mycelium, the filaments of which after a time were observed to contain granules and nucules. At the end of about a month, the perfect fructification of *Aspergillus glaucus* appeared. During the growth of the plant, the different stages of development were observed daily, under the microscope, and the whole of the following *species* (*so-called*) were found accurately represented, so far as appearance goes, by one or other of the forms produced: *Micro-*

sporon furfur, Robin; *Oidium albicans,* Ch. R.; *Torula guttata*; *Trichophyton toneurans,* Malmsten; *T. ulcerum,* Ch. R.; *Microsporon Audouini,* Ch. R.; *M. Mentagrophytes,* Ch. R.; *Achorion Schönleini,* Remak.; *Leptomitus,* six species; with a considerable number of other epizootic forms. With regard to the majority of these, the author remarked that they could not be with certainty considered as identical with *Aspergillus,* but that there was every probability of such being the case,—1st, from the exact identity of form; and 2ndly, from the extreme unlikelihood of their being distinct species, as shown by their never or rarely producing fruit; proving them to be mere variations of some other fungus growing under unfavourable circumstances, and not arriving at a perfect development. With *Achorion Schönleini* the case is different. The following facts may be adduced in support of its alleged identity with *Aspergillus*:—1st. The sporules of the former, carefully watched during their growth, developed the perfect sporangia of the latter, which, 2ndly, is produced in a state of fructification in the air-sacs of birds,—showing the possibility of its growing on animal tissues. 3. The figure given by Dr. Bennett of a section of the scalp affected by favus, exhibits the true fructification of an *Aspergillus.*

2. "On the Properties of *Lolium temulentum,*" by Mr. John Lowe.

After noticing the physiological effects which have been ascribed to the action of Darnel, the author remarked that there exists a great want of information as to the amount of the seed requisite to produce these results. From all that has been written on the subject, it would appear as if the virulence of the herb varied in different localities. A series of experiments was given in detail, showing that Darnel grown in the Botanic Garden produced no effect when taken in doses of half an ounce. The observations of Professor Christison on the *Œnanthe crocata* show an analogous result, this plant being a virulent poison when grown in England, but innocuous in Scotland. A similar example is seen in the *Cannabis indica,* which only yields its gum-resin when grown in a hot climate. Further experiments are required with regard to *Lolium.*

3. "Further Observations on Dust-showers," by Mr. George Lawson, F.R.P.S.

Mr. Lawson laid before the Society a letter from Dr. J. O. M'William, R.N., in which that gentleman remarks: "While I was at Boa Vista, the easternmost of the Cape de Verd group, during the months of April, May, June, and part of July, 1846, I had ample opportunity of witnessing these phænomena. In my meteorological register I find that in April [1846] the atmosphere is recorded as hazy, and filled with sand, ten days; in May, eleven days; in June, five days; and during the first ten days of July, three days. As a general rule, when these sand-fogs prevailed, the north-east trade-winds were blowing with more than usual force; they sometimes lasted for three or four days without any intermission. At the period of their prevalence, the sand-heaps which abound in this barren, parched, volcanic region are drifted about from the windward to the leeward side of the island, filling the hollows in the plains, and sometimes, in the course of a few hours, obliterating all traces of pathways, and thus bewildering the newly-arrived traveller. I was in the leeward side of the island when the first sand-shower occurred, and the residents differed in opinion as to its source, some saying that it came from the beach and sand-hills on the windward side of the island; while others, more correctly, as I consider, attributed its origin to the African Desert. I had soon an opportunity of ascertaining that they did not originate on the island itself, for I witnessed a sand-shower of considerable density over the sea *to windward of the island, between which and the African coast no land intervened*; and I therefore came to the conclusion that that coast was its source."

4. "Analogy between the serial arrangements of the Leaves of Plants and Crystalline Forms," by Mr. William Mitchell.

MISCELLANEOUS.

On the Causes of the Opening and Closing of Stomates. By Hugo von Mohl.

In this memoir Von Mohl corroborates by actual experiments the general impression, the truth of which had not been demonstrated, that stomates shut when the guardian-cells collapse, and open when they become turgid.

The opening of the stomate is guarded by two crescent-shaped cells, the guardian-cells, which generally take the following form. On their external surface each bears a cuticular projection, which is usually formed by a thin membrane; in other cases, however, it consists of the cell-wall considerably thickened, or the cell-wall is sometimes even thick enough to form a salient protuberance. The edges of these projections unite at both ends of the stomate, so as to make an orifice above the true opening of the stomate; this orifice may be wider or narrower than the true opening. It leads into a continuation of the true opening, filled with air, and lying above the opening; this Von Mohl calls the anterior cavity, or antechamber (*Vorhof*), and the opening, the orifice of the antechamber. It is bounded on both of its lower sides by the upper part of the lateral surfaces of the guardian-cells, these surfaces being concave horizontally and convex vertically. Turned towards the stomatic cavity, on the lower side of the guardian-cells, there lies in most plants another projection like that on the upper side, but generally smaller, by which a posterior cavity, corresponding to the anterior cavity, is separated from the cavity of the stomate.

A transverse section usually shows that the thickness of the walls of the guardian-cells is very unequal in different places; the part of the wall contiguous to the epidermal cells is generally rather thin, so that these cells must prevent the guardian-cells from swelling out at this par'

Having cut through the epidermal cells, so as to discharge their contents, and thus prevent them from exerting any lateral pressure on the guardian-cells, it was found that when placed in *water* (which they imbibe), the guardian-cells increased the space between them very perceptibly; but when placed in a *solution of sugar* (into which they exude a portion of their contents), they closed it completely. By changing from water to a solution of sugar, the same opening might be alternately opened and closed. Another series of experiments on *intact* leaves showed that this action of the guardian-cells is impeded by the pressure of the epidermal cells, in proportion as they come into contact with the former. This is also shown by the fact, that when this pressure is taken off by emptying the epidermal cells of their contents (which may be done by immersing the latter in a solution of sugar), the guardian-cells always open. As the epidermal cells contain more sap than the guardian-cells, the same result is obtained by letting a leaf wither off. The orifices of intact leaves cut off in the morning were found to be closed; when exposed to the sun for several hours, they opened again, but closed with rapidity when immersed in water,—showing that the power of the guardian-cells is increased, in comparison with that of the epidermal cells, by the influence of light and heat, quite independently of the humid state in which they may occur. This, the author thinks, can hardly be explained except by assuming that when the guardian-cells are exposed to the influence of these agents, they form such combinations as are able to induce a powerful endosmosis, and are more or less decomposed when light is withdrawn; for, as is well known, the guardian-cells, like the cells of the parenchyma, contain chlorophyllaceous matter.

Direct comparative measurements show that the projecting part of the guardian-cells, beyond the anterior cavity, contracts but slightly, so that the process is effected chiefly by the change in the form of the boundaries of the true opening.

The guardian-cells expand most in a vertical direction, and thus change their transverse diameter from a circular to an elliptical form, so as to draw in the thinner portion of the lateral surface which lies free in the opening of the stomate. This explains why the opening is not closed when these cells are distended by the water which fills them.—*Botanische Zeitung*, 1856, No. 40, and *Silliman's Journal*, March 1857.

Descriptions of new Norwegian Annelides. By M. Sars.

Family Telethusa.

Genus *Notomastus*, Sars, n. g.

Lobus capitalis conico-acuminatus. Os subtus; pharynx exsertilis breviter clavata, papillis obsita. Anterior corporis pars cylindrico-subfusiformis, e segmentis duodecim medio sulco in annulos duos divisis, primo absque et cæteris undecim utrinque fasciculis binis setarum capillarium, mamillis pedalibus carentibus, composita. Posterior corporis pars longior et tenuior, e segmentis constans numerosis indivisis, utrinque mamillis pedalibus seu toris et superioribus et inferioribus sine setarum uncinatarum ornatis. Branchiæ nullæ.

Species unica: *Notomastus latericeus.*

This species resembles an *Arenicola,* and belongs, like it, to the family *Telethusa.* Its nearest ally is *Dasybranchus* of Grube (Fam. der Anneliden). Its colour is a brilliant red on the anterior part of the body, brick-red on the posterior, passing gradually into reddish-yellow and yellow. The pedal tubercles are all of a paler red or yellowish-red. Its length is 5–6 inches, and its breadth about $\frac{1}{6}$th of an inch.

This Annelide is rare, and is found buried in the sand. At Floroën in the Söndfjord it occurs in the Laminarian zone, so that when the reflux of the tide is very great, it may sometimes be obtained by digging. It was also taken at Manger, near Bergen, at a depth of 50–60 fathoms, and at Oxfjord, in Finmark, at 20–30 fathoms.

Clymene Mülleri, Sars, n. s.

Corpore segmentis 25–27, quorum 17–19 setigeris, 5 ante-analibus nudis; segmento anali margine cirris 15–23 vel pluribus, quorum 2 ventrales cæteris duplo longiores sunt, ornato; lobo capitali declivi, ovato, plano, margine circumdato integro; segmentis 4 anterioribus setigeris modo aculeum in mamilla pedali ventrali gerentibus.

This species is usually found of about 4 inches in length and $\frac{1}{8}$–$\frac{1}{10}$th of an inch in thickness, but imperfect specimens $\frac{1}{6}$th of an inch thick have been met with, and these were probably of larger size. Its colour is yellowish or brownish-red, or flesh-colour; there is usually a darker ring across each segment at the point where the bristles are placed. It is the commonest species of the genus on the west coast of Norway, where it is found at a depth of 12–50 fathoms. It lives in a cylindrical tube, open at both ends, composed of sand, fragments of shells, &c., like that of *Terebella.* It approaches nearest to *Clymene Ebiensis,* Aud. and M.-Edw.

Clymene quadrilobata, Sars, n. s.

Corpore segmentis 26, quorum 19 setigeris, 5 ante-analibus nudis; segmento anali margine cirris 35, quorum uno ventrali cæteris longiore; lobo capitali declivi, ovato, plano, margine cristis duabus lateralibus cutaceis bilobatis circumdato; segmentis 3 anterioribus setigeris modo aculeum in mamilla pedali ventrali gerentibus.

Perfect specimens, of which only two have been met with, are about 5 inches long and $\frac{1}{10}$th of an inch broad; the segments behind the middle of the body are of remarkable length. It is found rarely at Floroën and Manger at a depth of 20–40 fathoms.

Sabellides borealis, Sars, n. s.

Sabellides octocirrata, Sars, Mag. f. Naturv. 1850, p. 85.

Pollicaris, flava; cirris tentacularibus octo sulphureis; tentaculis oralibus pinnatis; segmentis sectionis anterioris corporis 14, tribus anticis mamilla dorsali setis capillaribus instructa absque pinna ventrali, cæterisque et pinna dorsali setis capillaribus et ventrali setis uncinatis; segmentis sectionis posterioris corporis 12 absque setis in pinna dorsali cirriformi, et setis uncinatis in pinna ventrali; segmento anali cirris duobus.

This species, previously described erroneously by Sars as *S. octocirrata*, is an inch, or rather more, in length. Its colour is light yellow, and that of the tentacular cirri bright sulphur-yellow. It was found at Reine in Lofoten, and at Oxfjord in Finmark, at a depth of 50 fathoms on a muddy bottom.

Sabellides sexcirrata, Sars, n. s.

Pollicaris, fulva; cirris tentacularibus sex; segmentis sectionis anterioris corporis 17, tribus anticis mamilla dorsali setis capillaribus instructa absque pinna ventrali, cæterisque et pinna dorsali setis capillaribus et ventrali setis uncinatis; segmentis sectionis posterioris corporis 13 absque pinna dorsali et setis uncinatis in pinna ventrali; segmento anali cirris nullis.

A single specimen of this species was taken at Manger at the depth of 50–60 fathoms on a muddy bottom. In form and dimensions it resembles *S. borealis*.

Sabellides cristata, Sars, n. s.

Sesqui-bipollicaris, fulva; cirris tentacularibus octo; tentaculis oralibus filiformibus simplicibus (absque pinnis); segmentis sectionis anterioris corporis 18, tribus anticis fasciculo setarum capillarium dorsali absque mamilla pinna ventrali carente, cæterisque et pinna dorsali mamilla setis capillaribus et ventrali setis uncinatis; segmentis sectionis posterioris corporis 50–53 absque setis in pinna dorsali cirriformi minima et setis uncinatis in pinna ventrali; segmento anali cirris nullis.

The colour of the body of this Annelide is yellowish or minium-red, with the tentacular cirri light green; its length is $1\frac{1}{2}$–2 inches, and that of the cirri $\frac{1}{3}$rd of an inch. It lives in a cylindrical tube of 5 or 6 inches in length, and $\frac{1}{10}$–$\frac{1}{8}$th of an inch in thickness, resembling that of *Sabella*, and similarly formed of clay or mud. It is found pretty frequently in the vicinity of Manger, with the lower extremity of its tube attached to submarine objects, at a depth of 50–60 fathoms on a muddy bottom, and has also been met with, under the same circumstances, at Reine in Lofoten and at Havösund in Finmark.

Sabellides octocirrata, Sars,

the fourth Norwegian species described in 1835 by Sars, is only half an inch in length, of a fulvous colour, with the tentacular cirri greenish. It has only been met with hitherto in the neighbourhood of Bergen, near Glesvaer and Floroën, at a depth of 20–40 fathoms on a muddy bottom.—*Fauna Littoralis Norvegiæ*, part 2. pp. 9–24.

GLADIOLUS IMBRICATUS, *Linn.*

Mr. Borrer has sent to me specimens of the above-named plant, found by the Rev. W. H. Lucas in the New Forest, Hampshire, in 1856. Mr. Borrer says, "I saw the plant in two places [in June 1857], about two miles apart, and each of them at least a mile from any house. One is on the road from Lyndhurst to Balderwood, where it grows in some quantity on both sides of the road; the other in the heart of the Forest, S.E. from the turnpike, two miles from Lyndhurst on the Christchurch road. Here it abounds for about a quarter of a mile, with short intervals. In both places it grows scattered on dry ground amongst *Pteris*, which overtops it before it comes into flower." "The situation is such in both places, that I should suppose no one would suspect that the plant is other than indigenous; as truly as its companion *Habenaria bifolia*." This seems to be a very interesting addition to our flora, which has escaped notice from its being hidden in the masses of brakes.—C. C. B.

Notes on some new and rare Diatomaceæ from the Stomachs of Ascidiæ. By GEORGE NORMAN, Esq.

Being engaged some time ago in examining dredged oyster-shells for Diatomaceæ, I discovered on the surface of one of the shells a cluster of semi-transparent gelatinous bodies of a yellowish-green colour, of which the shape, however, was not uniform, owing perhaps to their being dead and flaccid. In size they approached small hazel-nuts. These I take to be Ascidiæ of some species, as they were apparently enveloped in an outer mantle or skin of somewhat tough consistency. By cutting through this mantle and towards the centre of the body, a large stomach was exposed, quite distended with what appeared to be brown mud. On examining this under the microscope I was delighted to find it almost entirely composed of Diatomaceæ, still quite fresh and full of chlorophyll. The Diatoms were mostly uncommon forms: the most conspicuous of those which occurred in the first I opened were, *Coscinodiscus concinnus* (in great numbers and of unusually large size), *Pleurosigma lanceolatum*, n. s., *Eupodiscus crassus* and *Ralfsii*, *Eucampia zodiacus*, and a very curious tubular *Rhizoselenia*, which Mr. Brightwell has named *Rhizoselenia styliformis*.

Since then I have examined many Ascidiæ from the same source, and have never failed in any instance in obtaining Diatomaceæ in abundance; these have mostly consisted of species which, from their occurring in deep water, are somewhat uncommon and difficult to obtain, unless the collector be furnished with an expensive dredging apparatus.

Some of the forms are of great rarity, and others are even quite new. I would, therefore, call the attention of all diatomists to this source as an easy and inexpensive means of obtaining good and rare forms, in a comparatively clean state and without much trouble, as the trawling-boats are constantly bringing to market the large dredged oysters, which are frequently covered with Ascidiæ. The locality whence my oysters were obtained is some twenty or thirty miles from the Yorkshire coast, a little to the north of the river Humber, and is known as the "Silver Pit." I annex a list of the species hitherto detected in merely four gatherings, and this will serve to show what may be expected when Ascidiæ are examined from other and possibly more favourable localities. The letter A. preceding the name denotes that the species occurs abundantly, F. that it occurs occasionally (though less frequent than the first), and R. that it occurs rarely—perhaps, for instance, one or two specimens in a slide.

List of Species.

F. *Eucampia zodiacus.*
F. *Pinnularia distans.*
A. *Pleurosigma lanceolatum*, n. s.; resembling *P. angulatum*, but has much coarser striæ, the valve nearly straight, the central line much curved, and with a faint depression running across the centre of the valve. The colour of the dry valve is the same as in *Pl. transversale.* This form is constant, and occurs in most gatherings from deep water.
F. *Pleurosigma prolongatum.*
R. *Pleurosigma*, small form, with very acute extremities.
R. *Pl. transversale.*
R. *Pl. fasciola.*
A. *Coscinodiscus concinnus*, very large.
F. *C. perforatus.*
A. *C. excentricus*, very fine.
F. *C. radiatus.*
A. *Eupodiscus crassus*, fine.
F. *E. Ralfsii.*
R. *E. sculptus.*
R. *E. argus*, in fragments.
R. *Eupodiscus*, new species, with cellular markings like a *Coscinodiscus*, and a single process near the margin.
R. *Amphiprora didyma*?
R. *Surirella fastuosa.*
F. *Doryphora amphiceras.*
F. *Doryphora*, sp.?, with parallel moniliform striæ.
A. *Actinocyclus undulatus*, fine.
R. ? *Actinocyclus*, sp. without rays.
A. *Rhizoselenia styliformis*, n. s.
F. *Rhizoselenia*, small species, with ends produced into a long, slender, hair-like filament.
F. *Rhizoselenia*, a curious and beautiful species, apparently new, with feather- or scale-like markings.
F. *Biddulphia turgida*, not entire.
A. *B. Baillyii*, fine.
F. *B. rhombus.*
A. *B. aurita*, in filaments.
F. *Chætoceras Wighamii.*
F. *Chætoceras*, apparently two more species.
R. *Nitzschia Closterium*?
R. *N. lanceolata*?
F. *Orthosira marina.*
R. ? *Orthosira*, sp.
A. ? *Asterionella*, two species.
R. *Podosira maculata.*
A. ? *Melosira*, sp.
F. *Stephanopyxis*, species; beautiful form with cellular structure, and furnished with clubbed or forked horns at the ends of the valves; occurs in filaments of four to five frustules.
F. *Stauroneis pulchella.*
R. *Triceratium favus*, fragments.
R. *T. striolatum.*
R. ? *Triceratium*, curious form with a star-like marking in the centre of the valve.
F. ? *Melosira*, small form with longitudinal markings.
R. *Navicula Hennedyii.*
R. *N. lyra.*
A. ? *Himantidium*, sp.

Hull, 27th July, 1857.

On the Vascular System of Anodonta. By Professor LANGER.

The structure of the circulatory system of the Mollusca having given rise to a great number of discussions during the last few years, it is interesting to see new data coming in for the solution of the debate. According to Langer's observations, the vascular system of the *Anodontæ* appears to be closed. The walls of the vessels may be demonstrated in most of the organs. The venous system originates in two ways: in certain parts of the animal (the alimentary canal, tentacles, and sexual glands) it is the simple continuation of a superficial capillary network; in other organs (the foot and mantle) it arises from a peculiar tissue (*Schwellgewebe*) capable of dilatation.

The venous blood of the body flows into the median venous sinus discovered by Bojanus, and passing thence through the meshes of the organ which that anatomist regarded as a lung*, arrives in the branchiæ. The venous blood of the central parts of the mantle, on the contrary, does not pass into the respiratory organs, but arrives directly in the auricle of the heart, like the venous blood of the walls of the vestibule of the *corpus Bojani* and that of the partitions of the branchial walls. The arterial circulation, consequently, is not completely isolated from the venous. The afflux of the blood into the branchiæ takes place across the vessels of the *corpus Bojani*, which constitutes a sort of *rete mirabilis* between the median venous sinus and the branchial arteries.

Langer was unable to ascertain the presence of an aquiferous system in the *Anodontæ*. He nevertheless convinced himself of the existence of a direct communication between the vascular system and the exterior. It is the *corpus Bojani* that serves for the absorption of water. The aperture which was described even by Bojanus under the name of *respiratory orifice*, leads into the space which Keber has called the vestibule, and which is itself in direct communication with the proper cavity of the *corpus Bojani*. These two cavities are only enlargements of a long viscus twisted in different directions, and of which the extremity opposite to the orifice of the organ of Bojanus is nothing but the well-known aperture of communication of the pericardium. The water is thus conducted into the pericardium. The two orifices which Keber has described in the latter at the side of the rectum are constant; they lead into the venous network of the mantle.

Analogous observations have been made by Gegenbaur in the Heteropoda, by Agassiz in the Lamellibranchiata, &c. Langer supposes that the introduction of water from without into the sanguiferous system is for the purpose of furnishing calcareous salts required for the formation of the shell. We must confess that we do not know why the carbonate of lime should be furnished in this way rather than any other.—*Sitzungsber. der Akad. zu Wien*, 1856, p. 150. *Abstract in Bibl. Univ. de Genève*, Nov. 1856, p. 252.

* This organ, known under the name of *corpus Bojani*, is generally considered as the kidney. It is to be noted, however, that Schlossberger, in some recent investigations, was unable to discover in it the least trace of uric acid.

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XV.—*Researches on the mode in which Gum-Tragacanth is formed.* By Hugo von Mohl*.

The examination of Tragacanth gum possesses some theoretical interest, for it is connected with many difficult and as yet obscure points in the anatomy and physiology of plants.

Tournefort† was the first of those to whom we are indebted for exact observations on the secretion of gum-tragacanth from one of the plants furnishing this substance. His observations were made on *Astragalus creticus*, Lam., on Ida in Crete‡. According to the figure which he gives, the stem of the said tragacanth-plant attains a thickness of about 1 inch. The exudation of the tragacanth, in the form of coiled threads, takes place at the end of June and in the succeeding months.

Tournefort regarded tragacanth as the sap inspissated by the heat, which burst the vessels and poured itself out in the middle (*le cœur*) of the stem and branches, as well as in the medullary rays (dans l'interstices des fibres, lesquelles sont disposées en

* Botanische Zeitung, Jan. 16, 1857. Translated by Arthur Henfrey, F.R.S. &c.

† Relation d'un Voyage au Levant, i. 22. Amsterd. 1718.

‡ Sieber (Reise nach Kreta, ii. 68) has endeavoured to prove that Tournefort's statement is altogether incredible, for, according to his investigations in Crete, no tragacanth at all is secreted from the plant above named; but since not only Tournefort's statements regarding the parts of the stems in which the tragacanth is formed agree perfectly with my investigations, but his indication of the season at which the tragacanth exudes, as well as of the furtherance of the exudation resulting by making incisions in the stems, are confirmed by the observations made a century later by Olivier in Persia,—no one will be led to doubt, on such authority, Tournefort's statement that the said plant secretes tragacanth in Crete. When Sieber refers to the testimony of Belon, he makes a mistake, for Belon (Observat. p. 23) only says that no gum is collected on Mount Ida.

rayon), and as it was gradually driven out on the surface of the stem by fresh sap taken up by the roots, hardened in the air in the shape of worms. He adds further, the conjecture that contraction of the fibres of the stem assists in pressing out the gum, since the fibres, broken down into stringy masses, where exposed to be trampled on by sheep and horses, were contracted by heat, which would favour the emission of the sap.

These statements agree in many points with those of Olivier*, who observed the secretion of tragacanth from *Astragalus verus* in Persia.

In this species, also, the stem attained a thickness of an inch or more, and the gum exuded at the time of the greatest heat of summer, partly where the bark was split by the pressure of the sap, partly where the stem was injured by the tread of animals.

Further confirmation as to the season at which the tragacanth exudes from the stem is furnished by the statements of Labillardière and Landerer, the former of whom saw the gum excreted from *Astragalus gummifer*, Labill., in August, on Mount Lebanon; the latter, from *Astragalus aristatus*, in Greece, in August and September. In like manner, the statement that wounding the plants favours excretion of tragacanth, derives confirmation from the circumstance that in the district of Bitlis it is customary to make incisions in the plants for this purpose†.

Labillardière‡ mentions as an additional external circumstance favouring the exudation of tragacanth, moisture of the atmosphere, stating that, in Lebanon, cloudy nights and abundant dew are necessary for the excretion of the gum, and that this only exudes in quantity during the night, and for a short time after sunrise,—whence it happens that the shrubs growing on the lower part of Lebanon, which are exposed to very great heat by day, but receive little moisture at night, yield only a small quantity of tragacanth.

These statements of Labillardière are confirmed by the observations of Fraas§ in Greece, who states that no gum exudes (from *Astragalus aristatus* and *creticus*) on the higher mountains of the Peloponnesus, on Parnassus, or on dry mountains in general, while the gum is collected in Achaia. He regards the excretion of the gum as dependent on atmospheric influences, and ascribes it to the abundant cold rain with alternations of great heat, in the mountains of Calaryta, &c.

Labillardière drew, from the facts he observed, the conclu-

* Voyage dans l'Empire Othoman, 1807.

† Ritter, Erdkunde, x. 689.

‡ Rozier, Observations sur la Physique, &c., 1790, xxxvi. p. 48.

§ Synops. Plant. Floræ Classicæ, p. 39.

sion, that the tragacanth-shrubs, exposed to the glowing heat of the sun by day, rapidly absorbed the moisture of the clouds and fogs, and that the tragacanth, greatly swollen by the moisture of the fogs and dew, broke out through the pores of the bark, and exuded in the form of curled worms.

Labillardière's observation furnished DeCandolle* with an opportunity of explaining in a somewhat different manner the way in which tragacanth is squeezed out. He compared this exudation of tragacanth with that of *Nemaspora crocea* (which he at that time regarded as a gum, and not as a fungus) from the bark of the beech-tree, when kept in a damp place. He retained this view in his 'Physiologie' (i. p. 175), after he had recognized that *Nemaspora* was an independent plant, having convinced himself that the eruption of *Nemaspora* on dead trees was connected with the moisture of the atmosphere, and concluding from this that the action of moisture caused the wood to expand more than the bark; the wood being thus as it were compressed in a sheath, squeezed out upon the surface any slimy substance lying in the inner part of the bark. This explanation did not meet with any favour from Treviranus†, who assumed that the exudation of the gum depended upon increased secretion.

The botanists above mentioned, as also the most recent pharmacologists (for instance, Pereira) had not the slightest doubt that tragacanth was a mucilaginous juice secreted by the plant. Kützing‡, from the microscopic examination of exuded gum, set up the view that it was an independent organism, a fungus, composed of starch-bearing cells, among which lay the fibres of the parent-plant. The walls of these cells were described as consisting of many thick layers, composed of bassorin, and lined by a delicate membrane composed of cellulose. We look in vain for any proof that these cells are of Fungal nature; although such would be anything but superfluous, for Fungi with cellulose membranes and starch-granules would be not a little remarkable.

Unger§ ascribes a totally different origin to gum-tragacanth, stating that it is formed of the secondary layers of the medullary rays in several species of *Astragalus*.

I know of no other microscopic investigations of tragacanth which teach anything; those of Guibourt‖ are devoid of interest.

Seeking for an explanation of the nature of gum-tragacanth, I regarded it as of primary necessity to examine, not the gum occurring in commerce, but the stems of a large number of species of *Astragalus* of the section *Tragacanthæ*. Unfortunately

* Astragalogia, 1802, p. 12.
† Physiologie, ii. p. 21.
‡ Philos. Botanik, i. 203.
§ Anat. u. Physiol. d. Pflanzen, 119.
‖ Hist. naturelle des Drogues simples, 4 edit. iii. p. 420.

my materials were so far imperfect that I possessed no thick stems, only such as were at most as thick as a little-finger, such as are found in herbarium specimens, on the bark of which no exudation of tragacanth was visible. The sequel will show, however, that this material was sufficient for the investigation of the mode in which the gum is formed.

The examination of excreted tragacanth is most instructively made in thin flat pieces. A transverse section of such a plate, swollen in water, exhibits abundance of thick-walled cells lying in an amorphous slimy mass. The walls of these cells are colourless, gelatinous, and formed of thick layers in part clearly separated from each other, so that in this respect they exhibit much resemblance to the laminated substance of a starch-grain. In the cavity of the cells lies a more or less considerable quantity of small starch-granules. Application of iodine is necessary for the exact investigation of these cells. It acts upon them very slowly, the iodized chloride of zinc solution producing no other alteration for several hours beyond colouring the starch-grains blue, and producing a slight yellow colour in the cell-walls. Distinct coloration of the cell-walls only commences after the solution has been in operation twenty-four hours or more. The thin innermost layer of the cell-walls is then found coloured bright violet, and isolated thin layers, of a more or less bright violet colour, are observed in the thick swollen cell-membrane, their thin, coloured laminæ being separated from each other by thick, colourless, gelatinous layers. The outermost of these coloured laminæ are frequently torn, in which case the colourless gelatinous substance has partly exuded through the rents, and become blended with the slimy substance in which the cells lie imbedded. From this partial solution of the outer layers, the magnitude of the cells, which are about ·07 millimetre in diameter, cannot be determined accurately, and many detached fragments of the blue iodine-coloured laminæ occur, scattered irregularly in the amorphous mucilaginous mass.

In tragacanth of the form of vermicular filaments, the cells were less perfectly preserved, and the amorphous mucilage in which the lighter and darker violet membranes and starch-granules were diffused, formed a relatively large portion of the entire mass.

In still smaller quantity did well-preserved remains of cells occur in Syrian tragacanth, having the form of nodular, yellowish fragments, in which, moreover, the quantity of starch-grains was far greater and their size more considerable, the granules being also frequently conglomerated in compound granules.

From the investigation of tragacanth gum I proceeded to the examination of the stems, which extended to all the following species of the section *Tragacanthæ*: *Astragalus angustifolius,* Lam.; *aristatus,* L'Herit.; *Anacantha,* M. B.; *aureus,* Willd.; *Barba Jovis,* D.C.; *breviflorus,* D.C.; *bunophilus,* Boiss.; *campylanthus,* Boiss.; *caucasicus,* M. B.; *cephalanthus,* D.C.; *chromolepis,* Boiss.; *compactus,* W.; *creticus,* Lam.; *cyllenius,* Boiss. et Heldr.; *denudatus,* Stev.; *echinoides,* L'Herit.; *Echinus,* D.C.; *erianthus,* W.; *gossypinus,* Fisch.; *lagopodioides,* Vahl; *leiocladus,* Boiss.; *massiliensis,* L.; *microphysa,* Boiss.; *murinus,* Boiss.; *persicus,* Fisch. et Mey.; *plumosus,* W.; *Pseudo-tragacantha,* M. B.; *ptychophyllus,* Boiss.; *pychocephalus,* Fisch.; *pycnophyllus,* Stev.; *sciureus,* Boiss.; *siculus,* Biv.; *susianus,* Boiss.; *tumidus,* W. Among these occurred only four species in which no tragacanth-formation could be found in the stems, namely *A. aristatus,* L'Herit. (from the Pyrenees), *massiliensis,* L., *angustifolius,* Lam., and *echinoides,* L'Herit. In all the rest, tragacanth had made its appearance in more or less abundance*.

The structure of the stem in general is as follows. The wood is composed of thin annual layers, extremely tough, tearing easily in a longitudinal direction into slender fibres, enclosing a small pith, and traversed by pretty numerous medullary rays, exhibiting nothing unusual, as is the case with the bark also, which contains a well-developed liber and is clothed by a dense, tough periderm. The pith, on the other hand, and a large portion of the medullary rays, have a most striking characteristic, for, instead of presenting a thin-walled parenchymatous tissue, they appear to the naked eye in the form of a hard, transparent, gummy mass, and swell up into a jelly in water. On cut surfaces of the stem we frequently find a projecting mass of dry gum, which has exuded from the pith-cavity.

When we have recourse to the microscope, we perceive immediately that the gum-like mass which fills up the pith-cavity and the medullary rays, or has exuded from cut surfaces, does not consist of dried mucilage, but of the cells of the pith and medullary rays themselves, which have undergone a more or less complete transformation into gum-tragacanth.

Ordinarily this transformation has not affected all the cells of the pith and the medullary rays, but the outermost layers of the medullary rays, next to the wood-cells, regularly, and not unfrequently, in like manner, the outer part of the pith, lying against the woody bundles, are composed of ordinary thin-

* How far the subsequently described conversion of the cells into gum-tragacanth occurs in the species of *Astragalus* belonging to the other sections of the genus, I have not specially investigated; I may remark, however, that I observed the same transformation also in a couple of species of the section *Incani* which I took out at random, viz. *A. brachycarpus,* M.B., and *A. angulosus,* D.C.

walled parenchyma-cells, the membrane of which is coloured bright violet by the iodized chloride of zinc solution. These unaltered cells form, however, usually only a very thin stratum, composed of but a few cells, while all the rest of the cells constituting the central mass of the pith and of the medullary rays are metamorphosed.

That the peculiar character of these cells is a result of the transformation of ordinary parenchymatous cells, and not an original peculiarity of the cells of these parts, is shown by the fact, that the pith and medullary rays of the extremities of the shoots exhibit no unusual appearance.

The metamorphosed cells are distinguished from ordinary cellular tissue, in respect to their physical character, in that in a dry condition they form a very hard, transparent, gum-like mass, and in a wet condition a swollen slimy substance. Under the microscope these cells display, when their transformation has not advanced far, the angular forms and the close cohesion of parenchymatous cells, but their walls are very thick, and distinctly composed of many very thin laminæ; their primary membrane may be readily distinguished from the secondary layers of thickening, and is not thickened, as is seen in particular in cross-sections of the 'pits,' in which the primary membrane lies free. The whole form of these cells, the distinct lamination of their membrane, and the gelatinous softness of the latter in a wet condition, impart to them a great resemblance to the well-known cells of the cotyledons of *Schotia*.

In this stage of transformation into gum-tragacanth were, according to circumstances, either only those cells next in contact with the unaltered layers, or those also which formed the centre of the pith and the medullary rays; as I saw in young stems of *A. cyllenius*, Boiss., which, according to Orphanides, is one of those from which tragacanth is collected in Greece.

If the metamorphosis has advanced a step further, the individual cells swell up in a conical form in water, and become more or less completely isolated, retaining however their full integrity, no slime exuding from them into the water being rendered visible by the application of iodine.

In the last respect, however, I found a striking exception in some species (*A. aureus*, W.; *Pseudo-tragacantha*, M.B.; *compactus*, W.; *pycnocephalus*, Fisch.), for the cells were surrounded by an exuded slimy substance, apparently perfectly soluble in water, which immediately assumed a beautiful indigo-blue colour on the application of the iodized chloride of zinc. The same colour was produced in the amorphous contents of the cells, as also in the contents of the unchanged cells of the medullary rays, and of a part of the cortical cells. But this coloration was transitory, for in the course of a few hours the blue colour had entirely vanished, and a yellowish tint remained. This phænomenon again reminds us of the cotyledons of *Schotia*, from which in like manner exudes a slimy substance coloured bright blue by iodine and coagulable by alcohol. In other cases, in particular in *A. cyllenius*, the metamorphosed cells discharged into the water a slimy substance coloured yellow by iodine; both this, however, and the slime coloured blue by iodine, are exceptional.

When the transformation of the cells into gum-tragacanth has advanced farther, the membrane which swells up strongly in water is no longer distinctly seen to be composed of numerous thin laminæ. This conversion into a mass, of homogeneous aspect, advances from without inwards in the cell-membrane; for I saw (in *Astragalus murinus*) cells in which this affection had attacked the outer half of the cell-wall, while the inner half, separated from the outer homogeneous mass by a sharp line, still displayed the fine lamination.

The final conversion into perfect tragacanth results when the cells lose their external solid boundaries, and their outer laminæ coalesce into a more or less uniform slimy mass; in which, as is frequent in exuded gum, the inner laminæ may still exist in perfect integrity.

The cells metamorphosed in the above-described manner exhibit, at least when wetted, a considerably greater diameter than the thin-walled cells from which they originate: thus, one of the large unaltered cells of the medullary rays of *Astragalus denudatus* is ·0064 of a millimetre in diameter, while a metamorphosed but still distinctly defined cell from the interior of the same medullary ray measures ·035 millim., that is, about five times the size; in *A. Echinus* the size of the metamorphosed cells of the pith amounted to ·06 of a millimetre, and had thus reached about the magnitude of the cells contained in tragacanth which had exuded from the stem.

The behaviour of the cells with iodine alters in proportion to the degree of metamorphosis they have undergone. The unchanged cells of the pith and medullary rays assume a deep violet colour with the iodized chloride of zinc solution in the space of twenty-four hours. The cells which have been only slightly altered, and have still the form of angular but thick-walled prosenchymatous cells, are likewise coloured deep violet. But this colour is not uniform throughout the whole thickness of the cell-wall, the innermost and outermost laminæ being especially brightly coloured, while solitary thin lamellæ among the secondary layers exhibit a violet tint. I could not determine whether the uncoloured laminæ between these coloured layers were perfectly colourless or tinged with a very light violet colour. A similar condition is well known to occur frequently in other thick-walled parenchyma-cells which become softened and greatly swollen when placed in water; for instance, in those of *Schotia*.

The further the dissolution of the cells and their conversion into gum-tragacanth proceeds, the lighter is the violet colour assumed by the entire mass of them, since the uncoloured or slightly tinted laminæ more and more exceed in proportionate dimensions; and even the coloured laminæ, especially the outer, perhaps simply as a result of greater mechanical expansion, exhibit a lighter colouring.

The described observations will leave no doubt of the fact that gum-tragacanth is neither a secreted sap dried by exposure to the atmosphere, nor an independent Cryptogamic organism, but that its formation depends upon a more or less perfect transformation of the cells of the pith and medullary rays into a gelatinous mass, which swells up to many hundred times the original size of the cells when placed in water.

Whether the production and expulsion of the gum occur but once in one and the same part of the stem, or are repeated during many years, can of course be determined only in the native country of the tragacanth-plants; perhaps, however, the conjecture that it is a process persisting through an extended period is not too bold. The transformation of the pith can of course only occur once in any given part of the stem, and this source will be extinguished with the earlier or later expulsion of the gum formed. But the case may be otherwise with the medullary rays, since all the medullary rays of any particular part of the stem do not undergo their metamorphosis at the same time. In the younger of the stems examined by me, at least only a portion of the medullary rays had undergone this change, while the rest still displayed the usual constitution of thin-walled cells. It may be indeed assumed, from the great firmness of the periderm clothing the stem, that the breaking-out of the gum through the bark takes place annually from only a small portion of the medullary rays, and thus perhaps goes on for many years, until all the medullary rays of a length of the stem have been emptied.

Surveying the vegetable kingdom, with a view to ascertain whether analogous conversions of cells into mucilage occur elsewhere, we find similar processes to be anything but rare. Attention has been especially directed by Alex. Braun* to the fact of an exactly corresponding softening of the cell-membranes,

* Verjungung, p. 203. Ray Society's Memoirs, 1853, p. 189.

a swelling-up in a gelatinous form, terminating in their dissolution, being a very ordinary phænomenon in the families of Palmellaceæ, Chroococcaceæ, and Nostochineæ; that analogous changes of the cell-coats occur in *Hydrodictyon* and *Botrydium*; and that the gelatinous softening of the membrane of the parent-cells of pollen-grains also stands in connexion with their subsequent solution. In like manner I have satisfied myself that the abundant 'intercellular substance' in the albumen of many Leguminosæ, such as *Gleditschia* and *Sophora,* depends on an exactly analogous process, on a conversion of the outer laminæ of the cell-walls into a homogeneous jelly, in which latter an indication of the primary membrane may often be detected for a long time, till at length it vanishes, and leaves no trace. I have also no doubt that the formation of the 'intercellular substance' of the Fucoids, of *Chondrus crispus,* &c., depends upon exactly analogous processes. We have therefore to regard the formation of gum-tragacanth as a special example of a widely diffused disorganization-process of cell-membrane, which proceeds from without inwards, sometimes affecting the whole cell-wall, sometimes only the outer laminæ, and terminates in the conversion of the membrane into a more or less soluble jelly. On the other hand, it appears to me less proper to draw a parallel, with Unger, between the formation of gum-tragacanth and the formation of the secondary and tertiary gelatinous cell-membranes, such as occur in the seed-coats of *Cydonia, Linum, Collomia, Ruellia,* &c.; at all events, it is not known to me that these exist in the condition of cellulose-membrane previously to the period in which they are found with the character of gelatinous pellicles.

Tubingen, Dec. 1856.

[*Note of Translator.*—With regard to the remarks in the last paragraph, we find the 'swelling-up' coats of the hairs of *Collomia, Ruellia,* &c., to be the metamorphosed *outer* membranes, which take a violet colour with sulphuric acid and iodine when dissolved into a mere jelly, while the spiral fibres or rings (secondary deposits) are coloured yellow. Hence we regard these structures as parallels of the cell-membrane of tragacanth. The author's view of the structure of the horny thallus of *Chondrus* is entirely confirmed by our own examinations of the tissue in various stages of development.—A. H.]

XVI.—*On the Sands intermediate the Inferior Oolite and Lias of the Cotteswold Hills, compared with a similar deposit upon the Coast of Yorkshire.* By JOHN LYCETT*.

My friend Professor Buckman having invited me to throw together some geological conclusions to serve as a foundation for a discussion, I select a subject which has already received some consideration at the hands of the Club, and which, from its local position, and a difference of opinion which has arisen with respect to the zoological affinities of its fauna, seems to claim some further examination. I allude to the series of micaceous sands and marls which are situated intermediate the Inferior Oolite and Lias, and which are known to English geologists generally as the Sands of the Inferior Oolite, and to continental cultivators of the science as the Jurensis marls; the Grès Supraliassique; the Hydroxyde Oolithique; the superior portion of the Upper Lias; the Lias *Zeta* of Quenstedt, &c. Dr. Wright† and Mr. Hull‡ have each recently exemplified this deposit in copious and well-known memoirs; but as regards the Cotteswold Naturalists' Club, the present is the first communication which has been presented to it in a written form. The conclusions arrived at by the authors above referred to are based solely upon zoological evidence, and are therefore liable to be affected by subsequent additions, which may tend to alter the relative proportions of Oolitic or of Liassic species found in the deposit; and as some interesting accessions to its fauna have recently been made, more especially in the lower fossiliferous zone, which was but little known until within these few months, I present a notice of them, with the remark, that although as contributions they possess some value, they by no means afford a triumph to any foregone theoretical conclusions;—that they may be compared rather to a portion of the materials forming a part of the structure of a buried edifice whose proportions are not yet fully developed, and of whose full history so much yet remains to be ascertained, that at present it would be injudicious to indulge in absolute conclusions respecting it. This sandy deposit must be seen to be fully appreciated: presenting much variability in its thickness throughout its long course in the Cotteswolds, it is everywhere readily recognized, and even the approximate position of any small exposures of it may be predicated with tolerable exactness. Unfortunately, nearly the whole of the

* Read to the Cotteswold Naturalists' Club, July 28, 1857.

† "On the so-called Sands of the Inferior Oolite." Journn. Geol. Soc. 1856.

‡ Mem. of the Geol. Surv. of Gr. Brit. "The country around Cheltenham." 1857.

Cotteswold sections are of a small and imperfect character, consisting chiefly of cuttings of rock upon deep lane-sides, or upon the banks of water-courses; and although these in the aggregate exhibit the entire physical features of the deposit, they do not enable us to ascertain the thickness of the whole, in particular localities, with any near approach to accuracy. We can therefore only estimate the thickness by tracing upwards the beds upon hill-sides, and occasionally by examining the rock brought up during the process of well-sinking. From information obtained in this manner, it would appear that the thickness of the sands varies in the middle Cotteswolds from 35 to 80 feet; and Mr. Hull has shown that over the northern and southern Cotteswolds they present even a greater amount of variability in thickness. My own observations lead to the conclusion, that, like the mass of the Inferior Oolite generally, the thickness is greater upon the outer western escarpment of the Cotteswolds than in the interior valleys, where they are far remote from the outer range. In tracing upwards the beds from the Lias there occurs the following general order of succession:—

A. Upper Lias clay, grey or blue, soft, and clearly distinguished from

B. Brown or chocolate-coloured, marly, micaceous sandstone, with frequent red ferruginous stains between the lamination; occasionally the stone is more argillaceous, and buries the hammer when struck; in other instances, from the presence of portions of shells, it is more hard, but is peculiarly irregular and uncertain both in hardness and colour, varying from a blackish-grey to a bright foxy or reddish hue, everywhere glittering with micaceous particles. At about 4 feet from the base are usually one or two thin bands charged with fossils, the greater number of which are very imperfectly preserved: this may be designated as the lower shelly zone, and may be studied in small lane-side sections at Nailsworth and at Brimscombe. In the Yorkshire exposition of the deposit, I shall subsequently show that a shelly zone occurs in a similar position. Passing upwards from 10 to 20 feet, there occurs a general diminution of compactness in the rock, and of its marly structure; there gradually sets in

C. Micaceous, foxy-coloured or yellowish, incoherent sands, seldom much compacted, but locally becoming soft sandstone, from 20 to 40 feet, abruptly terminated upwards by

D. Concretionary marly bed, usually darker in colour than the sands, but varying much in structure and aspect within short distances, and everywhere more or less fossiliferous; the tests of Mollusca are less frequently preserved than in the lower zone. A constant mineral feature is the presence of small oval grains of hydrate of iron disseminated through the rock; a structure which, however, is not peculiar, as it is present in the Inferior Oolite at Dundry and in the Lias of France. From 2 to 4 feet is the thickness of this bed in the Cotteswolds.

Immediately overlying this upper Ammonitiferous bed are several others of hard brown or yellowish calcareo-siliceous sandstones, in which fossils are usually very sparingly distributed, and, from the evidence these afford, the beds have by universal consent been assigned to the Inferior Oolite.

In Yorkshire, the lofty iron-bound coast at the Peak and at Blue Wick exhibits the same remarkable deposit in considerable thickness, and slightly modified in its mineral character from the Cotteswold Sands. In a visit which I recently made to this coast, in company with my friend Professor Morris, the identity of the lower portion of the Dogger or Inferior Oolite of Phillips with the Gloucestershire Sands was strongly impressed upon my mind. At Blue Wick the Dogger is altogether about 80 feet in thickness, and rises in successive beds in descending order from the rocky beach into the face of the lofty cliff, the lower 40 feet representing the sands of the Cotteswolds. Beneath these succeed the hard beds of the Upper Lias Shale, 200 feet thick, followed by the Middle Lias, nearly equal in mass; ultimately, at the Peak, facing Robin Hood's Bay, these great deposits are all exposed in one vast unbroken section, forming a lofty mural cliff, nearly 400 feet in height and three miles in length, in the course of which the Dogger attains the summit of the cliff. Words are scarcely adequate to express my admiration of this grand exposition of the lower Jurassic rocks, which for extent and completeness can scarcely be paralleled. Proceeding northwards, the upper 40 feet of the Dogger loses more than half its thickness, and the lower portion, or representative of the Sands, thins out altogether; a great fault then succeeds, by which the Middle Lias is upraised to the summit of the cliff.

The highest bed of the Upper Lias consists of black, finely laminated shale, the transition to the sandstone above being abrupt and very distinctly marked. The sands are here compacted into thick-bedded, dark grey micaceous sandstones in the lower part, and into brownish or foxy-coloured micaceous sandstones in the upper part, so that the whole nearly resembles the Cotteswold Sands, and differs chiefly in its greater compactness. Fossils are distributed very sparingly throughout the mass of the sandstones, but they are present more abundantly, as in the Cotteswolds, in two calcareo-argillaceous zones, situated in like manner, the one at the top, the other near to the base of the series. The lower fossiliferous zone is a dark grey concretionary band of rock crowded with valves of *Lingula Beanii*; in smaller numbers are *Orbicula reflexa, Vermetus concinnus, Avicula inæquivalvis*? and another *Avicula*, a small smooth *Pecten, Cerithium*, &c. Belemnites are not uncommon, but Ammonites are rare, and are obtained singly and at intervals throughout the sandstones; these are, *A. variabilis*, var. *Beanii*, *A. striatulus*, and *A. Aalensis*; the latter form has not been observed in the Cotteswolds, but occurs in the same stage (Lias *Zeta* of Quenstedt) in the Jura. *Vermetus concinnus* occurs at intervals throughout the sandstones in small groups, and usually isolated. The dark grey colour of the lower beds of sandstone changes upwards to a foxy hue, and at the summit is the upper fossiliferous zone, from 14 to 18 inches thick, concretionary and dark-coloured; altogether it nearly resembles the Cotteswold bed at Haresfield Hill, with Cephalopoda. In like manner, each abounds with a Terebratula, which is its predominating fossil; the Yorkshire shell is the *Terebratula trilineata* of Young and Bird, *T. ovoides*, Sow., a larger form than the *subpunctata* of Haresfield, but which very much resembles the latter shell when collected indiscriminately at each locality, and without preference to presumed typical forms: unfortunately, the Blue Wick specimens are more frequently compressed and distorted. Other fossils recognized are, *Pleurotomaria subdecorata*, D'Orb., which also occurs at Nailsworth; *Belemnites compressus, B. irregularis*, and portions of Ammonites. *Rhynchonella cynocephala* has occurred very rarely, and several specimens of *R. bidens* are also recorded. The thick sandstones of the Dogger which overlie this zone abound with small quartzose pebbles, which are never seen beneath the *trilineata* bed.

In Gloucestershire, the lower zone at Brimscombe and Nailsworth has produced the Liassic *Orbicula reflexa, Avicula inæquivalvis*?, *Lima Galathea, Ammonites Raquinianus*, which is the *crassus* of Phillips, and another tumid form which much resembles it, and may be only a distinct variety. These have not been found to pass into the upper zone; but the oolitic element is fully represented in this lower zone by certain Conchifera, as *Myoconcha crassa, Perna rugosa, Trigonia striata, Pholadomya fidicula, Modiola cuneata, Goniomya angulifera, Mytilus lunularis, Modiola ungulina, Gresslya abducta*, and *Modiola compressa*. The upper zone contains in addition the following Oolitic species:—*Cypricardia cordiformis, Hinnites abjectus, Astarte excavata*, Sow., var., *A. detrita, Macrodon Hirsonensis, Modiola Sowerbii, Gervillia Hartmanni, Gresslya conformis, Homomya crassiuscula*. *Pecten textorius* and *Turbo capitaneus* appear to have a considerable stratigraphical range, as they are found from the Upper Lias to the Inferior Oolite inclusive. Of the eighteen Ammonites, which appear to include fifteen distinct species, several are undoubtedly derived from forms which occur in the higher beds of the Upper Lias shale of the counties of York and Somerset; others seem to be proper to the stage, and not one of the Ammonites passes upwards into the Inferior Oolite. The Brachiopoda appear to be entirely Liassic derivatives; and even *Rhynchonella cynocephala*, which, from its abundance and wide diffusion, seems to offer a good designation for the stage (Cynocephala-stage), is perhaps nothing more than a variety of *R. acuta*,—the number of plaits, whether anterior or lateral, affording no constant or reliable distinctive character; in other respects the general figure of both is absolutely the same. The single Nautilus, *N. latidorsatus*, is also Liassic. On the other hand, in the numerous Conchifera the Liassic element nearly disappears altogether, and we find a considerable infusion of the Oolitic, leaving, however, no inconsiderable number of species which appear to be proper to the stage. It is indeed a very striking but undoubted fact, that of the very numerous Liassic Conchifera and Gasteropoda, not more than four or five are continued into the Cynocephala-stage, and even of these two only are found in the upper zone. The more common Upper Lias Ammonites (Lias *Epsilon*) are equally absent in the Cynocephala-stage, as *A. communis*, *A. serpentinus*, *A. bifrons*, *A. annulatus*, *A. exaratus*, *A. elegans*, Y. & B., *A. fimbriatus*. *A. striatulus* is strictly identical with the Liassic form; but the common Cotteswold form of *A. variabilis* var. *dispansus* offers well-marked distinctions from the Liassic variety, which, as it is the *A. Beanii* of Simpson, may be termed the variety *Beanii*. The variety *dispansus* is more compressed, the volutions more enveloped; both the fasciated tubercles and the ribs are smaller, less prominent and more numerous; the ribs being much more curved near to the keel. The Liassic variety, however, occurs very rarely at Frocester Hill. *Ammonites opalinus* I have omitted altogether, as the single specimen found lying upon the ground at Haresfield Hill may have been derived from those superincumbent Inferior Oolite beds to which it has been referred by Quenstedt and Oppel. The species alluded to is the *opalinus* of Reinecke, Zieten, and Quenstedt, but not the *primordialis* of Schlotheim and D'Orbigny, which is sometimes confounded with it. *A. primordialis* is an Upper Lias species. Two forms of these Cotteswold Ammonites appear hitherto to have been undescribed; these will shortly appear, under the names of *A. Moorei* and *A. Leckenbyi**; the former is allied to *Aalensis*, the latter to *hircinus*.

* The Cotteswold Hills: Handbook to their Geology and Palæontology.

The statement that these Ammonites all cease with the highest bed of the stage, needs some little qualification: a single specimen of *A. striatulus* and *A. variabilis* has occasionally been detected in the lowest of the hard brown beds which overlie the Cephalopod-bed at Frocester Hill; *Belemnites* and *Rhynchonella cynocephala* are more frequent. Whether, however, these Testacea may have been washed into the newer bed, or may for awhile have lingered there as living denizens, is of little moment, as it is certain that the occurrence is of a local nature, and extends only to the lowest bed of the Inferior Oolite.

In assigning to the Sands the provisional rank of a distinct zoological stage, my conclusions are founded upon a review of its fossils compared with those of the Upper Lias "*Epsilon*" on the one hand, and of the Inferior Oolite on the other, to each of which they offer certain approximations, in some instances amounting to absolute identity, in others to the more distant affinities of varieties; after deducting these, a considerable number still remain, which appear to be proper to the stage. This view is to some extent in accordance with that of Quenstedt, who, in his 'Jura,' has separated the Jurensis marls from his Lias "*Epsilon*," or Upper Lias shale, into a distinct subdivision or stage of the Lias, under the name of Lias "*Zeta*." It may be preferable for the present to allow it to remain as an independent stage until more extended observations shall have been made,—more especially until the Testacea of the Lias "*Epsilon*" shall have been more fully figured and described. In this respect it may rank as of the same stratigraphical value as the Cornbrash or the Kelloway Rock, a theoretical arrangement which will leave the problem to be determined by future researches, viz. to which of the two great formations bordering it, its fossils offer as a whole the nearest approximation. Considerable as the list of these has now become, it is evident that much still remains to be done; other localities require to have their fossils better collected and examined. How insufficient is our list from Dorsetshire; how few species have been distinctly assigned to the stage in Yorkshire; how short a time has elapsed since the fossils of the lower zone have been collected in the Cotteswolds; how meagre is the list of M. Eugène Deslongchamps from Calvados; and, in the Mozelle, how considerable a number of the species remain undetermined! The recollection of these deficiencies should induce us to discourage for awhile all decisive conclusions, and lead us rather to compare our acquisitions from time to time, carefully and rigidly subjecting them to the necessary comparisons, free from the bias of preconceived opinions.

In the Cotteswolds, 56 Testacea have been obtained in the upper, and 54 in the lower zone; in all, 81 species,—divided into, Cephalopoda, 22; Brachiopoda, 4; Gasteropoda, 9; Conchifera, 46.

The following amended list of fossils from the Cynocephala-stage of the Cotteswolds offers some additions and corrections to those previously published, and is divided into two distinct zones.

Upper Zone at Frocester Hill, at Haresfield Hill, and at various other smaller sections.

Ammonites variabilis, *D'Orb.*, var. Beanii.
—— variabilis, var. dispansus.
—— striatulus, *Sow.*
—— radians Orbignianus, *Schlot.*
—— radians Dewalqueanus, *Rein.*
—— comensis, *De Buch.*
—— insignis, *Schub.*
—— ——, var. with compressed back.
—— subinsignis?, *Op.*
—— Jurensis, *Ziet.*
—— discoides, *Ziet.*
—— Boulbiensis, *Y. & B.*
—— Levesquei, *D'Orb.*
—— torulosus, *Schub.*
—— Moorei, *Lyc.*
—— Leckenbyi, *Lyc.*
Belemnites tripartitus, *Schlot.*
—— irregularis, *Schlot.*
—— compressus, *Voltz.*
Nautilus latidorsatus, *D'Orb.*
Turbo capitaneus, *Münst.*
Cerithium papillosum, *Desh.*
Cypricardia cordiformis, *Desh.*
—— brevis, *Wright.*
Cucullæa ferruginea, *Lyc.*
Tancredia, n. sp.
Cardium Hullii, *Wright.*
Opis lunulatus, *Sow.*, var.
Opis carinatus, *Wright.*
Trigonia Ramsayi, *Wright.*
—— striata, *Sow.*
—— costata?
Astarte complanata, *Rœm.*
—— excavata, *Sow.*, var.
—— detrita, *Goldf.*
—— lurida, *Sow.*, short, gibbose var.
Macrodon Hirsonensis, *D'Arch.*
Gryphæa plicata, *Lyc.*
Hinnites abjectus, *Phil.*, sp.
Lima Electra, *D'Orb.*
—— bellula, *Mor. & Lyc.*, var.
Modiola Sowerbyi.
Pecten textorius, *Schlot.*
Gervillia Hartmanni, *Goldf.*
Pinna fissa, *Goldf.*
Goniomya angulifera, *Sow.*, sp.
Pholadomya fidicula, *Sow.*
—— arenacea, *Lyc.*
Gresslya abducta, *Phil.*, sp.
—— conformis, *Ag.*
Myacites arenacea, *Ag.*, sp.
——, species undet.
Homomya crassiuscula, *Mor. & Lyc.*
Terebratula subpunctata, *Dav.*
Rhynchonella cynocephala, *Rich.*
—— Jurensis, *Quenst.*, var.

Lower Zone at Nailsworth and Brimscombe.

Ammonites variabilis, var. dispansus.
—— Raquinianus, *D'Orb.*
——, species allied to Raquinianus.
—— Jurensis, *Ziet.*
—— radians Orbignianus, *Schlot.*
—— striatulus, *Sow.*
—— subinsignis?, *Op.*
—— concavus, *Sow.*
Belemnites compressus, *Voltz.*
—— tripartitus, *Schlot.*
Nautilus latidorsatus, *D'Orb.*
Turbo capitaneus, *Münst.*
Trochus duplicatus, *Sow.*
Pleurotomaria subdecorata, *D'Orb.*
Chemnitzia lineata, *Sow.*, sp.
——, species undet.
Natica adducta, *Phil.*
—— Oppelensis, *Lyc.*
Orbicula reflexa.
Astarte lurida, *Sow.*
—— complanata, *Rœm.*
—— rugulosa, *Lyc.*
Trigonia striata, *Sow.*
Cypricardia brevis, *Wright.*
—— cordiformis, *Desh.*
Cucullæa ferruginea, *Lyc.*

Cucullæa olivæformis, *Lyc.*
Nucula Jurensis, *Quenst.*
Cardium Hullii, *Wright.*
Unicardium, sp. indet.
Myoconcha crassa, *Sow.*
Perna rugosa, *Münst.*
Goniomya angulifera, *Sow.*, sp.
Gervillia Hartmanni, *Münst.*
—— fornicata, *Lyc.*
Avicula inæquivalvis?, *Sow.*
Modiola cuneata, *Sow.*
—— Sowerbii, *Sow.*, sp.
—— compressa, *Münst.*
—— ungulina, *Y. & B.*
Mytilus lunularis, *Lyc.*
——, sp. indet.
Lima Electra, *D'Orb.*
—— bellula, var., *Mor. & Lyc.*
—— Galathea, *D'Orb.*
—— ornata, *Lyc.*
——, n. sp.
Pholadomya arenacea, *Lyc.*
—— fidicula, *Sow.*
——, sp. indet.
Myacites arenacea, *Lyc.*
——, sp. indet.
Rhynchonella cynocephala, *Rich.*
—— plicatella, var.

XVII.—*Descriptions of new Ceylon Coleoptera.* By John Nietner, Colombo, Ceylon.

[Continued from vol. xix. p. 388.]

In the first of these papers (Annals, xix. p. 247) I have described a winged species of *Œdichirus,* a genus supposed to be without organs of flight; and I have since (xix. p. 385) given publicity to the more important discovery of wings in the single genus which forms the family of the Georyssi, also hitherto supposed to be apterous; I am now about to announce to some and confirm to others the existence of these organs in the family of the Scydmænidæ, a fact, although incomplete, of more importance than either of the former, considering the extent of the family and the difference of opinion which appears to exist on the subject amongst the most eminent entomological authorities. It is this importance which induces me to enter more fully on the subject.

I am not acquainted with the famous monograph of the family of the Scydmænidæ by Dr. Schaum; however, from the manner in which it is quoted by Lacordaire in his 'Genres des Coleopt.,' I should infer that these two celebrated authors agree in all vital points. In Lacordaire's diagnosis of the family, these insects are described as having (with the exception of the American genus *Brathinus,* of which Lacordaire is not quite sure that it belongs to the family) the elytra soldered together, and being destitute of wings. Now, it is scarcely credible that on a point so easily ascertained as this, any difference of opinion should exist; still, Westwood, in his 'Modern Classification of Insects,' in describing the same family, makes statements which imply the contrary. However, Lacordaire's description, being by fifteen years more recent, and, in fact, the latest, is, if only for this reason, entitled to be considered before all others; and looking upon it in this light, that is, as the essence of all former observations, I shall for the present occupy myself with it alone. According to this description, as mentioned above, the insects which it regards *have the elytra soldered together and are destitute of wings.* This being the case, I was startled to find that out of the thirteen species described below, nine or ten which I examined in this respect had neither the elytra soldered nor were they destitute of wings;—*on the contrary, the elytra were unconnected in the middle, and the wings were nearly double the size of the whole insect, and could not possibly be overlooked.* I would willingly have supposed that the 100 species of this family contained in European collections, and principally derived from Europe and North America, agreed with Lacordaire's description, and that the Ceylon species were exceptions to the general rule, had not Westwood's observations alluded to above corroborated my own, thus rendering me suspicious of some unaccountable mistake or oversight somewhere or other. That this mistake cannot consist in a slip of the pen or a misprint in the 'Genres des Coleopt.' quoted above, is clear from the obvious care which has in every respect been bestowed upon this work, and from the same remarks being repeated in different words. Where this mistake is, and upon what grounds it rests, it would, under my circumstances, be useless to attempt to unravel. However, it appears certain to me that some more detailed and positive remarks on the subject cannot be superfluous, and must be new to some entomologists. Placing the fullest confidence, as every one would do without hesitation, in the infallibility of the description of the Belgian author, it was not likely that I should have looked for wings at all in the Scydmænidæ (a family to which I have not until lately paid much attention) had I not been struck by seeing the elytra of my *S. alatus* open, when handling it with a fine painter's brush in a drop of water, it being at the time quite out of the question that the opening could have been effected by pressure. On opening the elytra fully, I had no difficulty in discovering the wings. Rendered extremely curious by this discovery—diametrically opposed to the distinct statement of so great an authority as the one just alluded to—I now examined other species, and all with the same result, most of them opening the elytra without my assistance, in the same manner as the *S. alatus*; and I have not the slightest doubt that when a sufficient number of specimens enables me to examine the rest, it will still be with the same result. That these insects use their organs of flight, may be gathered from the following:—At a former period I lived in a house situated on a small eminence, and overlooking extensive groves of cocoanut-trees, cinnamon gardens, paddy-fields, and patches of jungle. Here I collected large numbers of Pselaphidæ, especially *Euplectus*, in thin, scarcely visible spider-webs, with which the white walls of the house were covered in certain places—thus forming one large trap for anything small flying about. That these had been caught here when on the wing, there could be no doubt; but I was much surprised to find with them (what is so common in more congenial localities, here also) a considerable number of *Scydmæni*, especially my *S. advolans* and *pubescens*, as they were said, by the most recent authority, to be unable to fly, and the position they then found themselves in was one they could not well, or could not possibly, have got into otherwise than by flying. For some reason or other, I am ashamed to say, I did not follow up the matter at the time; but I am now certain on the subject:—indeed, to remove all doubt, and to settle all disputes, I have just been so fortunate as to take my *S. advolans* actually on the wing, flying in my garden in the evening at sunset.

Having gone so far, I will (in spite of some slight misgivings of being laughed at for telling an old story with so grave a face) add a few descriptive words about the organs in question. The wings of my *Scydmæni* are ample, about double the size of the whole insect, oblong, having the margin beautifully ciliated, and, with the exception of a few yellowish veins at the base, without any visible organs of this kind.

In spite of the difference in their shape, &c., I believe all the species described below to be genuine *Scydmæni* as restricted at present. Being, however, unacquainted with the sexual distinctions of these insects (which, indeed, I believe not to have been satisfactorily pointed out by any one, and to differ in different species), I should not be surprised if one or two of my species were eventually ascertained to have been separated upon these grounds alone. However, as I have been very reluctant to admit new species, it is just as likely that individuals may hereafter be found united in one, which ought to be separated into two species. But I trust that neither may happen. The species were all collected by myself in the immediate neighbourhood of Colombo; I have, however, no doubt that they occur all over the S.W. of the island, which is of a uniform physical character, and perhaps occupy a still larger portion of it. None of them are quite common; on the contrary, of nearly half of them I possess only one or two specimens. My *S. femoralis* I found under the soft, rotting bark of an *Erythrina indica*; *S. Ceylanicus* and *ovatus* I found dead in spider-webs; *S. graminicola, glanduliferus,* and *pyriformis* I have hitherto exclusively taken in the sweeping-net on the lawns of my garden about sunset; the other species I have met with indiscriminately in spider-webs, under rotting vegetable substances, and in the grass.

After this preamble, which I trust may not be deemed quite superfluous, I now enter upon the description of my species, drawing attention previously to the three very natural and very distinct groups which they form, the characteristics of which will at once be perceptible from the headings given below. With regard to the first group (A. I. sp. 30–34) I may mention that the elongated legs, largely developed posterior trochanters, and often distant posterior coxæ, render the motions of the insects belonging to it staggering when walking, which, together with their oblong, subdepressed body, distinguishes them at a glance. I have subdivided them from the cultriform or grooved mesosternal carina. The second group (A. II. spec. 35–41) is equally well characterized by the more robust, pyriform and subconvex body of the insects. *S. pselaphoides* in the former, and *S. advolans* in the present group, form connecting links between the two; especially *S. pselaphoides*, which in general appearance rather belongs to the second; upon closer examination, however, it is easily ascertained to be an anomalous member of the former. From the rounded or narrowed occiput I have divided the second group into two subdivisions, giving preference to the distinctions to be drawn from this part of the body to those to be derived from the thorax, which, from the variety of shapes it assumes, would naturally suggest itself for that purpose; but the gradations between the principal forms appear to me too many, too fine, and therefore too indistinct, to adopt them. As to the third group (B. spec. 42), the insect which alone forms it amongst those described below, is so different from any of the others, that its peculiarities must strike any one at first sight.

A. *Species with a thick neck, abruptly formed and immersed in the thorax.*

I. *Fourth joint of the maxillary palpi not acuminated; head subquadrato-ovate; eyes middling or small, finely granulated, little or not at all prominent; antennæ subapproximate at the base; posterior trochanters elongated at the apex; thorax obovate; body elongate, subdepressed.*

a. *Mesosternal carina slight, simple.*

30. *Scydmænus alatus*, N.

S. dilute brunneus, pedibus antennisque dilutioribus, tarsis palpisque testaceis; pubescens. Long. corp. $\frac{2}{3}$ lin.

Antennæ art. 1° apice biacuminato, 3–4 subæqualibus, 5 præcedente majore, 6 longitudine inter 4 et 5, ovato, 7–8 subæqualibus, 9 majore, 7–9 *apice angustatis, tubiformibus,* 10–11 ovatis, clavam formantibus, *vel* art. 9 globoso, 9–11 clavam formantibus. Palpi maxill. art. ultimo minimo, apice truncato. Mandibulæ dente bifido munitæ, basi fortiter abrupteque dilatatæ. Thorax foveis basalibus nullis. Pedes elongati, tarsis art. 2–3 subæqualibus.

I include in this species individuals with a 2- and others with a 3-jointed antennal club. The latter are further distinguished by having a slight sinuosity in the rounded outline of the basal angles of the thorax, by having the posterior part of the metathorax and the base of the abdomen sensibly incrassated, and the head rather less quadrate than the former. However, the individuals thus distinguished being in all other respects exactly like those with the 2-jointed club, I cannot help looking upon all these distinctions as sexual ones, and uniting the insects in the same species.

The head from the eyes to the neck is of a transverse subquadrate form merging into the oval by the angles being rounded off; the anterior part is narrowed. This is the typical form of the skull in all the five species of this group. The eyes in the present species are middling. The antennæ are rather approximated at the base, and inserted in the centre of the front under a ridge which runs across it from eye to eye. The first joint is biacuminated at the apex; the fifth is longer than the adjoining ones; joints 7–9 in the individuals with the two-jointed, and 7–8 in those with the three-jointed club, are of a peculiar construction, being narrowed at the apex, and fitting into each other like the tubes of a spy-glass. The club-joints are ovate, flat at the base; the last is large and obtusely acuminated. I consider the principal distinguishing character to lie in the remarkable structure of joints 7–9 of the antennæ. The maxillary palpi have joint 2 rather strongly incrassated at the apex; joint 3 obovate, narrowed at the base; joint 4 very minute, truncated at the apex. The mandibles are furnished with a bifid tooth, and are strongly and abruptly dilated at the base. The thorax is of an obovate or obcordato-ovate form, being rather strongly rounded off before the middle and gradually narrowed below it; the usual basal impressions are wanting. The posterior margin has two slight sinuosities; the posterior angles are rounded-off or obliquely truncated. Scutellum obsolete. Elytra furnished with a very short elevated ridge at the shoulder. Legs elongated; coxæ large, the two posterior ones rather distant from each other; two posterior trochanters much elongated, incrassated at the tip; apex of tibiæ subcylindric, but not narrowed, and hairy, especially in the second pair; joints 2–3 of the tarsi of equal size, the first longer, the fourth a little shorter; two anterior tarsi slightly contracted, second and third pair more and more elongated. Penultimate segment of abdomen with a strong longitudinal groove on the back.

31. *Scydmænus femoralis*, N.

S. statura et magnitudine præcedentis; testaceus. Antennæ art. 3–4 subæqualibus, 5 præcedente longiore, 6–8 gradatim minoribus, subglobosis, 7–8 apice fortius oblique truncatis, 9–11 gradatim majoribus, subglobosis, clavam formantibus. Palpi maxill. art. ultimo minimo, semigloboso. Thorax magnus, obovatus, basi rotundatus, 4-foveolatus. Elytra *apice truncata, 2-sinuata.* Pedes *femoribus 2 posticis medio constrictis,* tarsis art. 1–4 gradatim minoribus.

Of the general appearance of the former, but of a light yellowish colour, and well distinguished by the large thorax, truncated elytra, and abnormal construction of the two posterior femora. Antennæ with joints 7–8 rather strongly obliquely truncated at the apex, 9–11 forming a club, subglobose, flat at the base, the last acuminated and slightly cut away, or even excavated on the inside at the apex. Last joint of maxillary palpi semiglobose; these otherwise the same as in the former. Thorax and elytra of *S. alatus,* the former, however, larger, rounded at the posterior margin, and with four basal impressions; the latter slightly truncated at the apex, and with a slight sinuosity in the truncature on either side of the suture. Scutellum very small. Legs with the tibiæ slightly bent at the base, the apex as in the former; tarsi with joints 1–4 gradually decreasing in size, first pair contracted and furnished with brushes on the inside. The two posterior legs inserted rather distant from each other, the basal part of abnormal construction: the trochanters are much elongated and incrassated at the tip, whilst the femora are at the place of the juncture rather abruptly narrowed, bent and slightly compressed; as they are at the same time thinner than the adjoining apex of the trochanter, the constriction is very striking.

32. *Scydmænus Ceylanicus*, N.

S. alati colore, sed major et magis depressus. Long. corp. $\frac{3}{4}$ lin. Caput magnum, robustum, thoracis latitudine. Antennæ basi non approximatæ, art. 3–4 et 5–7 inter se subæqualibus, *arcum formantibus,* 8–10 gradatim majoribus, subglobosis, depressis, apice oblique truncatis, 11° magno, conico, 8–11 longius pilosis, clavam formantibus. Palpi maxill. art. 4° minimo, semigloboso. Thorax ovatus, foveis basalibus nullis. Elytra apice singulatim rotundata. Pedes validi tarsis art. 1–4 subæqualibus, 2 anterioribus art. 1° *subtus acumine sat forti producto.*

An anomalous species, especially with regard to the antennæ, which are much less approximated at the base than those of the rest of the species belonging to this group, and with regard to the two posterior coxæ, which, on the contrary, are more approximated than in any of the species just referred to. The insect is of the light brown colour of the two former, but larger and more depressed. The head is strikingly large and heavy, of the width of the thorax; in its hind part, which is strongly transverse, the oval form prevails over that of the square. Eyes small. Antennæ inserted under two strong protuberances rather than under a ridge; their club four-jointed, joints 3–7 forming a section of a circle bent inwards; joints 8–10 strongly compressed, obliquely truncated (subperfoliated), 11 large, conic. The third joint of the maxillary palpi is of an oblongo-ovate shape; the external basal angle is prolonged into a small peduncle inserted in the apex of the second joint; the fourth joint, about the semiglobose shape of which I am not quite satisfied, appears to be obliquely inserted in the tip of the preceding. Thorax oval, of a similar shape to that of the former; anterior margin slightly emarginated. Scutellum obsolete. Elytra with the traces of a humeral costa, separately rounded-off at the apex. Legs strong; two posterior coxæ not more distant from each other than the four anterior ones; tibiæ elongated, bent at the base and apex, at the latter place slightly narrowed, subcylindric and hairy; tarsi with joints 1–4 subequal, in the first pair strongly contracted, joint 1 of this pair produced in a spine on the inside.

b. *Mesosternal carina middling, grooved.*

33. *Scydmænus intermedius*, N.

S. alati statura sed major et robustior, colore obscuriore. Long. corp. $\frac{3}{4}$ lin.

Antennæ art. 1° apice biacuminato, 2 et 5, 3 et 4, 7 et 8 inter se subæqualibus, 6 quarto paulo minore, obovato, 7–8 subglobosis apice oblique truncatis, 9–11 gradatim majoribus, obovatis, clavam formantibus, 11 acuminato. Palpi maxill. art. 3° obovato, 4° minimo, semigloboso. Thorax subrotundatus, basi 4-foveolatus. Elytra apice singulatim rotundata. Pedes tarsis art. 1–4 gradatim minoribus vel 2–3 subæqualibus, 4 anterioribus intus pilosis. Mesosternum sat fortiter carinatum, *carina dorso deplanata, fossulata, apice acuminata.*

This species stands in the middle between *S. alatus* and *pselaphoides*. To the former it is allied by its general appearance rather than by anything else, differing from it very much in the structure of the antennæ and the mesosternal carina. To the latter, on the contrary, it is allied by similarity in the structure of the said carina, differing, however, from it in general appearance. The colour is that of *S. alatus*, but a shade or two darker, the insect being at the same time larger and altogether more robust. The eyes are small. Antennal club three-jointed, the joints forming it gradually increasing in size, obovate, flat at the base, the last acuminated. Scutellum obsolete. Elytra with two slight basal impressions, the traces of a humeral costa, separately rounded-off at the apex. Legs elongated as usual; two posterior coxæ distant; tibiæ straight, subcylindric, but not narrowed at the apex, the four anterior ones hairy; tarsi with joints 1–4 almost imperceptibly decreasing in size, or perhaps 2–3 equal, the anterior ones slightly contracted, these and the intermediate ones hairy on the inside. Mesosternal carina middling, flat on the back, with a shallow, but very distinct, longitudinal groove or excavation, anterior part projecting, acuminated.

34. *Scydmænus pselaphoides*, N.

S. subpyriformi-ovatus, subconvexus, magis minusve brunneus, pedibus antennisque subtestaceis, femoribus apice nigrescentibus, tarsis palpisque testaceis; flavo-pubescens. Long. corp. 1–1¼ lin.

Antennæ art. 1° mediocri, apice biacuminato, 2–4 sensim minoribus, 5 et 2, 6 et 3, 7 et 8, 9 et 10 inter se subæqualibus, 9–11 clavam formantibus, 6–11 basi rotunde truncatis, 6–8 apice oblique truncatis, 7–8 compressis, 9–11 obovatis. Mandibulæ dente bifido munitæ, basi dilatatæ et ciliatæ. Palpi maxill. art. 3° inverte conico, 4° minimo apice truncato. Thorax obovatus, latitudine quarta parte longior, basi 4-foveolatus. Elytra apice singulatim rotundata. Pedes validi, tarsis art. 1–4 gradatim minoribus, anterioribus dilatatis, his cum intermediis subtus fortius pilosis. Mesosternum præcedentis.

An anomalous species with regard to its general appearance, which differs considerably from that of the rest of the group, and makes it, as I have remarked above, the connecting link between this and the following group. This is the largest species I have hitherto met with. The system of coloration is the usual one,—more or less deep brown, legs and antennæ lighter, tarsi and palpi very light. Eyes middling. Antennæ with a 3-jointed club, the joints subglobose, flat at the base, the last large, conic; joints 6–8 are slightly truncated at the apex; 7 and 8, being at the same time strongly compressed, have a subperfoliated appearance. The mandibles are furnished with a bifid tooth. The third joint of the maxillary palpi has the shape of an inverted cone, the fourth minute and truncated at the apex. The thorax is of an obovate form, about ¼ longer than broad, rounded-off before and gradually narrowed below the middle, subquadrate at the base, impressed with four foveæ or pits, the posterior angles rounded-off. Scutellum minute. Elytra with two short humeral costæ, separately rounded-off at the apex. Legs stout; two posterior coxæ distant; tibiæ slightly bent at the base, subcylindric at the apex, the four anterior ones hairy; tarsi with joints 1–4 gradually decreasing in size, the anterior ones dilated, the joints transversely triangular, the intermediate pair hairy on the inside. Mesosternum of the preceding. Metasternum with a slight longitudinal depression down the middle. Penultimate abdominal segment grooved on the back, as in *S. alatus*. In the enlargement of the anterior tarsi lies undoubtedly, as in other beetles, a sexual distinction, as it is not equally strong in all individuals. I may mention here, that upon some of the individuals I found ticks (some genus allied to *Ixodes*, but not a *Gamasus*) fastened, one of them having made a wound such as, supposing it to be inflicted at a corresponding place and on a proportionate scale, few animals of a higher order, I think, would have survived; still this little beetle appeared perfectly at its ease. The parasite alluded to had fastened itself right in the centre of the forehead, and the wound it had inflicted in this, one would imagine most dangerous place, was a deep hole or pit with a callous border. The latter led me to infer that the injury was an old one, and the tick being at the time fastened in it (and this so firmly that I had some difficulty in detaching it), I felt sure it had been in this position for months. The injury was observable under a slight magnifier, and to compare it to one inflicted by a rifle-ball, would, I think, be greatly underrating its importance.

II. *Fourth joint of the maxillary palpi acuminated; mesosternal carina strongly developed; eyes large, prominent, coarsely granulated; antennæ distant at the base; two posterior trochanters simple; thorax variable; body robust, pyriform, subconvex.*

a. *Occiput rounded.*

35. *Scydmænus advolans*, N.

S. long. corp. ¾ lin. Antennæ art. 3 et 4, 5 et 6, inter se subæqualibus, obovatis, 7 majore, subgloboso, 8–10 subglobosis, basi rotunde-, apice oblique-, truncatis, cum 11° conico clavam formantibus. Palpi maxill. art. 3° elongato, inverte conico, 4° mediocri. Mandibulæ tenues, medio acuminate 1-dentatæ, basi abrupte dilatatæ. Thorax ovato-rotundatus, apice fortius angustatus, basi leviter 2-sinuatus, 4-foveolatus. Elytra apice singulatim rotundata. Tarsi art. 2–3 subæqualibus.

The insect is of a brown colour, the antennæ lighter, the legs still more so, the tarsi and palpi very light; the femora are dark towards the apex; the head, thorax and suture are occasionally of chestnut-colour; it is, as usual, pubescent. The sculpture of the head in this and the following species is not, as in the preceding, based upon the oblong square or the oval, but rather upon the form of a ball, which, in a more or less compressed state, is always perceptible; in some instances it is narrowed on one side. In the present species the head is heavy and subglobose. The eyes are large, prominent, and coarsely granulated. The antennæ are inserted distant from each other under two protuberances of the anterior part of the forehead. The club is four-jointed, the joints composing it being flat at the base, and, with the exception of the last, obliquely cut away at the apex, the last itself being conic. The maxillary palpi have joint 3 rather elongated, and of the form of an inverted cone; joint 4 middling, acuminated. The thorax is of a rounded-oval shape, and rather strongly narrowed towards the apex. The scutellum is obsolete. The elytra have the usual rudimentary costæ at the shoulders, and are separately rounded-off at the apex. The legs are middling; two posterior coxæ inserted close together; trochanters all simple; tibiæ slightly bent at the base, narrowed and subcylindric at the tip, the four anterior ones hairy; tarsi with joints 2–3 subequal, the first a little longer and the fourth shorter, the two anterior ones slightly contracted. I include in this species some individuals which slightly differ from the foregoing description, being more robust, covered more densely and with longer hair, especially on the occiput and thorax, with the latter rather obconico-ovate, and the costæ of the elytra more distinct, and, moreover, occasionally of a chestnut colour.

36. *Scydmænus pubescens*, N.

S. præcedente gracilior; long. corp. $\frac{2}{3}$ lin. Antennæ art. 3 et 4, 5 et 6 inter se subæqualibus, subcylindricis, 7° secundo paulo minore, *fortiter cylindrico*, 8–10 subglobosis, cum 11° conico clavam formantibus. Palpi maxill. art. 3° inverte conico, 4° minuto. Mandibulæ tenues, medio obtuse obsoleteque unidentatæ, basi abrupte dilatatæ. Thorax conicus, latitudine haud longior, basi 4-foveolatus. Elytra et pedes præcedentis, tibiis tamen apice leviter arcuatis.

Less robust than the former, and further distinguished from it by the seventh antennal joint (the one preceding the club), which is of a strongly cylindric shape, by the minuteness of the last joint of the maxillary palpi, the obtuse and nearly obsolete tooth of the mandibles, the short conical form of the thorax, and the tibiæ, which are slightly bent at the apex.

37. *Scydmænus pygmæus*, N.

S. statura et colore præcedentis sed longius pubescens et sesqui minor; long. corp. $\frac{1}{3}$ lin. Antennæ art. 3 et 4, 5 et 6 inter se subæqualibus, 7° majore, ovato, 8–10 subglobosis, fortius compressis, cum 11° clavam formantibus, hoc magno, obconico, apice obtuso. Palpi maxill. art. 2° tenuiore, 3° inverte conico, 4° minuto. Mandibulæ obsolete unidentatæ. Thorax conicus, latitudine parum longior, elytris fortiter applicatus, basi 2-sinuatus et 4-foveolatus. Pedes et elytra præcedentis, his tamen amplioribus.

Strongly allied to the two preceding species, but very much smaller, more compact, and covered with longer hair,—thus of rather a different appearance regardless of its size. From *S. pubescens* this species would principally differ in the shape of the seventh antennal joint, also in that of the first three club-joints, which are much more compressed and more hairy in *S. pygmæus*. The thorax of the latter is more firmly applied to the base of the elytra, the latter have a fuller and more robust appearance about them, the palpi are more slender, and the tooth of the mandibles is pointed. From *S. advolans* it would principally differ, besides the generalities mentioned above, in the shape of the thorax and in some of the points in which it differs from *S. pubescens*.

b. *Occiput narrowed.*

38. *Scydmænus glanduliferus*, N.

S. robustus; long. corp. $\frac{3}{4}$ lin. Antennæ art. 3–7 sensim majoribus, 8–10 globosis, fortiter compressis, cum 11° *glanduliformi* clavam formantibus, longe ciliatis. Palpi max. art. 2° tenuiore, 3° inverte conico, 4° mediocri. Thorax conicus, latitudine basali haud longior, elytris fortiter applicatus, basi 2-impressus, in impressionibus 2-foveolatus. Tarsi art. 2–3 subæqualibus.

Of the size of *S. advolans* and the plump shape and colour of *S. pygmæus*, the latter being rather lighter than that of *S. advolans*; it has the longer hairy vesture of the former (especially on the occiput and thorax). The occiput is slightly narrowed behind. The antennal club is composed of four joints, the first three of which are strongly compressed, the fourth being plump, and of the shape of an acorn with its cup; all are strongly ciliated. The thorax is conic, firmly applied to the base of the elytra, as in the preceding species, depressed, and with two pits at the base, posterior margin with two sinuosities. The shoulder-ridges of the elytra are short, but rather strongly marked. The tibiæ are narrowed, subcylindric, and hairy at the apex. Joints 2–3 of the tarsi are subequal, the anterior pair more, the intermediate less contracted.

39. *Scydmænus graminicola*, N.

S. gracilior; long. corp. $\frac{3}{4}$ lin. Antennæ art. 3 et 4, 6 et 7, 9 et 10 inter se subæqualibus, 5° adjacentibus paulo longiore, 3–7 subcylindricis, 8 subgloboso, 9–10 fortiter globosis cum 11° clavam formantibus. Palpi maxill. art. 3° inverte conico, 4° mediocri. Mandibulæ apice arcuatæ, medio acuminate 1-dentatæ, basin versus *sensim dilatatæ.* Thorax obconicus, basi depressus, 2-sinuatus et 2-foveolatus, rectangulatus. Pedes *tibiis elongatis* basi apiceque arcuatis.

Of the usual brown colour, legs and antennæ lighter, tarsi and palpi very light; femora nigrescent at the apex; hairs of occiput and thorax rather long, the former slightly narrowed behind; the head thus of a somewhat rhomboid form. Antennal club composed of three joints, the first two of which are strongly globose, the last being acuminated and slightly cut away on one side at the apex. The mandibles are furnished with an acuminated tooth at the middle, bent at the apex, and, what is rather uncommon in this genus, gradually enlarged towards the base. The thorax is obconic, rather longer than broad. The elytra are somewhat more extended than usual in this group; the rudimentary humeral costæ are rather prominent, they are separately rounded-off at the apex. Tibiæ more or less elongated, slightly bent at the base and apex, at the latter place subcylindric and hairy. Tarsi with joints 2–3 subequal, first pair slightly contracted. A sexual distinction appears to be expressed in the length of the tibiæ, which are less elongated in certain individuals, which are at the same time less robust than the others. The insect is easily distinguished by its general appearance.

40. *Scydmænus pyriformis*, N.

S. supra castaneus, subtus brunneo-testaceus, pedibus antennisque dilutioribus, tarsis palpisque flavo-testaceis, antennarum clava nigricante. Long. corp. $\frac{1}{2}$ lin.

Antennæ art. 3–8 fere subæqualibus, excepto 5° parum longiore, 8° subgloboso, minore, 9–10 subglobosis majoribus cum 11° acuminato clavam formantibus. Palpi maxill. art. 3° inverte conico, 4° minuto. Thorax obovatus, basi 2-foveolatus. Pedes coxis 2 posticis distantioribus; tibiis 2 anterioribus basi apiceque leviter arcuatis, reliquis subsimplicibus; tarsis art. 2–3 subæqualibus.

A pretty little species, at once distinguished by its colour, which is chestnut, darker at the base and suture of the elytra, and light, more or less brownish or yellowish, below; the antennæ being of the latter colour, with a nigrescent club. The occiput is slightly narrowed; the head altogether plump, heavy, and transverse. The antennal club is composed of three subglobose joints, the last of which is acuminated and slightly cut away on one side, as in some of the preceding species. The thorax is obovate, broadest below the middle, and gradually narrowed towards the apex. The elytra have the usual two shoulder-ridges, and are rather strongly dehiscent at the apex. The two posterior coxæ are rather distant at the base; the tibiæ are slightly angustated and subcylindric at the apex, the four anterior ones hairy; the first pair, moreover, slightly bent at the base and apex, but the rest nearly straight.

41. *Scydmænus angusticeps*, N.

S. castaneus, antennis pedibusque dilutioribus, tarsis palpisque testaceis. Long. corp. 1 lin.

Caput magnum, subtrigonum, occipite *fortiter angustato*, hoc et thorace longe pilosis. Antennæ art. 3 et 4, 5 et 6 inter se subæqualibus, 7–11 gradatim majoribus, vel 9–10 subæqualibus, subglobosis, 8–10 leviter depressis, cum 11° clavam formantibus. Palpi maxill. art. 2° tenuiore, 3° inverte conico, 4° mediocri, conico-acuminato. Thorax obconicus, basi subquadratus, 2-sinuatus et 4-foveolatus. Elytra costis 2 fortioribus abbreviatis. Tibiæ subrectæ.

A handsome species, of a chestnut colour, more or less deep, with lighter legs and antennæ. The head is large, heavy, and, from the eyes to the neck, strongly triangular; the occiput and thorax are covered with long hair, which adds much to the peculiar appearance of the insect. The antennæ are thick and robust, the club 4-jointed. The thorax is subquadrate at the base up to the middle, and conic towards the apex. The punctures or pits at the base are four in number. The scutellum is small. The humeral costæ are more strongly developed than in any of the other species, and traceable to the middle of the elytra. The tibiæ are nearly straight, subcylindric at the apex; the four anterior ones hairy. The tarsi have joints 2–4 nearly subequal.

B. *Species without a neck.*

42. *Scydmænus ovatus*, N.

S. ovatus, convexus, brunneus. Long. corp. ½ lin.

Caput subquadrato-ovatum. Antennæ art. 3–11 sensim incrassatis, 9–11 subglobosis, depressis, cum 11° magno, conico clavam formantibus. Palpi maxill. art. 4° minuto, acuminato. Thorax *amplus, semiorbicularis*, margine posteriore medio producto, basi 2-foveolatus. Tarsis art. 1–4 subæqualibus.

The colour of this insect is, as usual, shaded-off from brown to light yellow; however, in other respects it differs materially from all the preceding species. The body is regularly oval; thorax and elytra convex, pubescent. The head is subquadrate-ovate; the eyes rather small, but prominent; the neck is altogether wanting. The antennæ are as distant from each other at the base as they can be, being inserted below the eyes; the club is three-jointed; the joints increase gradually in size from the third to the eleventh. The maxillary palpi have the second joint slender, the third rather pear-shaped, the fourth minute and acuminated. The thorax is very ample, semiorbicular, of the shape and nearly the size of the apical half of the elytra; the basal angles are acuminated, and slightly envelope the shoulders; the posterior margin is prolonged in the middle towards the scutellum; the foveæ or basal impressions are two, and rather distant from each other. Scutellum obsolete. Elytra with two depressions at the base. Tibiæ straight; tarsi with joints 1–4 subequal, or very nearly so. Mesosternal carina middling.

[To be continued.]

XVIII.—*Remarks on the Lias of Barrow in Leicestershire, compared with the lower part of that Formation in Gloucestershire, Worcestershire, and Warwickshire.* By the Rev. P. B. Brodie, M.A., F.G.S., Vice-President of the Warwickshire Naturalists' Field Club*.

During a late visit to the well-known Lias quarries at Barrow-on-Soar, I was able to compare the various sections there exposed with those in the equivalent beds in Warwickshire, Worcestershire, and Gloucestershire; and, although I could detect no remains of Insects, nor even a trace of them†, the position of the strata, and their lithological characters, are identical with the true *Insect limestones* in the counties above mentioned.

As Mr. Jukes has already described the lower Lias at Barrow and the neighbourhood in 'Potter's Charnwood Forest,' it will be needless for me to repeat those sections; but it will be necessary to give one not referred to by him, taken from an upper quarry of Mr. Lee's, in order to identify the beds,—where we have, in descending order,

* Read to the Cotteswold Naturalists' Club, January 27, 1857.

† Although, in the short examination I was able to give the Barrow limestones, I could discover no Insect remains, nor could hear of any ever having been found, it is possible that a closer research would detect them.

		ft.	in.
1.	Alluvial drift, sand and red clay, with rolled boulders of Lias	8	0
2.	Blue shale	3	0
3.	Hard blue limestone (*Rummels*), with young *Plagiostoma gigantea, Lima rudis*, and numerous Ammonites, similar to the *Plagiostoma-bed* in Gloucestershire	0	9
4.	Thick blue shale	4	0
5.	Blue limestone (representative of *Insect-bed*)	0	6
6.	Black shale	1	2
7.	Limestone (representative of *Insect-bed*)	0	6
8.	Black shale	1	0
9.	Blue nodular and crystalline limestone (*top hurls*)—a very peculiar band, resembling a bed near to the '*firestone*' of Warwickshire, as at Grafton in that county	0	6
10.	Shale.		
	Bottom of quarry.	19	5

As Mr. Jukes truly observes, the strata vary considerably even in adjacent quarries—certain beds thin out and others come in; thus, in Mr. Ellis's large pit on the other side of Barrow, there is at least 30 feet of shale above the '*rummels,*' No. 3 in section, and there are more courses of limestone, especially those which appear to represent the *Insect limestone.* It is worthy of note, that while the *Rummels* No. 3 is evidently the equivalent of the *Plagiostoma-bed* in Gloucestershire and elsewhere, it is succeeded at once by the beds of Lias, which in Gloucestershire, Worcestershire, and in some portions of Warwickshire, occur much lower in the series, the intervening strata being entirely wanting in that part of Leicestershire. Most of the quarries do not exceed 30 feet in depth, but some have been opened to a depth of 42 feet, the lowest stratum being a bed of blue marly clay. The limestones are used in Leicestershire for the same economical purposes as the Warwickshire 'paving-stones,' and are equally adapted for this object; but they do not seem to be employed for making hydraulic lime, as they are in the quarries belonging to my friends Messrs. Greaves and Kershaw at Wilmcote, near Stratford-on-Avon.

In places there are several small faults, and in one pit the lower strata were thrown up so as to form a complete saddle, of limited extent, at right angles to Mount Sorrel, not far off,—showing on a small scale what the effect of such a dislocation would be on a large one.

Except in No. 3 of section, shells are scarce; below this, I observed only a few *Ammonites planorbis* and *Aptychus,* and a long shell (*Meleagrina*?) common in the shale at Brockeridge Common, near Tewkesbury in Gloucestershire, and there associated with numerous and beautiful specimens of the same Ammonite.

The fine Saurians and Fish for which this district has been long famous occur more or less in all the shales and limestones, though some courses are richer than others; and for the last two years very few have been met with. In Mr. Lee's extensive collection, the genus *Dapedium* was by far the most abundant, many of which were quite perfect; and among several fine fish, I noticed one nearly 2 feet in length, belonging to a different genus, and in a remarkably fine state of preservation.

The only Crustacean I observed was the *Eryon Barroviensis* (M'Coy), which was small and ill-preserved, and by no means equal to the large and perfect specimens met with occasionally at Bidford in Warwickshire*.

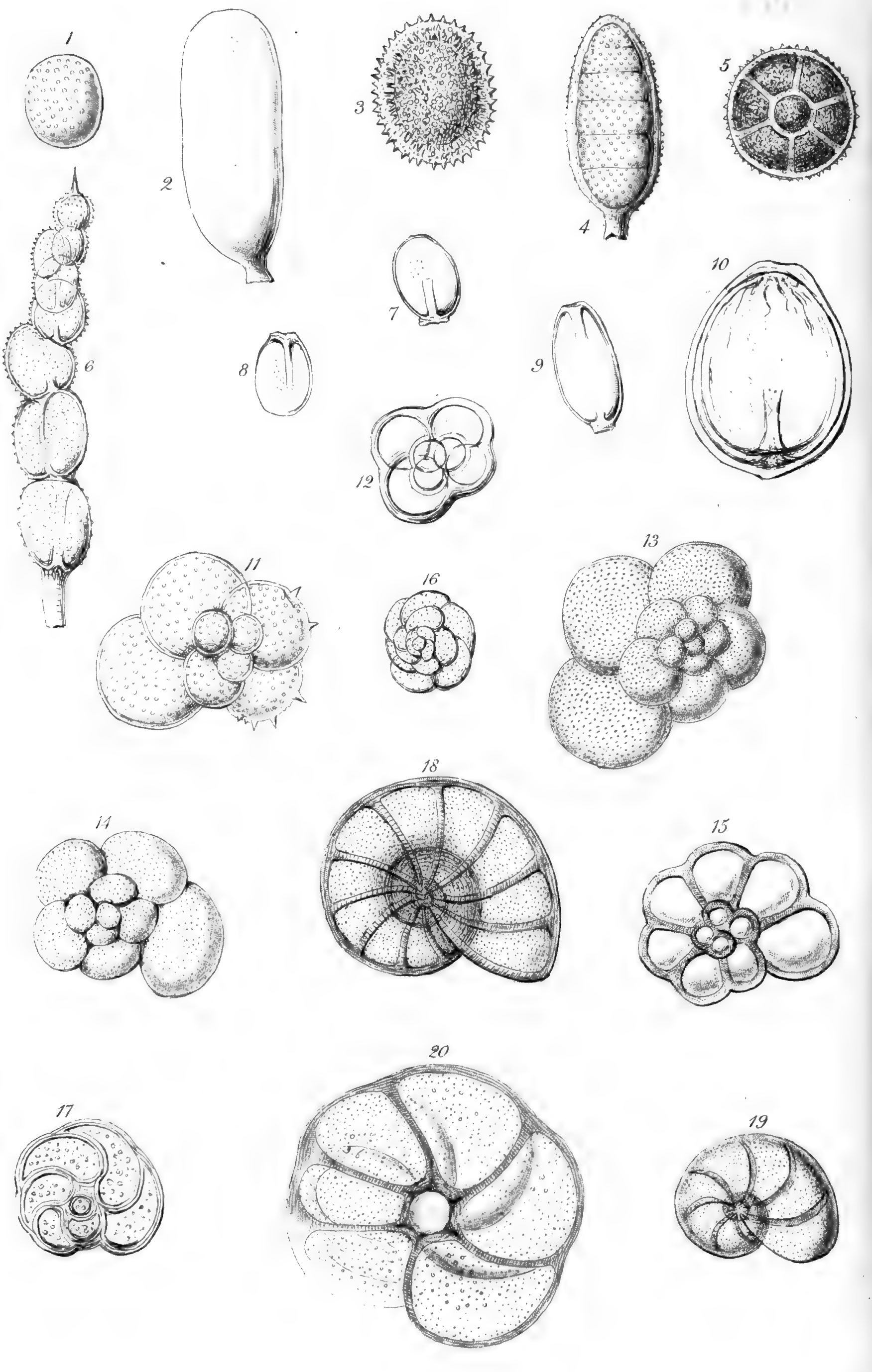
I did not detect any remains of plants.

At Wilmcote in Warwickshire there are indications of numerous faults (which were lately pointed out to me by Mr. Kershaw), in all directions round the district, more than are generally supposed. Thus the 'firestone,' which is the lowest and hardest stratum worked, crops-out at various points and dips at a considerable angle, on the higher ground; and the several bands of 'Insect limestone' and shale lie in a basin formed by the outcrop of this lower bed. The 'Plagiostoma-bed,' containing *P. gigantea, Cardinia ovalis,* and *Astarte lurida,* occurs in places in its normal position; but there appears to be no trace of the underlying Saurian beds, which are of considerable thickness in Gloucestershire, and their absence is to be noted both at Wilmcote and Barrow, which implies a great thinning-out of the lower Lias in that direction. This holds good, at all events, with respect to the lower Lias at the latter place, where there are fewer bands of 'Insect limestone;' but at the former they are more numerous, not less than eight courses divided by thick shale; and as the 'Insect-bed' in Gloucestershire is often confined to one, or at most two layers, only a few inches thick, the increased number of 'Insect-beds' in Warwickshire may represent the 'Saurian beds' in Gloucestershire and other places, with which they were perhaps coeval in point of time.

The 'firestone' above referred to is a hard, crystalline limestone, full of oysters and spines of Echini, from 3 to 7 inches thick. In Warwickshire it always underlies the last bed of 'Insect limestone,' but does not occur in Leicestershire.

* This species is not uncommon in the *Insect limestone* at Strensham in Worcestershire (where the finest Insects have been obtained, but the pits are now, unfortunately, closed), and Forthampton, near Tewkesbury, where they are generally well preserved, though invariably of small size. I have only seen two specimens of the large *Eryon* from Warwickshire, one of which is in my own collection, and the other in that of my friend Mr. Kershaw. I am indebted to his kindness for another fine but apparently distinct species of this genus.

The largest measures 6 inches in length from the top of the head to the extremity of the tail, and a little more than 2 inches in breadth in the widest portion of the body.



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XIX.—*Observations on the Microscopic Examination of Foraminifera obtained in Deep-sea Bottoms at the Feejee Islands.* By John Denis Macdonald, Assistant Surgeon H.M.S. Herald.

[With two Plates.]

The accompanying figures (Plates V. and VI.) represent some forms of Foraminifera obtained by two soundings taken in the Feejee group, from the respective depths of 1020 fathoms and 440 fathoms; the former between Kandaru and Mbengga, and the latter between Ngau and Viti Laru, about four miles from the barrier reef.

Illustrations of all the divisions of D'Orbigny's classification were found in a few atoms placed under the microscope; and from the great number of species occurring in so small a quantity of the bottom, it may be readily conceived how vast must be the accumulation of these microscopic beings at the depths of the ocean, but more especially in the neighbourhood of islands and continents, on whose coasts they are originally developed.

The figures may be arranged as follows:

I. Monostega, figs. 1–5.	IV. Entomostega, fig. 25.
II. Stichostega, figs. 6–10.	V. Euallostega, figs. 26 & 27.
III. Helicostega, figs. 11–23, 24?.	VI. Agathistega, figs. 28–30.

The *Stichostega* and *Agathistega* occurred in the bottom taken at 440 fathoms, and nearly all the others were found in that brought up from a depth of 1020 fathoms; but this I am inclined to refer to casualty rather than to any essential difference in the materials existing in both.

Figs. 31–33, representing living Helicostega, obtained in shallow water, will presently be noticed.

During our late cruises we frequently observed considerable numbers of recent Foraminifera adhering to the fronds of the smaller marine Algæ (Confervaceæ, &c.), either floating on the surface of the ocean, or growing on the shores of the Pacific Islands; so that the abundant appearance of the dead shells of these animals in the sand of every beach, and in every sea-bottom fathomed by the armed lead, was satisfactorily accounted for.

On examining some living Bryozoa taken with the dredge at Port Curtis, and including the British genera *Serialaria, Vesicularia* and *Crisia,* I first observed that the Foraminifera brought up with them were pedunculated, and so fixed to the polypidoms as to preclude locomotion completely*. I could not help re-

* These results furnish a striking confirmation of the statements published by Mr. W. Clark in the Annals for May 1849 and March 1850.—Eds.

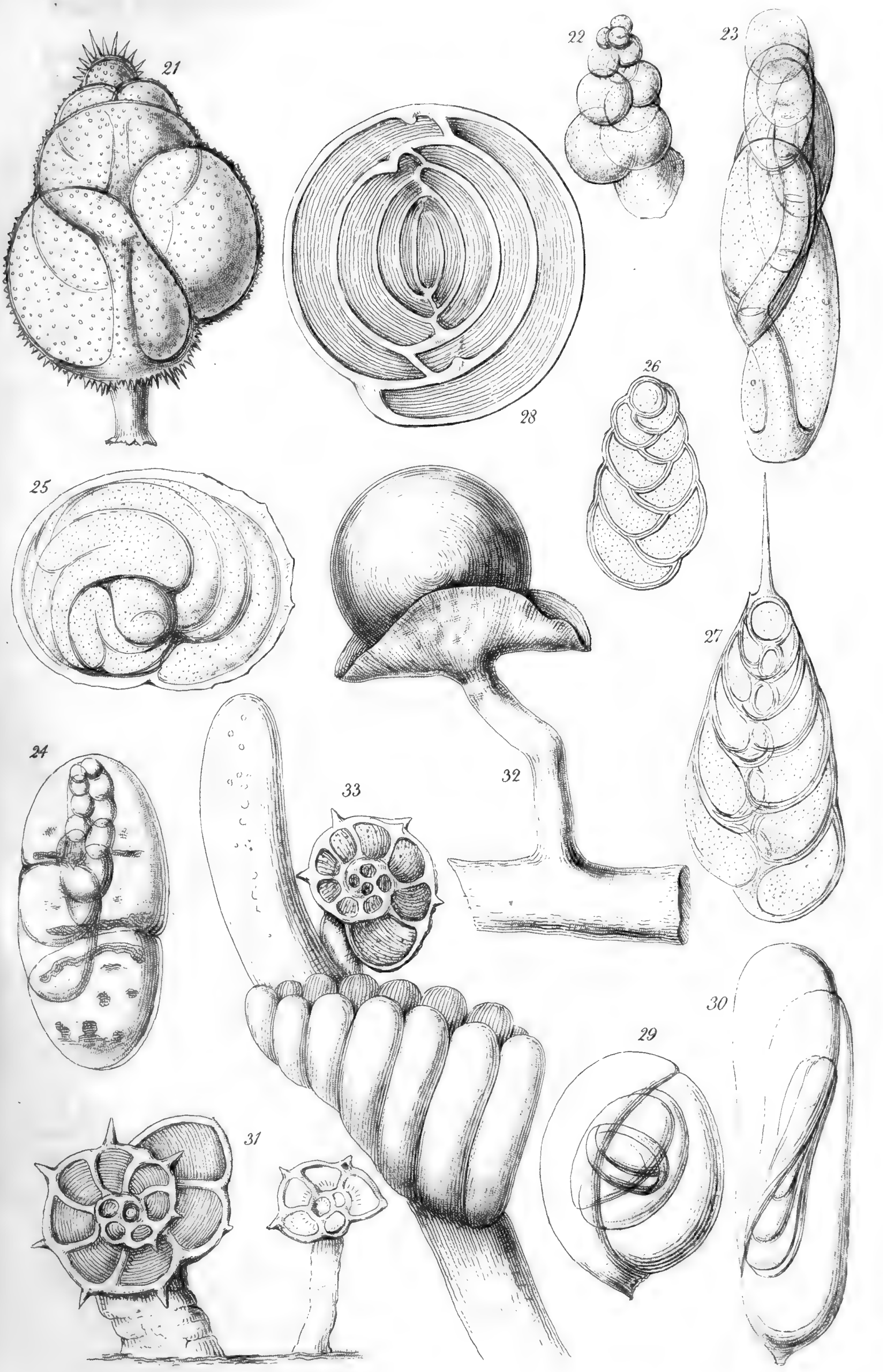
marking also that the Foraminifera themselves closely resembled some of the forms entombed in the chalk formations of England, and there can be little doubt that these facts will prove of considerable importance in a geological point of view. I generally find it convenient to support the correctness of my own observation by submitting any particular object to the scrutiny of others, and in this way I can vouch for the truth of figs. 31, 32, and 33. Fig. 32 is a minute *Nummulina*, nearly sessile on the frond of a sea-weed, gathered on the barrier reef at Ovalau; but in figs. 31 and 33 (*Operculina*) the pedicle is more distinctly seen. In the latter, the little Foraminifer is attached to a sprig of *Serialaria*.

The pedicle in some instances very much resembles, both in colour and general appearance, that of a young *Lepas*, but in other cases it is short, ill-defined, and interspersed with calcareous granules.

With these facts before us, the nature of the broken stems of figs. 2, 4, 6, 21, 23 and 30, becomes at once apparent; and a simple rule is thus established for our guidance in representing these objects.

It is not at all improbable that the tubular structure, often so distinctly visible between the cells on the umbilicated side (*Faujasina*, *Operculina*), is intimately connected with the development and growth of the pedicle, offering some analogy to the cement-tubes of the *Lepadidæ*.

It is rather difficult to comprehend the nature of an animal which is invested with an incompressible case, composed of cells, which only communicate with one another by very small openings, and with the exterior by still more minute perforations, frequently amounting to a mere porosity. Moreover, each addition newly made is in a certain ratio larger than that which preceded it, and parts once formed suffer no farther increase in size or change of form. In all these particulars the Foraminifera so differ from other forms of animal life, that, as might be expected, diversity of opinion and misconceptions respecting their true position in the scale of being, have existed from the days of Linnæus to the present time. That illustrious naturalist referred them to the highest order of Mollusca, namely the Cephalopods, and was supported in this fanciful idea by succeeding anatomists of deserved celebrity; but no one appears to have questioned its truth until Dujardin proved its fallacy in a memoir published in the 'Annales des Sciences Naturelles,' 1835. Strange to say, however, the total absence of any affinity existing between the Foraminifera and the Mollusca was not generally admitted until the year 1846, when D'Orbigny, who had laboured most in this field, abandoned his former views,



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and released the Cephalopods from a reputed alliance which must have been based on the most superficial observation. Another idea, however, requiring some qualification, has been substituted by this naturalist, namely that the Foraminifera hold a position intermediate between the Echinodermata and Polypifera. "Much less complete than the Echinodermata or the Polypifera as to their internal organization, they have, through their filaments (pseudopodia), part of the locomotion of the former, and are, by their isolated, non-aggregated, free existence, more advanced in the scale than the latter. This individual existence of the Foraminifera, the liberty they enjoy, and their mode of locomotion, are characters which deserve to be taken into consideration*."

The fancied resemblance of the pseudopodia, or the filaments that protrude through the cell-walls of the Foraminifer, to the ambulacral tubes of an Echinus may partake somewhat of analogy, but this does not necessarily imply affinity. Apart, however, from the internal anatomy of the Foraminifera (a subject which I hope to enter upon more in detail at a future period), I merely desire, at present, to reconcile the facts above stated, from my own observations, with those doctrines so prominently set forth in the quotation just given from D'Orbigny, namely that these curious little animals are free and locomotive.

The spicula of Sponges and Asteroid Polypes, and the minute or embryonic shells of Gasteropoda, Pteropoda and Conchifera, are usually found with the Foraminifera in sea-bottoms. The pelagic shells descend into the deep by their own gravitation, but the others are washed off from every coast and reef; thus, millions of organic forms enrich the dark bed of the ocean and smoothen its rugged surface. The muddy bottom outside the Heads of Port Jackson is nearly altogether composed of these materials, and a portion brought up from a depth of 70 fathoms contained some few Foraminifers which I have not detected elsewhere.

In connexion with the geological bearing of the subject now briefly reviewed, it is of importance to observe that *Lunulites* are frequently brought up on the sounding-lead, in much the same condition as the Foraminifera, while living examples of those Bryozoa are to be found on the Australian coast at the depth of a few fathoms. I have not yet sufficiently proved their existence in the recent state amongst the South Sea Islands, though this can scarcely be doubted.

* D'Orbigny, Sur les Foraminifères Fossiles du Bassin Tertiaire de Vienne, as quoted in the English Cyclopædia.

XX.—*On the Development of* Neritina fluviatilis. By E. Claparède*.

The capsules, which are usually taken for the eggs of the *Neritinæ*, are round balls, a little flattened on one side, 0·7–1 mill. in diameter, enclosed in a hard shell, which has been described as calcareous, but which does not effervesce with acids. They consist of two segments, firmly united at first, but readily separable afterwards; the upper one is larger, and forms a hemispherical dome; the other is of a flatter form, and resembles a bowl. Each female attaches her eggs to the back of her neighbour, but not to her own. In the neighbourhood of Berlin this is not the case, but the capsules are usually attached to stones, or, where these are wanting, to the shells of *Dreissenæ* and other Mollusca. When the capsules dehisce, the lower segment remains attached, and this has given rise to an erroneous opinion that the capsules corrode the surface of the shell, producing small indentations: this appearance is caused by the raised margins of the lower segments.

The capsules consist of two membranes, not easily separated: the inner one is delicate, perfectly colourless, transparent and structureless; the outer thick, yellow and opake. The outer membrane of the upper segment has sometimes an appearance of cellular structure, which is due to adherent Diatomaceæ: the outer membrane of this part exhibits no recognizable structure; that of the lower segment, however, shows a reticulated structure, caused by round or oval spaces separated by darker intervals. These are not cells, but lighter and probably thinner spots in the capsule. Their diameter varies from 0·006 to 0·04 mill.

The margins of the segments possess a horizontal border, like the rim of a plate, 0·06 mill. in breadth; these two borders are in contact. Their surfaces are finely striated or furrowed, and the adherence of the segments is doubtless caused by the raised lines on the rim of one segment fitting into the furrows of the other.

In the earliest stage of development observed, the capsules contained from forty-five to sixty or more spheres. These might have been globules of segmentation, as only a single embryo was developed in each capsule; this was originally very

* An abstract of part of M. Claparède's paper "On the Anatomy and Development of *Neritina fluviatilis*," in Müller's Archiv, 1857, pp. 109–248. This abstract is confined to the portion which refers to the earliest development of *Neritina*, as this alone bears upon the opposite views of the development of these Mollusca held by Dr. Carpenter and MM. Koren and Danielssen.—W. S. D.

minute, and gradually increased in size, whilst the yelk-mass disappeared in the same proportion. But they had exactly the appearance of segmented eggs: they were yellow, transparent globules, 0·12–0·07 mill. in diameter, and appeared to be composed of a great many smaller spheres. The latter were perfectly transparent, their surface alone being sparingly sprinkled with small, strongly refractive, vitelline granules. The spheres presented the greatest resemblance to the egg of *Modiolaria marmorata* in the last stage of segmentation, as figured by Lovén. No vitelline membrane could be detected with certainty upon them: when crushed, a sort of empty envelope was obtained, but this deliquesced immediately. The small internal globules (nuclei) presented a distinct contour, but they were not true cells, contained no nucleolus, and, when pressed, broke up like lumps of a gelatinous or fatty substance. Lovén mentions the same thing with regard to the nuclei of *Modiolaria*.

The diameter of the spheres contained in the capsules exactly agreed with that of the mature eggs from the upper part of the oviduct; and it was scarcely probable that in their progress to the vaginal orifice they would acquire fifty or sixty times that bulk. New matter would certainly have exhibited a different nature from the rest of the yelk, but the 45–60 spheres were exactly similar. The capsules were therefore to be regarded as containing numerous eggs.

The development of the single embryo in this case could not take place in the way described by Koren and Danielssen, as the smallest embryos were not much larger than the segmented eggs, so that the embryo must be formed in accordance with the ordinary law, from a single egg. The embryo in the period of rotatory movement is a round creature, ciliated on its whole surface, with a diameter of 0·112 mill., or about the same as that of a moderate-sized egg. It turned round within the vitelline membrane, which was now distinct, although soft; its contents formed an opake coarsely granular mass, a sort of emulsion of larger or smaller fatty drops, in which the peripheric layer was not clearly perceptible, probably from its being very thin. In most known larvæ of Mollusca, the rotating embryo is clothed with cilia, which are either produced beneath the vitelline membrane, through which they afterwards penetrate, or formed upon that membrane itself; in *Cardium*, however, according to Lovén, the same thing occurs as in *Neritina*. The only embryo seen in this condition died before breaking through the vitelline membrane.

The embryo developed from one egg devours the other eggs, as was stated by Carpenter, in opposition to Koren and Danielssen, to be the case in *Purpura*. In *Purpura*, as in *Neritina*, all the spheres undergo segmentation, but they are not surrounded by a peculiar membrane. There is no perceptible difference between them; and in *Neritina* no such distinction in the mode of segmentation as that discovered by Busk in *Purpura*, was to be seen. The only difference is in their ultimate destiny; and it appears probable that the genesis of both structures is the same, as the segmentation of the "egg-like bodies" is in favour of their being true eggs; and the distinction observed by Busk may not be of great importance, as it is asserted only that many of the "egg-like bodies" contained in the capsule exhibit a very marked irregularity in the first segmentation; so that it is not impossible that the others might have presented the same thing less distinctly; and, moreover, there is no certain proof that the former were really the so-called true eggs. All the eggs in the capsules both of *Neritina* and *Purpura* may therefore be regarded as genuine eggs, but how most of them are arrested in their development still remains a mystery.

When the abortive spheres in the capsules of *Purpura* have undergone segmentation, they exhibit a decided tendency to become amalgamated, and adhere to each other with such tenacity, that they cannot be separated without difficulty; finally, their boundary-lines disappear entirely, and there remains only a uniform conglomeration of small vitelline segments. This never occurs in *Neritina*. At the time when the embryo makes its appearance, the abortive segmented eggs split up into groups of globules, each of which is about half the size of an entire egg, and sometimes even smaller. These usually consist of one large and numerous smaller yelk-spherules. But there is never even a slight mutual adhesion of these groups, and they remain separate until they disappear by being devoured by the embryo.

The observation of the different stages of development was rendered difficult by the opacity of the capsules, which required to be opened to enable their contents to be examined, and by the fact that the *Neritinæ* do not lay their eggs in captivity, probably because the still water does not suit them. The smallest embryos detected, which had completely lost their ciliary coat, formed an irregular cylinder, divided into two parts by a circular notch; these parts may be distinguished as "cephalic" and "abdominal," names employed by Vogt in *Actæon*. The cephalic portion bears an elevation on its dorsal surface, forming a more or less distinct oval swelling, beset with very delicate cilia. This is the first trace of the velum. Close before it, at the anterior end of the animal, is a shallow impression,—the mouth. Immediately below this a disciform organ soon makes its appearance, which is at first very narrow and short, but gradually increases in size posteriorly. This is the first indication of the still inoperculate foot. At this period the internal organs of the abdominal part or true body are not recognizable. The velum very soon increases rapidly, becoming developed like a hem, whilst its margin acquires longer, more distinct, and more numerous cilia. This margin grows considerably thicker in proportion to the membrane of the velum. In the abdomen a spacious cavity is formed, and in this a quantity of formative mass collects as an aggregation of fatty drops of various sizes. The foot forms an oval organ possessing thick walls and an inner cavity which seems to be in connexion with that of the abdomen. The foot is still completely destitute of cilia. The pit-like anterior impression becomes converted into a transverse buccal orifice, which leads into a tubular œsophagus. The entrance into the mouth is ciliated all round, as is the whole surface of the œsophagus. The same thing was seen by other observers in the embryos of many Mollusca.

Thus the alimentary canal makes its appearance in the embryo of *Neritina* as soon as the foot, or perhaps sooner. In *Actæon,* according to Vogt, the alimentary organs are very late in appearing,—much later, for example, than the otolithes and the shell. The same was observed by Sars, Lovén, &c., especially in the Nudibranchiata; and, according to Koren and Danielssen, the formation of the heart in *Buccinum* precedes that of the œsophagus, although this appears improbable, both from Carpenter's statements with regard to *Purpura,* and from what takes place in *Neritina.* In *Neritina* the œsophagus is formed and lined with cilia before the first traces of the auditory and visual organs, the shell, &c., have appeared; and Carpenter met with the same conditions in *Purpura.* Leydig also says that the embryos of *Paludina* are furnished with a mouth and anus, and the foundations of the pharynx and intestine, before any trace of an ear exists.

This early appearance of the alimentary organs is of great importance for the further development of the *Neritina.* From this moment it is no longer a mere immature embryo, but a larva, swimming freely about in the capsule, and feeding upon the remaining contents of the latter, the sister-eggs, which have not arrived at development. This is not a mere assertion, rendered probable by the gradual increase of the minute embryo and the simultaneous disappearance of the rest of the yelk-mass, until the embryo fills the whole capsule,—but a fact proved by observation. If the capsule be opened carefully, the little embryo escapes and swims about amongst the numerous groups of globules already mentioned as formed by the breaking-up of the abortive eggs, which are perfectly transparent and of a pale golden-yellow colour; they consist of a homogeneous, tenacious, fat-like substance. These globules are enveloped by a thin, colourless layer of a mucous matter, in which extremely fine yelk-granules are imbedded. This is the food of the young *Neritina*. The larva swims about in the water under the microscope, and is soon seen to approach a yelk-mass and give it a revolving motion by means of the cilia of the velum, whilst the animal itself is stationary. By this means the globules are brought to the mouth, not to be swallowed at once, but merely licked away. They are constantly turned before the mouth, whilst the granules of the colourless outer layer are torn away and swallowed by means of the cilia. They pass into the funnel-shaped pharynx, where they are kept in tremulous movement by the cilia, until they reach the abdominal cavity and unite with the accumulation of nutritive material already existing there. Although the yelk-granules of a globule are seen continually passing into the pharynx, their number does not perceptibly diminish; so that one is compelled to suppose that new granules are formed, probably from the transparent yelk-globule, to replace those which are swallowed. This feeding of the young *Neritinæ* in the capsule suffices to explain their great increase of size; for towards the end of its embryonal life the animals have attained forty to sixty times their original volume. Carpenter states that in *Purpura* this feeding can rarely be observed, and only under peculiarly favourable circumstances; in *Neritina* it may be seen with almost every embryo. The young animal sometimes swallowed foreign bodies besides the yelk, when they came within reach of the cilia of the velum: a *Navicula* or a *Synedra* was several times carried into the pharynx. It must be remarked that Koren and Danielssen represent the abdomen in young embryos of *Purpura* and *Buccinum* as filled with an aggregation of yelk, consisting of uninjured eggs, although the œsophagus is too narrow to allow of the passage of these. No eggs are found in the abdominal cavity of embryos of *Neritina* in the corresponding state, but merely an aggregation of larger or smaller granules or drops, agreeing in nature and colour with the vitelline substance. Nevertheless, the nutriment, when swallowed, not very unfrequently cakes together within the embryo in such a manner that similar formations might easily have been mistaken by the Scandinavian naturalists for eggs. Their statements with regard to the original aggregation and fusion of the eggs for the formation of embryos, does not agree with what takes place in *Neritina*; so that Carpenter has probably come nearer to the truth.

It is only after the embryo of *Neritina* has reached a certain size, acquired a mouth and œsophagus, and eaten foreign yelk, that the shell makes its appearance, and soon afterwards the operculum and organs of the senses show themselves. At this time the velum has reached its greatest development, and it then gradually diminishes. The tentacles first appear as small tubercles close to the eyes, and gradually increase until they form distinct tentacles by the time the animal quits the capsule. When the velum has completely disappeared, and the triturating plate and lingual cartilage have made their appearance, the capsule opens and the little *Neritina* escapes, to live henceforward in freedom. It creeps about upon the *Dreissena* whose shell bore its egg-capsule, and finds upon this the microscopic organisms which now serve for its nourishment instead of its sister-yelks.

XXI.—*Observations on* Trachelius ovum, *Ehrenberg.* By Professor Carl Gegenbaur*.

In the course of last November I met with an Infusorium, which, at the first glance, I took to be *Trachelius ovum*. Of this, however, I soon began to entertain doubts, although I could discover no known form with which there existed any agreement. For this purpose I could only consult Ehrenberg and Dujardin. The outlines agreed with *Trachelius ovum*, and the form of the "intestine" also was in general the same as in that species. The longitudinal series of cilia, however, were far more numerous; and beneath the cuticula, in the walls of the body, a great many vesicles, arranged at regular distances apart, lay imbedded: with a moderate magnifying power, these looked almost like nuclei, but they were really contractile organs. I reckoned their number at from 50 to 60. They were not spherical, but discoid; they contracted very slowly, and out of about ten which might be watched at the same time, I never found more than one or two in action. In Ehrenberg's figure of *Trachelius ovum*, something is represented that may be referred to these organs. A little above the middle of the body there is a large, richly ciliated cleft, which I regard as the mouth. It leads by a pouch-like prolongation, which is also ciliated, into a finely granular organ, which passes through nearly the whole length of the animal, and which possesses a very different form in different specimens. This part never lies in the middle of the body, but always nearer to the side on which the buccal slit is situated, where it is also partially amalgamated with the wall of the body. Numerous processes, consisting of hyaline or finely granular substance, issuing from this "intestiniform" organ, penetrate the cavity of

* Translated by W. S. Dallas, F.L.S., from Müller's Archiv, June 1857, p. 9.

the body, and become amalgamated with the wall of the body, which is considerably thickened here and there. These trabeculæ are contractile. In the principal mass of the structure originating from the mouth, and which has been compared to an "intestine," I not unfrequently found balls of food, and indeed always in the posterior and never in the anterior half of the body, the direction of the pouch-like cleft being downwards. Sometimes the balls of food were accumulated in the obtuse extremity of the body. They appear also to be capable of passing through thin trabeculæ, for not unfrequently one of these enclosed a ball, often of considerable size, about the middle of its length.

I have given the name of "intestine" to the branching substance passing through the body from the mouth, merely because the food is always enclosed in it, but no further idea is to be attached to this term. There exists no essential difference between it and the substance of the walls of the body.

In the substance enclosing the balls of food, however, there lies an organ, which, in accordance with Siebold's views, must be designated the "nucleus." It is a sharply circumscribed, band-like structure, somewhat inflated at both ends, and composed of closely appressed globules. One end is usually directed forwards, the other backwards. Is this Ehrenberg's band-like gland? All individuals presented this organ; the form, size and position certainly varied, but it always lay with its central part close to the buccal cleft, which passed over it with its cæcal process.

The buccal cleft, that is to say, what I regard as such, is not, however, the only opening on the body. A far smaller one lies further in front, a little below the moveable "proboscis;" at that point also the wall of the body is more strongly thickened, and produced into a trabecula, which is either united with the rest of the trabecular system only by a very thin branch, or inserted with its extremity at some point in the opposite wall. I always found the opening to be of the same diameter; the cilia surrounding it strike towards it. It leads into a tube which is at first somewhat dilated and provided with firm walls, then narrowed in the form of a funnel, but destitute of cilia throughout; it frequently presents delicate longitudinal folds, and is continued into the above-mentioned trabecula.

This aperture with its continuation has nothing except its position in common with the orifice described by Ehrenberg in *Trachelius ovum*. I have observed a great many individuals for a long time under the microscope, but have never seen a dilatation of the aperture; on the contrary, I have seen, although rarely, a dilatation of the funnel-shaped extremity of the canal, so that the lumen equalled the external aperture. At the same time I also think I have seen an opening at the end of the canal;

it appeared to be a longitudinal cleft, which closed again in a moment, and left no trace after the walls of the extremity of the canal had come in contact. The frequent union of the end of the trabecula in question with the opposite wall of the body, its delicacy, which often causes it to appear like a fine filament, the constancy of the size of the external orifice, and the circumstance that balls of food were never to be seen in its vicinity, or indeed in the anterior portion of the body generally,—lead me to conclude that this anterior aperture has nothing to do with the reception of aliment.

It has already been mentioned, in the description of the buccal orifice, the "intestine," and the trabecular system, that there is a "general cavity" (*Leibeshöhle*), and I regard this as not unimportant in judging of the nature of this creature. The general cavity never contains food; and even when particles of food project into it from the so-called "intestine" and the trabeculæ, they are still always enveloped by a distinctly perceptible layer of the finely molecular substance of the body. The general cavity is filled with a clear fluid, which never contains any distinctly formed parts. I regard this fluid as water, and must suppose that it is admitted through the above-mentioned canal. I have not seen this take place, and experimental feeding with colours gave no result, probably because the delicate cilia standing round the small orifice prevented the entrance of molecules. On the other hand, I am convinced that water is nevertheless admitted.

Thus, when I had been for a long time observing an animalcule imprisoned in a narrow space, it happened, nearly every time that I could wait long enough for it, that it suddenly contracted strongly; the trabeculæ shortened themselves, and the form, which was originally full and tense, shrank into a deformed, irregular, and folded mass. I thought that I should now see the *itio in partibus* take place, but, by continued observation, I found not only that no particle separated from the shrivelled body, which was evidently reduced in size much more than half, but that the animal even continued to swim about briskly. How little injury had been suffered by such a specimen was evident when I put it into a more spacious capsule, for it then very soon acquired the same form and size as before, and on comparison with figures previously prepared, exhibited no change, except that some trabeculæ had become amalgamated together, whilst others had made their appearance. I have repeated this observation several times, and always with the same results. How can the considerable alteration of volume be explained, except by the consecutive loss and reception of water?

XXII.—*On true Parthenogenesis in Plants.* By Dr. L. Radlkofer, of Munich*.

It would indeed be difficult to find anywhere a more evident proof of the imperfection of human knowledge than is furnished by the contradictory results of the latest embryological investigation, in the departments of zoology as well as of botany. If our knowledge of the process of fecundation in animals appear to have made an important step forward through the observation of the penetration of the spermatozoids into the ovum,—if this seemed to put beyond all doubt the material participation of the spermatozoids in the formation of the embryo,—we must be doubly surprised by the observation, that in particular—apparently determinate—cases, the formation of the embryo occurs without any cooperation of the spermatozoids, therefore *without previous fecundation of the ovum.* This true Parthenogenesis, demonstrated with all the exactness which science can require by Prof. Von Siebold†, in the Lepidoptera, and in the Bees particularly, is paralleled by analogous cases in the neighbouring domain of plants.

In calling the attention of zoologists for a moment to an account of them, I have a twofold purpose: to convince those still in doubt by the number of proofs, and to attract to the subject itself as many observers as possible.

Embryological researches in the vegetable kingdom have kept pace with those in the department of zoology. Analogues of the animal ovum, analogues of the animal fecundating matter, have been demonstrated in all groups of the vegetable kingdom, with the exception of the Fungi and Lichens.

To the ovum corresponds the *germ-vesicle* of the Phanerogamia, of the Rhizocarpeæ, Equisetaceæ, Ferns and Mosses; and, besides this, the *primordial spore-cell* of the Algæ. The germ-vesicle (*vegetable ovum*) presents itself as a perfect cell, furnished with a membrane and a cytoblast‡; in the Algæ we find, instead of the perfect cell, one devoid of a membrane, an *ovum* without an integument,—the naked primordial spore-cell.

To the spermatozoids contained in the spermatic fluid of animals, the material basis of which we must regard, according to

* Translated from Siebold and Kölliker's Zeitschrift, viii. Heft 4 (1857), by Arthur Henfrey, F.R.S. &c.

† True Parthenogenesis in Moths and Bees, &c. By C. Th. Von Siebold. Translated by W. S. Dallas, F.L.S. London, Van Voorst, 1857.

‡ We dissent from the author on this point, believing that the unimpregnated germ-cell has not yet a cellulose membrane, but resembles the unimpregnated spore of *Fucus*. See Annals of Nat. Hist. 2nd ser. xviii. p. 217 (Sept. 1856).—[A. H.]

researches now before us, either in its totality or in part, as the proper fecundating power, as the *actual fecundating substance,*—correspond the *spontaneously moving form-elements* (*spermatozoids*) in the fertilizing (spermatic) fluid of plants. In some Algæ and in the Phanerogamia only are these form-elements wanting in the fecundating fluid; the fertilizing fluid itself appears in these cases as the fecundating substance.

Throughout the vegetable, as in the animal kingdom, the *act of fecundation* is completed by the fecundating matter—whether it possesses an independent form or not—coming into immediate contact with the vegetable ovum and its contents*. This is the case in particular in the Phanerogamia, as I have placed beyond all doubt by my investigations†. As we shall have in the sequel to speak more minutely, and exclusively, of this, it is requisite to sketch briefly the process of fecundation in the Phanerogamia, and in so doing, we may take the liberty, for the sake of simplicity, to omit all reference to the fecundating processes of the Coniferæ and Cycadeæ, which deviate from those of the rest of the Phanerogamia in many respects.

The *ovum to be fertilized*, the germ-vesicle, is contained, in the Phanerogamia, in a large cell, the so-called embryo-sac, which itself constitutes the centre of a variously constructed, cellular organ, the *seed-bud* (*gemmula*—hitherto inconveniently termed *ovulum*). This seed-bud (ovule) it is which, when perfectly developed, becomes, in its mature condition, the *seed*. It is enclosed in the germen or ovarium, and usually a number of these ovules occur in the same ovary.

The *fecundating matter* consists of the contents of isolated cells, the *pollen-grains*. If one of these pollen-grains arrive at the proper part of the ovary, upon the *stigma*, it undergoes further development. The cell of which it consists grows, becomes tubular (*pollen-tube*), and penetrates through all the parts lying between the stigma and the embryo-sac, so as at length to allow its contents to pass over into the embryo-sac and germ-vesicle, by endosmose, and thus to render the germ-vesicle capable of further development, of forming an embryo.

It is no wonder, in the face of the observations on the material participation of the fecundating substance in the formation of a new plant (*i. e.*, in the Phanerogamia, the formation of seeds), mentioned at the beginning of this paper, that little faith came to be placed in the accounts of the earlier botanists, of

* For the further explanation of the conditions here referred to, I would direct the reader to my recent treatise "Befruchtungsprocess im Pflanzenreiche," &c., Leipsic, 1857. [A translation of this will shortly appear in our pages.—Ed. *Ann. Nat. Hist.*]

† Radlkofer, Die Befruchtung der Phanerogamen. Leipsic, 1856.

cases of *formation of seed without cooperation of the male organs*, of the pollen. The more surprising therefore are the proofs of the reality of such cases which are here gathered from the most recent observers.

In the first rank here must be mentioned the observations on *Cœlebogyne ilicifolia*, a diœcious Euphorbiaceous plant, native of Australia, female specimens of which were long since introduced into England, and were widely distributed from there, before the male plant had been detected by travellers in its native country. No living specimens of the male plant have yet reached Europe; only a dried shoot with male flowers exists in the Herbarium at Kew. A glance at this suffices to show, from the composition of the inflorescence of the plants, the impossibility of the occurrence of a hermaphrodite flower in *Cœlebogyne*, and to show, further, that if the exceptional case which has been observed in other plants, of a production of male flowers on female specimens of diœcious plants, occurred in *Cœlebogyne* also, it could not be overlooked. Finally, all botanists who have had an opportunity of examining the female plants of *Cœlebogyne*, and among these are numerous authorities, agree in declaring that no male organs occur on them. In spite, however, of the fact that the exclusion of the fertilizing pollen of the same species must here certainly be most perfect, the plants cultivated at Kew annually ripen an abundance of seeds, from which even the third or fourth generation of (*female*) plants have been raised there.

Observation of the fact that at Kew the *Cœlebogyne* is kept in company with other Euphorbiaceæ, led me to think, while staying there, that the enigma might probably find its solution in the detection of a hybridation. Although this conjecture was very much weakened by the simultaneous observation that the progeny have hitherto preserved entirely the character of the original mother-plant, yet I was more inclined even to the idea that, as an exceptional case, a hybrid might be developed with the characters of only one of its parents, than to believe that a seed, and consequently an embryo, could be developed without previous fecundation. I endeavoured to acquire certainty on this point by the following means:—

1. An examination of the stigmas of all the ovaries (placed at my disposal by the kindness of Sir W. Hooker, Director of the Garden), in order to detect if pollen-grains were present; and

2. A search through the cavities of the ovaries and the ovules, for the presence of pollen-tubes.

Among twenty-one ovaries which I examined, I found, upon the stigma of *one* alone, a dried pollen-grain, which adhered to the surface with other bodies which come under the denomination of dust. No pollen-tube could be observed in this case. It is further to be remarked, that no embryo could be found in the ovules of this ovary, although it was at the proper age.

Each ovary contains three ovules. In *none* of these could be discovered a pollen-tube, by the most careful examination, in which, by longitudinal sections and subsequent dissection with the needle, the path which the pollen-tube must have taken, down to the embryo-sac, was visibly exposed. Neither could any be found in the cavity of the ovary, outside the ovules.

In other Euphorbiaceæ, chosen for comparative investigation, whose ovaries and ovules had essentially the same structure as those of *Cœlebogyne,* and presented neither more nor less difficulties than *Cœlebogyne* for the discovery of the pollen-tubes in their course from the stigma to the embryo-sac, a pollen-tube was readily demonstrated in the interior of the ovules.

Notwithstanding this *absence of pollen-tubes* in *Cœlebogyne*—in two-thirds of those ovules which were neither too young, nor were rendered abortive by the overpowering growth of their neighbours,—of the three ova (germ-vesicles) which were contained in each embryo-sac, sometimes all, sometimes two, and sometimes only one, were *developed into young embryos,* and the particular stages of development in the formation of the embryo were found to be perfectly in agreement with those which are passed through, in other Euphorbiaceæ, *after fecundation has taken place.*

After these observations, the idea of a hybridation in *Cœlebogyne* must be given up. I think that I am rather warranted in concluding from them—with the same certainty as Von Siebold derived from the numerical proportion of the positive and negative results of his observations on the presence of spermatozoids in the eggs of worker- and drone-bees—that in *Cœlebogyne* the embryo really can be developed *without a previous fecundation of the ovum.*

A testimony in favour of the correctness of this assumption is furnished by the *behaviour of the stigmas* of our *Cœlebogyne*-plants, upon which the first observer of the Parthenogenesis of *Cœlebogyne,* J. Smith*, very properly laid great weight.

In all plants which are regularly fertilized, in which a sufficient number of pollen-grains arrive at the stigmas of the ovary, to provide the ovules with the requisite pollen-tubes, the expansion of the ovary, which takes place simultaneously with the development of the embryo, is the signal for the decomposition of the stigmas: they wither, dry, and mostly separate from the ovary. The delivery by the cells of the stigma of the material

* Linnæan Transactions, xviii. p. 509.

necessary for the development of the pollen-tubes from the pollen-grains, brings in its train the immediate death of the former, and a *destructive action upon the stigmas* is usually ascribed to the pollen-grains. In our *Cœlebogyne,* on the contrary, the stigma not only does *not* wither and dry up at the epoch in which the development of the embryo is announced by the expansion of the ovary, but it *grows* and *increases in size* simultaneously with the enlargement of the ovary.

We are indeed deficient here in comparative observations on the behaviour of the stigmas of individuals regularly exposed to the influence of the pollen, which hitherto could only be examined in the native country of *Cœlebogyne*; and a doubt may perhaps be expressed whether we may venture to take the persistent enlargement of the stigmas of *Cœlebogyne* as a *proof* that no pollen has acted upon them, or whether we may not have to do here with an exceptional peculiarity, opposed to the ordinary behaviour of plants. For the removal of this doubt, however, facts come to our aid from other quarters, facts which we have become acquainted with through a series of observations on the occurrence of Parthenogenesis in the vegetable kingdom, which we place in a second rank.

Spallanzani's observation, of the power of reproduction possessed by the *female plant of Hemp* (*Cannabis sativa*), without the cooperation of pollen, has been subjected, in the last few years, by Ch. Naudin of Paris, to repeated test-experiments, the investigations being extended at the same time to *Mercurialis annua* and *Bryonia dioica**. From all these plants he has obtained fertile seeds, *i. e. seeds containing an embryo, in spite of the exclusion of the pollen.* The plants raised from these, in *Cannabis,* were male and female: no statement is made on this point in reference to the other plants.

With regard to the results obtained in *Bryonia,* we shall not place any dependence upon them, since the specimens used in the investigations were cultivated in the open ground, and therefore could not be guarded from the influence of the pollen with all the precautions requisite in such experiments.

The female Hemp-plants were, however, raised in a detached, constantly closed chamber, so that the advent of pollen-grains, either of the same or other species, was most improbable;—I will not say it was impossible, for I will not deny to accident the pleasure of now and then intervening when we least expect it, and since we even know that ordinary door- and window-fittings can be no absolute obstacle to the entrance of pollen-

* Bullet. de la Soc. Botan. de France, xii. p. 754, No. 11. Paris, 1855; and Comptes Rendus, xliii. p. 538 (1856).

grains. The impossibility of the action of Hemp-pollen, at least, was, however, really secured by the circumstance that the period of the experiment did not coincide with the epoch of flowering of the Hemp cultivated in fields and gardens. For the absence of any abnormally developed male flowers from the plants used, we have the testimony of the eyes of Naudin and Decaisne. I owe it to Decaisne's kindness that I myself had an opportunity of seeing one of these plants. Nothing could be stranger than their appearance: the plant was just ripening its fruits; these *ripening* fruits were, however, still crowned by long feather-like *stigmas*, in which there was no trace of commencement of withering,—and this at an epoch when the ovaries of the same plants which have been exposed to the action of pollen have long lost their stigmas.

The same phænomenon was observed in plants of *Mercurialis annua*, which Thuret of Cherbourg raised in a closed chamber, excluding males, for the purpose of testing Naudin's experiments. Here also, giving not a little peculiarity to the whole habit, the highly developed fruits were still, when they had attained nearly their full size, furnished with *unwithered stigmas*, which had enlarged in proportion with the growing ovaries; while in such specimens as vegetate under regular conditions, in company with male plants, the stigmas are very transitory, and always wither and fall off when the expansion of the ovary has scarcely begun. Dissection proved that the seeds of those plants raised in closed chambers contained embryos.

This unusual and remarkable behaviour of the stigmas cannot be ascribed to any other circumstance than this,—*that they had not been exposed to the action of the pollen*; that their cells had not been called upon to give up any part of their contents for the nutrition of the tubes growing from the pollen-grains. The researches on *Cannabis* and *Mercurialis* complete the above-mentioned observation of the peculiar behaviour of the stigmas in *Cœlebogyne*, in a manner calculated to remove completely any doubt that might still prevail in that case. This behaviour of the stigmas is the *surest evidence* that the exclusion of the pollen in the experiments on *Cannabis* and *Mercurialis*, and, in like manner, on *Cœlebogyne*, was not merely probably but actually *complete*; and we are no longer compelled, in making certain of this, to trust to the supposed sufficiency of the artificial means of exclusion, nor to the belief in the impossibility of our eyes being deceived.

Thus, then, is proved the existence of Parthenogenesis in the vegetable kingdom.

Circumstances, unfortunately, did not allow of my giving the same negative testimony, as in the case of *Cœlebogyne*, as to the absence of pollen-tubes in the ovaries and ovules of *Cannabis* and *Mercurialis*,—nor to institute here, as I did in that case, comparative investigations on the development of the fecundated and the virgin ova into embryos. I trust to be able to do so hereafter.

Reviewing the facts which compel us to transfer the idea of Parthenogenesis in the vegetable kingdom from the domain of chimæras into the domain of reality, we find them, briefly, as follows:—

A. We are acquainted, in the specimens of *Cœlebogyne* cultivated in Europe, with plants in which the participation of the pollen of the same plant in the production of the embryo is impossible. The participation of the pollen of any allied plant is rendered in the highest degree improbable by the absence of all signs of hybridation in the progeny.

The absence of any such participation is directly demonstrated here by microscopic investigation.

This evidence is strengthened by the behaviour of the stigmas of the ripening ovaries. Our observations on this point can of course be only one-sided, but they are rendered good testimony by the support derived from analogy.

B. In other plants (*Cannabis, Mercurialis*) we may acknowledge, not indeed the impossibility, but the great improbability of an action of the pollen of the same or allied plants on flowering female plants kept in closed chambers.

For the absence of such action we are still without the negative proof, derived from microscopic examination, which we must never dispense with in scientific questions. On the other hand, we have a supplementary *positive* proof of it in the behaviour of the stigmas, on which we here possess observations made on all sides and mutually corrective.

We might greatly increase the number of these cases of Parthenogenesis, if we made use of the statements for whose accuracy we might take the name of the observers as surety. But we prefer, in so important a question, in which is involved the upsetting of a physiological law which is supposed to have been just certainly established by the most recent researches,—not to advance beyond our own observations; moreover, it was not part of our plan to give a list of the cases in which Parthenogenesis had been observed, but only a statement of those in which and through which it could be *demonstrated.*

Munich, Dec. 4, 1856.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

December 9, 1856.—Dr. Gray, F.R.S., in the Chair.

Descriptions of Coleopterous Insects in the Collection of the British Museum, hitherto apparently unnoticed. By Adam White.

In addition to the species described in my previous paper (Annals, vol. xviii. p. 475), I have reason to believe that the following are also new.

1. Deucalion Wollastoni, n. s.

D. aterrimus; capite post oculos in mare elongato, thorace lævigato, lateribus inermibus, elytris dorso depressis, a basi ultra medium punctato-impressis, singulis lineis tribus lævibus longitudinalibus.

Hab. Lord Howe's Island.

Although this Longicorn differs in some particulars from either of the species of Mr. Wollaston's most interesting genus, I am unwilling to form another genus for its reception till the group has been more studied. The antennæ in the female are considerably longer than the elytra: in the male they are very long; the head in the male is considerably produced behind the eyes; the thorax is twice constricted: above the surface is smooth, beneath before the fore legs it is delicately and closely transversely striated.

2. Moneilema albo-pictum, n. s.

M. aterrimum, thorace elytrisque pilis albis variegatis; oculis antice pilis albis marginatis, capite inter oculos pilis albis ornato.

Long. lin. 8½.
Hab. Mexico.

3. Moneilema lævidorsale, n. s.

M. aterrimum, supra læve; elytris lateribus valde compressis, basi punctatis, dorso carina separatis.

Long. lin. 8.
Hab. Mexico.

4. Moneilema ? longipes, n. s.

M. scabriuscule punctatum, aterrimum; pedibus elongatis crassis, thoracis lateribus obsolete tuberculatis; tarsis subtus fulvis.

Long. lin. 8.
Hab. "China?"

This species differs somewhat in form from the others; it is longer and less squat; the spine on each side of the thorax is almost obsolete; the legs, especially the femora, are longer and thicker; the coxæ have no spot of hairs. It is rather coarsely and generally punctured, even on the legs and the antennæ; the tibiæ of all the legs are considerably bent at their origin.

This was obtained on the voyage of H.M.S. Sulphur, and is more likely to be from the west coast of America than from China.

5. Anisocerus onca.

A. pallide ochraceus rufescenti tinctus; capite thoraceque nigro maculatis et fasciatis; elytris singulis 17–18 *maculis nigris; corpore subtus nigro fasciato; antennis articulo tertio apice nigro-fasciculato; tibiis tarsisque pallidis, tibiis apice nigris.*

6. Anisocerus capucinus.

A. ater, genis miniaceo vittatis; scutello nigro; elytris miniaceis, fasciis tribus transversis et macula ante apicem nigris, sutura nigra.

7. Anisocerus dulcissimus.

A. ater, genis miniaceo vittatis; elytris sulphureis seu albido-flavescentibus; fascia basali angusta et scutello miniaceis, fascia lata ante medium obscure miniacea; marginibus apicali et laterali miniaceis; punctis quatuor nigris in parte postica elytrorum.

These three fine species of the peculiarly Brazilian genus *Anisocerus* are described in the second part of the Museum Catalogue of Longicorn Beetles, pp. 405, 406. It is just possible that the two last so-called species may eventually be found to be one. We have two specimens of the last which differ from each other in coloration, and probably connecting varieties may yet be sent to our collections from the banks of the Amazon. The *A. capucinus* was first obtained at Para by J. P. George Smith, Esq. of Liverpool; the *A. dulcissimus* was found on the Tapayos, a tributary of the Amazon, by Mr. Bates, who also sent the *A. Onca* from Ega, a locality on the same great river, which has proved to be very prolific in insect life.

8. Phædinus xanthomelas, n. s.

P. niger; abdomine subtus pallido, elytris sulphureis, apice maculaque ante medium nigris; femoribus subtus ultra medium ciliatis.

Long. lin. $6\frac{3}{4}$.

Hab. Villa Nova, in ripis fluvii Amazon (*Coll. Bates*).

Head rather wide, black; eyes ferruginous; a yellow mark on the clypeus, with many scattered punctures. Antennæ with the two basal joints shining, the others dull; joints from the third to the tenth dilated triangularly at the tip on the inner edge; terminal joint oblong, sides parallel, tip pointed. Thorax densely punctured and hairy, a smooth spear-shaped space on the back in the middle, pointed in front, a tubercle on each side; scutellum black. Elytra rounded at the tip, of a sulphur-yellow, each broadly tipped with black, and having a subtriangular spot just before the middle; each elytron with two parallel costæ, evanescent about the middle just behind the black spot which lies across them. Under side of abdomen pale ochraceous; legs black; femora grooved beneath at the base, edges of the groove ciliated with pale hairs.

Having only seen a single specimen of this curious species, I am unwilling to give it a new generic name, although its short form, simple sternum, grooved and ciliated femora, and the soft under side of the abdomen, with other characters, show that it differs considerably from *Phædinus*.

9. PHŒBE CONCINNA, n. s.

P. albido-pubescens; thorace postice pallide violaceo, elytris pallide violaceis, fascia latiuscula ante apicem alba, pedibus pallide flavis, antennis basi flavis, apice fuscis, capite bicornuto.

Long. lin. 5–5½.

Hab. Ega, on the banks of the Amazon (*Coll. Bates*).

A most delicately coloured species of the genus *Phœbe* of Serville. The head, thorax, and body are clothed with a dense white pubescence; the hinder part of the thorax has a pale violet band with a projecting lobe in front. The elytra are covered with a most delicate pale violet pubescence, passing into white at the tip, and with a rather wide transverse white band before the tip, widest at the sutures. The antennæ spring from a portion of the head, which divides each eye into two portions; the first four joints are pale yellow, the others are brown; the face has two projecting upturned horns, which are sharp and brown, and when viewed in front have a semicircular outline. The abdominal segments beneath in the middle and at the end are tinged with yellowish-pink. The legs are of a delicate yellow.

10. AGELASTA CALLIZONA, n. s.

A. nigra, supra pube curta griseola reticulata; elytris fascia transversa mediana rubescente albo-reticulata, apice rubescentibus; femoribus supra tibiis basi rubescentibus, tibiis apice nigro-fasciculatis, tarsis aurato-fulvis, articulis basalibus supra nigris.

Long. lin. 6–9½.

Hab. Sarawak, Borneo (*Coll. A. R. Wallace*).

Blackish, with scattered punctures; the head, thorax, and elytra reticulated all over with a short griseous pubescence; the elytra at the tip and a transverse band across the middle of a pinkish-red, reticulated with white; sides of thorax, plate above, middle legs, and band behind base of hind legs pinkish-red; femora on the upper side and tibiæ, except at tip, pinkish-red; tibiæ at the ends black, and clothed thickly with hairs. Tarsi of a tawny golden-yellow, the base of the last joint above and the upper side of other joints black. Antennæ blackish-brown; basal joint the longest, reticulated with griseous pubescence; five terminal joints short, brown-black, the others ringed; the sixth joint pinkish-grey, except at the tip, which is black.

11. Agelasta Wallacii, n. s.

A. capite nigro-fusco, ochraceo vittato ; thorace nigro-fusco, lateribus albidis, dorso ochraceo quinque-lineato tribus lineis abbreviatis ; elytris nigro-fuscis, fascia lata alba transversa ; elytris singulis basi ochraceo uni-guttatis, apice quinque-maculatis ; pedibus ochraceis, tarsis supra nigris.

Cat. Longicorns, Brit. Mus. pt. 2. pl. 10. f. 10.

Long. lin. 6–8.

Hab. Borneo (Sarawak) (*Coll. A. R. Wallace*).

Head blackish-brown, cheeks and face banded with ochraceous pubescence, crown with three ochraceous lines ; antennæ dark ferruginous, outside of first joint and base of the four succeeding joints pale ochreous. Thorax blackish-brown, sides margined with whitish pubescence ; the back with five longitudinal ochraceous lines, two extending from front to hind margins, the alternate three abbreviated. Scutellum of a deep blackish-brown. Elytra deep blackish-brown, with a very wide white pubescent band, which is continued on the underside of the thorax ; an ochraceous spot at the base, a little white spot on the suture behind the scutellum ; each elytron with five ochraceous marks on the apical half, three on the suture. Legs ochreous ; femora subferruginous ; tarsi above black ; claw, except at the base and tip, ochreous.

12. Agelasta amica, n. s.

A. nigrescenti-fusca ; capite thoraceque albo-lineatis, elytris rufo-fuscis cinereo polystictis, punctis majoribus nigris, fasciis duabus subundatis nigris, anteriore interrupta.

Long. lin. 6–6½.

Hab. Borneo (Sarawak) (*Coll. A. R. Wallace*).

Blackish-brown ; head lineolated longitudinally with white. Thorax above with about ten white lineolets arranged longitudinally. Scutellum blackish. Elytra mostly covered with a light reddish-brown pubescence, varied with many small black dots, and with two transverse, somewhat waved, black bands, the anterior ones interrupted. Abdomen black, sides with white pubescence, edges ciliated with white ; sides beneath with greyish pubescence ; middle black, sides spotted with black. Legs cinereous ; tarsi and tips of tibiæ black.

13. Agelasta Polynesus, n. s.

A. nigro-brunnea ; capite thoraceque cinereo lineatis ; scutello cinereo ; elytris cinereo irregulariter lineatis et notatis ; pedibus cinereo-pubescentibus.

Cat. Longicorns, Brit. Mus. pt. 2. pl. 10. f. 9.

Long. lin. 6–7½.

Hab. Borneo (Sarawak).

Of a very dark ferruginous brown. Head with five cinereous lines and a short one behind each antenna. Thorax with seven cinereous pubescent lines, the central one the slightest ; scutellum cinereous ; elytra covered with many irregular pubescent cinereous lines and marks, well relieved by the dark blackish-brown background; underside covered with whitish pubescent hairs; abdomen down the middle nearly bare of hairs; legs with cinereous pubescence.

14. Agelasta Newmanni, n. s.

A. cærulescenti-cinerea, pubescens; thorace nigro transversim unifasciato, elytris nigro bifasciatis et maculatis.

Long. lin. $6\frac{1}{2}$.

Hab. Borneo (Sarawak) (*Coll. A. R. Wallace*).

The greater part of the insect covered with a bluish-grey pubescence; the head with some black marks; the antennæ black, the five basal joints bluish-grey at the base; thorax above with a transverse black band, the front and hind margins running into the greyish pubescent part. Scutellum covered with grey pubescence. Elytra with two transverse black bands, one before, the other behind the middle; the parts clothed with greyish pubescence have a few black spots, those between the bands arranged transversely, those at the apex triangularly.

February 24, 1857.—Dr. Gray, F.R.S., in the Chair.

A Monograph of the Genus Lasiurus. By Robert F. Tomes, Esq.

The object of the present memoir is rather to enumerate and describe all the species at present arranged under the above name, than to enter into the claims of the group to be considered as a distinct genus.

An attempt is also made to give a tolerably correct synonymy; but there are so many descriptions which appear to refer to varieties only, as to render this part of the work by no means easy, and not altogether satisfactory. Attached to the account given of the first species on the list—*Lasiurus noveboracensis*—will be seen a rather voluminous list of synonyms; and it may appear as if too little regard had been paid to the labours of other writers, in thus reducing to one species what has by them been considered as constituting at least six. But in the examination of a large number of examples, I have felt myself quite unable to come to any other conclusion than the one here given. The various descriptions apply to the same species under the influence of the climate of different degrees of latitude. Thus the *Vespertilio noveboracensis* answers well to the account given of it in its proper locality; but as we proceed southward, we find that a Bat occurs, having precisely the same form and size, but differing somewhat in the colouring of the fur; and this difference continues to increase until we reach the tropical parts of America, where a *bright ferruginous* colour completely supersedes the original *hoary-brown*, or, as it might not improperly be called, *roan-colour*.

At various localities it has been met with by travellers, and the colour of the fur varying in most of them, has given rise to the great multiplicity of names. A large series has passed under review whilst preparing this paper, and the most exact and rigorous examination, both externally and internally, has failed to afford any material difference, beyond that of colour.

I have already referred this to the effect of climate; but it is necessary to add, that the colour of the fur is so capricious, even in the temperate parts of North America, that Major Le Conte, when describing specimens from the vicinity of Philadelphia, found the varieties so perplexing, that he could give no very definite description.

However, it may be stated, that *generally* the North American examples are some mixture of brown or rufous, thickly sprinkled with white, giving a hoary appearance; whilst those from Tropical America are almost uniformly of a bright ferruginous hue, without any mixture of white.

1. Lasiurus noveboracensis, Erxl.

Vespertilio noveboracensis, Erxl. Syst. Règ. Anim. p. 155, 1777; Harl. Faun. Amer. p. 20, 1825; Godm. Amer. Nat. Hist. i. p. 50, 1826; Fisch. Synop. Mam. p. 114, 1829; Coop. Ann. Lyc. N. H. New York, iv. p. 57, 1837; Le Conte, Proc. Acad. Nat. Sci. Philad. 1855.

New York Bat, Penn. Arct. Zool. p. 184, 1792; Synop. Quad. p. 367, 1771.

Vespertilio rubellus, Palisot de Beauvois, Cat. Peale's Mus. 1796.

Vespertilio lasiurus, Linn. edit. Gmel. 1788; Schreib. Säugt. 1826; Geoff. Ann. du Mus. viii. p. 200, 1806; Desm. Mam. p. 142, 1820; Fisch. Synop. Mam. p. 109, 1829.

Vespertilio Blosseivillii, Less. et Garn. Bull. des Sci. Nat. viii. p. 95; Fisch. Synop. Mam. p. 110, 1829.

Vespertilio Bonariensis, Less. Voy. de la Coquille, 1829.

Vespertilio villosissimus, Geoff. Ann. du Mus. viii. p. 478, 1806; Desm. Mam. p. 143, 1820; Fisch. Synop. Mam. p. 110, 1829; Rengg. Säugt. von Parag. p. 83, 1830; Wagn. Supp. Schreib. Säugt. i. p. 536, 1840.

Vespertilio monachus et *V. tessellatus*, Raf.?

Nycticejus noveboracensis, Temm. Mon. ii. p. 158, 1835–41; Wagn. Supp. Schreib. Säugt. i. p. 546, 1840; Schinz, Synop. Mam. i. p. 199, 1844.

Nyct. varius, Poep. Reise in Chili, i. p. 451, 1835; Wagn. Supp. Schreib. Säugt. i. p. 547, 1840.

Nyct. Atalapha, Raf.?

Atalapha Americana, Raf. Prin. de Som.?; Desm. Mam. p. 147, 1820.

Chauve-souris septième, Azara.

Lasiurus rufus, Gray, Cat. Mam. B.M. 1843; Gosse, Nat. Sojourn. Jamaica, p. 280, 1851.

The muzzle is of very moderate length and substance, and rather pointed; the nostrils are rather small, near together, and directed sublaterally. The end of the nose, between the nostrils, is somewhat emarginate. The ears are short, ovoid, and very much rounded at their tips, which are directed outwards. Towards the base of the front edge of the ear is a lobular projection, occasioned by a notch in the margin immediately under it, quite at the base of the ear, and contiguous to the tragus. The outer margin is continued forward along the side of the face toward the angle of the mouth, and ends near to it, in the form of a moderately developed lobe. The tragus is narrow at its base, from which it expands evenly and rather rapidly for half its length, where, making a conspicuous angle, it slopes inwards, and comes to a narrow but rounded point, its inner margin all the time maintaining a nearly straight line, excepting near the tip, where it has a decided inward curvature. The outer marginal angle, already mentioned, is something more than a simple angle, being, in fact, a rounded projection from the crooked edge of the tragus.

The wing-membranes extend to two-thirds of the distance between the extremity of the tibia and the base of the toes.

The face is more or less covered with hair on all parts, the end of the nose and the margins of the lips only being naked. On the forehead the fur is very thick, and approaches nearly to the end of the nose. Immediately in front of the eye is a tuft of stiff hairs, and on the upper lip is a moustache of softer ones. The inner surfaces of the ears are sparingly suffused with very fine short hairs, as are also their outer margins.

The interfemoral membrane is densely hairy on the whole of its upper surface, and the same peculiarity extends to the upper surface of the feet. The fur of the back also extends on to the membranes of the wings, over and beyond the tibia, but is there bounded by a well-defined line. It differs in this respect from the fur of the under surface, where it is seen to extend along the membrane beneath the fore-arm, somewhat irregularly scattered, and having the appearance of yellow down. Towards the wrist it becomes thicker, and is more especially so about the base of the fourth finger. This finger is also seen to be fringed with fine soft hairs at its base, when viewed from above; and a small patch of hair is visible at the base of the thumb.

Everywhere the fur is soft in texture, rather long, and tolerably thick. That which extends on to the under surface of the membranes is unicoloured, and of a yellowish buff colour. A narrow stripe of fur, bounding that of the back on each side, is frequently of the same colour. But the colour of the body varies so much, that it appears desirable to give a short description of each of the extreme varieties, observing, at the same time, that every intermediate state may be met with.

Var. 1. Fur of the back of four colours: dark near to the skin, succeeded by yellowish brown, which is again succeeded by pale rust colour, and finally tipped with white.

Beneath, the fur is nearly similar, excepting that which is contiguous to and on the membranes; this is unicoloured and pale buff.

Hab. North America, "from one end of the country to the other, equally numerous" (*Le Conte*).

Var. 2. Similar to the last, but with the colour brighter and without the white tips to the fur.

Hab. The same as the last.

Var. 3. Fur of the upper parts nearly black at the base, succeeded by yellowish-buff, passing into bright ferruginous-red, shining and silky. That on the interfemoral membrane uniform bright ferruginous. Beneath, the fur is nearly black at its base, passing into dark brown, and tipped with bright rust-colour. The fur on the under surface of the membranes is also of the latter colour. Sometimes this variety has the chin and throat of a yellowish-buff colour, and then answers well to the description of *Nycticejus varius*, as given by Poeppig.

Hab. South America; Jamaica; Canada.

In all these varieties a white spot is observable at the axilla. The membranes appear to be light or dark, according to the depth of the colour of the fur. Frequently the membranes of the wings, near to the sides of the body, exhibit a singularly spotted appearance, occasioned by the network of veins being paler in colour than the portions enclosed by them. It was probably to one of these that Rafinesque applied the appropriate epithet "*tessellatus*." The example in which I have seen this peculiarity most conspicuous was obtained in the Island of Mackinac, between Lakes Huron and Michigan, by my friend Mr. P. L. Sclater, who, knowing how much I am interested in this order of Mammals, kindly presented it to me, with other North American Bats collected by him in the autumn of 1856.

Dentition.—In. $\frac{1\cdot1}{6}$, C. $\frac{1\cdot1}{1\cdot1}$, P.M. $\frac{2\cdot2}{2\cdot2}$, M. $\frac{3\cdot3}{3\cdot3}=\frac{14}{18}$.

The first pre-molar on each side in the upper jaw is small and rudimentary, and perhaps is sometimes wanting. It is placed in the angle between the canine and the contiguous pre-molar, in such a manner as not to be visible from the outside.

	1.		2.		3.		4.		5.	
	in.	lines.	in.	lines.	in.	lines.	in.	lines.	in.	lines.
Length of the head and body...	2	1	2	1	2	2	1	11	2	7
——— of the tail	1	11	2	0	2	0	1	10		...
——— of the head..............	0	8½	0	8	0	8	0	7½	0	7½
——— of the ear	0	3	0	3	0	3	0	3	0	3½
——— of the tragus	0	2	0	2	0	2¼	0	2	0	2¼
——— of the fore arm	1	7	1	6½	1	7½	1	6½	1	5½
——— of the longest finger ...	3	3	3	2	3	5	3	2	2	11

2. LASIURUS PRUINOSUS, Say.

Vespertilio pruinosus, Say, Long's Exped. Rock. Mount. i. p. 168, 1825 (?); De Kay, Nat. Hist. New York, i.; Fisch. Synop. Mam.

p. 113; Godm. Amer. Nat. Hist. i. p. 68; Harl. Faun. Amer. p. 21; Coop. Ann. Lyc. N. H. New York, iv. p. 54.

Scotophilus pruinosus, Gray, Mag. Zool. and Bot. ii. p. 498, 1838.

Nycticejus pruinosus, Temm. Mon. ii. p. 154, 1835–41; Wagn. Supp. Schreib. i. p. 544; Schinz, Synop. Mam. i. 197.

Lasiurus pruinosus, Gray, Cat. Mam. Brit. Mus. p. 32, 1843.

Vespertilio cinereus, Palisot de Beauvois, Cat. Peale's Museum, 1796.

It is not unusual to see the name of this species attached to specimens of the former, an error not easy to commit, if actual comparison of the two were made. The present one is greatly superior in size to the last, and besides this, presents some other very distinctive characters.

The head is broad, and the forehead flat; the muzzle is obtuse; the nostrils are surrounded by a well-defined rim, are directed sublaterally, and separated by a considerable interval, which is emarginate. The ears are irregularly round, their front margins projecting considerably over the forehead. Their outer or hinder margins are brought forward along the sides of the face in the shape of narrow prolongations, and terminate in two slightly projecting lobes behind the corners of the mouth. The tragus appears to offer some slight variations of form in different individuals, and even in the same specimen I have, in one instance, observed it dissimilar in the two ears. In its general form it resembles the same part in the last species, but it is much less attenuated towards the tip, and the outer margin has a less distinctly angular projection. At its base it is of average width, from which it expands rather rapidly, and proceeds outwards for the distance of about a line, when it takes an upward direction, and becoming narrower, ends in a rounded tip. This change of direction from horizontal to vertical leaves an angle at its outer edge, which is nearly a right angle, whilst its inner edge maintains a pretty regular concave line from the base to the tip. In one instance, above alluded to, I have observed it in one ear only of full breadth at the base, and gradually curving upwards and inwards, terminate in a rounded end, about half the breadth of the base; the tragus of the other ear being of the usual form.

The membranes of the wings barely extend to the base of the toes. The thumb is rather long, and has its terminal phalange twice the length of the basal one.

The fur of the forehead extends nearly to the end of the nose. The sides of the face, and the muzzle, are moderately hairy, with a tuft of stiffish hairs in front of the eye, and a black moustache fringing the upper lip. The chin is nearly naked. A patch of fine, short, adpressed hairs occupies the inside of the ear near its tip, and the exposed surface of the tragus is similarly furnished.

Seen from beneath, the whole of the antibrachial membrane is covered with close downy hair of a yellowish colour, and fur of the same kind extends from the side of the body along the membrane beneath the arm and fore-arm, to the bases of the fingers, which, in some examples, are completely obscured by it. In breadth this band of fur varies from half to three-quarters of an inch, widest towards the fingers. Only a portion of the base of the interfemoral membrane, as seen from below, is hairy.

Viewed from above, the whole of the interfemoral membrane is hairy, as are the feet and legs, and a portion of the membrane of the wings, where they are attached to the sides of the body. The hair on the latter part, however, is of no great breadth, and its outer margin is usually straight and well defined. Over the tibia the interfemoral fur passes but to a trifling extent, and in many specimens that limb constitutes its exact boundary. In the species last described, the fur usually passes over it, and occupies a considerable space on the base of the wing.

The variations in colour in this species appear to be much less considerable than in the last. The fur of the muzzle, chin, and around the eyes, is black; that of the throat pale buffy-yellow, the line of separation of the latter colour and the black of the chin being pretty distinct. On the forehead the fur is of the same yellowish hue as that of the throat, and on the top of the head it is similarly coloured at its base, but becomes of an umber-brown colour about its middle, and is then tipped with white. This arrangement of colours represents pretty nearly the colour of all the upper parts of the body, excepting that the fur has in addition a dark-coloured root. The colours may be thus briefly given:—dusky-grey (at the root), yellowish-buff, umber-brown, and finally white. The white is most plentiful on the shoulders, along the middle of the back, and on the rump; the yellow colour prevails on the head and neck, but becomes less in regular gradation towards the rump, where the brown in great measure takes its place, which it does completely on the interfemoral membrane.

The under surface is nearly similar, but differs in having the colours paler, the yellow less conspicuous, and the tips of the hairs buff-coloured instead of white. On the under parts, as on the upper, the yellowish colour gives way to the brown on approaching the hinder parts, and the hair on the contiguous part of the interfemoral membrane is wholly dark for the greater part of its length, and is tipped with light brown. At the insertion of the humerus is a light-coloured spot. The fur of the sides of the body, under the arms, is of a brownish-buff colour. All the fur on the wing-membranes is buffy-yellow.

The membranes are dark, excepting where there is a growth of hair, such parts being reddish-brown.

Dentition.—In. $\frac{1\cdot1}{6}$; C. $\frac{1\cdot1}{1\cdot1}$; P.M. $\frac{1\cdot1}{2\cdot2}$; M. $\frac{1\cdot1}{3\cdot3}=\frac{12}{18}$.

In the following Table of dimensions, column No. 1 has been taken from a specimen purchased of Mr. J. G. Bell of New York, No. 2 from a specimen in the British Museum, from the United States, and No. 3 from a specimen not quite adult, taken in Bermuda by the Rev. H. B. Tristram, and very kindly forwarded by him for my use.

	No. 1. in.	No. 1. lin.	No. 2. in.	No. 2. lin.	No. 3. in.	No. 3. lin.
Length of the head and body, about	3	6	3	10	2	10
——— of the tail	....		1	10	....	
——— of the head	0	11	....		0	10
——— of the ear	0	4½	....		0	4½
——— of the tragus	0	3	....		0	3
——— of the fore-arm	2	3	2	2	2	0
——— of the longest finger	4	4	4	0	4	0
——— of the fourth finger	2	8	2	7	2	4
——— of the thumb	0	6	....		0	6
——— of the tibia	....		0	11	0	9
——— of the foot and claws	0	6	0	5	0	5½
——— of the os calcis	0	9	....		0	7½
Expanse of wings	16	6	....		15	6

Hab. North America, not abundant.

Major Le Conte observes, that he has only had the opportunity of examining six or seven examples. The British Museum contains a specimen from California, and another presented by Mr. W. S. MacLeay is labelled South America. Assuming the latter specimen to be correctly labelled, its locality renders it probable that this species, like the last, is distributed over a considerable part of the New World, and the idea is somewhat strengthened by its occurrence in California and Bermuda.

Major Le Conte has referred this species to the *Vesp. cinereus* of the Catalogue of Peale's Museum, bearing date 1796. There appears to be no doubt that it was to this species that the above name was applied, as the only other North American Bat with which it would be likely to be confounded—*V. noveboracensis*—was clearly distinguished in the Catalogue, and called *V. rubellus*. As I do not know whether any description accompanied the name of *V. cinereus*, I must for the present retain the name given by Say; but in the event of any specific characters having been added in the Catalogue just referred to, the name of *L. cinereus* must of course be adopted.

3. Lasiurus Grayi, n. s.

This species, which I believe is undescribed, is in size a little superior to the larger examples of *L. noveboracensis*, but smaller than *L. pruinosus*. To the latter species, however, it bears the greatest resemblance in its forms and general appearance, but differs in several respects, which will be hereafter noticed.

The muzzle is rather obtuse, but less so than in *L. pruinosus*. The ears are angular-round, but more pointed than in the last-mentioned species, and have the ear-lobe near the angle of the mouth more strongly developed. The tragus, although it presents the same general form, yet differs in having the upper or ascending part straight instead of being curved. It is also much narrower at its base.

The thumb has the same long terminal phalange and short basal one observable in the last two species. The feet are large in relation to the size of the animal. The membranes of the wings extend a little way beyond the extremity of the tibia, but *do not reach halfway along the foot*, exclusive of the toes. The extreme tip of the tail is slightly exserted, and very pointed.

The fur of the head extends down the forehead nearly to the nose; the face is moderately hairy, and has a tuft of fine long hairs immediately in front of the eye. The basal part of the hinder surface of the ear is hairy, some of the hair projecting beyond the inner margin so as to be visible from the front. Two patches of short adpressed hair of a fine nature line the inside of the ear, one of them extending from the front margin to near the tip, and the other fringing that part of the margin nearest to the root of the tragus. The latter part is sparingly covered with short adpressed hairs on its exposed surface.

The muzzle and greater part of the face are brownish-black. The fur of the upper parts is of four colours—dark at its root, then yellowish-brown, succeeded by dark brown, and tipped with white. Towards the hinder parts of the body, and on the interfemoral membrane, the yellowish colour gives way to the brown, and the fur is wholly of the latter colour, tipped with white. The throat is light yellowish-brown, passing into dusky-brown on the breast. On all the under parts the fur is of a faded brown colour for the greater part of its length, but near the tip it becomes a little darker, and is finally tipped with dirty buff colour. The fur on the membranes beneath the humerus is in some examples of the same tricolour as the under parts of the body, but more frequently it is of a uniform brownish-yellow hue, as is that beneath the fore-arm, and that at the base of the fingers.

The hairy portions of the membranes are reddish-brown; the remaining parts very dark brown.

The variations in colour to which this species is subject depend upon the tint of the brown colour near to the tips of the hairs. In one example in the British Museum, this part of the hair is of a light red colour, inclining to pinkish, and takes up a much greater space than usual in each hair, the dusky at the base being there very much reduced. In this specimen the black of the face and the yellowish colour of the throat are scarcely observable; and this, with the red colour, gives it, at first sight, a great resemblance to the *L. noveboracensis*.

The colour of the fur is an index to that of the membranes—in this instance a reddish-brown.

The dentition has not been well examined, but the incisors are similar in number and shape to those of the last two species.

Five examples have been examined in drawing up the above description, and these are all so remarkably uniform in size, that it appears unnecessary to give the dimensions of more than two, those presenting the greatest disparity being selected.

	No. 1. in.	lin.	No. 2. in.	lin.
Length of the head and body, about ..	3	2	3	3
——— of the tail	1	7	1	8
——— of the head	....		0	9
——— of the ears	0	3½	0	3½
——— of the tragus	0	3	0	2¾
——— of the fore-arm	1	9½	1	9½
——— of the longest finger	3	10	3	8
——— of the fourth finger..........	2	3	2	1
——— of the thumb	0	5½	0	5
——— of the tibia	0	8	0	8
——— of the foot and claws	0	5	0	4½
——— of the os calcis	....		0	8
Expanse of wings	14	0	13	9

The dimensions in column No. 1 have been taken from a perfectly adult individual in the British Museum, the locality being unknown. The specimen which has furnished the dimensions in the second column is also full-grown, but nevertheless retains some indications of youth.

Hab. This second specimen was forwarded with another, perfectly similar, from Chili, by Mr. Bridges. All the other specimens in the British Museum Collection are without authentic habitats.

4. Lasiurus caudatus, n. s.

The extreme length of the tail of this species, exceeding that of the head and body, together with the considerable length of the hinder limbs, gives to it a very remarkable appearance, and seems to distinguish it at first sight from all the others of the group.

The muzzle has much the form and proportions of that of *L. noveboracensis*. The ears are obtusely triangular, as broad as high, and have their outer margins brought downwards and forwards along the side of the face to within a little distance of the corners of the mouth, and on the same level with it. Here they terminate, as in all the preceding species, in a separated lobe, in this instance more clearly developed than usual. This part of the ear bears considerable resemblance to the same part in the genus *Molossus*, but is less considerable in degree. The tragus is narrow at its base, from which it rapidly expands, and abruptly bending inwards, leaves an outer angle and curves to an obtuse point. It differs chiefly from the same part in *L. pruinosus* in having a more decided inward direction.

The wing-membranes barely extend to the base of the toes. The tail is longer than the head and body.

The fur of the forehead extends uninterruptedly in the direction of the nose, and approaches it nearly. As in all the preceding species, the other parts of the face are moderately hairy.

The fur of the back encroaches on the membranes of the wings for a distance of about four lines, where it has a clearly defined boundary. That of the under parts extends on to the membrane beneath the humerus, but has no regularly defined margin. Between the fore-arm and the fourth finger, in the angle formed by the two, is a growth of extremely short downy hairs of a yellow colour. The upper parts of the feet are moderately hairy, much less so than is usual in *L. pruinosus* and *L. noveboracensis*. On the upper surface of the interfemoral membrane, the fur of the rump extends only for half its length, the remaining half being naked. Its under surface is sparingly clothed with hairs for about one-third of its length, *near to the tail only*; that part of the membrane near to the knees and the end of the tail being quite naked.

The membrane itself is rather thickly marked with transverse dotted lines.

The fur is rather long and silky; that of the whole of the upper parts is of a uniform yellowish-buff colour, brown for a short length in immediate proximity to the skin. Beneath, it is reddish-brown at the base for about a third of its length; the remainder being yellowish-buff.

Dentition.—In. $\frac{1\cdot 1}{6}$; C. $\frac{1\cdot 1}{1\cdot 1}$; P. M. $\frac{1\cdot 1}{2\cdot 2}$; M. $\frac{3\cdot 3}{3\cdot 3}=\frac{12}{18}$.

	No. 1.		No. 2.	
	in.	lin.	in.	lin.
Length of the head and body	1	9	2	0
——— of the tail	2	0	2	6
——— of the head	....		0	7½
——— of the ears	0	3½	0	3
——— of the tragus	0	3	0	3
——— of the fore-arm	1	8	1	8
——— of the longest finger	3	3	3	6
——— of the fourth finger......	2	0	2	3
——— of the thumb	0	4	0	4½
——— of the tibia	0	8½	0	9½
——— of the foot and claws	0	3½	0	4
——— of the os calcis.........	0	5	0	6
Expanse of wings	13	0	12	9

Hab. Pernambuco, from which place the specimen was received which furnished the above description, and the dimensions in column No. 1. No. 2 is from a specimen in a bad state in spirit, from Chili. I have met with no other examples than the ones here described.

5. Lasiurus Aga, P. Gerv.

Nycticejus Aga, P. Gerv. in Castelnau, Expéd. dans les parties centrales de l'Amérique du Sud, &c., livr. 16. p. 73, 1855.

The following description is taken from that by the original describer.

Ears subround; tragus in the form of a hooked knife ("à peu près de la forme d'une *serpette*"). The nostrils are subtubular, pierced in the sides of the small nose, which is a little emarginate in the centre.

Tail, in the two specimens examined, absent, having been withdrawn from the membrane, in which a median furrow is left in its stead, from the inspection of which it may be inferred that the tail occupied the whole length of the membrane (as in the other species of this group).

The upper surface of the interfemoral membrane has some hairs on its base, as in many species of the genus *Vespertilio*; and its under surface bears some transverse lines of small follicles.

The general colour of the fur is buffy-chestnut, glossy above, and paler beneath.

	in.	lin.
Length of the body	2	4 (English).
Interfemoral membrane along its central line..	1	9
Fore-arm	1	7
Tibia	0	9

I now give a description of a specimen evidently of this species collected at Ega, on the Amazon, by Mr. Bates, and labelled by him "houses, Ega." As it appears to be in a better state of preservation than the two obtained from the same place by M. Castelnau, I am able, besides confirming the accuracy of his description, to give a more detailed scale of dimensions than he has given.

It is desirable to note, that this specimen, although probably full-grown, yet exhibits some slight indications of non-maturity.

The muzzle is a little longer relatively than in the species I have before described, and is about as much pointed as in *L. noveboracensis*. The end of the nose is small; the nostrils somewhat tubular, with a distinct notch between them.

The ears are triangular-round, and somewhat more pointed than those of any other species here described. The tragus is similarly formed to that part in *L. pruinosus*.

The wing-membranes barely extend to the base of the toes, and the extreme tip of the tail is exserted.

The fur of the forehead does not approach so nearly to the nose in this species as in the others of the group.

The basal half of the superior surface of the interfemoral membrane is hairy, but the hair does not reach laterally over the tibia. Beneath, it is sparingly hairy at the root of the tail only. The membranes of the wings contiguous to the body, both above and below, are hairy, more especially on their under surface, where the hair reaches to the elbow, but does not follow the fore-arm.

On all the upper parts the fur is yellowish-buff, the hairs slightly tipped with brownish, and on the under parts uniform yellowish-buff.

Membranes of the wings darkish brown, the interfemoral membrane being paler and marked with about twenty transverse dotted lines.

	in.	lin.
Length of the head and body, about ...	2	0
——— of the tail..................	1	7
——— of the head	0	8
——— of the ears	0	$3\frac{1}{2}$

	in.	lin.
Length of the tragus	0	$2\frac{1}{2}$
——— of the fore-arm	1	7
——— of the longest finger	2	$7\frac{1}{2}$
——— of the fourth finger	1	10
——— of the thumb	0	4
——— of the tibia	0	$8\frac{1}{2}$
——— of the foot and claws	0	$5\frac{1}{2}$
——— of the os calcis	0	8
Expanse of wings	11	6

In colour this species very closely resembles the last, but, besides many minor points of distinction, the great length of the tail in the former will at once be sufficiently distinctive.

I have now described all the species that I am able with certainty to refer to this group; but there are two others described by Major Le Conte in the 'Journal of the Academy of Natural Sciences of Philadelphia' for 1855, characterized by the same formula of dentition as in *Lasiurus*, but which appear nevertheless to have the other parts as in the more ordinary Bats.

One of these—*Vesp. pallidus*, Le Conte, — the writer says, has only four incisors in the lower jaw,—altogether an anomalous character, if not due to some accidental cause.

The other species is the *Vesp. crepuscularis* of the same naturalist (*V. creeks*, F. Cuv.), which, while possessing only two upper incisors, precisely as in *Lasiurus*, has yet all the other characters similar to those of *Vesp. Carolinensis*,—a species clearly appertaining to that division of the genus *Scotophilus* which constitutes Section *b*. of the genus *Vesperugo* of MM. Keyserling and Blasius.

It would appear from this that the number and form of the incisors in the upper jaw do not furnish a very valuable generic character; and when we find another species from India, not only different in its forms from *Lasiurus* and *Nycticejus* (so called), but also differing from the above-mentioned *Vesp. crepuscularis* in all respects save in the upper incisors, which are similar, we are quite justified in regarding this as a character of subordinate value in the arrangement of this difficult group of animals.

The Indian species to which I allude is referable, as far as external form is concerned, to that section of the genus *Vespertilio* which has been called *Cappacinius* by Prince Charles Lucien Bonaparte, and *Trilatitius* by Dr. Gray. It is closely affined to the *Vesp. Tasmanensis* of the latter zoologist, and may perhaps prove identical with it.

Besides the species given in this Monograph, there are several others differing materially from them, and from each other, but which have the tail-membrane hairy. As instances, may be cited *Vesp. noctivagans*, Le Conte (*V. pulverulentus*, Temm.), *Lasiurus Pearsonii*, Horsf. (closely affined to the *Vesp. emarginatus** of the

* In alluding to this species, I may mention, that it is the *Vesp. emarginatus* of continental writers to which I refer,—a well-marked species very similar in ap-

continent of Europe), and *Vesp. suillus*, Temm., called *Murina suillus* by Dr. Gray, and *Noctilinia Lasyura* by Mr. Hodgson.

From this it must be evident that this character is of generic value only when associated with others of greater constancy, and it is only by the characters taken collectively that the groups can be truthfully defined.

The form of the head, the muzzle, and the nostrils, of the ears and the tragi, the extent of the membrane in reference to the hinder extremities, the quality and distribution of the fur, the number and form of the upper incisors, and more than all, the general conformation of the cranium, supply the means by which the *Lasiuri* may be recognized and associated.

Mr. Tegetmeier exhibited a collection of skins of new varieties of domestic Fowls, the property of Mr. C. Darwin.

Those from the Madras Presidency were chiefly of the Malay type, more or less resembling the gigantic Kulm Fowls that were imported some years since by Colonel Sykes, and which were formerly in the possession of the Society. The Fowls from Singapore were remarkable for the recurved character of the plumage. The interior of Persia furnished a very beautiful steel-black variety, perfectly distinct from any known in this country, and which was stated to be the Common Fowl of the district. Good specimens of the black-skinned, white silky-plumaged Fowl with black periosteum were forwarded both from Singapore and Madras. Mr. Tegetmeier called attention to the fact, that all the specimens shown differed in a much greater degree, than our common English Game Fowls, from the *Gallus Bankiva*, so frequently asserted to be the origin of our domesticated species of the genus *Gallus*.

March 10, 1857.—Dr. Gray, F.R.S., in the Chair.

Descriptions of Four undescribed species of Bats. By Robert F. Tomes.

1. Scotophilus pachyomus, n. s.

Muzzle rather obtuse; ears ovoid; tragus short, of nearly uniform breadth, and round at the end. Wing-membranes extending to the base of the toes. Fur bicoloured. Size rather larger than S. noctula.

This species appertains to the same division of the genus as *S. pipistrellus, S. Kuhlii, S. marginatus, S. minutus,* and perhaps *S. Carolinensis*; but it is to the *S. discolor* of Europe that it bears the greatest apparent resemblance, owing in some measure to the similarity in the quality and colour of the fur.

In size it a little exceeds the Noctule Bat, being much the largest species of the restricted group to which it belongs.

pearance to *Lasiurus Pearsonii*, but not more than half the size, and with less hair on the interfemoral membrane. The so-called British species is, I believe, no other than *Vesp. mystacinus*.

The muzzle is somewhat obtuse, the nostrils rather prominent, and opening sublaterally. The ears are rather long, ovoid, and narrowed towards their tips. The tragus is scarcely half the length of the ear, of nearly uniform breadth, round at the end, and slightly curved towards the head.

The wing-membranes extend to the base of the toes; the latter are a little longer than the remaining portion of the foot.

The face is moderately hairy; on the top of the nose and about the muzzle nearly naked, but with a slight group of hairs on the gland of the upper lip, which extends to the angle of the mouth.

The fur is markedly and singularly bicoloured, very much resembling that of *S. discolor*. That of the upper parts is of a dark brown, conspicuously tipped with whitish brown. Beneath, it is brown at its base, with the terminal half yellowish brown.

The upper incisors are four in number, in pairs, of nearly uniform size, separated from the canines by an interval on each side, and with an interval in the middle, of very moderate extent.

	"	'''
Length of the head and body......	2	6
——— of the tail	1	10
——— of the head..............	0	9
——— of the fore-arm	2	1
——— of the longest finger	3	9
——— of the fourth finger	2	7
——— of the tibia..............	0	10
——— of the foot and claws......	0	$5\frac{1}{2}$
Expanse of wings	13	6

Hab. India. In British Museum, collected by Capt. Boys.

2. Scotophilus pumiloides, n. s.

Muzzle tumid; ears small, broadly ovoid, not emarginate, with their tips directed a little outwards. Tragus of nearly uniform breadth, round at the end, and curved inwards. Wing-membranes extending to the base of the toes.

In its general character this species bears considerable resemblance to the smaller Australian species of Bats, such as *S. picatus*, Gould, *S. Greyii*, Gray, and *S. pumilus*, Gray, all having the forms of the *S. pipistrellus* of Europe, with some slight modifications. As its name indicates, it is most closely affined to *S. pumilus*, but it differs from it in being somewhat larger.

The muzzle is short and rather tumid; the nostrils and lips present no variation from what is usual in the restricted group to which the species belongs, being in fact similar to the same parts in the common *Pipistrelle*.

The ears are small and very short, being scarcely longer than wide, and are of a tolerably regular ovoid form, but with their extreme tips brought to a blunt angle directed somewhat outwards.

The tragus is about half the length of the ear, of nearly uniform breadth, with a rounded tip, and a slight inward curvature.

As in all the species above enumerated, the wing-membranes extend as far as the base of the toes. The extreme tip of the tail is exserted, and the interfemoral membrane is marked with twelve transverse dotted lines.

The fur of the whole of the body is very thick and close, that of the back extending on to the interfemoral membrane for nearly a fourth of its length. In one example, the fur of the pubes also extends on to the membrane around the root of the tail; but this appears to be an exception.

On all the upper parts the fur is bicoloured, dark at its root, with the terminal third yellowish-brown; beneath it is similar, but the tips are pale brown with a slight olive-yellow cast, which is most conspicuous on the pubes and flanks.

The cutaneous system is of a medium brown colour.

The dentition has not been examined.

	"	‴	"	‴
Length of the head and body	1	6	1	6
——— of the tail	1	0	1	3
——— of the head, about	0	7	0	6½
——— of the ears..............	0	3½		
——— of the tragus	0	2		
——— of the fore-arm	1	3¼	1	3
——— of the longest finger	2	4	2	3
——— of the fourth finger	1	9	1	9
——— of the thumb, about	0	2½		
——— of the tibia	0	6	0	5¾
——— of the foot and claws......	0	3¼	0	3½
Expanse of wings	9	0	9	3

Hab. China.

3. Vespertilio Chinensis, n. s.

Top of the head very slightly elevated; muzzle rather thick; ears narrow, ovoid; tragus narrow, nearly straight and pointed; wing-membranes extending to the base of the toes; toes longer than the remaining portion of the foot.

In its general forms this species bears considerable resemblance to *V. murinus* of Europe, but the ears are much narrower. It is also somewhat larger; and if we except the *V. maximus* from South America, is the largest true *Vespertilio* known*.

The top of the head is elevated only to a very moderate extent, and the face is rather long and thick. The nostrils are slightly tubular, and open sublaterally. The ears are of a longish oval form, not emarginate, but narrowed towards the tips. They bear greater

* The specimens of *V. murinus* that I have made use of for comparison with this species, have been received from various parts of the continent of Europe, from Algeria, and from Nubia. Those from Switzerland are the only ones that appear to approach it in size; but even they, although perfectly adult, are decidedly smaller, whilst the species I am describing presents indications of youth in the imperfectly ossified condition of the finger-joints.

resemblance to those of *V. Nattereri* than to those of any other species with which I am acquainted, but are relatively more narrow towards the ends. The tragus is narrowish at its base, from which it expands to near its middle, which is the widest part. From this it tapers to an acute point, having a slight inward tendency.

The wing-membranes extend to the base of the toes, and the latter are longer than the remaining part of the foot, just as in *V. murinus* and *V. formosa*, Hodgs.

The forehead is hairy, and the hair extends nearly to the end of the nose. On the upper lip is a thick moustache, the space around the eye being the only part of the face which is naked.

The fur is longish, fine in texture, and rather cottony, but not very thick. It does not anywhere encroach on the membranes.

All the upper parts are very dark brown, with the extreme tips of the hairs a little paler. Beneath, nearly similar, but the tips of the hairs are pale grey-brown on the breast and belly, whilst the sides of the body and pubal region are almost black.

The membranes are very dark.

	"	'''
Length of the head and body, about......	3	9
——— of the tail	2	2
——— of the head....................	1	0
——— of the ears	0	8
——— of the tragus	0	3½
——— of the fore-arm	2	5½ or 6
——— of the longest finger	4	0
——— of the fourth finger	2	3
——— of the thumb......................	0	6 or 6½
——— of the tibia.....................	1	1
——— of the foot and claws............	0	7
Expanse of wings, about................	16	0

Hab. China, collected by Mr. Fortune.

4. Vespertilio Blythii, n. s.

Ears ovoid, somewhat pointed, their ends sloping outwards. Tragus narrow and tapering to a subacute point. Crown moderately elevated. Feet large, wholly disengaged from the wing-membranes.

In form and proportion this species resembles *Vesp. macropus*, Gould, from Australia, and in colour is somewhat like *V. ferrugineus*, Temm., from South America, both having the same subgeneric characters as *V. Hasseltii, V. Carolii, V. Daubentonii*, and *V. dasycnemus*.

To the restricted group of which the above are representatives, Prince C. L. Bonaparte has given the name of *Cappacinius*, whilst Dr. Gray distinguishes it by the name of *Trilatitius*.

The crown is moderately elevated, and the snout is of medium length and substance. The ears are oval, somewhat pointed, and have their tips directed a little outwards. The tragus is narrow, and tapers evenly to a subacute point, which has a very slight outward tendency.

The wing-membranes extend only to the distal extremity of the tibia, leaving the feet wholly disengaged. The latter are large, and have the toes longer than the remaining part of the foot.

On the interfemoral membrane may be observed about eight strongly marked transverse lines. The tip of the tail is free for the length of its terminal joint.

The wings are ample and broad, as the length of the fingers relatively to each other, and to the other dimensions, as given below, will testify.

The fur of the forehead approaches to near the end of the nose, but around the eyes the face is nearly naked, and the upper lip is destitute of a moustache. All the membranes are naked.

The fur is long, rather soft, and inclining to silky on the upper parts. On the whole of the upper surface of the body it is dark brown at the root, with its terminal half cinnamon-brown, brightest on the rump, and tinged with grey on the head and neck. Beneath it is dark at its base, with its terminal half brownish-white. Both above and beneath, the bicoloured character of the fur is conspicuous, and, as already mentioned, bears some resemblance in this respect to that of *V. ferrugineus*.

	"	'''
Length of the head and body, about	2	3
——— of the tail	1	9 or 10
——— of the head	0	10?
——— of the ears	0	$7\frac{1}{2}$
——— of the tragus	0	4
——— of the fore-arm	2	2 or 3
——— of the longest finger	3	10
——— of the fourth finger	3	0
——— of the thumb	0	5
——— of the tibia	0	11
——— of the foot and claws	0	$6\frac{1}{2}$
Expanse of wings	15	0

Hab. A single specimen in the British Museum Collection is labelled "India, Nassenabad, from Mr. Warwick, 1848," and, I believe, was collected by Capt. Boys.

GEOLOGICAL SOCIETY.

April 8, 1857.—Col. Portlock, R.E., President, in the Chair.

The following communication was read:—

"On the Species of Mastodon and Elephant occurring fossil in Great Britain.—Part I. Mastodon." By H. Falconer, M.D., F.R.S., F.G.S.

The object of this communication is to ascertain what are the species of the Proboscidea found fossil in Britain; what the specific names which ought to be applied to them; and what the principal formations and localities where they are elsewhere met with in Europe. The Mastodon of the Crag forms the subject of this first part of the memoir: the second part will treat of the Elephant-remains found in Britain. The author commenced by insisting on the importance to geology that every mammal found in the fossil state should be defined as regards, first, its specific distinctness; and, secondly, its range of existence geographically and in time, with as much severe exactitude as the available materials and the state of our knowledge will admit. He observed that with regard to the remains of the proboscidean genera, Dinotherium, Mastodon, and Elephant, some of which abound in the miocene and pliocene deposits of Europe, Asia, and America, the opinions respecting the species and their nomenclature, in all the standard palæontological works on the subject, are extremely unsettled and often contradictory.

Dr. Falconer then proceeded to explain his views of the natural classification of the proboscidean Pachydermata, recent and fossil, according to dental characters. In the Dinothere, with its tapiroid molars, the last milk-molar and the antepenultimate (or first) true molar are invariably characterized by a "ternary-ridged-crown-formula," or in other words, their crowns are divided into three transverse ridges. In the Mastodon not only the last milk-molar and the first true molar, but also the second or penultimate true molar (being three teeth in immediate contiguity), are invariably characterized in both jaws by an isomerous division of the crown into either three or four ridges; or, in other words, are severally characterized by either a "ternary-" or "quaternary-ridge-formula." These three isomerous-ridged teeth are referred to as "the intermediate molars." To the ternary-ridged species the author assigns the subgeneric name of *Trilophodon*; and *Tetralophodon*, to the quaternary-ridged species. The molar in front, and that one behind these intermediate molars are also characteristically modified in these two subgenera. In *Trilophodon* the penultimate or second milk-molar is two-ridged, and the last true molar is four-ridged: in *Tetralophodon* the former is three-ridged, and the latter five-ridged. The author considers it highly probable that a subgeneric group characterized by a quinary-ridge-formula (*Pentelophodon*) has existed in nature, but of which no remains have yet been discovered.

The Elephants are distinguished from the Mastodons by the absence of an isomerous-ridge-formula, as regards the three intermediate molars, and by the ridges ranging from six up to an indefinite number in these teeth, in different groups of species. Dr. Falconer arranges the numerous fossil and recent forms in three natural subgenera, founded on the ridge-formula, in conjunction with other characters. In the *Stegodon* (comprising besides other forms the *Mastodon elephantoides*, Clift) the ridge-formula is hypisomerous; and the ridges number six or eight. The *Loxodon* (including the African Elephant) is also hypisomerous, and has from seven to nine plates or ridges. The *Euelephas* (including the *Elephas indicus* and six fossil species) is the largest and most important group, and comprises the typical Elephants having thin-plated molars.

Here the ridge-formula is anisomerous, and regulated by progressive increments, as 8, 12, 16; the higher its numerical expression, the greater the liability to vary, within certain limits dependent upon the race, sex, and size of the individual; the lower molars often exhibiting an excess of plates over those in the upper molars.

Reverting to the Mastodons, Dr. Falconer observed that the sub-genera *Trilophodon* and *Tetralophodon*, as regards number of forms, are of nearly equal value; the former comprising seven, and the latter six well-marked species. Each group is divisible into two parallel subordinate groups. In the one series the ridges are broad, transverse, more or less compressed into an edge; with the intermediate valleys open throughout and entirely uninterrupted by subordinate tubercles. These are represented in *Trilophodon* by *Triloph. ohioticus*, and in *Tetralophodon* by *Tetr. latidens*. In the other series the ridges are composed of blunt conical points, which are fewer in number, flanked in front and behind by one or more subordinate outlying tubercles, which disturb the transverse direction of the ridges and block up the valleys. This series is represented by *Trilophodon angustidens* and by *Tetralophodon arvernensis*. In both subgenera the species with transverse compressed ridges may be compared with *Dinotherium*, as regards their molar crowns; and the other series with *Hippopotamus*.

The European fossil species of *Mastodon*, according to the author, are the following:— *Trilophodon Borsoni*, I. Hays, *Tril. tapiroides*, Cuvier, *Tril. angustidens*, Cuvier (*pro parte*), *Tril. pyrenaicus*, Lartet MS., *Tetralophodon longirostris*, Kaup, and *Tetr. arvernensis*, Croizet and Jobert. With the exception of *Triloph. Borsoni* and *Tetral. arvernensis*, which are of Pliocene age, the above-named species are of Miocene age.

Dr. Falconer proceeded to state that the remains of only one species of Mastodon have hitherto been discovered in the British Isles. They occur in what is called the Older Pliocene Red Crag, at Felixstow and Sutton, in Suffolk, and in the Newer Pliocene Fluvio-marine or Mammaliferous Crag at various localities near Norwich and in Suffolk. After remarking that Professor Owen had referred the teeth of the Crag Mastodon to *M. angustidens*, making *M. longirostris* and *M. arvernensis* to be synonyms of this species (as Cuvier had also done), Dr. Falconer gave in detail the history of the discovery and publication of the true *M. angustidens* (Cuvier), and of the *M. arvernensis* and *M. longirostris*. He then passed in review the opinions and statements of these authors, as well as of Blainville, Laurillard, Gervais, Pomel, Lartet, and Sismonda, on these species, and on the specimens which these observers had severally described, sometimes under additional specific names. He then described the characteristic peculiarities both of the molars and of the symphysis of the lower jaws in these three species; and showed that the molars from the Crag Mastodon were, like those of *Tetral. arvernensis*, characterized by four-ridged molars, with their conical points more or less alternating, and with their valleys blocked up; and that they essentially differed from the molars of the *Triloph. angustidens* from Simorre, Dax, &c., and from the *Tetral. longirostris* of Eppelsheim. The *M. arvernensis* of Montpellier, Auvergne, Italy, &c. had no lower tusks; and the author is of opinion that the only specimen which has been figured and described as one of the lower tusks of the Crag Mastodon is a terminal fragment of one of the upper tusks of that species.

From osteological considerations it appears that *Tetral. arvernensis* was of a low and heavy make; that *Tetral. longirostris* was of similar general proportions; and that *Triloph. angustidens* was higher in its limbs and of a comparatively light and slender shape.

In his observations on the geological age and associated faunas of the formations in which these species severally occur, Dr. Falconer observed that *Trilophodon angustidens* is a characteristic species of the miocene Falunian beds throughout Europe, and is associated with *Triloph. tapiroides* in the Faluns of France and the upper freshwater Molasse of Switzerland. *Tetralophodon longirostris* is an important member of the Eppelsheim fauna, which, though its determination is accompanied with great difficulty, appears to be identical in its leading features with that of the Falunian deposits of France and Switzerland. The *Tetralophodon arvernensis* is characteristic of the pliocene fauna; and it had a very extended range of habitat over Europe, accompanying *Loxodon meridionalis* (Nesti) in Tuscany,—*Trilophodon Borsoni, Loxodon priscus,* and *Euelephas antiquus* in Piedmont and Lombardy,—*Loxodon meridionalis* at Montpellier,—and *Tril. Borsoni, Lox. meridionalis,* and *Lox. priscus,* in Velay and Auvergne. After having reviewed the circumstances under which Mastodon-remains occur in the British strata, Dr. Falconer concludes that,—1st. The Mastodon-remains which have been met with in the Fluvio-marine and Red Crags belong to a pliocene form, namely *Tetralophodon arvernensis*. 2ndly. The Mammalian fauna of the Red and Fluvio-marine Crags, regarded as a whole, bears all the characters of a Pliocene age, and is identical with the Subapennine Pliocene fauna of Italy. 3rdly. The Red and Fluvio-marine Crags, tested by their mammalian fauna, must be considered as beds of the same geological age.

Throughout this paper, for the sake of clearness, the subgeneric names have been used in designating the species. The author, finding that the name *Elasmodon,* applied to the third group of Elephants, in the 'Fauna Antiqua Sivalensis,' in 1847, had been previously used for a fossil fish, has abandoned it, and applies the term *Euelephas* in lieu of it.

April 22, 1857.—Colonel Portlock, R.E., President, in the Chair.

The following communications were read:—

1. "Description of a Crustacean from the Lias Bone-bed." By C. Gould, Esq., B.A. Communicated by J. W. Salter, Esq., F.G.S.

The specimen described was found in a coprolitic mass from the bone-bed of Aust Passage, by E. Higgins, Esq. It consists of a carapace and four abdominal segments. The former is smooth, subrectangular, with the eyes widely separated, and has three longitudinal ridges, and a cervical furrow extending right across the carapace. The latter are sculptured somewhat after the pattern of *Nephrops,* and are 2 lines in length altogether. Some small fragments of subtrigonal limbs accompany the carapace. After comparing the specimen with the known forms of Stomapoda and Macrura, the author concludes by stating that it appears to be a Decapodous Crustacean presenting certain points of resemblance to *Scyllarus* and *Nephrops,* but not assignable to any existing genus. Mr. Gould names it *Tropifer lævis.*

2. "Description of a Crustacean (*Pygocephalus Cooperi*) from the Coal-measures." By Prof. Huxley, F.G.S.

This new and remarkable Crustacean is represented by three specimens in ironstone nodules; each presenting, from the breakage of the nodules, the ventral surface in relief, with the corresponding impression. Two of the specimens are the property of R. S. Cooper, Esq., of Bilston, and were obtained from the shale overlying the upper or thick coal-beds of that place, associated with fragments of *Pecopteris.* The other specimen belongs to the Manchester Museum, and was derived from the coal-shales at Medlock Park Bridge. The animal is about $1\frac{1}{3}$ inch in length; its ventral surface presents at one extremity a quadrate disk, about $\frac{5}{8}$ inch long, furnished anteriorly with two pairs of jointed appendages (the large outer pair being antennæ; the inner smaller pair, the antennules), and margined by the narrow flattened edges of the carapace. The central portion of the body is about $\frac{1}{2}$ an inch in length, and is divided into a series of seven thoracic segments, composed of one medial and two lateral subquadrate plates, and increasing in size backwards by the gradual widening of the medial plates. Each segment is provided with a slender jointed limb on either side: the limbs are directed either forward or outward; and in one instance at least there is clear evidence of a fine, jointed filament, or exopodite, attached to a limb (the fifth). The posterior extremity of the specimen (constituted by the termination of the large abdomen, bent upon itself) is much wider than the other, and has the form of a semicircular disk; the base of the semicircle forming the widest part of the body, and being about half an inch distant from the centre of the curve. This semicircular, caudal plate is traversed by a linear depression at about the middle of its length; another transverse depression mark is near its periphery; and, on clearing away the matrix from the opposite surface of one of the specimens, this portion was found to be continued underneath with a greater convexity, and with indications of other transverse lines of depression, bounding dorsal segments. The surface of the caudal plate is also divided longitudinally by two depressions into three broad subtriangular lobes.

Prof. Huxley described in detail the process of his determination of the above-described characters from the successive examination of the several specimens; and intimated that at first, so problematical were the characters afforded by one or two specimens only, that the broader extremity was regarded as possibly the cephalic buckler of an anomalous Apus-like crustacean, with its dorsal surface presented to view. Subsequent examination of the specimens kindly lent by Mr. Cooper enabled the author to take a different and more probable view of the structural relations of these interesting fossils. Prof. Huxley pointed out that the *Pygocephalus Cooperi* has some peculiar relations with the little *Mysis* or Opossum-shrimp, especially in the schizopodous character of its thoracic appendages, in the proportional size of the carapace, and in the gradual increase in width, from before backwards, of the sterna of the thoracic somites. In the proportions of its abdomen, however, the *Pygocephalus* approximates more nearly to the true Stomapoda; and a *Gonodactylus* bent upon itself presents an appearance in some respects very analogous to that of the fossils in question.

MISCELLANEOUS.

On the Nervous System of Dentalium entalis. By M. T. de Lacaze Duthiers.

Three pairs of ganglia constitute the nervous system of animal life. One is placed in the cavity of the foot, another above the mouth, and the third a little in front and on each side of the anus.

The ganglia of the first pair, or *pedal ganglia*, are pyriform and approximated; they furnish the nerves of the foot and a single thread to the diaphragm which separates the visceral cavity from that of the foot.

The supra-œsophageal ganglia are well developed and approximated by their margins; each of them presents behind a secondary inflation, which cannot be regarded as another ganglion; from them arise important nerves, some of which, to the number of five, pass to all the anterior part of the tube of the mantle, others to the mouth, whilst the last, two in number, are distributed in the fold which serves as the base of the tentacular filaments surrounding the base of the buccal process.

The ganglia of the third pair are small, triangular, distant, and placed on each side a little in front of the orifice of the digestive tube. They only give origin to a long nerve, which after gliding between the elements of the liver, passes to the dorsal surface to run to the posterior extremity of the body, to the cavity through which the water serving for respiration enters. From their position and the nerves which originate from them, these ganglia appear to be exactly analogous to the branchial ganglia of the lamellibranchiate Acephalous Mollusca.

Connective nerves and commissures unite these little nervous centres amongst themselves. The cords which unite the pedal to the supra-œsophageal ganglia enclose the first portion of the digestive tube in a collar and are deeply seated; those which join the supra-œsophageal to the posterior ganglia are in the fold of union of the mantle and the base of the foot; they form a new circle which embraces the whole base of the foot and the digestive apparatus. The anus always remains beyond this. The ganglia being generally close together, there is only one distinct commissure, that which unites the two posterior ganglia, passing in front of the anus.

This arrangement of the nervous system reminds one of that of the lamellibranchiate Acephala: there are two collars attached to the supra-œsophageal ganglia,—one anterior, terminating with the pedal ganglia,—the other posterior, and completed by the posterior ganglia and their commissure. The mouth is surrounded by the former; the anus, on the contrary, is behind and without the second, as in the Acephala.

The organs of special sense are the otolithes and the tentacles. The *otolithes*, formed by two small transparent vesicles containing a great number of small calcareous corpuscles (soluble with effervescence in nitric acid) constantly agitated by the movements of the vibratile cilia of the walls, are attached to the back of the pedal ganglia.

The very numerous *tentacular filaments*, placed in the vicinity of the mouth and forming two tufted branches, appear to be organs of touch, and perhaps of prehension, like those on the heads of some Annelides. The cutaneous fold which bears them receives a very voluminous nerve which is distributed in its interior and furnishes numerous branches; there is no part of the animal so richly provided with nervous filaments. The tentacles themselves possess so much contractility and execute such varied movements that they might be taken for twisted worms, and their extremities are clavate and furnished with a cavity which forms a true sucker. From this cavity, which is clothed with vibratile cilia, a canal penetrates into the filaments, but the author has been unable to follow it far. *Dentalia* placed in small glass vessels protruded their filaments and fixed them to the walls. There are no apparent organs of vision.

The *stomato-gastric* or *sympathic nervous system* exists in *Dentalium*. It arises from the buccal nerves furnished by the same supra-œsophageal ganglion by two roots, one right, the other left. These two roots run backward towards the lingual musculo-cartilaginous mass, become inflated into two small ganglia united by a transverse commissure, then continue their course, rising towards the back, become inflated again into two small ganglia also united by a transverse commissure, and lose themselves in the digestive canal. The lingual apparatus is thus surrounded by a network formed by the commissures, the roots and the branches arising from the secondary ganglia. Towards the middle the first commissure furnishes a single branch which penetrates into the lingual apparatus from its lower surface.

The nervous system of *Dentalium* is therefore much more complete than was supposed. The division of *Cirrhibranches* formed by Blainville, in accordance with the interpretation given by Deshayes to the tentacular filaments, is much compromised if these filaments, instead of being branchiæ, are organs of touch, and it will also be difficult to admit the opinion of Mr. W. Clark, who regards them as salivary glands.—*Comptes Rendus*, April 27, 1857, p. 864.

Descriptions of some new Norwegian Polypes. By M. Sars.

1. *Briareum grandiflorum*; 2–3-pollicare, miniatum, basi effusa, tenui; ramis cylindricis, gracilibus, patulis, flexuosis et tortuosis, dichotomis; cellulis polyporum maximis (diametrum rami duplicem longitudine æquantibus), cylindricis, sparsis, ad apicem ramorum densioribus seu coacervatis; polypis non retractilibus.

Taken at Öxfjord in Finmark, at a depth of 200 fathoms, attached to living specimens of *Oculina prolifera*, to dead branches of *Primnoa lepadifera*, and to the tubes of *Tubularia indivisa*; often covering these objects with a coating of isolated polypiferous cells and ascending branches.

2. *Rhizoxenia filiformis*; 2–3-pollicaris, cinereo-albida; basi communi repente filiformi, diametrum cellularum polypiferarum conico-convexarum bis crassiorum longitudine bis–ter superante; polypis albis, retractilibus.

Taken once at Manger, at the depth of 30–40 fathoms, attached to a large stone. *Sarcodictyon catenata*, Forbes, also belongs to this genus.

3. *Virgularia finmarchica*; 40-pollicaris, sanguinea; stipite sterili crassiore, fusiformi, 6–7-pollicari; pinnulis utrinque 100–112, crassitudinem stipitis æquantibus vel paululum superantibus, semilunaribus, sessilibus, latera et faciem anteriorem stipitis oblique circumdantibus (dorso nudo relicto), seriem cellularum 8–10, spiculis densis fasciculatis farctarum, gerentibus.

Taken only at Öxfjord in Finmark, in the deepest part of the bay, at a depth of 240 fathoms, with the barren part of its stem buried in the mud. It is frequently brought up by the hooks of deep-sea lines.

Of the family *Pennatulidæ*, of which only three species are recorded as British by Johnston, no less than seven occur on the Norwegian coast. These are—

Pennatula phosphorea, Linn. (*P. rubra*, Ehrb., not Linn.)
Pennatula borealis, Sars.
Pennatula stellifera, Müller (*Kophobelemnon Mülleri*, Asbjörnsen, Fauna Litt. Norv. ii. p. 81).
Virgularia mirabilis, Müller.
Virgularia Christii, Koren and Danielssen.
Virgularia finmarchica, Sars.
Pavonaria quadrangularis, Blainville.

Genus Ulocyathus, Sars.

Polyparium calcareum, turbinatum, simplex, liberum, cum vestigiis adhæsionis (in ætate juniore) in basi brevissima, cuneiformi, adunca, acuminata. Costæ parum eminentes, interdum obscuræ. Calyx profundissimus, margine sinuato et crispo. Columella nulla, patuli nulli. Lamellæ radiantes (septa) tenuissimæ, altæ, super marginem calycis valde prominentes, tota longitudine discretæ. Animal simplex, actiniforme, ore plicis numerosis, seriebus tentaculorum conicosubulatorum verrucosorum apice globoso lævi non retractilium pluribus (3–4) circumdato.

4. *Ulocyathus arcticus*, the only species, was taken at Öxfjord in Finmark, at a depth of 150–200 fathoms, perfectly free, upon a bottom of clay and mud. The largest specimen met with was $1\frac{1}{6}$ in. (Paris) in height and $1\frac{5}{12}$ inch in its largest diameter. The smallest specimen measured about $\frac{1}{2}$ an inch in each of these directions. The colour of the animal is bright minium-red, with the inner tentacles darker, and the folds of the mouth blood-red or brownish-red. The polype is quite solitary, and resembles an *Actinia* in appearance, but the base of the coral is naked.—*Fauna Littoralis Norvegiæ*, livr. ii. pp. 63–79.

Natural History of the Conway Reef.

By John Denis Macdonald, Assistant-Surgeon H.M.S. Herald.

Gasteropoda.—After a little search, we obtained one recent *Stomatella* of small size, with a white, polished shell; *Cypræa annulus* (young), and a species of *Vermetus*; but, besides these, no other living Gasteropods were observed, although it cannot be doubted that many exist. Amongst the dead shells, however, which had been washed up from the deeper parts, more especially on the northern side of the Sandy Islet, we noticed a great profusion of a species of *Turbo*, apparently identical with that which is so conspicuous in the elevated coral terraces of the Isle of Pines.

Examples of the following genera were also noticed, though in smaller quantity: viz. *Pyramis* and *Conus*, a very large species of each; *Conus generalis*, and one or two others; *Triton tritonis*, *Dolium perdix*, and *Cypræa*, several species.

Conchifera.—With the exception of the genus *Tridacna*, two species of which were everywhere to be found, no Conchifera seemed to exist on this reef.

Crustacea.—Species of the genera *Pisa*, *Portunus*, *Pyremela* and *Sesarma* were taken on the verge of the Sandy Islet, with a single member of the genus *Squilla*.

Annelida.—Dorsibranchiate and Tubicolous kinds numerous.

Echinodermata.—These embraced examples of the genera *Echinus*, chiefly occurring in the deeper parts amongst the branches of Madrepores, *Ophiocoma*, *Holothuria*, and *Sipunculus*, the latter belonging to the small coral-perforating division.

Turbellaria, Dendrocœla.—Planariæ of comparatively large size.

Phytozoa.—*Astræa*, *Caryophyllia* and *Madrepora* in great variety, with Nullipores and small Sponges.

Algæ.—Nearly all the Algæ are small, and require microscopic examination; the total absence of any of the larger kinds is very remarkable.

The Sandy Islet is mainly composed of disintegrated coral and marine shells; and in several superimposed and sloping layers of coral-conglomerate rock occurring on the south side, portions of species at present existing on the reef may be distinctly recognized. As the outer margin of the reef has not yet been elevated above the surface of the sea, there is necessarily some difficulty in its examination; but future years will bring to light many of the hidden treasures of its natural history.

Description of Siphonactinia, *a new genus of* Actiniæ *from Norway.* By D. C. Danielssen and J. Koren.

Genus Siphonactinia.

Siphone cylindrico, valde excentrice extra discum prominente, a disco et aliquanto sursum duodecim plicis membranaceis cohærentibus—collari tentaculiformi—circumdato; superiore in parte margo rotundatus, cujus in parte exteriore tres eminentiæ cartilaginosæ et in interiore fissura per totam siphonis longitudinem porrecta; tentacula uniseriata nec retractilia.

Siphonactinia Boeckii, the only species, occurs on the coast of Norway at a depth of 80–200 fathoms. It is a small species, with the body about an inch in length; and the tentacles, which are twelve in number and arranged in a single row, measure about $\frac{2}{5}$ths of an inch.—*Fauna Litt. Norvegiæ*, livr. ii. p. 87.

On the Occurrence of Urocerus gigas *in Cornwall.*

To the Editors of the Annals of Natural History.

Gentlemen,—Observing in the Number of the Edinburgh Philosophical Journal for last month (p. 172) a notice of the appearance of *Urocerus gigas* at Banchory in Scotland, I am induced to call your attention to a similar fact having taken place in my neighbourhood, at Coldrennick, near Liskeard, Cornwall, the seat of Charles Trelawney, Esq. Some ladies, last week, sitting in an arbour, were attracted by a singular tapping in one of the posts of fir (which had been cut from a neighbouring plantation in the previous year); after a time, a black, moveable head made its appearance on the surface, which was speedily followed by the body of an insect, which they caught, and which turned out to be the *Urocerus*. Subsequently, for several days, fresh specimens were noticed of individuals of the same species, though varying in size. Although most writers speak of these pests being rare in this country, yet it is to be feared, from these two localities above mentioned being infested with them, that they have probably become indigenous, and will require the attention of naturalists to devise some method of destroying them, short of the German practice of cutting down the plantations.

I enclose one of the insects, a male, which corresponds with the plate and description given in Donovan's 'British Insects,' except that the abdomen is entirely black, and the last seven segments of the back of a yellow colour.

Your obedient Servant,

Plymouth, Aug. 10, 1857. Edward Moore, M.D., F.L.S., Vice-President Plymouth Institution.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 118. OCTOBER 1857.

XXIII.—*The Process of Fecundation in the Vegetable Kingdom, and its relation to that in the Animal Kingdom.* By Dr. L. Radlkofer*.

Sect. I. *The Regular Propagation of Plants, and the Organs devoted to it.*

After the existence of different organs, whose *cooperation* for the production of the rudiment of a new vegetable individual appeared to be a *necessary* condition, had been demonstrated in one series of the plants long regarded as Asexual—the Cryptogamia of Linnæus,—it was natural that the question should press itself upon the minds of naturalists, whether or not a *sexual* process of propagation was not connected with the *maintenance of the species,* in *all* departments of the Vegetable Kingdom, either occurring by itself, or in company with other contrivances for attaining a similar end,—I mean the multiplication of plants by division and gemmation, through the individualization of cells or groups of cells.

Many who had entertained the question had also arrived at the conviction that it must be answered in the *affirmative;* and they were not behindhand even in finding out the required sexual organs in the said plants. But their efforts served for the most part only to verify the words with which Montagne commences the account of his observations on the multiplication of the Characeæ: "The sciences of observation, and natural history in particular, present in their study this remarkable circumstance, that we scarcely ever arrive, at the first onset, at the aim which we propose to attain†." Now, however, reliable ob-

* Leipsic, 1857, 8vo. Translated by Arthur Henfrey, F.R.S. &c.

† Ann. des Sc. nat. 3 sér. xviii. p. 65.

servations have in many cases confirmed the earlier conjectures; not in all groups of plants, however, have they demonstrated the existence of sexes. This applies to the Fungi and Lichens in particular. We shall endeavour in the following pages to expound the results of these observations in systematic order, making reference at the same time to the opinions of the older writers.

1. Fungi.

Micheli had already discovered those organs, terming them sometimes 'filamenta' and sometimes 'stemones,' which Gleditsch, Bulliard, and some later observers regarded as homologous with the stamens of the higher plants. Micheli* himself had ascribed to them the office of keeping apart the 'lamellæ' of the Agarici, so as to prevent the seeds decaying between them.

These organs, which have been observed in various Hymenomycetes, are cylindrical tubular cells, standing on the hymenium itself between the basidia and the paraphyses, and containing colourless granular fluid. The granules display molecular motion.

According to Montagne†, their contents are ultimately discharged, and appear at the points of the cells in little round drops. He ascribes to the stickiness of this liquid the adhesion of the spores detached from basidia, to their cells, without decidedly adopting the opinion of Corda, that the spores are thereby fecundated. Corda‡ regarded these 'granule-bearing utricles,' from the analogy of their structure and contents, as organs representing anthers, 'antheridia.' In the third volume of his 'Icones Fungorum§,' he altered his opinion, and thought it better to compare these organs rather with the simple pollen-cell than with the elaborately constructed anthers; hence he gave them the name of 'pollinaria.' He assures us that their appearance is anterior to the development of the basidia, that the spores are not formed until the period when the pollinaria begin to discharge their contents, and that the latter disappear soon after,

* P. A. Michelius, Nova Plant. Genera juxta Tournefortii methodum disposita. Florent. 1729, pp. 126, 133. tab. 68. L, 73. I. K. L, 76. A. B. See also Hedwig, Theoria Generat. et Fructificat. Plantar. Cryptogam. Linnæi. Petropol. 1784, p. 130.

† C. Montagne, Organography and Physiology of the Class Fungi. Transl. by the Rev. M. J. Berkeley, Ann. Nat. Hist. vol. ix.

‡ A. J. Corda, Ueber Micheli's Antheren der Fleischpilze. Flora, 1834, i. p. 113; Icones Fungor. tom. ii. p. 35. tab. 15. fig. 124. 4. *g*. (Prague, 1838.)

§ Ic. Fung. t. iii. p. 44 *et seq.* (Prague, 1839.)

at the time when the spores are ripe. Klotzsch* calls them anthers, and believes that he has observed that the spores which come in contact with these utricles are more certain to germinate. The majority of recent inquirers regard these structures as forms representing stages of development of the basidia†. Berkeley‡ calls them 'utricles.' Leveillé§ gives them the name of 'cystidia.' We shall immediately examine his view of their import.

In his "Disposition méthodique des espèces du genre *Erysiphe*‖," the last-named *savan* expresses the opinion that the *cystidia* of other Fungi are represented by the cells which rise from the mycelium in longitudinal rows, as jointed filaments (*spores articulées*, Lev.; *filaments sporifères* (*Oidium*), Bornet) supported on branches of the mycelium (*pedicellis*), and which, from separating readily, like the cells of *Oidium*, fall on the mycelium, and give this a pulverulent aspect. He conjectures that these cells are destined to fecundate the subsequently developed *conceptacula* (*peridia*)¶. Although far from regarding the granules of the contents of these cells, which likewise exhibit molecular motion, as spermatozoids, yet he sees, in the relative time and order of development of these and the conceptacles, and the circumstance that enduring rain, which washes these cells from the mycelium, or continued heat, which dries them up, produces barrenness of these Fungi,—sufficient ground to support his conjecture. The words with which he concludes his exposition appear to me so characteristic of the present state of the question, and the mode in which it is usually treated, that I cannot refrain from quoting them here** :—

"The Fungi have been considered as asexual plants, and there is really no proof that they have sexual organs. But it is not long since the Algæ were also regarded as asexual plants. The beautiful researches of MM. Decaisne and Thuret have taught us that these plants are not only furnished with male and female

* Dietrich's Flora der Konigreich. Preussen, Band vi. (Vide Schleiden, Grundzüge der wiss. Botanik, 3rd edit. ii. p. 40.) (Principles of Botany (London), p. 156.)

† *Vide* Tulasne, Ann. des Sc. nat. 3 sér. xx. p. 173, note 2 (1853).

‡ Berkeley, on the Fructification of the Pileate and Clavate Tribes of Hymenomycetous Fungi. Annals of Nat. Hist. i. p. 81 *et seq.*

§ Leveillé, Recherches sur l'Hymenium des Champignons. Ann. des Sc. nat. 2 sér. viii. pp. 325, 326 *et seq.* (1837).

‖ Ann. des Sc. nat. 3 sér. xv. p. 109 (1851).

¶ Lindley, Berkeley, Fresenius, Amici and Tulasne have seen these cells germinate, and regard them as brood-cells. Tulasne, Quædam de *Erysiphis* animadversiones. Bot. Zeit. 1853, p. 259–60. [Also Nouv. Obs. sur l'*Erysiphe*. Ann. des Sc. nat. 4 sér. vi. p. 299 (1856).—A. H.]

** *Loc. cit.* p. 119.

organs, like the Characeæ, Mosses, and Hepaticæ, but that they are also monœcious and diœcious. How is it, then, that we find nothing of the same kind in the Fungi? Perhaps, as was long the case with the Ferns and Equisetaceæ, the organs are sought where they do not lie. The cystidia of the Basidiosporous Fungi, the paraphyses of the Thecasporous Fungi and of the Lichens, and the free utricles of the mycelium of the *Erysiphes,* seem to me to represent organs of fecundation. Although their presence is not constant, we cannot refuse them a destination. No one has hitherto thought of attributing to them any part in the nutrition, respiration, or circulation; and it does not require any great effort of imagination to suppose that they serve for reproduction: what is difficult, is to prove this. But ought we to conclude from the fact, that these organs do not exist in all Fungi, that they do not fulfil any function, and that they are useless in those cases where they are observed? No; we must wait until experience has spoken. In the research of truth, we have first to prove that existing theories are false, and then to show by direct experiment the reality and the advantages of that which is proposed: this, however, is impossible for me at present. With the aid of the simplest preparation, I doubt not, the existence of fecundating organs will be established; but it must not be forgotten that the principle vivifying the germs is not always accompanied by spermatozoids, as is shown us by the Phanerogamia. Why should not this be the case also in other plants? In seeking and recognizing as the incontestable character of the existence of male organs, these moving corpuscles, do we not seek that which cannot be found? This great exception of the Phanerogamia is well worthy to fix the attention of investigators of nature."

To render the historical summary complete, we have still to mention that which, in Hedwig's eyes, above all spoke decisively against their supposed nature, namely that the 'stamina' of Micheli remain equally fresh during the maturation of the spores, which in his opinion must always be subsequent to the fecundation. From observations on species of *Agaricus, Hydnum* and *Boletus,* resting upon the epoch of their development, and its non-coincidence with that of the formation of the spores, he considered "the very numerous, oval, light brownish globules lying on the filaments on the inner surface of the volva, annulus, and the surface of the stipe itself," as the male fecundating apparatus. *Agaricus* and *Boletus* are, in his view, monœcious plants with distinct sexes*. Similar conditions as regards the

* J. Hedwig, Theoria Generat. et Fruct. Plantar. Cryptogam. Linnæi. Petrop. 1784, pp. 132, 134 *et seq.*

order of their appearance led Meyen* to the opinion "that the *Æcidiolum exanthematum,* Ung., is the male or fecundating structure of the *Æcidium*-pustule containing true spore-like vesicles, by which it is succeeded." At the same time, Meyen was "by no means of opinion that an actual or true fecundation took place here." The same contradiction occurs in his expressions relating to the Fungus-anthers of the older authors (*cystidia,* Lev.), which he held to be "organs which contain a fertilizing substance," and a few lines further on, "abnormally altered sporophores†" (basidia).

The investigations of Tulasne, which are in close connexion with the researches of Itzigsohn on the Lichens, presently to be mentioned, are partly supplementary to those above enumerated, and partly of a nature to open out new points of view for the study of the organs of fructification of the Fungi. For the sake of rendering these matters perfectly clear, I postpone the details to the section on the Lichens, and only mention here, that Tulasne found in the Fungi, and in the first instance in the Pyrenomycetes ‡, corpuscles similar to Itzigsohn's spermatozoids of Lichens. He calls them *spermatia,* and the structures in which they are contained, *spermogonia.* The latter are found sometimes on the same thallus with the thecæ filled with spores, sometimes separated from these, and have frequently been regarded as distinct and independent Fungi (species of *Sphæria, Cytispora, Microspora, Polystigma, Ascochyta,* &c.). And he considers several genera of the Coniomycetes, in like manner, to be dependent and imperfect structures, and thinks that they represent, as for example *Æcidiolum exanthematum,* Ung., spermogonia of Uredineæ or Sphærieæ, &c.§

Besides these spermatia and the spores contained in the thecæ, the same inquirer found, in some cases in the same Fungi, other spore-like bodies, which, like the spores of the Hymenomycetes, were developed upon sterigma-like processes, each upon a basidium-like cell, and these he therefore calls *stylospores.* Concerning the order in which these various stages of development of the Fungi, bearing spermatia, stylospores, or proper spores, make their appearance, he observes, that the spermatia, which may be contemporaneous with the stylospores, always appear

* F. J. F. Meyen, Pflanzenpathologie, herausgeg. v. Nees v. Esenbeck. Berlin, 1841, p. 143.

† Wiegmann's Archiv, 5 Jahrg. Bd. ii. Berlin, 1839, p. 50.

‡ L. R. Tulasne, Note sur l'Appareil reproducteur dans les Lichens et les Champignons. Ann. des Sc. nat. 3 sér. xv. p. 370. [Transl. in Ann. Nat. Hist. viii. p. 114.]

§ See on this point Tulasne, Seconde Mémoire sur les Uredinées et les Ustilaginées. Ann. des Sc. nat. 4 sér. ii. p. 113 *et seq.* (1854).

before the perfect form, sometimes even several months earlier, "like the antheridia of the Ferns or Equisetaceæ before the formation of the spore-bearing capsules of these plants."

The occurrence of spermatia is not limited to the sections of the Fungi above mentioned. In the Discomycetes, also, Tulasne found them (as in *Cenangium, Tympanis, Dermatea, Peziza, Stictis, Tryblidium, Rhytisma, Hysterium, Heterosphæria, Bulgaria*), and in part upon the same organs which bore the sporiferous asci, preceding the formation of these (*Cenangium Frangulæ*, Tul.), or about simultaneous with them (*Peziza benesuada*, Tul.), "perhaps representing hermaphrodite receptacles*."

The like are met with in the Hymenomycetes (Tremellini) †. They have here two kinds of origin. In some (*Tremella mesenterica*, Retz.) they originate side by side with the basidia, at the ends of the hymenial filaments imbedded in the gelatinous mass; in others (*Dacrymyces deliquescens*, Dub., &c.) they are developed from the multilocular spores, each cell (each chamber) producing a pedicel, the end of which swells up into a globe, which subsequently separates as a spermatium. Another portion of the same spores exhibits the ordinary kind of germination—if, for the sake of convenience, this expression may be permitted,—such as is known of the spores of Fungi from the researches of Oschatz ‡, Corda §, Tulasne ||, Bornet ¶, Cohn **, De Bary ††, &c.: the cells of the spores extend out at one or more points into filiform prolongations, the threads of the mycelium. These spores exhibiting such diverse development, although they appear exactly alike to our eyes, are compared by Tulasne to the two kinds of spores in the Lycopodiaceæ and Rhizocarpeæ; and he regards it as fitting to apply to them the terms 'androspore' and 'gynospore,' which Bayrhoffer, without equal ground, had introduced for the Lichens. The latter kind of formation of spermatia

* Tulasne, Recherches sur l'Appareil reproducteur des Champignons. Ann. des Sc. nat. 3 sér. xx. p. 129, 1853; De Organis apud Discomycetes propagationi inservientibus. Bot. Zeitung, 1852, p. 49; Nouvelles Recherches sur l'Appareil, &c. Comptes Rendus, Nov. 13, 1852, p. 841. (See also the articles under the heads of the genera cited here, in the 'Micrographic Dictionary.')

† Tulasne, Observ. sur l'Organisation des Tremellinées. Ann. des Sc. nat. 3 sér. xix. p. 193 (1853).

‡ Oschatz, De Phalli impudici Germinatione. Nova Acta A. C. L. C. xix. ii. p. 663.

§ Icones Fungorum.

|| Ann. des Sc. nat. 3 sér. xv. p. 271, &c. *loc. cit.*

¶ Etudes sur l'Organisation des *Meliola*. Ann. des Sc. nat. 3 sér. xvi. p. 264.

** Entwicklungsgeschichte der *Pilobolus crystallinus*. Nova Acta A. C. L. C. xxiii. i. p. 505.

†† Botan. Zeitung, 1854, p. 425.

occurs also in *Peziza bolaris*, Batsch*, *Peziza vesiculosa*, Bull., and *Peziza tuberosa*, Bull.†, modified in the last two by the occurrence, in the place of the simple pedicel between the spermatia and the (andro-) spores, of a complicated structure forming in itself a kind of mycelium—*promycelium*, Tulasne; in *Bulgaria iniquans*, Fries, this occurs together with the former. "It corresponds in every respect to the formation of spermatia in the majority of the Lichens, where they originate singly upon a cell which nourishes them‡."

Of the subsequent history of the spermatia formed in this way, which Tulasne calls *sporogenous*, nothing further is known; on the other hand, a kind of germination has been observed in some of them which are produced, not from the spores, but from the spermogonia, and which Tulasne, in reference to their later evolution, calls *opsigenous*. When left for a long time in water, they develope filiform prolongations, like spores. So also with the spermatia which precede the formation of the ergot, which, with the tissue producing them, were described by authors as a *Sphacelia*§, and those of *Sphæria Laburni*, which hitherto had been regarded as the spores of a *Cytispora* in the vicinity of the perithecia of the former.

In face of these observations, and of the experience that physiologically diverse organs frequently have similar characters, Tulasne naturally did not venture to declare these two kinds of spermatia identical; nor, in the absence of direct observation on their relation to the fructification of the Fungi—not to speak of the opsigenous, which may merely represent a second form of the stylospores,—even to compare the sporogenous spermatia

* Now and then, though rarely, spores are met with which produce at the same time spermatia and one or more mycelial filaments. (Ann. des Sc. nat. 3 sér. xx. p. 174.)

† Of the spermatia of this species, Tulasne observes, "Neither is it uncommon to perceive, in the interior, an incomplete excentric circle, a sort of spiral line, the inner extremity of which would correspond pretty nearly to their centre; but I have never remarked that they were endowed with any movement." (*L. c.* p. 176.)

‡ In the same memoir Tulasne shows, that the pairs of cells (*sporidia bilocularia*) hitherto regarded as spores, in the genus *Podisoma*, are only the basidia, which produce much branched and multicellular sterigmata, and only upon these the proper, subsequently germinating spores; as Gasparrini had already observed. The granules of *Æcidium* and *Uredo*, and the fruits of *Puccinia* and *Phragmidium* behave like these sporidia of *Podisoma* as regards their growth in germination. See Bot. Zeitung, 1853, p. 611; Ann. des Sc. nat. 4 sér. ii. p. 123 (1854).

§ Tulasne, Mémoire sur l'Ergot des Glumacées. Ann. des Sc. nat. 3 sér. xx. p. 5. The ergot itself is shown, by Tulasne's beautiful investigations, to be the sclerotoid mycelium of a Sphæriacea (*Claviceps purpureus*, Tul.), the development of which takes place after the ergot has lain several months in moist earth. (See 'Claviceps,' Micrographic Dictionary.)

definitely with the spermatozoids of the rest of the Cryptogamia.

In like manner, future observations must decide whether these sporogenous spores resemble the proper spores of the Uredineæ in any other respect than that merely relating to their origin*. De Bary† and Caspary‡ have furnished researches, partly confirming Tulasne's, partly adding to them.

In conclusion, one more kind of spore-formation remains to be mentioned, which has its analogy and a wider field of occurrence in the Algæ (Zygnemeæ, Desmidiaceæ, &c.), the so-called *conjugation* in *Sizygites*§. We shall return to this case hereafter, in examining the import of the process of conjugation generally.

2. Lichens.

In the Lichens, Micheli‖ regarded the spores and thecæ as the (female) flowers, the sterile thallus as the male plant, the soredia as the seeds. Dillenius¶ and Linnæus** regarded the apothecia as the male, and the soredia as the female organs of fructification. Hedwig†† gave these parts, according to his observation that the latter preceded the former, exactly the reverse interpretation. He took for their male organs not merely the soredia, but also those structures already known by him and Dillenius, and figured in *Borrera ciliaris*,—distinguished by the former only so far as their external appearance allowed,—the brown or black dotted elevations‡‡, which recently, since Itzigsohn declared them to be antheridia, have so strongly excited the interest of botanists.

Schacht§§, in stating that "Itzigsohn's antheridia were first seen and figured by Alex. v. Humboldt‖‖—(he found them on

* *Vide* note ‡ (p. 247).

† Untersuchung. über Brandpilz. Berlin, 1853.

‡ 'Flora,' 1855, p. 483.

§ *Vide* Ehrenberg, Verhandl. Gesell. Naturf. Freunde. Berlin, B. 1. Stuck. ii. p. 98, 1820; Corda, A. C. J., Prachtflora europaisch. Schimmelbild. Leipz. u. Dresd. 1839, p. 49.

‖ Micheli, Nova Genera Plant. Florent. 1729, pp. 73, 74.

¶ Dillenius, Historia Muscorum. Oxon. 1741.

** Linnæus, Genera Plantarum, ed. 6. Holmiæ, 1764, p. 566.

†† Hedwig, Theoria Generat. et Fructificat. Plant. Cryptog. Linnæi. Petrop. 1784, p. 120 *et seq.*

‡‡ "Puncta quædam aliquid diversum ab ipsa fronde notantia;—verrucas nigro punctulo—brevi in vertice macula fusca, dein nigricante—notatus; hanc verrucam si verticaliter utrinque secaverimus....apparet distinctus sub vertice loculus......granulosa massa refertus," &c. *l. c.* pp. 121–123.

§§ H. Schacht, Die Pflanzenzelle. Berlin, 1852, p. 120.

‖‖ Alex. ab Humboldt, Flora Friburg. specimen, Plant. Cryptogamas præsert. subterraneas exhibens. Berol. 1793.

Lichen parietinus;—Humboldt explained them as rudiments of apothecia"),—appears to me to err in an explanation of a figure on Plate 2 of the 'Flora Friburgensis' of Humboldt, representing a *varietas prolifera* of *Lichen parietinus*, which the author describes as follows, at page 15: "Peltæ, margine revoluto, cui 6–8 peltæ juniores citrini coloris elegantissime impositæ sunt. Nescio an hæc varietas ullo Botanico jam prius observata fuerit?" On the other hand, Humboldt had of course seen the black spotted elevations on the surface of the thallus of *Borrera ciliaris*, described by Hedwig, but wholly refrained from expressing an opinion of their import; for at the end of the description of *Lichen ciliaris**, he mentions them merely with the words: "Quid verrucæ atræ quibus sæpissime pagina superior frondis vel laciniarum notata apparet?"

Meyer† regarded the organs in question as abortive apothecia, and considered their black colour, in Lichens which normally present no black apothecia, as a peculiar diseased character.

By other Lichenologists they were characterized, sometimes as peculiar species of Lichens (*Pyrenothea*, Fr.‡, *Thrombium*, Wallr.), sometimes as parasites (*Endocarpon athallon*, Spr.; *Sphæria epiblastemica*, Wallr.; *Sphæria lichenicola*, Smf.; *Sphæria Lichenum*, Rebent.); sometimes, when the papillæ were rather larger, as in *Lichen ciliaris*, &c., as 'vesicular-fruit' (*Physcocymatia*, Wallr.), or as a kind of accessory apothecia filled with gongyli (*Cephalodia*, Ach.), or as anamorphoses of apothecia (*status angiocarpi Lichenum gymnocarporum*, Fries§). Holle‖, when he describes among the rudimentary apothecia of *Borrera ciliaris* some of dark brown or blackish colour, the internal tissue of which is partly decayed, and appears like a fluid, in which often swim whole legions of small Fungoid structures,—appears to me also to have confounded the organs of which we are speaking with the young apothecia. Speerschneider describes them in *Borrera ciliaris* and *Parmelia Acetabulum*, as *soredia*¶; in another place as abortive and lignified apothecia**.

H. Itzigsohn†† next made the observation, that the corpuscles

* *Loc. cit.* p. 21.

† G. F. W. Meyer, Die Entwickl., Metamorph. und Fortpflanz. der Flechten. Göttingen, 1825, p. 162 *et seq.*

‡ V. Flotow, indeed, regarded part of the species of this genus as not independent, and called the individuals furnished with them *variet. pyrenodes.*

§ *Vide* Flotow, in a letter to Itzigsohn, Bot. Zeitung, 1850, p. 914, and Tulasne, Ann. des Sc. nat. 3 sér. xvii. p. 153.

‖ G. v. Holle, Zur Entwickl. von *Borrera ciliaris*. Göttingen, 1849, pp. 6 and 7.

¶ Botan. Zeitung, 1853, p. 730; 1854, p. 491 and p. 506. pl. 12. fig. 6.

** *Ibid.* 1854, p. 614. pl. 14. figs. 11 & 12.

†† *Ibid.* 1850, pp. 393, 916 *et seq.*

contained in these organs—described by him as exactly like the spermatozoids of *Polytrichum* and *Marchantia*,—when brought to light by pressure, began after some time to move tumultuously. He therefore held these corpuscles to be the *spermatozoa of the Lichens*, and their conceptacles *antheridia*. He describes the latter in *Cladonia alcicornis* as small (scarcely as large as a millet-seed), mostly stalked nodules at the tips of some of the lobes of the thallus, quite distinguishable by the naked eye, but not occurring in all individuals, on account of the probably diœcious inflorescence;—as larger in *Borrera ciliaris*, in which they are distinguished by their brownish colour from the young apothecia, which are green. The spermatozoa he describes further as little cylinders, whose length exceeds their diameter 10–20 times. They are stated to be developed in lenticular cells which are contained in the gonimic layer, and out of which he had seen them escape. Their movement was essentially different from mere molecular motion (no motive organs, however, are described, at all corresponding to the cilia of the Moss-spermatozoids): the motion was seen most clearly in those spermatozoa which collected at the top of the water as a shining, hard pellicle after several days' maceration of the Lichens, going on to the commencement of putrefaction (*Borrera, Peltidea, Lecanora, Parmelia, Cladonia*).

Kützing* and K. Müller† confirmed the existence of the cylindrical corpuscles, but saw no movement of them. Von Flotow‡ saw it (in *Verrucaria*), but regarded it as molecular motion, and the antheridia as abortive fruits. Rabenhorst, after many unsuccessful attempts§ with macerated Lichens, likewise perceived it, and was of opinion that it was of decided animal, *i. e.* spermatozoic nature‖. Schacht¶, after minute examination, can only recognize in the antheridia "stunted (verkummerte) rudiments of the apothecia," and the spermatozoa of Itzigsohn he regards as "the cells of the articulated paraphyses separated by absorption;" in a subsequent publication**, as "foreign bodies come in through decomposition, probably Vibriones." Hofmeister†† likewise only saw a molecular motion of the said corpuscles: the corpuscles with slow, snake-like motion, which

* Botan. Zeitung, 1850, p. 913.

† In the addition to his translation of Montagne's essay, "Morphologische Grundrisse der Flechten," Halle, 1851, p. 30.

‡ Botan. Zeitung, 1850, p. 916.

§ *Ibid.* 1850, p. 913. ‖ *Ibid.* 1851, p. 153.

¶ Pflanzenzelle, Berlin, 1852, p. 120.

** Schacht, Das Mikroskop. &c., 2nd edit. Berlin, 1855, p. 83.

†† W. Hofmeister, Vergleich. Untersuch. der Keimung, &c., höherer Kryptog. Leipzig, 1851, p. 139, note.

appeared after long maceration of *Borrera* (even of such pieces as bore none of the so-called antheridia), he regarded as Infusoria.

Tulasne* gave a new aspect to Itzigsohn's observations when he demonstrated the existence of his antheridia, not only in the great majority of all Lichens, but also in the Fungi (as above indicated, p. 245), and thus secured new points from whence their nature could be critically examined.

Their regular occurrence on almost all genera of Lichens, the peculiarity of their aspect and structure, would not permit him to regard them as *accidental organs*, as abortive apothecia, parasites, or Lichens *sui generis*, as had been done by previous authors,—but warranted him in the conviction that they were a *special reproductive apparatus, probably occurring in all Lichens*, which, in reference to physiological functions, doubtless stand in close connexion with the other fructifying apparatus, represented by the apothecia. He was prevented from distinctly acknowledging Itzigsohn's spermatozoa, as such, by the want of direct observations on their function. He therefore prefers for the present to attach to them the name '*spermatia*,' which, however, is only intended to express that they are bodies destined to play some part in the reproduction. He calls the organs in which they are contained '*spermogonia*.' The structure of these is the same as in many Fungi (Pyrenomycetes and Discomycetes)—closed receptacles more or less resembling the perithecia of the Pyrenomycetes, usually imbedded in the thallus and projecting only a little from its surface, rarely free above, like the apothecia (*Cladonia*, *Cetraria*, *Gyalecta*), of globular or oblong form, with a simple or multilocular cavity, which is clothed by a kind of hymenium; this consists of basidium-like cells or rows of cells (*sterigmata*) resembling Conferva-filaments, at the points and joints of which originate the spermatia, as linear corpuscles, apparently in the same way as the ramification takes place in *Conferva glomerata* †, and by no means in special cells ‡. He compares these spermatia with the motionless spermatozoids of the Florideæ, and—on the ground of the unexceptional differences between the form and dimensions of the spermatia on the one

* Tulasne, Note sur l'Appareil reprod. dans les Lichens et les Champignons. Ann. des Sc. nat. 3 sér. xv. p. 370 (translated in Ann. Nat. Hist. 2nd ser. viii. p. 114); Mémoire sur l'Histoire organographique et physiologique des Lichens. Ann. des Sc. nat. 3 sér. xvii. pp. 5 & 153 (1852).

† *Vide* the figures in V. Mohl's 'Vegetable Cell,' plate 1. fig. 1.

‡ Tulasne himself (Ann. des Sc. nat. 3 sér. xvii. p. 216) entertains some mistrust of his own earlier observation, that in *Verrucaria atomaria*, spermatia and fertile sporanges are developed in the same conceptacles (apothecia),—a condition which has an analogy among the Fungi in *Peziza benesuada*, Tul., *Cenangium Frangulæ*, Tul., and the Tremellini.

hand, and of the true spores and gonidia on the other, but, above all, from the consideration of the peculiar mode of development in each of these organs,—he declares distinctly against the opinion which would estimate the spermatia only as spores or gonidia*.

The view of Leveillé†, who regarded the paraphyses of the Lichens as their fecundating organs, and Bayrhoffer's‡, who ascribed a different sexual nature to the separate layers of the thallus, need merely be mentioned for the sake of completing the historical summary.

3. Algæ.

But a few years since, exact science knew nothing of a process of fecundation in the Algæ. The conjugation of *Spirogyra*, known as long ago as by Vaucher§, had indeed been taken to be such; but the asserted observation, that the formation of the spore occasionally occurred without any union of the conjugating cells really having taken place, had brought the whole matter into question again in the most recent time. Vaucher had perceived the so-called horns, and even conjectured that they had the import of anthers‖; but from the suspicion to the experimental proof, with which alone science can be satisfied, the road is often very long, and not to be traversed without numerous fruitless diversions.

* Tulasne's observations extend at the same time to the (so-called) germination of the spores of Lichens, and confirm and complete in this respect the statement of Meyer (*loc. cit.* p. 175), Fries (Lichenogr. Europ. reformat. Lund, 1831, pp. lv, lvi), Buhse (Ueber d. Fruchtkörper der Flechten, Bull. Naturforsch. Gesell. Moskau, Bd. 49, p. 32, 1846), Meissner (Bot. Zeitung, 1848, p. 90), Holle (*l. c.* p. 31), and Speerschneider (Bot. Zeit. 1853, p. 721, 1854, pl. 14. figs. 10 & 11). The internal cell of the spore breaks through the cuticle—in the compound spores usually at the points of the end-cells, and elongates into ramified filaments. Subsequently septa appear in these, from their point of origin onwards, by which they are converted into moniliform rows of cells. By interweaving together, these filaments form a tolerably closely-meshed plexus—*protothallus* of authors, *prothallus* of Tulasne,—on which, at several points, is formed a layer of colourless, round cells—to judge from fig. 3. pl. 3 of Tulasne's memoir, by detachment of cells produced as buds (*abschnürung*)—as is assumed of the gonidial cells by Schacht (Pflanzenzelle, p. 135) and Speerschneider (Bot. Zeit. 1853, p. 710, &c.; 1854, p. 214, &c.). Upon these soon appear cells, filled with green substance, perfectly resembling the gonidial cells of the full-grown thallus. The cultivation of the young plant never succeeded beyond this point.

† Ann. des Sc. nat. 3 sér. xv. p. 120 (1851).

‡ J. D. W. Bayrhoffer, Einig. über die Lichenen und deren Befruchtung. Bern, 1851.

§ J. P. Vaucher, Histoire des Conferves d'eau douce. Genève, 1803, p. 43 *et seq.*

‖ *L. c.* p. 14 *et seq.* pl. 2 & 3.

Thus the matter rested for more than fifty years, until knowledge took the place of conjecture. Pringsheim* it was who made the matter clear by the direct observation of the act of fecundation in *Vaucheria sessilis*. While other phycologists believed in a conjugation of the horn with the sporange standing beside† it, and Karsten‡ thought that he discovered a process of fecundation by the emission from the horn of a cell containing formative matter (which he compared with the pollen-cell, as supposed to be efficient on Schleiden's former hypothesis), which united, together with its membrane, with a germ-sac-cell contained in the sporange, and thus became a productive (*entwicklungsfähig*) germ or spore,—Pringsheim saw the terminal cell of the horn open at its point and emit a great number of minute, bacillar corpuscles—spermatozoids, which slipped away in all directions with a rapid motion. Many of them crowded into the orifice already formed in the beak-like apex of the sporange by the pressure of its accumulated protoplasm—*into the micropyle of the sporange*, and appeared partly to penetrate into the protoplasm itself. Immediately upon this, the protoplasm became enveloped by a new cell-membrane, and thus appeared as a complete resting-spore, completely filling the sporange. The formation of the horn—the *antheridium*, as well as that of the sporange, takes place by a papilla-like bulging-out of the wall of the tubular cell of *Vaucheria*, such as happens in the ordinary ramification, and a subsequent separation of its cavity from that of the general filament of the Alga, by a septum. The sporange remains as a simple cell, until the time of the formation of the spore; the curved, tendril-like antheridium is divided by a cross-septum into two superposed cells before it is mature.

In May of last year I had an opportunity of making confirmatory observations on this important discovery of Pringsheim's, which at once throws a bright light over the essential nature of the fecundating process in the vegetable kingdom, and fills up a hiatus in the related observations on the higher Cryptogamia.

Specimens of *Vaucheria sessilis*, collected in a ditch at Jena, exhibited both perfectly ripe fruits and partly decomposed horns, and, besides these, all the earlier stages of development of the sporange and antheridia, back to the earliest nipple-like pro-

* N. Pringsheim, Ueber der Befruchtung, &c., der höheren Algen. Monatsbericht der K. Acad. d. Wiss. Berlin, 1855. (Abridged in Ann. Nat. Hist. 2 ser. xiv. p. 346, &c. Quarterly Journal of Microscop. Science, iv. p. 63.)

† *Vide* Nägeli, Neuerer Algensystem, &c. Zurich, 1847, p. 175. pl. 4. figs. 21 & 22; and A. Braun's doubts as to Nägeli's account in his 'Verjüngung,' &c. (Transl. in Ray Society, vol. 1851, p. 296.)

‡ H. Karsten, Der Fortpflanzung der *Conferva fontinalis*, L. Botan. Zeitung, 1852, p. 89. pl. 2.

jection on the wall of the main tube. It was not difficult to find, after a little search, some which gave signs that the act of fecundation might be immediately expected,—that is, souranges in which the orifice for the entrance of the spermatozoids was already formed at the apex, while the neighbouring horn was still perfect. I isolated several of the filaments so developed, and carefully covered those which appeared ripest with a piece of thin glass, in order to trace their further development under the microscope. The pressure of the cover was even too much for the antheridia which were near bursting. They opened, and I saw the greater part of their mucous contents exude with a sudden jerk. A quantity of short spindle-shaped corpuscles escaped from this, and moved about in the water by means of cilia vibrating like a whip-lash (whether each corpuscle bore one or two—and, indeed, as it appeared to me in several, one at each end of the body—I could not make out with certainty). I saw but few, as compared with the total number, penetrate into the open beak of the sporange, and there perform the movement of crowding against the mass of protoplasm as described by Pringsheim. Whether any of them actually penetrated into this, I could not certainly ascertain. Pringsheim, indeed, has not directly observed the penetration of the spermatozoids into the mass of protoplasm; he rather concludes it, from the subsequent detection of a colourless corpuscle inside the new cell-membrane.

In the germination of the resting-spore of *Vaucheria*, the inmost layer of its membrane is directly developed into the thallus-filament*.

Pringsheim has demonstrated the existence of at least the *micropyles of the sporanges*, in which the resting-spores originate, in a number of other freshwater Algæ,—for example, in *Achlya prolifera*, where they exist in numbers probably equal to that of the spores formed in each sporange †; in *Œdogonium* and *Bulbochæte*. And his observations render it probable that the *microgonidia* first described by Alex. Braun ‡, and shown to exist in various families of freshwater Algæ, which in *Bulbochæte* and *Œdogonium* attach themselves upon the sporangium or in its immediate neighbourhood §, and discharge their contents either immediately or after forming a few cells—are to be regarded as *antheridia*.

* Pringsheim, *l. c.* p. 12.

† Thuret represented them in the masterly drawings accompanying his "Memoir on the Zoospores of Algæ," but he regarded them as little lids. Ann. des Sc. nat. 3 sér. xiv. p. 231. pl. 20. fig. 11 (1850).

‡ Alex. Braun, 'Verjüngung' (Ray Soc. vol. 1851, p. 137).

§ As observed also by De Bary, and figured in his essay "On *Œdogonium* and *Bulbochæte*," Abhandl. der Senkenberg. Naturf. Gesellsch. i. pl. 3 & 4. (Frankfort-on-Maine, 1854.)

(*Supplementary note.*—Just before the printing of this essay, we received, through the kindness of the author, Pringsheim's second memoir on the fecundation and alternation of generations in the Algæ*. This contains a full confirmation of the conjecture in the preceding paragraph. Pringsheim saw developed in a portion of the species of *Œdogonium* and in *Bulbochæte*, in the end-cells of a structure (*male plant*) produced from a microgonidium (now called *androspore*, to distinguish it from all other, probably very diverse swarming bodies hitherto confounded together under the name of microgonidia)—in each a spermatozoid furnished with cilia, which, after it had been set free, completed the act of fecundation exactly in the same way as in *Vaucheria*. In a portion of the species of *Œdogonium* the spermatozoids are developed singly in determinate, successive cells of the *Œdogonium*-thread, which consists of only one row of cells. In this case, Pringsheim applies the name of *antheridium* to the whole sum of the cells forming spermatozoids.)

In *Achlya prolifera* the antheridia are perhaps represented by the branchlets, first described by Alex. Braun (also in *Coleochæte pulvinata*†), which apply themselves upon the sporangium, and penetrate into the orifices of this by means of lateral, papillary, projecting processes. In *Bulbochæte*, as also in *Coleochæte* and probably in *Œdogonium*, the subsequent development of the resting-spore is essentially different from that of *Vaucheria*. It does *not directly* produce the thallus of the plant, but *zoospores* (almost like the other zoospores of the same plant), by the germination of which is first produced the structure resembling the parent plant.

A similar condition, formation of *spores of a third kind*, according to Pringsheim, occurs sometimes in the resting-spore of *Achlya prolifera*‡, probably also in *Spirogyra jugalis*§; whether

* Monatsbericht der Berlin. Acad. 1856.

† Alex. Braun, *l. c.* (Ray Transl. 298).

‡ Pringsheim, Entwickl. der *Achlya prolifera*. Nova Acta A.C.L.C. xxiii. pt. 1. p. 427. pl. 47. fig. 17. *Vide* also Nägeli in Zeitschr. f. wiss. Botanik, von Schleiden and Nägeli, 3 & 4 Heft, p. 30, note (1846).

§ Flora, 1852, p. 479. (Ann. Nat. Hist. 2 ser. xi. p. 210 *et seq.*) The active spores here described by Pringsheim in *Spirogyra jugalis*, formed sometimes in conjugated cells, sometimes in unconjugated young filaments, probably occasionally also in the conjugation-body itself—which Nägeli was also acquainted with, and, since they did not appear capable of germination, compared with the 'swarming-cellules' (spermatozoids) of *Fucus* (Botan. Zeit. 1849, p. 578)—are identical with Itzigsohn's '*spermatosphæria*' (mother-cells of spermatozoa) of *Spirogyra arcta*, Kütz.; the cilia of these spores doubtless constitute the little heads or tails of the discharged spiral animalcules which Itzigsohn described. (*Vide* the letter of this author on this subject to Tulasne, Ann. des Sc. nat. 3 sér. xvii. p. 150 (1852), and his figures in 'Hedwigia,' 1852, No. 2. pl. 1, and in Botan. Zeitung,' 1853, the quaternary division of the spores of *Mesocarpus, Staurocarpus,* and *Tyndaridea,* observed by Thwaites*, is referable here, must be shown by further observation. Parallel to this stand the conditions observed in the zoospores. Pringsheim has observed their division in *Achlya*†; and in *Œdogonium vesicatum,* Link, the same observer saw the contents of a germinating zoospore which had come to rest, transformed into a number of small, active spores, which again germinated‡.

Similar sexual conditions are rendered probable in the Palmellaceæ, by the discovery of resting, red spores (together with the zoospores).

Cohn has not only likewise confirmed the observation of Pringsheim on *Vaucheria,* but at the same time brought forward a new example of sexual reproduction in the Algæ, and in a plant widely differing from *Vaucheria,* namely *Sphæroplea annulina*§. The spermatozoids, externally resembling the microgonidia of other Algæ‖, which are developed in separate cells (*antheridia*) and are discharged from these by a previously-formed orifice, here fecundate still membraneless spores, formed by the division of the cell-contents, in other cells (sporangia), to which they make their way through minute orifices. Cohn does not consider that observations justify his assuming a direct penetration of the spermatozoids into the primordial spore-cell; it rather seemed to him as if they attached themselves on the outside of the spore, and were finally converted into mucilaginous globules. The further development of the fecundated spore is essentially the same as in *Bulbochæte.*

We have likewise recently received a satisfactory key to the import of the *conjugation of the Algæ.* Areschoug's¶ observations on this in the Zygnemeæ lead him to the conclusion, that the spores now and then observed in cells which have not con-

p. 201. pl. 5.) Cohn regards the structures in question, not as reproductive bodies, but foreign structures belonging to the domain of fermentation-phænomena (Unters. üb. Mikroskop. Alg. u. Pilze. Nova Acta A. C. L. C. xxiv. pt. 1. p. 160.) [This is decidedly erroneous.—A. H.]

* *Vide* Botan. Zeitung, 1846, p. 498.

† *Flora,* 1852, p. 484, note.

‡ *Ibid.* 1852, p. 482.

§ Ferd. Cohn, Ueb. Entwickl. u. Fortpflanzung der *Sphæroplea annulina.* Monatsb. Berl. Acad. May 1855. (Transl. in Ann. Nat. Hist. 2 ser. xviii. p. 81.)

‖ Meyen (Pflanzenphys. iii. p. 446) asserts that he often observed in very various Confervæ, about the time when the spores are formed, an innumerable quantity of small, spirally curled, and spirally or undulatingly moving animalcules (*spirilla*), and he represents these in *Sphæroplea annulina,* in plate 10. fig. 17; his drawing, however, agrees so little with Cohn's description of the spermatozoids of these Algæ, that it is difficult to suppose that Meyen really saw the same things.

¶ *Vide* 'Flora,' 1855, p. 675 *et seq.*

jugated, have not really the import of spores, but represent only the condition of cell-contents metamorphosed into a daughter-cell (?) just before conjugation; and the same of those cases in which a spore appeared to be contained in each of the conjugated cells. This author, in the last case, saw one of the supposed spores send out a long, tubular process through the conjugation-canal which pierced into the other pseudo-spore (in light-coloured, longish places lying transversely as regards the long axis of the conjugation-cell); its remaining portion soon passed by degrees through the canal, and penetrated into the interior of the other spore. The real spore was produced out of the pseudo-spores united in this way, and in a few days appeared in the same form as the resting-spores of the other joints. Further, the same observer saw all the stages of a case in which two supposed spores occurred in one conjugation-cell, arising from the tubular prolongation of the travelling pseudo-spore missing the above-mentioned spot in the other, and its penetration being thus frustrated; in this case no formation of a spore followed,—the two pseudo-spores, lying side by side, were dissolved without undergoing any further change.

The direct production of a plant resembling the parent-filament, from the spore produced through conjugation (of *Spirogyræ*), was observed by Vaucher*, and has been recently confirmed by Alex. Braun† and Pringsheim‡.

In the Fucoideæ, J. Ag., the presence of antheridia was first demonstrated by Thuret, and this in the section Fucaceæ. They here consist of ovate cells, seated on the hairs of conceptacles sometimes special and sometimes containing also sporanges, and they are filled with zoospore-like spermatozoids (antherozoids, Thuret). Lyngbye, Montagne, J. Agardh, Kützing, and other inquirers had already observed these, without having arrived at any clear conception of their import: by most, even by Nägeli§, Mettenius‖, and Al. Braun¶, they were taken for true zoospores, although no germination had been observed. Reaumur** had first announced the existence of male organs in *Fucus*, taking for such the filaments in the *cryptostomata* of Kützing.

First in connexion with Decaisne††, and next in his essay on

* Conferves d'eau douce, p. 47. pl. 4, 5 & 6.

† Verjüngung, &c. (Ray Transl. p. 135.)

‡ Pringsheim, Algol. Meth. Flora, 1852, p. 465. (Transl. in Ann. Nat. Hist. 2 ser. xi. p. 210, &c.)

§ Bot. Zeit. 1849, p. 578.

‖ Mettenius, Beiträge z. Botanik. Heidelb. 1850, p. 34.

¶ Verjüngung, &c. p. 152. (Ray Soc. transl. 1851, p. 142.)

** Historia Fucorum. Petrop. 1768.

†† Decaisne et Thuret, Ann. des Sc. nat. 3 sér. iii. p. 5 *et seq.* (1845).

the antheridia of the Cryptogamia*, Thuret assumed the active 2-ciliated corpuscles contained in the above-mentioned cells to be *spermatozoa*, on account of their not germinating; more recently†, he has given proof of the correctness of his hypothesis by experiments on diœcious species of *Fucus*, showing that where these bodies are excluded, the spores remain incapable of germination, *i. e.* unfecundated. According to his account, the spores (sporules of authors) are formed in eights, fours, twos, or only one, in the unicellular sporanges, which have a smaller cell forming a pedicle to attach them to the wall of the conceptacle. These spores emerge from the sporange as primordial cells, as yet unenclosed by a proper membrane, but surrounded by a common envelope (and thus hitherto regarded by authors as single 8- &c. parted spores, octospores, &c.), from which they are immediately set quite free, and come in contact with the spermatozoa. The author could not detect a material penetration of the spermatozoa into the spore-mass. Soon after fecundation‡ the spore becomes clothed by a cell-membrane, and then is developed into the young plant.

Pringsheim§ confirmed Thuret's statements. The only difference is, that Pringsheim thinks the spermatozoids actually penetrate into the membraneless spore-mass, and are immediately enclosed by the new cell-membranes. He was led to this opinion by observing a number of small red-brown nuclei inside the spore-membrane, which were not present before the fecundation, and appeared to him to be the remains of the spermatozoids, which are furnished with a red nucleus.

With regard to the other sections of the Fucoideæ, spermatozoids have been described by Thuret|| in *Cutleria*, by Pringsheim in *Sphacelaria* and *Cladostephus*¶. The structure of the antheridia is different in these plants.

In the Florideæ peculiar organs have likewise been long known, which the first observers, although without sufficient reasons, explained as antheridia. This was the case with C. Agardh. Lyngbye regarded them as an animal structure; J. Agardh as a hypertrophic metamorphosis of the ordinary organs of propagation; Kützing** applied to them the name of 'spermatoidia,' considering them as seed-like accessory struc-

* Ann. des Sc. nat. 3 sér. xvi. p. 5 (1851).

† *Ibid.* 4 sér. ii. p. 197 (1854).

‡ Thuret, Mémoires de la Soc. Imp. de Cherbourg, v. April 1857.

§ Pringsheim, Ueb. d. Befruchtung u. Keimung der Algen. Berlin, 1855, p. 12 *et seq.* (Annals, 2 ser. xiv. *l. c.*)

|| Ann. des Sc. nat. 3 sér. p. 12 (1851).

¶ Ueb. Befrucht. der Algen. Berlin, 1855, pp. 21, 23.

** Phycologia generalis, pp. 107–109 (1843).

tures, the development of which into new individuals had not yet been observed.

They ordinarily occur upon distinct individuals, and occupy upon them the same places as the fruits on the fertile plants. Their essential portion consists of numerous small round cellules, which are sometimes grouped, without any envelope, upon special organs, or definite regions of the frond, but sometimes enclosed by a common cuticle. These cellules were compared by Nägeli* with the spermatic cellules of the antheridia of Mosses, and he believed that he detected in them a spiral filament lying upon the wall. Derbès and Solier† also believe that each cellule contains an antherozoid, with a filiform appendage as an organ of motion.

Thuret‡ demonstrated with certainty the absence of this structure. According to him each antheridial cellule contains a hyaline, spherical or longish corpuscle, with somewhat granular contents (*antherozoid*), which is expelled with a slow movement from the cell, but then comes to perfect rest. Mettenius§ could detect no movement of these corpuscles, which he regarded as cells formed out of the entire contents of the antheridial cells. He applied to them the name of 'seminal cellules' (*Samenzellchen*) but declared himself inclined to regard them as spores which do not possess the power of germination. Pringsheim||, who calls them simply antheridium-cells, compares the statements of Thuret and Mettenius; the absence of movement is insufficient, in the face of the agreement of their structure with that of the spermatozoids of Fucaceæ and of *Sphacelaria*, to permit his asserting them not to be the real spermatozoids of the Florideæ.

At the same time, this author concludes, from his observations on the germination of the tetraspores and capsule-spores of *Ceramium*, that the former, which produce immediately a new plant resembling the parent, only officiate like buds, for asexual propagation; but that the capsule-spores are either themselves the true female sexual organs of the Florideæ (in those namely where the capsule-fruit has a canal penetrating into its interior), or (in those with a closed fruit, as *Ceramium*) that the structure produced from them in germination, unlike in appearance to the parent-frond, represents a kind of prothallium, which in some manner takes on the female sexual function.

* Nägeli, Neuer. Algensystem. Zurich, 1847, p. 190. pl. 6 & 7; also in Zeitschr. f. wiss. Bot. 3 & 4 Heft, p. 224 (Zurich, 1846), and Botan. Zeit. 1849, p. 569.

† Derbès et Solier, Org. reprod. des Algues. Ann. des Sc. nat. 3 sér. xiv. p. 275 *et seq*. (1851).

‡ Rech. sur les Antherid. &c. Ann. des Sc. nat. 3 sér. xvi. p. 14 (1851).

§ Beitr. zur Botanik, pp. 36, 39, 42.

|| Ueb. Befrucht. der Alg. p. 16.

17*

Characeæ.—These plants, hitherto destitute of a fixed home in Systematic Botany, we treat in connexion with their relatives the other Algæ, from which they have never been separated but with reluctance or by violence, and among which they will doubtless for the future occupy their right place, namely the uppermost.

The two kinds of organs of fructification are so conspicuous in these plants, that they were known in the earliest days of observation. The views of the older botanists were in tolerable agreement as to their sexual nature, although direct observations on the act of fecundation itself were and are still wanting. Most recent writers preferred, and justly, to withhold for the time any opinion of the import of the 'globules' (antheridia).

Linnæus, from the resemblance in external structure and the order of development, regarded the red 'globules' of *Chara* as anthers, the spores with their 5-celled envelope (sporange) as the pistil; and ultimately transferred these plants, which he had at first placed among his Cryptogamia*, into the Monœcia Monandria†.

Hedwig‡, in whose works we find figures executed with his usual accuracy, so far as the means of observation then accessible permitted, regarded the red granular contents of the oval cells which serve as the peduncle of the triangular external cells of the globules (and upon which appeared to him to depend the red colour of the external cells), as the fecundating matter,—the granular contents of the spore, exclusive of the starch-granules, as the proper seeds.

Vaucher§, Kaulfuss||, Bischoff¶, C. H. Schultz**, and K. Müller†† each observed the entire development of plants resembling the mother-plant from the spores. In this operation the spore (*nucule*) ordinarily first loses its cellular covering (*sporangium*), the outer coat of the spore opens at the upper end of the spore, and the inner cell expands into the first cell of the young plant.

Fritsche‡‡ furnished an exact description and representation of the globules (antheridia) and the spiral filaments contained in

* Genera Plant. Ed. 6. Holm. 1764, p. 567.

† Systema Naturæ. Ed. 12. Holm. 1767, ii. p. 613.

‡ Theor. Generat. et Fructif. Plant. Crypt. &c. Petrop. 1784, p. 125. pl. 22, 33.

§ Mém. sur les Charaignes. Mémoires de la Soc. de Phys. et d'Hist. nat. de Genève, i. pt. 1. p. 168 (1821).

|| Erfahrung. über das Keimen der Charen. Leipsic, 1825.

¶ G. W. Bischoff, Krypt. Gewächse. Nuremb. 1828, p. 9.

** Natur der lebenden Pflanze, B. ii.

†† K. Müller, Zur Entwickl. der Charen. Botan. Zeit. 1845. (Transl. in Ann. Nat. Hist. xvii. p. 254.)

‡‡ Fritsche, Ueber den Pollen. Petersburg, 1837, p. 6–19. pl. 1 & 2.

the confervoid rows of internal cells (pollen-cells, Fritsche). The Infusorium-like movement of these spiral filaments after their escape from the cells, was first observed by Bischoff*. Meyen† called them spermatozoids; in agreement with his statement, J. C. Varley‡ (1834) had already seen and figured a cilium on them, which Meyen himself copied§. Thuret|| and Amici¶ showed that each spiral thread possessed two cilia. Thuret** believes even that he has detected the opening in the cells through which the spiral filaments escape, ordinarily with the unciliated end first. According to the concurrent testimony of all observers††, the spiral bodies are developed from (in?) the nuclei, which, however, are not so sharply defined, but more irregularly shaped than usual. They are not formed simultaneously in a whole row of cells, but, according to Thuret, first in the cells of the apex, subsequently in those of the base of a filament;—according to Mettenius, in the contrary order.

Although we possess no direct observation on the process of fecundation in the *Charæ*, when we look at the certain explanations which we have lately obtained as to the import of active spiral filaments in the vegetable kingdom, and at the above-described mode of development of the young plants of *Chara* from the spore,—we may with safety suppose that the fecundating process takes place here before the complete development of the spore, and that to produce this the spermatozoids penetrate into the young sporange. In this hypothesis we are strengthened by the circumstance that the cells of the sporange are not completely closed up over the spore-cell in the earliest stage of its growth, but leave between them an open canal; the ripening of the antheridia, their dehiscence, and the emission of the spermatozoids taking place at this epoch; further, that in

* Kryptog. Gewächse, p. 13, note.

† J. F. Meyen, Pflanzenphys. ii. pp. 206, 217.

‡ Improvements on the Vial Microscope. Trans. Soc. of Arts, &c. London, vol. i.

§ Pflanzenphysiol. iii. pl. 12. figs. 22–28, and p. 222.

|| Thuret, Note sur l'Anthère du *Chara*, &c. Ann. des Sc. nat. 2 sér. xiv. (1840).

¶ Flora, 1844, B. ii. p. 516.

** *Loc. supr. cit.* pl. 6. fig. 21.

†† See, in particular, Mettenius, Beiträge zur Entwick. der bewegl. Spiralfas. von *Chara hispida*. Bot. Zeit. 1845, p. 17. pl. 1.

Nägeli, Zeitschr. f. wiss. Botanik, Heft 1. p. 55 (1844); Heft 3 & 4. p. 105 (1846), where he calls the nuclei 'seminal utricles.'

Thuret, Sur les Antheridies des Cryptog. Ann. des Sc. nat. 3 sér. xvi. p. 21 (1851).

Schacht, Pflanzenzelle, p. 113 (Berlin, 1852).

(Alex. Braun, Monatsb. Berlin Acad. Jan. 1853. Ann. Nat. Hist. 2 ser. xii. p. 297.)

those species in which the spores do not ripen until late in the autumn, the germination does not take place until the following spring, and occurs therefore at a time when none of the previous year's spermatozoids remain and no new ones are yet developed.

[To be continued.]

XXIV.—*On* Rissoa pulcherrima. By William Clark, Esq.

To the Editors of the Annals of Natural History.

Norfolk Crescent, Bath, 14th Sept. 1857.

Gentlemen,

My friend Mr. Barlee, to whom all that are interested in malacological pursuits are under the greatest obligations, has just favoured me, from Guernsey, with many lively specimens of the *Rissoa pulcherrima* of recent authors, which has been constituted a species, solely, I believe, from conchological indices. I have therefore thought that some of your readers would be glad to have an account of the external organs of this, if it be so, undescribed animal.

Rissoa pulcherrima, Forbes and Hanley.

Shell spiral, ovately conical, pale yellowish-white, of $3\frac{1}{2}$–$4\frac{1}{2}$ well-rounded volutions divided by a rather deep suture, and marked with 2–4 rows of distinct, palish rufous spots, which in other words are lines running from base to point, that are variously interrupted, so as to form well-separated, subquadrate, minute areas. The aperture is suboval, usually thin at the outer margin, with little or no umbilical fissure. Axis $\frac{1}{15}$–$\frac{1}{20}$, diameter $\frac{1}{35}$–$\frac{1}{45}$ of an inch.

Animal.—Ground-colour white, shot with the minutest snowy flakes and points, and blotched with dark smoke patches and lines, as well as with more or less yellow or sulphur-coloured suffusions on particular parts of the body. Mantle entire; but I did not detect the pendent filament from the aperture, which I have often mentioned as visible in the *Rissoæ*, and which is perhaps the generative organ.

Rostrum moderately long, above longitudinally cloven or bilobed; buccal disk below having the usual vertical fissure, from which the animal frequently protrudes the white corneous jaws and masticatory processes; it is tinged with yellow hues, above and below, of various intensity and extent.

The tentacula are long, slender and flat, rounded at the tips, and horizontally clothed with fine setæ; the eyes are large, very black, and fixed at the external angles on minute yellow mamelons.

Foot long, narrow and rounded in front, with minute auricles, and scarcely labiated; it is a little constricted at the junction with the body; the sole is impressed with a faint, central, longitudinal line, and the posterior termination is sublanceolate. The foot is also furnished with a large operculigerous plate, well alated at the hinder portion, and marked on each side with a dark irregular blotch, which often runs into stripes or fine lines at its margins; indeed, these markings vary, in most individuals, in shape, intensity of colour, and position. The black spot noticed by authors in the *Rissoa inconspicua* is sometimes, though not frequently, seen in this minute creature, and is often due to the phases of position of the lateral, dark, smoke-coloured patches that are often very apparent on the upper part of the alæ of the opercular lobe, which carries a grossly spiral, but finely striated, rissoidean, suboval, corneous operculum; and its caudal extremity is furnished with a very long, pointed, cirrhal filament, even more developed than in *Rissoa parva*.

The animal freely admits of the closest examination, and continues for several days with very little diminution of vivacity.

The object of this account of the animal of the so-called *Rissoa pulcherrima* is to propose its removal from the British list *as a species*, and to enable malacologists to compare these minutes with the recorded descriptions of what I consider its type—the common and very variable *Rissoa inconspicua*.

The agreement of the two appears complete in all essentials; the minor discrepancies arise from the minuteness of the object; but they yield at once to lenses of high power, which discover the elements of features that sufficiently prove the *pulcherrima* to be one of the endless varieties of the *Rissoa inconspicua*.

In support of these views on the soft parts, see Forbes and Hanley, 'Brit. Moll.' vol. iii. pp. 113–117; and myself in 'Brit. Mar. Test. Moll.' p. 358.

With regard to the shells I may state, that I have examples of the *inconspicua* taken by myself at Exmouth, of the same size as the *pulcherrima* found by Mr. Barlee at Guernsey; both having the partial spiral lines on the body-volution, and the peculiar and unmistakeable, often semi-obsolete, close-set, vertical ridges or striæ.

These united considerations are, I think, conclusive of the absolute affinity of the two animals.

I am, Gentlemen,

Your most obedient Servant,

William Clark.

XXV.—*Further Observations on Deep Soundings obtained by H.M.S. "Herald," Capt. Denham, R.N., F.R.S., employed on Surveying Service in the South-western Pacific; with an Account of the Examination of the Alimentary Matter of the* Salpæ *as bearing on the nature of the Materials composing the Sea-bottom.* By John Denis Macdonald, Assistant-Surgeon.

[With a Plate.]

The following observations are intended as an appendix to a former paper, on the microscopic examination of the bottom obtained in two soundings taken in the Feejee group, from the respective depths of 1020 fathoms and 440 fathoms. To these positive soundings we can now add several others of much interest, the most important of which, however, was registered on the 30th May 1856, when, in latitude 30° 25′ S. and longitude 161° 57′ E., and about forty miles E. by S. of the reported position of the Lady Nelson Shoal, a deep cast was taken, bringing up bottom from a depth of 919 fathoms.

Unfortunately, the greater part of the materials had been washed away during the ascent of the lead through the water; and it was only with the help of the microscope that many Foraminifera, siliceous spicula of Sponges, and the fragments of the solid parts of more minute organisms were detected. Enough, however, was retained in contact with the arming of the lead, to prove that the bottom had been reached. Indeed, this microscopic test is often in requisition, for in several instances we have been enabled by its aid to pronounce with certainty, where the most scrupulous examination by unaided vision had failed to decide.

It may be mentioned here, that when the deep sounding in 1020 fathoms, above alluded to, was obtained, a double lead was employed, and the greater part of the matter which had been submitted to microscopic analysis was taken out from between the strands of the lashing, very little being at all visible on the arming. While these facts show how readily one may be deceived in a matter apparently so easily determined, they suggest the adoption of some simple apparatus, by means of which a reasonable quantity of those minute materials might be safely brought up from the bottom, both for inspection and preservation.

As legitimately connected with this subject, the examination of the alimentary matter of the *Salpæ* opens up some new and interesting facts, which prove the wide dispersion of numerous minute organisms, both animal and vegetable, hitherto supposed only to be found in shallow zones skirting the land.

Having ascertained, with a certain degree of precision, the nature of the materials to be found in deep soundings off the coast of Australia, and in the neighbourhood of the South Sea Islands, it is a discovery of peculiar interest to find the same minute organic forms in vast numbers mixed up with the alimentary matter of Salpians and other pelagic animals, obtained in the open ocean far distant from those shores.

The presence of the siliceous spicula and the fenestrated cells of *Thalassicolla* with the embryonic shells of the pelagic Mollusca might be readily accounted for; but how minute bivalves, Foraminifera, and a great variety of Diatomaceæ, and even Desmidieæ, including the genus *Closterium*—and all apparently recent—could have been, as it were, casually inhaled, is not so easily explained. Such are the facts, however; and the means by which those bodies are so widely distributed seem inscrutable to us, unless it be ultimately determined that they are in great part purely pelagic examples of the orders and genera to which they belong. This appears to be the most consistent view of the matter, seeing that the agency of drift-weed, or any other fortuitous cause, would be quite inadequate to produce so vast a result, even so far as mechanical dispersion is concerned, not to complicate the question with the more important part of the problem, namely the preservation of the vitality and integrity of the beings under consideration.

Wherever the deep-sea lead plumbs the bottom, and, by simple inference, in those depths immeasurably below its exploring reach, geometrical atoms exist, far removed from the supposed source of their development. But when we know that identical or allied forms, with their living crust or contents, are being continually swallowed with the daily food of the Salpian and the Pteropod, at the surface of the ocean, we can easily perceive how, at the termination of their short existence, the less perishable parts may ultimately be distributed through the illimitable and unknown districts of the ocean-bed.

The alimentary matter of the *Salpæ* is composed of animal and vegetable elements in nearly equal proportions; and when the microscope reveals the calcareous shells of Foraminifera, the beautifully sculptured frustules of Diatomaceæ, keen siliceous needles, and the sharp armature of minute Crustacea, within an intestinal tube so tender and friable that it withers at the human touch,—one cannot help admiring the operation of those conservative properties with which its delicate tissues are endowed. Each atom yields to acute impressions as by an instinctive intelligence, evading injurious contact; and although a contractility of the tube is essential to the due performance of its functions, no evil thus befalls its integrity till the term of life is at an end.

The accompanying figures (Pl. VII.), which might be increased *ad infinitum,* sufficiently illustrate the character of the little bodies above noticed as occurring in the alimentary matter of *Salpæ.*

The Diatomaceæ appear to embrace many new genera, but some recent.

Gallionellæ (B), *Naviculæ* (C), and forms allied to *Pixidium* (D) will be readily recognized. The latter are composed of two valves. At fig. 1 (D) the separation of these valves is represented; but, from the want of symmetry exhibited by them, it would seem as though each pair originally formed one quarter of a quadrate body, dividing by crucial fission into four distinct portions.

Fig. 2 (D) is a simpler and more symmetrical form, with its soft contents remaining.

In fig. 3 (D), which is rather imperfect, the radiating ribs are beautifully branched and reticulated.

It is rather remarkable that the minute bivalves (fig. E) were generally found with the soft parts little changed, and the univalves (F) empty, as though the animals had been digested out of their shells.

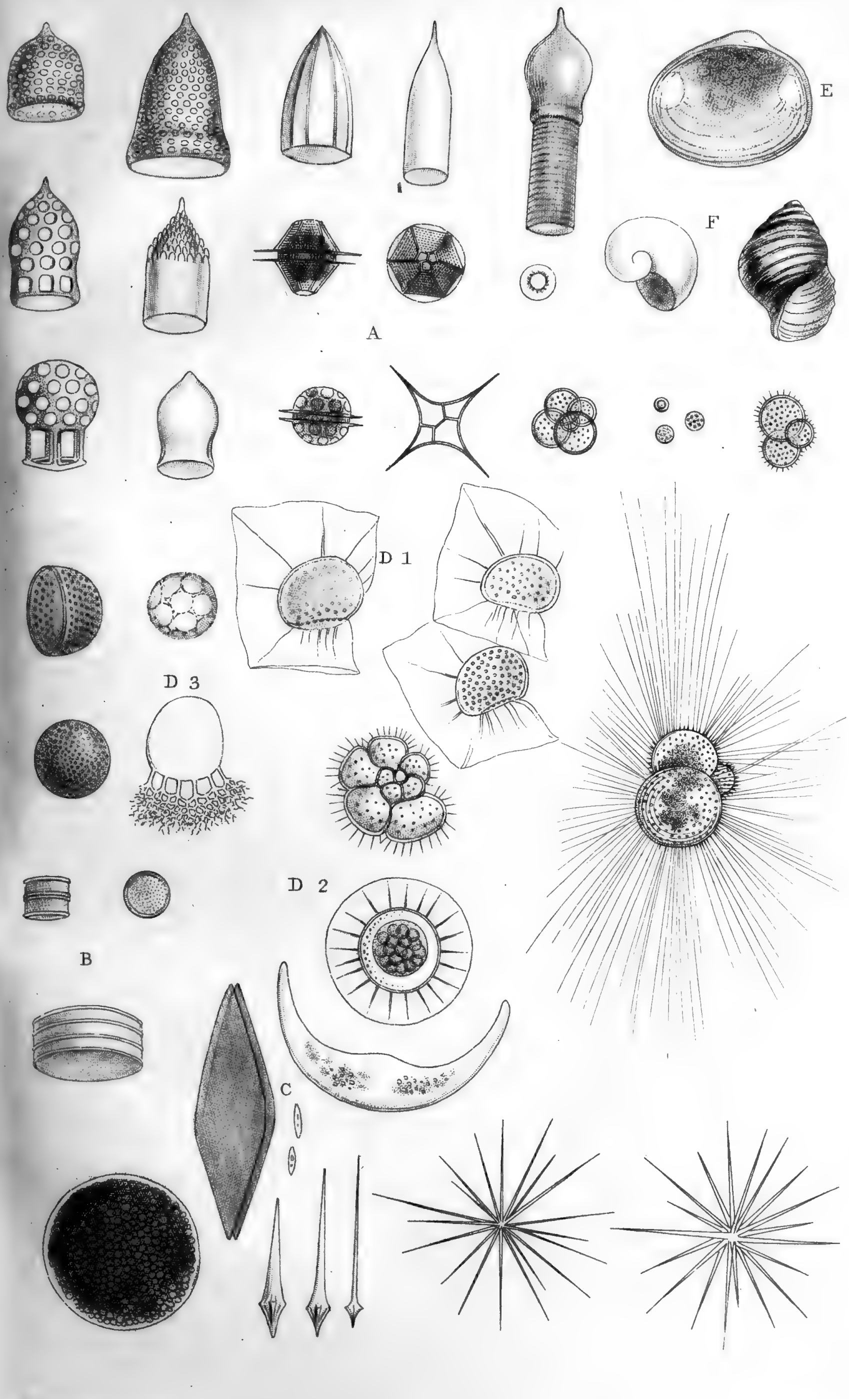
The Foraminifer with long silky hair-like processes is deserving of particular observation. It is the species most usually taken at the surface of the ocean. One or two other forms with minute spherical gemmules are figured in the neighbourhood.

It appears to be much easier to establish a line of demarcation between the Desmidieæ and Diatomaceæ than between the latter and the Foraminifera.

With all our opportunities of observing living Foraminifera in the South-western Pacific, where they abound in the most diversified forms, we have never been able to discover their branched "pseudopodia," so called, or the slightest evidence of the crawling movement which they are reputed to exhibit, while we can vouch for the actual fixity of some. The soft contents of the Foraminifer are grosser than those of the Diatom. They each consist of a yellowish amber-tinted, or rich brown, more or less homogeneous or granular pulp, interspersed with fatty globules. The essential differences are yet to be detected by the accurate observer of both.

The connexion of the Foraminifera with the encrusting Corallines, through the genus *Orbiculina,* is worthy of further investigation.

Mr. Huxley's curious genus *Thalassicolla* would appear to be referable rather to the Diatomaceæ than the Foraminifera, but I must defer any observations on this subject to a future period.



J.D.Macdonald, ad nat. del.

J. Basire, sc.

XXVI.—*On the Distribution of the Mollusca in Depth on the Coasts of Nordland and Finmark.* By R. M'Andrew, F.R.S. and L. Barrett, F.G.S.

We have divided the space between high water and 200 fathoms into four zones: the first, or Littoral zone includes the shore between high- and low-water marks; the Laminarian zone extends from low water to 20 fathoms; the Coralline zone between 20 and 60 fathoms; and the deep-sea Coral zone includes the ground between 60 fathoms and the greatest depth explored, which was 200 fathoms. We have given a list of the shells found in each zone.

Littoral Zone.

The species found living at low water on the coast of Finmark are all Arctic, the same species being inhabitants of the littoral zone of Greenland. In Nordland, *Patella vulgata, Trochus tumidus* and *Trochus cinerarius* are abundant in this zone, but they do not range to Finmark or Greenland; while *Buccinum cyaneum* and *Natica clausa,* abundant species in Finmark, are not found farther south than the northern part of Nordland. When the shore is composed of sand or mud, bivalve Mollusca are most common. On a rocky coast Gasteropoda are abundant, and Conchifera scarce. Several species included in the following lists ought perhaps to be considered inhabitants of the next zone, though they occurred abundantly on several occasions at extreme low water.

Testacea of the Littoral Zone.

Shore Rock.

Buccinum cyaneum*.
—— undatum.
Purpura lapillus*.
Bela turricula?
Littorina littorea*.
—— rudis*.
—— arctica*.
—— grœnlandica*.
Lacuna vincta?
Rissoa ulvæ*.
Skenea planorbis*.
Trochus tumidus.
—— cinerarius.
Margarita undulata?
—— helicina.
Acmæa testudinalis*.
Dendronotus arborescens.
Mytilus edulis*.
Crenella discors.
Saxicava arctica.

Shore Sand.

Natica clausa.
Mya truncata*.
—— arenaria*.
Astarte compressa?
—— arctica?
Cardium edule?

Note.—The asterisk indicates that the species attains its maximum of development in that region; the note of interrogation implies that the species is probably a straggler.

Laminarian Zone.

The ground in this region is generally rock; between low water and 15 fathoms the bottom is covered with Laminaria, and below 15 fathoms with a small red weed, which is the favourite habitat of *Margarita cinerea.* On the fronds of the Laminaria abound several species, as *Lacuna vincta, Trichotropis borealis, Margarita helicina* and *undulata,* and *Patella pellucida.* In the south, *Uraster rubens, Echinus sphæra* and *Echinus miliaris* are common among Laminaria; in the north, *Echinus neglectus* is found in great numbers just below low-water mark.

Testacea of the Laminarian Zone.

Gasteropoda.

Cancellaria viridula.
Trichotropis borealis.
Fusus antiquus.
Trophon clathratus.
—— Gunneri.
Buccinum undatum.
Nassa reticulata.
—— incrassata.
Bela turricula.
—— rosea.
—— rufa.
—— mitrula.
—— Trevelliana.
Defrancia linearis.
Natica nitida.
—— Montagui.
—— helicoides.
—— pusilla.
—— clausa.
Velutina lævigata.
—— flexilis.
Odostomia plicata.
Cerithium reticulatum.
Aporrhais pes-pelecani.
Turritella communis.
Scalaria grœnlandica.
—— Loveni.
Littorina littorea.
Lacuna vincta.
Lacuna labiosa.
Rissoa calathus.
—— striata.
—— parva.
—— rufilabrum.
Skenea, species.
Trochus millegranus.
—— tumidus.
—— cinerarius.
Margarita helicina.
—— undulata.
—— cinerea.
Puncturella noachina.
Emarginula reticulata.
Pileopsis hungaricus.
Patella pellucida.
Acmæa virginea.
—— testudinalis.
Pilidium fulvum.
Dentalium entale.
Chiton ruber.
—— asellus.
—— marmoreus.
—— cancellatus.
Cylichna truncata.
Philine scabra.
—— aperta.
Aplysia hybrida.

Lamellibranchiata.

Anomia ephippium.
—— patelliformis.
—— aculeata.
Pecten opercularis.
—— islandicus.
Pecten pusio.
—— striatus.
—— similis.
Lima hians.
—— Loscombii.

Lima subauriculata.
Mytilus edulis.
Modiola modiolus.
Crenella decussata.
—— discors.
—— nigra.
—— marmorata.
Arca nodulosa.
Nucula nucleus.
—— tenuis.
Leda caudata.
—— lucida.
Cardium echinatum.
—— edule.
—— fasciatum.
—— nodosum.
Lucina borealis.
—— flexuosa.
Artemis exoleta.
—— lincta.
Kellia suborbicularis.
Montacuta substriata.
Cyprina islandica.
Astarte sulcata.
—— elliptica.
—— arctica.
—— compressa.
Venus striatula.
—— ovata.
Mactra elliptica.
Tellina solidula.
—— fabula.
Psammobia ferroensis.
—— tellinella.
Syndosmya alba.
—— prismatica.
—— intermedia.
Solen pellucidus.
Mya truncata.
—— arenaria.
Corbula nucleus.
Saxicava arctica.
Thracia convexa.
—— phaseolina.
Periploma prætenuis.
Lyonsia arenosa.

Coralline Zone.

This region is very rich in Mollusca, and many of the rarest northern shells were obtained from it. The most common and generally distributed shells are, *Trophon Gunneri, Pleurotoma nivale, Cerithium metula, Scalaria grœnlandica, Trochus millegranus, Margarita alabastrum* and *cinerea, Patella cæca, Pilidium fulvum, Chiton asellus, Cylichna cylindracea, Terebratula cranium, Terebratulina caput-serpentis, Crania anomala, Pecten islandicus* and *striatus, Modiola phaseolina, Crenella nigra, Nucula nucleus* and *tenuis, Astarte crebricostata* and *elliptica.* Echinodermata are not so abundant as in the next zone, but several species are common, among which are *Echinus miliaris, Amphidetus ovatus, Schizaster fragilis, Astropecten Mülleri, Luidia fragilissima, Amphiura filiformis,* and *Ophiopholis aculeata.*

Testacea of the Coralline Zone.

Gasteropoda.

Cancellaria viridula.
Trichotropis borealis.
Fusus antiquus.
Trophon clathratus.
—— Gunneri.
Buccinum undatum.
—— Humphreysianum.
—— fusiforme.
Nassa incrassata.
Pleurotoma nivale.
Bela turricula.
—— rufa.
—— Trevelliana.
Defrancia linearis.
—— pyramidalis.
Natica nitida.
—— Montagui.
—— helicoides.
—— pusilla.
—— clausa.

Lamellaria prodita.
Velutina lævigata.
—— flexilis.
Odostomia plicata.
Chemnitzia, sp.
Eulimella Scillæ.
Eulima bilineata.
—— polita.
Cerithium metula.
—— reticulatum.
Triforis M'Andrei.
Aporrhais pes-pelecani.
Turritella communis.
Scalaria grœnlandica.
—— Loveni.
Lacuna vincta.
Rissoa striata.
Skenea, species.
Trochus millegranus.
—— tumidus.
—— cinerarius.
Margarita alabastrum.
—— helicina.
Margarita undulata.
—— cinerea.
Scissurella crispata.
—— angulata.
Puncturella noachina.
Emarginula reticulata.
Patella cæca.
Acmæa virginea.
Pilidium fulvum.
Dentalium entale.
Chiton Hanleyi.
—— ruber.
—— asellus.
—— lævis.
—— marmoreus.
Tornatella fasciata.
Cylichna alba.
—— cylindracea.
—— truncata.
Amphisphyra hyalina.
Scaphander librarius.
Philine scabra.
—— quadrata.

Brachiopoda.

Terebratula cranium.
Terebratulina caput-serpentis.
Rhynchonella psittacea.
Crania anomala.

Lamellibranchiata.

Anomia ephippium.
—— patelliformis.
—— aculeata.
—— striata.
Pecten opercularis.
—— islandicus.
—— tigrinus.
—— striatus.
—— similis.
Lima hians.
—— Loscombii.
—— subauriculata.
Mytilus edulis.
Modiola modiolus.
—— phaseolina.
Crenella decussata.
—— discors.
—— nigra.
—— marmorata.
Arca pectunculoides.
—— nodulosa.
Nucula nucleus.
—— tenuis.
Leda pernula.
—— caudata.
—— lucida.
Cardium echinatum.
Cardium edule.
—— fasciatum.
—— nodosum.
—— suecicum.
—— elegantulum.
Lucina borealis.
—— flexuosa.
—— ferruginosa.
Artemis lincta.
Kellia suborbicularis.
Montacuta bidentata.
Cyprina islandica.
Astarte sulcata.
—— crebricostata.
—— elliptica.
—— arctica.
—— compressa.
Venus striatula.
—— ovata.
Mactra elliptica.
Tellina solidula.
—— proxima.
Psammobia ferroensis.
—— tellinella.
Syndosmya alba.
—— prismatica.
—— intermedia.

Solen pellucidus.
Mya truncata.
—— arenaria.
Neæra cuspidata.
—— costellata.
Neæra obesa.
Saxicava arctica.
Thracia convexa.
—— phaseolina.
Teredo norvegica.

Deep-sea Coral Zone.

Off the coast of Nordland the ground of this zone was generally mud, but in the north a fine gravel or sand. The characteristic shells of the region are, *Eulimella Scillæ, Dentalium vitreum, Cylichna alba, Cardium fasciatum* and *suecicum, Leda lucida, Lucina flexuosa,* and *Arca raridentata.*

Most of the Arctic Echinodermata are found in this zone; the following are the species most generally met with:—*Psolus squamatus, Eupyrgus hispidus, Schizaster fragilis, Amphidetus ovatus,* the three species of *Astrogonium, Pteraster militaris, Ctenodiscus crispatus, Astropecten arcticus* and *Lutkeni, Ophiura albida* and *Ophiacantha spinulosa. Oculina prolifera* has only been taken living in this zone. Several species of Sponge are common.

Testacea of the Deep-sea Coral Zone.

Gasteropoda.

Cancellaria viridula.
Trichotropis borealis.
Fusus propinquus.
—— islandicus.
—— norvegicus.
Trophon clathratus.
—— Gunneri.
—— craticulatus.
Buccinum Dalei.
—— Humphreysianum.
—— fusiforme.
—— undatum.
Pleurotoma nivale.
Bela turricula.
—— rufa.
—— Trevelliana.
Defrancia pyramidalis.
Natica Montagui.
—— pusilla.
—— clausa.
Chemnitzia, sp.
Eulimella Scillæ.
Eulima bilineata.
Cerithium metula.
Triforis M'Andrei.
Aporrhais pes-carbonis.
Margarita alabastrum.
—— undulata.
—— cinerea.
Scissurella crispata.
Puncturella noachina.
Patella cæca.
Pilidium fulvum.
Dentalium entale.
—— vitreum.
Chiton Hanleyi.
—— asellus.
—— alveolus.
Cylichna alba.
—— truncata.
Philine quadrata.

Brachiopoda.

Terebratula cranium.
Terebratulina caput-serpentis.
Rhynchonella psittacea.
Crania anomala.

Lamellibranchiata.

Anomia ephippium.
Pecten tigrinus.
—— grœnlandicus.
Pecten, sp.
——, sp.
Lima subauriculata.

Lima excavata.
Limopsis, sp.
Modiola phaseolina.
Crenella decussata.
—— discors.
—— nigra.
—— marmorata.
Arca pectunculoides.
Nucula tenuis.
—— corticata.
Leda pernula.
—— caudata.
—— lucida.
—— pygmæa.
—— limatula.
Cardium nodosum.
—— suecicum.
—— fasciatum.
Lucina flexuosa.
—— ferruginosa.
Astarte sulcata.
—— crebricostata.
Venus ovata.
Tellina proxima.
Syndosmya intermedia.
Neæra cuspidata.
Thetis Korenii.
Saxicava arctica.
Thracia convexa.
Lyonsia striata.

XXVII.—*Descriptions of new Ceylon Coleoptera.* By John Nietner, Colombo, Ceylon.

[Continued from p. 190.]

43. *Cyclosomus dyticoides*, N.

C. suborbicularis, depressus, obscure castaneus, elytris piceis fasciis 2 testaceis ornatis, pedibus brunneo-testaceis, tarsis, antennis oreque magis minusve brunneis. Long. corp. 4½–5 lin.; lat. 2½–3 lin.

Antennæ art. 3–11 *depressis*. Thorax transversus, antice profunde semilunariter sinuatus; basi quadratus, medio leviter subquadrate emarginatus, elytris parum angustior, ante scutellum subtiliter strigosus; apicem versus sensim angustatus. Elytra basi subquadrata, striata, fasciis 2 (una subhumerali, altera subapicali) transversalibus, interruptis, interstitia 2–8 occupantibus, testaceis ornata. Pedes tibiis apice 2-calcaratis, *calcaribus 2-serratis, tarsis maris 2 anterioribus art.* 1–3 *subtus leviter dupliciterque penicillatis, intermediis fortiter simpliciterque penicillatis.* Prosternum subhastatum.

In prov. occid. arenis peraridis *Amararum* more victitat.

To judge from what Lacordaire says of this genus in his 'Genres des Coléoptères' (a work which, as I have said elsewhere, I look upon as containing the essence of all former researches), it would appear that the present species differs very materially from the three others hitherto described, namely in the flatness of the antennal joints, in the serrated edges of the tibial spurs, in the existence of the tarsal brushes in the male, and in the colour,—to say nothing of some other minor distinctions. The first three of these peculiarities (too important not to have been noticed by Lacordaire or any other describer of the genus, had they been aware of them) add considerably to the characteristics which already constitute this genus one of the most remarkable of the extensive family of the Carabidæ, whilst through the colour of the present species it becomes still more closely and more strikingly allied to certain Dyticidæ (*Hydaticus*) than has hitherto been the case.

The prevailing colour of the insect is deep chestnut, lighter along the sides of the thorax; the elytra darker. The latter are variegated with two transverse belts of irregular outline, and interrupted in the middle near the suture; one of these is subhumeral, the other subapical; they are of yellowish colour, and reach from the first to the eighth stria, a small discoloured spot being projected from the subhumeral belt on either side to the ninth stria, and a discoloured prolongation of the other filling the apical angles, with the exception of a dark spot; the margin is also of a more or less brownish colour. The legs are dark yellowish, with chestnut tarsi; the mouth and antennæ are brown, the latter light at the base. These colours vary altogether from lighter to darker. The head is of the typical sculpture; it has two impressions at the posterior margin of the clypeus, and is finely sulcated between the eyes. The antennæ are strong, stiff, and short, reaching hardly beyond the base of the thorax; joint 1 is of middling size; 2, short; 3, 4 are subequal; 5, rather shorter; 6–11 still shorter, subequal; joints 3–11 *are strongly compressed and pubescent, but only on the narrow side.* The labrum is deeply subtriangularly emarginated in front, and increases in breadth towards its base. The maxillæ are furnished with a thick brush at the apex, having much of the rough appearance of a minute bundle of coir. The inner edge of the lobes of the mentum is very broadly cut away. The ligula appears, as I understand it to be from Lacordaire's description, coriaceous, of middling size, of the shape of an oblong square, depressed in front and at the sides, set in its membranous and ample paraglossæ as in a broad frame; the whole obliquely truncated at the anterior angles, and ciliated along the anterior margin. The palpi can hardly be said to be truncated at the apex of the fourth joint, finishing off rather like an acorn. The remaining parts of the mouth and the head in general are of typical construction. The thorax is strongly transverse, subquadrate at the base, and firmly applied to the elytra, but not quite as large. The latter being also subquadrate at the base, the place of the juncture of these two parts of the body presents, upon close inspection, rather a peculiar appearance. The thorax is gently narrowed towards the apex; the anterior part is deeply emarginated in the shape of a crescent, the posterior part slightly so at the middle, the emargination being long, shallow, and nearly rectangular, its external corners fitting into two deep notches in the base of the elytra. The anterior angles are rather acuminated. The back is elevated and divided by a longitudinal line; it has two impressions at the base, and is finely sulcated just in front of the scutellum. The elytra are furrowed and regularly impressed with deep punctures along the ninth ridge; they are slightly dehiscent at the apex. *The legs of the male* are of the following description:—coxæ strong; trochanters and femora simple, the latter slightly setose; the anterior tibiæ strongly dilated towards the apex and costated, strongly spinoso-dentate at the outer edge, with a strong, blunt spur at the notch and another at the apex; the latter place, moreover, furnished with spines. The intermediate and posterior tibiæ with three rows of spines along the outer, and two rows of strong bristles at the inner side, all inserted on ridges, strongly 2-calcarated at the apex, the inner spur longer than the outer one. *These apical spurs of the tibiæ are in all the legs slightly compressed and serrated on the two narrow sides.* The anterior tarsi have joints 1–4 slightly dilated, *the apex of the first, second, and third being at the same time furnished below each with two small white brushes fenced-in by spines.* Joint 1 is triangular, with the external apical angle strongly prolonged; 2 and 3 are almost equal, transversely ovato-subcordiform, 2 slightly, but distinctly, prolonged at the external apical angle, 3 less so, but still prolonged; 4, small, cordiform; 5, long, subcylindric; joints 1–4 with two spines at the apical angles, these spines removed in the 5th, the one to a subapical, and the other to a position at the middle; in joints 1–3 these spines are shorter and thicker at the outer angle than at the inner; in the 4th this difference is scarcely observable, and in the last it does not exist; the claws are strong and simple. The intermediate tarsi are elongated; joint 1 triangular; 2 and 3 nearly equal, quadrato-subcordiform; 4, of a similar form, but much smaller; all furnished with spines at the apical angles in the manner of the anterior tarsi. *The inner side of the apical half of joint* 1 *and joints* 2 *and* 3 *with strong brushes of reddish colour bordered by rows of spines, the entire lower surface forming one thick brush, and not two, as in the first pair.* The posterior tarsi are still more elongated, joints 1–4 decreasing gradually in size, subcylindric; 5 quite so; all armed like the preceding. *The legs of the female* are very similar to those of the male, still there is some difference in the tarsi; the brushes are wanting; the anterior pair has joints 1–3 fully as much, and 4, more dilated; joints 2–4 are subcordiform, 2–3 rather more prolonged on the outer side than in the male. In the intermediate pair the joints are more distinctly triangular. The prosternum is elliptic, pointed at the apex, or of the shape of a spear-head with the lateral angles rounded-off; it is depressed at the sides, strongly marginated (as is also the anterior part of the mesothorax), being furnished with a few thin hairs within the margin. The size of the individuals is no criterion as to their sex, sometimes the female and sometimes the male being the largest.

Regarding the habits of these insects, one would feel inclined to suspect them to be of a semi-aquatic nature, that is, that the insects frequent the banks of rivers or other damp places; however, the direct contrary is the case: *they live in the driest, hottest, and sandiest places that can be found, where they burrow in the sand exactly in the manner of the well-known genus* Amara. In the course of six years I took but two of these interesting insects, both in the neighbourhood of Negombo, the one in the Cinnamon Gardens there, the other flying on my table at night. Of late, however, I have been more fortunate, taking considerable numbers of them in the Cinnamon Gardens of Colombo in holes, made by the rooting-up of weeds, into which they had run and could not escape, the loose sand giving way under them whenever they attempted to do so. When wishing to find them, I had to search the corners of these holes, where some leaves had usually collected, when I have sometimes dug up eight at a time, frequently rather deep in the sand. They are quick of motion, and being thus pursued, immediately bury themselves in the sand.

On reconsidering the peculiarities which so effectually distinguish this species from the three others known, and which I have thought it not superfluous to set forth at such length, I am doubtful whether there is not ample reason for forming it into a new genus, unless, indeed, the other species were very imperfectly known and described, which latter I almost suspect with regard to the foot-brushes of the male. If, however, otherwise, the diagnosis as given by Lacordaire requires at all events to be entirely recast, and the genus to be removed from the tribe Cratoceridæ (one of the characteristics of which is the want of foot-brushes in the male), in which he has placed it; and, this being agreed to, I would, taking all its peculiarities into consideration, propose to carry out Lacordaire's idea, and to form it into a new tribe, "Cyclosomidæ," to which it appears as much entitled as the genus *Omophrom.*

Tribe Bembidiidæ.

Ochthephilus, n. g., N.

Corpus oblongum, subparallelum, valde depressum. Caput magnum, antice trigonum; oculis magnis, ovatis, prominulis; collo forti. Mentum subquadrate emarginatum, lobis extus fortiter rotundatis, apice abrupte acuminatis, dente parvo acuminato. Ligula parva, apice quadrate truncata, libera, paraglossis setiformibus marginem anteriorem longe superantibus. Palpi robusti, art. 4° elongato, tenui, acuminato; maxillares art. 3° interne, 2° externe incrassato; labiales art. 3° robusto, externe incrassato, 2° parvo, cylindrico. Labrum parvum, subtrigonum, antice emarginatum. Mandibulæ elongatæ, rectæ, trigonæ, apice arcuatæ, infra medium pluries dentatæ. Antennæ robustæ corporis med. fere attingentes, art. 1° et 11° mediocribus, subæqualibus, 2–4 et 5–10 inter se subæqualibus, illis subcylindricis, his ovatis. Thorax subcordatus, basi quadratus. Pedunculus brevis. Elytra apice rotundata. Pedes omnes simplices, subæquales, anteriores tibiis profunde excavatis, tarsis leviter contractis, art. 1–4 gradatim minoribus, art. 1° subcylindrico, 2–4 subtrigonis, 5° sat magno, unguibus simplicibus.

44. *Ochthephilus Ceylanicus*, N.

O. brunneo-testaceus, pedibus palpisque testaceis, tenuiter pubescens; fronte profunde 2-sulcata; elytris obsolete striatis, in striis punctatis. Long. corp. $1\frac{1}{3}$ lin.

In fluminum ripis *Bembidiorum* more victitat.

This interesting little beetle might at first sight be mistaken for a *Læmophlœus*, of which it has the size, depressed form, and colour; the prominent eyes, however, and cordate thorax—to say nothing of its habitat—remind one very soon of its real connexions. I do not think there can be any doubt that this insect forms a new and interesting addition to the Bembidiidæ. In fact, the question whether it belongs to this tribe or not, depends, in my opinion, mainly upon the inferences drawn from the structure of the terminal joint of the palpi. It is true that this joint attains in *Ochthephilus* a degree of development unequalled amongst the Bembidiidæ; as, however, this development is not confined to the one particular joint alluded to, but affects the entire organ of which it forms a part, it can hardly be said to be a variation of much importance; and as, moreover, the general shape (independently of the elongation) and mode of insertion are the same as in the typical Bembidiidæ, I have not hesitated to refer my new genus to this tribe.

The head is as broad as the thorax, and altogether of about the same size; it is strongly triangular from the eyes to the tip of the mandibles; the forehead is impressed with two deep longitudinal furrows; the eyes are large, rather oval and prominent; behind them the head is abruptly contracted into a thick neck. The antennæ are long and thick, reaching nearly to the middle of the body; joints 1 and 11, 2, 4, 5-10 are subequal amongst themselves, 5-11 oval, 1-4 subcylindric. The labrum is small, rather triangular, being narrowed at its base; it is emarginated in front, with a slight angle in the middle of the emargination. The mandibles are long, straight, triangular, bent at the tip only, dentated below the middle, the one more so than the other. The maxillæ are thin and slender, gently bent outwards at the base, and inwards at the apex, the outer lobe corresponding with the inner one in shape and strength. The palpi are robust; both the maxillary and labial ones have joint 4 elongated, thin and acuminated, in fact, needle-shaped, firmly implanted in the preceding one, not loosely hinged to it. The maxillary ones have joints 3 and 2 robust, the former swollen on the inner, the latter on the outer side. In the labial ones, joint 3 is still plumper than in the others, but differs in shape by being incrassated on the outer instead of the inner side, the second joint being at the same time quite small and cylindric. The mentum is large and simple, as above described. The ligula is small, oblong, very slightly narrowed and transversely cut away at the apex; the paraglossæ separate from its sides a little below the anterior corners; they are setiform, and reach much beyond it. The whole organ is of membranaceous texture, having, however, a more substantial centre or back. The thorax and elytra are simple, and sufficiently described above. I may add, that the former is divided by a longitudinal furrow, and that both are furnished with a narrow margin at the sides. The scutellum is very small, and the abdomen furnished with a short peduncle. The legs are weak, simple, and nearly equal; the anterior tibiæ are deeply notched; the lower margin of the fourth tarsal joint of the same pair is furnished with a long, thin spine, the apex of which fits in between the claws. I have been unable to discover any foot-brushes or other sexual distinctions in the specimens before me; but it is not improbable that the tarsal spine just mentioned occurs only in one sex.

The habits of the insect are those of the *Bembidia,* in whose society it lives upon the banks of rivers, like them taking readily to its wings. I have found it occasionally in considerable numbers upon the sandy banks of the Maha Oya in the neighbourhood of Negombo, close to the edge of the water.

Tribe Lebiidæ vel Pericalidæ.

Creagris, n. g., N.

Corpus oblongum, valde depressum. Caput magnum, robustum; oculis mediocribus, ovatis, sat prominulis; collo brevi. Mentum forma ferri-equini vel trifurcatum (hinc n. g. *Creagris*), lobis angustis, subparallelis, inter med. et apic. leviter dilatatis, apice oblique truncatis, dente lobis parum breviore, tenui, acutissimo. Ligula magna, cornea, infra apicem leviter constricta, angulis anticis rotundatis, paraglossis connatis, apicem non attingentibus. Palpi maxill. art. 4° claviformi, apice fortiter truncato; labiales art. 4° subelliptico, truncato. Labrum maximum, suborbiculatum, convexum. Mandibulæ parvæ, basi obsolete unidentatæ, labro obtectæ. Antennæ robustæ humeros attingentes, art. 1, 3 et 11 longitudine fere subæqualibus, mediocribus, 2° parvo, rotundato, 4–10 subæqualibus, cum 11° ovatis. Thorax parvus, capite sesqui minor, transversus, longitudine duplo fere latior, infra med. fortius angustatus, basi parum prolongatus. Pedunculus brevis. Elytra apicem versus leviter dilatata, apice fortiter subquadrate truncata. Pedes robusti, simplices, subæquales, ant. tibiis profunde excavatis, omnes tarsis brevibus, art. 1° sequentium 2 fere longitudine, subcylindrico, 2, 3 gradatim minoribus, magis minusve triangularibus, 4° magno, profunde bilobo, 5° mediocri, unguibus simplicibus, art. 4° subtus dense penicillato.

45. *Creagris labrosa*, N.

C. picea, ore antennisque, coxis, trochanteribus, femorum tibiarumque apice et tarsis brunneis; dense punctata obsoleteque pubescens; elytris striatis. Long. corp. 4½ lin.

Specimen singulum prope Colombo nocte ad lumen cepi.

I consider this scarce and interesting insect to form a passage between the Lebiidæ and Pericalidæ, but am doubtful to which of these two tribes to refer it, as, although it partakes of the characteristics of each, it is at the same time distinct from both. Distinguished in several respects, its most extraordinary character lies in the curious shape of the mentum. This is, however, easily described as large, of the shape of a *horse-shoe*, with a long, thin, very pointed tooth in the middle, the apical half of the sides (lobes) being at the same time gently dilated, the apex itself being obliquely cut away from the outer towards the inner side (the inner angle being the most advanced), and slightly dentated at the edge thus formed. Or it may also be described as *a fork* with the outer teeth somewhat enlarged, truncated at the apex, and so forth. As far as I know, this variation from the usual form of the mentum is repeated in no other Carabideous insect. The other parts of the mouth have not much to distinguish them, with the exception, however, of the labrum, which attains a very extraordinary degree of development, occupying *rather more than one-third of the whole head, although the latter itself is large and heavy.* It is of a suborbicular shape, very slightly produced in front into an obtuse angle; it is vaulted, covers the mandibles, has two longitudinal impressions at the sides of the base, and is highly polished. The head has two impressions in front of the eyes, is densely punctured and thinly pubescent; it is strongly but gradually contracted behind the eyes, and formed into a short neck. The antennæ are strong, and reach to the shoulders; joints 1, 3 and 11 are of about equal length, middling, the two former subcylindric; joint 2 is small, rounded, 4–10 subequal, and with the 11th oval. The thorax is small, only half as large as the head, rather narrowed, strongly transverse, twice as broad as long, slightly emarginated in front; the anterior angles rounded, contracted below the middle, subquadrate and prolonged at the base; posterior angles depressed, longitudinally divided by a deep furrow. The elytra are striated, and, like the thorax, densely punctured and thinly pubescent. The legs are strong, simple, and subequal; the anterior tibiæ are deeply notched; the first joint of the tarsi is as long as the two succeeding ones together, subcylindric, the second triangular, the third of a similar but more transverse form, smaller—all three have the apical angles acuminated, the fourth is large and deeply bilobed, the fifth middling, thin; the claws simple. The tarsi are altogether short and strong, the first joint is furnished with longer, the second and third with shorter stiff hair, whilst the fourth is strongly penicillated below. The anterior tibiæ are slightly spinose, the others more so.

I believe the only specimen of this insect which has hitherto come into my possession, and which has served as a type for the above description, to be a female.

Tribe Galeritidæ.

Heteroglossa, n. g., N.

Corpus oblongum, subparallelum, depressum, tenuiter hirsutum. Caput mediocre, oculis semiglobosis, sat prominulis; collo brevi. Mentum sat profunde subquadrate emarginatum, lobis magnis, extus fortiter rotundatis, apice abrupte acuminatis, dente magno excavato, apice inflecto, obtuso, magis minusve profunde sinuato. Ligula subcornea, apice libera, truncata, vel quadrata, vel obconica vel leviter bisinuata; paraglossis cylindricis, marginem anteriorem longissime superantibus, magis minusve arcuatis. Palpi hirsuti, art. ultimo sat elongato, subcylindrico, apice truncato vel subtrigono. Labrum transversum, antice emarginatum. Mandibulæ validæ, trigonæ, apice arcuatæ, basi pluries dentatæ. Antennæ robustæ, corporis med. attingentes, art. 1° incrassato, sequentibus 2 longiore, 2° parvo, 3–11 subæqualibus. Thorax subcordatus, basi transversim truncatus leviterque prolongatus. Pedunculus brevis. Elytra apice fortiter subquadrate truncata, costata, costis 16 majoribus, in interstitiis subtilissime bicostulata, in sulcis (sulco e tribus inter costas binas majores medio excepto) tenuiter pilosa, in omnibus transversim rugulosa. Pedes anteriores tibiis sat fortiter emarginatis, tarsis maris art. 1–3 leviter dilatatis, subtus squamularum seriebus 2 munitis, art. 1° elongato-trigono, 2–3 rotundato-trigonis, 3° præcedente parum minore, 4° parvo cordato 3° plus sesqui minore, his omnibus angulis acuminatis, 5° magno, unguibus simplicibus.

This diagnosis may appear somewhat vague, still I have been unable to express the characteristics of the insects from which it is drawn in more precise terms, although they have features quite peculiar to themselves, by which they are easily recognized when once seen.

The points in which the three species which form this genus more or less disagree are the following:—(1) The labrum: this is more transverse in *H. elegans,* and less deeply emarginated in *H. ruficollis* than in the other two species respectively; still in all three it is *emarginated,* and has, moreover, the peculiarity of being furnished with bristles at the two anterior corners. (2) The mentum: this is subquadrately emarginated, the lobes being strongly rounded on the outer side, and abruptly acuminated at the apex; at the base of the emargination it is furnished with a broad, excavated tooth, which is inflected and obtuse at the apex: so far all three species agree; however, whilst in *H. elegans* and *ruficollis* this tooth is slightly emarginated at the apex, it is sharply notched in *H. bimaculata,* in fact, bilobed, the lobes being large and rounded at the apex. I look upon this notch, which is sharp, but not deep, as a mere variation from the emargination existing at the apex of the tooth of the former two species. (3) The palpi: these, the labial as well as maxillary, have their terminal joint truncated at the apex; and so far, again, all three species agree: however, whilst this joint is of elliptic form in the palpi of *H. ruficollis,* it is in *H. elegans* only so in the labial ones, that of the maxillary ones being cylindric at the base. In *H. bimaculata,* finally, this joint is rather club-shaped or subtriangular, and more strongly truncated than in the former two species. (4) The ligula: this organ is of subcoriaceous texture, middling size, the shape of an oblong square, free, and transversely truncated at the apex; these characters are common to all three species, and in *H. ruficollis* I have nothing to add to it; however, the anterior margin, which is straight in this species, is slightly bisinuated in *H. elegans,* the outer angles being acute, and the central one obtuse. The ligula of *H. bimaculata* differs from both the former in as far as it is narrowed towards the apex and depressed towards the sides and the front; the anterior margin is otherwise cut away straight, without any sinuosities, but it is rather strongly armed with bristles. The paraglossæ agree in all three species, in as far as they are highly developed, reach much beyond the anterior margin of the ligula, and are more or less bent inwards. Their greatest development they assume in *H. elegans,* in which they nearly touch each other in front of the anterior margin, being cylindric and slender at the same time. In *H. ruficollis* the paraglossæ are somewhat shorter and straighter, and in *H. bimaculata* still more so.

In all other points the three species perfectly agree, in saying which I lay particular weight upon the unusual sculpture of the elytra, and the rather peculiar hairy vesture of the insects, bearing also in mind their general appearance, proportions, system of coloration, mode of living, &c. As to the hairy vesture of certain parts of the body and the sculpture of the elytra, it is true that these are not generally looked upon as of much importance; however, they appear to me so in this instance, as they present certain unusual variations repeated in all three species. The hairy vesture consists of thin yellowish or reddish hairs thinly scattered over the back, and still more thinly over the whole of the lower surface of the insects, being at the same time longer on the latter place. This vesture acquires its greatest density on the legs, especially the tibiæ and tarsi, whilst its uniform presence on the palpi forms almost a generic character. The elytra are exquisitely sculptured into about eight larger costæ on each, and into two smaller ones between every two of these; the furrows thus formed are finely transversely rugose, and (with the exception of the central furrow between every two larger costæ) thinly pubescent.

It is possible that this sculpture of the elytra may occur in other Galeritidæ. If so, the insufficiency of my means to ascertain this fact to a certainty must plead my excuse for attaching undue importance to it. However, I should in this event consider my books of reference, none of which say anything to that effect, greatly (and, indeed, more than myself) at fault for not alluding to it, as, in my opinion, it is sufficiently peculiar to be mentioned.

After this lengthy preamble, I shall have but a few words to say in finishing the description of the species.

46. *Heteroglossa elegans*, N.

H. supra rufo-castanea, capite obscuriore, maculis 2 humeralibus obsoletissimis ferrugineis; subtus dilutior, pedibus, antennis oreque subtestaceis; elytris ad angulos apical. extern. testaceis. Long. corp. $3\frac{1}{2}$ lin.

In lacus Colombensis ripis sub vegetab. putrescent. non infrequenter cepi.

An agile, pretty little insect, of chocolate colour, and with its family features about it. Head smooth, polished, above and below slightly punctured, with two impressions in front of the eyes; anterior angles of labrum rather acuminated. Thorax deeper and more densely punctured than the head, and with the elytra thinly hirsute, rather strongly emarginated in front, less so behind; sides, especially at the basal angles, depressed, divided longitudinally by a deep furrow. Scutellum, like thorax, punctured and hairy. Elytra with the inner apical angle right-angled and the outer rounded-off, largely punctured within the margin, especially near the apex. Tibiæ with a row of large spines down the outer, and a row of smaller ones down the inner side, 4-calcarate at the apex, the two inner spurs larger.

47. *Heteroglossa ruficollis*, N.

H. colore præcedentis sed obscurior, thorace pectoreque rufo-testaceis, antennis art. 3 primis nigrescentibus. Long. corp. $4\frac{1}{2}$ lin.

Cum præcedente sed rarius et per occasionem nocte ad lumen cepi.

The shape of the body is quite that of the former, but the insect is larger. The head is less distinctly punctured than in the former, and there is an additional impression in the middle of the forehead. The thorax is also less deeply punctured, but the divisional furrow is more so than in the preceding species. The anterior tibiæ appear somewhat less deeply notched. There is nothing else to add to the description that has not been pointed out already.

48. *Heteroglossa bimaculata*, N.

H. subcastanea, thorace capiteque rufo-testaceis, elytris medio maculis 2 flavis pictis, pedibus abdominisque apice testaceis. Long. corp. $5\frac{1}{2}$ lin.

Ubi præcedentes infrequentissime legi.

Head, with the exception of the forehead, deeply punctured, with two impressions in front of the eyes; anterior angles of labrum rounded. Thorax densely and deeply punctured, with elytra thinly pubescent; the latter with a round, yellow spot at the middle of each.

[To be continued.]

XXVIII.—*Descriptions of the Male of* Lycosa tarentuloides Maderiana, *Walck., and of three newly discovered species of the genus* Lycosa. By John Blackwall, F.L.S.

Tribe OCTONOCULINA.

Family Lycosidæ.

Genus Lycosa, Latr.

Lycosa tarentuloides Maderiana.

Lycosa tarentuloides Maderiana, Walck. Hist. Nat. des Insect. Apt. t. i. p. 291, la femelle.

Length of the male $\frac{9}{10}$ths of an inch; length of the cephalothorax $\frac{1}{2}$; breadth $\frac{2}{5}$; breadth of the abdomen $\frac{3}{10}$; length of a posterior leg $1\frac{3}{4}$; length of a leg of the third pair $1\frac{2}{5}$.

The cephalo-thorax is large, compressed before, rounded on the sides, convex, hairy, with a slight longitudinal indentation in the medial line; it is of a dark greyish-brown hue, with a broad, yellowish-grey band extending along each side and another along the middle, the latter, whose anterior part is the broadest, being somewhat the darker-coloured. The four small anterior eyes form a transverse, slightly curved row, having its convexity directed upwards, and the two intermediate ones are larger than the lateral ones. The falces are powerful, conical, vertical, armed with a strong curved fang at the extremity, and a few teeth on the inner surface: the lip is somewhat quadrate, rather longer than broad, and slightly hollowed at its extremity. These organs are of a brownish-black colour, the apex of the latter having a red-brown hue. The maxillæ are straight, and rounded at the extremity, which is enlarged and truncated obliquely at its inner surface; and the sternum is oval. These parts are of a dark brown hue, the base of the maxillæ being the darkest. The legs are long (much longer than those of the female), densely clothed with hairs, and provided with long spines; the femora, on the upper side, have a yellowish-grey hue, that of the tibiæ, metatarsi and tarsi being bright orange-red, and the colour of the under side of all the joints is dark brown tinged with grey; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one, which is very small, is inflected at its base; the metatarsi and tarsi are provided on the under side with hair-like papillæ, constituting a climbing apparatus. The colour of the palpi resembles that of the legs, but is more intense; the under side is tinged with yellow, and the extremity of the digital joint has a dark brown hue; the radial is longer than the cubital joint; the digital joint has an elongated oval form, is convex and hairy externally, compact at its extremity, and has a concavity near its base, on the under side; this concavity comprises the palpal organs, which are moderately developed, rather complex in structure, with a prominent process near the base, below which there is a fine, pointed, straight spine directed obliquely forward and downward, and are of a reddish-brown colour. The abdomen is oviform, rather broader at the posterior than at the anterior part, convex above, densely clothed with hairs, and of a yellowish-brown colour; an obscure, fusiform band extends along the middle of the upper part, nearly half its length, and an angular, dark brown mark occurs at its anterior extremity, within the vertex of which there is a tuft of yellowish hairs; the under is paler than the upper part, except in the medial line, which has a brown hue, and that of the branchial opercula is brownish-yellow.

The male of this handsome species does not appear to be known to arachnologists. Having had an opportunity of examining adult individuals of both sexes, found under stones in the island of Porto Santo, by James Yate Johnson, Esq., I am enabled to supply the deficiency. M. Walckenaer has given a very brief description of the female, from a specimen in the collection of M. Guérin, but states erroneously that the legs are not provided with spines.

Lycosa ingens.

Length of the female 1 inch and $\frac{7}{12}$ths; length of the cephalo-thorax $\frac{7}{12}$; breadth $\frac{5}{12}$; breadth of the abdomen $\frac{5}{8}$; length of a posterior leg $1\frac{7}{10}$; length of a leg of the third pair $1\frac{2}{5}$.

The legs are long, robust, densely clothed with hairs, and provided with long, sessile spines; they are of a brown-black colour, with white annuli and spots; one of the latter occurs on each side of the extremity of the tibiæ, and another at the extremity of the metatarsi, on the upper part; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is very small, and inflected at its base; the metatarsi and tarsi are provided on the under side with hair-like papillæ, constituting a climbing apparatus. The palpi are short, and are terminated by a curved, pectinated claw; they resemble the legs in colour, but the radial and digital joints have neither annuli nor spots. The cephalo-thorax is compressed before, rounded on the sides, convex, thickly clothed with short hairs, and has a slight longitudinal indentation in the medial line; it is of a dark brownish-grey colour, with an irregular greyish-white band extending along each lateral margin, and another of the same hue along the middle, whose anterior part is the broadest, of an elongated oval form, and comprises two parallel, curved, brownish-grey, longitudinal lines, having their concavity directed towards each other. The four small anterior eyes are nearly equal in size, and form a straight, transverse row near the frontal margin of the cephalo-thorax. The falces are powerful, conical, vertical, convex at the base, armed with a strong, curved fang at the extremity, and a few teeth on the inner surface: the maxillæ are straight, and rounded at the extremity, which is enlarged and truncated obliquely at its inner surface: the lip is broader in the middle than either at the base or the extremity, which latter is truncated and hollowed;

and the sternum is oval and glossy, with small prominences on the sides, opposite to the legs. These parts are of a brownish-black hue, the sternum and the extremities of the maxillæ and lip having a tinge of red. The abdomen is oviform, rather broader at the posterior than at the anterior part, convex above, densely clothed with short hairs, and of a brown-grey colour, the sides and under part, which are rather paler, being obscurely spotted with brown; at the anterior extremity of the upper part there is a large, angular, brown mark, and within the angle a yellowish-white triangular spot, trifid at its base, and having its vertex directed forwards; to this spot succeeds a fusiform, brown band, whose margins are the darkest; it extends nearly to the middle of the upper part, is bifid at its extremity, and has a small angular point on each side, near the middle, immediately above which there is a minute, red-brown depression encircled with yellowish-white hairs; a similar but somewhat smaller depression occurs on each side of the posterior extremity of the band, and these latter depressions are wider apart than the former; a series of minute, obscure, yellowish-white spots, commencing nearly opposite to the small angular point on each side of the fusiform band, extends to the spinners, which have a dark reddish-brown hue; the sexual organs have a longitudinal septum in the middle and are of a red-brown colour, that of the branchial opercula being yellowish-brown.

Two adult females of this fine spider, the largest species of the genus to which it belongs, were discovered under a stone in one of the Desertas,—rocky, uninhabited islands near Madeira. They were sent to me for inspection in August 1857, by James Yate Johnson, Esq., to whom I am obliged for permission to describe this and the preceding *Lycosæ*.

Lycosa herbigrada.

Length of the female $\frac{3}{10}$ths of an inch; length of the cephalo-thorax $\frac{1}{8}$; breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{10}$; length of a posterior leg $\frac{1}{2}$; length of a leg of the third pair $\frac{1}{3}$.

The four small anterior eyes are arranged in a transverse row in front of the cephalo-thorax, the two intermediate ones being rather the smallest. The cephalo-thorax is compressed before, depressed and rounded on the sides, and has a slight longitudinal indentation in the medial line; it is of a red-brown colour, the space comprising the eyes, a broad, irregular band extending along each side, and a narrow line on each lateral margin having a brown-black hue; the red-brown spaces are covered with greyish hairs, and the medial one is abruptly contracted near its anterior extremity. The falces are powerful, conical, and armed with a curved fang at the extremity and a few teeth on the inner surface: the maxillæ are short, straight, and enlarged and rounded at the extremity: the palpi are moderately long, and are terminated by a curved, pectinated claw. These parts have a red-brown hue, the maxillæ being the palest, and the palpi the darkest at their articulations. The lip is nearly quadrate, being rather broader at the base than at the apex, and is of a dark brown colour. The sternum is heart-shaped, clothed with greyish hairs, and is of a red-brown hue, with an oval space in the middle bounded by a fine, dentated, brown-black line, and has spots of the same hue on the lateral margins. The legs are long, moderately robust, provided with hairs and sessile spines, and of a red-brown hue, with dark brown streaks, spots and annuli; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The abdomen is oviform, hairy, convex above, and projects over the base of the cephalo-thorax; it is of a reddish-brown colour, the under part being the palest, and has on each side of the upper part a strongly dentated, brownish-black band; these bands taper to the spinners, where they unite, and from some of their larger exterior angles, rows of brownish-black spots pass obliquely to the sides, which are marked with other spots of the same hue; in the anterior part of the space comprised between the dentated, brownish-black bands there is an oblong-oval, reddish-brown mark, bounded by a fine black line having an acute angular point on each side and its posterior extremity bifid; the sexual organs, which are highly developed and prominent, have a dark reddish-brown colour, and that of the branchial opercula is brown.

Two adult and two immature females of this *Lycosa* were forwarded to me in Wales in December 1856, by Mr. R. H. Meade. The two former were discovered by O. P. Cambridge, Esq., of Bloxworth House, in Dorsetshire, under a stone, near Pennsylvania Castle, in the Isle of Portland, on the 29th of September 1854; and the two latter were captured in July 1854, in Morden Park, near Bloxworth House, by the same gentleman, who has kindly permitted me to describe the species.

Lycosa pallipes.

Length of the female $\frac{7}{24}$ths of an inch; length of the cephalo-thorax $\frac{1}{8}$; breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{9}$; length of a posterior leg $\frac{2}{5}$; length of a leg of the third pair $\frac{5}{16}$.

The legs are moderately long, robust, provided with hairs and sessile spines, and are of a uniform pale yellow-brown hue; the fourth pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi resemble the legs in colour, and have a curved, pectinated claw at their extremity. The two intermediate eyes of the four forming the anterior row are very conspicuously larger than the lateral ones. The cephalo-thorax is glossy, thinly clothed with hairs, compressed before, depressed and rounded on the sides, which are marked with slight furrows converging towards a narrow longitudinal indentation in the medial line; it is of a pale brown colour, with a yellowish-brown band extending along the middle, whose broad anterior extremity comprises a pale brown, bifid line terminating in an angle at the medial indentation; the lateral margins are supplied with hairs of brilliant whiteness, and the part occupied by the eyes has a dark brown hue. The falces are powerful, conical, and armed with a curved fang at the extremity and teeth on the inner surface: the maxillæ are short, straight, and enlarged and rounded at the extremity. These parts are of a pale reddish-brown colour. The lip is nearly quadrate, being rather broader at the base than at the apex; it is of a dark brown hue tipped with yellowish-brown. The sternum is heart-shaped and of a pale yellowish-brown colour, with black spots on the margins, opposite to the legs. The abdomen is oviform, rather broader at the posterior than at the anterior extremity, sparingly clothed with hairs, convex above, and projects over the base of the cephalo-thorax; it is of a brown colour, the under part being the palest and the sides the darkest; a yellowish-brown band extends from the anterior extremity of the upper part more than a third of its length, and on each side of the pointed termination of this band there is a brownish-black spot; between it and the spinners several curved, transverse, brownish-black bars occur, which diminish in extent as they approach the latter; they have their convexity directed forwards, their extremities somewhat enlarged, and, with the two brownish-black spots, have brilliantly white hairs distributed upon them in the form of minute but distinct spots; a short, curved, white line is directed upwards from the base of each superior spinner, and the sides are densely mottled with white; the sexual organs are small and of a dark reddish-brown colour, that of the branchial opercula being yellowish-brown.

An adult female *Lycosa pallipes* was taken in Algeria, by the Rev. Hamlet Clark, in the summer of 1856. This species should occupy a place among the semi-aquatic *Lycosæ*, being nearly allied to *L. piratica* and *L. piscatoria*.

XXIX.—*On* Hydatina senta. By Dr. F. Leydig*.

[With a Plate.]

Whoever has taken notice of the literature of the Rotifera is aware that for a long time the sexual relations of this group of animals were involved in obscurity; for although recent observers were agreed that the parts described by Ehrenberg as testes, seminal ducts, and seminal vesicles, can by no means have any such import, still, on the other hand, no undoubted male sexual organs and seminal corpuscles could be detected.

The discovery of the sexual relations was made by Dalrymple†. He proved that *Notommata anglica* is not hermaphrodite, but that it possesses separate sexes. Subsequently the present writer made known the male of a new species‡, nearly allied to the English one; and on comparing the structure of the Rotatoria, with which I had become acquainted by my own observations, with the published statements, I was compelled to conclude, "that male individuals of other species have also been already described, but that they have been described under the title of peculiar genera and species." And amongst other things, I asserted that to my mind it was "beyond all doubt" that the *Enteroplea Hydatina* is the male of *Hydatina senta*.

Unfortunately, I could not at that time meet with this Rotifer in the neighbourhood of Würzburg, although, as many observers state, it is one of the very common and widely distributed species; and this was the more to be regretted, as, in consequence of Ehrenberg's descriptions, the *Hydatina senta* as it were played the part of a typical representative of the Rotatoria in books. Nevertheless I had the satisfaction of seeing my assertion with regard to the male nature of *Enteroplea Hydatina* confirmed by another observer. Cohn namely§ had the opportunity of examining this animal, and found the testes and motile spermatozoa. During the present spring, in the early part of March, I fished a small pool near Würzburg, which is dry in summer, and there obtained *Hydatina senta* in innumerable multitudes; at that time the animal was almost the sole inhabitant of the water, for besides it I only observed a few *Vorticellæ*, with here and there a *Brachionus* and some larvæ of Diptera. Towards the end of March they had increased to so extraordinary an extent, that

* Translated from Müller's Archiv, No. 4, June 1857, p. 404. By W. S. Dallas, F.L.S. &c.

† Phil. Trans. 1849.

‡ Ueber den Bau und den syst. Stellung der Räderthiere; Zeitschr. für wiss. Zoologie, 1854.

§ Zeitschr. für wiss. Zoologie, 1855.

they formed a nearly continuous greyish-white stratum close to the surface of the water. The *Enteroplea*, which at first occurred rather sparingly, had then also become so numerous, that perhaps one *Enteroplea* might be counted to every twenty or thirty *Hydatinæ*. I studied the animalcule closely, and as my results do not agree in all points with Cohn's, it may not be superfluous to give some details of the structure of *Hydatina* and *Enteroplea*.

It is incorrect when the above-mentioned author says that *Hydatina senta* "is one of the largest Rotatoria:" it is rather only one of middle size, for many other species, such as *Notommata myrmeleo*, and especially *Notommata Sieboldii*, exceed it three, four, and five times in size. That naturalist, indeed, well remarks, that the form of the animal in its true outlines can only be recognized when it is swimming about freely in a sufficient quantity of water; but neither the figure nor the description given by him of the form of *Hydatina* can be indicated as true; his figure of the rotatory organ especially departs far more from nature than that given by Ehrenberg, for which reason I consider it necessary to publish a new representation of it.

As regards the form of the animal, we perceive in individuals which are swimming about quietly, revolving upon their axis, that the body is divided into three principal parts,—a cephalothorax, an abdomen, and a tail. If we disregard the abdominal notch, the cephalothorax appears to be distinguished from the abdomen, especially on the dorsal surface, by a tubercular inflation, upon which the single setigerous pit (*Borstengrube*), beneath which nerves terminate, is situated. This tubercle of the cephalothorax, however, only makes its appearance distinctly when the stomach is not exceedingly full, or the ovary is not too much developed: when either of these circumstances occurs, the tubercle must of course disappear more or less in consequence of the inflation of the abdomen. The first or anterior third of the cephalothorax is separated as the head by a sharp furrow. The abdomen, which is faintly annulated, ceases with the segment which bears the cloacal orifice; then follow the segments of the tail, of which even the first is narrower than the last segment of the abdomen. The tail diminishes rapidly, and runs out into a didactyle foot.

The margin of the head or rotatory organ (Pl. VIII. fig. 1) is not simple, but distinctly formed of two lips, with a tolerably deep furrow between them. On the dorsal surface this furrow rises into a papilliform process, lying in the median line, corresponding to which the inner lip of the rotatory organ also gives rise to a prominence; the surface of the rotatory organ bounded by the inner lip sinks into a funnel-shaped depression or buccal cavity. As regards the ciliary coat, we may easily distinguish a border consisting of fine long hairs, which runs uninterruptedly round the rotatory organ and belongs to its outer edge. The hairs strike outwards. Perceptibly different from these, are some strong or bristle-like cilia, which stand next to them on the inner lip of the rotatory organ, and also form a continuous series; similar bristles also fringe the true margin of the buccal cavity, which lies further inwards; and even between the two series of bristles above indicated, cilia, of equal strength and irregularly distributed, are seen working; lastly, the two papilliform processes previously mentioned also bear a tuft of about six bristles. All the thick, bristle-like cilia strike like hooks inwards.

The ceaseless movements of the animal, and the constant inversion and eversion of the cephalic extremity, add not a little to the difficulty of observing it; and in order to convince oneself of the true form of the rotatory organ, it is advisable to kill the animal slowly, and without its inverting itself. For this purpose I made use of an extremely weak solution of bichromate of potash, in which they continued to swim about for hours, and remained extended after death. That a covering glass is not to be used in examining them, is a matter of course.

The *external integument* (Pl. VIII. fig. 2), as has been shown to be the case in other Rotatoria, consists of two different layers, namely of the external structureless cuticula, and the "granular layer" situated beneath this. I should not have considered this worth mentioning, had not Cohn said that the granular layer described by me is scarcely to be distinguished as such in mature individuals of *Hydatina*. Both in fresh objects and in animals which have been acted upon by acetic acid, the separate nuclei of the soft cutaneous layer in question may be seen as clearly as can be desired, and in many individuals single fatty points lie in this cutaneous stratum.

With regard to the muscles, it may be stated, that besides the longitudinal and annular muscles, of which the former are the broadest, and also exhibit a differentiation into a clear cortical, and granular axial substance (Pl. VIII. figs. 1 & 2, *b*), there are also branched muscles, and that not only in the head, where they are especially striking, but also in every segment of the body. In the broad, longitudinal muscles (figs. 1 & 2) the granules of the axial substance are sometimes observed to be very regularly arranged, so as to remind one of a delicately-marked transverse striation. Cohn's statement, that the substance of the muscles sometimes "appeared frothy from vacuoles," can only refer to altered or dead muscles.

Of the *brain* and the *nerves* radiating therefrom, I thought I might also give a new figure (Pl. VIII. fig. 2, *c*): this organ, when seen from above, is nearly quadrangular; when seen in profile, it presents a tolerably strong convexity above. To the single pit with the tuft of bristles two strong nerves pass; two other filaments also go to it; these are of a muscular nature, and I certainly saw them contract. These are the filaments which Cohn describes as "going to the same spot in the neck from other centres of the nervous system." The substance of the fresh brain exhibits small nuclei, imbedded in a homogeneous fundamental mass, in which there are also still more distinct molecules. The "large, circular, limpid vesicle, apparently a vacuole, very frequently observed" by Cohn, is, in my opinion, a product of decomposition; such appearances readily appear in the delicate tissues of the lower animals, when their vital activity is diminishing.

I shall pass over the *alimentary apparatus*, as it has the same structure which has been described by me in detail in other Rotatoria, whose alimentary system is divided into pharynx, œsophagus, stomach and intestine; only, with regard to the pharynx, I may add, that the apparently beautiful cells, which we think we see in the fleshy parts (see fig. 1, *a*), are the transverse sections of muscles, and, indeed, of such muscles the substance of which is separated into a homogeneous cortical layer and a granular axis; this, therefore, is the reason why, on close examination of these apparent cells, we perceive that they have a clear, distinctly marked, peripheric layer, and internally a granular mass of contents, from which a limpid nucleus glimmers*.

With reference to the "respiratory system," I am again under the necessity of declining the corrections which Cohn has bestowed upon my statement. I had stated (*l. c. sup.*) that the so-called tremulous organs (*Zitterorgane*) in their form represented two types, which, however, do not occur in one and the same animal, but show themselves to be distributed in different genera. Thus some remain as cylindrical tubes, of uniform width,—such are possessed, for example, by *Notommata myrmeleo*; others are dilated at the free extremity, and thereby acquire a somewhat trumpet-like form, as in *Notommata centrura*, *Euchlanis triquetra*, *Eosphora najas*. Cohn, however, asserts, "that one and the same tremulous organ presents one or the other form according to its position," and in support of this, cites the figure of *Notommata centrura*, in which both forms are to be seen. But our author here evidently misunderstands the figures, for

* In opposition to Cohn's statement that there is ciliary movement in the œsophagus of *Brachionus*, I adhere to my previous assertion, that the œsophagus of the Rotatoria is never clothed with cilia; in *Brachionus* the œsophagus is very short, and Cohn has erroneously transferred the strong ciliation at the commencement of the stomach into the œsophagus.

what he regards as cylindrical tremulous organs are trumpet-shaped ones seen in longitudinal section; from their flat nature, they then appear cylindrical. When Cohn becomes acquainted with true cylindrical, uniform tubes, such as occur, for example, in *Notommata Sieboldii,* he will perceive the difference of form between the two.

The fluid which fills the abdominal cavity, washes the viscera, and forms the analogue of the *blood,* in individuals which had been plentifully fed with *Euglena viridis,* contained numerous clear globules, or blood-corpuscles, of a roundish form and unequal size. It was remarkable to meet again in *Hydatina senta* with the same structures which I had formerly, as a matter of supposition, attempted to indicate in *Lacinularia* as spermatozoa*, and afterwards arranged in the series of parasitic formations. They are globular bodies with sharp outlines; their margin is furry, as if with a fine coat of hair. Towards the end of March the entire abdominal cavity of many individuals was so filled with these globules, that the animal appeared strongly white by reflected light. However, the individuals thus affected swam about just as briskly as those which exhibited nothing of the sort.

The *clavate bodies* in the tail consist of a delicate envelope and pale molecular contents, in which beautiful nuclei, each with a nucleolus, may be distinguished; in many individuals, small fatty points are also present in variable amount. I regard the organs in question as glands, which in their position and function correspond with the caudal glands of *Enoplus* for example†; they open at the apex of the caudal appendages (*Fusszangen*); and as the worm just mentioned "can attach itself firmly to the object-bearer by the posterior extremity of the body, in order to carry the body round this point with a waving motion," so also can the *Hydatina* fix itself by the tips of the caudal appendages, probably by means of the sticky substance excreted here. It seems to me also that in a certain upright position of the caudal appendages, I have detected the opening at their tip.

The hairy coat of the "winter eggs," which Ehrenberg, in opposition to R. Wagner, declared to be an Alga, *Hygrocrocis vestiens,* is distinctly perceptible even on the eggs in the ovary.

The male *Hydatina,* or the *Enteroplea Hydatina* of Ehrenberg (Pl. VIII. fig. 3), is certainly considerably smaller than the female, but has the same outline of body, and even the rotatory organ is notched on the ventral side, as in *Hydatina senta.* This structure is seen with certainty in animals which tumble about freely without being annoyed by a glass cover, and thus turn their rotatory organs to the beholder from all sides. Cohn erroneously

* Zeitschr. für wiss. Zool. 1851.

† Müller's Archiv, 1854, tab. 11. fig. 12.

asserts that the obliquely funnel-shaped depression of the rotatory organ is wanting in the male. In animals which begin to tire in their movements, we may perceive, with regard to the form of the body, that the dorsal surface is somewhat arched, and the ventral rather flat; perfectly fresh individuals are continually contracting, and the body thus appears strongly folded longitudinally.

The muscles, the brain with the nerves, the contractile vesicle with the vessels and tremulous organs, are essentially as in the female, for which reason they will not be further mentioned; I refer the reader to fig. 3. The clavate glands in the tail also are not wanting; but this difference is perceptible—they are faintly notched several times on the margin, which is not the case in the female.

Dalrymple had observed in *Notommata anglica*, as I have done in *N. Sieboldii*, that the male is entirely destitute of an alimentary canal. The male animals possessed neither pharynx nor jaws, œsophagus nor stomach. There was only an irregular aggregation of cells, which was regarded as the rudiment of the alimentary canal. Of the male *Hydatina* also Cohn states, that in it (the *Enteroplea*) the nutritive apparatus is completely wanting in all its parts, and that not even the cellular rudiments of the above-mentioned species of *Notommata* are to be detected. With this view, however, I cannot altogether agree. It is true that, as was already established by Ehrenberg, the *Enteroplea* is entirely destitute of biting organs, and a developed *tractus cibarius* is altogether wanting; moreover, no solid nourishment taken from without is ever observed in the transparent animal. But it may be said with perfect certainty, *that the alimentary canal exists in an abortive state.* Thus, the part which Cohn has characterized as the *suspensor testis*, and Ehrenberg as the intestine, and which the former author regards as a long and broad band, originating from the anterior apex of the testis, and running transversely through the cavity of the body towards the frontal region, is undoubtedly a rudiment of the alimentary tube (Pl. VIII. fig. 3, *a*), as is shown both by its position and structure. When the animal is examined in profile, the anterior extremity of the rudimentary intestine passes exactly towards that spot in the rotatory organ where the buccal orifice is situated in the female; posteriorly, as will be mentioned immediately, it extends to the cloacal orifice. As regards its more intimate conditions, we find the rudimentary intestine, like other organs which have become retrograde, more or less abortive in different individuals; sometimes it is a clear, folded tube, without cellular parts; in another case it contains unmistakeable remains of the stomachal cells—namely large vesicles, with aggregations of such yellowish-brown bodies as fill the stomachal cells of all Rotatoria,—thus furnishing a distinct indication of its nature.

In order to trace the further relations of the rudimentary intestinal canal, regard must at the same time be had to the *testis*, which is situated in the hinder section of the abdomen. This organ (Pl. VIII. figs. 3, 4, *c*, *c*) forms an oval sac, the walls of which are, however, by no means, as Cohn describes them, "very thick and muscular," but, on the contrary, formed of a thin membrane. What the naturalist just mentioned calls the "very thick and muscular walls" is the continuation of the rudimentary intestine: we see this soldered to the testis, and by this means an apparent second envelope of the organ is produced. Some band-like filaments pass from this envelope to the skin for the purpose of attachment. They are, however, no more contractile (here also Cohn makes an opposite assertion) than the entire rudimentary stomach which surrounds the testis. The testis itself and its contents, as well as the efferent duct and its accessory glands, display the greatest similarity with what I have described in *Notommata Sieboldii*, only that everything, down to the parts of the tissue, is smaller in *Enteroplea*. The *spermatozoa* (fig. 5), as in *Notommata*, are of two kinds: some have a bacillar form, exhibit no movements, and are stiff; the others consist of a body pointed before and behind, upon which an undulating membrane rises like a crest. In many individuals all the spermatozoa, so long as they were enclosed in the testis, remained quiet, and only began to move when they were pressed out and brought in contact with water; then, however, the movement became slower, and soon stopped altogether. Another time the spermatozoa exhibited a swarming movement even within the testis.

Perhaps the spermatozoa undergo a further development within the body of the female as soon as they are transferred there by copulation; at least, it is remarkable to me that the seminal elements moving about in the abdominal cavity of certain females were much thicker at one end, and as it were had a separated head, which was never seen in those pressed out of the testis. In exact accordance with what was observed in *Notommata*, the motionless, bacillar spermatozoa lie in the testis, especially at the point where the efferent duct commences, and by their regular arrangement produce a radiate striation at this point. I must directly contradict the statement that this "close, parallel, longitudinal striation" occurring at the posterior end of the testis, is due to "muscular fibres;" the "striæ" may be pressed out as well as the rest of the contents of the testis; and in this way we may convince ourselves that the bacillar spermatozoa were the cause of the striation. The wall of the testis, as has been already mentioned, is destitute of contractility; but it may be observed that the efferent duct is capable of strong contractions, and I also refer its thick wall and the transverse striation visible on the latter, to a muscular membrane. Cilia exist in the interior of the duct; they are longest at the orifice, and the latter is situated on the first segment of the tail. On the outside of the efferent duct there are some glandular bodies, which might be compared with accessory glands, perhaps a prostate, as was also done with regard to *Notommata*.

The same *dark aggregations of granules* (Pl. VIII. figs. 3, 4, *b*) which are observed in many embryos and young animals of the Rotatoria occur in *Enteroplea*; they usually form two masses, but sometimes three; the granules vary greatly in number and size, and sometimes we see accumulations of small globules; sometimes they consist of a few single, large fragments. From their optical and chemical characters, I had pronounced these granules to be uric concretions, and expressed the opinion that such accumulations of granules or crystalline formations occurring, except in the males, only in the embryonic stage and in early youth, might have the signification of a primordial kidney. Cohn, on the contrary, thinks that "this whole hypothesis falls with the proof that in *Enteroplea* the vesicle with the dark granules stands in no sort of connexion with the intestine, nor indeed can do so, as no intestine exists, and that it is rather firmly adherent to the outer wall of the testis, which I could prove beyond a doubt." And yet I cannot avoid remarking that, as is evident from the above description of the testis, Cohn's "undoubted proof" is an error. For the clear space containing the dark granules is not "adherent" to the true wall of the testis, but to that outer envelope which represents the rudimentary stomach and intestine; or, more properly speaking, the clear space enclosing the concretions belongs to the abortive alimentary canal itself, which extends from the notch of the rotatory organ to the cloacal opening; so that *Enteroplea* displays the same characters as the other Rotatoria, although this is in complete opposition to the description given by Cohn. My opinion that the granules in question are uric concretions, is of course no more strongly supported by the position of matters detected in *Enteroplea* than before, but the objection raised by Cohn appears to be removed. The opinion first put forward by Weisse, which is also favoured by Cohn, that the granules are the remains of unused yelk-masses, I must reject, without taking other reasons into account, if only because the vitelline elements and the granules in question have no resemblance to each other, but are perfectly different things.

In conclusion, something may be stated regarding a parasite living in the stomach of the female *Hydatina*, which appears to be hitherto undescribed, and may be referred to Ehrenberg's family of the Astasiæa. The parasite was so plentiful, that nearly every *Hydatina*, out of hundreds that were examined, had at least one in its interior; nay, it was found that very young individuals, of which the stomach was still colourless, harboured as many as five or six of these creatures. If it should be supposed that it might be a pseudo-parasite, which forms some part of the nourishment received, an idea which may occur at first, this is contradicted by the fact that the animalcule is never met with in a condition which indicates, even to a certain extent, that, like other swallowed animals, such as *Euglenæ*, it is subject to the digestive power of the stomach; it is rather found always uninjured, and in most powerful movement.

Our animalcule (Pl. VIII. fig. 6) is of the size of *Euglena viridis*, and has considerable resemblance to it in form; but it appears to be most nearly allied to the *Distigma tenax* of Ehrenberg (*Proteus tenax* of Müller and Schrank). The foundation of its body is formed by a soft, gelatinous substance, from which no proper cortical layer or skin has separated. In the interior there are numerous globules, of a fatty lustre, of various sizes, and not of a simple round form, but which appear sometimes stratified, sometimes as if pierced by an orifice, and sometimes repeatedly divided; many look as if they had undergone segmentation into four portions. After pressure with the glass cover, they acquire a tolerably intense indigo-blue colour. In consequence of these bodies, which resemble fat-drops, the parasite appears very white by reflected light. Moreover, towards the anterior extremity of the body, two clear, nucleus-like bodies are distinguished, and these again display a more opake spot. Lastly, a reddish point, or "eye-spot," which has a sharply circumscribed form, is situated quite in front. The movements of the animal are very lively, especially when the stomach of the *Hydatina* begins to make unusual contractions on the occurrence of any deficiency of water; it then endeavours to escape from the intestine, and if it succeed in this, it hurries away therefrom in great haste by its peristaltic contractions. The animalcule swells up, and constricts itself from before backwards, in a manner analogous to that in which, in the contractions of the muscles of the lower animals, a thickened space is often seen to pass in an undulating manner along the muscle.

EXPLANATION OF PLATE VIII.

[All the figures magnified about 300 diameters.]

Fig. 1. The head of the female *Hydatina* from below, to show the form of the rotatory organ: *a*, the pharynx, should be represented further forward nearer to the buccal orifice; *b*, *b*, muscles.

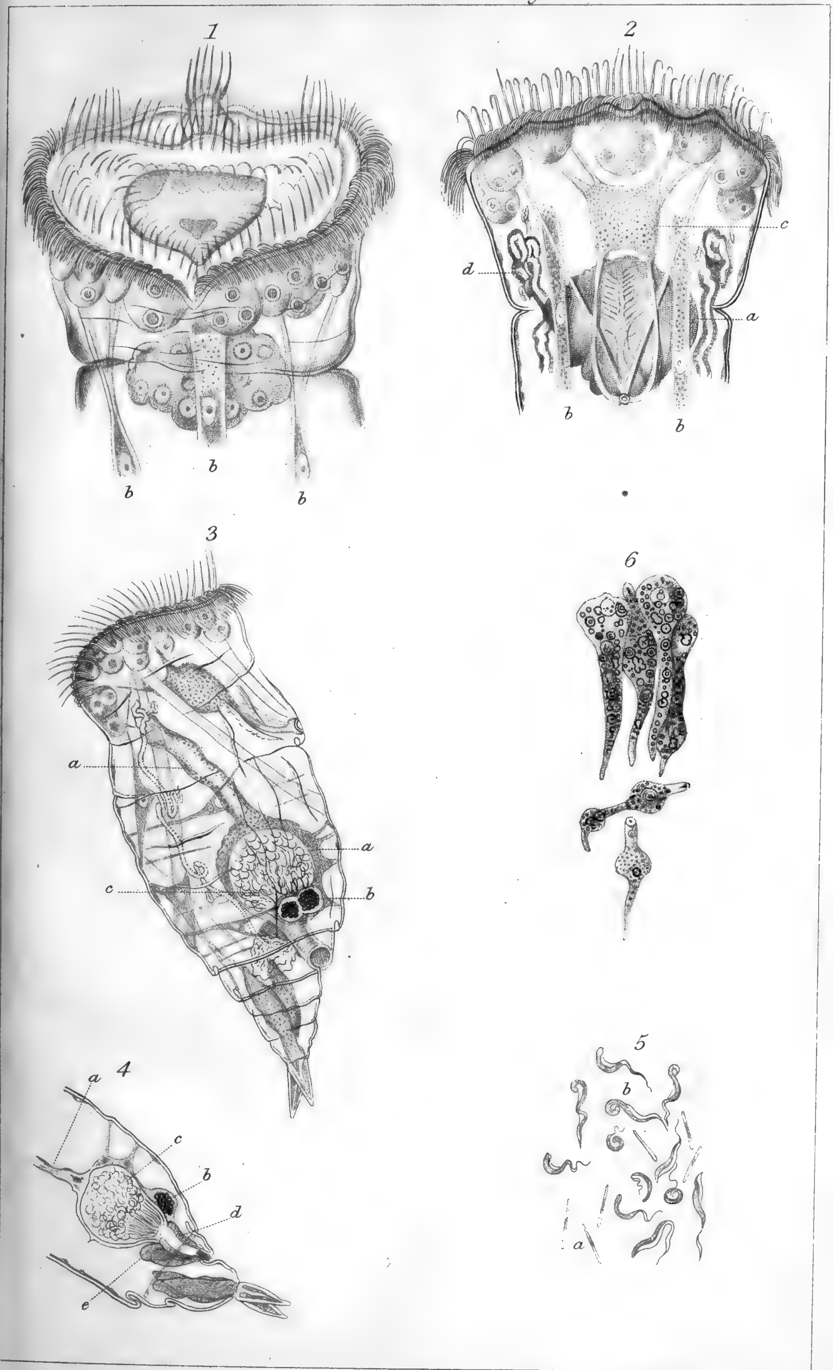


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Fig. 2. Head of a somewhat smaller animal, from above: *a*, pharynx; *b*, muscles; *c*, brain; *d*, "respiratory tubes."

Fig. 3. Male *Hydatina* (*Enteroplea Hydatina*): *a*, the rudimentary intestinal canal; to which the dark aggregations of granules, *b*, belong; *c*, testis.

Fig. 4. The hinder extremity of an *Enteroplea*, exactly in a lateral position: *a*, remains of the *tractus*; *b*, the aggregations of granules ("uric concretions"); *c*, testis; *d*, efferent ducts; *e*, "prostate."

Fig. 5. Spermatozoa of *Enteroplea*: *a*, stiff, bacillar form; *b*, form furnished with an undulating membrane.

Fig. 6. The animal living in the stomach of the female *Hydatina*. It is represented in its various stages of contraction.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 18, 1857.—The Lord Wrottesley, President, in the Chair.

"On the Development of *Carcinus Mænas*." By Spence Bate, Esq., F.L.S.

The author, after noticing the history of the subject, and the opposition which the assertion, "that the *Zoëa* of naturalists is the larva of a common crab," received, traces the progress of the development of the animal from the *Zoëa* to the adult, and endeavours to demonstrate, that from the youngest to the most perfect form, the changes are the result of no sudden transformation, but produced by a gradual series of alterations contemporary with every succeeding moult; that the *Zoëa* is connected with the *Megalopa*, and the latter with the adult by many intermediate gradations, each in itself scarcely appreciable, and progressively approximating more and more nearly to the more perfect stages.

The author asserts that the development is earliest and most complete anteriorly; that when first born, the seventh or posterior segment of the head, one or more of the posterior segments of the *pereion* (thorax), and the penultimate of the *pleon* (abdomen) are wanting in the brachyurous Decapods; but that this general law loses somewhat of its force in the descending scale of development; and as it becomes less persistent, the animal approximates in the larval condition nearer to the form of the adult type; while on the other hand, the same appears to be a constant law of the depreciation in adult forms, as exhibited in the more or less aberrant Amphipoda, such as *Cyrtophium*, *Dulichia*, &c. The author likewise shows that the appendages, which act the principal parts in the larvæ, become the secondary parts of the same organs in the perfect animal. For instance, the lower antenna is represented in the larva by the complementary appendage of the adult form; the true antenna is developed from the base of the embryonic organ, which represents the squamiform and spinous appendages, more or less constant in the macrourous Decapods, but lost in the short-tailed genera, and the organ itself is gradually increased with every successive moult. This is true, more or less perfectly, of all the other appendages present in the larvæ of all Decapoda; and no change of form, as understood in the term metamorphosis as applied to insects, takes place in the development of *Carcinus*. That the distance between the old and young forms is the result of an exaggeration of parts in the larva as compared with the relative proportion of the same in adult animals, together with the absence of others, which are gradually produced, and assume the permanent condition of the adult type.

The author has observed the rudiments of the future legs shortly after birth. He has dissected and figured eight or nine of the more important stages, and shown the relative alteration of each part consecutively, commencing with the *Zoëa* taken from the egg, and pursued the observations through the older forms to that of the adult *Carcinus*.

"On the Anatomy and Physiology of the *Spongiadæ*." By J. S. Bowerbank, F.R.S., F.L.S. &c.

The arrangement of the *Spongiadæ* by Lamarck, based entirely on external form, is wholly inadequate for the discrimination of species. The classification adopted by Drs. Fleming, Grant, and Johnston, dependent more especially on the chemical constituents of those bodies, is far too limited to be applied in generic characters. The author has, therefore, for this purpose rejected both systems, and has retained the latter one for forming primary divisions only; he purposes founding the generic characters principally on the organic structure and mode of arrangement of the skeleton, in accordance with the practice so generally adopted by naturalists with regard to many of the higher classes of animals. *Tethea, Geodia, Dysidea* and a few others are the only well-defined genera that have yet been established; while others, such as *Halichondria*, even in the narrow circle of the list of British species, contain at least ten distinct modes of arrangement of the skeleton, each of which is constant and well-defined in its character.

It is not intended to propose the rejection of any of the well-established genera of preceding authorities, but to confine each genus strictly within the bounds indicated by the peculiar mode of structure of the skeleton which exists in that species of sponge which is the oldest-established and best-known type of the genus, and to refer all others that may distinctly differ from that type to new genera founded on structural principles.

It is proposed to characterize the elementary tissues in the following order:—

1. Spicula.
2. Keratode or horny substance.
3. Membranous tissues.
4. Fibrous tissues.
5. Cellular tissues.
6. Sarcode.

And, in the second place, to treat of the organization and physiology in the following order :—

1. The skeleton.
2. The sarcodous system.
3. The interstitial canals.
4. The intermarginal cavities.
5. The dermal membrane.
6. The pores.
7. The oscula.
8. Inhalation and exhalation.
9. Nutrition.
10. Cilia and ciliary action.
11. Reproduction, gemmules, &c.

And to conclude with observations on the generic characters.

The author then proceeds to describe the spicula, which he states are essentially different in character from the fibres of the sponge; although the latter may be equally siliceous with the former. However closely the spicula may be brought into contact with each other, or with siliceous fibre, they appear never to unite or anastomose; while the fibre, whether siliceous or keratose, always anastomoses when it comes in contact with other parts of its own body or with those of its own species. A detailed description is given of the origin and progressive development of these organs, from which it is inferred that they are the homologues of the bones in the higher classes of animals, and that the forms they assume are always of an organic type, never crystalline or angular; and the same forms of spicula are found composed of either silex or carbonate of lime, demonstrating the fact that the deposits of earthy matter are influenced by the laws of animal organization only, and never by those of inorganic or crystalline arrangement.

Each species of sponge has, not one form of spiculum only, equally dispersed throughout its whole substance; but, on the contrary, separate parts have their appropriate forms; and thus we find that there are often three, four, or even more forms of spicula in the same individual. The author therefore, in describing them, proposes to treat of these organs in the following order :—

1. Spicula of the skeleton.
2. Connecting spicula.
3. Defensive spicula.
4. Spicula of the membranes.
5. Spicula of the sarcode.
6. Spicula of the gemmules.

1st. The spicula of the skeleton in the siliceous sponges are usually simple, elongate in form, slightly curved, and are occasionally more or less furnished with spines. They are either irregularly matted together, collected in fasciculi, or dispersed within or upon the keratose fibres of which the skeleton is to a great extent composed. All these elongate forms of spicula are subject to extreme variety of length. In some species they maintain a great degree of uniformity, while in others they vary to a very considerable extent, according to the necessities arising from the mode of the construction of the skeleton.

2nd. The connecting spicula are not necessarily a part of the skeleton; they are a subsidiary portion of it under special circumstances, in a few genera only; as in *Geodia, Pachymatisma,* and other sponges which have a thick crustaceous surface, which the spicula serve to support and retain in due connexion with the mass of the animal beneath. The normal form of these spicula is very different from that of the general mass of those of the skeleton, and they are much more complex and varied in their structure. They usually have a long, stout, cylindrical or attenuating shaft terminating either acutely or hemispherically at the base, while the apex is divided into three equi-angular radii, which assume in different species a considerable amount of variety as regards form and direction. The triradiate apices are usually cemented firmly to the inner surface of the crustular coat of the sponge; while the stout and elongated shaft is intermingled with keratode, and firmly cemented by it to the general mass of the skeleton.

3rd. The defensive spicula are divisible into two classes: those of the exterior, and those of the interior of the sponge. They are neither of them necessarily present in every species, nor are they confined to particular genera, but occur occasionally, and in certain species of various genera apparently as the necessities of the animal may render their presence requisite. Their office is evidently to defend the sponge from the attacks of predaceous animals. They are projected for about half or two-thirds of their length at various angles from the surface of the sponge, or they are based on the fibre of the skeleton, and are projected at about right angles into its interstitial cavities.

4th. The spicula of the membranes are of two distinct classes. The office of the first of these is to strengthen and support those delicate tissues, and to communicate to them a certain amount of tension. Their forms are few in number, and their structure comparatively simple. The office of the second class is that of assisting in the retention of the sarcode on the interstitial and other structures. They are usually minute in size, and often very complicated in form.

5th. Spicula of the sarcode. The numerous and beautiful tribe of stellate spicula appear to be devoted to connect and give substance to the gelatinoid sarcode which so abundantly covers the whole of the interior membranous structures of the sponges in which they occur. They are often exceedingly minute, and are occasionally remarkably complex and beautiful in structure, and we frequently find more than one form imbedded in the sarcode of the same sponge.

6th. The spicula appropriated to the gemmules of sponges occur in various modes of disposition. First, they are imbedded irregularly in an external envelope of the gemmule, or on the surface of the gemmule itself at right angles to lines radiating from its centre. Secondly, they are arranged symmetrically in the crust of the gemmule parallel to lines radiating from its centre. Thirdly, they are disposed in fasciculi in the substance of the gemmule from the centre to the circumference.

The forms occurring in the second class of these spicula are exceedingly varied and beautiful, and especially characteristic of the species in which they occur.

The author has named and figured the whole of the spicula described in the paper, and has traced some of the most complicated ones from their earliest and simplest state, through all the stages of their development to the adult condition. More than a hundred distinct forms of these organs are thus described, so as to render them available hereafter to naturalists as characteristic of species.

"On the Fructification of certain Sphæriaceous Fungi." By Frederick Currey, Esq.

The author refers to the recent inquiries into the diversities of form existing in the reproductive organs of Fungi, and notices the physiological importance of the results, and the probable future effect upon systematic arrangement.

Two different classes of Sphæriaceous Fungi are then noticed in detail, in the former of which the different forms of fruit produced are essentially distinct, whilst in the latter the fruit is modified so as to assume a form materially different from the normal form.

The following are the plants included in the former of these classes, with the principal points noticed in each.

1. *Sphæria verrucæformis,* Ehr. The occurrence of an ascigerous and cytisporous state of fructification within the same circumscribing line, and the nature of the cells constituting that line.

2. *Sphæria favacea,* Fr. Points of distinction between it and *S. verrucæformis*. Curious modifications in the shape of the asci.

3. *Sphæria olivacea,* n. s. Aberrant forms of asci, and description of the sporidia.

4. *Sphæria tiliaginea,* n. s. The existence of spermatia and stylospores, and description of the form and modes of growth of those organs.

5. *Sphæria vestita,* Fr. The existence of perithecia and naked spores within a conceptacle common to both, and having a common orifice.

6. *Sphæria fragiformis,* Pers. Description of a secondary form of fruit belonging to the *Sphæria,* hitherto considered to have been a growth parasitical upon it.

7. *Sphæria salicina,* Pers., and *Coniothecium Amentacearum,* Corda. The production of these Fungi (hitherto supposed to be distinct plants) from the same mycelium, and the probability of a similar relation between *Sphæria lanciformis,* Fr., and *Coniothecium betulinum,* Corda.

The following are the plants included in the latter of the two classes, and the principal points noticed with regard to them.

1. *Sphæria angulata,* Fr. The occurrence of a state of fructification similar to that of the genus *Cryptosporium*; the varieties of structure in the normal sporidia, and the probable origin and nature of the abnormal fruit.

2. *Sphæria lanciformis*, Fr., and *Hendersonia polycystis*, B. & Br. Irregularity of form in the sporidia of *Sphæria lanciformis*. The growth of perithecia in the same stroma, some producing the fruit of *Sphæria lanciformis*, others that of *Hendersonia polycystis*. Notice of the probable existence of a third form of fruit of *Sphæria lanciformis*.

3. *Sphæria siparia*, B. & Br., and *Prosthemium betulinum*, Kunze. Constant association of the two forms; their external resemblance; nature of the fruit and other circumstances leading to the conclusion of the identity of the two plants.

"On the Anatomy of *Tridacna*." By John Denis Macdonald, Esq., Assistant-Surgeon R.N.

The author first explains the peculiar position which the animal of *Tridacna* occupies in its shell, in which it differs from bivalves in general. He then describes the mantle and its borders, the membranous interpallial septum, the respiratory and wide pedal openings communicating with the interpallial space, the two pairs of branchiæ, the mouth with the anterior and posterior lip and the four oral palps, the foot, the extensive cloacal cavity with its subdivisions, and the circular contractile cloacal orifice opening on the dorsal surface. He next gives an account of the form and arrangement of the alimentary canal, and its relations to the liver and large ovary; and describes a large viscus situated in the space between the ovary, the adductor muscle, the base of the foot and the pericardium, divided into a central and two lateral portions, and secreting a dark brown liquid loaded with fatty matter. This body he thinks may be connected with the secretion of the byssus, but, at the same time, remarks that it may be homologous with the organ of Bojanus. Lastly, the anatomy of the heart and great arteries is given, and is in substance as follows.

On cutting through the floor of the cloaca, the pericardium is laid open, and in it is seen the large, rather square-shaped ventricle, with a capacious but thin-walled auricle opening into it on either side, through an orifice guarded by semilunar valves. From the thick-walled ventricle, a short tube conducts into a conical dilatation or *bulbus arteriosus*, with muscular walls, having its base included in the pericardium, and giving rise near its narrow end to the anterior and posterior pallial arteries; whilst a visceral artery passes from the ventricle to the ovary and adjacent parts. As in other bivalves, the intestine, before its termination, passes through the heart: in coming through the pericardium, surrounded by that membrane, it forms a short round pedicle which joins the fore part of the ventricle; it is then continued through the ventricle and bulbus arteriosus, and finally opens into the cloaca. The blood from the ventricle flows between the outer surface of the intestine and the inside of the sanguiferous channel; and "that part of the intestine which traverses the bulbus arteriosus is closely surrounded with elongated membranous valvulæ, which arise from the anterior part of the chamber where the gut enters, and are fixed by a number of chordæ tendineæ to the posterior wall, where it makes its exit;" a contrivance which permits the blood to pass between the rectum and the little valves, but prevents its reflux.

BOTANICAL SOCIETY OF EDINBURGH.

July 9, 1857.—Professor Fleming, President, in the Chair.

Professor Balfour exhibited specimens of *Bryum pallescens*, collected by Mr. W. Wilson near Warrington.

The following papers were read:—

1. "Notice of Cryptogamic Plants found near New Abbey," by the Rev. Hugh Macmillan.

During May 1857, at New Abbey, in Kirkcudbrightshire, I was particularly struck with the immense profusion of *Parmelia Borreri* and *P. tiliacea*. They occurred on almost every tree—pines, oaks, and ashes indiscriminately, sometimes even to the complete exclusion of the common species, such as *P. saxatilis* and *pulverulenta*, which usually monopolize their bark. I found them, also, occasionally spreading in large patches over rough boulders of grey granite. I gathered here and there a few specimens of both species, covered with fine apothecia. They occur in a little wood, with a stream running through it, at the base of Criffel, a lofty mountain rising up immediately behind New Abbey; also in Shambelly Wood, along with immense quantities of *Parmelia caperata* and *perlata*, *Sticta limbata*, *fuliginosa* and *scrobiculata*, and *Opegrapha elegans*, which affects most of the smooth-barked trees, and is particularly beautiful and luxuriant on the hollies. *Hypnum Crista Castrensis* is very abundant on mossy boulders, in damp shady places in the same wood, and *Parmelia sinuosa* occurs sparingly on the exposed rocks at the top of the wood; while *Neckera pumila* spreads in large patches over the oak- and beech-trees, amid dark masses of *Jungermannia tamariscifolia*.

2. "On the occurrence of *Pertusaria Hutchinsiæ* and other rare Lichens on the Breadalbane Mountains," by Mr. Alexander C. Maingay.

3. "Notice of Localities for some of the rarer Plants collected during the recent excursions of the Botanical Class around Edinburgh," by Professor Balfour.

4. "Remarks on certain Glandular Structures in Plants," by Mr. George Lawson.

The author stated that our knowledge of this subject had not kept pace with other branches of vegetable physiology, for it was very much in the same position in which Meyen left it twenty years ago. He pointed out many instances in which the secretions of plants were poured out upon the surface and into the cavities of the plant, and not stored up in its constituent cells; and referred particularly to the glands of Rubiaceæ, Galiaceæ, Aurantiaceæ, Passifloraceæ, &c. The statement that glands are modified epidermal cells, has long remained unquestioned. Some years ago Dr. Weddell discovered peculiar glands in Cinchonaceæ, and the results of his observations, as well as of my own, on the similar glands of Galiaceæ were detailed to the Society (Ann. Nat. Hist. ser. 2. xiv.). The homological character of these glands was not then referred to; for when viewed in connexion with the glands of Sundew and some other plants, their structure did not appear explicable on the supposition that they were formed of epidermal cells. Since my former paper was published, an extended series of observations on vegetable glands, and especially on the stipules of plants belonging to the Apocynaceæ, has shown that the cinchonaceous glands, and all other forms, are reconcilable with the idea of epidermal origin. The cinchonaceous gland consists of two kinds of cells, one of which represents ordinary leaf-tissue, and the other may be regarded as the epidermal cells transformed for secretion. The gland is, in fact, the homologue of the leaf,—a leaf very much reduced in size, as stipular leaves usually are, and with its epidermal cells changed into secreting ones; and it closely resembles in structure the stipules of *Dipladenia,* which no one can regard as being other than reduced leaves. When we see a gland thus formed by a cone of tissue elevated above the general surface of the organ to which it is attached, with its whole epidermal surface consisting of secreting tissue, we can readily understand how an epidermal gland can also be formed in the tissue of the plant, by simply introverting the epidermis. In this way the remarkable ovarian glands of endogenous plants are explained, and probably also the imbedded glands of the Orange, the latter bearing the same relation to the cinchonaceous gland as the conical receptacle of the Strawberry does to the hollowed-out receptacle of the Fig. The ovarian glands of Endogens are especially deserving of attention on this point, for we find them of very frequent occurrence; and in cases where three or more carpels are united into one fruit, these glands always occupy a position corresponding with the points of union of the carpels. Irrespective of histological characters, the glandular tissue is seen in these cases to be necessarily formed by the contiguous layers of epidermis where the two surfaces of the carpels are brought into contact.

5. "On the Development of the Yeast Plant," by Mr. John Lowe.

Mr. Lowe observed, that, under the microscope, brewers' yeast consists entirely of cells, spherical in form, transparent and nucleated, varying from $\frac{1}{7500}$th to $\frac{1}{2500}$th of an inch in diameter. The nuclei are highly refractive, and vary from two to ten in number. These nuclei were termed 'globuline' by Turpin.

The growth of yeast has been divided by Pereira into three stages. 1st, that in which the cells are single; 2nd, that in which they have become elongated, and form a mycelium; 3rd, that of aërial fructification. The first stage, or that of yeast proper, is said by Mitscherlich to consist of two kinds, viz. *Oberhefe* (or surface-yeast) and *Unterhefe* (or sediment-yeast). These two varieties are propagated in different ways, and each produces specific results upon the fermenting liquor. The *Unterhefe* is the ferment of Bavarian beer, which is allowed to ferment very slowly and at a low temperature. The formation of lactic and acetic acids is thus avoided. The following is a brief account of the changes which I have observed yeast to undergo in the process of fermentation at the distillery of Messrs. Duncanson, and at the brewery of Messrs. Jeffrey, to whose kindness I am much indebted. Before its application to the wort, yeast is seen to consist of isolated cells of a spherical form, intermixed with some which are oval or tubular. These latter are only formed on the surface of the yeast where it has come in contact with the air. They are the commencing mycelium, and should never be present in any considerable quantity, as they materially affect the process of fermentation. The spherical cells are seen to be of two kinds; the one having a thin, very transparent cell-wall, containing from two to ten nuclei; these are found in yeast which has become sour, and they are usually met with at the bottom of the yeast-cask. They appear to correspond with the *Unterhefe* of Mitscherlich. In specimens of yeast kept in bottles, I have found that the cell-wall became thinner and the nuclei more numerous in proportion as the fluid became more acid. The other kind of cell has a thicker cell-wall, and contains, instead of a number of nuclei, a large, globular, granular mass or blastema, which, in older yeast, is converted into nuclei. This is the most perfect form of yeast, and is the only kind which should be used. Its activity I have found to be always proportionate to the thickness of the cell-wall; and this, a most important subject to brewers, can easily be determined under the microscope, and thus the value of any specimen of yeast made apparent. After being added to the wort, yeast, which consists of the two varieties of cells above mentioned, is observed to undergo two kinds of growth. The nucleated cells, with the thin walls, burst and liberate the nuclei (*globulins seminifères* of Turpin), which then increase in size and become like the second kind of cells. This is the form of propagation which Turpin observed in the rupture of the cells, although he makes the cell-contents appear to be finely granular instead of nuclear. I am satisfied that it only takes place in old, acid yeast, and not, as Turpin imagined, as a result of normal fermentation; and this explains why others have failed to observe the process of bursting in fermenting yeast, for it can only be seen on the first addition of the yeast to the wort; and, moreover, in new yeast these cells are often altogether absent. The thick-walled cells and the enlarging nuclei, after the period varying according to the temperature and the activity of the yeast, are observed to put forth minute bud-like processes, which soon separate and enlarge themselves, afterwards undergoing the same process. This is the second mode of growth noticed by Turpin, and is, in fact, the only result of true fermentation. My own observations confirm those of Mitscherlich, who thinks the two modes of propagation just mentioned are the only ones, and that the conversion of '*globuline*' into cells is entirely erroneous. The budding was observed by Turpin to begin after an hour, and the gemmations were doubled in size in three hours; in eight, they had attained the size of the maternal cell. There can, however, be no stated time for these changes, for they vary with the temperature. In distillery-wash, which is worked at a much higher temperature than brewery-wort, the process begins much sooner, and is sooner completed; and, as might be inferred from the fact of their rapid growth, the cell-walls are much thinner in the former than in the latter. One very important fact results from this, viz. that yeast which has been worked at a high temperature loses a considerable amount of its activity. It is, in fact, "forced;" and if yeast of this kind be applied at once to work at a lower temperature, the process of fermentation will be late in commencing, and will often stop. If, however, the yeast be allowed to stand for a day or two, it recovers some of its activity, but it is never so good for working at a lower temperature; and, therefore, as a general rule, yeast should always be worked at a higher temperature in each succeeding operation; that is, it should, if possible, be worked in cool wort before being applied to wort which requires to be worked at a greater heat. As soon as the process of fermentation has attained its maximum, the budding begins to decline, and ceases towards the close of the operation. The cells, which were before of very variable size, now become more uniform, and the nebulous mass in their interior assumes a more definite outline, and appears to be finely granular. After remaining on the liquor for five or six days, a portion of the cells which are exposed to the atmosphere become oval, and then elongated into tubes, multiplying still by gemmation and fissiparous division. Similar formations are also found in the sediment of the tun. This is the first stage in the formation of the mycelium, and exercises an influence of an important kind over the fermentation of the liquor. The subsequent changes consist in the formation of a mycelium composed of a network of ramifying tubes. These tubes are identical in form with those given in a previous paper, and need not therefore be again described. The perfect fructification in the specimens which I have examined is that of *Aspergillus glaucus*, but there can be no doubt, as I have before remarked, that other species and genera are also present. In proof of this, a series of experiments were made in Messrs. Jeffrey's brewery, with the following results: 1st, A quantity of mixed *Penicillia* and *Aspergilli* (*P. glaucum, Asp. glaucus, A. nigrescens*, &c.) were placed in a gallon of wort, at a temperature of 65° Fahrenheit, and allowed to stand in the tun-room. On the second day the surface was covered with specks of foam. On the third day the fermentation had fairly set in, and the surface became coated with pale yeast, which, under the microscope, exhibited oval non-nucleated cells in a state of gemmation. On the fourth day, the fluid gave off a nauseous 'foxy' odour, which disappeared on the sixth day, when the yeast-cells were observed to have become spherical, and in all respects like good yeast. On the eighth day the yeast was removed from the surface, and applied to a fresh quantity of wort at the same temperature. This entered into fermentation on the first day, and exhibited all the characters of perfect yeast. The second experiment was made by placing a portion of

Penicillium glaucum in wort under the same circumstances as in experiment 1. The same series of phænomena ensued, ending in the production of good yeast. A third and fourth experiment were made with *Aspergillus glaucus* and *A. nigrescens*, with like results, the only difference being that the sporules produced by the latter were at the commencement larger and more spherical than in either of the other species, from which it may be inferred that this species would yield a better kind of yeast. The idea that yeast can be produced spontaneously in nitrogenous fluids, we hold to be entirely erroneous, for we see that the lower class of Fungi are capable of yielding it, and from the general distribution of these, they must be present in every kind of exposed fluid.

Another subject which has not received the attention it deserves, is the growth of Fungi on malting barley. Whole floors of malt may be seen in summer-time covered completely with various Fungi, which grow from the interior of the grain, and ramify within the perisperm. These must have a most important influence on the saccharine matter contained in the grain, and there can be little doubt that they effect its decomposition, and cause an immense loss to the brewer. The fact that malt made in summer-time is never so sweet as that made in winter, sufficiently attests to the truth of this observation. It is not improbable, where the fungus is so abundant as I have sometimes seen it, that one-third of the saccharine principle is destroyed, and the foundation laid for the inefficient working of the wort during fermentation.

In conclusion, I would merely remark upon one or two cases of skin-disease which I have met with in those engaged amongst the yeast in breweries. Brewers, generally speaking, are not likely subjects for the growth of parasitic plants, but I have met with several cases which seem to me to prove that these are derived from the growing yeast, and thus tend to establish the proposition laid down in my last communication regarding the origin of skin-diseases. In one brewery I met with two cases of psoriasis annulata, and one of mentagra. These occurred in the only persons who were engaged amongst the yeast. The former were both situated on the right upper extremity, in the one case on the back of the hand, and in the other, on the anterior surface of the fore-arm, about 3 inches above the wrist. It commenced as a small red spot, and in eight days had attained to the size of a shilling. On examining it carefully under the microscope, a distinct mycelium was obtained, differing in no respect from the same growth in favus, with a recent specimen of which it was compared. I have not yet had an opportunity of making inquiries at all the other breweries, but I have little doubt that other instances of a like nature will be found. Drawings were exhibited in illustration of Mr. Lowe's observations.

6. "List of Desmidieæ observed in the neighbourhood of Dundee," by Mr. W. M. Ogilvie. Communicated by Mr. G. Lawson.

This list embraced upwards of fifty species, many of them rare.

ZOOLOGICAL SOCIETY.

March 24, 1857.—Dr. Gray, F.R.S., in the Chair.

On the Nest and Eggs of the Waxwing (Bombycilla garrula, Temm.). By John Wolley, Jun., Esq.

The Waxwing, as observed in Lapland, makes a good-sized and substantial nest, but without much indication of advanced art. It is of some depth, and regularly shaped, though built of rather intractable materials. As in those of many other birds in the Arctic forests, the main substance is the kind of lichen commonly called tree-hair, which hangs so abundantly from the branches of almost every tree. This lichen somewhat resembles a mass of delicate rootlets, or perhaps may be compared to coarse brown wool; but some of it is whitish, and in one nest there is a little of this mixed with the ordinary brown or black. This main substance of the nest is strengthened below by a platform of dead twigs, and higher up towards the interior by a greater or less amount of flowering stalks of grass, and occasionally pieces of equisetum. It is also interspersed with a little reindeer lichen, perhaps a sprig or two of green moss, and even some pieces of willow cotton. There may also be observed a little of the very fine silvery-looking fibre of grass leaves which probably have been reduced to that condition by long soaking in water. In one of the nests examined there were several pen-feathers of small birds as an apology for a lining. Of other nests which are to be found in the same forest, it most resembles, but is considerably less than that of the Siberian Jay, which however is less securely put together, but has many more feathers and soft materials for a lining.

The nest of the Waxwing is built on the branch of a tree, not near the bole, and rather, as one of the observers has said, standing up from the branch like a Fieldfare's or other Thrush's nest, than supported by twigs touching it at the sides, as the nests of many birds are supported. Of six nests, four were in small Spruces, one in a good-sized Scotch fir, and one in a Birch—all placed at a height of from 6 to 12 feet above the ground. The tree in several instances was unhealthy, thin and scraggy in its branches, to which there hung a good deal of hair lichen; and the nest seems generally much exposed, though from its resemblance to the lichen hanging near, it might escape the eye. The nests found were in parts of the forest considerably open, once or twice on the side of low hills, near a river, or with an undergrowth of dwarf swamp-loving shrubs. But at present we have scarcely enough examples to show that there is a preference for any particular kind of ground.

Five seems to be the ordinary number of eggs; in one nest only there were as many as six. They have a pale salmon(?)-coloured ground, upon which are distributed pretty equally good-sized purple spots, some with more and some with less deep colour, but nearly all of them having a shade or penumbra, such as is common especially in eggs of the Chaffinch. The only very marked variety I have yet seen, has short streaks and much smaller and more numerous spots than usual, of which markings a considerable proportion are of a pale yellowish-brown. The eggs may be about an inch in length, but hardly enough have been obtained to determine the average dimensions. Marked differences in size in the eggs of the same nest have not yet been observed; but, as with other birds, we find that one nest may have all its eggs considerably larger than those of another nest.

In the backward and cold spring of 1856, Waxwings had their full complement of eggs about the 12th of June.

The writer abstains for the present from offering any remarks on the distribution of this bird in the breeding season, hoping that upon this subject, as upon the habits of the Waxwing in the summer, he may hereafter have some more complete observations to communicate.

Young of the Waxwing.

A young bird caught on the 5th of August, as it fluttered from the nest, had a general resemblance to the adult, though all the colours were more dull. The wax-like ends to the wing-feathers, the yellow tip to the tail, the black patch between the eye and the beak are all there, whilst the rich mahogany of the under tail-coverts is of a quieter brown; the blooming vinous colour of the head and back has not yet emerged from a homely neutral, and the crest is but just indicated by the longish feathers of the crown. The most marked difference between the adult and young is in the throat and under surface generally. There is at present scarcely a trace of the deep black patch of the chin, and the delicate tint of the general under surface of the adult is replaced by mottled neutral and white. This upon examination is found to owe its appearance to those longer webs, which arising towards the root of each feather, extend as far outwards as the webs which arise nearer its tip, being very pale or white, and thus relieving, on both sides, the last-mentioned darker webs.

Lapland Owl. *Strix lapponica*, Temm.

Two nests of the Lap Owl were found in Finnish Lapland in 1856. In one near Sodankyla there were two eggs, and when one of the birds was shot, a third egg was found ready for exclusion. They were placed on the jagged end of the stump of a large Scotch fir, about 12 feet from the ground, at which spot the tree had been snapped across by some storm, the upper part not yet entirely separated, but sloping downwards till the greater part of its weight was supported by the ground.

The other nest was near the Aunasjoki, at the top of a lowish Scotch fir. Some time previously in the same year a bird had been shot at this spot, which was found to be a female with eggs inside. The nest was not observed until after the shot was fired. At the second visit on the 28th of May, there were two eggs in the nest, and again a bird was shot, which turned out to be a new female with a fully-formed egg inside, through which the bullet had passed. The skin is now in England. The birds seemed on both occasions remarkably fearless.

The eggs are smoother, and, as might be expected, considerably smaller than those of the Eagle Owl. The dimensions of the two in the last-mentioned nest are 2 in. × 1·6 in. and 2·1 in. × 1·65 in.

At the meeting of Scandinavian naturalists in Christiania last summer, before I heard of these two nests having been found, I was able to announce that the Lap Owl generally makes its nest on the top of a stump. I had received several reliable accounts from different woodsmen, but had never found a nest myself, or been able to get the eggs, which indeed have, I believe, hitherto been unknown to ornithologists. It appears that three is the ordinary number of eggs.

TENGMALM'S OWL. *Strix Tengmalmi*, Gmel.,

lays its eggs in holes of trees and occasionally in egg-boxes. When once established it cannot easily be made to leave its quarters, and it can, as it is said, keep possession against a much larger bird; yet from the present nest (the only one I have had the good fortune to meet with), after having laid four eggs, the mother was ejected by a Golden Eye. The dimensions of the egg accompanying this paper are 1·32 in. × 1·05.

Muoniovara, February 2nd, 1857.

ON THE SKULL OF A SPECIES OF MECISTOPS INHABITING THE RIVER BÍNUË OR TSÁDDA, IN CENTRAL AFRICA.

BY DR. BALFOUR BAIKIE, F.R.Geogr.S., ETC.

The genus *Mecistops*, from the fewness of its numbers and the retired localities which it inhabits, is but little known, scarcely any mention of it being found in zoological writings. It was first distinguished as a species of *Crocodilus* by Cuvier, from a specimen still preserved in the Museum of the Royal College of Surgeons in London, and which he named *C. cataphractus*. Since that time two other species have been described, *M. Bennettii* or *M. leptorhynchus* from Western Africa, and *M. Journei*, said to be from New Guinea. With the exception of this latter species it is quite an African genus, inhabiting the various rivers falling into the Atlantic. In the 'Proceedings of the Zoological Society' for 1835, p. 128, the *C. leptorhynchus* of Bennett is said to have come from Fernando Po; but I should think that this, except established on undoubted authority, must be incorrect, chiefly because in that island the physical conditions requisite for its existence are wanting. Fernando Po is a small volcanic island, totally without the muddy rivers delighted in by *Crocodilidæ*, and possessing nothing beyond streams which, during the rainy season, are tumultuous mountain torrents with rocky beds. It is much more likely that the specimen alluded to was obtained from some of the numerous rivers opening into the Bight of Biafra, opposite to Fernando Po, and that it came to England *viâ* Fernando

Po, that island being a common point of call for vessels on their way home.

In August 1854, while at the town of Ojogo on the river Bínuë, my assistant procured from a native the skull of a *Mecistops*; and as this was the only occasion on which I met with its remains, and as I never saw one in the river, I conclude that it is there a comparatively scarce species. I have since described the animal to Dr. Barth, who informs me that during his lengthened wanderings he never remembers to have met with it. Crocodiles again were everywhere to be seen, and in many places most abundant.

The skull seems from its appearance to be that of an adult animal. Its extreme length is 22¼ inches, the greatest breadth being 9¼ inches, or nearly in the proportion of 2½ to 1. From this it may be inferred to be most probably *M. cataphractus*, that being the proportion of the length to the breadth in that species, while in *M. Bennettii* (if distinct) it is said to be as 3 to 1. It has seventeen alveolar sockets on each side of the upper jaw, and fifteen in the lower, in which particulars it agrees with the characters originally given by Cuvier in the 'Ossemens Fossiles,' "la longueur de sa tête étant comprise deux fois et demie dans sa largeur." * * * "On lui compte dix-sept dents de chaque côté à la mâchoire supérieure et quinze à l'inférieure," 4 ed. tom. ix. p. 116. In each are intermaxillary sockets; but for various reasons I am inclined to believe that this is the case only in the adult, and that in the young animal there are five intermaxillary teeth on each side. The ninth remaining upper tooth is the most prominent, and it is distant from the extremity of the snout 7½ inches.

In all essentials the skull of the *Mecistops* shows it to be properly a member of the family *Crocodilidæ* rather than the *Gavialidæ*. The teeth are irregular, the sides of the jaws are not parallel, there is a distinct swelling opposite the ninth remaining upper molar, and the lower canines are received in notches in the upper jaw.

The skull is considerably depressed, much produced anteriorly, and the extremity of the snout somewhat enlarged. Upper surface smooth. Forehead nearly flat, pitted, sides not raised, converging anteriorly. Cranial fossæ nearly circular, resembling those of the Gavial. Orbits rather more convergent than in the Crocodiles, and the nasal aperture more circular. Nasal bones more prolonged than in *Gavialis*, yet not reaching, as in the *Crocodili*, the nasal opening, but distant from it an inch and a half. Anterior spine of middle-frontal very long, slender, tapering, and pointed. Lacrymal bones lengthened and narrow. Notch for lower canines about an inch beyond posterior edge of nasal foramen, and about half an inch from the anterior extremity of the nasal bones. Anterior palatine foramen small. Palatine bones tapering and pointed anteriorly.

Extreme length of lower jaw 24½ inches, suture 5¾ inches in length, extending to opposite the seventh tooth on each side. Narrowest portion of lower jaw between fifth and sixth teeth, where it does not exceed an inch and three-eighths. Tenth and eleventh teeth nearly equal, the latter being rather the larger, but by no means exceeding the others in the same proportion that it does in *Crocodilus*. Its attenuated snout, narrow jaws, and small teeth would seem to indicate that it lives principally on fish.

Thus while it offers some analogies with the *Gavialidæ*, its true affinities are undoubtedly with the *Crocodilidæ*, though it may be held to represent the former in the African and other rivers which it inhabits.

April 28, 1857.—John Gould, Esq., F.R.S., V.P.Z.S., in the Chair.

Observations on the Species of the Genus Manatus. By Dr. J. E. Gray, F.R.S., F.L.S., V.P.Z. & Ent. Soc. etc.

Dr. Balfour Baikie having requested me to examine the skull of the Manatee from Africa, which he described at a preceding meeting, I am induced to send you the following observations.

There appears to be considerable confusion respecting the nomenclature of the skulls of these animals.

MM. Cuvier and De Blainville figure the skeleton and skull of the American Manatee (*M. australis*) from the same specimen sent from Cayenne in the Paris Museum. This animal differs essentially from all the four skulls from the American coast which are in the British Museum Collection, in the great elongation of the front of the lower jaw, and the comparative length and narrowness of the nasal opening. A copy of the front part of Cuvier's figures is given by Dr. Harlan as that of *M. americanus*. On the other hand, the four skulls (two of which come from the West Indies and one from Cuba) in the British Museum all agree with the skull figured by M. Cuvier as the *Lamantin du Sénégal* *, and also with that (which is probably from the same specimen as Cuvier's in a more imperfect state) which De Blainville figures under the name of *M. latirostris* of Harlan, in the short rounded form of the front end and the prominence of the gonyx on the under side of the lower jaw, and in the shortness and breadth of the nasal opening; and this appears to be different from the skull which De Blainville figured under the name of *M. Senegalensis*. The skeleton of a young female specimen from Jamaica is figured by Sir Everard Home (Lectures, iv. t. 54), and the head of this skeleton is copied under the name of *M. australis* by Wagner (Säugeth. t. 381. f. 4), and the animal is figured from a drawing by Mr. Gosse in the Figures of Animals published by the Christian Knowledge Society, as the *Manati*.

The more adult of the Museum skulls exactly agree with Dr. Harlan's figures of the skull on which he founded *M. latirostris* from the coast of East Florida.

I am inclined to believe that all the skulls from America in the British Museum, and that of a very young specimen in the same Collection, belong to one species, though they vary considerably in the height of the intermaxillary bones, in the comparative length

* The front part of this figure is copied by Dr. Harlan for comparison with that of his *M. latirostris*.

and breadth of the nasal opening, the extent of the bending down of the front of the upper jaw, the completeness and incompleteness of the orbit, and in the smoothness, roundness, or angularity and rugosity of the gonyx of the lower jaw; but I think that all these differences may be referable to the age and sex of the specimens, the upper jaw being more deflexed and lengthened as the animal increases in age. All the older specimens have a small, conical, rugose, bony prominence in the middle line of the front of the lower jaw, and the apex of the coronoid process truncated and expanded into an angle behind and before, as represented in De Blainville and Cuvier's figures of *M. australis* and *M. latirostris*. This is even the case in the skull of a very young animal with only the milk teeth.

On the other hand, in Dr. Baikie's skull of *M. Vogelii*, and in M. De Blainville's figure of *M. Senegalensis*, the coronoid process of the lower jaw is narrow above, with the hinder upper part obliquely rounded off, and with a slight angle in front; so that this is probably the character of the African species. I may also remark, that the front of the lower jaw of Dr. Baikie's specimen is produced and very differently shaped from that of any of the American skulls, and in this character it differs from M. De Blainville's figure of *M. Senegalensis*; but this difference may be only in consequence of its youth.

Dr. Harlan observes:—"Cuvier estimates the teeth at 36, nine on each side; in both my specimens they do not exceed 32, eight on each side."

In the very young skull above mentioned, which has holes for the rudimentary upper cutting or canine teeth, there are only 24, viz. six on each side; and the two hinder on each side must have been hidden in the gums. In the older skulls some have eight and others nine on each side, but in most of them only six on each side are perfect; as the anterior one on each side drops out as the new ones are formed behind, and in each of the skulls two hinder on each side are in process of development.

But the question of the permanent specific difference between the *M. australis* from Cayenne, the *M. latirostris* from East Florida, Jamaica and Cuba, and between *M. Senegalensis* of Blainville (not of Cuvier, which is like the first) and *M. Vogelii*, must wait for solution until a larger series of skulls of these species can be procured, and until the other parts of the skeleton can be compared; it being always borne in mind that, at least according to my experience, the skulls and other parts of the skeleton of the animals are quite as liable to vary in form and structure as any of the external soft parts by which they are moulded.

On the Genus Necturus or Menobranchus, with an Account of its Skull and Teeth. By Dr. John Edward Gray, F.R.S., F.L.S., V.P.Z. & Ent. Soc. etc.

Dr. Kaup lately sent to me the skull of the *Proteus of the Lakes*, *Necturus maculatus*. As it presents some peculiarities, I am induced to lay a figure and some observations upon it before the Society.

1. It is the general belief of the inhabitants of Lake Erie that the bite of the *Proteus of the Lakes* is poisonous.

Dr. Holbrook observes that by the fishermen these animals are regarded "as poisonous, and are consequently seldom taken in hand."

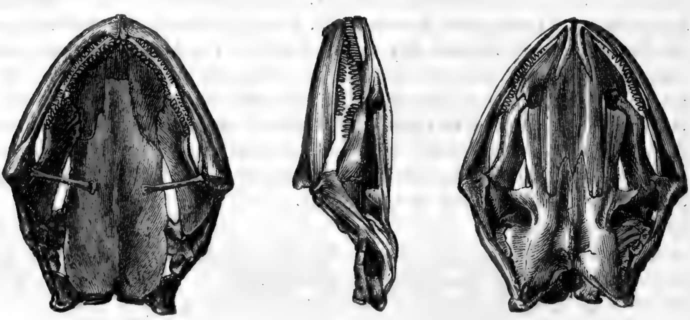
The Hon. Miss Amelia Murray in her 'Letters' mentions this animal as caught in a net at Detroit, under the name of *Fish Lizard* (vol. i. p. 172), and observes: "The fishermen said its bite was very poisonous, and it had the yellowish-brown lurid look which seems to appertain to venomous reptiles; but Dr. Kirtland says it is perfectly harmless."

And this latter opinion appears to be the almost unanimous impression of the naturalists of America.

Yet the examination of the teeth will almost justify the popular belief, and at least render it very desirable that the animal should be examined in its living state, and that its bite be submitted to careful experiment.

The upper jaw of the skull is furnished with two series of small, acute, uniform, nearly transparent, conical, slightly curved teeth, the outer series being placed on the narrow intermaxillary bone, the inner series on the front edge of the vomer and on the outer edge of the lateral processes of the pterygoid bone. The lower jaw has a single series of similar teeth, which lock between the two series above described.

All these teeth have a conical cavity on the hinder part of their base, with a short linear slit on the middle of the inner side, and an oblong perforation above the slit in the middle of the inner side of the tooth. The form of these teeth is exactly similar to the fang of poisonous Serpents; that is to say, the cavity is not a hollow in the substance of the tooth itself, but is formed by the sides of the teeth being produced and folded together, leaving a conical cavity in the inner side of the base, as is easily proved by the examination of the teeth, which shows that the cavity is lined with enamel; and the



junction of the two lateral expansions is rarely complete, but marked by a more or less distinct or continued slit between the basal notch and the subcentral foramen. In the poisonous Snakes the duct of the poison occupies this cavity; and the similarity of the form and structure leads to the idea that it may be used for the same purpose in the *Proteus of the Lakes*.

The chief difference between the teeth of the *Proteus of the Lakes* and the fangs of Serpents, is, that in the former the upper aperture of the cavity is nearer to the centre of the tooth, some distance from the apex, while in the fang of the Serpent it is generally near to the tip.

I know of no other instance of a Batrachian having this structure of its teeth, nor do I know any instance, except in the Mexican Lizard, called *Heloderma horridum,* in which *all the teeth* are uniformly furnished with a basal cavity and foramen; and this Lizard is said to be noxious, but the fact has not been distinctly proved.

2. When Dr. Barton, in his paper on the *Siren,* first described the Hell-bender (*Protonopsis horrida*), he considered the *Proteus of the Lakes* as the young state of the latter species.

The skull bears more affinity to the skull of that animal than to that of any other Batrachian, and the difference between them is just such as one might expect between the larva and adult of other similar animals; and it will be observed that the *Proteus of the Lakes* is only known in its larva-like state, and *Protonopsis,* as far as I know, only in its adult form.

The first great, and indeed almost insurmountable, argument against regarding the *Proteus of the Lakes* and the *Hell-bender* as two states of the same species, is the geographical distribution of the animals as given by the American herpetologist.

Thus Holbrook, for example, states, "The *Menopoma Alleghaniensis* (Hell-bender) is found in the Alleghany river and its tributaries, and doubtless inhabits many of the branches of the Ohio and Mississippi rivers;" and *M. fusca,* "the waters of the mountainous regions of North Carolina and Georgia;" while the Proteus of the Lakes (*Menobranchus maculatus*) has as yet been found only in Lake Champlain and Lake Erie and their tributary streams.

It is true that a second species of the genus, *Menobranchus lateralis,* according to Dr. Holbrook, "has a wide range, it being found in many of the rivers and streams that open into the Mississippi on its eastern side; but I am not aware of its existence west of that river. Say found it as far north as Pittsburg in Pennsylvania, and Troost as far south as Cumberland river in Tennessee:" and further, "the *Menobranchus lateralis* was first described by Say from a specimen taken by a hook in the Alleghany river." He proceeds: "At first I was disposed to believe that the *M. maculatus* and *M. lateralis* were one and the same animal, but I am now convinced that the latter is at least a well-marked variety, if not a distinct species; it is more slender in proportion, its colours and markings different; it is found only in the western waters that run into the Mississippi, while the former inhabits the rivers and streams that flow into the northern lakes, and all the tributaries of the St. Lawrence river."

From these remarks on the observations of other American herpetologists, one may conclude, that though one species or variety of *Menobranchus* is found in the same system of waters as the *Menopoma*, the *Menopoma* has not hitherto been observed in the same lakes, or indeed in the same district of country, where one variety or species, viz. the *Menobranchus maculatus*, is alone found, and where it is abundant.

But an experienced American naturalist, Dr. Baird, has observed, that "the non-discovery of the adult is no argument against its existence. I had caught hundreds of the very remarkable larva of *Pseudotriton Salmoneus* near Carlisle, before I found an adult." (Journ. Acad. N. Sci. Philad. 1849, 292.)

Dr. Holbrook observes, that "the *Menobranchus maculatus* is seldom taken except in the months of April and May, which is their spawning season. Their eggs are about the size of peas, and as many as one hundred and fifty have been counted in a single female."

This would lead one to believe that they are adult animals; but eggs have been equally found in the *Axolotl* of Mexico, which is regarded by most naturalists as a *larva*.

3. It is to be observed, that though the *Proteus of the Lakes* (*Necturus*) has a more distinct and separate opercular flap, united by a distinct fold under the throat, than either the *Proteus* of Carniola or the *Siren*, and in this respect more nearly resembles the *Axolotl* of Mexico and the larva of *Tritons*—yet, that, like the *Proteus anguinus* and the *Siren*, it has only two slits on each side of the neck, with a single free ray between them, the anterior and posterior cartilaginous ray being united to the skin, as in those genera; while the *Axolotl* and the larva of *Tritons* have the gill flat, quite free from the gill-rays, and there are three slits between the gill-rays as well as the larger anterior one, making four slits on each side, and the inner edge of the rays being toothed as in fishes.

From these considerations I am inclined for the present to consider the *Proteus of the Lakes* as a distinct kind of Batrachian, which is arrested in its development and never reaches the perfect state.

The skull is much more developed than in the other genera of *Meantia*, and in its outline and the disposition of its teeth it resembles that of the genus *Protonopsis* as figured by Cuvier (Oss. Foss. ii. 409. t. 26. f. 3, 4, 5), but there are no maxillary bones, and the nasal and frontals are more developed.

The exterior nostrils are on the upper surface of the margin of the nose, above the first third of the upper lip; and the inner nostrils are large, and, as in the other *Meantia*, not on the palate, but on the side of the mouth between the lips and the outer edge, near the hinder part of the series of vomerine teeth, nearly as they are in the genus *Axolotl*, well figured by M. Bibron (Herpet. t. 95. f. 2 *a*).

4. I may observe, that we have specimens both of *Necturus maculatus* and *N. lateralis* in the British Museum, the latter from the Ohio; and I cannot discover any difference between them, except that the one named *N. lateralis* has two broad, pale, dorsal streaks, and is about half the size of the other specimens; and I doubt if

these dorsal streaks are not the result of youth, and vanish as the animal increases in size, as is the case with the *Siren*.

5. While on these animals, I may observe, that Dr. Garden's specimen of *Siren* that was originally described by Ellis, which is now in the British Museum, shows a number of lines of mucous pores on the chin and on the head, the latter not being so distinct as the former, and a very distinct series of oblong white spots, forming an interrupted line along the upper part of the sides of the body, and continued to the middle of the sides of the tail; the spots on the hinder part of the body and tail being larger, more distinct, and closer. These spots evidently represent the lateral lines in *Tritons* and fish, and I have seen them mentioned in the modern descriptions of the animal.

MISCELLANEOUS.

On the Vitality of Seeds transported by Marine Currents. By M. C. Martins.

Botanists, struck by the facts establishing the transport of seeds by marine currents, have thought that the latter must have played a great part in the diffusion of the disjoined species of plants which form isolated colonies upon islands or continents separated by vast extents of sea. Geologists, surprised at the uniformity of the vegetation of the great archipelagos scattered in the ancient seas, were still more disposed to consider marine currents as the principal agents in the dissemination of seeds upon the surface of the globe. These *à-priori* conclusions have never been directly verified by experiment;—it has never been tried (1) whether many seeds are sufficiently light to float upon salt water; and (2) whether these seeds, after floating for a long time at the surface of the sea, still retain their germinative faculty.

To settle this question experimentally, the author selected some fresh seeds, of which the germination never fails, taking them from the principal families, and generally preferring those of large size, furnished with a hard and thick episperm, or those of littoral plants. The former should resist the action of salt water, from their volume and the impermeability of their envelopes; the others should have more chance of germinating if they fell upon a sandy shore.

Of 98 species, 55 floated, and 39 were specifically heavier than the water of the Mediterranean, the density of which, off Cette, is 1·0258. Four seeds had a specific gravity equal to that of salt water; these are, *Nelumbium speciosum, Datura Stramonium, Juglans nigra,* and *Gingko biloba*. Thus, of a certain number of seeds taken by chance, we may say that two-thirds float.

To try the action of sea-water upon floating seeds, the author endeavoured to place them in the same physical conditions to which they would be subjected when floating at the surface of the sea. A wrought-iron box, measuring 0·30 m. square by 0·03 m. in depth, divided into 100 equal compartments, received 98 species of seeds; each compartment contained 20 seeds of the same species. Of some large seeds there were only 6, 12, or 18, and of the small ones a large pinch was put in. The lid was then soldered on, and the walls of the box pierced with small holes, through which the water could pass easily.

The apparatus was fixed upon a buoy at the entrance to the harbour of Cette. By the rising and falling of the buoy, the box was alternately raised out of and immersed in the water, so that the seeds were exposed to the action of air and water, as if they were floating on the surface of the sea. The box remained attached to the buoy from the 14th February to the 1st April, 1856, or for six weeks; 41 of the 98 species of seeds were completely rotten. The other 57 were immediately sowed in pots of turf-mould, and placed under frames. Only 35 germinated, and from these 17 must be deducted, which, being heavier than salt water, could not have floated at the surface; this reduces to 18 the number of seeds which, after six weeks of floating, would be capable of germinating when placed in the most favourable circumstances. These are,—*Cakile maritima, Nelumbium speciosum, Linum maritimum, Paliurus aculeatus, Cucurbita pepo, Eryngium maritimum, Scabiosa maritima, Xanthium macrocarpum, Asclepias Cornuti, Rumex aquaticus, Salsola Kali, Beta vulgaris, Euphorbia paralias, Ricinus communis, R. africanus, Gingko biloba, Ephedra distachya, Pancratium maritimum,* and *Asphodelus cerasiferus.* These are the species which, after a navigation of six weeks, would have had some chance of establishing themselves upon the shore.

Six weeks being a very short time compared with that which some seeds must occupy in their voyage from one continent to another, the author resolved to replace in the sea the 35 seeds which had germinated after six weeks' exposure; of each of these 20 were placed in the same box, which was fastened to the buoy on the 17th June, 1856, and remained attached to it until the 18th September, that is to say, 93 days, or three months. At the end of this period, 11 seeds were rotten. The remaining 23 were sowed under frames, when 9 germinated; but from these 2 must be deducted, viz. *Acacia julibrissin* and *Canna gigantea,* which do not float upon sea-water. There remain therefore 7 species which might float upon the surface of the sea for three months without losing their germinative power, and these are only $\frac{1}{14}$th of the total number operated upon. They are, *Cucurbita pepo, Xanthium macrocarpum, Rumex aquaticus, Beta vulgaris, Ricinus communis, R. africanus,* and *Ephedra distachya.*

Considering the extraordinary concurrence of circumstances necessary to enable a seed thrown upon a shore to fructify and become the centre of a vegetable colony, we may conclude with Alph. DeCandolle that this mode of transport, which is so frequently referred to, can have taken only a very small part in the diffusion of the plants of the present and geological epochs; and yet the number of identical species separated by vast seas, and which marine currents alone could have transported from one continent to another, is so considerable, that the idea of the multiplicity of centres of creation will every day acquire more probability.—*Comptes Rendus,* 24 Aug. 1857, p. 266.

Description of a new Norwegian Star-fish. By M. Sars.

Astropecten arcticus.

Sinubus inter brachia rotundatis; diametro minore ad majorem (in $1\frac{1}{2}$ pollicari) = 1 : $2\frac{1}{5}$; scutis marginalibus 25; tuberculis conicis brevissimis undique obsitis, superioribus spatio paxillifero quater vel quinquies angustioribus, inferioribus latitudinem superiorum ter superantibus. Color pallide miniatus vel aurantiacus.

Size a little more than $1\frac{1}{2}$ inch. Colour pale minium- or orange-red on the dorsal surface, passing to bright yellow towards the margins of the disk and arms. The paxillæ and marginal plates are bright yellow; the spines of the ventral and adambulacral plates are bright, and the feet the same. Four individuals were taken at Öxfjord, at a depth of 100–150 fathoms, on a muddy bottom. It belongs to the third division of the genus, according to Müller and Troschel, in which there are tubercles in place of spines on the marginal plates of the back.—*Fauna Littoralis Norvegiæ,* livr. ii. p. 61.

Description of a new Tanager. By Philip Lutley Sclater, M.A., F.L.S., etc.

Euphonia Gouldi.

♂. *Supra olivacea, æneo induta: pileo usque ad oculos cum fronte flavis: subtus, gula et cervice flavescenti-olivaceis, abdomine medialiter castaneo, hoc colore flavo utrinque marginato; lateribus olivaceis flavo mixtis: crisso castaneo: rostro et pedibus nigris.*

♀. *Supra mari similis sed dilutior, fronte et pileo antico rubris: subtus flavescens, abdomine medio cum crisso dilute castaneis, lateribus flavido-olivaceis.*

Long. tota 4·1, alæ 2·2, caudæ 1·0, tarsi 0·7.

Hab. In Guatimala et Mexico Meridionali.

Gould's *Euphonia* does not sufficiently resemble any other of the known members of the group to render it liable to be confounded with them. It may, I think, be most naturally placed at the head of the section containing *Euphonia pectoralis, E. rufiventris* and others (which has been denominated *Iliolopha* by Prince Bonaparte), and will serve to connect them with the yellow-headed species which precede them in my arrangement. I have suspected its existence for some time, but these examples are the first good ones I have seen of it. I have had for several years in my possession a bird which I now find to be an immature individual of this species; and M. Sallé's collection comprised a single specimen not in very good condition, which he obtained in Southern Mexico. I gave a short description of the latter bird without naming it in my list of his collection (see P. Z. S. 1856, p. 303), but was mistaken (as I now see) in considering it a female.

This *Euphonia* is the fourth additional Tanager I have met with since completing the synopsis of these birds given in the Proceedings for last year; the others being *Calliste rufigena* (P. Z. S. 1856, p. 311), *Saltator melanopterus* (Pr. Ac. Sc. Phil. viii. p. 361), and *Pyranga roseigularis* (P. Z. S. 1857, p. 6). The latter bird was long ago described by Dr. Cabot, but at the time of completing my synopsis I had not seen specimens of it.—*Proc. Zool. Soc.* April 28, 1857.

Description of a new genus of Star-fish. By P. C. Asbjörnsen.

Genus Brisinga.

Discus aculeatus. Tessella madreporiformis marginalis. In brachiorum lateribus dorsalibus duæ pororum genitalium series; tentaculorum duæ series; os ab angulis brachiorum distans; brachia cylindracea, induta cute cum multis costellis transversalibus, calcariis, tenuibus. A brachiorum sulcis utrinque tres series papillarum acuformium, sicut aculeoli disco ceterisque partibus insidentes, et ipsæ echinulatæ, et insuper inclusæ vagina cutanea; innumeris pedicellariis tecta.

Brisinga endecacnemos, n. sp.—This is the only species. It was dredged at Hardangerfjord, at the end of August 1853, at a depth of 100–200 fathoms, where it was placed on the lateral and perpendicular plane of a mountain, which seemed to descend from 80 or 90 to 200 fathoms or more. It occurs rarely, and is very brittle, it being impossible to obtain perfect specimens, from the facility with which they throw off their arms. When seen under water in the dredge, the author describes it as a true "gloria maris." The smallest specimen obtained measured 6 inches between the points of the opposite arms; the largest was about 2 feet in diameter.

The colours are very brilliant. The disk is reddish-yellow, deeper in the centre; the arms are of a bright pale vermilion, becoming brick-red on the sides; the elevated ridges are pearly-white, and the marginal ridge greyish. The spines are pale red, with still lighter transparent vesicles at their extremities. The mouth is deep red, and all the other parts of the disk are reddish-yellow and yellowish.

This remarkable Star-fish seems to a certain extent to form a transition from the Asteriadæ to the Ophiuridæ. At the first glance it appears to be a gigantic *Ophiura* with the anomalous number of eleven arms, but it has the ventral furrows and rows of tentacles of an *Asteria*, and the structure of the skeleton and internal organs agrees with that presented by the Asteriadæ.—*Fauna Littoralis Norvegiæ*, livr. ii. pp. 95–101.

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XXX.—*On some new Palæozoic Star-fishes.* By J. W. Salter, Esq., F.G.S., Geol. Survey of Great Britain.

[With a Plate.]

It is not often that a dozen new Star-fishes turn up together from the same locality—even in the Oolites or Chalk, where we expect to meet with them. In the Silurian rocks they have been scarce indeed, except in one particular spot in Westmoreland, where, years ago, Professor Sedgwick obtained three or four species. These were described by Professor Edward Forbes, who thought he recognized in them affinities with our common Cross-fish, and in one remarkable long-armed species, to be presently noticed, relations with some Arctic forms of the *Euryales*.

Within the last twelvemonth a new and most prolific locality has been found at Leintwardine, Shropshire, and the active geologists of Ludlow have not been slow to work upon it. Col. Colvin, C. B., of Leintwardine, has also collected many specimens, and the locality is now becoming well known. Having visited it last year with Col. Colvin and Messrs. Lightbody and Cocking of Ludlow, no doubt could be entertained as to the geological position of the beds. They are the usual thin flagstones of the Lower Ludlow rock, and are covered by a thin course of Aymestry limestone, full of *Pentamerus Knightii*. The beds in question have yielded many other fossils besides the Star-fish, particularly some fine Crustaceans: *Pterygotus* (an undescribed one of great size), *Ceratiocaris* of several species, and *Limuloides*, a genus apparently closely allied to *Limulus*, but with moveable body-segments. There are also new Encrinites and Bryozoa, and abundance of the common Graptolite and shells of the Lower Ludlow rock.

The Star-fish in this locality therefore occupy nearly the same geological horizon as those found by Prof. Sedgwick in Westmoreland, viz. the upper portion of the Lower Ludlow rock; and one of them, the *Uraster primævus* of Forbes, is identical with a Kendal species.

Besides these Upper Silurian species, Prof. Forbes had one other from the Lower Silurian rocks of Wales. Another is now added, which fortunately supplies parts not observable in the species described by our late friend; and while these were being examined, a third was found among some rubbishy specimens from the Upper Caradoc or *Pentamerus beds* of the Malverns. They will be described first, as probably nearest to the living forms.

The species referred by Forbes to *Uraster* were not perfect enough for him to see whether they possessed more than a double row of suckers in each ambulacral avenue, and the general form—the reticular skeleton (above) and the tufts of short spines —resembled much the corresponding parts in that genus. But the specimens now at command are much more complete, and show that there were not more than two rows of hollows for suckers; while the other characters of the skeleton, particularly the row of great submarginal or rather *adambulacral* plates, are quite incompatible with the *Urasteriæ.*

The excessive shallowness of the ambulacra in most of the species, and the square plate-like form of the ambulacral ossicles, render two out of the five genera to be noticed unlike any of the modern forms; but in others there is a greater depth in the grooves, and the ossicles themselves are longer and narrower, and more of the ordinary type. This is the case with *Palasterina primæva* (*Uraster*, Forbes) (Pl. IX. fig. 2), the first-described of the British species; and the analogy of the pentagonal-plated, thin disk of this species with the *Asteriscus* (or *Asterina*) *roseus* is sufficiently close to induce a further comparison, and was indeed first suggested by Prof. M'Coy (Synops. Woodw. Mus. Fasc. 1, 1851).

After examination of all the accessible forms of *Asteriadæ* in the British Museum, or those figured in Müller's work, no better affinity than this could be found for the whole group—from *Palæaster* (Pl. IX. fig. 1), which in its thick and rounded arms closely resembles those species of *Asteriscus* called *Patiria* by Gray, to the extreme form of *Palæocoma* (fig. 3), in which the bordering spines are of enormous length compared with the size of the Star-fish. This latter form finds, I think, its nearest analogy in the northern form *Pteraster*, which Müller has separated from the other species of *Asteriscus*.

Protaster, in which the arms stretch far beyond the plated disk, presents some points of analogy with the latter-named genus, but it is clearly referable to the *Ophiuridæ*, and must be regarded as a new form of that family, in which the lower or basal plate (as well as the upper one) has become longitudinally divided †. The ambulacral pores (or passages for the feet) do not lie *between* the rows of plates, as in the *Asteriadæ*, but on the *outside* of them (Pl. IX. fig. 7), as in *Ophiura* (fig. 8).

Exclusive of the form last quoted, the Silurian Star-fishes present one character which effectually distinguishes them from *Asteriscus*, and indeed from any other group of *Asteriadæ*, unless it be the *Pteraster* above mentioned; it is the possession of the row of large adambulacral ‡ plates, or plates bordering the avenues before alluded to (*Goniaster* and its allies have the large plates marginal). If we compare, for instance, *Palæaster* with the living *Asteriscus* (*Patiria*) *crassus*, there is a near agreement in outline, and in the rough upper surface covered with close-set rows of prominent tubercles. But neither in this species nor in *A. graniferus*, or any other species I have seen, are the inner or adambulacral rows enlarged, although the basal pairs of each row (fig. 2, *c**) are increased in size, and bear combs of spines (in *A. Gunnii* for instance, which in this point exactly resembles our fossil).

This striking character should probably indicate a subfamily, which might be called *Palasterinæ*, and may hereafter be again subdivided according to the development or otherwise of the arms or disk respectively.

Fam. Asteriadæ.

Genus 1. *Palæaster* §, Hall. Arms thick, convex, short or

† The number of bones in the complete circlet for the arm in this genus (fig. 7) is at least six; to account for which, if we regard them as *Ophiuræ*, we must suppose the upper or dorsal plate to be divided, as well as the lower. Instances of accidental fission of the upper plate are indeed sometimes met with in recent *Ophiuræ*—*Ophiolepis* for instance; but no species is known which has it normally divided. The analogy with the *Euryales* is very remote, nor do I quite see in what way Forbes considered them allied, since no *Euryales* have the arms covered by plates externally.

‡ Forbes does not seem to have recognized this character, but to have mistaken these large adambulacrals for the ossicles of the avenues themselves: "Ossiculis ambulacralibus oblongis, latis, interstitiis linearibus," Decade i. pl. 1. p. 2. The true ambulacral ossicles are deep-set, and much smaller.

§ Prof. Hall's description of an Upper Silurian Star-fish under this name moderately elongate, and formed of many rows of small spinous ossicles above (with a madreporic tubercle near the angle of one pair of arms); ambulacra deep, with *transverse* ossicles, and a single row of large adambulacral plates. Disk plates between the arms none. [Lower Silurian to Carboniferous.] 5 species.

Genus 2. *Palasterina,* M'Coy*. Pentagonal, depressed, the arms a little produced, with three or five principal rows of tubercles above, combined with a plated disk which fills up the angles; ambulacra rather shallow, of subquadrate or slightly transverse ossicles, bordered by a single row of squarish large plates, the lowest of which (*ad-oral* adambulacral plates, Huxley †) are large and triangular, bearing combs of spines. [Upper Silurian.]

Genus 3. *Palæocoma,* n. g. Flat: all the centre of the disk above membranous, with scattered star-like spiculæ of lime, the angles filled up with a similar membrane. Arms of several rows of quadrate, reticular plates or ossicles, the outer ones fringed with spines. Beneath, the ambulacra are narrow and very shallow, the ossicles square or even elongate, and placed alternately. Two rows of bordering plates,—the inner squarish and free from spines, the outer oblique and with combs of very long spines. A loosely reticular membranous web between the arms.

Subgenus *Bdellacoma* (*βδέλλα,* a leech).

Arms as in *Palæocoma,* but elongate [and with no membranous disk between them?]; the ambulacral ossicles much contracted and with wide, open pores between. The upper surface with short, scattered clavate tubercles; margins with hair-like spines.

We have at present only one species, but the characters are so remarkable, that I cannot avoid giving it a name. If it were quite certain there was no membranous web between the arms (our specimens show no trace), it would clearly form a distinct genus.

Subgenus? *Rhopalocoma* (*ῥόπαλον,* a club).

Disk broad, membranous, with stellate spiculæ, which become square, reticular meshes upon the arms, and bear clavate, com-

does not make quite clear the structure of the ambulacra; they are, however, bordered by the large row of plates.

* Suggested by Prof. M'Coy for this Upper Silurian Star-fish, which seemed to him to differ from *Uraster,* and to resemble *Asterina.* He did not, however, describe the genus.

† Angle-ossicula (Forbes).

pressed spines. Ambulacra of slender remote ossicles, bordered by reticular plates, with club-shaped spines.

Fam. Ophiuridæ.

Genus 4. *Protaster*, n. g. Arms elongate, extending much beyond a circular, closely reticulate disk. The arms are composed above of *two* rows of deeply sculptured plates, spinous at the edge, and below of two rows of elongate ambulacral ossicles, bordered by a row of large spinous plates. The basal ossicles of the ambulacra, bordering plates, and disk, combined to form a petaloid mouth below.

Genus 5. *Palæodiscus*, n. g. Arms not produced beyond the large *plated* pentagonal disk, nor distinguishable from it above; ambulacra beneath of crowded transverse ossicles, the basal joints of which are greatly enlarged, thickened, and placed in vertical pairs to form the mouth.

There is not a complete series of affinities in the above five genera. We want a connecting link between *Palasterina* and *Palæocoma*; while the thick, obtuse-armed *Palæaster* needs some intermediate form to connect it closely with the first-named genus. The most difficult to place is *Palæodiscus*, which most resembles *Palasterina* in form and in the transverse shape of its ambulacral bones, but which is perhaps an extremely condensed form of *Ophiuridæ* allied to *Protaster*. Possibly some intermediate forms may be discovered to connect these two genera.

It is not desirable in this short sketch to give more than a diagnosis of each species, as I hope more fully to describe them in a Decade of the Geological Survey.

Palæaster, J. Hall.

We have materials to show both the upper and under surfaces, the former tuberculato-spinose, the latter with deep ambulacral grooves bordered by large plates. The madreporic tubercle is present in our figured species.

1. *P. asperrimus*, n. sp. Pl. IX. fig. 1.

P. triuncialis, convexissimus, brachiis brevioribus, fere cylindricis obtusis; pagina superiori tuberculis 12-fariis plurimis exasperata, nec coronata; ambulacris profundis, ossiculis marginalibus acuticarinatis, transversis.

Very like *Asteriscus crassus* (Gray) in general form.

Loc. In the Caradoc or Bala sandstones, at a spot called the Quakers' Burying-ground, near Welchpool, N. Wales.

2. *P. obtusus,* Forbes.

Uraster obtusus, Mem. Geol. Surv. Decade 1. pl. 1. f. 3, 1849.

P. uncialis, depresso-convexus, brachiis subconicis, disco brevioribus; infra assulis oblongis majoribus punctatis ("pagina superiori reticulato-spinosa," *Forbes*).

Better specimens than those Forbes had, show the ambulacra pierced for two rows of suckers only. The under side was closely plated-over by the large adambulacral bones, which are closely punctate. The shape was clumsy, with thick, short arms, very like the form of some recent Asterinæ.

Loc. This rarity should be sought for in the fossiliferous slates of Drumcannon parish, Waterford; also in the ash-bed west of Bala Lake, N. Wales, where it was first found by Prof. Sedgwick and myself, and mentioned under the name *Asterias primæva,* in the Quart. Geol. Journal, 1845, vol. i. p. 20. It would have been better to have kept this name, if Forbes had not appended it to the Kendal species.

3. *P. coronella,* n. sp.

P. parvulus, 6-coronatus; brachiis brevibus acutis carinatis, tuberculato-spinosis; pagina inferiori —— ?

A small species, with four rows of tubercles on each arm, and a close corona of six tubercles.

Loc. Gunwick Mill, Malvern (in the May Hill sandstone). Mus. Pract. Geology.

4. *P. Ruthveni,* Forbes, *l. c.* Decade 1. pl. 1. f. .

P. 2–3-uncialis disco fere nullo, brachiis teretibus longis subcarinatis; assulis [ad]ambulacralibus linearibus longis geniculatis.

It will not be difficult to distinguish from *P. asperrimus*; the arms are longer, slenderer, and pointed, and the disk is if possible smaller. Forbes's diagnosis (abbreviated) is given above.

Loc. Ludlow rocks, Westmoreland (Woodw. Mus.).

5. *P. hirudo,* Forbes, *l. c.* Dec. 1. pl. 1. f. 4.

It appears to belong to this genus, but is very imperfect; the lanceolate arms will easily distinguish it.

Loc. Very abundant at Pottersfell, Kendal; in Ludlow rocks.

6. There is a fine *Palæaster* in the Lower Carboniferous rocks near Barnstaple, N. Devon.

PALASTERINA, M'Coy (proposed 1851).

The type of this genus is the *Uraster primævus* of Forbes, but he would have referred it, and with it the whole group, to their true position near *Asteriscus* (*Palmipes*) but for an accident. In his enumeration of the fossil Asteriadæ*, he quotes the *Asterias antiqua* of Hisinger, not among the palæozoic rocks of Gothland, its real locality, but as from the cretaceous strata of Sweden. Its aspect is so much like that of the *Goniasters*, frequent in the cretaceous rocks, that the mistake is easily accounted for. It is an excellent species of *Palasterina*, and appears to differ from the British one chiefly in the large size of the disk, and consequent pentagonal outline.

P. antiqua, Hisinger, Leth. Suec. p. 89. t. 26. f. 6.

Loc. Mt. Hoburg, Gothland, Sweden; in Ludlow rocks.

1. *P. primæva,* Forbes, Mem. Geol. Surv. Dec. 1. pl. 1.
Pl. IX. fig. 2.

P. brachiis triangularibus acuminatis, disco lato brevioribus; pagina superiori tuberculata, brevi-spinosa; ossiculis [ad]ambulacralibus subquadratis, convexis, basalibus majoribus.

The basal, or angle-ossicula are enlarged, three-cornered, and furnished with a pyramid of spines pointed inwards. The upper surface is roughly tuberculate, and with short tufts of spines.

Loc. Underbarrow, Westmoreland; a common species in the Ludlow rocks. Leintwardine, Shropshire (fig. 2 is from thence).

PALÆOCOMA, n. g.

These differ widely from *Palasterina* in appearance, and in the much smaller amount of calcareous matter entering into the composition of their skeleton. Yet the principal characters by which they differ are the elongated shape of the narrow ambulacral bones and the double row of bordering plates, the outer of which bears the combs of long spines.

The spines are often so long as to form a complete fringe, and in one species, *P. Colvini,* the disk is equally spiniferous. In the curious subgenus *Bdellacoma* they are short, and intermixed with some larger clavate spines on the upper surfaces. And in the extreme form, *Rhopalocoma,* which may hereafter have to be separated as a distinct genus, the hair-like spines are all absent, and clavate ones take their place.

* Mem. Geol. Surv. vol. ii. pt. 2. p. 481.

[If *Pteraster militaris,* Müll., be compared with our fossils, it will be seen that the *inner* row of plates bordering the avenues is very large, but bears a comb of spines comparable to that on the *outer* row of *Palæocoma.* For the accompanying figures I am indebted to the kindness of Mr. L. Barrett.

Fig. 1.

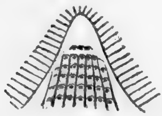


Fig. 2.

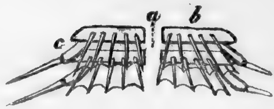


Fig. 1. *Pteraster militaris*; part of reticulated upper surface.
Fig. 2. Ditto, inferior plates, with combs of spines: *a,* ambulacral space; *b,* adambulacral row of plates; *c,* outer series.]

The first discovered and most plentiful species of *Palæocoma* is the

1. *P. Marstoni,* n. sp. Pl. IX. fig. 3.

P. triuncialis, brachiis lanceolatis, quam latis quadruplo longioribus, apicibus obtusis; ambulacris angustis; spinis brachiorum marginalibus rigidis haud longis; ore magno.

Shorter spines, set at a wide angle from the margins of the arms, distinguish this from the next species. The beautiful and delicate web-like disk between the arms bears short spines also; it is sometimes expanded as in our figure, but more generally contracted, so as only to make the arm a little broader, and give it a blunt appearance. The mouth is wide, of a true pentagonal shape, and with rather strong bordering plates, of which the triangular adambulacral plates (*) in fig. 3, *b,* are most conspicuous. The stellate calcareous spiculæ which dot over the thin disk are easily seen through the opening of the mouth.

Dedicated to my young friend Mr. Alfred Marston of Ludlow, to whose kindness I owe much valuable information, and the free use of all his choicest specimens. He is an ardent collector of the fossils of his district, and well acquainted with their characters.

Loc. Church Hill, Leintwardine. (Lower Ludlow.)

2. *P. Colvini,* n. sp.

P. planus, sesquiuncialis, spinis longissimis flexuosis hirsutus; brachiis ligulatis et cum disco tenui spinosissimis; ambulacris angustis; ore parvo.

Col. Colvin, C.B., of Leintwardine, found the first specimen of this remarkable star-fish, which in the length of its hair-like spines exceeds any known species, recent or fossil. It is in many respects like *P. Marstoni.*

There is another species very like *P. Marstoni,* but with slenderer and less closely reticular arms, much longer in proportion, clothed with delicate short spines, and with a thin, membranous, inter-radial web. It may be called *P. cygnipes,* and be thus characterized:—

3. *P. cygnipes,* sp. nov.

P. 2½-uncialis, tenuis, disco membranaceo expanso; brachiis elongatis brevi-spinosis; ore parvulo rosaceo.

Same locality as the last.

Subgenus Bdellacoma.

4. *P.* (*Bd.*) *vermiformis,* n. sp.

P. brachiis longis linearibus, brevi-spinosis, tuberculis clavatis remotis; assulis ambulacri lati alternatis, remotis, intervallis rotundis.

Differs from both the preceding by its short spines, long arms, and wide, flat, ambulacral avenues with large alternating apertures for the suckers. It is doubtful if these avenues are bordered by more than a single row of plates; but as there is a double set of tufts of spines, this is probable.

The main character of the species, however, and that which distinguishes the subgenus, is the possession of scattered clavate tubercles over the upper surface. These are nearly as long as the spines. The ambulacral avenues, too, appear to differ materially from those of *Palæocoma,* in which they are remarkably narrow and the plates close, while in *Bdellacoma* they are broad and the ossicles remote.

So much depends, however, on the state of preservation in these shale fossils, that I do not feel warranted at present in ranking *Bdellacoma* higher than as a subgenus. The ambulacra are not clearly seen.

Loc. Leintwardine.

Subgenus Rhopalocoma.

5. *P.* (*Rh.*) *pyrotechnica,* n. sp.

P. 2½-uncialis, pentagona; brachiis brevissimis reticulatis; spinis brevibus clavatis compressis.

The subgeneric and specific characters of this fine species must be taken together, and reside in the distribution of short, broad, clavate and compressed spines over the upper surface and margin, rather more than their own breadth apart, and set on at the intersection of the reticular meshes which cover the arms and the angles between the arms, but which are quite absent from the central portion of the disk. This central portion above, which corresponds to the wide aperture of the mouth on the under surface, is covered only by scattered, stellate, calcareous spiculæ of large size. A closer reticulation is found on the portions between the arms, and the meshes become square in a double row down the middle of the rays, and appear to correspond nearly in position to the ambulacral bones of the under surface. The latter are very slender and remote, even more so than in *P. vermiformis*, and form a broad ambulacrum, with only a few reticular plates bordering it, which bear clavate spines at intervals. The mouth-angles project a good deal inwards, and are armed with short combs of spines.

Loc. Leintwardine.

Protaster.

The species on which Forbes founded this genus is intermediate in size between the larger and smaller species here described. But it presents the same essential characters, the parts varying in proportion only: the plated disk, the arms reaching nearly to the centre, and forming a pentagonal rosette, and the double row of plates above and below. The largest form of the genus is the

1. *P. Miltoni*, n. sp. Pl. IX. fig. 4.

P. magnus, disco calcareo subrotundo, brachiis 3–4-uncialibus, latis; ossiculis incrassatis paribus, superne concavis, ad angulum internum perforatis *ambulacro** lato; assulis oris rectis.

The roundish disk of this conspicuous species is often more than 1 inch wide, and covered with small ridged plates. The arms are wide, composed of large ossicles, which become smaller at their base of insertion in the disk above, leaving a wedge-shaped space between, which, joined with those of the other arms, forms a conspicuous pentagon above, equal in size to that formed by the divergent ossicles of the mouth below.

The arms themselves are made up of a double row of about forty pairs of squarish concave plates above, placed exactly opposite, not alternating as in other species (Pl. IX. fig. 4, *b*). The sutures between these are deep, and the inner angles marked with a deep pit or pore, bounded by tubercles set cross-fashion. The outer margin bears a tuft of spines, long and short. On the

* The term may be conveniently applied to the pair of central plates (subambulacrals), though they cover the true ambulacrum.

under surface (4, *c*) the marginal plates are highly convex, and between them lies a double row of central plates of an hour-glass shape, on the outer sides of which, and between them and the marginal row, is a large round aperture on either side—the passage for the suckers or feet. The marginal plates bear a row of spines as long as the width of the arm, and striated across.

The oral pentagon is made up of twenty bones, five pairs of which are the central row enlarged (*), and these diverge at a wide angle, and nearly join the neighbouring pairs; the other five belong to the lateral rows, and are linear (×), set parallel, and bear the conspicuous, triturating combs of spines. The oral ossicles in this species form an angular pentagon, being made up of straight pieces; in some others they are arched, and give an ogive form.

Loc. Abundant and of all sizes in the quarry at Leintwardine. The environs of Ludlow have been rendered classic by the great author of 'Comus.'

2. *P. leptosoma*, n. sp. Pl. IX. fig. 5.

P. disco tenuissimo, brachiis angustis, superne ossiculis alternatis semisulcatis; infra ambulacro angustissimo impresso, spinis brevibus, paucis ?; ore rosaceo.

This is also a very abundant species, and occurs in hundreds over the surface of the slabs, just as *Ophiuræ* are now found in clusters upon the muddy bottom, the dredge often coming up filled with a single species.

It is a small star-fish, the rays seldom above an inch long; and the central disk apparently very thin, and often scarcely visible on the stone. The oral pentagon, however, is always conspicuous, and is of a beautiful petaloid shape, made up of a series of ogives, the salient angles of which are inserted into the base of the arms, and formed of three pairs of bones (while in *P. Miltoni* only two are distinct, and these are set in an angular form); small spines are affixed to their extremities.

The arms appear more slender than they really are, in consequence of their being only convex along the median line; the sides of the ossicula are very thin, and only by careful search can the prominent margins be seen. These are thickened a little along the outer and the hinder edges, but not in front; and the squarish plates (more transverse near the mouth and elongate towards the tips) are rounded-off behind and pointed in front, so as to be somewhat falcate.

The plates of the lower surface are four, as in the other species, the lateral ones squarish, and bearing rows of short spines; the middle rows are exceedingly narrow, and offer an excellent character for distinguishing the species; they are scarcely half the width of the outer plates.

Named in compliment to our friend R. Lightbody, Esq., of Ludlow, an indefatigable collector and liberal donor.

From the same locality as the last.

3. *P. Sedgwicki*, Forbes.

P. Sedgwicki, Forbes in Mem. Geol. Surv. Decade 1. pl. 4.

P. disco conspicuo, brachiis elongatis, superne ossiculis quadratis, alternatis, profunde exaratis, infra ambulacro latissimo, ossiculis convexis; spinis —— ?; ore rosaceo.

The disk in this species is large, full $\frac{3}{4}$ of an inch in breadth, and coarsely reticular. The arms start nearly from the centre, leaving a small five-petaled rosette, which corresponds to the oral pentagon below. The rays are rather broad, and very strongly sculptured, convex along the middle line, as in *P. leptosoma*, with a sharp median line and short sutural grooves. The outer half is far more deeply grooved than in the preceding species, the strong, oblique furrow occupying nearly all the central portion of each ossicle, and leaving a thickened margin all round. The ossicles are transverse, nearly twice as wide as long, and show no trace of spines in the figured specimen (a cast of which I have before me), though such are represented by Forbes in his restored figure, having probably been detected in other specimens.

On the under side the arms present a good character in the very wide and convex median (ambulacral) rows, much wider than in *P. Miltoni* or the *P. leptosoma*, and even wider than the lateral plates. The central pentagon is very deeply cut, of five oval, pointed petals.

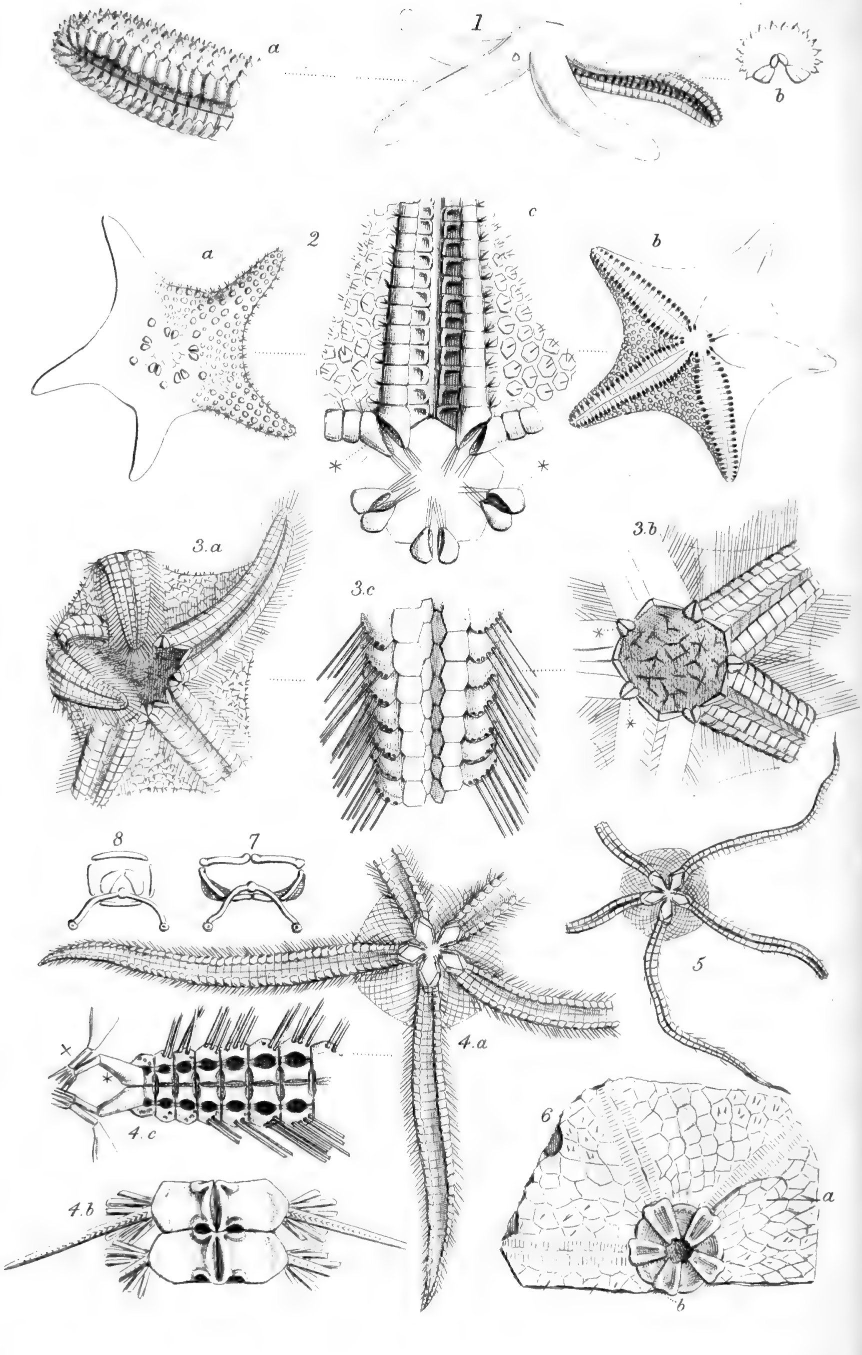
Loc. Underbarrow, Westmoreland.

4. Another species of this genus, *P. Salteri**, should be sought for by collectors in the *Lower* Silurian rocks, near Cerrig-y-Druidion on the Holyhead Road. Prof. Sedgwick and myself found a very perfect specimen in the large quarry there, but it was unfortunately lost by the late Prof. Forbes.

Palæodiscus, n. g.

It now only remains to notice the somewhat anomalous form to which the above name seems appropriate, and which, whether it eventually prove to be an incomplete specimen or not, differs

* Quart. Geol. Journal, vol. i. 1845, p. 20.



J. W. Salter del.

J. D. C. Sowerby sc.

widely, both in specific and generic character, from all that are yet described.

P. ferox. Pl. IX. fig. 6.

P. disco magno, e squamis hexagonis majoribus spiniferis structo; assulis (brachialibus *seu*) *ambulacralibus* intra discum creberrimis; ossiculis oris robustis parallelis.

We have only the disk, and its angles are not complete. It is composed of large, irregularly rhomboid plates, radiating in seven or eight rows from the mouth in each interambulacral space, and furnished with short spines.

The inner angles of each of these spaces form a prominent triangular boss or tubercle, cut off distinctly by a furrow, and between these are the large elongated basal plates (*b*) of the ambulacra, lying parallel, and not at all divergent. They are thick and blunt, and, together with the bosses above mentioned, form a circumscribed star in the centre, the massive character of which contrasts strikingly with the thinness and delicacy of all the other parts either of the ambulacra or disk. The ambulacra are narrow, composed of a double row of transverse plates, narrower and more crowded than in *Palasterina* or *Palæaster*, and apparently very thin in texture. They can be detached, and leave the upper plated surface (*a*) free, which is covered with the irregular plates. If there be no deception in this—for we have only a single specimen—the affinity would be much closer with the forms above mentioned, although the strong oral apparatus reminds us more nearly of the *Protaster*. Till other specimens are obtained with the angles perfect, it will not be easy to decide whether it be an Ophiurid with contracted arm-plates, or one of the Asteriadæ with a greatly developed masticatory apparatus. The powerful teeth suggest the specific name. The specimen is in the cabinet of Mr. Marston of Ludlow, who has contributed largely to the illustration of these Silurian star-fish.

Loc. Leintwardine.

Other species, both of *Protaster* and of *Palæocoma*, are known, but it is only necessary here to notice those which serve to illustrate the genera proposed in the Reports of the British Association for 1856, p. 76, Trans. Sections. There are, no doubt, many species yet to be discovered in the old rocks of our own country, and, judging from what has already been collected, a great variety of forms may be expected to reward research.

EXPLANATION OF PLATE IX.

[The figures are only diagrams, but express the principal characters of the species represented.]

Fig. 1. *Palæaster asperrimus*, n. sp. Lower Silurian. Welchpool, North Wales: *a*, magnified underside; *b*, section of arm.

Fig. 2. *Palasterina primæva*, Forbes. Upper Silurian (Lower Ludlow rock). Church Hill, Leintwardine, Shropshire: *b* is a cast of the lower surface; *c*, portion of ditto, magnified, showing the large adambulacrals and their basal ossicles (*).
Fig. 3. *Palæocoma Marstoni*, n. sp. Same locality: 3 *b*, somewhat magnified; 3 *c* shows the narrow ambulacral rows, the broad smooth adambulacrals, and the outer spine-bearing rows.
Fig. 4. *Protaster Miltoni*, n. sp. Same locality: 4 *a*, nat. size; 4 *b*, upper plates magnified; 4 *c*, lower surface with the large pores.
Fig. 5. *Protaster leptosoma*, n. sp. Same locality.
Fig. 6. *Palæodiscus ferox*, n. sp. Same locality.
Fig. 7. Section of arm of *Protaster*, for comparison with *Ophiura* (fig. 8). It shows the *six* component plates.
Fig. 8. Section of the arm of *Ophiura*, to show the *four* component plates and the passage for the suckers.

XXXI.—*Observations on the Habits of various Marine Animals.* By Madame Jeannette Power†.

On the Food and Digestion of the Bulla lignaria.

From 1832 to 1842 I was engaged in studying marine animals in aquaria established in my house at Messina. These aquaria were filled with sea-water, and about 1832 I gave them the name of 'cages‡.' In 1833 I invented other aquaria, which I also called 'cages'§; these I deposited (after obtaining permission from government) in a stream of sea-water which flows through the lazaretto of Messina.

Marine animals of large and moderate dimensions being thus kept in their native element, were in a better condition for my investigations than in the aquaria placed in my house; and as the sea which washes the coast of Sicily is very limpid and transparent, I was enabled to observe the least movements of my animals minutely and exactly.

The smaller marine animals I continued to study in my own house; and I had also invented a small glass aquarium, which I suspended by means of cords in a large 'cage' in the sea.

After publishing memoirs upon *Argonauta Argo* and other marine animals, I proposed to continue my publications; but, unfortunately, in the confusion of packing-up, preparatory to my departure from Sicily, my manuscripts were mislaid, and I

† Communicated by Prof. Owen.

‡ See the Journal of the "Cabinet littéraire de l'Académie Giœnia de Catania" for December 1834, in which Professor Carmelo Maravigna gives an account of the investigations which I made upon *Argonauta Argo*, in my own house at Messina.

§ In 1835 these cages received from the Académie Giœnia the name of 'Gabiole alla Power,' and in 1838 the Zoological Society of London called them 'Power cages.'

have only just discovered them amongst some old papers; I therefore hasten to lay the following observations before you.

Having procured several living specimens of *Bulla lignaria*, I opened their digestive sacs, to ascertain what their nourishment consisted of; in almost all I found small specimens of *Dentalium entale*. I then set myself to investigate the mode and the time which they employ to digest the *Dentalia*.

On the 15th July 1836 I placed some specimens of *Bulla lignaria* in a 'cage,' without providing them with food, and on the 16th I placed close to my *Bullæ* a quantity of *Dentalia*; when, by not losing sight of the *Bullæ*, I saw that they devoured the *Dentalia*. An hour after their repast, I took one of them, opened its digestive sac carefully, and found in the alimentary canal, extending in a straight line from the mouth to the orifice of the digestive sac, five *Dentalia* placed side by side, and their points were already digested for a distance of 2 millimetres in length. The digestive sac of the *Bulla* consists of two very hard pieces, supported by membranous and elastic ligaments, which allow the movement of trituration, and this acting from right to left, and facilitated by the gastric juice, reduced the *Dentalia* into a nutritive pulp; they slip by little and little and altogether into the sac, in proportion as the animal triturates them. This is the only food of the *Bulla lignaria*.

Two hours after my first observation, I took a second *Bulla*: its alimentary canal only contained four *Dentalia*, which were more than half digested. Two hours afterwards I took a third: of six *Dentalia* which it had in its alimentary canal, there only remained a length of 3 millimetres. The last that I opened had employed seven hours in its digestion.

From the observations which I have made, I have ascertained that some *Bullæ* digest more rapidly than others.

On the Nourishment and Digestion of the Asterias (Astropecten) aurantiacus.

On the 20th July 1836, I placed three large specimens of *Asterias* in a 'cage,' and left them until the 23rd, without giving them any food; I weighed them, noted their weight, then put them again in the cage, and placed within their reach a quantity of living *Naticæ* of various dimensions, and some *Trochi*. The *Asterias* feeds only upon these mollusks.

The mode in which it swallows and arranges them in the interior of its rays and body is very curious. It commences by seizing a small *Natica* with the point of each of its rays, and then brings it gradually up to the body, which is of a spherical form; it places on, or beneath the body a circular row, and then a second of rather larger size, and so on, finishing in the centre with a very large one; after this it buries itself in the sand, and remains quiet to digest its food, employing in this function two or three days, and sometimes more. I weighed my Star-fishes again after their repast: one of them had swallowed 370 grms. of *Naticæ,* the second 256, and the third 240.

They have the habit of coming out of the sand early in the morning, hide themselves about nine o'clock, and reappear about four in the afternoon, when the heat of the sun begins to diminish.

Observations upon Octopus vulgaris *and* Pinna nobilis.

Into one of my cages I had put a living *Pinna nobilis* adhering to a fragment of rock; this cage also contained an *Octopus vulgaris* and some living testaceous Mollusca which I had placed there for the purpose of my investigations.

One day, whilst observing my animals, I saw that the Poulpe was holding a fragment of rock in one of its arms, and watching the *Pinna,* which was opening its valves; as soon as they were perfectly open, the Poulpe, with incredible address and promptitude, placed the stone between the valves, preventing the *Pinna* from closing them again, when the *Octopus* set about devouring the mollusk.

The next day I was observing the Poulpe again, when I saw him crush some *Tellinæ,* then search about amongst other shells, and finally stretch himself close to a *Triton nodiferum.* I had the perseverance to remain on the watch for four hours. The *Triton* extruded half the body from its shell, no doubt with the purpose of going to seek its food, when the Poulpe sprang upon it, and surrounded it with his arms; the mollusk retired precipitately into its shell, and in closing this with its operculum pinched the point of one of the arms of the Poulpe, which, by struggling, at last left the tip of his arm in the shell of the *Triton.*

It would require whole pages to describe all the stratagems employed by the Poulpe for the capture of his prey. I should have to tell things which would appear incredible; and his voracity is such, that notwithstanding the abundance of nourishment with which I furnished him, I was compelled to remove him from the cage, or he would have devoured all my Mollusca.

I would beg Professor Costa and others who occupy themselves with this branch of science to repeat my experiments in their aquaria; they are of the greatest interest in the appreciation of the habits of this animal. So great is its voracity, that it even attacks man, tears away his flesh, and eats it. In the Port of Messina they occur in great numbers and of large size.

XXXII.—*On the discovery of* Cnicus tuberosus *at Avebury, Wilts**. By Professor Buckman, F.L.S., F.G.S., F.A.S. &c.

In reporting upon our meeting at Avebury, Wilts, on July 15, 1856, I took occasion to remark upon some interesting plants which I had obtained from the Druidical Circle; and amongst notes upon others, will be found the following:—

"*Cnicus acaulis*, Stemless Thistle, with—anomalous as it appears—stems several inches high. This is one of the forms which has given rise to the many synonyms by which the true species is surrounded†."

In July of the present year I found myself at the Avebury Circle in company with my friend Edwin Lees, Esq., F.L.S., F.G.S., when this Thistle was more minutely examined by us; and upon carefully getting some specimens up by the roots, we were pleased to find that it agreed in this and other respects with the *Cnicus tuberosus*, Willd., Tuberous Plume Thistle,—a specimen of which appears to have been sent by A. B. Lambert, Esq., to Sir J. E. Smith, and is figured in 'English Botany,' t. 2562, to the description of which is appended the following *habitat*:—"A copse-wood, called Great Ridge, on the Wiltshire Downs, between Boyton House and Fonthill, abundantly;" and Smith states that he there gathered it in 1819‡.

For many years, however, this form appears to have become extinct in this its original habitat; and it was thought to have been entirely lost to our flora until within the last few months, when my friend Mr. W. Cunnington of Devizes fortunately discovered that a nurseryman in his neighbourhood had propagated the plant from its original stock presented to the nurseryman by Lambert himself; the two or three specimens thus handed down are now in Mr. Cunnington's possession; and upon paying him a visit at Devizes, on our way from Avebury to Stonehenge, I was gratified to see a specimen in full flower in his garden, as well as two dried examples in his herbarium; from an examination of these, I am enabled to declare their complete identity with those I had so recently gathered at Avebury.

Here, then, we have a curious example of a plant having been lost for many years in one locality, and subsequently occurring in another; and yet, though the collecting botanist may perhaps felicitate us upon restoring this to the British flora, I have myself great hesitation in receiving it as a true and un-

* Read to the Cotteswold Club, Oct. 6, 1857.

† Address to the Cotteswold Naturalists' Club, by Prof. Buckman, Jan. 27, 1857, p. viii.

‡ English Flora, vol. iii. p. 393.

doubted species, the grounds for which I would shortly sum up as follows:—

It occurs sparingly at Avebury, surrounded by the true *Cnicus acaulis* and *Cnicus acanthoides* in great abundance.

Its most important distinctive character will be found in the radical tubers, which, in full-grown examples, are somewhat large and fleshy, and unilaterally placed on the rhizome. In smaller specimens the roots are long and flexile, but not expanded into tubers,—which is just the state in which they occur in the *Cnicus acaulis*.

It is true that it cannot be described as *acauline*, as the stem is more than a foot in height, but this is also often the case with the true *acaulis*, as we have now before us examples of this species several inches high.

From these circumstances, in connexion with the rarity of the tuberous form in a plant that seeds so abundantly, each head of flowers being capable of perfecting as many as 150 seeds,—taking also into consideration the well-known sporting propensity of this genus,—I cannot help thinking this to be a *hybrid*; and from the fact of the abundance of the two forms before indicated in its immediate vicinity, we may not unreasonably look upon them as the origin of our tuberous type.

There is perhaps no genus of plants more perplexing to the botanist than that of *Carduus*, which is now made to include *Cnicus*; hence the variation in the number of species in our different floras; and thus Babington heads his descriptions of them with the following significant note—"many hybrids occur in this genus*;" and my friend Lees has kindly furnished me with the following note upon another disputed species, which bears directly upon this question:—

"In August 1856, I found the *Cnicus Forsteri* of Smith, in a field near Crowle, Worcestershire. In the same marshy field was a considerable quantity of *Cnicus pratensis* and a very numerous growth of *C. palustris*. The position of Forster's Thistle was between the *C. pratensis* and *C. palustris*, so as to give rise to an immediate suspicion of its hybridity; and, upon examination, the characters shown by *C. Forsteri* were exactly intermediate also. The leaves were much like those of *C. palustris*, while the stem and flowers were in small clusters, instead of being single as in the latter. Indeed, the result of my examination convinced me that *C. Forsteri* could be only a hybrid; and this I stated in an account I sent to the 'Phytologist,' and which appeared in the September Number of that Journal for 1856."

For the present, then, I must content myself with having

* Manual of British Botany, 3rd edition.

offered presumptive evidence of the non-specific character of what is, after all, a decidedly distinctive form; and as I have brought home some specimens and planted them in my botanical garden, where I shall also introduce the *acaulis* and *acanthoides*, I shall look forward to the result of experiments with these with no little degree of interest, as in all probability, like so many other experiments which I have been enabled to perform in the same direction, these may serve still more to perplex the question "What is a species?"

Cirencester, July 1857.

XXXIII.—*On the* Amphioxus lanceolatus. By Alexander Lindsay, M.D.

The *Amphioxus lanceolatus* is said to inhabit most, if not all, the European seas. It was first discovered on the coast of Cornwall. Since that time it has occasionally, and at distant intervals, been found on various other parts of the British coasts. The late Mr. Yarrell, to whom we are indebted for its first accurate description, had, when he wrote, only one specimen for his guidance. Mr. Goodsir, who ably investigated the anatomy of this interesting fish, had, while making his researches, only two at his disposal. Hitherto it has been reckoned among the rarest of our fishes,—the securing a specimen a something worthy of note.

The object of this communication is to show that in some localities the *Amphioxus* is neither so rare nor so difficult to obtain as is generally supposed, and that in localities supplying the necessary conditions for its existence, it may be sought for with every hope of success. We think it due to naturalists to make them aware of this fact. To the zoologist this little creature is full of interest, to the anatomist and physiologist equally so. From the transparency of its tissues, and from its being, like all animals low in the scale of organization, tenacious of life, it affords great facilities for microscopic observation.

The writer was desirous of procuring an *Amphioxus* for anatomical purposes. Aware that it had been obtained within recent years on the west coast of Scotland, he concluded that by a diligent search others might be secured. His own opportunities for researches of this kind being few, he solicited the aid of an intimate friend and industrious naturalist, Mr. David Robertson of this city. He is engaged in preparing a list of the Crustaceans procurable in the Frith of Clyde, for the Natural History Society of Glasgow. Much of his spare time being devoted to dredging for this purpose, he was requested to watch for the fish when opportunities offered for pursuing his investigations. In April last he succeeded in obtaining one.

No further examination of the ground whence the first was obtained was made till August. In that month the writer, with his friend and a companion naturalist, Mr. Little of Millport, made arrangements for a second exploration of the locality. To the surprise of all, we captured no less than three in our first dredge, and on the same day other three were taken. On a subsequent occasion, Mr. Robertson obtained five in one haul. Without entering into particulars, we may at once state, that in five different dredgings, on separate days, twenty-two were captured.

The scene of operations was on the Ayrshire coast, near Portincross, at a point nearly midway between the mainland and the east end of the Little Cumbrae. Dr. Landsborough mentions his having dredged one near the same place.

On looking at some statements regarding this fish, it is said to be found principally among sand. It may be so; but this did not by any means accord with our experience. Invariably they were present in clean unmixed gravel. When even a very moderate amount of sand or mud appeared in the dredge, we soon learned not to expect the fish. As regards this, we were never disappointed. It was further remarkable, that when we had secured the *Amphioxus,* there was a complete absence of everything else likely to interest either the marine botanist or zoologist. To this we may state there was one exception, there being invariably an Annelide present, evidently one of the family Nereidæ. The species we were unable to determine.

Already we have spoken of the tenacity of life manifested by the *Amphioxus*. Half an hour under the microscope seemed to interfere little with its vitality: on being replaced in the water, it darted rapidly off, little the worse for the examination. It may not, however, be always convenient to examine them in the live condition. When placed in alcohol, they speedily become opake: the addition of soda, in certain proportions, is said to prevent this. We cannot on this point speak from our own experience; but we can confidently advise the use of glycerine as a preservative fluid; the appearance of specimens of the *Amphioxus,* after being put up for weeks, being not in the slightest degree altered.

169 George Street, Glasgow.

XXXIV.—*On the Production of Varieties and Monstrous Flowers by Pruning.* By B. Clarke, F.L.S., &c.

As the varieties of species are attracting increased attention, and the circumstances in which they originate are becoming more particularly attended to, the following notes on the effects of increased luxuriance from pruning, and especially on the seed, may perhaps assist in throwing further light on this department of vegetable physiology, as making it, I believe, sufficiently evident that varieties, and not improbably improved varieties, could be produced, at least in some instances, by placing a plant in peculiar circumstances during the period of flowering.

Having cultivated female specimens of the variety of Hemp known as *Cannabis indica*, for the purpose of inquiring into the truth of the report that seeds could be produced without the fertilizing influence of pollen, and apparently with success, as a few seeds came to perfection*, a specimen of the common variety was grown, to further substantiate, if possible, the result of the trial with the *C. indica*.

It was raised so early as to be in flower in the last week of June, but, unlike the *C. indica*, the first flowers produced no seed, although the plant was growing much more luxuriantly. The upper portion of the stem was then cut off, for the purpose of giving to the remaining masses of flowers an increased supply of sap; but this also failed, except that three or four fruits were observed growing on the main stem, the masses of inflorescence remaining quite barren, although the remaining foliage had acquired a deep and very luxuriant green. The experiment was then continued by cutting off each fresh shoot as soon as it appeared; but it bore no more seed till about the latter end of August, and then twelve or fifteen were observed in the outer portions of the masses of inflorescence.

The following spring these seeds were planted; but, as some

* Two plants of this variety were raised late in summer, and flowering in the autumn, proved to be both females; they produced two seeds each from the first pairs of flowers, some time after the male plants usually have ceased flowering; neither was Hemp known to grow in the neighbourhood. These were planted early in the following spring, and proved to be all female plants, which in some degree confirmed the supposition that they were produced without the aid of pollen. Two or three of them produced seeds from the first flowers as before, and then remained barren until some male plants of the common variety, which had been sown later, came into flower, and they then fruited abundantly. One of them, however, which which was quite as strong or rather stronger than the others, and covered with flowers, bore no seed, although masses of male flowers were repeatedly placed upon it; but as its ovules appeared to be perfect, as in the other plants, its barrenness was thought to be the consequence of the seed from which it had been raised having been produced without the aid of pollen.

of them proved to be males, it was concluded that some male plants must have been growing in the neighbourhood. Among them, however, was a plant having a peculiar appearance, and it was found that instead of the two opposite or somewhat alternate leaves which Hemp usually has, it had three regularly opposite leaves at each node, which was continued quite to the summit of the inflorescence. The plant being a female, it was fertilized by the flowers of a male, the inflorescence of which had for the most part been cut off, to give an increased luxuriance to the remaining part, and an abundance of seed was produced. From this seed twenty plants were raised, and six of them not only have three leaves opposite, but five of them germinated with three equal opposite cotyledons; and in two instances, two embryos were produced, in one of them the two being adherent by their cauliculi. Of the five plants with three cotyledons, a part are males, so that a permanent tricotyledonous variety could most probably be produced by cultivation, particularly as the tricotyledonous plants are all of them amongst the largest, the greater part of the dicotyledonous being comparatively small.

This unexpected result suggested that by cutting away the greater part of the inflorescence of a plant just before flowering, so as to give the remaining flowers an increased quantity of sap, improved varieties might be produced. For this purpose a variety of red wheat was allowed to grow till it became evident the ears had begun to form, although they had not protruded from their sheaths; and all the smaller stems were then cut away, leaving only two, the upper half of each ear being subsequently cut off, as soon as it began to protrude from its sheath, by which it was expected a vigour would be acquired by the remaining anthers which could not otherwise be attained. During their progress to maturity, fresh shoots frequently sprang from the roots, which were always removed as soon as they appeared. Of this seed five grains were planted the following autumn, and although grown under circumstances less favourable than the year before, the ears were decidedly longer, from an increased length of the rachis, giving them a peculiar appearance*; and one of the ears had five of its spikelets containing five seeds each, four being the highest number of the year before†. It may therefore be supposed that an increased vigour in growth

* An ear had been kept, which allowed the comparison to be made.

† Wheat-ears having some of the spikelets 'five-set,' are found occasionally in the most luxuriant corn-fields (on the borders of them only), but are not known to occur under other circumstances; but this plant was grown in poor ground, being only 3 feet high, and this same variety of wheat, when it is 'five-set,' has not the increased length of ear alluded to as an effect of the experiment.

has been gained in one year, giving to the ear a different habit; and although a distinct variety was not produced, yet the same process continued yearly, selecting the largest grains of the year before, might lead to useful results.

As serving to show the facility with which a departure from an ordinary mode of growth may occasionally be effected, merely through a superabundant supply of sap from pruning, a variety of inflorescence was in a few weeks produced in a plant of *Atriplex angustifolia,* which may deserve attention, because it is not known, that I am aware of, to flower in this very unusual way, however rich the soil may be in which it is growing; and this plant was not very luxuriant, as it grew in a rather poor soil. It was allowed to grow till most of its branches had the appearance of commencing inflorescence, and then about half of them were removed, and the remainder more or less cropped, the young shoots which subsequently sprouted being cut off every week or ten days. The remaining portion soon acquired a congested appearance, and it was found on examination that the receptacles of some of the female flowers had produced additional female flowers; from two to six, and in one instance seven were observed, each having two sepals as usual, and the ovary two stigmas. When two, they were opposite the sepals; when five or six, they irregularly surrounded the ovary.

These flowers, developed from the receptacle, may serve to explain the origin of a singular monstrosity occurring in *Dianthus barbatus**, in which a flower, the calyx of which consisted of the usual number of parts, had within it five imperfect flowers, which grew from the receptacle so as to surround the ovary; and the same variation in growth is also noticed as occurring in the Clove Carnation.

A monstrosity occasionally occurs in *Prunus spinosa,* apparently produced in the same way as in the *Atriplex,* consisting of flowers with double the number of petals and stamens, and two or three ovaries.

Should such experiments on other plants be followed by the production of permanent varieties from the seed, it will become obvious that the grazing of cattle would occasionally give rise to varieties, inasmuch as the greater part of the inflorescence of a plant is often destroyed, leaving a few flowers only to perfect seed.

* Phytologist, vol. ii. p. 667.

XXXV.—*The Process of Fecundation in the Vegetable Kingdom, and its relation to that in the Animal Kingdom.* By Dr. L. Radlkofer.

[Continued from p. 262.]

4. Mosses.

The opinion that the antheridia of Mosses constitute the male reproductive organs of these plants, is as old as the observation that they are matured and their contents discharged at the same epoch as that at which the archegonia are developed,—as old, in fact, as any minute investigation of the characters of Mosses. Micheli *, Dillenius †, Linnæus ‡, and Haller §, generally compared the spores of the Mosses with the pollen-grains of the Phanerogamia, and therefore took the capsule for the male and the antheridia for the female organs; while Micheli, Schreber ||, and others had proclaimed the paraphyses, Hill ¶ the teeth of the peristome, Kölreuter ** the calyptra, Schmidel †† the cells between the inner and outer walls of the capsule, Miller ‡‡ the upper part of the columella inserted in the operculum, and O. F. Müller §§ (in the Jungermannieæ) the abortive archegonia—as male organs;—Hedwig ||||, however, first observed the development of the young plants from the spores, detected the relation in time in which the perfect condition of the antheridia, first discovered by him in the majority of Mosses (to which, also, Schmidel ¶¶ ascribed a fecundating office), stood to the archegonia, and in consequence of this pronounced decidedly for the above-mentioned view. This opinion remained predominant from that time; and while, in recent times, more definite evidence was, with right, required of the sexuality of the plants, yet, in the face of the continually multiplying observations of the sterility of diœcious Mosses in the absence of antheridium-bearing individuals, criticism could scarcely do more than cause Hedwig's opinion to be expressed with a little less determination. Still more lately, however, an analogy was sought to be established between the spores and

* Nova Gen. Plant. Flor. 1729, p. 108. pl. 59, h. j.
† Histor. Muscorum. Oxon. 1741.
‡ Syst. Natur. ed. 12. Holm. 1767, ii. p. 698.
§ Historia Stirpium. Bern. 1768.
|| J. Ch. D. Schreber, De Phasco Observationes. Lips. 1770, p. xix.
¶ History of Plants. London, 1751.
** Das entdeckte Geheimn. der Krypt. Karlsruhe, 1777, pp. 34, 133.
†† Dissert. de Buxbaumia. Erlang. 1758, § xxiv. p. 37.
‡‡ Illustration of the Sex. System of Linnæus. London, 1779, i. p. 104, pl. 103. figs. 10–13.
§§ Flor. Friedrichsdal. Argentor. 1767, p. 188, no. 378.
|||| Theoria Generat. et Fruct. Plant. Crypt. Petrop. 1784.
¶¶ Icones Plant. ed. 2. Erlang. 1793, i. p. 85. no. 4.

pollen-grains—not, however, in the same sense as by Linnæus—by Valentine* and Schleiden†, so long as the latter regarded the pollen-grain as the vegetable ovum.

The antheridia consist, in the Liverworts‡, of an ellipsoidal mass of small cubic cells, which are enclosed by a layer of larger cells containing chlorophyll; sometimes they are imbedded in the frondose stem (*Riccia, Pellia*), or on a special receptacle (*Marchantieæ*); sometimes they are borne on small cellular pedicels on the frond (*Fossombronia*), or on the axils of the leaves (leafy *Jungermannieæ*). In the Mosses§ their structure is the same, but their form is in general more cylindrical, their place at the end of the stem (of the shoot). In the interior of each of those cubic cells, which, when the antheridium is perfectly ripe, separate from their fellows and become absorbed, is formed, nearly filling it, a lenticular vesicle (daughter-cell?—see on this point Nägeli ||, who calls it a 'seminal utricle' = *samen-bläschen*), in which is developed a spirally-coiled spermatozoid¶. After the escape of the vesicle from the opened apex of the antheridium, each spermatozoid is set free, by rupture or solution of the vesicle, and moves about in the water by the help of two long cilia.

Schmidel**, to whom we are indebted for the knowledge of the antheridia of Liverworts, detected the motion of the discharged contents of the antheridia of *Fossombronia pusilla*, without clearly perceiving the spermatozoids themselves; the same was the case with Nees v. Esenbeck in respect to *Sphagnum capillifolium*††. The latter regarded the vesicles, set in motion by the still en-

* Trans. Linn. Soc. xvii. London, 1837.

† Grundz. wiss. Botanik.

‡ *Vide* on this point the excellent works of—

Nees v. Esenbeck, Naturgesch. d. europ. Lebermoose. Berlin, 1833.

G. W. Bischoff, Bemerk. üb. die Lebermoose. Nova Acta A. C. L. C. xvii. pt. 2. p. 924.

J. B. W. Lindenberg, Monogr. der Riccien. Nov. Act. A. C. L. C. xviii. pt. 1. p. 392.

C. M. Gottsche, Ueb. *Haplomitr. Hookeri.* Nova Acta, xx. pt. 1. p. 293.

Hofmeister, Vergleich. Untersuch. &c., höh. Krypt. Leips. 1851.

Thuret, Rech. sur les Anthéridies des Cryptog. Ann. des Sc. nat. 3 sér. xvi. (1851).

§ See W. P. Schimper, Rech. anat. et morpholog. sur les Mousses. Strasburg, 1848.

Thuret, *l. c.*

Hofmeister, *l. c.*, and Botan. Zeit. 1849, p. 793.

|| Zeitschr. f. wiss. Botanik, Heft 3 & 4. Zurich, 1846, p. 105.

¶ Schacht believes that he has certainly observed that the spiral filaments are produced from the nuclei of the cells, of which one exists in each of the daughter-cells formed in fours inside the antheridium-cells. *Vide* Pflanzenzelle. Berlin, 1852, pp. 107, 112; Ueb. Antherid. der Leberm. Bot. Zeit. 1852, p. 155.

** Icones Plant. ed. 2. Erlang. 1793, i. p. 85. no. 5. pl. 22. fig. 8.

†† Flora, 1822, B. i. p. 33. pl. 1.

closed spermatozoids, as Monads; the former observed the spermatic vesicles with the spermatozoids imperfectly extricated from them, and described them as actively-moving, stalked molecules, possessing a tail. Later observers, as Mirbel*, overlooked this motion. Unger † first distinctly observed the spermatozoa themselves, and called them *Spirillum bryozoon.* Decaisne and Thuret ‡ observed their cilia. Hofmeister §, who, following Nägeli ||, traced the antheridia back to the first cell, could find only two cilia in *Pellia.* Schacht ¶ did not see more than one anywhere.

The statements of Gottsche** and Schacht ††, that the antheridia of some Liverworts have the envelope composed of a double layer of cells,—and those of Unger ‡‡, Schleiden §§, and Schacht || ||, that the whole of the spermatic vesicles are contained in one large cell whose wall lies immediately beneath the envelope,—are in contradiction to the observations of Hofmeister ¶¶.

The archegonia, for a knowledge of whose whole course of development we are likewise indebted to Hofmeister, in their earliest stages exactly resemble the rudimentary antheridia. When fully developed, they consist of flask-shaped organs, mostly stationed at the ends of the shoots, and surrounded by special leaves (*perichætium,* Mosses), or cup-like envelopes (*calyx,* Liverworts); more rarely they are immersed in the flat stem (*Riccia*). The axial row of cells of each archegonium loses its horizontal walls by solution, so that they are converted into a canal, which leads below into an enlarged cell (central cell of the archegonium) lying in the expanded part, and at the epoch of puberty opens at the top by the separation of the uppermost layer of cells bounding it. According to Hofmeister***, the central cell of the archegonium contains a daughter-cell formed

* Compl. des Obs. sur *Marchantia.* Mém. de l'Instit. de France, xiii. p. 377. Paris, 1835.

† Ueb. Anthere v. *Sphagnum.* Flora, 1834, i. p. 145.—Neuer Beob. üb. die Moos-anthere, &c. Nova Acta A. C. L. C. xviii. pt. 2. p. 687.—Weitere Beob. üb. die Samenthierch. der Pflanzen. Ibid. p. 785 (Ann. des Sc. nat. 2 sér. xi. p. 257, 1839).

‡ Ann. des Sc. nat. 3 sér. iii. p. 14 (1845); xvi. pl. 10–14 (1851).

§ Vergleich. Untersuch. &c. Leipsic, 1851, p. 16.

|| Zeitschr. f. wiss. Botanik, Heft i. p. 172. Zurich, 1844.

¶ Das Mikroskop, &c., 2nd ed. Berlin, 1855, p. 86.

** Nova Acta, xx. pt. 1. p. 294. pl. 16. fig. 8.

†† Pflanzenzelle, p. 109; Mikroskop, p. 83.

‡‡ Nova Acta, xviii. pt. 2. p. 689. pl. 53. fig. 1, *b*.

§§ Grundz. d. wiss. Botanik, 3rd ed. ii. pp. 67 & 80.

|| || Pflanzenzelle, p. 110.

¶¶ Vergleich. Unters. &c. Leips. 1851, pp. 43, 69; and Flora, 1855, p. 438.

*** Flora, 1854, p. 259.

round a secondary nucleus (the rudiment of the future capsule) before the time when the canal opens at the top. Pringsheim* states that he could not convince himself of the presence of this cell *before* fecundation.

The majority of the archegonia are arrested at this stage of development. In the rest, as Hofmeister has shown, and as Valentine† likewise had previously described, there originates from the last-mentioned free cell, by repeated division and the enlargement of the newly produced cells, a more or less fusiform cellular mass (formerly described as a 'nucleus,' and regarded as an integral part of the archegonium—and so even by Schacht ‡), lying free in the simultaneously expanding cavity of the original central cell, its lower end penetrating, in its further growth, into the base of the archegonium, and becoming intimately connected with the surrounding structures through the products of solution of the cells which it here displaces. The archegonium being no longer capable of withstanding its continued vertical extension, becomes circularly torn at the bottom, and its upper fragment is carried up by the young capsule as the *calyptra*, while the remnant remains as the *vaginula* §. I need not further describe the development of the lower part of the cellular body into the *seta* (*pedunculus*), and of the upper into the *theca* (*capsula*), still less the formation of the spores through quaternary cell-division in mother-cells which are arranged in one or more layers. It is equally unnecessary to discuss here the analogies between this and the formation of pollen in the Phanerogamia ||. The spore-capsules of the *Marchantieæ* and of

* Pringsheim, Ueb. Befrucht. u. Keimung der Algen, &c. Monatsber. Berlin. Acad. 1855, p. 15.

† W. Valentine (Trans. Linn. Soc. of London, xvii. p. 466, read May 7th and June 18th, 1833) had already described a free cell at the bottom of the archegonium, and assures us that he had succeeded in dissecting it out *uninjured*. See also his figures, pl. 23. figs. 1–7, and the explanation, p. 482.—H. Philibert likewise detected a free cell ('*embryo-cell*') before fecundation in the central cell of the archegonium (which he called the 'embryo-sac') both in Mosses and Liverworts, and in the Ferns. Comptes Rendus, 1852, p. 851; Ann. Nat. Hist. 2nd ser. xi. p. 482 (1853).

‡ Bot. Zeitung, 1850, p. 459. pl. 6. figs. 1–4.

§ *Vide* Hofmeister, *l. c. supra*; and on the structure of the ripe capsule, Lantzius-Beninger, Nova Acta, xxii. pt. 1; and Schimper, Recherch. sur les Mousses, &c. Strasburg, 1848.

|| See hereon—

V. Mohl, Ueb. Entw. d. Sporen von *Anthoceros lævis*. Verm. Schr. p. 84, and Einig. Bemerk. üb. d. Entw. u. Bau der Sporen der Crypt. Gewächse, *id. op.* p. 67.

Lantzius-Beninga, De Evolutione Sporid. in Capsul. Muscorum. Götting. 1844.

Schacht, Beitr. z. Entwick. d. Frucht u. Sporen v. *Anthoceros lævis*. Bot. Zeit. 1850, p. 457.

Riccia are distinguished merely by their lower portion not becoming developed into a pedicel.

Only *Anthoceros* possesses, according to Hofmeister and Schacht, a structure of the archegonia aberrant from that hitherto described. They do not appear here as organs isolated from the rest of the cellular tissue, a particular row of cells of the frondose stem, simply, becoming converted into the archegonial canal. The cell lying immediately beneath this row assumes the part of the central cell of an archegonium.

Hofmeister found inside the calyx of *Jungermannia bicuspidata* and *divaricata,* beside the just-opened archegonia, spermatozoids still in motion; motionless ones frequently in the mouth of the archegonial canal*, and, according to his most recent publication†, still moving ones which had penetrated a third of the distance down the archegonial canal in *Funaria hygrometrica.* A similar statement is made by Schimper in respect to *Sphagnum*‡.

The development of the young plant of Mosses from the spore was first observed by Hedwig; more recently, by Nees v. Esenbeck, Bischoff, and, above all, by Gottsche, W. Schimper and Hofmeister§. In the Mosses, it is not produced directly from the internal cell of the spore, but through the intermediation of a tissue of jointed confervoid filaments—*protonema* (*pro-embryo,* Hofmeister). According to Hofmeister, these filaments are not all of one kind, some appearing to correspond to stems, others to leaves. The former only are capable of development, by the division of their terminal cell by means of alternately inclined septa, into bud-rudiments, sometimes bearing leaves and root-fibrils, and thus of becoming the foundation of perfect Moss-plants. When they penetrate into the soil, they acquire oblique septa, and are destitute of chlorophyll, like the so-called roots of the Mosses; on the other hand, Nägeli‖ and Schimper have observed that the protonema-threads developed in the axils of leaves or from the cells of leaves (aërial roots of authors), and even the roots of Mosses, become green, form perpendicular cross-septa and produce buds, in situations where they are exposed to the light.

In regard to the Liverworts, Hofmeister's account of the development at least renders the universal occurrence of a pro-embryo doubtful¶. Gottsche's opinion is to the same effect**.

* Vergleich. Unters. pl. 8. figs. 49 (properly 79) & 61, pl. 9. fig. 2. pp. 37, 38.

† Flora, 1854, p. 259.

‡ Ann. des Sc. nat. 4 sér. i. p. 320 (1854).

§ *Op. cit. supra.*

‖ Zeitschr. f. wiss. Botanik, Heft ii. p. 168. Zurich, 1845.

¶ See also Hofmeister, Ueb. die Stellung der Moose in Systeme. Flora, 1852, p. 6.

** Nova Acta A. C. L. C. xx. pt. 1. p. 386.

Bischoff thought he detected a pro-embryo in some species*. J. Groenland also regarded the cellular body produced by the spore in all the species he examined, which by no means passed gradually into the proper frond, as the pro-embryo (*protonema*)†.

5. Pteridoideæ (Ferns and their allies).

It would lead too far if I more than mentioned summarily the attempts of the older botanists to demonstrate in the Filices (in the widest sense) sexual organs, on the cooperation of which they believed the regular reproduction of all plants to depend—attempts which were taken up again with the more zeal, since Hedwig had made good so preponderating a probability of the existence of sexuality in the Mosses. While Linnæus and his predecessors thought that the spores of these plants generally must be identified with pollen, subsequent investigations as to their further development, their germination, the final result of which was known even by Morison and Stehelin, led, here as everywhere else, to their unconditional estimation as seeds, and consequently to that of the spore-capsules as female organs. The function of male organs of the flower has been attributed successively, in the true Ferns, to corpuscles (glandular hairs) occurring among the ramenta of the young petiole (Micheli ‡)—upon these ramenta (Griffith §)—and on the points of the indusia (Schmidel ||); to the stomata (Gleichen ¶); to the annulus of the capsules (Schmidel **); to groups of spiral-fibrous cells at the ends of the nerves of the leaves (Bernhardi); to the indusium (Kölreuter ††); to the glandular hairs of the nerves of the pinnæ (Hedwig ‡‡); to the contents of young spore-capsules with their spores (Gaertner and Mirbel); to the loose cells of the lenticels of Tree-ferns (V. Martius §§); to the glandular hairs occurring

* Bischoff, Bemerk. z. Entwick. der Lebermoose. Bot. Zeit. 1853, p. 113 (from observations made in 1828–9).

† Mém. sur la Germin. de quelques Hépatiques. Ann. des Sc. nat. 4 sér. i. p. 5 (1854).

‡ Tozzelius, in Append. ad Michelii Cat. pl. hort. Cæs. Florent. Florent. 1748, p. 135.

§ Posthumous Papers, Journal of Travels (teste A. Henfrey, Rep. Brit. Assoc. 1852, p. 107).

|| Icon. Plant. ed. 2. Erlang. 1793, p. 48. pl. 13. figs. 6–9.

¶ Das Neueste aus dem Reiche der Pflanzen. Nuremb. 1764, p. 24. pl. 3. fig. 6. Abschn. ii. p. 30. pl. 24. fig. 9.

** Dissert. de *Buxbaumia*. Erlang. 1758, pp. 37, 38.

†† Das entdeckte Geheimn. der Kryptogamen. Karlsruhe, 1777, pp. 89, 135.

‡‡ Theoria Gener. et Fruct. Pl. Crypt. Petrop. 1784, p. 40.

§§ Denkschr. der Bot. Gesellsch. in Regensb. ii. p. 125 (teste V. Mohl, Verm. Schrift. p. 111).

on the pedicels of the spore-capsules of many Ferns (Presl*, Meyen†), &c. In the Equisetaceæ, Du Hamel‡, Hedwig§, and Vaucher|| regarded as stamens the extremities of the elaters, upon which they had observed small granules; Kölreuter regarded the shields of the spore-fruits as stamens;—in the Lycopodiaceæ the membrane of the capsules¶. In the Rhizocarpeæ, most botanists regarded the small spores as male, and the large as female organs**.

Ferns (in the restricted sense).—Observations on the development of Ferns from their spores led Nägeli†† to the discovery of antheridia upon the lower face of the *prothallium* (*pro-embryo* of some authors), previously described (by Kaulfuss‡‡, Nees v. Esenbeck§§, &c.), and called the *pseudo-cotyledon.* Leszczyc-Suminski, Wigand, Thuret, V. Mercklin, Schacht, Hofmeister, and Henfrey have furnished contributions to the history of their development and the knowledge of their contents. In their origin and general structure they repeat the type of the antheridia of Mosses, and are usually elevated above the surface of the prothallium upon one or a few superimposed peduncular cells. Their envelope consists, according to Hofmeister||||, of a few large cells. These enclose a globular group of small cubic cells, whose walls are dissolved when the antheridia are ripe, and thus set free the vesicles (primary nuclei of the cubic cells?) contained in them, which have the spiral threads in their interior. The uppermost enveloping cell of the antheridia then tears in a stellate manner, the spermatic vesicles escape, and are likewise ruptured, letting out the spirally-wound spermatozoids, which are furnished with numerous cilia at the anterior, thicker extremity.

According to Wigand¶¶, the antheridia of different species, and often even those of one and the same prothallium, possess a different structure, in some cases consisting of a single cell.

* Tentamen Pteridographiæ. Prague, 1836, p. 15. pl. 11, A. B.

† Pflanzenphysiologie, iii. p. 199.

‡ Physique des Arbres. Paris, 1838.

§ *Op. supra cit.* p. 35.

|| Monogr. des Prêles. Mém. de la Soc. d'Hist. nat. de Genève, i. pt. 2. pp. 350, 359 (Geneva, 1822).

¶ *Op. supra cit.* pp. 119, 135; pp. 73, 174.

** See the more complete bibliography in Mettenius, Beitr. z. Kenntn. der Rhizocarpen. Frankfurt, 1846.

†† Zeitschr. f. wiss. Botanik, i. Zurich, 1844, p. 168.

‡‡ G. Fr. Kaulfuss, Das Wesen der Farrenkräuter. Leipsic, 1827.

§§ Entwickl. der *Pteris serrulata.* Nova Act. A.C.L.C. xii. pt. 1. p. 157.

|||| Vergleich. Untersuch. Leipsic, 1839, p. 79 *et seq.*

¶¶ Alb. Wigand, Entw. der Farrenkräuter. Bot. Zeit. 1849, p. 17; and Botanisch. Untersuch. Brunswick, 1854, p. 44.

Leszczyc-Suminski* thus represents the antheridia of *Pteris serrulata.* Hofmeister observed such conditions only in the antheridia of the proliferous shoots of abortive prothallia†. Thuret‡ and Mercklin§ regarded the centre of the antheridium as an intercellular space; Schacht‖, in agreement with his views of the structure of the antheridia of Mosses, as a large cell, inside which the swarming-filament cells originated in fours in mother-cells. Henfrey¶ agrees with him in regard to the first point. The shape of the spermatozoids and the mode of arrangement of their cilia, first detected by Thuret and Suminski, are also stated by Wigand** to be very various.

The archegonia, the discovery of which we owe to Leszczyc-Suminski††, appear a little later, before the successive production of antheridia is at an end,—ordinarily upon the same, but in a few cases upon separate prothallia. They present themselves as shortly cylindrical, ellipsoidal organs projecting from the prothallium on the lower surface, and consist of four (8–10-jointed) rows of cells surrounding a central canal. The canal is formed either by the solution of the transverse walls of a fifth axial row of cells, or by the separation of the four rows at their common commissure. Both modes of formation occur in different archegonia of the same species, even of the same prothallium‡‡. According to Mettenius§§, the lower part of the canal is formed as an intercellular space above the central cell of the archegonium (called by Mettenius the germinal vesicle) before the longitudinal growth of the cylindrical neck of the archegonium is completed. This canal leads at the bottom to a cell, distinguished by its magnitude, seated at the base of the archegonium—the central cell of the archegonium. In this, as in the Mosses, before the opening of the canal externally, a free cell (germinal vesicle), a daughter-cell, is formed around a new secondary cell-nucleus‖‖, constituting the foundation of the new plant¶¶.

* Zur Entwickl. der Farrnkr. Berlin, 1848.

† Vergleich. Untersuch. &c. p. 84.

‡ Sur les Anthérid. des Fougères. Ann. des Sc. nat. 3 sér. xi. p. 5 (1849).

§ Beobacht. an dem Prothall. der Farrnkr. Petersburg, 1850.

‖ Pflanzenzelle. Berlin, 1852, p. 114; and Beiträge zur Entwickl. der Farrnkräuter, 'Linnæa,' xxii. p. 753 (1849).

¶ On the Dev. of Ferns from their Spores. Trans. Linn. Soc. London, xxi. p. 121 (read June 15 and Nov. 2 & 16, 1852).

** *Op. cit.* p. 46.

†† *Op. cit.*

‡‡ The Ferns thus form, in reference to the construction of the archegonia, the connecting link between the Mosses on one side and the Rhizocarpeæ and Lycopodiaceæ on the other. Hofmeister, Vergl. Untersuch. p. 81.

§§ Beitr. z. Botanik, Heft i. p. 18. Heidelberg, 1850.

‖‖ *Vide* Hofmeister, Ueb. Befrucht. der Farrnkr. 'Flora,' 1854. (Ann. Nat. Hist. 2 ser. xiv. p. 272.)

¶¶ As to the presence of this cell at the epoch before the archegonium

As a rule*, only one archegonium becomes further developed. The cell just described increases in size, until it fills the central cell, and is converted by repeated divisions into a multicellular, ellipsoidal body lying in the cavity of the archegonium, forming thus the rudiment of the new plant—the *primary, never-developed embryonal axis.* In the course of further growth, its point gradually acquires rather intimate adhesion to the cells of the base of the archegonium. Beneath the point, at the anterior side, turned towards the younger, cordately-notched border of the prothallium, sprouts out the *first frond,* soon breaking through the archegonium and curving upwards. Opposite this, from the side next the older part of the prothallium bearing the antheridia and radical hairs, arises the *first adventitious* root. The *main* (axial) *root,* the lower end of the ovate embryo, remains undeveloped. Between the first frond and the permanently undeveloped point of the embryo soon arises, as a little cellular papilla, the *secondary, developing axis* of the new plant, which continually throws out new fronds from beneath its apex.

On abortive prothallia, which under favourable circumstances continue to vegetate for a long time, new archegonia are successively developed, but of different shape, wanting the elongated neck; they were regarded by Suminski and Mercklin as younger stages of development of the archegonia. In addition to these, there occur numerous shoots bearing abundance of unicellular antheridia.

Leszczyc-Suminski and Mercklin† have observed the *entrance of the spermatozoa into the canal of the archegonia.* The account, long ago and generally refuted, given by the former, of the origin of the embryo from the end of a spermatozoid which had entered into the central cell of the archegonium—arising from confounding the coagulated protoplasm of the archegonial canal with a spermatozoid—requires no further notice. Even Mercklin modified Suminski's statements, saying that the spiral filaments which penetrated the archegonium "here dispose a cell (through dynamic or material action ?) to development under definite laws

becomes either abortive or further developed, Hofmeister, Wigand, Mercklin, and Suminski are agreed; Pringsheim, on the contrary, states that here, as in the Mosses, he could not detect it at this time as a cell (*vide op. cit.*). With him accords Henfrey, if we properly connect his comparison of the said structure with the germinal vesicles of the Phanerogamia (Linn. Trans. xxi. p. 125), and his opinion, subsequently to be mentioned, that these germinal vesicles possess no membrane before fecundation, but are mere masses of protoplasm.

* Exceptional cases were observed by Mercklin and Wigand (*vide op. cit. supra*).

† *Vide op. cit. supra,* and Mercklin, Offentl. Briefe an H. Schacht, 'Linnæa,' xxiii. p. 732.

of formation, whose product is the frond." Hofmeister has recently seen* *the spermatozoids penetrate through the attenuated and softened membrane of the central cell of the archegonium, into its interior, and then for a time move round the free part of the germinal vesicle.* The inner end of the canal of such archegonia appeared closed by the subsequent expansion of the surrounding cells,—the first sign of fecundation having taken place.

EQUISETACEÆ.—The so-called germination of the spores of the *Equiseta* had been long ago minutely investigated, especially by Agardh†, Vaucher‡, and Bischoff§, but it was only after the discovery of the antheridia of the Ferns had excited new conjectures, that the antheridia were observed in the irregularly lobed prothallium of the *Equiseta*, first by Thuret‖, and afterwards by Milde¶ and Hofmeister**. They occur upon the border of the prothallium, as conical, cellular papillæ, not definitely separated from the prothallium, but with their bases imbedded in it; the cells of their simple envelope are directly continuous with the upper layer of cells of the prothallium. The nucleus consists, in the young state, of small cubical cells, in which are formed spiral-thread-producing vesicles, in the same way as in the Ferns. When perfectly ripe, they open by the separation from each other of the upper cells of the envelope, which remain connected with the lower cells only by their inferior walls, and surround the orifice like a crown††. The spermatozoids are larger than those of the Ferns—in fact, are the largest hitherto met with in plants, and consist of a band-like body, wound like a corkscrew, furnished with numerous cilia at the anterior extremity. The posterior extremity, in contrast to that of all other known spermatozoids, is much spread out.

The emission of the spermatozoids from the spermatic vesicles is often imperfect, as occurs also in the Mosses and Ferns; the vesicle then remains hanging on the anterior or posterior extremity of the spermatozoid, and is carried along by it.

The first notice I find of the detection of a (dead) archegonium

* Flora, 1854, p. 257. (Ann. Nat. Hist. 2nd ser. xiv. p. 273.)

† Observ. sur la Germination des Prêles. Mém. du Muséum, Paris, ix. p. 283 (1822).

‡ Monogr. des Prêles. Mém. de la Soc. phys. &c. de Genève, i. pt. 2. p. 347 (1822). Mém. sur la Fructification des Prêles. Mém. du Muséum, Paris, x. p. 429 (1823).

§ Kryptog. Gewächs. Nuremberg, 1828.—Ueb. Entw. d. Equiseteen. Nova Acta L. C. N. C. xiv. pt. 2. p. 779 (1828).

‖ Ann. des Sc. nat. 3 sér. xi. p. 10 (1849).

¶ Zur Entwickl. der Equiset. u. Rhizocarp. Nov. Act. xxiii. pt. 2. p. 630. De Sporarum Equiset. Germinat. Linnæa, xxiii. p. 558 (1850).

** Vergleich. Untersuch. &c. p. 100.

†† See Thuret's figure, Ann. des Sc. nat. 3 sér. xvi. pl. 15 (1851).

on the prothallium of the *Equiseta* is by Mettenius*. Hofmeister† and Milde‡ had figured rudiments of archegonia in their earlier essays; subsequently these two observers simultaneously discovered them in a developed condition on prothallia which, after various, often unsuccessful attempts, they had raised from the spores; Milde in *Equisetum Telmateia* §, Hofmeister || in *Equisetum arvense* (*pratense* and *variegatum*).

In the species hitherto observed the archegonia are ordinarily developed, and at a comparatively late period, on separate prothallia¶, not bearing antheridia at the same time, distinguished by more vigorous vegetation, or at least upon separate, later-formed shoots of the prothallium**. They originate at the border of the prothallium, but by the continued development of the mass of the prothallium under them, they are ultimately brought upon its upper surface. Their structure is essentially the same as in the Ferns; their course of development is as follows††:—A cell of the surface of the prothallium bulges outwards and divides into two superposed cells by forming a septum parallel to the surface of the prothallium. The lower cell of the two is the *central cell* of the archegonium; the upper cell is divided by two septa at right angles to each other, but perpendicular to the upper surface of the central cell, into four cells, which by repeated division by horizontal septa, form the cylindrical neck of the archegonium, consisting of four collateral rows of cells. The cells bordering on the central cell, dividing many times, form one or two epithelium-like layers of cells surrounding the central cell. The cells at the apex of the neck of the archegonium elongate more than the lower ones, and curve back, after the formation of the archegonial canal (by the separation of the four rows of cells at their common commissure), like the top of the stigma of a *Campanula*. In the very earliest stages of development of the archegonium, a free daughter-cell—the *germinal vesicle*—is formed round a secondary nucleus in the central cell‡‡. That part of

* Beiträg. zur Botanik, Heft 1. Heidelberg, 1850, p. 22.

† Vergleich. Untersuch. Leipsic, 1851, pl. 20. figs. 61, *a, b,* & 62.

‡ *Op. supra cit.* pl. 59. fig. 47, *a.*

§ Das Auftreten der Archegon. am Vork. von *Equiset. Telmateia,* Ehr. Flora, 1852, p. 497. (Aug. 28. From a private letter to Prof. Schleiden, accompanied by a drawing, dated June 20, 1852, I find that this discovery was made simultaneously with Hofmeister's.)—Zur Entwick. d. Equiseteen Bot. Zeitung, Aug. 6, 1852, p. 537.

|| Ueb. Keimung der Equisetaceen. Flora, 1852 (June 7), p. 385.—Beitr. z. Kenntn. der Gefäss-Kryptog. Abhandl. Sächsisch. Gesellsch. der Wissensch. Leipsic, 1852, p. 168. pl. 17–19.

¶ B. Bischoff describes an exceptional case in *Eq. sylvaticum,* L. (Bemerk. z. Entwick. der Equiset. Bot. Zeit. 1853, p. 97.)

** *Vide* Milde, Nova Acta A. C. L. C. xxiv. pt. 1. pp. 68, 71 (1854).

†† *Vide* Hofmeister, *op. supra cit.*

‡‡ Milde was fortunate enough to press out this cell 'entire' from a

the contents of the central cell not consumed in nourishing the germinal vesicle, appears to be discharged into the canal of the archegonium.

Ordinarily, more than one archegonium is fecundated on the same prothallium. The earliest processes after fecundation has taken place, are so completely accordant with those in the Ferns, that their description may be passed over. Here, again, *the primary axis of the embryo remains undeveloped.* On one side of its apex shoots forth the *secondary axis* of the new plant, soon turning upward and penetrating through the prothallium; opposite to it, and breaking through the prothallium below, appears the first *adventitious root.*

Rhizocarpeæ.—To Nägeli* we owe the knowledge of the spermatozoids of these plants. They are developed as simple filaments in minute vesicles (nuclei?), which are contained, singly (*Pilularia*) or several together (*Salvinia*), inside small cells produced during the so-called germination of the *microspores*; this germination consisting of the bursting of the cuticle and the protrusion of the internal cell in the form of a tube about as long as the spore, inside of which those cells are formed, afterwards to be set free by its bursting. In *Salvinia* the microspores are agglutinated together inside their sporangium; they germinate without leaving it, their tubes breaking out through it†. From the isolated cells the spermatozoids themselves emerge at once, without any previous escape of their parent-vesicles from the spore-cell. In their motion and the arrangement of their cilia they exactly resemble the spermatozoids of the Polypodiaceæ‡.

The same inquirer opened the way to the correct comprehension of the *prothallium*, which emerges from the summit of the *megaspore*, composed of few cells, and remains in connexion with the spore to bear the *archegonia* there. Our insight into the import of this organ was completed by the investigations of Hofmeister§ and Mettenius‖.

The archegonia of *Pilularia* perfectly agree with those of the Equisetaceæ in the main points of structure. In this, as in the next genus, the prothallium bears only one archegonium.

In *Marsilea* there is a little difference, since not only the four

favourably ruptured archegonium. Nova Acta A. C. L. C. xxiv. pt. 1, p. 69 (1854).

* Fortpflanz. der Rhizocarpeen. Zeitschr. f. wiss. Bot. Heft iii. & iv. p. 188. Zurich, 1846.

† Milde, Beitr. z. Keim. v. *Salvinia* u. *Pilularia*. Nova Acta A. C. L. C. xxiii. pt. 2. p. 642. pl. 60.

‡ Hofmeister, Vergleich. Untersuch. p. 109.

§ *Op. supra cit.* p. 103; and Fruchtbild. u. Keim. der höher. Krypt. Bot. Zeit. 1849, p. 793.

‖ Beitr. z. Botanik, Heft i. p. 3.

cells originally covering the central cell, but also those lying beside them, undergo repeated division by cross-septa, parallel to the outer surface of the prothallium, where the neck of the archegonium appears immersed in the substance of the prothallium instead of projecting in a cylindrical form above it.

In *Salvinia,* finally, this neck of the archegonium is composed exclusively of these four covering-cells. The archegonial canal leading to the central cell is then a short intercellular passage formed by the separation of these cells at their common commissure. Two germinal vesicles are often formed in the central cell here*.

The transformation of the germinal vesicle into the embryo, and its subsequent development, follow essentially the same type as in the Equisetaceæ and the Ferns.

The statements of earlier observers, that when the microspores and megaspores are kept apart, the latter produce prothallia, but no young plants, are confirmed by Hofmeister†.

The *microspores* are formed inside spore-cases comparable with those of the Ferns, collectively enclosed, with the megaspores, in a common envelope, which constitutes the *fruit* (*receptaculum*) of the Rhizocarpeæ. Their *development* is according to the same type as that of the formation of pollen in the Phanerogamia, in special mother-cells arranged tetrahedrally inside a mother-cell. The *megaspore* is produced by the preponderating growth of a young spore of this kind, accompanied by the displacement of not merely the other young spores contained in the same mother-cell, but also of all the rest of the spores in the whole sporange (together with their enveloping mother-cells). In *Salvinia,* the microspores and megaspores are contained in separate receptacles.

The analogy of structure between the large spore of *Azolla* and that of *Salvinia,* as also between the microspores of the same genera, has been demonstrated by Mettenius‡.

Lycopodiaceæ.—A. *Selaginelleæ.*—The excellent researches of Mettenius§ and Hofmeister‖ show us that the *small* and *large spores* of the *Selaginelleæ* behave exactly like the microspores and megaspores of the preceding groups, both in reference to their *mode of development* and their *import in the process of reproduction.*

As regards the first, it will suffice to observe, that the course of development of the *megaspore-capsule* (*Kugel-kapsel,* Hofm.) is the same as that of the *microspore-capsule* (*Staub-kapsel,* Hofm.),

* Flora, 1854, p. 257.

† Among them was P. Savi, Sulla *Salvinia natans,* &c. Biblioth. Italic. xx. (G. L. Duvernoy, De *Salvinia nat.* Dissert. Tübingen, 1825, p. 5).

‡ Linnæa, xx. (1847); Ann. des Sc. nat. 3 sér. ix. p. 116 (1848).

§ Beitr. z. Botanik, p. 7.

‖ Vergleich. Untersuch. p. 118.

as far as the formation of the mother-cells of the spores. In the megaspore-capsule only one of these continues its development —to the formation of four special mother-cells, and spores, all of which here attain their full development. According to Hofmeister, the spore-capsule is not produced from the leaf upon which it afterwards appears implanted, as assumed by V. Mohl*, but arises from the cells of the stem just above the leaf.

Five months after sowing, Hofmeister saw small globular cells in the microspores, in which cells were developed spirally-coiled spermatozoids, moving slowly after they had emerged from the cells †.

Not until six weeks later occurs the *so-called germination of the megaspores,* the development of a prothallium bearing archegonia, so that fecundation could only be possible when later-sown microspores were present at this epoch. While the megaspore is still contained in its capsule, it exhibits at its upper part (under the point where it was originally in contact with the three sister-spores, at which place meet three ridges with longitudinal slits, corresponding to the commissural angles) a double layer of cells, of which it is not yet decided whether they are produced by free cell-formation in the manner of the endosperm-cells in the embryo-sac of the Coniferæ, or by cell-division. A few repetitions of the process of longitudinal and transverse cell-division convert this layer into the flat *prothallium.* At several points on this arise *archegonia* formed by the horizontal division of a cell bulging outwards, enlargement of the lower, new cell into the central cell, and the successive division of the upper into two tiers, each composed of four cells, the upper tier of which alone projects from the surface of the prothallium. The archegonial canal and the germinal vesicle are formed as in the Rhizocarpeæ. The free space in the cavity of the spore situated below the prothallium becomes gradually filled up with cellular tissue which grows from above downwards.

The first step in the *formation of the embryo* is the horizontal division of the germinal vesicle. Ordinarily this is repeated a number of times, with simultaneous longitudinal extension of the newly-formed cells; in this way is formed a pro-embryonal cord of cells (*suspensor*) which penetrates downwards into the cellular tissue filling the megaspore, and here first gives birth to the body of the *embryo,* by the division of its end-cell by alternately-inclined septa. The secondary axis is not produced from the apical cell of the embryonal mass, but from one at the side, quickly assuming an ascending direction, breaking through the

* H. Von Mohl, Vermischte Schriften, p. 106.

† [We have found the spermatozoids developed, but not yet moving, after a much shorter interval than this.—A. H.]

prothallium above and soon displaying leaves; the first adventitious root appears opposite to it. The end of the primary axis expands in the internal cavity of the spore, displacing the cellular tissue existing there. It is rare for more than one embryo to be formed on a prothallium.

B. *Isoëteæ.*—The reproduction of *Isoëtes* is the same in all essential points as in *Selaginella.* The *spermatozoids* are developed in lenticular vesicles, which are produced singly or two together in small cells formed from the contents of the *microspores* (in their so-called germination). The spermatozoids are filiform, with the anterior end thicker and ciliated, the posterior attenuated; the movement is slow compared with that in the Ferns. Mettenius observed this first*.

Hofmeister† gives a complete history of the stages of *development of the embryo.* It agrees in its essentials with that of *Selaginella,* but the suspensor is wanting. Rarely more than one embryo is developed on the same prothallium. Hofmeister‡ believes that he has often seen the remains of spermatozoids which had ceased to move, lying in the archegonial canal.

C. *Lycopodieæ.*—There still exists here an essential gap in our knowledge of the reproduction of the higher Cryptogamia. The sowing of the spores of this group has never been attended with any result hitherto, however frequent or varied the attempts may have been. Since they only bear one kind of spore, it may be conjectured that this produces in germination a prothallium bearing both antheridia and archegonia.

6. Phanerogamia.

In the Phanerogamia Meyen§ attempted a comparison between the granules of the fovilla (in part starch-granules, as in the Onagraceæ) which exhibit molecular motion, and spermatozoids, calling these granules "spermatic molecules." Grisebach‖ imagined that he found in the winter-buds of *Rhamnus infectoria* and other plants an apparatus analogous to the antheridia of the Mosses and Ferns (to which at the same time he denied any sexual import), believing that he found in them long-tailed corpuscles ("*Phytozoa*") either enclosed in a cell or swarming about free. Itzigsohn did not hesitate to assert that these phytozoa were the true spermatozoids of the Phanerogamia¶. A production of cellules in the pollen-tubes of the Coniferæ, similar to

* Beitr. z. Botanik, p. 16.

† Beitr. z. Kenntn. der Gefässkryptog. Abhandl. Sächsisch. Gesellsch. der Wissenschaft. iv. p. 123. Leipsic, 1852. See here also for the other bibliography on *Isoëtes.*

‡ *Op. cit.* p. 131.

§ Pflanzenphysiologie, iii. p. 192.

‖ Botan. Zeitung, 1844, p. 661.

¶ Bot. Zeit. 1849, p. 560.

what occurs in the tubes of the microspores, led Hofmeister to the conjecture that spermatic filaments might also be produced there*; but his own later researches, and those of Schacht†, have not confirmed this supposition.

CONIFERÆ and CYCADEÆ (GYMNOSPERMIA).—In the Coniferæ the investigation of the *formation of the embryo* has not arrived at satisfactory conclusions in all points‡. But there exists evidence to produce overwhelming probability that it originates from a cell—*a germinal vesicle,*—with which the pollen-tube enters into as intimate contact as in the rest of the Phanerogamia. But the process of fecundation in Coniferæ deviates strikingly in two points.

The first deviation is in the *organization of the ovule.* The embryo-sac here becomes filled-up with endosperm, by cell-formation around free nuclei and subsequent cell-division, before the complete penetration of the pollen-tube through the nucleus (which is clothed by a single integument). Certain of these endosperm-cells (belonging to the second stratum, counting down from the micropyle) expand, displacing the neighbouring tissue, forming *secondary embryo-sacs* (*corpuscula,* R. Br.), and subsequently, as 5–8 longish sacs, either lie immediately side by side (Cupressineæ) or remain separated by layers of unenlarged endosperm-cells. That cell of the outermost layer of endosperm-cells which covers the summit of each *corpusculum,* is converted by crossing perpendicular walls into a rosette of four cells, between which the pollen-tube, after breaking through the softened membrane of the (primary) embryo-sac, subsequently penetrates, bulging out, either simply to apply itself upon the outside of the *corpusculum,* or, by the absorption of the apex, to advance some distance into the interior.

About this time the corpusculum becomes filled up with delicate cells (some of which already contain four daughter-cells), swimming free, one of which immediately begins to enlarge, and is subsequently found at the end of the corpusculum turned

* Vergleich. Untersuch. p. 132 (1851).

† 'Flora,' 1854, p. 529.

‡ *Vide*: Hofmeister, Vergleich. Unters. &c. Leipsic, 1851, p. 126; Ueb. Befrucht. der Coniferen. Flora, 1854, p. 529. (Ann. Nat. Hist. 2 ser. xiv. p. 429.)

Schacht, Pflanzenzelle, p. 417 (1852); Beitr. z. Anat. u. Phys. der Gewächs. Berlin, 1854, pp. 287, 324; Das Mikroskop. Berlin, 1855, p. 148.

Géléznoff, Ann. des Sc. nat. 3 sér. xiv. p. 188 (1850).

Pineau, Ann. des Sc. nat. 3 sér. xi. p. 83 (1849).

Gottsche, Botanische Zeitung, 1845, pp. 378, 507.

Mirbel et Spach, Ann. des Sc. nat. 2 sér. xx. p. 257 (1843).

Rob. Brown, Ann. des Sc. nat. 2 sér. xx. p. 193 (1843); Ann. Nat. Hist. xiii. p. 368 (read at the meeting of the British Association at Edinburgh in August 1834).

away from the micropyle, where it first of all becomes divided by a cross-septum. Sometimes in both daughter-cells, sometimes in one only, there occurs a division by two vertical septa standing at right angles, forming the so-called lower cell-rosette, the *pro-embryo* (Hofmeister). After further cross-division once or several times repeated (and longitudinal division in some Coniferæ), the pro-embryo comes to consist of a few (3–4) superposed stories, each of 4–6 cells, the second or first of which (counting away from the micropyle) elongates greatly, breaks through the base of the *corpusculum,* and penetrates into the disintegrated endosperm, pushing onward the lower tiers of cells before it.

In the further behaviour of this *pro-embryo,* usually composed of four strings of cells, lies the second of the deviations indicated above; to wit, the individual strings of cells of which it is composed separate from each other gradually, from below upwards (in *Taxus* only imperfectly), and the end-cell of each string produces a rudimentary embryo of some size; but only one of all those contained in the ovule proceeds further in its development, all the rest becoming abortive. Some observers, especially Géléznoff, question the subdivision of the pro-embryo into single suspensors*.

So far as existing researches can show, the Cycadeæ agree with the Coniferæ in the organization of the ovule and the formation of the embryo.

Monocotyledones and Dicotyledones (Phanerogamia in the restricted sense).—In these plants, one (rarely more) of the two or more cells lying in the apex of the embryo-sac—the *germinal vesicles,*—is, through the influence of the *pollen-tube,* which ordinarily applies itself upon the outside of the embryo-sac, more rarely breaks through it, and allows a part of its contents to exude, enabled, by elongation and one or several times repeated cross-division, to change into a one- or many-celled *pro-embryo,* the *end-cell* of which, by repeated division in different directions, produces the embryo-mass, the *embryonal globule.* This constitutes the rudiment of the *first, developing axis* of the new plant, the lower end of which, turned toward the micropyle, becomes the *root,* while, by the sprouting of the first leaves below its point, the upper end becomes the *terminal bud.*

For the literature and the evidence of the statements made in the text, I refer the reader to my recently published memoir 'Die Befruchtung der Kryptogamen,' Leipsic, 1856. To the literature cited in the historical part of that essay—in which it was only intended to touch upon what was of especial importance for the deve-

* Gottsche, Botan. Zeitung, 1845, p. 378 *et seq.*

lopment and present state of the question—I here add what I have learnt since from new works or from such as I had not then access to. For acquaintance with part of these I am indebted to Dr. Caspary. [The older literature here alluded to will be found for the most part included in the list of works appended to a Report by the translator on this subject, printed in the 'Annals,' 2nd ser. ix. p. 458.—A.H.]

An essay of Mirbel and Spach on *Zea Mays* ('Notes pour servir à l'histoire de l'Embryogénie végétale.' Ann. des Sc. nat. 2 sér. xi. p. 200, 1839; and 'Rectification d'un erreur,' &c., *id. op.* pp. 381, 382), is very far from hitting the decisive points.

Wilson's Researches on *Tropæolum majus* (Hooker's London Journal of Botany, ii. p. 623, 1843) do not go back to the epoch of the actual origin of the embryo.

Trécul ('Recherches sur *Nuphar lutea*.' Ann. des Sc. nat. 3 sér. iv. p. 328, 1845), according to his description, saw the pollen-tube in the micropyle canal, but regarded it as a "coagulated stream of fovilla," and he left it undecided whether the embryo seen in connexion with this "proceeded from the fovilla," or whether "the ovule also contributed a few granules" to its formation.

Dickie (Ann. Nat. Hist. ser. 1. xvii. p. 5, 1846, & ser. 2. i. p. 260, 1848) wandered from the right path. He, like Brongniart previously, took the end of the pollen-tube projecting from the micropyle for a process belonging to the nucleus (*Narthecium*) or the embryo-sac (*Euphrasia*), ending blindly outside (*ovule-tube*); the suspensor he thought was a continuation of this, and the point of the embryo-sac perforated; and he did not explain the connexion of the embryonal body with the end of the suspensor. According to his own view, he could not find the pollen-tube. Independently of these observations, his reasonings inclined to Schleiden's theory.

Gasparini (Ann. des Sc. nat. 3 sér. xi. p. 365, 1849), continuing his earlier publications, gave some very imperfect researches, deviating far from the facts, on the supposed formation of an embryo without the influence of the pollen, in Figs.

Cobbold ('Embryology of *Orchis, Gesneria*,' &c. Ann. Nat. Hist. ser. 2. x. p. 238. London, 1852; written in the summer of 1849) found in the embryo-sac before fecundation "one or more cytoblasts or embryonal vesicles," and believed that the embryo was formed either through the metamorphosis of one of these pre-existing "germinal or embryonal vesicles," under the dynamic influence of the fovilla, or, as appeared to him more probable, through the union of the contents of the pollen-tube with those of a germinal vesicle, which process he compared with the conjugation of the Algæ.

A. Henfrey ('*Orchis Morio*,' Linnæan Trans. xxi. p. 7. Read April 3, 1849) found ordinarily three germinal vesicles in the unfecundated embryo-sac; usually one, more rarely two of them were converted into embryos after fecundation by the pollen-tubes, which mostly travelled down a little distance on the side of the embryo-sac. His researches are accompanied by more detailed drawings than those of his predecessors in the examination of the same plant.

Sanderson ('*Hippuris vulgaris*,' Ann. Nat. Hist. ser. 2. v. p. 259,

1850) detected the germinal vesicle long before the bursting of the anthers, but only a single one. From this, after fecundation, he saw produced the suspensor and embryo.

H. Crüger ('Befrucht. bei den Orangen,' Bot. Zeit. 1851, p. 57) placed himself decidedly in opposition to Schleiden. His observations, however, were by no means complete; in particular, he did not detect in the unfecundated embryo-sac the germinal vesicles, of whose presence recent researches leave me in no doubt.

W. Hofmeister, in his memoir on *Zostera* (Bot. Zeit. 1852, p. 121, and Taylor's Scientific Memoirs, ser. 2. Nat. Hist. i. p. 239, 1853) adds to his numerous earlier researches a new history of development of the embryo, agreeing perfectly with his former account.

Postscript.—I make use of this opportunity to report on certain memoirs which, either more recent or of the same date as my own, have come into my hands since that was printed.

Schacht has published new researches 'On the Origin of the Embryo in *Tropæolum majus*' (Bot. Zeit. 1855, p. 641; Ann. des Sc. nat. 4 sér. iv.). He here detected the germinal vesicles in the unfecundated embryo-sac, but was of opinion that they disappeared again at the time when the pollen-tube entered the micropyle. He regarded the fecundated germinal vesicle, which he detected at a subsequent period, as a totally different structure from the first—namely, as the immediate prolongation of the pollen-tube.

Th. Deecke ('Entwickl. der Embryo der *Pedicularis sylvatica*,' Bot. Zeitung, 1855, p. 657; Ann. des Sc. nat. 4 sér. iv.) endeavoured to answer Hofmeister's objections to the interpretation given by himself and Schacht to his much-discussed preparation, and to strengthen his reasoning with the results of new investigations. I was indebted to the kindness of Th. Deecke for an opportunity of examining this preparation, and of acquiring a positive conviction as to the condition of the anterior end of the embryo-sac. I perceived not merely the two lines which Schacht has drawn as running away from the points of contact of the lateral boundary-lines of the embryo-sac and suspensor, and uniting below in an angle projecting downwards,—but also two others, which (as nearly as I can describe their positions) passed from the same points, each running about parallel to the lines drawn by Schacht on the *other* side, thence uniting at angles projecting upwards. These two lines, therefore, with the two drawn by Schacht, bounded an almost rhomboidal hole, which, from the condition of its edges, was doubtless artificial; one section of this (I do not recollect exactly whether the lower (figured) or upper one) being over, the other under the suspensor which had been drawn forward out of it.

With regard to Th. Deecke's newer preparations, on which pl. 10 is based, several of which also he was kind enough to show me, what I observed agrees no better with his drawings; for example, in the preparation drawn in fig. 6, I saw, in the space which exists in the drawing between the end of the suspensor (t, p) and what is represented as the introverted membrane of the embryo-sac, a germinal vesicle which had remained unfecundated; and in this, as well as in the suspensor, the characteristic surface of attachment against the internal wall of the embryo-sac.

In the 'Botanische Zeitung,' 1856, p. 121 (*Stachys sylvatica*), the same author publishes his latest researches. He has overlooked the germinal vesicles in the unfecundated embryo-sac. In the impregnated sac he never found but one; this he regarded as the pollen-tube, which he supposed to have penetrated into the embryo-sac. The point of attachment of the germinal vesicle to the embryo-sac was looked upon by him as a hole made by the pollen-tube.

Tulasne published first in the 'Comptes Rendus' (1855, No. 12. p. 790) a short report of the results of his later embryological studies, which have since appeared in full (Ann. des Sc. nat. 4 sér. iv. p. 65). So far as relates to the *fecundated* embryo-sac, they agree perfectly with our observations, and especially contain many proofs of the peculiar circumstance that the end of the pollen-tube often lies at a considerable distance from the point of attachment of the fecundated germinal vesicle to the outside of the embryo-sac. *On the other hand, Tulasne in these cases, again, has been unable to detect the germinal vesicles in the unfecundated embryo-sac.* Moreover, we miss frequently in his figures, and indeed in all the very recently fecundated embryo-sacs, any representation of the abortive germinal vesicles or their remains.

Tulasne's (erroneous) view of the act of fecundation has consequently undergone no alteration. The fact that (at the end of his essay) he considers it illogical to perceive the germinal vesicle in the unfertilized embryo-sac, cannot alter the fact of our having seen it.

A. Henfrey read before the Linnæan Society of London, March 4, 1856, a paper 'On the Development of the Ovule of *Santalum album*, with some remarks on the Phænomena of Impregnation in Plants generally,' the essential contents of which are reported in the Annals of Nat. Hist. ser. 2. xvii. p. 438 (published in Linn. Trans. vol. xxii. p. 69). He thinks that Griffith was decidedly in error on the point that the pollen-tube penetrated into the embryo-sac. The *unfecundated germinal vesicles detected in the embryo-sac* are stated by him to be devoid of a bounding cell-membrane, and he regards them as *mere masses of protoplasm* (pre-existing protoplasmic globules). He thinks that a similar relation is set up between the embryo-sac and the end of the pollen-tube, to that existing in the *conjugation of the Algæ.* Soon after the pollen-tube has become adherent to the point of the embryo-sac, the pre-existing protoplasmic globule—the 'germ-globule'—acquires a cell-membrane and becomes an *actual cell,* the *germinal vesicle,* from which is produced the suspensor.

I must abstain from any close discussion of Henfrey's observations until the entire memoir, with the drawings, is published, since I cannot until then contrast and compare what I saw in the preparation kindly shown me by Prof. Henfrey, with his own views derived from them. But I cannot help making a few remarks on the conclusions he has drawn.

My last-year's observations on various plants, and some which I have just completed on the unfecundated embryo-sac of *Viscum*, have taught me that the germinal vesicle by no means possesses so firm a cell-membrane as we are accustomed to see in completely-developed vegetable tissues; that it has sufficient solidity to retain its original oval form for a few moments when the section passing through, halves both embryo-sac and germinal vesicle; but very soon, directly the contents of the latter begin to coagulate under the influence of water, it shrivels up, follows the contracting contents, and can no longer be perceived as distinct from them. In other words, the coagulating cell-contents do not retract from the cell-wall, but remain constantly in intimate contact with it, the cell-wall coagulating equally with the contents. But that we have not here to do with a mere primordial utricle, with a *naked* cell, is shown by the following conditions:—If we take a portion of the embryo-sac of *Viscum album* consisting of about $\frac{1}{6}$th of its length, and turn this inside out, so that the germinal vesicles lie outside and are seen free, with no membranous portion of the embryo-sac lying over or under them to obscure the view,—and then carefully tear them with a needle, supposing this has not already happened in the previous manipulation,—*their membrane remains as an extremely delicate, ragged, and wrinkled pellicle* adhering to the everted inner surface of the embryo-sac. It is of unequal thickness—thicker at the base of the germinal vesicle, thinner at its apex. At the exact place where it passes off, free (as side-wall), from the basilar surface of the germinal vesicle, its surface of attachment to the embryo-sac, its optical section appears as a broad line with a double boundary, under a power of 160 diameters. Towards the apex of the germinal vesicle (turned away from the top of the embryo-sac) the membrane becomes thinner and thinner, until, at the very top, it is, in its earlier stages, a scarcely consolidated pellicle. *If the germinal vesicle had not a proper membrane*, of appreciable thickness at least at the base, the boundary-line of its surface of attachment to the embryo-sac could not present itself as *double*, which is the case here in *Viscum*, even under a low magnifying power. Henfrey's observations were made on flowers which had been long preserved in spirit: the germinal vesicles must here naturally have been contracted, and could no longer present a distinct cell-membrane. I shall discuss in the sequel Henfrey's view as to the occurrence of conjugation between the embryo-sac and the pollen-tube.

London, June 8, 1856.

[*Note by Translator.*—The remarks in the preceding paragraphs are by no means convincing. It is our universal experience of nascent cells, that the cellulose membrane, be it ever so thin, does not contract on the contents; on the contrary, it is always first somewhat expanded through endosmose, and *leaves* the contents, afterwards shrinking again (evenly), which is admissible by its elasticity; by that time, however, the contents have shrunk up and coagulated, so that they lie free permanently in the cavity of the cell.—Since the above notices were written, Schacht has published a paper on *Gladiolus Segetum* (Ber. Berl. Acad. May 22, 1856), in which he takes up our view entirely, from independent observation, made in ignorance of our researches. A notice of his results appeared in the Annals, ser. 2. xviii. p. 217, 1856. In a still more recent essay by Hofmeister (Jahrb. d. wiss. Botanik, Heft i. Berlin, 1856), the existence of a cellulose membrane on the germinal vesicle before fecundation, is said to be usual, but liable to exception.—A. H.]

[To be continued.]

XXXVI.—*On the Presence of Motile Organs, and the Power of Locomotion, in Foraminifera.* By P. H. Gosse, F.R.S.

In a valuable paper by Mr. Macdonald "On Deep Soundings in the Pacific," which was published in the 'Annals of Nat. Hist.' for October last, there occurs the following passage:—"With all our opportunities of observing living Foraminifera in the South-western Pacific, where they abound in the most diversified forms, we have never been able to discover their branched 'pseudopodia,' so called, or the slightest evidence of the crawling movement which they are reputed to exhibit; while we can vouch for the actual fixity of some."

I have read this passage over and over, and cannot come to any other conclusion than that, as the language is unlimited, it is intended that the doubts should apply to the whole class of Foraminifera. As the opinions of so excellent a zoologist will have deserved weight, though founded on evidence which is merely negative, it may not be amiss to furnish some positive testimony on the opposite side—testimony which I should otherwise have thought perfectly superfluous. For, on turning to the works of one of our most eminent physiologists, Dr. Carpenter, who has devoted much careful attention to these minute animals, I find him (in his treatise "On the Microscope," for instance, p. 503 *et seq.*) recognizing, without any doubt, the existence of pseudopodia; and he reproduces two beautiful figures, after Schultze, of the genera *Gromia* and *Rosalina*, taken from the life, in which these organs are seen extended in copious profusion. He does not, indeed, allude to their power of changing place; but to this fact, as well as to the existence of pseudopodia, I can add my own testimony.

In the spring of 1855, at Weymouth, I obtained, chiefly in the minute tufted Algæ, such as *Corallina*, *Polysiphonia*, and *Ceramium*, a good many specimens of the pretty little *Polystomella crispa*. These were always found, a few hours after the weed had been deposited in my vases, adhering to the glass, with the pseudopodia extended in opposite directions, just as represented in my outline figure of the species*, which was taken from the living animal. Very frequently these tiny atoms were found, in the morning, two, three, or even four inches up the sides of the perpendicular glass vases, having crawled this distance in the course of the night. And they never remained long stationary; the next morning would find them in some remote part of the glass. The night was manifestly their time of activity.

After my return to London, all through the spring and early summer, one of my tanks was literally swarming with a species of *Polymorphina*; the individuals increasing immensely and rapidly by generation, or perhaps by gemmation (for, being very much pressed with other work, I had not time to investigate the interesting problem of their mode of increase); although, when I stocked the tank, I was not cognizant of the presence of any; the fruitful parents of this abundant progeny having doubtless been introduced in some tuft or tufts of weed.

The individuals were of various dimensions; a large number having quickly attained the adult size, viz. about $\frac{1}{16}$th of an inch in length. They studded the sides of the vessel, the stones, and the slender weeds, adhering to the filaments of the latter in such profusion as to cover the whole contents of the vessel with white dots, conspicuous even upon the most cursory glance. These, like the *Polystomellæ*, were constantly roaming; they crawled up and down the stems and branches of the Algæ, and over the various objects in the tank, never remaining long in one station.

On removing one from the vessel (which I did frequently) to an aquatic cell or 'live-box,' for microscopic examination, it was found to be entirely withdrawn; but, in the course of a few minutes, the pseudopodia were seen to be protruding their tips; and then they gradually (so gradually that the eye could not recognize the process of extension) stretched and expanded their lines and films of delicate sarcode, till, in the course of a few hours, these would sometimes reach almost from side to side of the glass cell. The extension was principally in two opposite directions, corresponding to the long axis of the shell; though the branched and variously connected films often diverged considerably to either side of this line, giving to the whole a more or less fan-like figure.

Though the array was so very deliberately put forth, it was very rapidly withdrawn on any disturbance to the animal; as when the water was agitated by slightly moving or turning the cover of the cell.

I am quite certain, from manifest (though small) changes of

* Marine Zoology, vol. i. p. 13. fig. 14.

position in the shells, while under observation on the stage of the microscope, that it is by means of the adhesion and contraction of the pseudopodia, that the animal drags itself along a fixed body.

I hope I have not misunderstood the observation of my respected fellow-labourer, by supposing it more absolute than he intended it; but, at all events, the facts above recorded may possess an intrinsic interest sufficient to warrant their publication.

XXXVII.—*Note on the Presence of the Fossil genus* Isodonta, *Buv., in the English Jurassic Rocks.* By John Lycett, Esq.

To James Buckman, Esq., Hon. Sec. to the Cotteswold Naturalists' Club.

Dear Sir,

Will you have the goodness to communicate to the Club, at their next meeting, that we may claim the genus *Isodonta*, Buv. (*Sowerbya*, D'Orb.), as an addition to the fauna of the English Jura?

The sole species hitherto described is the *Isodonta Deshaysea*, Buv., from the ferruginous Oolite of the Oxfordian beds of the Department of the Meuse. Recently, my good friend Mr. Leckenby presented me with a fine specimen of the so-called *Cucullæa triangularis*, Phill., from the Cornbrash of Scarborough. The resemblance in the general aspect of this shell to the *Isodonta* of Buvignier was at once apparent; but it was only upon an inspection of specimens in the British Museum, collected by M. Tesson, that their identity with the Yorkshire shell became a conviction to my mind. Individual specimens vary in their elongation and in the degree of angularity at their infero-posterior extremity: little differences of this kind form the sole distinction between the British fossil and that of the Meuse, and the Normandic specimens in the Museum differ from each other at least to an equal extent. The *Cucullæa triangularis*, Phill. Geol. York. i. tab. 3. fig. 31, is from the Coralline Oolite of Malton; it is somewhat less elongated than my Cornbrash specimen, and agrees more nearly with the figures of Buvignier, 'Paléont. de la Meuse,' Atlas, pl. 10. figs. 30–35, except that the figure of Phillips is somewhat more inequilateral from the shortness of the posterior slope: in the Cornbrash specimen, as in those from Normandy and from the Meuse, this feature is less conspicuous; but there can be no doubt that the anterior side is always somewhat more produced than the other; the surface is smooth, but with two distant and strongly-marked folds of growth. The very tumid figure and incurved umbones are the external characters whereby it may be distinguished from *Tancredia*; the test is likewise thicker than in the latter genus. At present it does not seem that the Cornbrash shell can be separated as a species either from that of the Yorkshire Coralline Oolite, from the Normandic specimens, or from those figured by Buvignier from the Department of the Meuse; but it is desirable that additional British examples of this rare form should be examined. I need hardly suggest to you the expediency of making a rigorous search in the Cornbrash and the Kelloway rock of the vicinity of Cirencester; and believe me to remain, dear Sir,

Yours, &c.,
JOHN LYCETT.

Minchinhampton, October 19, 1857.

XXXVIII.—*Descriptions of new Ceylon Coleoptera.* By JOHN NIETNER, Colombo, Ceylon.

[Continued from p. 282.]

Tribe CRATOCERIDÆ.

Oosoma, n. g., N.

Corpus ovatum, subconvexum, glabrum. Caput transversim suborbiculare, robustum; oculis magnis, ovatis, parum prominulis. Mentum profunde emarginatum, lobis extus rotundatis, apice subobtusis, dente minimo, obtuso. Ligula submembranacea minima, angustata, paraglossis maximis, connatis, ligulam totam amplectentibus, apice leviter sed abrupte et sat profunde emarginatis. Palpi art. ult. ovato, apice abruptius angustato leviterque truncato. Clypeus subsemilunariter emarginatus. Labrum transversum, profundius angulate emarginatum, angulis anter. rotundatis, lateribus angulato-rotundatum. Mandibulæ parvæ, validæ, edentatæ, inter med. et apic. arcuatæ. Antennæ robustæ, thoracis med. parum superantibus, art. 1 et 11 subæqualibus, 2–10 parum brevioribus, subæqualibus, 1–3 basi angustatis, reliquis ovatis, 5–11 leviter depressis. Thorax transversus, capite parum latior, basi quadratus, apicem versus leviter angustatus, antice vix emarginatus, postice leviter bisinuatus, elytris fortiter applicatus. Elytra basi quadrata, thoracis latitudine, apice oblique subtruncata, striata. Pedes validi fortiterque armati, subæquales; tibiis costatis, ant. sat profunde emarginatis, apicem versus dilatatis, 4 post. apice 4-calcaratis; tarsis art. 1–4 gradatim minoribus, ant. leviter dilatatis, art. 1° cylindrico-trigono, 2–4 trigonis, post. art. 1–4 subtus longitudinaliter biserratis.

Interesting insects, apparently nearly allied to *Nothopus*, of an appearance which easily distinguishes them from any other

Carabidæ I have hitherto met with in this island. The head is plump, transversely orbicular, immersed up to the eyes in the thorax. The clypeus is narrow, transverse, rather deeply emarginated in the form of a crescent; anterior angles acuminated. The labrum is of thin, translucent texture, deeply angularly emarginated in front; the anterior angles rounded, setose, sides angular, rounded. Mandibles short and thick, curved from the middle to the tip, edentate. Maxillæ simple. Antennæ short, thick, reaching a little beyond the middle of the thorax; joints 3–11 pubescent, 5–11 slightly compressed, 1–3 narrowed at the base, 4–11 oval, 1 and 11, 2–10 of about equal length respectively. Mentum with a straight, deep emargination; lobes rounded externally, rather obtuse at the apex; tooth very small, obtuse. Ligula very small, narrow, slightly dilated towards and rounded at the apex; paraglossæ very large, connate, enveloping the ligula on all sides, the whole slightly truncated at the anterior angles, and slightly, but sharply and pretty deeply emarginated or notched at the centre of the anterior margin. Palpi, both maxillary and labial, with the terminal joint oval, rather abruptly narrowed and slightly truncated at the apex; these characteristics are more distinctly expressed in the labial palpi. All the lower part of the mouth is situated in or forms a cavity. Thorax a little broader than the head, nearly twice as broad as it is long, quadrate at the base, slightly narrowed towards the apex, anterior angles slightly produced; the anterior margin can hardly be called emarginated; two slight sinuosities at the base, firmly applied to the elytra, and as broad as these. Scutellum broad, triangular. The elytra rather abruptly cut away at the apex; internal angles rather obtuse, slightly dehiscent. Legs stout and strongly armed, very much in the manner of my *Cyclosomus dyticoides,* of which the insect under consideration in various respects reminds me most forcibly. The spines of the tibiæ are inserted on ridges, the anterior ones being dilated. The tarsi are all concave on the inner side. I have been unable to discover anything in them by which to distinguish the sexes, not even additional spines or bristles; however, the sexes appear well marked by the difference in size. The anterior tarsi are dilated, the intermediate and posterior ones more and more elongated, and the joints subcylindric; joint 1 of the latter is longer than the three following together; all four have the edges of their concave inner side serrated—an extraordinary circumstance. The highly-developed prosternum reminds me again of *Cyclosomus.*

The habits of these insects are those of the *Amaras*: they live in dry, sandy places under grass and leaves; at certain times they take freely to their wings, and *O. arenaria* may then be caught in great numbers at night about the lights. This species is very common in all the dry and sandy parts of the neighbourhood of Colombo; the pretty little *O. Gerstæckeri*, however, is scarce.

49. *Oosoma arenaria*, N.

O. supra brunneo-æenea, subtus magis minusve brunnea, pedibus, palpis antennarumque basi testaceis, tarsis, labro limboque angustissimo obscurioribus; capite ad clypei marginem post. punctis 2 impresso; thorace ad basin obsoletissime 4-foveolato, linea longitud. abbreviata, indistincta, diviso, basi anticeque obsoletissime striguloso; subtus tenuiter hirsuta. Long. corp. $2\frac{1}{2}$–3 lin.; lat. $1\frac{1}{4}$–$1\frac{1}{2}$ lin.

50. *Oosoma Gerstæckeri*, N.

O. supra brunneo-æenea, sæpius glaucescens, elytris dorso dilute brunnescentibus maculis 4 longitud. irregularibus flavis pictis, subtus magis minusve brunnea, pedibus, antennis labroque testaceo-brunneis, palpis antennarumque basi testaceis. Long. corp. $2\frac{1}{4}$ lin.; lat. $1\frac{1}{8}$ lin.

Excepting in colour, not essentially differing from the former. However, the marks of the thorax are more distinct, and the four obsolete pits are replaced by two longitudinal impressions; the whole insect is, moreover, more graceful than the former. The maculæ of the elytra may be said to commence at the basal angles of the thorax, which are of a similar, but less distinct, colour. The true humeral maculæ begin at the base of the elytra, and stretch nearly to the middle as a thick straight line or narrow parallelogram, the principal part of which occupies the sixth interstice, a spot being thrown out on either side. The apical maculæ commence a little below the middle, and are essentially composed of small squares heaped upon each other, so as to form steps or an inverted pyramid.

As this design varies more or less in different individuals, it can be of no importance to describe it in a more detailed manner; suffice it to say, that apparently in no instance does any part of it reach either the inner or outer margin, the field upon which it is displayed being enclosed by the first and seventh striæ. The brownish-green metallic upper surface of the insect in some individuals throws off a fine blue reflex, very perceptible on the head and thorax. The part of the back enclosed by the maculæ is washed out to a light brown, with the exception of the suture, which remains dark.

In naming this pretty species after Dr. Gerstæcker of the Royal Museum, Berlin, I wished to pay that gentleman the only trifling compliment circumstances admit of, in acknowledgement for various useful hints he has kindly communicated to me.

51. *Chlænius princeps*, N.

C. aureo-viridis, scutello cupreo, elytris nigro-viridibus ad basin et infra marginem viridibus, sutura nigra, subtus piceus, coxis trochanteribusque 4 ant. dilutioribus, femoribus trochanteribusque 2 post. testaceis, tibiis tarsisque obscurioribus, ore antennisque brunneis, labro, mandibulis limboque castaneis; capite obsolete ruguloso, punctulato; antennis art. 3° quarti prope longitudine; menti dente forti laciniis apice rotundatis; thorace ovato-quadrato, latitudine parum longiore, angulis ant. subrectis, post. rotundatis, basi fortiter 2-impresso, punctato; scutello canaliculato; elytris striatis, in striis punctatis, ad strias, præsertim apicem versus, tenuiter pilosis. Long. corp. 8 lin.; lat. 3 lin.

Specimen singulum f. prope Colombo sub lapidibus cepi.

A very handsome species, distinguished by its size and comparatively great breadth. The clypeus is impressed with two setigerous pits near the anterior corners. The labrum is transverse, slightly sinuated in front, narrowed at the base, and has the anterior angles strongly rounded-off. The last joint of both the maxillary and labial palpi is cylindric and truncated at the apex; in the maxillary it is shorter than in the labial ones, in the latter somewhat narrowed at the base and slightly inflated at the middle; both appear slightly compressed at the apex. The elytra are strongly rounded at the apex. The insect has a very strong smell, somewhat like musk, about it.

52. *Chlænius maleolens*, N.

C. capite, thorace scutelloque obscure cupreo-viridi-glaucescentibus, elytris obscurioribus, pubescentibus, maculis 2 subapicalibus flavis ornatis, subtus piceus, pedibus testaceis, ore antennisque brunneis, mandibulis limboque castaneis; capite ad clypei marginem post. profundius 2-foveolato, punctulato, occipite leviter transversim ruguloso; antennis art. 3° quarto subæquali vel paulo breviore; menti dente apice leviter sinuato; thorace subquadrato, lateribus leviter rotundatis, profundius punctulato atque levissime transversim ruguloso, ad basin 2-impresso, parce piloso; elytris densius pubescentibus, striatis, in interstitiis 3–8 utrinque ante apicem macula suborbiculari flava ornatis. Long. corp. $6\frac{1}{4}$ lin.

Specimen singulum m. prope Colombo cepi.

Also a handsome and rare species, smelling strongly and disagreeably of creosote. The head, thorax and scutellum are of a dull bluish-green colour, with a copper reflex from the back; the elytra are of a blackish-green, pubescent, and adorned with two yellow spots between the middle and apex; these are of irregular rounded outline, and stretch from the middle of the third interstice across to the eighth stria. The fourth joint of the maxillary palpi is subcylindric, that of the labial ones larger, plump, and rather triangular. Tooth of the mentum not bifid, but truncated and merely slightly sinuated at the apex. The elytra are narrowed at the apex.

53. *Chlænius Dohrnii*, N.

C. elongatus, parallelus, capite thoraceque viridi-nitentibus, elytris viridi-glaucescentibus maculis 2 apicalibus flavis pictis, subtus dilute piceus, apicem versus brunneus, pedibus testaceis, ore antennisque brunneis; capite sublævi nitidissimo; antennis art. 2° parvo, reliquis longitudine subæquali; palpis maxill. art. 4° cylindrico, lab. eodem subtrigono; thorace ovato-quadrato, crebrius punctato, basi 2-impresso; elytris striatis, punctatis, pubescentibus, 2-maculatis, maculis subapicalibus prolongatis, interstitia 2–8 et angulum apicalem occupantibus, flavis. Long. corp. 6 lin.; lat. 2 lin.

Specimen singulum f. prope Colombo nocte ad lumen cepi.

The elongated and parallel shape of the body distinguishes this species at first sight; it is very pretty and scarce, but has otherwise nothing remarkable in its construction. However, I may add to the above description, that the mentum is large, the lobes obtuse at the apex, and the tooth but slightly sinuated at the tip. The ligula is of the usual construction, the paraglossæ obtuse and ciliated at the apex. The last two joints of the labial palpi are rather elongated, whilst in the maxillary ones they are the reverse; the former have the terminal joint triangular, the latter cylindric; both are strongly truncated at the tip. The head is middling, with two impressions in front of the eyes; the mandibles are rather more curved than usual; the labrum is emarginated in front; the antennæ are rather short and stout, reaching only to the base of the thorax; the latter is a little broader than the head, and of an ovato-quadrate form. The elytra and legs are simple.

I have named this species after the president of the Entomological Society of Stettin, to whom I am indebted for much entomological information.

54. *Harpalus* (*Ophonus*) *senilis*, N.

H. oblongo-ovatus, subdepressus, punctato-rugosus, griseo-pubescens, supra æneus, subtus piceus, ore pectoreque dilutioribus, pedibus testaceis, antennis basi palpisque apice flavis; capite robusto, antice rotundato, postice parum angustato, thorace vix angustiore; antennis humeros attingentibus, art. 2° parvo, reliquis longitudine subæqualibus; mandibulis obconicis, robustis, una unidentata, altera incisa; labro vix emarginato; palpis art. 4° ovato, apice abruptius angustato, leviter truncato; thorace transverso, longitudine tertia parte latiore, elytris vix angustiore, lateribus rotundato, infra med. leviter angustato, basi subquadrato, hic vix, antice leviter emarginato, angulis apicalibus obtuse acuminatis, basalibus subrecte rotundatis; elytris punctato-striatis, apice fortius 2-sinuatis et angustatis; tarsis art. 4° cordato. Long. corp. $4\frac{1}{2}$ lin.; lat. $1\frac{1}{2}$ lin.]

Prope Colombo sat copiosus.

This, as well as the succeeding two species, flies very commonly into the rooms at night during the rainy weather. The present species is a fine, comparatively large, robust insect. I may add to the above description, that the emargination of the mentum is of middling size, its lobes rounded externally, and its tooth just marked in the shape of a slight obtuse rising at the bottom of the emargination. The ligula is very small and narrow, the paraglossæ very large, adhering to it, and enveloping it fully and on all sides; the whole is very slightly cut away at the apical angles, and slightly, but abruptly and rather deeply, notched at the centre of the anterior margin. I may further notice, that some of the individuals before me have the apex of the maxillary palpi prolonged, cylindric, and slightly bent inwards. As this is not a sexual distinction, and as the insects thus distinguished differ in no other respect from the rest, I look upon them as curious varieties.

55. *Harpalus* (*Ophonus*) *rugosus*, N.

H. præcedenti simillimus sed sesqui minor, magis rugosus, antennis robustioribus art. 5–11 ovatis, leviter depressis, colore supra parum obscuriore, subtus dilutiore, pedibus albidis, coxis tarsisque brunneis, antennis totis castaneis. Long. corp. $3\frac{1}{2}$ lin.

The small size and, upon close inspection, the other peculiarities just pointed out, readily distinguish this species from the former, in spite of their close affinity in other respects. They are both equally common about Colombo.

56. *Harpalus* (*Selenophorus*) *Colombensis*, N.

H. statura præcedentis sed gracilior, glaber, supra læte æneus, subtus subcastaneus, pedibus albidis, coxis, tarsis, antennis palpisque testaceis, ore brunneo; capite transversim ruguloso; antennis præcedente tenuioribus, palpis gracilioribus apice magis angustatis; labro basin versus leviter dilatato; mandibulis infra apicem abruptius arcuatis, una uni-, altera bi-dentata; thorace lateribus præcedente minus rotundato, basi minus angustato, hic rugoso-punctato, antice leviter longitudinaliter strigoso; elytris striatis, parce punctulatis, in interstitiis 3°, 5° et 7° punctis majoribus impressis. Long. corp. 3 lin.

Prope Colombo sat copiosus.

A pretty little insect, very distinct from the preceding two. I may add, that it also differs somewhat in the paraglossæ, the interior angles of which are distinct.

Tribe HARPALIDÆ?

Lepithrix, n. g., N.

Corpus oblongum, robustum, subconvexum. Caput ovatum, mediocre; oculis semiglobosis, prominulis. Mentum leviter subsemilunariter emarginatum, lobis extus rotundatis, dente vel parvo, obtuso vel nullo. Ligula mediocris, cornea, oblonge quadrata, apice transversim truncata, libera, paraglossis cylindricis apice truncatis, sat robustis, marginem ant. parum superantibus. Palpi articulo ultimo elliptico, truncato. Labrum apicem versus angustatum, apice rotundatum. Mandibulæ validæ, apice arcuatæ, una uni-, altera bidentata. Antennæ filiformes humeros parum superantes, art. 2° parvo, reliquis longitudine subæqualibus. Thorax mediocris longitudine parum latior, antice vix, postice haud emarginatus, lateribus leviter rotundatus, basi parum angustatus, angulis omnibus rotundatis, margine elevato. Elytra ovata, infra med. parum dilatata, apice leviter angustata et acuminata. Pedes subæquales, tibiis apice bicalcaratis, calcaribus intus subtiliter serratis, ant. leviter emarginatis, tarsis 2 ant. art. 1–3 leviter dilatatis gradatim minoribus, art. 1° cylindrico, 2° obcordato, 3° trigono, omnes art. 4° *maris* bilobo, *fœminæ* bifido, art. 5° magno, unguibus validis, simplicibus; *subtus* tarsis 2 ant. art. 1–4, intermed. art. 2–4 squamularum longepedunculatarum seriebus duabus munitis.

57. *Lepithrix foliolosa*, N.

L. glabra, supra obscure brunnea, thoracis elytrorumque limbo testaceo, subtus brunneo-testacea, pedibus albidis, antennis art. 3 primis flavis, reliquis nigrescentibus, palpis art. ultimo testaceo, reliquis flavis; thorace ad angulos basales profundius foveolato; elytris striatis; prosterno canaliculato. Long. corp. 3–4 lin.

Specimina nonnulla mens. Octob. prope Colombo nocte ad lumen cepi.

The internal vesture of the tarsi of these otherwise inconspicuous insects constitutes their most important character, and is altogether of a very interesting nature. I proceed at once to describe it at full length, premising that *I believe* I have both male and female before me. The individual which I take to be the male is smaller and of a darker colour than the other. The legs, with the exception of the tarsi, are the same in both sexes. They are of middling strength; the tibiæ are furnished with two spurs at the inner side of the apex, which spurs are finely serrated along their inner edge; the tarsi have joints 1–3 of the first pair slightly dilated; the posterior pair is elongated, subcylindric; and the intermediate one forms a passage between the two. Joints 1–3 of the first pair gradually decrease in size, joint 1 being at the same time subcylindric, joint 2 rather cordiform, and joint 3 rather triangular; joint 4 in all six tarsi is bilobed in the male and bifid in the female, this character being, however, less distinctly expressed in the two posterior tarsi than in the four anterior ones; joint 5 is large, and the claws strong and simple; a membranaceous process of triangular form covers the base of the latter above.

The internal vesture of the four anterior tarsi of the *male* is of the following description. The inner part of joints 1–4 of the two anterior ones is furnished with two longitudinal series of pedunculate squamulæ, which are of a broad triangular form, and lie like tiles upon each other, covering the sole of the tarsus; they are flanked by bristles, which partake of the nature of scales, being dilated in the shape of a lancet. These squamulæ are without any particular colour, they are unconnected amongst themselves, their edges are entire, and they attain their highest development at the apex of the fourth joint; in fact, their development is gradual, from the base of the first joint to the apex of the fourth. The intermediate tarsi, although not dilated, are similarly provided with the anterior ones, but only at the apex of the second and at the third and fourth joints, the squamulæ being of rather a square shape triangularly prolonged and pedunculate at the base; the first joint is naked in this pair.

The tarsi of the *female* are very much the same as those of the male, excepting the fourth joint, which, as above mentioned, is bifid. A further distinction exists, however, in the squamulæ. In the two anterior tarsi of the female these are present at the apex only of the first and second joints (hardly distinct at the former); however, they are well developed in the third, and very highly in the fourth joint; the squamulaceous bristles are less conspicuous, but the peduncle attains extraordinary length in the fourth joint; the squamulæ do not cover each other like tiles, but stand more freely and loosely, and are curved inwards so as nearly to touch in the middle; their shape is that of an elongated triangle; they are veined, and their apical edge is serrated. Being such, and placed upon long, slender peduncles, they forcibly remind me of the leaflets of certain Ferns (*Adiantum*), and hence the specific name *foliolosa.* The intermediate tarsi are similarly provided, but, as in the male, the first joint is naked, and the second furnished with scales at the apex only. The lower edges of the two posterior tarsi are very neatly fenced-in with small, closely-set spines.

I feel doubtful as to the affinities of these insects, especially if in reality I have described both sexes, and if the vesture of the intermediate tarsi is allowed to be of the same importance as that of the anterior ones; however, I think they must find a place amongst the Harpalidæ as restricted by Lacordaire. I must not omit to mention that the tooth of the mentum appears to be variable, one of my specimens (a male) being decidedly without it, whilst another is furnished with a small, obtuse one.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

March 10, 1857.—Dr. Gray, F.R.S., in the Chair.

Characters of some apparently New Species of American Ant-Thrushes. By Philip Lutley Sclater, M.A., F.L.S., &c.

1. Formicarius trivittatus.

Supra fusco-cinnamomeus, subtus clarior, gula pallidiore: alis caudaque nigris cinnamomeo tinctis, illarum tectricibus minoribus et majoribus fascia terminali et remigibus ipsis fascia mediali alba præditis, itaque alis trifasciatis: oculorum ambitu seminudo: rostro et pedibus nigris.

Long. tota 7·0, alæ 3·4, caudæ 2·5.

Hab. In ripis fl. Amazonum.

Mus. Brit.

The only individual of this species which I have yet seen is that in the British Museum. It is easily recognizable among its congeners by its thrice-banded wings. I am now acquainted with seven birds which I consider to be probable members of this genus, viz. —(1.) cayanensis, Bodd. Pl. Enl. 821 (*colma*, Gm. et Bodd., *tetema*, Licht., *fuscicapilla*, Vieill., *ruficeps*, Spix), ex Guiana et Brasilia. (2.) analis (Lafr. et d'Orb.), Voy. d. l'Am. Mér. Ois. pl. 6*. f. 1, ex Bolivia, Cayenna et ins. Trinitatis. (3.) nigrifrons, Gould, P. Z. S. 1855, p. 68, ex Nov. Grenada et fl. Amazon. (4.) moniliger, Sclater, P. Z. S. 1856, p. 294, ex Mexico. (5.) trivittatus. (6.) erythropterus, Gould, P. Z. S. 1855, p. 69. (7.) nigromaculatus (Lafr. et d'Orb.), Voy. d. l'Am. Mér. pl. 6*. f. 2, ex Bolivia et fl. Amazon sup.

The last three birds have the space round the eyes more or less denuded, and would form the subgenus *Phlegopsis*, Reichb., of which, I believe, *F. nigromaculatus* is the type. In that very peculiar member of this family *Pyriglena nudiceps* (*Myiothera nudiceps*, Cassin, Pr. Ac. Sc. Phil. v. p. 106. pl. 6), this formation is developed to a still greater extent, the whole top of the head being naked.

2. Conopophaga castaneiceps.

Conopophaga ardesiaca, Tsch. Faun. Per. p. 179, et Sclater in P. Z. S. 1855, p. 145, nec Lafr. et d'Orb.

Supra olivascenti-brunnea; pileo castaneo, frontem versus lætiore: lateribus capitis et gula nigricanti-cinereis: penicillum postoculari album: subtus cinerea, abdomine medio albescentiore: lateribus olivaceo indutis: mandibula superiore nigra, inferiore flava, pedibus brunneis.

Long. tota 4·4, alæ 2·9, caudæ 2·7.

Hab. In Nova Grenada, Bogota et in Peruvia Orientali (*Tsch.*).

Mus. Brit. et P. L. S.

This is a typical *Conopophaga*, with the characteristic white pencil of feathers on the sides of the head. Trusting to Tschudi's identification of a specimen collected by him, which is now in my collection, I had considered it to be d'Orbigny's *C. ardesiaca*. But upon examining the type of that species in the French National Collection I found such was not the case. That bird does not possess the chestnut-brown cap or darker cinereous colour of the throat belonging to the present species, but is more uniform in its colouring both above and below.

There is a specimen of this bird in the British Museum from Bogota.

M. O. des Murs, in the Ornithology of the Voyage of Castelnau and Deville, has described and figured another *Conopophaga*, somewhat resembling the present, *C. peruviana*, pl. 16. f. 1. But this bird has spots upon the wings and a varied back.

3. Hypocnemis elegans.

Hypocnemis ——?, Sclater, P. Z. S. 1855, p. 147.

I have lately seen other specimens of this bird, and have one in my own collection—a Bogota skin. Though closely allied to *H. melanosticta*, I cannot consider it otherwise than specifically distinct, and therefore propose a name for it: I have already given its characters in the Proceedings of the Zoological Society for 1855.

4. Myrmeciza hemimelæna.

♂. *Castaneus: dorsi medii pennis basi albis, inde nigris, apice castaneis: capite toto undique et corpore subtus ad medium pectus nigris: ventre medio albido: campterio summo et maculis tectricum alarium apicalibus albis: rostro nigro, pedibus flavis: cauda rufo-castanea unicolore.*

♀. *Obscure olivacea rufo tincta: interscapulii pennis basi albis: dorso postico, alis et cauda rufis: alarum tectricibus nigris, sicut in mari albo aut fulvescenti-albo guttatis: subtus læte ferruginea, pectore et ventre medio pallidioribus: lateribus et crisso rufescenti-olivaceis.*

Long. tota 5·0, alæ 2·4, caudæ 1·7.

Hab. In Bolivia (*Bridges*).

Mus. Brit.

There are single specimens of both sexes of this bird in the British Museum, which are the only examples I have yet seen. It may be best arranged near *Myrmeciza loricata*, the type of the genus, with which it agrees generally in form, although the tail is comparatively much shorter.

5. Formicivora hæmatonota.

Supra brunnea, dorso medio rubro, hoc colore uropygium versus dilutiore: alarum tectricibus nigris, omnibus macula terminali pallide cervina præditis, secundariarum externarum apicibus eodem colore obsolete terminatis: subtus cinerea, gula nigra maculis triangularibus albis aspersa: ventris lateribus et crisso *pallide brunneis : cauda unicolore brunnea : rostro nigro, pedibus brunneis.*

Long. tota 4·0, alæ 2·0, caudæ 1·2.

Hab. Chamicurros in ripis fl. Huallaga in Peruv. Orient. (*Hauxwell*).

Mus. Brit.

Obs. Similis *F. gulari* (Spix, Av. Bras. ii. t. 41. f. 2) sed dorso medio rubro nec cinnamomeo, et colore subtus dilutius cinereo dignoscenda.

On the species of Crocodilus inhabiting the rivers Kwóra and Bínuë (Niger and Tsadda) in Central Africa. By Dr. Balfour Baikie, F.R.Geog.S. &c.

Among the Zoological collections which I made during my visit to the rivers Kwóra and Bínuë in 1854, were several skulls of Crocodiles, varying in length from 14 to 26 inches. A careful comparative examination of these shows them all to be possessed of similar characters; but on attempting to refer them specifically, I have experienced considerable difficulty, their proportional measurements not agreeing with any hitherto described. Two African species of *Crocodilus* are already known,—*C. vulgaris*, the Nilotic or Egyptian Crocodile, and *C. marginatus* of Southern Africa. Of these, according to the best recent authority, namely Dr. Gray, the characters are,—

C. vulgaris.—"Head elongate, triangular, flat, smoothish above, narrow, tapering at the sides, nearly twice as long as the width of the head behind; muzzle at the notch nearly two-thirds the width of the forehead, at the ninth tooth as wide as half the distance between the eyes and nostrils; forehead flat, with nearly parallel sides."

C. marginatus. — "Head elongate, triangular, rather convex, rounded, sides slightly swollen behind the notch, half as long again as the width of the head behind; muzzle at the first notch as wide as the forehead, and at the ninth tooth as wide as two-thirds the distance between the eyes and nostrils; forehead deeply concave, with the sides high, prominent and nearly parallel; dorsal plates very strongly keeled."

I shall now describe generally the skulls which I brought home, giving the measurements of four of them; from which it will be seen, that while in various prominent points they more resemble the latter, yet in proportional measurements they approach more nearly to, while not altogether agreeing with, *C. vulgaris*, thus showing that in many characters they are intermediate, and thus either lowering these two into mere varieties, or what is, I believe, more probable, establishing for themselves specific characters.

Head elongate, oblong, somewhat triangular, rather convex, especially posteriorly, rounded, upper surface rough, sides distinctly swollen behind the notch; length more than twice the width of head behind; forehead slightly concave, sides not prominent, converging anteriorly; muzzle at notch nearly two-thirds the greatest width of forehead; at the ninth tooth more than two-thirds the distance between the eye and nostrils.

Measurements.

	No. 1. in.	No. 2. in.	No. 3. in.	No. 4. in.
Extreme length	26	$24\frac{1}{2}$	$22\frac{1}{2}$	21
Greatest width behind......	$12\frac{3}{4}$	12	$11\frac{1}{8}$	$10\frac{1}{4}$
Distance from eye to nostril..	$10\frac{3}{4}$	10	9	$8\frac{3}{4}$
Breadth at ninth tooth......	$7\frac{3}{4}$	$6\frac{1}{2}$	$6\frac{1}{4}$	$5\frac{3}{4}$
Breadth at notch..........	$4\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{5}{8}$	$2\frac{3}{4}$
Width of forehead, anteriorly.	5	$4\frac{1}{2}$	$4\frac{1}{8}$	4
Width of forehead, posteriorly	$6\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{1}{4}$	5
Extreme length of lower jaw ..	29	27	$24\frac{1}{2}$	—

The proportions of all these correspond almost exactly, and I have ascertained the proportional measurements of a smaller one to be the same, although from its being in pieces and not yet put together, I have not time to take the exact dimensions. They show the Crocodile from the Bínuë to be proportionally longer than *C. vulgaris,* and much more so than *C. marginatus,* to be in form of upper surface and of forehead near the latter, but without the prominent sides to the forehead,—also in breadth at the ninth tooth to agree with *C. marginatus,* while the converging shape of the forehead differs from both.

I shall add some few other general characters derived from these skulls:—Cranial fossæ somewhat oblong and ear-shaped, converging anteriorly, and almost touching by their inner and anterior margins, the outer side being nearly straight. Orbits with a slight notch anteriorly. Nasal foramen broadly pyriform, and almost quadrilateral. Foramina for the two anterior teeth converted in old specimens into deep notches. Articulating extremities of lower jaw much curved inwards.

I have compared these skulls with twelve others of Indian and American species, from all of which they are quite distinct.

The ninth upper tooth of Crocodiles is said to be enlarged like a canine, but this is not strictly correct. I have examined the dentition in eighteen skulls of various species; in the lower jaw there are always nineteen teeth, but in the upper jaw the number in the adult is seventeen on either side, while in the young it is eighteen. This is owing to the second incisor being deciduous, and in old skulls the socket is completely obliterated by the enlargement of the foramen for the two anterior teeth. Thus in old animals there are only four teeth in each intermaxillary bone, while in younger individuals there are always five. So, more strictly, it is the tenth and not the ninth upper tooth which is enlarged.

The characters which I have above enumerated seem to me distinctive, and possibly on further investigation, when the entire animal is examined, and its external characteristics determined, it may prove a new species. The Crocodiles which I saw on the mud banks, or swimming about in the river, appeared of a dark green colour.

Adanson mentions two apparently from the upper parts of the Niger, which he distinguished—"Crocodile vert du Niger" and "Crocodile noir du Niger." Whether either of these resembles my specimens I have no means of ascertaining; but Cuvier speaks of African Crocodiles "qui ont la tête un peu plus allongée à proportion de sa largeur," though he adds, "et un peu plus plate, ou plutôt moins inégale, à sa surface." If this prove to be distinct, I would suggest for it the specific designation *C. Binuensis*, from the name of the river whence I obtained the specimens.

April 28, 1857.—John Gould, Esq., F.R.S., V.P.Z.S., in the Chair.

Descriptions of three new and very beautiful species of Birds, from Guatemala and from the Island of Lombock. By John Gould, Esq., F.R.S., V.P.Z.S. etc.

Cotinga amabilis.

Male. Head, lores, line beneath the eye, all the upper surface, lesser wing-coverts, upper tail-coverts, sides of the chest, band across the breast, flanks, vent and under tail-coverts fine verditer blue; wings dull black, the greater coverts, spurious wing and the secondaries margined with verditer blue; tail dull black, margined externally with dull verditer blue; chin, throat and centre of the abdomen very rich purple.

Female. Upper surface greenish-brown, each feather tipped with greyish-white; under surface greyish-white, with dark brown centres to the feathers of the breast, upper part of the abdomen, and flanks; vent and under tail-coverts dull white.

Total length, 8 inches; bill, $\frac{3}{4}$; wing, $4\frac{1}{2}$; tail, $2\frac{3}{4}$; tarsus, $\frac{7}{8}$.

Hab. Guatemala.

Remark.—The *Cotinga amabilis* forms one of the most beautiful members of this lovely genus of birds, and affords the first instance of a species being discovered to the northward of the Isthmus of Panama. It is allied to *Cotinga cincta* and *C. Maynana*; the chest being crossed by a band as in the former, which it also resembles in the black colouring of the under surface of the wing, while it assimilates to the latter in the peculiar tint of the verditer blue of the upper surface and flanks.

For a knowledge of this lovely species we are indebted to the researches of George Ure Skinner, Esq., than whom no one has done more towards making us acquainted with the rich ornithological and botanical treasures of the fine country to which this bird belongs.

Halcyon fulgidus.

Head, cheeks, back of the neck, back, wings, flanks and under tail-coverts deep black, washed with rich ultramarine blue on the back of the neck, back and wings; rump-feathers glaucous or chalky white, with black bases, and with a narrow line of blue between the black and the white portion, which alone is seen; tail deep ultramarine blue; chin, breast, and abdomen white; bill and feet coral-red.

Total length, $12\frac{1}{2}$ inches; bill, $2\frac{1}{4}$; wing, $5\frac{1}{4}$; tail, 5; tarsus, $\frac{3}{4}$.

Hab. The Island of Lombock.

Remark.—This is an exceedingly fine species, of which I have not been able to find a description. I am therefore induced to believe that it is new: still it may be contained in the Leyden Collection; but on this point I have consulted Mr. Frank, who is well acquainted with its rich stores, and he tells me that he has no recollection of it.

Pitta concinna.

Head, back of the neck, cheeks, chin and stripe down the centre of the throat velvety black; from the nostrils over each eye a broad mark of deep buff, posterior to which is a narrower one of pale glaucous blue; back, tail and wings dark grass-green; lesser wing-coverts and a band across the rump glossy verditer blue; primaries and secondaries black, the fourth, fifth and sixth of the former crossed by a band of white near their base, and all the primaries tipped on the external web with olive-grey; upper tail-coverts black; under surface delicate fawn-colour, becoming much paler where it meets the black of the cheeks and throat; centre of the abdomen black; vent and under tail-coverts fine scarlet; bill black; feet fleshy.

Total length, 6 inches; bill, 1; wing, 4; tail, $1\frac{1}{2}$; tarsus, $1\frac{3}{8}$.

Hab. The Island of Lombock.

Remark.—This bird ranks as one of the smaller species of this particular section of the group, it being even less than the *Pitta brachyura* of authors, to which it bears a general resemblance, but from which the black colouring of its throat will at all times distinguish it.

For this and the preceding species we are indebted to the researches of A. R. Wallace, Esq.

May 12, 1857.—Dr. Gray, F.R.S., in the Chair.

On Parus meridionalis and some other species mentioned in the Catalogue of Birds collected by M. Sallé in Southern Mexico. By Philip L. Sclater, M.A., F.L.S., etc.

In the Catalogue of Sallé's Mexican Collection, read before the Society in July last, I described a new species of Titmouse under the name of *Parus meridionalis*. Not having at that time within my reach specimens of *Parus atricapillus* of the United States, it was not without hesitation that I separated the Mexican species from that bird. I am now, however, able to exhibit to the Society specimens of *Parus atricapillus* which I obtained in North America last autumn, and I think that a comparison of them with the type of my *Parus meridionalis* (which M. Sallé has again kindly placed in my hands) leaves no doubt that these two *Pari* are, as I had anticipated, really distinct, although closely allied species. In its upper plumage *Parus meridionalis* differs from *P. atricapillus* in having the back deeper cinereous without any tinge of brown—the narrow outer edgings of the secondaries are brownish and not white, and the black does not extend so far down the nape. Below, the plumage is also much darker; the whole abdomen and crissum being of a nearly uniform rather mouse-coloured cinereous, with a pale whitish medial line. In *Parus atricapillus* the whole middle of the belly is much lighter and more white, and the sides are deeply tinged with pale rufous.

There is not much difference in the size of the two species, but the tail of *Parus meridionalis* is slightly longer.

Mr. Gould's collection contains an example of *Parus meridionalis* also from Mexico.

With regard to other species contained in the same catalogue, I have to state that *Cyanocitta floridana* (sp. 135) is probably an immature bird of *C. ultramarina* (Temm.).

I have compared specimens of *Passerculus zonarius*, Bp. (sp. 187) with examples of *Peucæa Lincolni*, which I obtained in the United States, and can discover no difference between them, and I consider these two names to be synonymous.

The bird named *Coturniculus Henslowii* (sp. 187), upon further comparison, does not seem to be distinct from the ordinary *C. passerinus*, of which I also possess specimens from Guatemala.

On Three New Species of the genus Todirostrum. By Philip Lutley Sclater, M.A., F.L.S., etc.

Sir William Jardine has kindly lent me some specimens of birds of the genus *Todirostrum* out of a collection received by him a short time ago through Professor Jameson of Quito from the Rio Napo. They were obtained in that locality, as I have reason to believe, by Don Villavicencio, a Naturalist who was for some time resident at Porto del Napo, on the Upper Rio Napo, where the Italian traveller Osculati mentions having seen him in 1847. Two of them appear to be certainly undescribed. The third is not in a very good state of preservation, but I think it may possibly be referable to Dr. Hartlaub's *T. rufilatum*.

1. Todirostrum calopterum, n. s.

Supra flavescenti-olivaceum; pileo et cauda nigris: alis nigris, harum tectricibus læte flavis, campterio intense badio; secundariis ultimis extus flavicante limbatis: subtus flavum; gutture albo: tectricibus subalaribus flavidis: rostro nigro: pedibus pallidis.

Long. tota 3·6, alæ 1·9, caudæ 1·2.

Hab. In rep. Equatoriana in ripis fl. Napo.

Mus. Gul. Jardine, Baronetti.

This is a typical *Todirostrum*, but with the beak rather shorter and broader than in *T. cinereum*. The only known species which it at all resembles in colouring is *T. nigriceps*, mihi (P. Z. S. 1855,

p. 76. pl. 84. fig. 1), from which it may be at once distinguished by the fine deep chestnut colouring of the bend of the wing. It is, I think, the most beautiful species of this group yet discovered.

2. Todirostrum capitale, n. s.

Supra olivaceum, pileo rufo; alis caudaque nigris extus olivaceis, secundariis ultimis et caudæ rectricibus lateralibus in pogonio externo lactescenti-albo late limbatis, hoc colore extus tenuiter olivaceo marginato: subtus cinerascenti-album, medialiter albescens, ventre medio et tectricibus subalaribus flavicantibus: rostro superiore nigro, inferiore flavido, pedibus fuscis.

Long. tota 3·7, alæ 1·8, caudæ 1·2.

Hab. In rep. Equatoriana in ripis fl. Napo.

Mus. Gul. Jardine, Baronetti.

The rufous crown of this species distinguishes it from every one of its congeners except *T. ruficeps*, from which it may be separated by the want of the dark pectoral band, and other easily perceived characters.

The shape of the bill is typical, but rather broader and flatter than in *T. cinereum*.

I have also lately obtained two specimens of another species of this genus, not quite so typical in form or striking in plumage as the last two, but hardly to be placed without the limits of the group. This I propose to call

3. Todirostrum exile, n. s.

Supra olivaceum, alis caudaque fusco-nigris; illarum secundariis et tectricibus flavicanti-olivaceis, hujus rectricibus olivaceo extus marginatis: loris et capitis lateribus fusco-albidis: subtus margaritaceo-album, lateribus flavido tinctis; gutture et pectore striis paucis elongatis fuscis obsoletissime flammulatis: rostri nigri basi pallida, tarsis gracilibus et cum pedibus colore carneis.

Long. tota 3·5, alæ 1·7, caudæ 2·6.

Hab. In Nova Grenada.

The first example of this species that came under my notice was received from MM. Verreaux of Paris in 1854. It is labelled "New Grenada." I purchased a second not quite mature from Mr. Hurst of Albany in the State of New York. A third is in the British Museum, and is evidently a Bogota skin. The bill of this *Todirostrum* is smaller than in the ordinary run of the species, but of nearly the same form, though not quite so flat. The tail is proportionately rather longer, the tarsi very slender.

Descriptions of some New Species of Lepidopterous Insects from Northern India. By Frederic Moore, Assistant Museum East India Company.

1. Pieris Nama, E. Doubleday, MS.

Male.—Upper-side white; fore-wing with a narrow brown line along costal margin, curving and widening across near the middle of the wing, and again tapering to posterior angle; hind-wing tinged with black (as if from intensity of that colour on the under-side) along the outer margin, where the veinlets are dark brown.

Female.—Brown, with three longitudinal white streaks in middle of fore-wing, and two in the hind-wing: these streaks in some specimens being confluent and occupying nearly the whole of the middle of both fore- and hind-wings; under-side, along costal margin and widening to the outer margin of fore-wing, greenish-yellow, the rest white; hind-wing greenish-yellow, darker on the veins, and nearly white along discoidal cell towards anterior angle.

Expanse of wings $2\frac{1}{4}$ to 3 inches.

Hab. Darjeeling; Sylhet; Bootan. In Mus. East India Company.

Remark.—The late Mr. E. Doubleday was acquainted with the male insect only, to specimens of which in the British Museum he applied the above MS. name; I have now the pleasure of characterizing both sexes.

2. Pieris Seta, Moore.

Upper-side blackish-brown; fore-wing with two rows of narrowish white marks, two lengthened marks between median and submedian veinlets, and four small spots within discoidal cell; hind-wing with a marginal row of whitish spots, another row from costal margin widening towards the anal angle, abdominal margin broadly whitish, the latter tinged with yellow, also a white linear mark in discoidal cell. Under-side as above, but with all the markings on the hind-wings yellow. Wings shaped as in *P. Thestylis.* Expanse of wings $3\frac{7}{8}$ inches.

Hab. Bootan. In Mus. East India Company.

3. Pieris Sanaca, Moore.

Upper-side white; fore-wing with the veins and veinlets broadly clouded with black, leaving only a row of lanceolate white spots on the outer margin, and another row of more linear-shaped marks extending across the disc; hind-wing with the veins and veinlets sharply defined with black, discoidal and median veins clouded with black, the latter broadly so; also a marginal row of angular lunate marks; anterior base and anal angle bright yellow. Under-side: fore-wing as in the upper-side, but the white markings more clearly defined, those near the anterior angle being yellowish; hind-wing with the dark colour broader, and the white spaces nearly covered with yellow. Shape of wings as in *P. Belladonna.*

Expanse of wings $3\frac{1}{4}$ inches.

Hab. Darjeeling. In Mus. East India Company.

4. Pieris Indra, Moore.

Upper-side dark brown; fore-wing with a central longitudinal space of white from the base, also two small white spots near anterior angle; hind-wing with the anterior base brownish greenish-white, also with two white spots near anterior angle. Under-side: fore-wing with a broad irregular fascia from middle of costal margin to posterior angle; anterior angle chrome-yellow, with some white dividing the two colours; basal half white, tinged with straw-yellow along discoidal cell; hind-wing chrome-yellow, and minutely irrorated with brown; anterior half of discoidal cell and space between each veinlet near outer margin white, also a dark brown dot on disco-cellular veinlet. Wings shaped as in *P. Paulina.* Expanse of wings 3 inches.

Hab. Darjeeling. In Mus. East India Company.

The nearest ally of *P. Indra* appears to be *P. Lalage,* E. Doubleday, Diurnal Lep. t. 6. f. 5, also from N. India.

5. Pieris Durvasa, Moore.

Male.—Upper-side white; fore-wing from middle of costal margin, curving transversely, apically, and scolloped to near end of outer margin, black, and having near the apex some white marks, generally three, the outer ones being sometimes indistinct; base of costal margin and body greenish; on the middle of disco-cellular veinlets is a round black spot, and another more quadrate spot between the first and second median veinlets, the latter slightly touching at the angle the scolloped black outer margin.

Female.—Black colour broader, the quadrate spot larger and broadly confluent at the angle with the outer margin, thus forming a white spot on middle of outer margin; hind-wings of female with a marginal row of blackish spots, the extreme margin and anal angle being yellowish-white. Under-side: apex of fore-wing pale yellow, the black colour forming only a curved transverse bar, besides the two black spots; hind-wings wholly pale yellow, and having a small disco-cellular black spot; body yellowish.

Expanse of wings $2\frac{1}{4}$ to $3\frac{3}{8}$ inches.

Hab. Darjeeling, Assam. In Mus. East India Company.

The form of the wings of *Pieris Durvasa* is the same as in *P. Paulina* and *P. Pandione.*

6. Papilio Janaka, Moore, n. sp.

Upper-side black; hind-wing with a white patch on the disc, which is divided by three of the veinlets, thus forming four separate patches, the outer one on each side being the shortest, and the two nearest the abdominal margin being tinged with red; three submarginal and three marginal lunules and circular mark at anal angle red; tail with two red spots. Under-side black; fore-wing with the base red; hind-wing with patch on the disc as on upper-side, but the portion nearest abdominal margin nearly covered with red, which colour is continued upwards and downwards, occupying the base of the wing and the whole space between the third median veinlet and submedian vein; lunules as above, but larger, and a fourth submarginal one appears between the discoidal and first median veinlets; tail spotted as above ; cilia between the angles white ; head, neck, body beneath and sides red.

Wings shaped as in *P. Bootes*, Westw. Arc. Ent. t. 31.

Expanse of wings 5 inches.

Hab. Darjeeling. In Mus. East India Company.

Remark.—Papilio Bootes appears to be a near ally of *P. Janaka.*

May 26, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

Description of Chinese Sheep sent to H. R. H. Prince Albert by Rutherford Alcock, Esq., H.M. Vice-Consul at Shanghai. Presented by H. R. H. to the Zoological Society in April 1855. By A. D. Bartlett, Esq.

These Sheep differ from all others that I have seen in not possessing external ears. In size they are equal to ordinary sheep ; the wool is perfectly white, rather *coarse and mixed with long hairs* ; the head and face are smooth, and covered with white hair ; they have no horns ; the tail is short, rather broad, and turned up at the tip ; the profile is very convex.

My attention was first called to these sheep from the fact of their great reproductive power. I find they breed twice in a year, and produce four and sometimes five at a birth, the three ewes now in the Society's Gardens having this spring produced *thirteen lambs*. These lambs are very easily reared by hand, and are perfectly hardy. Upon referring to Miss Corner's 'History of China,' published in 1847, it appears that since the introduction of the cotton plant into China (which took place during the Ming dynasty, about 500 years ago), the breeding and rearing of sheep have been neglected, as the following extract will show :—

"The extended cultivation of cotton was one of the causes that led to the almost entire disappearance of sheep from the southern provinces, for it was found that it would take much more land to supply a certain number of persons with mutton and wool, than with rice and cotton. Then the pastures were gradually turned into rice and cotton plantations, while sheep were banished to the mountains and less fertile parts of the country. For the same reason cattle, horses, and other domestic animals are scarce ; the few that are kept for the purposes of husbandry are poor and ill-fed ; for there is not a common on which they can graze, so that they are tied up in stalls when not employed in the field. Dairy farms are unknown in China, where people use neither milk, butter, nor cheese."

In a recent letter from China, the writer mentions, among other matters, that in giving a good dinner to some distinguished friends, one of the choicest dishes was a leg of mutton, the cost of which was equal to 30*s*.

Having submitted specimens of the wool of this animal to my friend Dr. Price, who kindly forwarded the same to Mr. Darlington, the Secretary to the Chamber of Commerce at Bradford, for the purpose of having it examined by the most competent judges, the following report from these gentlemen was received. They say, "That the sample of sheep's wool from China enclosed in Dr. Price's letter, is a class of wool which would be extensively used by the manufacturers of this district for goods of low quality; that it appears to be wool suitable for combing purposes, and would now command about one shilling per pound."

That the wool does not appear to offer any great inducement for its introduction will be seen by the above report, but I think it highly probable that, by cultivation and judicious crossing, a great improvement may be fairly looked for. It is, however, a matter of the utmost importance to us that we should possess animals whose power of reproducing is greatest, in order to supply the increased demand for meat.

The origin of our domestic animals has been a subject of much discussion; the remote period of their domestication involves us in much doubt; and this mystery and obscurity will probably never be satisfactorily cleared up. It is, however, interesting to find in a country whose civilization is of such ancient date as China, the most perfect of domestic animals: I mean by this, the animals that are furthest removed from their natural condition.

Now, knowing what wonderful changes can be, and are produced in the vegetable kingdom by skilful modes of propagating, cultivating and artificially treating plants, causing them completely to change their nature, producing all kinds of variety of monstrous growth, double flowers, fruit and seed in enormous abundance;—all this being done by the interference of man, may I ask, is it not probable that a people like the Chinese, whom we know to have practised these arts for ages,—is it not likely that they have by artificial means induced a similar power in these domestic animals; as we find, for example, the pigs, the fowls, the geese and the sheep of China more prolific than the same animals in any other part of the world? Instances of Chinese sows producing twenty-two at a litter have come within my own observation; their fowls are certainly unequalled for the number of their eggs, and their geese as reproducers stand unrivalled.

It is almost needless to say, that the result of cultivation, whether as applied to plants or animals, has produced an unnatural and abnormal condition: instances too numerous to mention may be found, but it will be sufficient to notice the pigeons and ducks. The former in a wild state produce only two broods in a season; while in a state of domestication they continue to breed all the year. The domestic ducks not only produce a much larger number of eggs, but one drake is sufficient for a number of ducks, five or six; while in a state of nature they universally are found in pairs.

Experience has proved that by a careful admixture or crossing in the breed of the Chinese pigs, geese, and fowls, the mixed races are much improved in quality and size, while they retain the reproductive power undiminished, and the animals are more hardy. As regards poultry, I cannot admire the celebrated Cochin China breed in their pure state, but I have abundant proof of their great

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value for breeding and crossing; the least possible trace of the breed appears sufficient to impart all that is desirable, and by after-breeding, the improvement that may be made is as astonishing as it is undeniable. As crossing the breed in the animals before mentioned has been attended with so much success, there is no reason why crossing the Sheep should not also produce a favourable result.

It must not be supposed, because the Chinese have banished their Sheep (having found cotton and rice more suited to their climate and better adapted to their wants), that they are unworthy of our notice, taking into consideration that in this country we cannot grow cotton or rice.

Having witnessed the many attempts that have been made to reduce some of the existing wild animals to a state of domestication, and observing the utter failure in all instances of producing what may fairly be called a domestic variety of any true species, I am inclined to believe it is necessary as a means of reducing wild animals to a domestic condition, that they must be crossed with nearly allied species; by this means the creatures are rendered unnatural, and consequently dependent on man. Different varieties would doubtless be produced, according to the manner in which they were crossed, and permanent varieties would be thus established. Such is the opinion at which I have arrived, after a long and mature consideration of this extremely interesting subject.

June 23, 1857.—Dr. Gray, F.R.S., V.P. Zool. & Ent. Soc., in the Chair.

On Two Species of Bats inhabiting New Zealand. By Robert F. Tomes.

The first notice of the occurrence of *Cheiroptera* in New Zealand was given by Forster in 1772–74 *, who recorded the occurrence of a Bat flying over the sea-shore near the margin of a wood in the estuary of Queen Charlotte. It was shot, but being struck only in the wing, lived for two days. "He was described by me," says he, "and was drawn by my son." To this species Forster gave the name of *Vespertilio tuberculatus*. The description has been published in the work noted below, and the drawing is now in the British Museum. I shall have occasion to refer to both the description and the figure.

In 1843 Dr. Gray gave a very condensed description of a Bat in the Appendix to Dieffenbach's Travels in New Zealand, which he, believing to be the species mentioned in the MSS. of Forster, called by the same specific name. As Dr. Gray had specimens for examination, he at once perceived that they could by no means be considered as representatives of the genus *Vespertilio*, and that they did not even belong to the same family. Accordingly we find them in the 'Catalogue of the Mammalia of the British Museum,' pub-

* Descriptiones animalium in itinere ad maris australis terras per annos 1772–74 suscepto observatorum, edidit H. Lichtenstein. 1844.

lished in 1843, placed in the family *Noctilionina,* with the new generic appellation *Mystacina,* the old specific name *tuberculata* being retained.

Having some time since had occasion to examine some species of Bats in the Museum of the College of Surgeons, Prof. Quekett showed me one which had been recently received from New Zealand. It was not until I had been assured that it came directly from that country, in a bottle with a collection of New Zealand insects, that I could be persuaded that no mistake as to locality had been made. The forms presented by this example were so entirely unlike those of the only New Zealand species with which I was acquainted, that it was with considerable surprise I beheld a bat having pretty much the same forms and proportions as the common little English *Pipistrelle.*

Shortly afterwards an opportunity occurred of inspecting the fine collection of *Cheiroptera* in the Leyden Museum, which contains three examples of this supposed new species, but without any specific name. Finally, I detected other examples in the British Museum, amounting in number to five.

Being then satisfied of the existence of two species of Bats in New Zealand, I was anxious to pursue the subject further, and to determine, if possible, to which of these Forster had given the name of *V. tuberculatus.* The kindness of Dr. Gray speedily placed in my hands all the necessary materials. There could be no hesitation; the supposed new species was undoubtedly the one from which Forster's drawing had been made, whilst the description, indicating the number of incisors, and other peculiarities, pointed unequivocally to the same conclusion.

As the above-mentioned zoologists have certainly been the first describers of two distinct animals, the names imposed by them will of course be retained; but it is much to be regretted that their specific names are similar; and the more so, as the one most recently given was clearly intended as a reference to the earlier known species.

The following description has been taken from the specimen in the College of Surgeons, and also from the specimens in the British Museum. With the advantages of specimens in spirit and in skin, it is probable that the description will be found tolerably correct, both as regards the form of the face, ears, &c., and the quality and colour of the fur.

Fam. VESPERTILIONINA.

1. SCOTOPHILUS TUBERCULATUS, Forster, Descript. Anim. p. 63, 1772-74, Icon. ined. in Brit. Mus. t. 1.

In form and proportions somewhat resembling the Pipistrelle *of Europe; in size resembling* Vesp. Nattereri*; in colour very nearly similar to the* Scotophilus Gouldii *of Australia.*

The muzzle is rather broad and obtuse, and moderately hairy. The nostrils are tumid, and of an oval form, with their inner margins more prominent than their outer, giving them a sublateral opening;

they are distant from each other about two lines. The forehead is rather flat. The lower lip is broad, with the extreme edge naked, and rather thickly clothed with short hair on the chin, which becomes very thick on the throat. Immediately within the *symphysis menti* is a small but distinct wart.

The ears are rather small, oval-triangular, with a pretty uniform outline, and with a kind of plait or crease on the basal front of the inner margin, giving that part of the ear a slightly projecting lobe, not however of sufficient magnitude to interfere materially with its general uniformity of outline. The outer margin is not hollowed out, but maintains a pretty regular curve, and has its basal portion brought forward, in the form of a narrow rudiment of membrane, on to the cheek, where it ends immediately under the eye.

The tragus is short, rather broad, and of nearly uniform breadth, with the end round. It has, as in all the other species of this restricted group, an inward curvature.

The wing-membranes spring from the base of the toes, and the latter occupy about half the length of the entire foot. The *os calcis* extends one-third of the distance from the foot to the tip of the tail, which has its extreme tip free.

The face is furnished with some tufts and lines of bristly hair. Immediately in front of the eye may be noticed a tuft, consisting of a few hairs, and on the gland of the upper lip is a similar one. From behind the nostril proceeds a narrow band of fine bristly hairs, which curves downwards and backwards on the lip for a short distance, and then taking an upward curvature, passes in front of the eye, and is lost in the fur of the forehead.

All the membranes, both above and below, have those parts contiguous to the body, hairy, especially the interfemoral, on which it extends more markedly than elsewhere. The part of the latter membrane which is destitute of hair is smooth, and has about ten transverse strongly dotted lines.

Over the whole of the body the fur is very thick, soft, and rather long. On the top of the head it is long enough to obscure the basal half of the ears, and thus give the appearance of an elevated crown.

Everywhere the hair is unicoloured, and of a black-brown colour on the head and back, passing into chestnut-brown on the rump. Beneath it is similar in colour, but more strongly tinged with brown, especially towards the pubal region, where it is reddish-brown.

On examining the cranium, I find that its chief peculiarity consists in its extreme shortness in relation to its other dimensions. In this respect it more nearly resembles the cranium of *Lasiurus noveboracensis* than that of any other species of Bat I have yet seen, but it is even shorter than in that species. In its general conformation it bears considerable resemblance to that of the common *Pipistrelle* of Europe, especially in the degree of elevation of the cerebral region; the arrangement of the dental series is more like that of the *Noctule Bat* than that of the *Pipistrelle*, but bears a still greater resemblance to that of the *Scotophilus Gouldii* of Australia. Thus, on examining the teeth of the upper jaw, they are seen to be arranged in two ***straight*** lines which are nearly parallel, the incisors only deviating from these lines, being placed across the front of the space enclosed by them. This enclosed space—constituting the anterior part of the palate—is nearly a parallelogram, being but slightly narrower in front than posteriorly. Its length to its breadth is as one and a quarter to one.

The range of the teeth in the lower jaw must, of course, bear exact relation to that of the upper *, varying only in the number of the teeth and their individual form.

The number of the teeth is as follows:—

In. $\frac{2-2}{6}$; Can. $\frac{1-1}{1-1}$; Premol. $\frac{1-1}{2-2}$; Mol. $\frac{3-3}{3-3}=\frac{14}{18}$.

The upper incisors are arranged in pairs, of which the inner one of each pair is much larger than the outer one. They are all somewhat elongated, conical, and pointed, and when viewed in front are seen to have their points directed inwards, but when seen laterally have nearly a vertical direction, similar in this respect to the canines. A considerable interval separates them on each side from the latter teeth, and this, with their regular conical outline and nearly vertical position, constitute their chief peculiarities. In the centre, between the inner ones, is a considerable opening, caused by the non-development of the anterior margins of the intermaxillary bones, and the notch in the front of the palate, just as in the *Noctule Bat* and most other true *Vespertilionidæ*. The other teeth in the upper jaw present no deviations from what is usual in the genus.

In the lower jaw the incisors are of the form ordinarily observed in this genus; they are symmetrically arranged and trilobed. The canines present no marked peculiarities of form. The premolars are small, pointed, and have their basal cusps less developed than those of the corresponding teeth in the *Noctule Bat*. The first of these teeth is much the smaller of the two. The molars differ in no respect from those of the above-mentioned species, excepting that their cusps are perhaps somewhat longer and more pointed.

In the following Table of dimensions, the first column represents the measurements of the specimen in spirit in the Museum of the

* It will not be out of place here to remark, that this expression applies exclusively to the normal state of dentition of animals in a state of nature. The reverse of this may occasionally be seen in accidental varieties or malformations, and frequently in domesticated animals, where a great change in the form of the jaws and teeth has often resulted from long-continued selection of individuals from which to produce a breed for some special purpose, which selection may have been further assisted by a constant training to the purpose for which the breed was designed. This must certainly be the case with some of the varieties of dogs. In the bull-dog, for instance, we find a most remarkable development of lower jaw, attended with an equally distorted arrangement of the teeth. It is scarcely necessary to allude to the singular appearance often observable in the front teeth of the human species, under- or over-lapping each other, as the case may be, and displaying every degree of intermediate arrangement. But these deviations from the normal state of dentition in no way affect the statement above made respecting the relation of the inferior to the superior maxilla, and their implanted teeth.

College of Surgeons, before alluded to, and the other columns have been taken from specimens in skin in the British Museum:—

	No. 1.		No. 2.		No. 3.		No. 4.	
	"	'''	"	'''	"	'''	"	'''
Length of the head and body..	2	1						
——— of the tail	1	7	1	6				
——— of the head..........	0	$7\frac{1}{2}$						
——— of the ears	0	$3\frac{1}{2}$						
——— of the tragus	0	$1\frac{3}{4}$						
——— of the fore-arm	1	6	1	6	1	6	1	6
——— of the longest finger ..	2	8	2	10	2	8	2	7
——— of the fourth finger ..	1	10	1	10	2	0	2	0
——— of the thumb........	0	$2\frac{1}{2}$	0	$3\frac{1}{4}$	0	$3\frac{1}{2}$	0	$3\frac{1}{2}$
——— of the foot and claws..	0	$3\frac{3}{4}$	0	4	0	4	0	$4\frac{1}{2}$
Expanse of wings	10	9	10	4				

The foregoing description had been taken with a view to its publication, before that of Forster had been examined, the impression at that time being that the species was new.

For the convenience of immediate comparison, and to show the general similarity of the two descriptions, a condensed description will now be given of that furnished by Forster.

About the size of *Vesp. communis*, or a little larger; the head like that of a mouse, and of medium size; snout blunt, emarginate, simple, with bi-tuberculated nostrils. The lower jaw rather shorter than the upper.

Incisors in the upper jaw 4, in pairs, of which the two inner ones are the larger; the two outer ones smaller, and approximate to them. In the lower jaw 6, very small and approximate. *Laniares* (?) $\frac{1-1}{3-3}$; molars $\frac{4-4}{4-4}$.

Ears moderate, smooth, subovate; tragus semiorbicular. Wings large and dark brown. The fur everywhere soft, fine, and rusty brown.

Length from the end of the nose to the root of the tail.........................	2 inches.
Length of the tail	$1\frac{3}{10}$ "
Expanse of wings	$10\frac{1}{2}$ "

Fam. Noctilionina.

Genus Mystacina, Gray.

Body very short and broad. Snout much produced; nostrils sublateral, surrounded by a thickened projecting rim. Under jaw much shorter than the end of the nose. Top of the head considerably elevated; ears lateral, simple; tragus long, narrow, and pointed. Wings moderate; thumb moderate. Index finger with two phalanges, second finger with *four*, third and fourth fingers with three, each. Wing-membranes extending to the distal extremity of the tibia. Legs and feet short and stout. Tail very short, piercing the interfemoral membrane near to its base, and projecting on the upper surface of it, as in *Taphozous.* Interbrachial membrane, a narrow piece of membrane beneath the fore-arm, that adjoining the sides of the body, and that enclosing the tibia, as well as the basal portion of the interfemoral membrane, thick and leathery, with numerous deep wrinkles or corrugations on its upper surface. Incisors, 2 in the upper jaw, large, contiguous, and shaped like canines ; in the lower jaw 2, small, and placed in front of the canines.

1. Mystacina tuberculata, Gray.

Mystacina tuberculata, Gray, Cat. Mam. Brit. Mus. p. 34, 1843 ; Gray in Dieffenb. Journ. App. p. 296, 1843 ; Gray, Zool. Voy. Sulphur, No. II. p. 23, 1843 ; Zool. Voy. Erebus and Terror, No. IV. pl. 22. 1844.

The snout of this singular-looking species is considerably elongated, with the end of the nose emarginate between the nostrils, which are very prominent, and directed sublaterally. The mouth is placed far back in relation to the nose, and a space intervenes between the two, which is clothed with very fine short hairs. The hairiness and form of this space are somewhat similar to the same part in the *Coati Mondi.* No very strongly-marked peculiarity is observable in the mouth itself, but it is rather small, and has only the extreme edges of the lips destitute of hair.

The top of the head is convex, rounding off on every side, and the space between it and the end of the nose, *i. e.* the face, is concave in its longitudinal direction, but not transversely, as in *Taphozous.*

The ears are lateral, and remarkably simple in form. Instead of the forward extension on the side of the face, so usual in the insectivorous species of this order, they are attached precisely as in the fruit-eating species, *i. e.* just as we may observe them in a *dog* or *cat.* In form they are regularly oval, and slightly pointed. The tragus is straight, narrow, and pointed, reaching to the middle of the ear.

The wings are rather broad, and of medium length. The thumb is of moderate size, with the basal joint very short ; the index finger is composed of two phalanges, the terminal one being very minute. The second finger has *four* phalanges, and the third and fourth fingers have three each. The presence of four phalanges in the second finger, instead of the usual number of three, in this family, will be again adverted to. The wing-membranes barely extend to the distal extremity of the tibia.

The legs and feet are very short and stout, as in the genus *Molossus.* The heel-cartilage is of medium length and substance, and the interfemoral membrane is rounded at its posterior margin, and is perforated near its base by the tail, which is short, and exhibits its terminal half free above the membrane, as in the genus *Taphozous.*

The portions of membrane contiguous to the fore-arm, the sides of the body and the tibia, are very thick and leathery, with numerous deep wrinkles, and the basal half of the interfemoral membrane (as far as to where the tail becomes free) possesses the same peculiarity. The wrinkles, in many places, cross the legs and fore-arms, but they are only observable on the *upper* surfaces of the membranes and limbs. This singular part of the cutaneous system is marked by a regular and decided outline, and can scarcely be said at any place to graduate into the smooth membrane of the wings. Its extent is pretty well indicated by the hairy portions of the membranes in the genus *Lasiurus*, excepting that it only occupies one-half of the interfemoral membrane.

In its general character, the fur is short, crisp and thick, having a grizzly shining appearance, very similar to that of some of the *Soricidæ*. That of the head extends towards the nose, and covers the whole of the face, being bounded anteriorly by a frill of stiff upright hairs; that commencing near the corner of the mouth extends upwards in front of the eye, and meets on the top of the nose with the corresponding part of the other side of the face. On all the upper parts of the body the fur is similar. It is dusky at its base, and tipped for half its length with shining grey-brown, having a slight tinge of olive. Beneath, the fur is brown at its base, with shining tips of grey-brown. The fur of the throat extends to the chin and under-lip, and densely covers the whole, excepting the extreme edge of the lip.

The whole of the cutaneous system is very dark brown, with the exception of the wrinkled part already mentioned, which is paler, and tinged with yellowish.

The cranium exhibits some peculiarities worthy of note. Viewed from above, the cerebral portion is seen to be about as much arched as that of *Vesp. Nattereri*, and has a faint sagittal crest towards the occipital region. There is also a moderately pronounced occipital crest, which becomes more strongly developed in the vicinity of the acoustic elements of the skull. The auditory bullæ have much the same form and proportion as the same parts in *Vesp. Nattereri*, and the facial portion of the skull is proportioned much as in that species. The orbital openings are of very moderate size, and the zygoma but little arched, and very slender. The bony palate terminates a little posteriorly to the last molar. The nasal opening is small, and the intermaxillary bones meet in front, for the support of the contiguous incisors, as in *Miniopteris* and *Furipterus* among the *Vespertilionina*, and *Molossus*, *Rhinopoma*, and *Noctilio* among the *Noctilionina*.

The incisors in the upper jaw are two in number, large, conical, and pointed. They are provided with a distinct *cingulum*, visible in front, which passes into a well-marked basal lobe, or cusp, behind the tooth. As the incisors are situated very near to the canines, and are themselves in contact, this lobe is only visible when seen directly from behind. The incisive foramina are two in number and very minute. The canines are long, pointed, and triangular, without any basal lobe. The next two teeth in the upper jaw present the same forms which usually characterize the premolars in the insectivorous *Cheiroptera*; and the three remaining teeth, *i. e.* the molars, may be similarly passed over.

The hinder part of the lower jaw is formed very similarly to the same part in the genus *Vespertilio*, but has the *posterior process* less produced. Another point of difference occurs in the form of a somewhat rounded *posterior angle*, something like that observable in *Furipterus*, but more nearly resembling the same part in the jaw of the *Ursus labiatus*, and, as in the latter instance, very thin in substance laterally. The jaw itself is straight, especially the alveolar margin, which is in a line continuous with the *posterior process*.

The canines in the lower jaw are of considerable size, and have a basal lobe behind. They are nearly contiguous, and the incisors, two in number, are placed in front of them, as in some species of the genus *Molossus* (*Nyctinomus*), and, as in that genus, are probably lost with age. They are very small, feebly implanted in the jaw, and have their tips trilobed. The next two teeth are of the usual premolar type, such as we find in *Vespertilio* proper, and they are succeeded by the three molars, presenting no marked peculiarities of conformation.

Dentition :—In. $\frac{2}{2}$; Can. $\frac{1-1}{1-1}$; Premol. $\frac{2-2}{2-2}$; Mol. $\frac{3-3}{3-3}=\frac{14}{14}$.

In the following Table of dimensions, column No. 1 has been taken from a large and probably adult specimen in the British Museum, and Nos. 2 and 3 from specimens, perhaps not quite adult, in my own collection. The latter one, having all the bones retained, would furnish the more exact dimensions, but that it is probably immature. From it the skull was extracted, from which the above characters have been taken :—

	No. 1.		No. 2.		No. 3.	
	″	‴	″	‴	″	‴
Length of the head and body	2	6	2	4	2	4
—— of the enclosed part of the tail	0	3	0	3	0	3
—— of the free part of the tail	0	3	0	3	0	$2\frac{1}{2}$
—— of the head	1	$0\frac{1}{2}$	0	$11\frac{1}{2}$	0	11
—— of the fore-arm	1	$9\frac{1}{2}$	1	7	1	8
—— of the longest finger	3	0	2	11	2	$11\frac{1}{2}$
—— of the fourth finger	2	6	2	4	2	4
—— of the thumb	0	5	0	$4\frac{1}{2}$	0	4
—— of the tibia	0	8	0	7	0	7
—— of the foot and claws	0	$7\frac{1}{2}$	0	6	0	6
Expanse of wings	12	0	11	10	11	6

The following are the dimensions of the skull extracted from the specimen which has supplied the measurements given in the second column of the above Table :—

	″	‴
Length from the occipital crest to the anterior margin of the maxillary bones	0	$9\frac{1}{4}$
Breadth across the zygomatic arches	0	5
Length of the nasal bones	0	3
Greatest breadth of the nasal bones	0	$1\frac{1}{4}$
Length of the dentinal series in the upper jaw	0	4
Breadth between the two outer cusps of the two posterior molars	0	$3\frac{1}{2}$
Breadth between the points of the two upper canines	0	$1\frac{1}{2}$

	″	‴
Total length of the lower jaw	0	$6\frac{1}{2}$
Length of the dentinal series in the lower jaw	0	4
Breadth between the outer cusps of the two posterior molars	0	$2\frac{3}{4}$
Breadth between the points of the lower canines	0	1

In summing up the characters of this singular species (which, as far as is known, is the sole representative of the genus), several affinities not usually associated are manifest. Thus in the form of the tail, and the way in which it perforates the interfemoral membrane, it bears strong resemblance to the genus *Taphozous*, whilst the strength and form of the hinder limbs, but more especially the form and implantation of the canine and incisor teeth, would seem to indicate an affinity with the genus *Molossus* (*Nyctinomus*), both of these genera being representatives of the family *Noctilionina*. Again, on examining attentively the forms of the ear and tragus, we shall be struck with the great resemblance which the latter bears to that of some of the examples of the genus *Vespertilio*, and the former, although differing considerably from the ear in *Vespertilio*, bears nevertheless a greater resemblance to it than perhaps to that of any other genus. But there is another peculiarity to which I have already alluded, which is deserving of especial notice—the presence of *four* bony phalanges in the second finger,—a peculiarity in which it resembles the *Phyllostomidæ* or Leaf-nosed Bats of the New World, that number being one of their characteristics; whilst in all the Old World genera, with the exception of the one now under notice, we find that that finger has only *three* bony phalanges*. There are, however, several characters present which appear to belong exclusively to the present genus, such as the form of the snout and nostrils, the singular markings on some of the membranes, and the peculiar quality of the fur.

MISCELLANEOUS.

Note on Elephant Remains from the Gravel near Ballingdon Hill, Essex. By John Brown, Esq., F.G.S., of Stanway.

To the Editors of the Annals of Natural History.

Stanway, near Colchester, Oct. 1, 1857.

Gentlemen,—In the eighth volume of the Magazine of Natural History, for the year 1835, p. 353, is an article which at that time I had the pleasure of sending to Mr. Loudon, the then editor of that interesting and very useful work, on some fossil remains (teeth and bones) found at that time in a gravel-pit at Ballingdon, Essex, near Sudbury. These remains consisted of tusks, teeth, and many bones of

* A similar peculiarity occurs in the genus *Centurio*, which, when first described by Dr. Gray, was thought to be a native of the Old World, but there was some doubt as to the exact locality from which it had been received. But other examples have been since obtained from the New World, and its near alliance with the tailless *Phyllostomidæ* has been satisfactorily established. The existence therefore of *four* phalanges in this finger in *Centurio* cannot be considered, as in *Mystacina*, as an exception to a general rule, but on the contrary as a further extension of it.

the Elephant, and bones and horns of a large species of Deer. Subsequently to that period, many fossils of the same kind have been met with from time to time in the same gravel-pit: some of these still remain in the possession of the proprietor of the estate, some are in the Museum of the Geological Society of London, and some have been sent to private museums in the neighbourhood.

Unfortunately, the Elephants' tusks found in former excavations in this gravel were so much decomposed as to baffle every attempt to remove them; they all fell to pieces when touched: an outer coat of ivory was left on the spot where one tusk had lain so long, and its strong curvature could be very plainly seen. In the year 1855 another tusk was found in the same bed of gravel,—broken, indeed, into several pieces, but not so much decomposed as former ones. In laying all these pieces out carefully according to their natural curvatures, they were found to form collectively a tusk seven feet in length on its outer curve, and it showed a curve that was quite as deep as that of a former tusk found here, viz. nearly a half-circle.

On a chord-line, the distance from the basal part to the extreme point of this fossil, which is fortunately preserved, is 3 feet 10 inches, and 21 inches from the chord-line to the upper surface of the tusk, in the position in which it is now mounted—its natural position,—a greater curvature than any I have before observed in tusks found in this county.

An Elephant's tusk, equally large, was found at Clacton, about sixteen years ago, but not so deeply curved as the tusks above noticed.

If we allow 3 feet to any Ballingdon tusk for that part which goes into the socket on the side of the Elephant's head (which I am told is not too much), we have a tusk altogether 10 feet long. The tusk found at Clacton was, when alive, 12 feet.

As the former discoveries of Mammalian fossils at Ballingdon are recorded in the Magazine of Natural History, this is also at your service, if sufficiently important.

The last tusk found at Ballingdon was only mounted last Monday week. It was found, as well as all the other mammalian fossils, 30 feet below the surface, in gravel of the glacial period.

I am, Gentlemen,
Your most obedient Servant,
John Brown.

Note on Bovine Remains, lately found at Clacton, Essex. By John Brown, Esq., F.G.S., of Stanway.

To the Editors of the Annals of Natural History.

Stanway, Oct. 22, 1857.

Gentlemen,—On a visit to the freshwater deposit at Great Clacton, about three weeks ago, I fortunately obtained a beautiful pair of horn-cores of a large species of *Bos*; and, compared with the description given by Professor Owen in his Report to the

British Association for the Advancement of Science, for the year 1844, on "British Fossil Mammalia," these fossils appear to belong to *Bos priscus,* described in that work, page 234.

The Clacton freshwater deposit has from time to time, ever since its discovery in 1832, produced highly interesting remains of the Elephant and other large Mammalia, in great numbers, now to be seen in various museums; a long series of freshwater Mollusca has also been obtained from this deposit.

The horn-cores so recently obtained from the Clacton freshwater deposit are quite as large as any of that species heretofore found there: their entire length is 2 feet 9 inches from base to point upon the outer curve, 17 inches in vertical diameter, and 4½ inches from front to back at their base. In these specimens we have also the graceful double curvature and the deeply impressed grooves usual in the horn-cores of *Bos priscus,* pointed out by Professor Owen in his Report above alluded to.

The curvature of these cores, on the inner side, is 7 inches from the chord-line to the inner surface.

Still larger specimens than the foregoing have been met with in the freshwater beds at Clacton; but as they do not possess the deep-grooved character, and are of greater dimensions, they may probably belong to a different species, and perhaps to *Bos primigenius.*

I am, Gentlemen,
Your obedient Servant,
JOHN BROWN.

Description of a new species of Pachyrhamphus. By P. L. SCLATER.

PACHYRHAMPHUS ALBO-GRISEUS, sp. nov.

♂. *Supra cinereus, pileo cum nucha nitenti-nigris : linea frontali inter oculos alba : alis nigris, tectricibus et secundariis extus late albo marginatis : subtus albus, præcipue apud latera cinerascente tinctus : cauda nigra, rectricibus omnibus, sed harum extimis præcipue, late albo terminatis : rostro plumbeo : pedibus nigris.*

♀. *Saturate castanea, subtus valde dilutior, cinnamomescenti-ochracea.* (?)

Long. tota 5·5, alæ 3·0, caudæ 2·4.

Hab. New Grenada, Bogota.

Mus. P. L. S.

I possess an adult male specimen, and what, I think, is probably the female of this Becard, which is a close ally of the two preceding species. It is, I suppose, the New Grenadian representative of the form; and, I confess, it is not without hesitation that I separate it specifically from *P. marginatus.* The differences are the further extension of the black over the nape of the neck, the entire want of black on the back, the more purely white colouring below, and the much deeper white terminations of the outer rectrices in the present species.—*Proc. Zool. Soc.* April 28, 1857.

PLACODUS ANDRIANI.

To the Editors of the Annals of Natural History.

Gentlemen,—In examining some fossil specimens recently transmitted for sale, by M. Krantz of Berlin, to the British Museum, I noticed certain structures in a part of the cranium of the *Placodus Andriani*, Agassiz, which convinced me that that triassic animal belonged to the class of Reptiles, and not, as Count Münster and Prof. Agassiz have described, to the class of Fishes. As some account of the teeth of *Placodus* is given in the chapter on the dentition of Pycnodont Fishes, in my 'Odontography' (p. 73. pl. 30), on the authority of those eminent palæontologists, and before I had had the opportunity of seeing original specimens, I lose no time in correcting the error, as I trust to be able to prove it to be, when the evidences of the Reptilian nature of *Placodus* are given in detail.

I am, Gentlemen,
Your obedient Servant.

British Museum, October 13, 1857. Richard Owen.

A few Remarks on the Midge Fly which infests the Wheat. By Jonathan Couch, Esq., F.L.S. &c.

In the more eastern parts of the kingdom there has been long known a little fly, the larva or maggot of which is highly injurious to the ear of wheat, but, as far as my limited inquiries extend, it has been little known in Cornwall, and it is only in the present year that I have had an opportunity of examining it, or of hearing of its ravages among us. It is called the wheat midge, or, according to its more scientific name, *Cecidomyia Tritici*; of very minute size, dark colour, and slender shape; the larva is of a decided yellow colour and active habits.

A long, and it may be supposed accurate account of this little pest is to be found in a small work on the Blights of Wheat, published by the Religious Tract Society; and as the smallness of the price of this volume renders it accessible to all who wish for information on the subject, I will not repeat anything which is to be learnt there. But in addition to this, an account of this midge-fly—for there are several others of this genus—in its depredations on our staff of life, was read before the meeting of the British Association, when it was held at Plymouth, by an eminent naturalist; and it is to notes made at that meeting, added to the few observations collected in the month of July in the present year, that I am desirous of soliciting attention on the present occasion, to prepare our farmers for meeting this plague, and, if possible, to prevent its obtaining residence among us.

According to the little tract above referred to, this fly lays its eggs in the grain in the month of June; but some of them were busy about the grains in the latter half of July; and the succession of development and hiding, which appears to take place in the larvæ, is presumptive proof that the depositing of eggs is not accomplished in a very short space. At this time the grains of wheat had grown to the full size, and such as had been first attacked had disappeared altogether, their place being marked with an empty husk. But these maggots, small as they are, are not soon satisfied, nor is their larval state of very short duration; they therefore scatter themselves further among the grains; and one of the latter was observed especially, that had suffered no injury in the course of its growth, but which was infected with a pale spot at the place where a wandering maggot had fixed itself to begin its operations. Under such circumstances, the ravages of this apparently contemptible insect must prove exceedingly formidable; and the more so, as there is reason to suppose that they continue to feed until the hardening of the grain renders it beyond their power. It is remarkable that this larva has not been traced into its state of chrysalis. Such of these larvæ as are first hatched escape into the earth, where, no doubt, they undergo their natural changes, to prepare them for again appearing in the form of a fly in the following year; but such is not the fate of a large number of them, which, according to the observant naturalist quoted above, are conveyed to the barn, and from thence to the winnowing machine, where they become separated in the chaff. So great is the number of these, that from 10,000 to 20,000 are believed to have been contained in a single bushel. By the action of winnowing they become separated with the dust, and they are found to drop to the ground within the distance of three yards from the machine. It is not the least remarkable point in the history of this animal, that all these larvæ, thus separated, are incapable of surviving; and the utmost skill has not been able to rear them into the condition of a fly: no danger for the future is therefore to be feared from them; and it is only those which have buried themselves in the field that produce the insect for the future harvest. The difficulty of providing against future injury is great in proportion to our ignorance of the further history of the insect; but it has been observed that heavy rolling of the ground in which it is buried—or what is better, the trampling of much cattle—has been to a considerable extent successful. The exact season for doing this must be determined by experience.—*Report of the Royal Cornwall Polytechnic Society for* 1856.

Description of Actinopsis, *a new genus of* Actiniæ *from Norway.* By D. C. Danielssen and J. Koren.

Genus Actinopsis, n. g.

Brevis, cylindrica, infra in magnum et gracilem basin extensa, margine oris in duos longos et rigidos semicylindros prolongato, quorum margines laterales deorsum flexi et extremitates bisulcæ; tentacula non retractilia.

Actinopsis flava, the only species, is about $\frac{1}{2}$ an inch in length of body, and the outer tentacles measure about $\frac{2}{5}$ths of an inch. Its colour is yellow. Two specimens were taken in the Bay of Hardanger, half a league from Utne, at a depth of about 250 fathoms. They were attached to *Lima excavata*.—*Fauna Litt. Norveg.* ii. p. 87.

THE ANNALS

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XXXIX.—*Description of eight new species of Entomostraca found at Weymouth.* By JOHN LUBBOCK, F.G.S.

[With two Plates.]

DURING a short visit to Weymouth this autumn, I endeavoured to rediscover *Calanus* (or *Temora*) *Finmarchicus*, in order to clear up certain doubtful points in its anatomy.

Though unsuccessful in this search, I was amply repaid by the discovery of eight new species of Entomostraca, three of which belong to genera not previously caught in our seas, and two are even the representatives of families not hitherto recorded as British.

Calanus Euchæta.

Frons obtusa. Cephalothorax 5-articulatus, postice obtusus, superne visus sinuatus. Antennæ anticæ cephalothoracis longitudine; setis apicalibus, et subapicali postera, æquis, subapicalibus anteris brevibus. Antennæ secundæ, ramo uno longo, altero plus duplo breviore, 1-articulato. Pedes primi, ramo uno 3-articulato, altero 2-articulato, articulo primo elongato. Pedes posteri, parvi, uno tantum ramo, setis plumosis non instructi. Styli caudales breves, setis mediocribus.

This species is colourless, except the eye, which is bright red. The cephalothorax is of the ordinary form, and much resembles that of *C. comptus*, except that it is rather more obtuse; in this respect more nearly resembling *C. simplicicaudus*. The first segment of the cephalothorax occupies about $\frac{2}{5}$ths of its whole length. The antennæ, measured from end to end in the position they usually occupy, are as long as the cephalothorax, and about eight of the setæ are considerably longer than the rest, and equal to one another; two of these are situated at the apex, one on the posterior side of the second segment, one on the anterior side of the fourth, and the others at nearly equal distances along the antenna. The penultimate anterior and the antepenultimate setæ are short. This diffusion of the long setæ over the whole length of the antennæ is very peculiar, and similar to what occurs in the genus *Euchæta.*

The second pair of antennæ, Pl. X. fig. 3, are also abnormal, and resemble those of no other species with which I am acquainted. They consist, as usual, of two branches, one of which is long and three-jointed, and bears at the apex two tufts, one of six, the other of eight long hairs. The second segment bears one hair, and the basal one eight, increasing in length from the base towards the apical end. This branch is neither rounded nor truncate at the free end, but ends in a sharp edge like an adze, or the gnawing tooth of a Rodent. The smaller branch is not jointed, and is truncate, with eight hairs at the end.

The first pair of legs (or, according to Prof. Dana's nomenclature, the second), Pl. X. fig. 4, have the outer ramus three-jointed, the first and second each bearing one hair on the inner side, and, as well as the third, a short spine on the outer margin. The inner branch consists of two segments, of which the basal is long and narrow, with parallel sides, and three hairs at equal distances.

The fifth pair of legs (Pl. X. fig. 5) have only one ramus, are four-jointed, and have no plumose setæ, and only one long, naked hair at the base.

The abdomen has four subequal segments and short lamellæ, with six diverging hairs, of which the fourth (counting from the outside) is a little the longest; the third and fifth are rather shorter, the second again rather shorter, and the first and sixth are quite small.

The cephalothorax had, in the greater number of specimens, three very minute spines on the posterior margin of the last segment; a few specimens, however, had four; and one or two had only two, or even none.

I also found other specimens which had the abdomen only three-jointed, and the posterior legs (Pl. X. fig. 6) consisting of a basal part bearing on each side a long and large hair, and of a small second segment ending in a stout spine about half as long as these hairs. These specimens I have little doubt were the females of this species, since they agreed in all the other characters, especially in the form of the cephalothorax, the structure of the two pairs of antennæ, and the first pair of legs.

I have described this species at length, in order to distinguish it from others that may hereafter be discovered; from all those at present known, however, it is separated by the arrangement of the setæ of the anterior antennæ.

It was frequent at Weymouth this last September and October, and in confinement preferred the top of the water, and the sunny side of the glass in which it was kept. Several specimens had spermatic tubes attached to them.

Length $\frac{1}{33}$th of an inch.

Pl. X. figs. 1–6.

Calanus anglicus, n. s.

Frons rotundata, contracta. Cephalothorax 4-articulatus, postice rotundatus, superne visus sinuatus, subacutus. Antennæ corpore paulo breviores, setis brevibus, subapicalibus longioribus, postica penultima brevi. Pedes primi, ramo uno 3-articulato, altero 1-articulato. Pedes alii, ramis ambobus 3-articulatis. Abdomen 4-articulatum; stylis setisque abdominalibus mediocribus.

This species occupies a place in the genus close to *C. lævis*, with which alone it can be confounded. The anterior penultimate seta of the anterior antenna is much longer than the posterior penultimate, and the antennæ themselves are rather shorter than the body. Moreover, all my specimens had the abdomen four-jointed. It might be objected to this, that my specimens may have been males, and those of Dr. Dana females; but I believe that I found both sexes,—at least some had the posterior abdominal segment quite short, while in others it was nearly as long as the preceding segment. One specimen had, attached to the first abdominal segment, a sac, containing a round, darkish body, which seemed too large to be an egg (Pl. X. fig. 10).

Colour red. Length of cephalothorax ·028 of an inch; total length ·04. Length of anterior antenna (measured across the curve) ·035.

Caught at Weymouth in October 1857.

Pl. X. figs. 9 & 10.

Diaptomus.

This genus, when originally founded by Mr. Westwood, contained only our well-known freshwater species, *D. Castor*; and it maintained its freshwater character until I assigned to it, with some doubt, the marine form *D. dubius*. I have now to describe two new species, both characterized by having the eyes small and close together, if not united; the right anterior antenna of the male, and the fifth pair of legs in the same sex, prehensile; and the maxillipeds and second pair of antennæ Calanoid. Prof. Dana describes the posterior legs of the female as being long, thick, and unlike the preceding pairs. In these organs, however, there is considerable variation: in *D. longicaudatus*, now to be described, they consist each of one three-jointed ramus, possess no hairs, but only a few spines, and altogether resemble the same organs in some species of *Pontella*. In *D. Castor* and *D. americanus*, on the contrary, both legs possess two three-jointed branches, and if not ordinary hairs, at any rate a very near approach to them.

Further, in *D. Bateanus*, my other new species, the organs in question much resemble the other legs, and indeed differ only in having a spine, stronger than usual, but varying considerably in size, on the inner side of the second segment of the outer branch. This spine is the representative of a much larger one which occupies a corresponding situation in the right leg of the male, but (and this is somewhat remarkable) is not present in the left leg of that sex, although present on both sides in the female.

It follows from Prof. Dana's description, that his species of *Calanopia* resemble *Pontella* in their maxillipeds and first pair of legs, but he does not expressly say so, and in other respects they so closely resemble the species now to be described, that I cannot doubt that they belong to the same group.

Diaptomus Bateanus, n. s.

Frons obtusa. Cephalothorax postice rotundatus, mucronatus. Antennæ anticæ corpore paulo breviores, setis brevibus, postica penultima articulum longitudine superante, setis aliis brevioribus. Pes posticus maris dexter magnus, digito elongato, inflexo. Pedes postici fœminæ pedibus aliis fere similes.

The right male antenna has a series of minute teeth occupying the anterior side of the fifth, sixth and seventh segments, counting from the free end, and the hinge-joint is between the fifth and sixth.

The maxillipeds resemble those of the species which I have named *Diaptomus dubius*.

The first pair of legs have both branches three-jointed; the basal segment of the lesser ramus bears one hair, the second two, and the third three on the inner margin and two at the apex. The second segment of the larger branch bears one hair, the inner margin of the terminal segment four, and the apex has a large spine, serrated on the outer side.

The fifth pair of legs resemble those of *C. brachiata*, but the long spine on the second segment of the outer branch of the right leg is curved, but not bent at a right angle.

The *abdomen* is four-jointed, and the caudal lamellæ and setæ are moderately long, the fourth from the outside being the longest.

I found some specimens agreeing with this species in the form of the second pair of antennæ, second pair of maxillæ, cephalothorax, the first and fourth pairs of legs, maxillipeds, and the abdominal lamella. The fifth pair of legs, however, were large and natatory, but the inner branch exactly agreed with that of the male. The outer one was two-jointed, the apical segment twice as large as the basal, and bearing at the free end a large spine, and on the inner margin four long hairs, all on the apical half of the segment. I believe therefore that these were females of this species.

I have named it after Mr. Spence Bate, who has done and is doing so much good service in the cause of science.

Caught at Weymouth, October 1857.

Length of cephalothorax ·034; of abdomen ·016; of anterior antenna ·046.

Pl. XI. figs. 1–3.

Several specimens were attacked by one of the parasitic Isopods, apparently an *Anilocra*, which was firmly fastened to the back of its victim. This is the first time, I believe, that a Crustacean parasite has been observed attached to any of the Cyclopoidea. The *Anilocra* was more than half as long as the *Diaptomus*.

Diaptomus longicaudatus, n. s.

Frons obtusa. Cephalothorax postice rotundatus. Antennæ anticæ corpore breviores, setis brevibus, subæquis. Pedes primi, ramo uno 3-articulato, altero 2-articulato. Pedes postici, uno tantum ramo præditi. Abdomen 5-articulatum; styli caudales longi, abdomine vix breviores.

The absence of angles to the cephalothorax, and the structure of the fifth pair of legs, separate this from the preceding species; but as it has the right antennæ and right posterior leg of the male prehensile, and the second pair of antennæ Calanoid, it must belong to this genus.

The first pair of antennæ are shorter than the body, but longer than the cephalothorax; the setæ are all short, none of them much exceeding the length of one of the segments.

The second pair of antennæ are Calanoid.

The maxillipeds closely resemble those of *Diaptomus dubius*.

The first pair of legs have one segment three-, the other two-jointed. This is also the case with the first pair.

The fifth pair of legs are prehensile and Pontelloid. The figure will give a better idea of their form than description can convey.

The abdomen is five-jointed. The caudal lamella is nearly as long, and has five hairs at the end, of the usual relative lengths.

Length of cephalothorax ·03, of abdomen ·012, of lamella ·01. Total, ·052. Length of antenna ·043.

Colour opake brown; eye red. Not so numerous as *D. Thompsoni,* but not unfrequent.

Weymouth, October 1857.

Female. I also caught several specimens of a female, which I believe belongs to this species. It agreed in the general form of the cephalothorax and abdominal lamellæ, antennæ, maxillipeds, and first pair of legs. The fifth pair of legs are small, symmetrical, and three-jointed; the apical segment bearing four spines, two at the end and one on each side. The abdomen was three-jointed.

Pl. X. figs. 11, 12; Pl. XI. figs. 12, 13.

Pontella.

The genus *Pontia* was instituted by Milne-Edwards; but the name was altered by Dana to *Pontella, Pontia* having been already used. Before the appearance of Dana's work on Crustacea, three species only were known; but that great naturalist described and figured no less than twenty-seven new species, and divided them into three highly natural groups: 1st, *Calanopia,* the species of which ought rather, I think, to be referred to *Diaptomus*; 2nd, *Pontellina,* having the head unarmed; and 3rd, *Pontella,* in which it has a reversed spine on each side.

The present species is the first that has been found in our seas, and may be described as follows:—

Pontella Wollastoni.

Frons subtriangulata, apice rotundata. Cephalothorax 7-articulatus, postice acutus. Oculi magni. Antennæ anticæ cephalothorace non breviores, maris dextra, crassa, prehensilis, setis brevibus. Pedes primi paris, ramo uno 3-articulato, altero 2-articulato. Pes posticus maris dexter, crassus. Abdomen 4-articulatum, stylis setisque caudalibus mediocribus.

In this species the front is subtriangular, rounded in front. The cephalothorax is seven-jointed, the posterior segment being short and having its angles slightly elongated. The anterior antennæ are swollen; the fourth and fifth segments (counting from the apex) are elongated, and toothed along the inner margin. The setæ are short.

The posterior antennæ have the larger branch only about ¼ longer than the other.

The *maxillæ* and *maxillipeds* are as usual.

The first and fourth pairs of legs have both rami three-jointed.

The fifth pair (Pl. XI. fig. 11) are as usual. The penultimate segment, or hand, is swollen, and bears at the base a long immoveable spine, which acts in opposition to the still longer curved finger. The left leg appears to consist of two rami.

Caudal setæ as usual; the fourth (counting from the outside) being the longest.

Female. The preceding description applies to the male. The female, which I believe to correspond to this species, agreed with the male in the general form of the cephalothorax, which was ·07 of an inch in length, but the posterior segment was not very clearly separated from the penultimate. The anterior antennæ were rather longer than the cephalothorax; the posterior penultimate seta was about half as long again as its segment. The other setæ scarcely exceeded the length of the segments to which they were attached. The maxillipeds and first pair of legs agreed with those of the male.

Prof. Dana observes, that the fifth pair of legs in the female do not afford good specific characters in this genus; but, with all respect for so great an authority, I venture to offer a different opinion, at least as regards all those which I have been able to examine. In this species the two branches are reduced to simple, ovate, inarticulate lobes; the outer and larger being about $\frac{1}{4}$ longer than the other, and having a small tooth on the inner margin near to the apex.

Colourless, except the bright red eyes.

Collected at Weymouth in October 1857.

I have named the species after my friend Mr. Wollaston, so well known for his excellent work on the Coleoptera of Madeira, and for other interesting essays on various branches of entomology.

Pl. XI. figs. 9, 10, 11 & 18.

Pontellina brevicornis.

Frons rotundata. Cephalothorax 5-articulatus, articulis quatuor posticis subæquis, postice in angulis productus, dextro longiore; segmento primo non lateribus angulatis. Antennæ primæ cephalothorace breviores, setis brevibus, apicalibus longioribus, articulum longitudine superantibus. Antennarum posticarum rami non valde inæquales. Pedes primi, ramis 3-articulatis. Pedes postici maris crassi. Abdomen 5-articulatum, stylis setisque mediocribus.

This species represents the third of the groups into which Prof. Dana has divided the genus, and consequently wants the reversed spine on the side of the first cephalothoracic segment. The front is rounded, and the posterior corners of the cephalothorax are produced into short angles.

The anterior antennæ are shorter than the cephalothorax; some of the apical setæ are more than twice as long as the segment; the penultimate setæ are short, the anterior antepenultimate is longer again.

The second pair of antennæ have the lesser ramus nearly as large as the other, and with six long terminal hairs.

The maxillipeds have the five terminal segments united into one, which, however, shows its compound nature by being provided with five lobes or shallow projections on one side.

The first pair of legs have both rami three-jointed; the outer branch has one hair on each of the two basal segments; the inner branch has one hair on the basal segment, two on the second, and six in all on the apical.

The fifth pair of legs differ so much in *Pontella*, that the different species may generally be distinguished by them alone. Their forms, however, are so irregular, as to be somewhat difficult of description. In this case both legs consist of three subequal swollen segments, differing, however, in the two legs, and ending in the right by a simple, rather long spine. There are no setose hairs.

The abdomen is five-jointed; the caudal lamellæ are about as long as the posterior segment, and the setæ are of the usual length and comparative sizes.

All the upper part of the body was colourless, the lower part dark brown.

Length of cephalothorax ·03 of an inch, of abdomen ·01; total ·036. Length of anterior antenna ·028.

Found at Weymouth, October 1857. There were not many specimens.

The female which I suppose to belong to this species was the only female *Pontellina* I met with, as the male was the only male; they agree in the general form, in the anterior antenna of the left side, the maxillipeds, first pair of legs, abdominal lamellæ and setæ. Most of the specimens were colourless, but one was black.

The branches of the fifth pair of legs (Pl. XI. fig. 8) consist of only one segment, and are of almost equal breadth throughout; the lesser branch ends in two equal teeth, and the larger has the external angles produced into two spines, the inner one being the longer, and also a still larger spine projecting from the apex; there is also a small spine on the middle of the outer margin.

Pl. XI. figs. 4–8.

Corycæus anglicus, n. s.

Cephalothorax crassiusculus, postice acutus. Conspicilla larga, remotiuscula. Antennæ anticæ longe setigeræ. Antennarum secundarum digitus articulo secundo longior. Abdomen 2-articulatum. Styli caudales abdomine breviores. Setæ caudales stylis longiores.

This species belongs to a small group of the genus which contains four others also. From *C. crassiusculus* it may be at once distinguished by the two-jointed abdomen; from *C. laticeps* by the caudal lamella being more than half as long as the abdomen (excluding, of course, the lamella itself); and from *C. vitreus, agilis,* and *orientalis* by the finger of the second antenna being considerably longer than the second segment.

The cephalothorax, seen from above, much resembles that of *Corycæus styliferus*, mihi.

Specimens of this species were often found *in coitu*, and when so, clung together very tenaciously, not being in some cases separated when put into spirits of wine, so that they were not divided even by death. Prof. Dana was unable to discover any sexual differences in the genus, but I always found in this species the first segment of the abdomen of the male occupied by a bright mass, which was absent from that of the female. The vermiform mass of pigment attached to the eye, also, went considerably further back in the male than in the female; so that I should be inclined to regard Prof. Dana's representation of *C. vitreus* as that of a male, and that of *C. agilis* as that of a female.

Being the first species found in the British seas, I have named it *C. anglicus*.

Length of cephalothorax ·029, of abdomen ·014; total ·04.

Pl. XI. figs. 14 to 16.

Monstrilla.

The genus *Monstrilla* and the family Monstrillidæ were founded by Prof. Dana for a single specimen caught by him in the Sooloo Sea; and I have now the pleasure to record a second species found by me at Weymouth. Both appear to be very rare; at least Prof. Dana in all his travels met with only one specimen; and though I searched with great diligence, I was scarcely more fortunate.

Monstrilla anglica.

Frons quadrata, angulis rotundatis. Cephalothoracis segmentum primum postice paulo latius. Antennæ 5-articulatæ, setis antenna brevioribus. Abdomen 4-articulatum, segmentis subæqualibus. Styli caudales oblongi, divaricati, setis 6 subæquis, diffusis.

This species differs considerably from *M. viridis*. In the first place the cephalothorax is rather broadest behind instead of in the middle, and the three posterior segments are somewhat moniliform, so that their sides do not form an even line. The abdomen is four-jointed, and the basal segment bears on each side a large plumose hair, which passes backward and outward. Upon the fourth caudal seta (counting from the outside) is another, rather smaller than the other five. It lies so close to the fourth seta, that it might easily be overlooked. For the sake of clearness, however, I have in my figure separated them.

Length of cephalothorax ·037, of abdomen ·012; total ·049; of antenna ·027.

Caught at Weymouth, October 1857.

Pl. X. figs. 7 & 8.

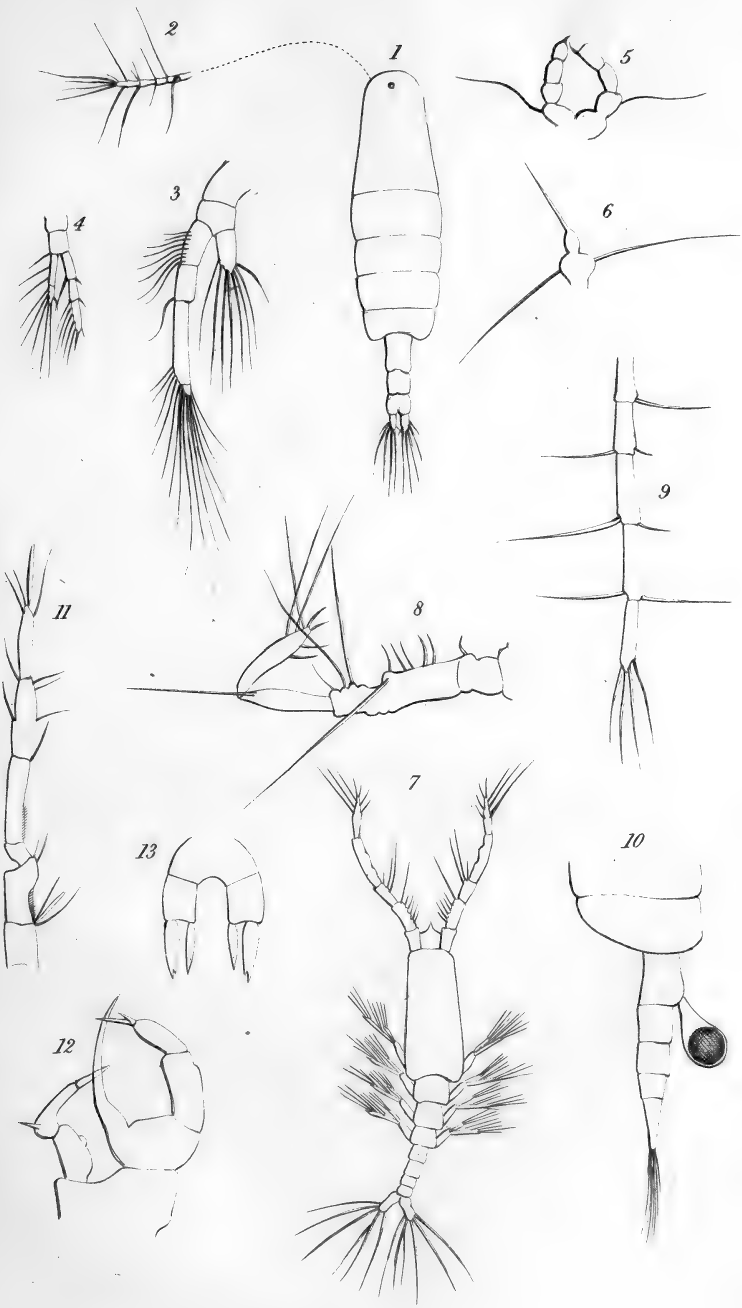
EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. *Calanus Euchæta,* in outline, seen from above; ×65.
Fig. 2. Ditto. End of left anterior antenna; ×65.
Fig. 3. Ditto. Antenna of the second pair; ×250.
Fig. 4. Ditto. Leg of the first pair; ×65.
Fig. 5. Ditto. Fifth pair of legs of the male; ×125.
Fig. 6. Ditto. Fifth pair of legs of the female; ×125.
Fig. 7. *Monstrilla anglica*; ×30.
Fig. 8. Ditto. Antenna; ×65.
Fig. 9. *Calanus anglicus*; end of antenna; ×125.
Fig. 10. Ditto. End of cephalothorax and abdomen, seen from the side; ×65.
Fig. 11. *Diaptomus longicaudatus*; end of anterior antenna of male; ×140.
Fig. 12. Ditto. Fifth pair of legs of male; ×125.
Fig. 13. *Pontella Wollastoni*; fifth pair of legs of female; ×30.

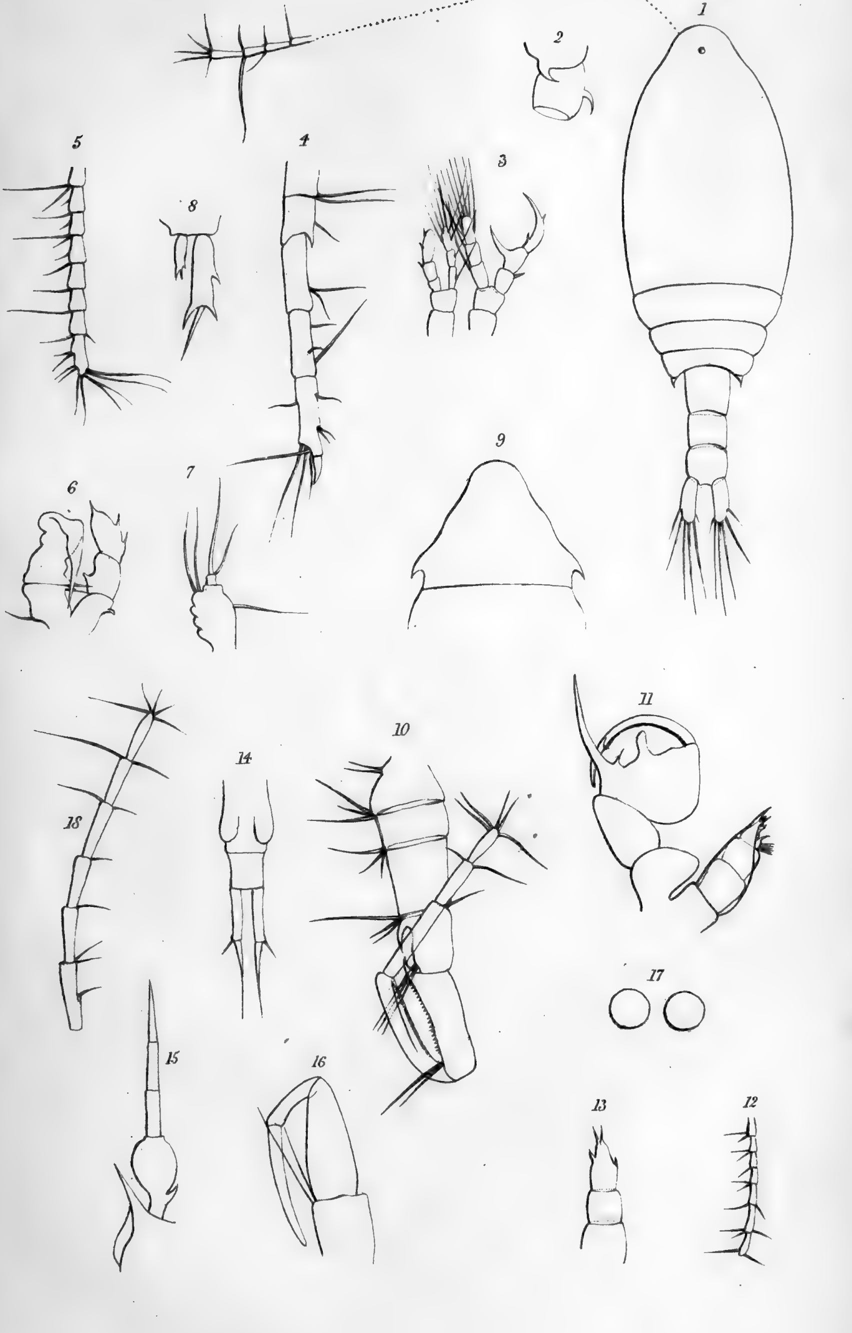
Plate XI.

Fig. 1. *Diaptomus Bateanus*; ×65.
Fig. 2. Ditto. End of cephalothorax, and beginning of abdomen, seen from the side; ×65.
Fig. 3. Ditto. Fifth pair of legs of male; ×50.
Fig. 4. *Pontella brevicornis*; end of left anterior antenna of male; ×100.
Fig. 5. Ditto. End of left anterior antenna of female; ×65.
Fig. 6. Ditto. Fifth pair of legs of male; ×100?
Fig. 7. Ditto. End of maxilliped; ×250.
Fig. 8. Ditto. Fifth pair of legs of female; ×100.
Fig. 9. *Pontella Wollastoni*; front seen from above.
Fig. 10. Ditto. Anterior antenna of male; ×65.
Fig. 11. Ditto. Fifth pair of legs of male; ×65.
Fig. 12. *Diaptomus longicaudatus*; end of anterior antenna of female; ×65.
Fig. 13. Ditto. Leg of fifth pair of female; ×130.
Fig. 14. *Corycæus anglicus*; abdomen seen from above; ×65.
Fig. 15. Ditto. Abdomen and end of cephalothorax, seen from the side; ×65.
Fig. 16. Ditto. Antenna of second pair; ×80.
Fig. 17. Ditto. Eyes; ×250.
Fig. 18. *Pontella Wollastoni*; end of anterior antenna of female; ×65.



Lubbock. Del.

J. De C. Sowerby. Sc.



J. Lubbock, Del.

J. De C. Sowerby. Sc.

XL.—*On the great Bird of Paradise,* Paradisea apoda, *Linn.*; 'Burong mati' (Dead bird) *of the Malays*; 'Fanéhan' *of the Natives of Aru.* By Alfred R. Wallace.

Having enjoyed the rare privilege of a personal acquaintance with this remarkable bird in its native haunts, during my residence in the Aru Islands, I am enabled to give a more complete account of its habits, its local and geographical distribution, and some peculiarities of its structure and œconomy, than has yet been published, and to correct several errors and misstatements which occur in all the accounts I have seen. I have supplied the deficiencies of my own observations by carefully comparing the accounts of those natives who shoot the birds and prepare the skins for sale, and with whom I have resided for more than two months in the interior of the forests. My own Malay hunters, who have shot most of the fine specimens which I have obtained, have been another independent source of information.

A person cannot be long in the interior forests of Aru without hearing a loud, harsh, often-repeated cry, *wawk-wawk-wawk, wōk-wōk-wōk.* This is the *Paradisea,* and it is sure to be heard morning and evening, besides occasionally throughout the day. It is the most frequent and the loudest of all the cries in the forest, and can be heard at the greatest distance. One soon becomes convinced that the bird is most abundant; and it is, in fact, over a very large part of Aru, one of the very commonest species. Much of the noise, however, is made by the young birds of various ages, and who seem to be ten times as numerous as the full-plumaged, adult males. We shot nearly a dozen of the former before we even saw one of the latter. The adults frequent the very loftiest trees, and are shy and wary, and so strong and tenacious of life, that I know no bird of its size so difficult to kill. It is in a state of constant activity, flying from tree to tree, scarcely resting still a moment on the same branch, and, at the slightest alarm, flying swiftly away among the tree-tops. It is a very early bird, commencing to feed before sunrise; but it does not seem to gorge itself and then rest half-torpid, like many fruit-eating birds, as it may be seen and heard at all times of the day in a state of activity.

On examining a freshly killed bird, we see the great muscular strength of the legs and wings, and find the skin to be remarkably thick and tough, and the skull as well as all the bones very hard and strong. The whole neck is lined with a thick, muscular fat, exactly similar to that of the *Cephalopterus ornatus,* in the same position, and probably serving in both cases to nourish the highly developed plumage of the adjacent parts. This causes the throat externally to appear very wide, and as if swollen, which displays to great advantage the dense, scaly, metallic plumage. The flesh, as might be expected, is dry, tasteless, and very tough—to be eaten only in necessity. By far the greater number of the birds I have opened have had their stomachs full of fruit, and this seems to be their usual and favourite food. At times, however, they seek after insects, principally Orthoptera; and I have found one of the largest of the Phasmidæ almost entire in the stomach of a full-plumaged bird.

It is only for two or three months of the year, during the height of the east monsoon, that the natives obtain them; and this circumstance has no doubt led to the statement that they are migratory in Aru, arriving from New Guinea at the end of the west, and returning there again at the end of the east monsoon—which is quite incorrect, as they are permanent residents in Aru, and the natives know nothing about their being found in New Guinea. About April, when the change from the west to the east monsoon occurs, the Paradiseas begin to show the ornamental side feathers, and in May and June they have mostly arrived at their full perfection. This is probably the season of pairing. They are in a state of excitement and incessant activity, and the males assemble together to exercise, dress and display their magnificent plumage. For this purpose they prefer certain lofty, large-leaved forest-trees (which at this time have no fruit), and on these, early in the morning, from ten to twenty full-plumaged birds assemble, as the natives express it, "to play and dance." They open their wings, stretch out their necks, shake their bodies, and keep the long golden plumes opened and vibrating—constantly changing their positions, flying across and across each other from branch to branch, and appearing proud of their activity and beauty. The long, downy, golden feathers are, however, displayed in a manner which has, I believe, been hitherto quite unknown, but in which alone the bird can be seen to full advantage, and claim our admiration as the most beautiful of all the beautiful winged forms which adorn the earth. Instead of hanging down on each side of the bird, and being almost confounded with the tail (as I believe always hitherto represented, and as they are, in fact, carried during repose and flight), they are erected *vertically* over the back from under and behind the wing, and there opened and spread out in a fan-like mass, completely overshadowing the whole bird. The effect of this is inexpressibly beautiful. The large, ungainly legs are no longer a deformity—as the bird crouches upon them, the dark brown body and wings form but a central support to the splendour above, from which more brilliant colours would distract our attention,—while the pale yellow head, swelling throat of rich metallic green, and bright golden eye, give vivacity and life to the whole figure. Above rise the intensely-shining, orange-coloured plumes, richly marked with a stripe of deep red, and opening out with the most perfect regularity into broad, waving feathers of airy down,—every filament which terminates them distinct, yet waving and curving and closing upon each other with the vibratory motion the bird gives them; while the two immensely long filaments of the tail hang in graceful curves below*.

In the freshly killed specimens it can be easily seen (even did not observation of the living bird prove it) that this is the natural position of the long plumes. They all spring from an oval fold of the skin, about an inch in length, situated just below the elbow or first joint of the wing. On this point they turn as on a hinge, and admit only of being laid down closed beneath the wing, or erected and expanded in the manner described, which position they take of their own accord, if the bird is held up by the legs, with the head inclining a little downwards, and the whole gently shaken. In this manner, by slightly altering the position of the body, all the forms which the plumage assumes during life can be correctly and beautifully imitated. If I am right in supposing this attitude to be now first made known in Europe, and our taxidermists succeed in properly representing it, the Bird of Paradise will, I am sure, excite afresh universal admiration, and be voted worthy of its illustrious name.

The curious habit of the males assembling to play and exercise their limbs and feathers, occurs in some other birds, as the Turkeys and Argus Pheasants, and particularly in the *Rupicola cayana*, which, though a true arboreal bird, has its ball-room on the ground, generally on a flat rock, on which a space of a few feet in diameter is worn clean and smooth by the feet of the dancers. On these spots the natives set snares, and catch these beautiful birds alive. The soaring of the Lark, and, in all song-birds, the exertion of singing, probably results from the same desire for action at the time when the moulting is completed, and the frame overflowing with health and vigour.

When the natives wish to procure 'Burong mati,' they search for one of the trees on which the birds assemble, and, choosing a time when they are absent, construct among its branches a little hut of boughs, so chosen as to afford them a good concealed station for shooting the birds. They say the greatest care is necessary to make the covering very close, and at the same time not too artificial; for if the birds once see anything move within, they will quit the tree, and never return to it. They ascend to this nest before daylight in the morning, with their bow and a good stock of arrows; a boy accompanying them, who

* A note on the mode in which the male Bird of Paradise displays his plumes, will be found in the Annals for February 1854, vol. xiii. p. 157.

remains crouched at the foot of the tree, to secure the birds as they fall, and recover the arrows. They sometimes use arrows with a large rounded piece of wood at the end, so as to make no wound; but they say the bird is so strong, that it is very hard to kill them with this, and they therefore prefer the usual long, pointed arrows, which transfix the body and certainly bring down the bird. The assembly commences soon after sunrise, and when a sufficient number are in full play, the archer begins his sport, and if skilful, will shoot nearly the whole of them in succession, as each bird seems so much intent on his own enjoyment as not to miss his companions. In skinning, they take out the bones of the head and legs, and apply ashes to the skin, a stick being pushed up to the base of the beak, on which the skin of the head and neck shrinks to about a tenth of its natural size. A little peg of wood is pushed through the nostrils, by which the skin is hung up to dry, and a string tied round the wings to keep them in their place. In damp weather the skin about the base of the beak often breaks, and is then mended with pitch! and the smoky atmosphere of the native houses, in which half-a-dozen families have their cooking-fire in daily action, soils and darkens the whole plumage, especially the pale yellow head and the delicate downy portion of the long plumes. When dry, they are preserved wrapped in palm-leaves, which, however, seldom cover the extreme ends of the feathers, which thus become still more rubbed and dirtied. Some years ago, two dollars each were paid for these skins, but they have gradually fallen in value, till now there is scarcely any trade in them. I purchased a few in Dobbo at 6*d*. each.

Of the geographical distribution of the Bird of Paradise many erroneous statements have been published. Its supposed migrations have by some been extended to Banda, by others to Ceram and all the eastern islands of the Molucca group. These statements are, however, totally without foundation, the species being strictly confined to New Guinea and the Aru Islands, and even to a limited portion of each of those countries. Aru consists of a very large central island, and some hundreds of smaller ones scattered around it at various distances, many being of large size and covered with dense and lofty forests; yet on not one of these is the *Paradisea* ever found (although many of them are much nearer New Guinea), being limited to the large island, and even to the central portions of that island, never appearing on the sea-coast, nor in the swampy forests which in many places reach some miles inland. With regard to its distribution in New Guinea, the Macassar traders assured me it was not found there at all; for, although they obtain quantities of 'Burong mati' from most of the places they visit on the west coast of

New Guinea, they are all of another kind, being the *Paradisea papuana*, a smaller and more delicate, but less brilliantly coloured species. On inquiry I found they did not trade to the eastward of Cape Buro (135° E.). Lesson*, I believe, found the larger species in the southern peninsula of New Guinea, and an intelligent Ceramese trader I met at Aru assured me that, in places he had visited more eastward than the range of the Macassar traders, the same kind was found as at Aru. It is therefore clear that the *Paradisea apoda* is confined to the southern peninsula of New Guinea and the Aru Islands, while the *Paradisea papuana* inhabits only the northern peninsula, with one or two of the islands (most probably) near its northern extremity. It is interesting to observe, that though the Ké Islands and Goram approach nearer to New Guinea than Aru, no species of the Paradise birds are found upon them,—pretty clearly showing that these birds have not *migrated* to the islands beyond New Guinea in which they are now found. I have, in fact, strong reasons for believing, from geographical, geological, and zoological evidence, that Aru is but an outlying portion of New Guinea, from which it has been separated at no very distant epoch.

In examining my series of specimens, I find four such well-marked states of the male bird, as to lead me to suppose that three moults are required before it arrives at perfection. In the first condition it is of a nearly uniform coffee-brown colour, darker on the head and paler on the belly, but entirely without markings or variety of colour. The two middle tail-feathers are exactly equal in length to the others, from which they only differ in having a narrower web. In the next series of specimens, the head has acquired the pale yellow colour, and the throat and

* Since writing this paper, I have, by the kindness of a German physician residing at Macassar, Dr. Bauer, obtained a perusal of the 'Zoology' of the voyage of the 'Coquille,' containing Lesson's observations on the Paradise Birds. There is, however, a great want of preciseness in his account, owing to his using French trivial names, and his not stating *where* and *how* he obtained each species. He visited, I find, only the north coast (Dorey Harbour) and the islands of Waigiou. His details of habits refer to, and the specimens shot by himself or companions are spoken of as, the "petit Emeraude," which must be the *P. papuana*, Bechst. (*P. minor*, Forst.). He states, however, that he procured from the natives at Dorey *the two species of 'Emeraude,'* the other being, no doubt, the true *P. apoda*, Linn., which I believe does not inhabit that district. They were probably obtained from the Ceramese traders, who had brought them from the south or from Aru, just as they offered me at Aru specimens of the *P. papuana* which they had brought from the north peninsula of New Guinea. He mentions the apparently large number of females, and concludes that the bird is polygamous! but I have no doubt that what he took for females were mostly young males. He says nothing about the vertical expansion of the plumes, which will form, I hope, an important addition to our knowledge of these remarkable birds.

forehead the rich metallic green of the old birds; the two middle tail-feathers, however, are still webbed, but are now two or three inches longer than the rest. In the next state these two feathers have been replaced by the immensely long, bare rachides, quite equal to the greatest size they attain; but there is yet no sign of the fine side-plumes which mark the fourth and perfect state of the species. I am inclined to believe, therefore, that this extraordinary mass of plumes is only obtained by the *Paradisea* in its fourth year, and after three complete changes of its feathers. This will account for the very large number of immature birds everywhere seen, while the full-plumaged males are comparatively scarce. It is singular that I have not been able to obtain a single adult female, my only specimen of that sex being, I think, also a young bird. It is exactly similar to the youngest males, of a coffee-brown all over; but in Bonaparte's 'Conspectus' it is stated that the female is dusky yellow and brown, with the under parts *entirely white*. This, I cannot help thinking, must be a mistake, or altogether another bird; for neither myself nor my hunters have ever seen one at all resembling it, out of many hundreds in various states of plumage. The natives who shoot the birds are also quite unacquainted with it, and always declared that the birds of a uniform brown colour were the females. I am sorry I could not positively determine the point, because I shall probably not again visit the districts in which the *Paradisea apoda* is found. I hope, however, to obtain the allied *P. papuana* on the north coast of New Guinea, and trust to be more successful in ascertaining the female of that species. It is also worthy of notice that the long cirrhi of the tail in the full-plumaged males vary very much in length, and the shortest is often the most worn, showing that it has reached its full development for the year. A specimen occurs occasionally with immense cirrhi; one of mine has these feathers 34 inches long, while the general length seems to be from 24 to 28 inches. I think it probable, therefore, that these cirrhi increase in length each year, and that the very long ones mark very old birds. The other dimensions of the bird, and the length of the ornamental side-plumes, are in all cases almost exactly equal.

XLI.—*Observations on the Habits of the common Marten* (Martes foina). By Madame Jeannette Power*.

Every one knows that the Marten is very wild, and that it inhabits the forests. As cunning as the Fox, it prowls like that animal round about isolated houses and farms, and enters these for the purpose of plunder; its visits, which are not disinterested,

* Communicated by Prof. Owen.

reduce the farmer's wife to despair, for the passage of the Marten is always indicated by ravages in the pigeon-house and poultry-yard. It almost always escapes the traps which are laid for it, and all the precautions employed to protect the poultry-yard from its attacks. Nor does it find much sympathy amongst sportsmen, who regard it as a formidable rival.

It generally feeds upon small birds and quadrupeds, causing an immense destruction of young partridges, leverets, young rabbits, and other small game. It eats dry fruits, almonds, walnuts, nuts, figs and grapes.

Wishing to study the habits of these little animals, and to ascertain the extent of instinct with which they might be endowed, I succeeded in obtaining a pair, male and female, which were caught, at the age of about three or four months, in the forests of Mount Etna.

My observations soon showed me that the Marten is a very interesting animal, in respect of the perfection of its instinct; one might say that it possesses a consciousness of what it does.

To tame my Martens, I began by giving them their food with my own hands, three times a day regularly. Their food consisted of beef. At first they were rather wild; but with perseverance and care, I succeeded in overcoming their wildness; they formed a great friendship for me, and began to mount upon my knees and to lick my hands; they followed me all over the house, and at last they were almost always close to me.

When I went out, I shut them up in a little room; on my return, they came to me with a sad aspect, listened to me, and gave me to understand how weary they had been of my absence. I would take them upon my knees and caress them; my caresses brought them to a good humour, when they would leap upon the chairs and tables, or whatever was within their reach.

To make a slight trial of their natural forest instinct, I had a tree brought into my antechamber; hardly had it been placed there, when my Martens climbed to the top of it; but on seeing me return to my room, they descended from the tree in order to follow me. They slept upon the tree, and almost always with the head bent down. If I shut them up in my antechamber, they gnawed at the door, and cried with all the force of their little lungs; I was then obliged to yield and open the door for them.

When I was dressing for the evening, or undressing to go to bed, the Martens introduced themselves gently between the mattresses of my bed, with the view of keeping me company and passing the night with me, which did not suit me at all.

Shortly after I obtained my Martens, the mice which we had in the house disappeared; but I never observed that they caught any. I even made the experiment of giving them, at one of their meals, the flesh of a large rat; they smelt at it, at the same time making faces, but did not touch it, and went away from it with an air of disgust and repugnance.

The Marten has the senses of smell and hearing very delicate. Mine always smelt at their meat before touching it, exactly in the same way as a cat. If the meat were not fresh, they did not eat it, came to me with an uneasy air, and endeavoured, by their little actions, to make me understand that they were hungry. When my servant came to fetch the basket in which he usually placed the meat which I sent him to buy for the Martens, they would spring upon the window-sill, and there watch for his return; when they saw him, they ran before him, jumping about with joy, and emitting their little cry, *hi, hi, hi.*

One day the servant, wishing to see what the Martens would do if he arrived with empty hands, left the basket upon the staircase, and came into the antechamber. They were soon convinced, by the fineness of their scent, that he had not brought any meat. A very interesting scene then took place: first of all, they showed their anger against the servant, by grimacing at him and showing their teeth; then they came to me, opening their mouths, and endeavoured to make me understand that their food had not been given to them. They mounted upon my knees, gave me a thousand caresses, played a thousand tricks, and at this critical moment displayed all the sagacity with which they were inspired by their instinct. I was then obliged to yield to their earnest entreaties, and give them the meat for which they were so anxious.

Wishing to know how the Martens contrive to attack squirrels, and the mode of defence of the latter, I procured a living squirrel, and put it upon the tree; as soon as the Martens perceived it, they threw themselves upon it, and notwithstanding its agility, it could not long escape from the cruelty of its two enemies. The battle was short; the squirrel was attacked, killed, soon torn to pieces, and devoured. The Martens only left the skin, the head and the intestines.

I remarked that although they were very fond of the flesh of young game, they always gave the preference to beef, but they never ate the fat. Another very curious and interesting observation with regard to the instinct of these animals is, that when my Martens saw ill-dressed people entering the house, even though they were in the habit of seeing them come frequently, they threatened them by showing their teeth, and their hair stood on end to the very tips of their tails. I was then called immediately, and was compelled to threaten them with a cane which I held in my hand when I was angry with them, to prevent them from springing at the face of these people. This did not happen with persons of my acquaintance, whose costume differed from that of the class of people for whom they had such a dislike; they ran before these, testifying by caresses, cries of *hi, hi, hi,* and leaps, the pleasure which they experienced in seeing them again. I cannot compare these amicable demonstrations to anything better than those of a dog towards those whom he knows to be friends of the family.

They often went into the kitchen, and one day they carried off a fillet of beef; after eating a piece of it, they hid the remainder under my bed. I was informed of this robbery, and thought it necessary to watch my Martens. I soon perceived that they went frequently under my bed. I gave orders for an inspection in this direction, but they soon saw that the booty which they had deposited there was about to be taken from them, and began to show signs of discontent and irritation towards the servant. I was obliged to interfere, with all my authority, and armed with the stick, in order to prevent them from biting the person to whom I had given orders to carry off their prey, that is to say, the remainder of the fillet of beef.

I was not long in showing them the means of cleanliness, and for this purpose I frequently took them into the kitchen. If this room happened to be closed, they got the door opened by signs, and then went of their own accord into a corner, where I had from the first caused some sand to be placed and renewed daily.

It is customary in Sicily to take the air upon the balconies of the houses: when I did this, my Martens followed me, and mounted upon the balustrade of the balcony, or upon my shoulders, to look into the street. When they perceived any of my friends, they had a movement, a manner of recognizing them; but if a dog came by, they put themselves in a threatening posture; their hair stood on end, they showed their teeth with contortions of the face, and uttered a slight grunting noise. Frequently I have seen the passengers stop to look at them, and many of these kept their dogs by them in order to prolong a scene which was truly amusing in every respect. From time to time, also, they gave chase to the cats; and there was not one of these animals that ventured to approach my house.

A still more extraordinary fact is the following. The Martens often remained alone upon the balcony, when, if they happened to notice one of my friends, they came into the room, and by means of repeated and unequivocal signs, made me follow them to the balcony; but if they saw that the person turned the corner of the street, they ran to a window which opened above the gate of our court-yard, where they watched and waited for my friend's entrance; then they ran to let me know, by their usual demonstrations, and afterwards went into the antechamber; if the servant was not there, they ran to seek him, just as an intelligent dog might have done.

If, in jumping about, they happened to break a glass or a cup, they appeared to be quite conscious of their fault; for they made their escape and hid themselves, dreading correction.

My maid having left a ball of knitting cotton upon a chair, one of the Martens took the end of the thread, and mounted upon the tree; in less than two hours it succeeded in constructing, at the top of the tree, a sort of net, most artistically interwoven, so as only to leave very small spaces between the threads. I could not imagine for what purpose this pretty piece of work was intended. At last I understood, and calling in some boys, I promised them a reward if they were clever enough to catch me some living birds; I gave them my nets, a cage, and some corn, and in eight hours they brought me eleven birds. The next morning I opened the cage underneath the net; several of the birds flew into the tree, others upon the windows and doors. The Martens, on seeing the birds, climbed up the tree, the windows, and the doors, killing those which they could catch: the chase was for some time very amusing, not for the poor birds, but for me, and two of my friends who were present. When all the birds were killed, the Martens devoured several of them, only leaving the feathers, the beak, the feet and the intestines; afterwards they hid the other birds under a piece of furniture, going from time to time to make sure that they were still there. When they were hungry, they went to take the birds and eat them.

When they saw me busy writing, they mounted upon my shoulders, and watched for a favourable moment to steal a book or some papers, which they carried off to their tree with incredible velocity, or hid under some furniture.

One day, my servant, on going into the kitchen to clean the plate, could not find it, and then perceived that many kitchen utensils and all the dusters were wanting, as well as some linen which was being washed; he came to me, pale and frightened, to tell me that I had been robbed. I went into the kitchen, where I thought it strange that the Martens had not followed me; I called them, and they came with a timid air, trembled, and kept at a distance from me, and I observed that they looked towards a cavity under a staircase. I took the cane with which I corrected them, and showed it to them, scolding them at the same time with a severe air, and making them understand that they had committed a crime. They fled into a corner, and took a supplicating posture, on seeing them in which I could not help laughing. I told the servant, who understood nothing of this scene, to look under the staircase; to his great surprise, the objects were found, and, which is astonishing, not one of them was broken or torn. Whilst we were busy looking over the different objects recovered, the Martens took to flight, and went to hide themselves between the mattresses of my bed; they remained concealed there for more than two hours, but hunger caused them to make their appearance. They passed along the wall of the room in which I was; they had a frightened air, and did not venture near me. I pretended not to see them. After their meal, they hid themselves again; I called them; they came to me with a pitiful look; I scolded them, and showed them the cane, when they began their little cry of *hi, hi, hi,* and came in a supplicating manner to lick my hands. After this, they were well-behaved for some time.

If any one pretended to strike me, my Martens became exceedingly angry, and if I had not kept them back by menaces, they would have bitten him. One evening, being very busy writing, I had my door closed. One of my friends, Mr. Pinkerton, called upon me, and was told that I was not to be seen. In going away, he met one of his friends, who was also coming to see me. He told him that I did not wish for any visitors; but in passing along the street, a foolish idea came into their heads. Meeting one of the lamp-lighters, to take his ladder, mount to the balcony, and enter the saloon was the work of a moment. The Martens went before them with the usual ceremonies, and then came into my study to announce that I had visitors; not understanding what they wanted, I turned round and saw the two gentlemen, when I understood everything. As I was going to scold these gentlemen, I saw my Martens getting angry; I ran into the saloon, and arrived just in time to hinder the Martens from biting a gentleman who had imprudently followed the example of his friends. The Martens had never seen this gentleman, who had been absent from Messina whilst I had these animals, and certainly he did not expect such a reception. Two of my intimate friends presented themselves; the servant, knowing that I had somebody in the drawing-room, showed them in. The Martens went before them with a thousand caresses; the stranger advanced to shake hands, but the Martens would not permit him, and the scene was about to recommence. I then took the cane, and they retired into a corner of the room, but still kept their eyes fixed upon their enemy. As it was the time for their meal, I had some meat brought upon a plate, and gave it to this gentleman, at the same time placing one of the Martens upon his knee. The Marten took the meat with a grunting noise; the other Marten jumped up close to his companion, and after their meal, peace was established.

A fortnight after this incident, I heard a noise, and ran to my balcony. There was a crowd of people in the street, and my neighbour was telling them that she had been robbed. Being too far off to hear what she said, I passed into my bed-room, the balcony of which was close to that of my neighbour, when I was struck by seeing there some things which did not belong to me. There was a bonnet, some shoes, two cups, a glass, a watch, some flowering plants which had been torn up from their pots, and other things. I begged the lady to come into my house, assuring her that I would give her some information about the robbers. One may easily understand the pleasure which this lady experienced on seeing her goods.

I told her the history of my Martens, and of the taste they had for stealing, at which she laughed much. I called my Martens, but they did not come; I looked about for them; I had the mattresses removed from my bed, but they were not there; at last I found them concealed at the top of the curtains, when they took to flight. I called them, when they came and received a good punishment. It is strange that they never touched anything either in my drawing-room or my bed-chamber.

My Martens feared, but were much attached to me; they never attempted to bite me when I punished them. One day I was weeping for the loss of a friend; they climbed upon me, caressed me, put on a sad air, and seemed to partake of the grief which I experienced.

The two Martens lived in perfect friendship; what one did, the other imitated, and they were always together in committing any mischief. Sometimes, however, although very rarely, the male corrected his companion.

Being obliged to quit Sicily to come to London, and expecting to return to Messina, I confided my Martens to the Duchess of Belviso; her husband, the Chevalier Benoit, who studied natural history, undertook the care of them. The female, which was near littering, died, either from grief at not seeing me any more, or from some other cause; and the male made his escape. This surprised me, for during the fifteen months that they stayed with me, they had every liberty, but never attempted to escape. Sometimes they crept along the wall into the street; they then went close to the gate of the courtyard, and when this was opened, returned into the house.

XLII.—*On the Unity of the genera* Pleuracanthus, Diplodus *and* Xenacanthus, *and on the Specific Distinction of the Permian Fossil* Xenacanthus Decheni (*Beyrich*). By Sir PHILIP DE MALPAS GREY EGERTON, Bart., F.R.S.

To the Editors of the Annals of Natural History.

GENTLEMEN,

I am induced to offer the following notice for publication in the Annals of Natural History by the strong feeling I entertain (in common, I believe, with all naturalists) of the advantage of correcting and amending the nomenclature of the various objects of our studies in accordance with the progress of scientific knowledge and the discoveries of the day.

The genus *Pleuracanthus* was established by Professor Agassiz in the year 1837. The only portion of the fish then discovered was the defensive spine, the resemblance of which to the dagger of the Trygon and other armed Rays induced him to classify *Pleuracanthus* with that family. The species *P. lævissimus* was found in the Dudley coal-field. Two other species were subsequently named, found in the coal-fields of Leeds and North Wales. More recently these peculiar spines have been found in considerable abundance in the neighbourhood of Edinburgh and at Carluke, and three additional species have been described by Dr. Newberry from the coal-measures of Ohio. In the year 1834 I discovered, in the coal-shale of the Silverdale Mine in North Staffordshire, some remarkable tricuspid teeth, to which Agassiz assigned the new generic title *Diplodus*. Similar teeth were discovered about the same time by the late Dr. Hibbert Ware in the neighbourhood of Edinburgh, and by Mr. Rankin at Carluke. They have since proved of common occurrence in most of our British coal-fields, and I have also received specimens from Prof. Dawson from the same formation in Nova Scotia.

In the 'Jahrbuch' for 1849, Professor Beyrich gives a detailed description of *Xenacanthus Decheni*, a most remarkable fish found in the Rothe-todt-liegende at Rüppersdorf in Bohemia. The general form of the fish resembles *Squatina*, but its most remarkable feature is the insertion of a defensive spine immediately behind the occiput. This spine is described as having the greatest resemblance to those of the genera *Pleuracanthus* and *Orthacanthus* of Agassiz; so much so, that Beyrich suggests the propriety of uniting the three genera as a subfamily of the *Raiidæ*. The late Prof. Goldfuss went a step further, and merged *Xenacanthus* in *Orthacanthus*. It is therefore fair to presume, that the continental discovery has given us the clue to the true characters of the fish from which these peculiar spines are derived. In his lucid description of *Xenacanthus Decheni,* Beyrich remarks that the teeth resemble those of *Diplodus.* If evidence were wanting to complete the argument for the approximation of these genera, it is supplied by this fact; for I had the opportunity of determining most conclusively, by the examination of the fine series of specimens exhibited at the meeting of the British Association at Glasgow (1855), that the spines of *Pleuracanthus* and the teeth of *Diplodus* belonged to the same fish.

Through the kindness of Sir Roderick Murchison, I have been enabled within the last few days to settle this matter decisively, by the inspection of a series of most perfect specimens of *Xenacanthus Decheni,* Beyr., from the Permian strata of Klein Neundorf. The spines of this Permian fish cannot be *generically* distinguished from those of the genus *Pleuracanthus* of the Carboniferous rocks; neither can the teeth be separated from those of *Diplodus* of the same age. There are, no doubt, differences between them, but these are of *specific,* not of *generic* significance. The genus *Orthacanthus* of Agassiz has evidently very close affinities with *Pleuracanthus*; but the approximation of the lateral rows of tubercles on the under surface of the spine, is a character, perhaps, of generic import. All these spines differ from the defence-bones of the armed *Raiidæ* in having hollow bases. Considering publication as the test of priority, the genera *Diplodus* (1843) and *Xenacanthus* (1847) must merge into *Pleuracanthus,* which was put forth in the 'Poissons Fossiles' in 1837.

I remain, Gentlemen,
Your most obedient Servant,
P. de M. Grey Egerton.

Oulton Park, Nov. 17, 1857.

XLIII.—*Remarks on the species of Whales which have been observed on the coasts of Cornwall.* By Jonathan Couch, Esq., F.L.S. &c.*

There is no department of Natural History, unless perhaps we except the minute and microscopic, which is so little understood, especially in regard to the distinction of species, as that which comprises the Whale tribe; two or three of which, that have been numbered among British animals, appear to have been confounded together by different writers, while others have been considered as distinct that are only varieties, and some have probably escaped observation altogether;—circumstances which were the chief inducements to F. Cuvier, brother of the more

* Abridged from the Report of the Royal Cornwall Polytechnic Society, 1856, p. 27.

celebrated Baron Cuvier, to write his well-known and excellent work on these animals, in which, however, he has carried his scepticism to a somewhat unwarrantable extent. This confusion of species, with its attendant ignorance of habits, is in part owing to the distance which the larger species keep from the haunts of men, to their migratory habits, according to the seasons or the distribution of their food, or to their mighty bulk and strength, which prevent their becoming the prey of the fisherman, whose efforts are only directed against such as, by the abundance of oil they furnish, are likely to pay him for his expense and danger. A practical fisherman has rarely been a scientific naturalist; and therefore, if an individual of the rarer species has chanced to fall in the way of those most likely to meet with it, it has not been examined with such intelligent attention as is likely to add to the amount of our knowledge.

It is, again, only after long intervals that, most frequently compelled by the violence of some disease, an individual of the larger sort has become stranded on our shores; and in cases like this, it is to be regretted that the fact has not been known to a competent observer until the animal has suffered such mutilation as obliterates the particular characters of the species; or perhaps such fragments only are left for his inspection as serve to increase rather than diminish the general amount of error regarding them. Unfortunately for the cause of science, it has very rarely happened that any one observer has had an opportunity of inspecting more than a single specimen of the rarer species, and consequently of comparing one individual with another,—a circumstance which, perhaps more than any other, has led to the multiplication of species in the catalogues of naturalists; and under the more ordinary circumstances, a great amount of uncertainty, both in the description and drawing, will necessarily arise, from the presence of a crowd of people which are sure to gather together to the sight, and the awkward manner in which the enormous bulk is likely to take the ground as the tide retires, at which time only, for the most part, the whole of the body can be seen.

These latter remarks are not only intended as an apology for the imperfection of the notes I have brought together of such of those animals as have been met with on our coasts, but also to point out to fishermen and others how much it may be in their power to assist the researches of the naturalist, which more especially may be done by communicating to any competent observer the occurrence of a specimen that might not otherwise be known to him, and by refraining from mutilating it until an examination of it has been made,—a circumstance which may prove highly to the advantage of the fisherman himself; since the preservation and sale of an unknown or rare example may prove of far more value than might arise from the price of the oil it may produce. A measurement of the length, the preservation of the bones of the jaws, with a note of the situation and form of the teeth or whalebone, and also of the blowing-holes on the top of the head—whether single or double,—with the situation and shape of the hump or dorsal fin, and the presence or absence of a series of longitudinal folds under the throat, will considerably assist in determining the character of an uncertain species. But as also in some instances it has happened that even an observing fisherman has been at a loss to decide whether the creature he has seen at sea has been a whale or one of the larger species of sharks (and more than one of the latter class has been known to attain the size, with much of the shape, of a whale of the middle order, so that the basking shark was long confounded with the whales, even by naturalists), it is proper to remark, that cetaceous animals or whales may be easily determined, even when moving through the water, by being seen to have their tails placed horizontally, or across the direction of their course; whereas the line of direction of the tail in all true fishes, as the shark, is upright, or perpendicular to their course, and consequently with a lateral, and not an elevating or depressing motion. The circumstance of spouting water or vapour from the head, is also a character of most of the species of whales. Whales, in fact, are not to be classed with fishes; for they give suck to their young with milk drawn from teats, and draw air through breathing-holes on the top of the head into real lungs, spouting it out again through the same orifices, either in the form of vapour, or with an accompanying rush of water; and it is an excellent fitting of parts to the necessities of the creature, that this horizontal position of the tail is so well adapted to the purpose of raising the head with a slight effort, and of again sinking it below the surface. It is thus that the rolling motion is obtained which is seen in almost all the whales, when they offer themselves to an observer, but especially in the group of Dolphins. It appears, also, that some of the larger whales possess a power which enables them to sink in the water by an imperceptible action, independent of the motion of the tail; for a fisherman has informed me that he has seen, and carefully noted, a large whale very near his boat, which more than once threw itself on its back, with its white belly uppermost; and after lying in this position for a time, it sank without apparent effort, deeper and deeper, for several fathoms, until it was out of sight. The Rev. Mr. Scoresby, who was a Greenland fisherman for several years, has, I believe, noticed the same thing; and it is known that several diving birds are able to keep themselves deeply immersed without apparent effort, while swimming and seeking to escape observation,—a fact which is explained by the supposition that they are able to increase the specific gravity of their bodies by means of an inherent muscular contraction: it is probable that this sinking of the Whale is effected by a somewhat similar means.

(Family BALÆNIDÆ.)

Genus BALÆNOPTERA.

RORQUAL.—*B. musculus,* Fleming's British Animals, p. 30; Bell's British Quadrupeds, p. 520. *B. Boops,* Zoologist, vol. i. p. 33; Gray's Catalogue of the British Museum, p. 32.

Dr. Gray describes, under the name of Razor-back (*Physalus antiquorum*), a whale that was brought into Plymouth by some trawlers, in October 1831, and which by others has been described as the species *B. musculus.* It "was found floating on the sea in a decomposed state, and is said to have been 102 feet long and 75 feet in circumference; but most likely the abdominal cavity was distended by the internal decomposition." These particulars, with others in the same volume, are so very different from notes in my own possession concerning a whale that was towed into Plymouth, about the same date, that they would seem to refer to another capture and species, although I have not heard of more than one of those enormous creatures as being obtained at that time. The advertisement which drew public attention to the skeleton of this whale, as it was exhibited at Plymouth in December 1831, announces it as being 75 feet in length; and my own note, written at the time, is—"*B. musculus*: a female specimen of this species was found dead, and towed into Plymouth by some trawlers, Sept. 27th, 1831; its length was 79 feet. Its gullet was found filled with a large quantity of pilchards, by which it was supposed to have been choked." This whale frequented our coast for a few years. It was first noticed in February 1828, and was described by a fisherman as about 60 feet in length, with a low fin far back on the body, and blowing or spouting from the top of the head. In February 1831, it approached very near the shore, and came so close to our fishing-boats as to excite alarm. Three individuals, supposed to be of the same species, were in company, and one of them was judged to be nearly 100 feet long. In August and September, one of them, supposed to be the same that was found afterwards dead, kept close to the land, and remained in the neighbourhood of Lantivet Bay (near Fowey) for three weeks, feeding on the abundance of young *Clupeæ* (herrings or pilchards) that were assembled there.

This species seems to be not uncommon, and most usually comes near us in the winter. There are traditionary notices of perhaps the same kind of whale having come on shore near Padstow about the end of the last century; and at the beginning of the same a very large individual came on shore near Looe. About the year 1810, another, much mutilated, was thrown on shore at Polperro; but, as the head was defective, after close examination, I was unable to determine the species.

Pike-headed Whale.—*B. rostrata* of Gray, Hunter; Bell's Brit. Quad. p. 521.

There is little doubt that this is the *B. Boops* of some naturalists, and perhaps of F. Cuvier, pl. 20; but if so, he has confounded two species together under this name,—this name having been assigned to a single specimen by an observer who had never seen another.

A specimen was caught in a mackerel drift-net, and brought into Polperro, in May 1850. By the obliging assistance of the fisherman, I had an opportunity of making a sketch of this specimen before it was quite dead, and while yet afloat, the body being sustained on its side with ropes for that purpose. All the published figures I have seen are imperfect in form or expression. This individual is described in the 'Reports of the Natural History Society of Penzance.' The blubber was 2 inches in thickness. Another specimen was taken at Plymouth a few years before, and it appears to be not uncommon on our coasts.

In the museum of the Natural History Society of Penzance there is a ramus of the jaw-bone of some species of Whale, which is marked as belonging to the *Hyperoodon*; but, for anatomical reasons, it cannot be assigned to a species classed by naturalists under that name. It resembles much more closely a branch of the jaw of *B. rostrata*; and it is here noticed more particularly, because of the information supplied by Mr. Chirgwin, who presented it to the museum,—that the animal, which was 22 feet long, produced 90 gallons of oil. Another whale, which was 18 feet in length, and which the same gentleman called the Lesser Rorqual, but which I suppose to be the same species, afforded also 90 gallons.

Genus Megaptera.

M. longimana, Gray (Catalogue of Brit. Mus. p. 26), who, quoting Professor Eschricht, says, "this is the most common whale in the Greenland seas;" but it is not distinguished by Scoresby, Cuvier, or Bell. I have supposed it to be the species referred to in the information given me by an observing and intelligent fisherman.

In the middle of July 1835, a whale came about his boat, and continued near it, at intervals, for a long time, sometimes at no greater distance than a fathom. It was such as, although an old fisherman, he had never seen before; and he supposed it to be between 30 and 40 feet long; but he could not well distinguish the hinder part of the body. The body itself was very thick and solid, and it had a fin on the back, of an extraordinary shape, appearing like a hump,—not high, but, as he judged, about two fathoms long, having the upper portion in a waved form, as if in separate humps, and tapering behind into the general shape, where the body became more slender. It appeared to blow or breathe from the middle of the head, and seemed by no means shy, although at times it moved swiftly.

A doubt must rest on this species, as a visitor to our coast, until an instance of its capture shall enable some fortunate observer to examine it more closely; but there is little difficulty in believing that some of the larger whales which come to us are still little known to naturalists.

It is to this class of whalebone whales that writers refer when they tell us that whales, sturgeons, and, as some assert, porpoises, are royal fishes, which the king, by his prerogative, has a right to claim when cast on the shore in any place within the kingdom; except this right has been granted, as in a few instances it has been, to any of his subjects. "The king himself," says Jacob in his 'Law Dictionary,' "is to have the head and body, to make oil; and the queen is to have the tail, to furnish whale-bones for her royal vestments." I shall say more on this subject when I come to speak of the fisheries of former days.

The royal vestments would have been badly supplied, if stiffened only with the bones obtained from the whale's tail; and the whale itself is so seldom thrown on shore, that we might suppose the regal cupidity to have received but little gratification from the occurrence of such an accident. But we shall by-and-by discern other reasons that made it valuable; and therefore it was thought not unworthy of being included within a grant by the crown of the charter constituting the Black Prince the first Duke of Cornwall, where whales and sturgeons occurring within the king's dominions on that coast are specially granted to him. It is uncertain what other permanent lay grants besides this, in our county, of the same objects, exist; but at least there is one of small extent, along the eastern shore of the county, in the parish of Talland, and which is claimed—and for other objects besides whales has been exercised, even in recent instances,—by the ancient family of Trelawny, in right of purchase with the family mansion from the crown in the reign of Queen Elizabeth. But it can scarcely be supposed that ecclesiastical persons would overlook an acquisition esteemed so valuable; and although in this instance there were no ladies to require in their garments the stiffening formed by the bones of the animal's tail, yet at least the oil would serve to light the midnight lamp, supposed to be employed to afford light to his studies; and a tithe of it was therefore secured by the bishop. This will be seen, from the following extract of a letter from the famous antiquarian herald, Anstis—himself a native of Cornwall—to his patron the Bishop of Exeter; and it is to be observed that, in the grant referred to, the word *Balæna*, signifying the large whalebone whale only, is not used, but another, which might be interpreted to mean any of the species that was worthy of notice. "I met with," says he, "an Inspeximus of a grant made by Henry the 3rd, wherein is granted to the Bishop of Exon and his successors for ever omnes decimas Craspesiorum within Cornwall and Devon, and is confirmed to them by Edward the 2nd. This without doubt was of value, otherwise the Bishopps would not have been solicitous to have had a confirmation of itt, But it is a question of what it is, the word not being to be found in any of the Glosaryes, And I have asked many persons whose business lyes among the old Records, who never remember that they mett with any such word, But I think that I have since mett with the meaning thereof in the Patent Rolls of R. 2, wherein are those words de piscibus regalibus vocatis whales sive Graspes, from which word I suppose like Lawyers they make Craspesiorum, But if it only extended to such great fishes, it will be of no great value.—The word Craspisces is used in Bracton, not only for Royall fishes, but for any big fish whatever, And I take the word in the Grant to be of the same signification. Oct. 10. 1700."

The doubts of the learned Anstis about the meaning of a name applied by lawyers to a species of animal, of the nature of which they were clearly ignorant, will also apply to the designation given in another document, of which I possess a copy, to some one of the same class of creatures; and of which I have not been able to obtain an explanation in any work to which I could obtain access. It is found in a Commission under the Great Seal of Charles the 2nd, in which that sovereign appointed Sir John Trelawny, Baronet, Vice-Admiral of the south coast of Cornwall; and under the authority of which the latter appoints Nicholas Sunders of Truro his Deputy; authorizing the latter therefore "to serrè, secure, recover, recerize and regavè—among other rights of the Admiralty—all fishes Royall: namely Sturgeon, Whales, Rigges, Porpusses, Granpoles, and generally whatsoever fish of a great breadth and fulness antiently of right belonging to the Lord High Admiral." I confess my utter ignorance of the creatures here mentioned under the name of

Rigges—a name which does not occur in any of the ancient books on Natural History.

(Family PHYSETERIDÆ.)

Genus PHYSETER.

BLUNT-HEADED BLOWER.—*P. macrocephalus*, Linn., Fleming's Brit. Animals, p. 39; Jenyns' Manual, p. 44; F. Cuvier, Cetacées, pl. 19; Bell's Brit. Quad. p. 506; Gray's Catalogue Brit. Mus. p. 49. Humped Blower, Cornish Fauna.

Dr. J. E. Gray says, "the dorsal fin or hump forms a very obtuse angle, and is ill-defined, being about 10 inches in length and 3 inches in height, there being also between it and the caudal two or three quite small finlets." But it is probable that these finlets, humps, or irregularities, vary in number, and may at last disappear; and also that what is more properly the dorsal hump or fin is more elevated and fin-like in the younger condition. This whale grows to a large size; but the only one I ever had an opportunity of examining, which I supposed to belong to this species, but of which I was prevented from obtaining a figure, was less than 20 feet in length: it had run itself on shore in pursuit of small fish, and was left by the tide. There is no particular account of the capture in Cornwall of an individual of full growth, although in the eastern counties this has often happened; but it has certainly been seen at the entrance of the Channel. When met with, it may be known by the enormous proportions of its head, from which spermaceti may be extracted. A specimen, which was called in the newspapers the lesser Cachalot, 20 feet in length, was taken at Ropehaun, and had 300 mackerel in its stomach.

HIGH-FINNED BLOWER.—*P. Tursio*, Fleming's Brit. An. p. 38; Bell's Brit. Quad. p. 512. Compare Gray's Catalogue of Brit. Mus. p. 48.

This is a rare species, not often seen, and still less frequently caught; but although doubted by some, its existence as a species cannot with any probability be called in question. I myself once saw the dorsal fin of what could only be this species, as it is described by those who have examined it more closely. It was tall and slender, in shape like the trysail of a small boat, and it passed along the surface for a considerable space without dipping under, while the body was concealed below. Fishermen also have informed me of a similar circumstance. In the month of May, 1850, an observant fisherman told me that he had noticed a cetaceous animal, the fin of which rose above the surface to the height of not less than 7 feet, and of the form I have described; and although accustomed to a fisherman's life for more than forty years, he had never seen the like before. Another of our fishermen saw one of these whales in the month of April, while engaged in the drift-fishery for mackerel: his attention was directed to the height of its fin, which remained above the surface for a quarter of an hour, as the body continued its progress beneath. The accuracy of these remarks, made by intelligent but unscientific fishermen, is authenticated by a communication made by the late Mr. William Thompson to the Annals, &c., of Natural History, vol. xviii., where it is illustrated by a characteristic sketch. Capt. Walker, who was Mr. Thompson's authority, reports that he saw several of these whales, which came close to his boat: two of them appeared, as comparing them with his boat, to be about 25 feet long; and they were so near, as to cause him to be afraid that they would overturn his boat: this was off Wexford. The back fin appeared to be from 10 to 12 feet high, and there was a round, white spot on the back. They went on steadily in the water, without rolling over, a circumstance which implies some difference of structure from that of the whales with which we are best acquainted; and it is remarkable that this habit should have attracted the attention of myself, and also of the only fishermen who, as far as my knowledge extends, have particularly noticed these animals.

Sir Robert Sibbald quotes the 'Polyhistor' (of Solinus) as saying that whales were so common in Britain, that the inhabitants employed the teeth to ornament the handles of their swords, the substance being polished like ivory. This could only apply to the teeth of the family now under consideration; of which also, according to Belon, or of whales in general, the bones were commonly employed as pales for their gardens. It is probable, however, that this excellent observer committed the error of confounding a special instance with a general practice; for we can scarcely believe that whales were more abundant in the reign of Queen Elizabeth than in that of Victoria.

(Family Delphinidæ.)

Genus Hyperoodon.

Bottlehead.—*H. Butzkopf*, Bell's Brit. Quad. p. 492. *H. rostratum*, Gray's Catalogue Brit. Mus. p. 64; Thompson, Ann. & Mag. Nat. Hist. for 1838, p. 221.

In the year 1821, a specimen, which appears to have been of this species, was washed on shore at Looe, in a putrid state, with much of the tail and the dorsal fin gone. It measured 18 feet in length: the pectorals not large; the under jaw slender in front, at which part were two blunt teeth, in size and form resembling the eggs of the common Bantam fowl. It is said that, at least sometimes, these teeth are imbedded in the gums.

Genus Delphinus.

1. *Delphinus.*

Dolphin.—*D. Delphis*, Linn., Fleming's Brit. An. p. 35; Jenyns' Manual, p. 40; Bell's Brit. Quad. p. 463; Gray's Catalogue of Brit. Mus. p. 120.

This very prettily marked species is the Dolphin of ancient Roman and Greek writers, who tell surprising stories of its affection for the human race, none of which, however, have been verified in later ages. They come to our coasts in considerable numbers, more especially when pilchards and mackerel abound; and not unfrequently they are taken in the drift-nets, in the meshes of which they become entangled by their teeth. In the month of September 1845, so many as eight or ten in a day were brought on shore in Mount's Bay, for many days in succession.

Bottle-nosed Dolphin.—*D. Tursio*, Bell's Brit. Quad. p. 469; Gray's Catalogue of Brit. Mus. p. 109.

It seems probable that the figure in Borlase's 'Natural History of Cornwall,' which he calls a porpoise, compared with his first figure, of the true Dolphin, belongs to this species. That it is furnished with a snout, is a proof that it is not the common porpoise or sniffer, and the inferior dimensions of that part are sufficient to show its distinction from the true Dolphin. This species is not so beautifully marked with lines as the last-named; the snout is much shorter; the upper jaw not so long as the lower; the dorsal fin smaller, and more posterior, as I noticed also in a specimen inspected at Plymouth. The eye also appears smaller, and placed more directly over the angle of the mouth; the teeth small, conical, and twenty-three on each side. It is not known in what respect its habits differ from those of the more common Dolphin.

Double-finned Dolphin.—*D. Mongitori*, Rafinesque?

We are informed, in M. F. Cuvier's 'Hist. des Cetacées,' that the French naturalists, MM. Quoy and Gaimard, when in the South Sea, had an opportunity of observing in the water a kind of Dolphin which they perceived to be furnished with two fins on the back, one of which was so far backward as to be not far from the tail, and the other close to the head—if, indeed, it was not on the very forehead itself; for the creature was not caught, and the observers were unable to discern with certainty the head itself. Several examples of this remarkable species were seen at a short distance from the ship; but these naturalists remained at last uncertain whether they should regard the anterior protuberance as a fin or a horn; although we may judge that their final opinion inclined to the latter supposition, from the fact of their assigning to it the name of the "Rhinoceros Dolphin." We can scarcely suppose that this remarkable species, seen in the South Pacific Ocean, can be the same with that which was noticed in the Mediterranean by M. Rafinesque, and which also was furnished with two fins on the back; but, unfortunately, in the last-named instance also, no specimen was caught; and we can only judge it to be the same with an example lately seen under favourable circumstances on our own coast, by the closeness of the described likeness, and the known disposition to wander, which all the cetacean animals possess.

In the month of April of the present year (1857), a close and accurate observer of nature, in company with some friends, had an opportunity of observing a company of dolphins at play, at a very short distance from him, with the water so clear, that the projecting snout was easily seen, and all actions closely traced. Being elevated on a rock above them, an individual was made out, which without difficulty was distinguished from the others by the remarkable character of having two dorsal fins. It was the belief of the observers that there was a pair of these two-finned Dolphins in the herd; but one of them was especially the object of their attention: the snout of the Dolphin distinctly visible; length of the body from 6 to 8 feet; the shape more slender than in the common Dolphins, of which about a dozen were in the company; the colour much as in the ordinary species; and as it repeatedly came to the surface, it was noticed that the first dorsal fin was at about the middle of the length, and the other 2 feet nearer the tail. Its motions were like those of the other Cetaceans that were then amusing themselves at their leisure near the rocks in Lantivet Bay, but they appeared a little more active. There is no reason to suppose that this species has ever been taken; but, should it fall into the hands of a fisherman, it is important to science that it should be examined by some competent naturalist, as there can be no doubt it will show some other peculiarities besides that of having two dorsal fins.

2. *Phocæna.*

Pilot or Leading Whale.—*Delphinus Deductor,* Scoresby. *D.*

melas, Fleming, Brit. An. p. 24. *Phocæna melas*, Bell's Brit. Quad. p. 483; Gray's Catalogue of Brit. Mus. p. 87.

The figure given by Mr. Bell, copied originally, as I think, from Scoresby, is altogether unnatural; for it is only by great violence that the tail could be thrown into the posture there represented. In the specimens I have closely examined, the teeth in the upper jaw were loosely, yet securely, attached by a tendinous or cartilaginous substance, and not inserted into sockets, although the animals were of full growth, and with the appearance of age. They seem to be common on our coasts; since I have known the capture of three specimens, two of which ran themselves on shore. In one instance sixty, and in another seventy gallons of oil were obtained. In one of them there were remains of Hakes in the stomach.

From two of these specimens I had an opportunity of taking a figure at leisure; and at that time the following notes were made, in reference to Mr. Bell's figure:—"It is far too slender—not enough compressed posteriorly, nor sufficiently ridged above and below at that part: the tail not characteristic; the forehead not sufficiently prominent and rounded; the teeth too numerous and prominent, and in the under jaw too projecting. I find eleven in the under jaw, on each side, well worn down, with a separation of teeth at the symphysis." The men report that when one of these specimens was taken, it made a great bellowing; and that some species of whales are able to utter loud sounds, the following instance, among others reported to me, will render highly probable:—A fisherman was not far from land, early in the morning, in the month of June, and a herd of porpoises, probably dolphins, were at their gambols near him, when there rose up, close to his boat, an individual of another sort,—as he judged, about 20 feet long, and much blacker than a porpoise (in this respect, as in some others, answering to the Leading Whale), and it uttered a loud note, which he compared to the sound of the horn then usually employed by the postman, and which, for three times, as the animal rose to the surface, was repeated, with a continuance of half a minute at a time. At the hearing of this sound, the porpoises or dolphins hastened towards it, and followed its progress to the westward for a long distance. M. F. Cuvier says that this species blows or spouts water from its breathing-hole in the same manner as the *Physeters*.

GRAMPUS.—*Delphinus Orca*, Fleming's Brit. An. p. 34. *Ph. Orca*, Bell's Brit. Quad. p. 477. *D. gladiator*, Gray's Catalogue of Brit. Mus. p. 92.

This species is either rare, or rarely taken. One was found dead on the shore near the Lizard, in October 1846, a female, containing a fœtus. Of another, the remains of which came on shore in Mount's Bay, I had an opportunity of examining the jaw-bone, which cannot be mistaken for that of any other of the British species. The decay had advanced so far, that the two sides had separated at the symphysis, and the teeth had dropped out. It was 17 inches long, with nine sockets for teeth, rather closely placed together, and occupying about one-third of the space of the jaw; and five openings for blood-vessels or nerves, at increasing distances from each other backward. The line of insertion of the teeth was singularly deflected.

Pliny the naturalist, B. 9. c. 6, gives a remarkable instance of the gladiatorial habits of this species, and something not much unlike it took place in the autumn and spring of 1855-56, as reported to me by several persons who were witnesses to it. The visits of this animal in Plymouth Sound were continued at intervals for the space of about six months; it was very active, and attracted much notice by the boldness, not to say fierceness of its conduct. It on one occasion laid hold of a boat's hawser with its mouth, and, as the rope happened to be unfastened, it carried it entirely away. It seized the blade of an oar a man was sculling with; went in among the boats and vessels in Plymouth Pool without fear, so that some of the men who had occasion to go on the water in small boats became afraid of it. It not unfrequently leaped out of the water, and on one occasion was seen to lay its head on a buoy in the harbour, and appeared to rub its face against it. To an observer it seemed to be about 12 feet long, very thick and solid in the body, with a blunt head; the dorsal fin not sufficiently high to be conspicuous; the colour dark. Attempts were made to shoot and catch it, but in vain.

Sniffer, or common Porpoise.—*D. Phocæna*, Linn., Fleming's Brit. An. p. 33. *Ph. communis*, Bell's Brit. Quad. p. 473; Gray's Catalogue of Brit. Mus. p. 81.

The most common, although perhaps not the most abundant of our cetaceous animals; usually keeping in pairs. The name of Sniffer is bestowed on it by fishermen, from the sound it utters as it rolls itself up to the surface, to expel its breath and take in a new supply of air. A description of the skeleton of this animal is contained in the Report of the Royal Cornwall Polytechnic Society for 1852.

White specimens of some one or other of the cetaceous animals are not uncommon, and mottled individuals are still more frequently seen. Fishermen frequently report them to me; and on one occasion three individuals, which were supposed to be more than 16 feet in length, were observed to keep themselves separate from other species, while they remained about the same place for a few weeks. In August 1853, I noticed a herd of Cetaceans, eight or ten in number, all of which were cream-coloured; and on another occasion I traced the actions of a herd, as well when under water as above, and saw among them a single white one, which accompanied them in all their movements. But as thus it appears highly probable that some tribes of these animals are much disposed to assume a white appearance, and perhaps by keeping constantly in one herd preserve this distinction in the race for several generations, on the other hand there is reason for believing that we are sometimes visited by the *Beluga*, which is pre-eminently called the White Whale; and that there is also a species of which white or a light grey is the prevailing colour, but which has not yet been scientifically recognized.

White Whale.—*Delphinus albicans*, Jenyns' Manual, p. 43. *Delphinaptera albicans*, Fleming's Brit. An. p. 36. *Beluga leucas*, Bell's Brit. An. p. 488.

The following description of a species of Whale that was seen in Mount's Bay in 1854, communicated by a friend, can only apply to the well-known *Beluga*, an inhabitant of the Northern Seas. It was judged to be about 10 feet in length: the head blunt, of a conoidal form: the body spindle-shaped, or tapering much towards the tail: no dorsal fin; and as on one occasion it rose above the surface, the pectoral fins were seen to be very small: the mouth small: the body a reddish-cream colour. It remained in the bay for several weeks, and appeared to be feeding on pilchards.

The only reason for doubting whether the following account refers to the same species, arises from the mention of a dorsal fin; but as this was assigned to a situation on the body where it is unusual, if not unknown, in any known whale, it is more probably a mistake of the observer. It was about mid-channel that the fisherman found himself surrounded by a multitude of whales, the numbers of which he estimated by hundreds, scattered as they were over a wide space, where they were feeding on herrings. He saw them for several days in succession; and they were so little afraid, that they came very near his boat, and even went under it at no great depth in the water. They were all white, or a pale grey, about 18 feet long, and remarkably slender, the proportions being much like those of the blue shark. He supposed he could perceive a low fin on the back, about 4 feet from the head. In some instances, about half the body was raised out of the water; but he never saw any one that leaped entirely out of it.

We have already referred to a supposed prerogative of the crown, by which whales and porpoises are claimed as belonging exclusively to the king; and this very remarkable right, however it arose, is recognized in an act of parliament passed in the year 1324—the 17th of Edward the Second, Stat. i. c. 2—where "Ballenas et Sturgiones captos in mari vel alibi intra regnum, exceptis quibusdam locis privilegiatis per Reges" are particularly specified, but without, in this instance at least, any mention of the grampus or porpoise—the latter so highly esteemed as a royal dish at table, on which it was accustomed to appear, even so late as the reign of Charles the First. Whales, porpoises, and thulapolls formed part of a feast made by Bishop Cosin in that reign. I suppose the last-named to be grampuses, and I believe they have also been called whirlpols; the latter a corruption of the former, which signifies what they have also been called, northcapers, from their residence near Ultima Thule, whence the Bishop of Durham might obtain them. If strictly interpreted, this act of parliament would authorize a royal claim to any whalebone whale—*ballena* and *sturgiones,* for *balæna* and *sturio* —even when taken in a regular fishery within the jurisdiction of the British Admiralty; and that it was not suffered to lie a dead letter under the Norman sovereigns, appears from a grant made by King John to some merchants of Bayonne, who rented the monopoly of this fishery, through the British Channel, from St. Michael's Mount to Dartmouth, for which they paid him £10 yearly—a large sum at the time, when a quarter of wheat was sold for 12*s*. The same claim also appears from the grant, already quoted, of the Droits of Admiralty to Sir John Trelawny, in the reign of the second Charles. It was in acknowledgment of the same prerogative that, on the authority of Tonkin, as quoted by Lysons in the early part of the last (18th) century, Mr. Corker of Falmouth, Mr. Kemp of Rosteage, and some other gentlemen, *procured a patent* for a whale-fishery, and were at some expense in providing expert harpooners; but it did not answer—not, however, for want of fish, if they could have taken them. They disposed of their patent among the bubbles of 1720, and "saved themselves harmless."

Tonkin mentions the existence of two fisheries for cetaceous fishes, that of the Porpoise and the Whale, the former of which, he says, would have been of great value, if they had understood how to extract the oil and make the most of it. He once saw, in 1720, between eight and nine score of porpoises (but which, from their number, may have been the Leading Whale), taken in a creek under St. Mawes. The second fishery he mentions took its rise from the quantity of what he calls grampuses and blowers that frequented the coast in the pilchard season; but, owing to mismanagement or some other cause, the concern did not prosper. These grampuses would not have been recognized by naturalists as the species now known by that name, for they seem always to have been rare, and usually solitary in their habits; but they were probably the more common Dolphin. The numbers taken at times at a remote date would seem to show that the ecclesiastical right of the Bishop of Exeter, as mentioned by Anstis, was not unworthy of attention; but it is to be presumed that the merchants of Bayonne were too much alive to their own interests to bring the produce of their fishery within the reach of the bishop's officers, or that of the clerical incumbent of the parish, who made claim to tithe from fish thus caught. Buchanan says, as quoted by Sibbald, that on one occasion—of course, in Scotland—twenty-seven whales were taken as tithes from the number that were caught.

XLIV.—*The Process of Fecundation in the Vegetable Kingdom, and its relation to that in the Animal Kingdom.* By Dr. L. Radlkofer.

[Concluded from p. 365.]

Sect. II. *The Process of Fecundation.*

Our insight into the events occurring in fecundation, into the *essential nature of the process of fecundation,* has been importantly advanced of late, in the *department of zoology* in particular, by direct observation of the behaviour of the spermatozoids in regard to the ovum. Although Keber's* account of the penetration of the spermatozoids into the micropyle of the ovum of the Naiadæ has been shown by Von Hessling's† researches to be fallacious, yet the fact, *that the spermatozoids reach not merely the outer surface of the membrane of the ovum, but, penetrating this, come into direct contact with the vitellus itself,* has been completely demonstrated by the observations of other inquirers.

This was the case first with Barry in the ovum of the Rabbit‡.

* F. Keber, Ueber den Eintritt der Samenzellen in das Ei. Insterburg, 1853.

Ibid. Mikrosk. Unters. üb. Porosität der Körper, nebst ein Abhandl. üb. d. Eintritt der Samenzellen in das Ei. Königsberg, 1854.

† Zeitschr. für wiss. Zoologie, Von Siebold und Kölliker, Bd. v. Heft iv. p. 392 *et seq.*

‡ Martin Barry, Spermatozoa within the Mammif. Ovum. Phil. Trans. London, vol. 133. p. 33, 1843.

His observations were confirmed by Meissner*, and then by Bischoff†, previously Barry's opponent. Beyond this, by Nelson‡ (and Meissner, *loc. cit.*) in *Ascaris mystax*; by Newport§ in the ovum of the Frogs; by Leuckart‖ and Meissner (*l. c.*) in the Insecta; by the latter, also, in *Lumbricus* (*l. c.*); and by Lacaze-Duthiers¶ in *Dentalium*.

The modes in which the penetration of the spermatozoids is rendered possible, are diversified. Either the coat of the ovum (chorion) or vitelline membrane, or both, presents ready-made holes—*micropyles*—at determinate points, especially in those cases where the whole coat is of tough texture (as in the Insecta, in *Gammarus*, in the Holothuriadæ, certain Star-fishes, Worms, bivalve Mollusks; probably also in the Frogs, bony Fishes, &c.); or the coat is of such consistence that the spermatozoids can penetrate at any point whatever, without the pre-existence of orifices, as in the Mammalia**; in a third case, finally, the coat is entirely wanting at the time of fecundation, the ovum consisting then solely of a compact mass of yelk, into which directly penetrate all or part of the spermatozoids, as in the Earth-worm††. We perceive at once, from the last circumstance, that the membrane of the ovum cannot constitute any essential part of the ovum.

Of the subsequent fate of the spermatozoids which penetrate the ovum, of the share which they take in the immediately succeeding changes in the ovum, we must own ourselves, in point of fact, ignorant.

Let us hear Leuckart on this point‡‡: "The only thing that we know definitely is this: that the spermatozoids, which partly penetrate into the vitellus, partly remain in the immediate vicinity of the vitellus, between this and the vitelline membrane, are gradually dissolved (according to my observations on *Melophagus* and *Ephemera*) far more rapidly than spermatozoids which remain outside.......What, however, becomes of the remains of these fecundating elements, is at present unknown to us. ......

* G. Meissner, Beobacht. üb. das Eindring. der Samenelemente in den Dotter. Siebold u. Kölliker's Zeitschr. für wiss. Zoologie, Bd. vi. Heft ii. (1854).

† Bestätigung der von Dr. Newport bei den Batrachien u. Dr. Barry bei den Kaninchen behaupt. Eindring. &c. 1854.

‡ H. Nelson, Reproduction of *Ascaris mystax*. Phil. Trans. London, vol. 142. p. 563, 1852.

§ G. Newport, On the Impregnation of the Ovum in the Amphibia. Phil. Trans. London, vol. 143. p. 233, 1853.

‖ Müller's Archiv, 1855, p. 90 *et seq.*

¶ *Vide* Leuckart, *op. cit.* p. 249.

** Leuckart, *l. c.*

†† Meissner, *l. c.*

‡‡ *Op. cit.* p. 252.

It is extremely probable that the mass of the corpuscles becomes, after solution, mixed with the vitellus, but whether as fluid, or in the form of molecules, we know not; we do not even know whether this mixture takes place only after the completion of the fecundation, or whether it constitutes some essential element of the processes of fecundation and development. Still less, of course, can we judge whether, in the last case, any remnants of the spermatozoids take a direct part in any way in the formation of the embryonal cells, or in the evolution of the embryo."

The former of the two cases here referred to is in favour of the hitherto current theory as to the essential nature of the fecundating process, in accordance with which the spermatozoids perform merely the part of a ferment. Meissner* declares decidedly for the latter. He thinks we may imagine that the changing spermatic elements, like fermenting bodies, may excite in the vitellus, with which, as we now know, they come into direct contact, movements—the immediately commencing phænomena of development—and that at the same time their component parts, which remain in the ovum, do not undergo changes independently of the vitellus, but become at last blended with the parts of this (into an embryonal yelk, as Nelson called it), and constitute a material portion of that which becomes developed into the embryo; he regards the process of fecundation neither as a simple chemical process, nor as a simple contact-action, but as a process *sui generis,* which exhibits traces of the presence of both, but yet is itself neither one nor the other.

Obscure as are at present our conceptions therefore as to the essential nature of the process of fecundation, yet the existing observations appear to me to give satisfactory evidence of two things: first, of the error of Burmeister†, when he regarded "the *male molecular element* (spermatozoid) no longer as merely constituting the vivifying agent in fecundation, but even as the actual *primitive germ,* the primary rudiment of the new organism," and considered "the female individual really as the *alma mater,* which rears, nourishes, and developes the germ delivered to her as a formally and materially determinate rudiment,"—an error which Schacht‡ has also adopted, on which account alone I of course come to speak of it here. From other quarters, besides those above cited, facts come to oppose this hypothesis: the independent, if not ordinarily very far-extended expression of the developmental force which has its seat in the ovum, the segmentation and formal development of embryos in unfecun-

* Siebold u. Kölliker's Zeitschr. f. wiss. Zoologie, Bd. vi. Heft ii. p. 259 *et seq.,* 1854.

† Abhandl. Nat. Ges. zu Halle. 2 Bd. 3 Quartal. pp. 189, 190.

‡ Ueb. Befrucht. der *Pedicularis sylvat.* Flora, 1855, p. 471.

dated ova*. In the second place, it seems to me a settled fact, that the part played by the spermatozoid after penetration into the ovum in fecundation, whether it be a ferment or anything else, is not connected with its *shape*, but purely with the *substance* of which it is composed, and consequently that we need not particularly wonder, if we should meet anywhere in nature with a fecundating substance—I might say spermatozoids —without definite, independent form.

From each vitellus is produced first of all an *individual being* (the embryonal vitellus itself appears to a certain extent as such†). It either remains as such until at the highest stage of its development it has acquired the power of sexual reproduction, or it *becomes multiplied before that epoch by asexual propagation* (by formation of gonidia and buds, division). *A special form of this asexual propagation*, in which the progeny, either of the first or of a subsequent generation, appear *from their origin* onward‡ under a form unlike that of the asexual plant—as *nurses*—is known by the name of *alternation of generations*§. This is a

* Leuckart, Article 'Zeugung,' in Wagner's Handwörterbuch der Physiol. Bd. iv. p. 958 (1853). I shall not refer here to the observations of development of individuals from unfecundated ova of *Daphnia, Talæporia, Psyche*, &c., the explanation of which is perhaps still to be discovered. But, as will be seen clearly in the sequel, the clothing of the unfecundated spore of *Fucus* by a cellulose membrane, and the formation of tubular prolongations from these, is certainly connected with the above questions. (Thuret, Ann. des Sc. nat. 4 sér. ii. p. 204, 1854.)

† I consider myself quite justified in leaving unnoticed, as insufficiently established, the single case, as yet contradictory of the above, of the occurrence of several embryos in one ovum in *Planaria*. The accounts given by Van Beneden of a subdivision of originally simple ova of *Tubularia* and *Hydractinia* into several smaller ova, each of which produces an embryo, are, as Prof. Gegenbaur of Jena informs me, already refuted; and also those of Koren and Danielssen, forming a counterpart to the former, as to a supposed fusion of every 20–40 of the fecundated ova of the Gasteropodous genera *Buccinum* and *Purpura* into a common mass, which produced only one single embryo. [See on this point Ann. Nat. Hist. ser. 2. xix. pp. 336, 433, and xx. p. 6.—A. H.]

‡ Following Leuckart, we do not include in the conception of *alternation of generations* the case certainly not yet discovered in the Animal Kingdom, but conceivable, and actually occurring in the Vegetable Kingdom—in the propagation of Algæ by zoospores, which again multiply before their metamorphosis into the plant, unless we rather regard them as gonidia, and therefore as larvæ,—where an undeveloped animal (larva) should produce by asexual generation a multitude of individuals like itself, which, no matter whether in the first or a later generation, would become capable of going through the metamorphosis not completed by the latter, in which case, consequently, the metamorphosis would appear, not as associated with reproduction, but merely as a transformation of a being;—this we regard as an ordinary metamorphosis with multiple larva-generations.

§ See Leuckart, Siebold u. Kölliker's Zeitschr. Bd. iii. p. 170 (1851), and Article 'Zeugung,' *l. c. supra*.

result of a 'setting-back' (*zurück-greifen*) to a very early stage of development, of the asexual multiplication, which otherwise mostly occurs only just before puberty, and then with variability as to whether the puberty is subsequently attained or not,—or after that epoch*. These themselves are not repeated (at least not in the last generation), but others, *ab origine* different, are produced—the asexual multiplication appears *directly* combined with metamorphosis. Such is the case in Animals.

In the Vegetable Kingdom, the observations of Pringsheim, Cohn, and Thuret on certain Algæ, which are reported with some confirmations in former pages (352–8), have *demonstrated a process of fecundation* exactly resembling that of animals, completed through immediate contact of spontaneously moving spermatic (fecundating) corpuscles with a naked mass of germinal substance† corresponding with the naked vitellus of the Worms. Without contact with the former, the latter remains undeveloped, or its development does not go on beyond the first step (commencement of germination of the spore of *Fucus*‡); the contact, on the contrary, is followed by development, and either proceeds without interruption, or, after definite periods of rest, with or without intermediate forms (intermediate generations), onward to the repetition of the sexual mother-plant.

In the Mosses and Ferns (in the extended sense) we are acquainted, in the spermatic filaments, with structures corresponding exactly to the fecundating corpuscles of the Algæ; here also the germinal vesicle (the daughter-cell of the central cell of the archegonium) is completely analogous to the germinal substance of the above: it requires for its further development the influence of the spermatozoids, whose approximation to it has been observed by Suminski, Mercklin, and Hofmeister (see pp. 348, 352). It may for the present remain as undecided here, whether the germinal vesicle about to be fecundated is, as Pringsheim conjectures, a naked primordial cell, or, as Hofmeister states, already possesses a cellulose membrane. The latter condition, which would correspond to an ovum possessing a vitelline membrane at the epoch of fecundation, would merely require that the spermatozoids, to come into direct contact with the proper vitelline (germinal substance) mass, should penetrate the enve-

* In the case of *Alcyonella*, to be mentioned presently, we see it set back to the rudimentary embryo.

† Cell-contents without coating membrane; "the contents enclosed by this envelope (cellulose membrane) are the essential and original part of the cell, indeed must be considered as the cell even before the enveloping membrane is formed," says Alex. Braun ('Verjüngung,' p. 166); and in this sense I use, in the sequel, the expression 'primordial cell,' without at all including in the conception the presence of a primordial utricle.

‡ Ann. des Sc. nat. 4 sér. ii. p. 204 (1854).

loping membrane. That we are still in some uncertainty on this point, appears scarcely more than a gap in our knowledge; the recognition of the phænomena known to us as a *process of fecundation perfectly corresponding to that of animals,* can no longer be delayed by this.

The fecundating corpuscles of the plants as yet referred to, possess a peculiar, as we usually say, independent motion, like the spermatozoa of most animals. Of most? Even in animals this is not a universal property of the fecundating corpuscles. It is absent in the Isopoda and Amphipoda. Its absence will not therefore deter us, in plants, from acknowledging as fecundating corpuscles, things, which on other important grounds we are obliged to accept as such. We find ourselves in this position in reference to the corpuscles contained in the antheridial cells of the Florideæ. Yet at present we can scarcely venture more than conjectures as to the fecundating process of these plants; we are still in uncertainty which of the parts capable of being regarded as ova, really have that import.

In the Charæ, also, in which we are acquainted with motile spermatozoids, it remains for future researches to furnish evidence of the conjecture ventured on in an earlier page, that the young (primordial?) spore-cell has the import of an ovum.

Neither the independent movement, therefore, of the spermatozoids, nor, as we have already noticed above, their independent form, appear to be essential properties in reference to their final destination—the fecundation of the ovum. They appear only essential to this in ensuring that the fecundating substance, the substance of which the spermatozoids is composed, *arrives at the place of its destination**. Consequently we have no need to be surprised if Nature, where (to speak anthropomorphically) she can accomplish this object in a different way, does not in the first instance organize the fecundating substance into the form of spermatozoids. We meet with this case in the Phanerogamia.

By my researches I have established with scientific *certainty,* that the embryo of the Phanerogamia is produced, not from the end of the pollen-tube, but from a cell—the germinal vesicle—existing in the embryo-sac before the pollen-tube arrives at the latter. Further, it is the general rule, that this remains undeveloped when it does not receive the influence of the pollen-tube†. The fact that no one has happened to think that the

* We are at present ignorant of the arrangement by which this is effected in the animals with motionless spermatozoa.

† In recent years little faith was any longer placed (Mohl, 'Vegetable Cell,' 1851) in the assertions frequently made by the older authors, of exceptions to this rule, in *Cannabis sativa, Spinacia,* and *Mercurialis* (*vide* Bernhardi, Sur la Formation des Graines sans l'aide de Fécondation. Ann.

influence of the pollen-tube resides in its *membrane,* is no proof that such is not the case; but it is a sufficient reason for our not introducing such a speculation here. We have not only a right to assume the *transfer of its contents into the germinal vesicle* in those cases where a direct contact of the pollen-tube with the latter takes place, or only the membrane of the embryo-sac intervenes, but we are compelled to assume it in the case where, as the optical conditions alone suffice to show, the contents on the two sides are different.

des Sc. nat. 2 sér. xii. p. 362 (1839), translated from Allgemeine Gartenzeitung, 1839, nos. 41 & 42; also Meyen's Report on an Observation by Ramisch in Wiegmann's Archiv, 5 Jahr. B. ii. p. 42. Berlin, 1839). The more enigmatical therefore appeared the uncontested fact of the formation of seeds and embryos in the introduced female specimen of *Cœlebogyne ilicifolia* (Euphorbiaceæ) without the presence of anthers. (Smith, Linn. Trans. xviii. p. 509. London, 1841.)

To the kindness of Sir William and of Dr. J. D. Hooker I am indebted for materials for the investigation of this phænomenon. *Cœlebogyne,* the male spiked blossom of which is known in Europe only in the Hookerian Herbarium, is cultivated at Kew in company with a great number of other Euphorbiaceæ. The possibility of hybridation was therefore considerable. But this conjecture was necessarily greatly weakened by the observation, that plants of the third and fourth generations still exactly resembled the mother-plant. The circumstance that I detected a dry pollen-grain upon the stigma of one of the fertile germina which I examined, cannot, from its isolated occurrence, counterbalance the evidence against hybridation arising from the permanence of character. I could not discover a pollen-tube in any part of an ovary or ovule of *Cœlebogyne*; in other Euphorbiaceæ selected for comparative examination, there was no difficulty in demonstrating a fragment of a pollen-tube protruding from the mamilla nuclei. The young ovule of *Cœlebogyne* exhibited three germinal vesicles adherent to the internal surface of its upper end; in older ovaries, sometimes one, sometimes two, sometimes even all three, had been converted into embryos. The various conditions of development of the germinal vesicle into the embryo exactly resembled those in all other Euphorbiaceæ.

Naudin has published an account of repeated and fully established observations on the related cases in *Mercurialis annua, Bryonia dioica, Cannabis sativa,* &c. (Bulletin de la Société Botanique de France, xii. p. 754 (no. 11, 1855), and more at length in the Comptes Rendus of the present year). Liebmann also (Ann. Nat. Hist. 2 ser. vi. p. 395, 1850) reports the formation of an embryo in a Cycad without the influence of pollen. We may mention, finally, Gasparini's account (Note sur l'Origine de l'Embryon. Ann. des Sc. nat. 3 sér. v. 1846, p. 306) of the formation of embryos in Figs developed in summer, which are said never to contain male flowers—although, from the actual words of this writer in a later publication (Nouv. Recherch. sur l'Anat. et la Physiol. du Figuier. Ann. des Sc. nat. 3 sér. xi. pp. 369, 371, 1849), it appears to follow that he detected a pollen-tube in the micropyle-canal of the ovule of the Fig, but mistook its nature.

The cases in the Animal Kingdom comparable with these (*Daphnia,* &c.) have already been mentioned, and we may direct attention on this head to Siebold's recent essay on 'Parthenogenesis.'—Author's Note, Oct. 1856. [See 'Annals,' the present volume, p. 204.—A. H.]

In the case where the point of attachment of the end of the pollen-tube on the outside of the embryo-sac corresponds, not to the point of attachment on the inside of the wall of a germinal vesicle developed into a suspensor, but to the point of attachment of a destroyed germinal vesicle—it can scarcely be decided whether the transit of the contents of the pollen-tube into the former is effected through the intermediation of the latter, or through an exudation of the contents of the pollen-tube over the embryo-sac, which can be shown to occur to a certain extent.

When one sees how the germinal vesicle lying immediately opposite the end of the pollen-tube, the contents of which assume exactly the optical character of the contents of the pollen-tube, is aborted in certain plants with apparently unexceptional regularity, while the other, seemingly less favourably situated, is developed, the idea is not far-fetched, that the further development of the former is arrested actually by the transfer to it of too large a quantity of the dense fluid contents of the pollen-tube. At present we are, indeed, ignorant of the more intimate relations in which the growth or re-formation of a cell-membrane stands to the character of the cell-contents; yet we may assume that both (putting all else out of the question) may be rendered impossible by too slight or by too great a concentration of the formative fluid. It might even be supposed that the contents of the pollen-tube must here first undergo dilution in the one germinal vesicle, to enable it to fertilize the other! Strange as this arrangement may appear to our existing notions, yet, even if a perfect analogy ought scarcely to be sought beyond the limits of the vegetable kingdom, a phænomenon may be referred to which admits of the supposition, that in the fecundation of the animal ovum, also, it may be by no means left to accident how much of the fecundating substance mingles with the vitellus. When we observe, namely, in the ova of the frog, which come in contact on all sides with a great quantity of spermatozoids, that the vitelline membrane is only penetrable by them at a definite and limited spot, while no great resisting power can be attributed to this on physical grounds, it may be admissible to allow the above idea a place in the discussion of this question.

Lastly, by what means the mixture of the *fecundating substance* with that *to be fecundated* takes place in the case where the end of the pollen-tube touches the embryo sac at a distance from the points of attachment of the germinal vesicles, and therefore does not come in contact with any of them, as strangely happens in various plants, according to Hofmeister's recent investigations, which I believe are not yet published*,—by what

[* Hofmeister, Embryo-bildung der Phanerogamen. Jahrb. für wiss. Botanik, i. p. 180. Berlin, 1857.—A. H.]

means this takes place, cannot be quite perceived, unless we assume that such a dilution of the contents of the pollen-tube as must occur here before it can reach a germinal vesicle, does not remove its fecundating properties, or is perhaps even actually necessary for their operation. Such cases alone may yet leave some hope for those who, *in contradiction to the negative results of all existing observations,* still expect, from analogical reasoning alone, *to find morphological fecundating elements—spermatozoids*—in the Phanerogamia.

In the foregoing we have discussed only an endosmotic transit of the contents of the pollen-tube into the embryo-sac and germinal vesicles. Earlier observers, as Meyen * and Cobbold †, and also, quite recently, Henfrey ‡, have been inclined to assume that a *copulation* or *conjugation,* analogous to that of the Confervæ, takes place between the end of the pollen-tube and the embryo-sac, thus furnishing a *direct passage for the transit* of the contents of the pollen-tube. We are certainly not of opinion that such a condition is impossible, but must at the same time own that we have never yet been able actually to observe anything of the kind. If such negative observations have but a very inferior value, yet on the other side there exist no positive proofs; and, in addition to this, the circumstance, that in the ordinarily occurring condition of the germinal vesicle to be fecundated, standing at a distance from the end of the pollen-tube, such an arrangement *would not cause a direct passage of the fecundating substance to the mass of germinal substance*—is by no means calculated to render us more inclined to adopt the hypothesis in question.

However this may be, so much is ascertained,—that the contents of the pollen-tube form the analogue of the spermatozoids, the germinal vesicle that of the ovum; *that the fecundating process of the Phanerogamia corresponds completely to that of the Cryptogamia, and to that of Animals.*

Are we justified in distinguishing in the germinal vesicle of the Phanerogamia contents and membrane, like the vitellus and its membrane? It might almost appear so, since we see that in no case does the original membrane of the germinal vesicle take part in the *structure of the embryo itself.* Yet, since the mode of formation of the latter is so different from that of the animal embryo, it may be going too far to try to find analogies here.

It remains only for us to estimate the import of the *conjugation of the Algæ.* Areschoug's observations have removed every difficulty that might have prevented us from regarding it as *a true process of fecundation.* If some room still remain for doubt

* Pflanzenphysiologie, iii. p. 314. † *L. c. supra.*
‡ *L. c. supra.*

whether the contents of each of the conjugating cells are converted into separate cells before copulation, by the formation of an investing membrane, and whether this opinion may not have originated perhaps merely from cases of monstrous spore-formation, similar to those represented by Cohn, fig. 10. pl. 17, in the 'Nova Acta Acad. C. L. C.' vol. xxiv.,—the observations of Areschoug have assured us that the resting-spore originates *only* by the *union* of two masses of plasma developed and nourished in separate organs. We can no longer hesitate to consider one of them as the analogue of the male semen, the other as the analogue of the ovum*. We meet here with a second example of *fecundation without definitely formed spermatic elements.* At the same time we see here unequivocally, the fecundating substance take a direct share in the constitution of the germ (the resting-spore). This simplest case of the fecundating process is that in which its essential nature is most clearly announced.

We also obtain here some important indications as to the proper *signification* of the process of fecundation. For when we behold in the Desmidiaceæ that from the conjugation of two individuals, which are only capable of this act *once,* in each instance only *one* spore is produced, and therefore find the process of fecundation here a *process of reduction* instead of a process of multiplication, we are necessarily led to the conclusion that we must not conceive fecundation to be essentially a means for the multiplication of individuals, *that is, for the maintenance of the existence of the species,* even in those cases where nature has assigned this part to it on account of the complicated organization of a being having rendered impossible a multiplication through direct individualization of one of its parts—that is, through asexual propagation. When we see, on the other hand, how, in asexual propagation, the progeny depart more and more from the type of the first, sexual stock (the ancestors), while this type is restored by sexual reproduction, we can hardly be in error if we regard the fecundating process as essentially the means which nature employs *to maintain the species in its full integrity, corresponding to the original plan of structure.* This object (if, for convenience, we may be allowed so to express it) seems to be so important to it, that in certain cases an effort is made to attain it even at the cost of diminishing the number of individuals. Perhaps this condition is most strikingly exemplified in the behaviour of *Palmoglœa,* in which we see even two individuals, not merely their parts, become blended together, in

* We have already become acquainted with a spore-formation through conjugation in the Fungi also. Unless the position of the plant in question among the Fungi be doubtful, this would be the first case of a sexual reproduction in the class.

order to form the foundation of a series of individuals produced from the conjugated structure by asexual multiplication*. The Protozoa exhibit to us an exactly similar condition in the Animal Kingdom†.

Sect. III. *The different Phases of Development in the Vegetable Kingdom.*

Having recognized the act of fecundation as a universally equivalent formative process, in the majority of the divisions of the Vegetable Kingdom (excepting, namely, the Fungi and Lichens), and as corresponding to the act of fecundation in the Animal Kingdom, we may consider ourselves justified in inquiring how far the stages of development preceding and succeeding this act correspond in various places, and how far the organs most intimately concerned in it stand parallel to each other in physiological and, to some extent, in morphological respects. We do not, indeed, propose to give a detailed exposition of this plan, but must confine ourselves in general to giving merely indications, especially in those cases where the matter seems to declare itself immediately as a result of the facts given above, and entering upon minute discussion only in reference to the more important points. Where gaps occur in the text, the tabular surveys will conveniently complete it, and we therefore refer the reader to them (pp. 457, 458, 459).

In the Vegetable Kingdom, as in the Animal Kingdom, the fecundated germinal mass presents itself as the first rudiment of a new individual being‡. This either remains as such, and sooner or later acquires the capacity to act in the sexual generation of new plants, which course of development we must designate as the highest, in a physiological point of view, of which either plant or animal is capable,—or it *multiplies asexually* before it has attained this stage. *The same form of this asexual multi-*

* Alex. Braun, Verjüngung (Ray Translation, 1851, p. 135).

† Siebold, Zeitschr. f. wiss. Zoologie, iii. p. 62.

‡ I use the term 'individual' only in the ordinary sense, not desiring to enter upon an *exhaustive* definition of it here,—as a single being which presents itself as a living, independent, finite whole,—and this I do on physiological grounds. If, with Alex. Braun, from morphological considerations, we apply the term 'individual' to the shoot, calling, for instance, a tree a colony of polymorphous individuals, a vegetable stock (or phytidom), analogous to the polype-stock or polypidom,—which, however, in a physiological point of view can likewise only be placed beside the simple animal (see Leuckart, Wagner's Handwörterbuch d. Physiol., Article 'Zeugung,' B. iii. p. 975),—the results of the following reflections would be altered in the main only so far that we must assign to the alternation of generations a much more comprehensive field of operation in the Vegetable Kingdom than we are here inclined to do; at the same time we see that phænomenon assume far more complicated conditions. We shall return to this point.

plication which we have called *alternation of generations* in animals, must receive the same name here. The question, whether an alternation of generations, according to the definition which we have above given, is possible in the asexual multiplication *of plants which have attained the highest point of their development* (*puberty*)—a question which we first arrive at here, because no case of this kind is known in the Animal Kingdom—must be answered in the *affirmative.* But this is in such cases of course only possible when the asexually produced progeny, which ordinarily directly repeats the development of its mother, has undergone a retrogressive metamorphosis. We shall refer to this again.

The comparison of *Phanerogamous plants* with animals, as we have attempted it in Table I., scarcely requires discussion. The position of the developed animal as correspondent to the leafy (and rooted) axis, whether this be simple or branched, is a direct consequence of that conception of the individual which we have declared for above. The comparison of the anthers with the testis, of the ovule with the ovary, &c., bears reference of course to morphological conditions.

Very closely connected with the Phanerogamia as most strictly defined, are the *Gymnospermia* (Cycadeæ and Coniferæ), differing from the former only in the internal structure of their ovules, but through this very deviation forming the most direct and easy transition to the groups of *Selaginellæ* and *Rhizocarpeæ.* Hofmeister* has already shown most strikingly that the essential parts of the ovule of the Coniferæ, the secondary embryo-sacs (*corpuscula,* R. Br.), correspond in every respect with those of the archegonia, and, with their neighbouring structures—epithelial appendage, covering-cells,—frequently imitate even the form and structure of the archegonia. The only distinction which can be found between the female organs of reproduction, the essential parts of the female inflorescence of the two groups of plants, is that in the *Gymnospermia* they remain in connexion with the mother-plant until after fecundation is completed, while in the *Selaginellæ* and *Rhizocarpeæ* they separate from it in a very early stage of their development, as rudimentary flowers (megaspores).

If we wish to call to mind further analogies within the reproductive sphere of the two groups, we may mention the behaviour of the pollen-grains on the one hand, and of the antheridial grains (microspores) on the other, in both of which a long interval of time intervenes between the morphological completion and the accomplishment of their functional activity; also the occurrence of a *suspensor* in *Selaginella.*

* Vergleich. Untersuch. p. 140.

Whether or not the suspensor of the Coniferæ, which gives origin to a *number of embryos*, is to be regarded as a *nurse* (Amme), cannot be decided from the varying statements of authors, nor, indeed, until we obtain perfectly continuous series of observations on the stages of development of the Coniferæ. The phænomenon in question would in such case assume a great peculiarity, beyond its early occurrence, from the fact that, since only one of the numerous embryos actually becomes developed,—asexual *multiplication* of a sexually generated individual in truth never taking place,—it would represent little more than an attempt (*sit. ven. verb.*) at alternation of generations.

The antheridial granules of the Selaginellæ and Rhizocarpeæ constitute the most direct transition imaginable between the pollen-grains of the Phanerogamia and the antheridial cells (of an early rank—the mother-cells of the cells producing the spermatozoids) of the Equisetaceæ and the Ferns (in the restricted sense). While they correspond with the former completely in reference to their origin and formation, and even in the earlier features of their subsequent development—the emergence of the internal cell out of the cuticle in the form of a tube,—they agree with the latter in the ultimate formation of definitely shaped fecundating elements inside special vesicles. An immediate approximation to the last process is met with in the pollen-tubes of the Coniferæ, in the occurrence of a distinct cell-formation.

If, led by the unmistakeable analogies which the Coniferæ exhibit, on the one hand with the Phanerogamia, and on the other with the Lycopodiaceæ and Rhizocarpeæ, we have found the right path to the explanation of the import of the fecundating organs in the Ferns (in the wider sense), we shall hardly allow ourselves to be diverted from it again, although in the lower sections of this group, the *Equisetaceæ* and *Ferns proper*, we may find these organs no longer rigidly preserving their original resemblance. We find the germinal vesicle, central cell of the archegonium, and the archegonium itself, here still true to the former type. Only the organ bearing the latter, the female receptacle, the prothallium, undergoes striking metamorphoses. These relate above all to its size, shape, and its relation to the cell (spore) giving origin to it; more remotely they result from the necessities of an independent nutrition (formation of radical fibrils). In the male fecundating organs also we here find diversities connected both with their organization and their position. We have already referred to the former; in regard to the latter, we here no longer find the antheridia connected with the morphologically developed plant, but transplanted, either alone (unisexual flowers), or together with the archegonia (hermaphrodite flower) on to a prothallium. If we understand by the term *flower* the totality of the organs necessary for fecundation, or of these together with their immediate support and special envelope when this is present, we may apply the term to the prothallium bearing antheridia and archegonia, as was done by Suminski, the discoverer of the fecundating process of the Ferns; and it may be regarded only as an inessential peculiarity that here this does not attain its perfect development in connexion with the plant which produces it, but separates from the latter in its most rudimentary condition,—we may say, *as the first cell of the flower-bud.*

In the Mosses we find archegonia and antheridia both again developed and their functions completed in connexion with the plant morphologically perfect and arrived at puberty. But from the fertilized germinal vesicle is not produced, as in the Phanerogamia and Ferns (in the widest sense of both terms), an embryo, which—either as primary or secondary axis—grows up, after a period of rest in the former, and immediately in the Ferns, into a plant like the mother; it gives rise to a structure totally dissimilar from the mother-plant, remaining mechanically connected with this, finally, by the production of numerous gonidia (spores) in its interior, which do not give birth to a like progeny, displaying the character of a genuine *nurse* (*Amme*). Its progeny even (of the first generation) do not—in the Mosses, at least—regain the type of the sexual plant; they represent rather a *second generation of nurses—protonema,*—each of which produces a renewed asexual propagation by the formation of buds. It is the individuals originating in this way that assume the power of growing up into sexually-potent plants.

In here agreeing with Henfrey* in regarding the protonema (pro-embryo) of Mosses as a *nurse,* in opposition to Hofmeister's† opinion, I consider it less necessary to justify myself, since in so doing I remain true to the above-given well-established conception of the alternation of generations, than to endeavour to remove the obstacles for those who might find an objection in the difficulty which seems to be produced by the occurrence of a similarly formed pro-embryo in the asexual multiplication of *full-grown* Mosses, on their radical hairs, cells of the leaves, &c. We have discussed above the question whether an alternation of generations is possible in the asexual multiplication of perfectly developed organisms, *i. e.* whether with the asexual multiplication of such can be combined a metamorphosis terminating in the restoration of the mother-type. Such a combination involves, of course, a previous retrogression to a lower stage of development. This is given when the cell of the full-

* Report Brit. Association for 1851, p. 121, note.

† Flora, 1852, p. 6.

grown Moss-plant forms a new protonema-tissue (nurses) in place of immediately reproducing itself; with the asexual multiplication of this is combined the same ascending metamorphosis as before, the propagula of the protonema-threads re-assuming the form of the perfect plant.

The alternation of generations of the Mosses,—both on account of the occurrence of two diverse generations of nurses, and in reference to the production of these, the first time through gonidia*, the second time through buds,—bears a striking resemblance to the alternation of generations in the Trematoda: that the first nurse remains mechanically connected with the mother-plant, seems altogether an inessential condition, and has its counterpart in *Coryne,* in which the sexual animals remain in connexion with the nurse producing them, and almost appear to be the sexual organs (testes and ovaries) of the nurse-individual.

To the much-favoured notion which regards the prothallium of the Ferns as a distinct generation, standing parallel with the leafy Moss-plant (as a sexual generation), while the morphologically developed Fern-plant is placed beside the capsule (with the seta) of the Moss, as a nurse, no objection is to be made, provided the view is carried out logically, and, as is necessary, extended to the Phanerogamia. This carrying-out leads inevitably to a *more morphological conception of the idea of a "vegetable individual,"* in Al. Braun's sense†. We must then regard, not merely the leafy (simple!) Moss-plant bearing antheridia and archegonia, and the prothallium of the Ferns, as well as the prothallium enclosed in the megaspore of the Lycopodiaceæ and Rhizocarpeæ, together with the microspores,—as complete, sexually developed plants, but also the *flowers* of the Phanerogamia, now once and for all corresponding to the prothallium. But if we regard the flower—the floral shoot—as a perfect plant, as an individual, we must attribute the same value to the preceding shoots; we must regard the compound plant‡ as a colony of polymorphous

* These should perhaps be regarded merely as a peculiar form of buds. Montagne described, in a letter to Berkeley (Annals, xvi. p. 354), a monstrosity of *Eucamptodon perichætialis,* the perfectly ripe capsule of which contained buds instead of spores, analogous to the gemmule-cups of *Marchantia,* and Berkeley confirms the fact. In reference also to the import which we have above attributed to the spores of Ferns, Henfrey's remarks on this case appear very much to the point (Ann. Nat. Hist. ser. 2. ix. p. 453, note), when he says that it is a distinct evidence of the *bud-nature of the spores of the higher Cryptogamia.*

† Al. Braun, Das Individuum der Pflanze. Berlin, 1853. (Annals, ser. 2. xv.) See also former note, page 449.

‡ The simple plant, in Schleiden's sense, appears—if, in the present obscurity which prevails upon the laws of the ramification of roots, we may be permitted to regard only the ascending growth—as a colony of homo-

individuals, and the shoots which *necessarily* precede the flower in the series as so many generations of nurses. In like manner with the stems of the Lycopodiaceæ, Rhizocarpeæ, and Equisetaceæ. But then we must not compare the compound Moss-plant as a whole unconditionally with the prothallium (the floral shoot) of the Ferns, but only the floral shoot of the Moss-plant*.

The first two (Lycopodiaceæ and Rhizocarpeæ) would in this case correspond almost completely to the already-mentioned conditions of *Coryne,* since here the developed individuals, at least the males, appear as it were as merely organs appendicular to the nurses. The fact that the assumption of this point of view leads to the appearance sometimes of the nurse (Ferns) and sometimes of the sexual plant (simple Moss) as the *morphologically developed* member of the series,—could not give ground for any limitation of it, since the like occurs in the Animal Kingdom, which, moreover, affords us information that morphological and functional development do not keep side by side in all cases (retrogression of the parasitic Crustacea at the period of puberty).

I hope in this way to have successfully elucidated a contradiction which must have been repugnant to all primary impressions of the facts,—the contradiction which lay in making the prothallium of the Fern equivalent to the ramified Moss-plant, and the separation of the latter from the vegetative formations of all the higher groups of vegetables. Which of the two views I have here attempted to expound, deserves the preference, must be decided by every one for himself, according as he adopts a *physiological* or the pure *morphological* conception of the 'vegetable individual'—until science has decided the point. I confess freely that I have been guided merely by the simple verdict of natural impressions, in for the present inclining to the former.

Against one thing more I must declare, and that decidedly, namely, against the view which makes the Ferns fecundate in the *middle of their lives,* by this becoming capable of growing up to perfection,—according to which, the new individual cycle of development commences not with the *germinal vesicle,* but with the *spore* (in the Mosses as well as the Ferns) †. To show that the name *spore* is applied to *things of very diverse import,* is almost superfluous, after what we have said above ‡. The spores of the

morphous (sexual-) individuals, developed without antecedent nurse-formations.

* The merely trifling changes which would thus be required in columns 2nd to the 5th of our Table I. are included in Table II. All the other columns remain unaltered.

† V. Mohl, Vegetable Cell, p. 125. London, 1852.—Al. Braun, Verjüngung, &c. (Ray Translation, 1853, p. 307).

‡ Neither morphology nor the history of development give us invariably

Mosses are gonidia of a nurse; those of the *Ferns* and *Equiseta* correspond to the hermaphrodite or unisexual flower-buds of the Phanerogamia, or rather to the rudiment of these, their primary cell—separating from the mother-plant before their development into flowers; the *megaspores* of the *Lycopodiaceæ* and *Rhizocarpeæ* stand in the same relation to the female flowers of the Coniferæ; the *microspores,* lastly, to the pollen-grains of the Phanerogamia, to which latter may be applied the name 'spores' with the same right as to the previously enumerated structures, since the term can relate to nothing further than individualized cells of similar outward character and corresponding mode of formation, which play a part in the propagation of plants. And yet with so vague a definition we should already take away the name from the spores of the Algæ!

We have already given the reasons for our opinion of the import of the spore of *Chara.* From it, after *a long pause,* directly proceeds a sexually-potent thallus. In this respect it corresponds to the embryo of the Phanerogamia. Its envelope, the sporangium, as Schacht has already rightly observed*, corresponds to the archegonium of the higher Cryptogamia.

The value of the spores and spore-capsules of the *Florideæ* must be decided by future researches.

In the *Fucaceæ* (so far as is known at present) the segmental spore, as primordial cell, corresponds to the unfecundated germinal vesicle of the higher divisions of the Vegetable Kingdom. From it is directly produced the sexual plant.

Among the *Freshwater Algæ, Vaucheria* is most allied to the Fucaceæ. A cell preparing germinal substance opens at its apex, and from this moment its membrane becomes a sporangium, and its contents a primordial cell corresponding to a germinal vesicle. After fecundation it presents itself, enclosed by a special membrane, as a completed propagation-cell—embryonal cell, which, after a long rest, is developed directly into the perfect plant.

The fecundation of *Sphæroplea* (and *Achlya*) takes place in a similar manner. The only distinction here consists in the sporangium containing a number of primordial spore-cells, which, as in *Fucus,* are all fecundated!

In *Sphæroplea,* in *Bulbochæte* and *Coleochæte,* the perfect spore presents itself as a *nurse,* whose dissimilar progeny (zoospores) become perfect Algæ. We here meet with retrogression to an asexual multiplication at a very early epoch of life, and it might appear questionable whether we ought to consider the said process merely as such, or as a true *alternation of generations.*

the correct criterion for determining the value of a structure; we must regard the *function* as, above all, decisive on this point.

* Pflanzenzelle, p. 400.

However, the spore-cell, which enlarges and becomes tubular, still remaining simple, before propagation, cannot be considered equivalent to even a very young Alga-thread, and in so far, therefore, the germ-cells (zoospores) asexually produced from it certainly ascend to a higher stage of metamorphosis, since they do not become resting-spores again, but perfect Algæ.

That the form of the alternation of generations is here the same, or nearly the same, as in the asexual multiplication of the developed plant, is certainly a peculiar, yet in our eyes irrelevant condition. When Cohn* sees a resemblance, in the case above mentioned, to the origin of several embryos in the ova of *Planaria*, the well-founded doubt which may be entertained of the correctness of the observation of the latter point is sufficient to make me withhold my assent; besides that I can by no means compare the swarming-spores to an embryo. On the other hand, I believe I have better right to introduce here another case from the Animal Kingdom, as analogous to ours, in which likewise a very early asexual multiplication occurs combined with an immediately advancing metamorphosis,—the case, namely, of *Alcyonella*, whose rudimentary embryo (nurse) gives birth by a kind of gemmation to *two* tufts of polypes†.

In regard to the Algæ *fecundated by conjugation*, I have nothing to add to what I have already said, or to what is indicated in the Tables. Here, also, the perfect spore presents itself as a *nurse*; as in *Palmoglœa*, and probably also in the conjugation-bodies of *Mesocarpus* and *Staurocarpus*, referred to in a former page.

In conclusion, I subjoin a third Table, in which on the one hand the spore, on the other the embryo contained in the seed, are taken as the point of departure of the individual cycle of development, and the separate stages of development placed together in the order of time. The contradictions which occur from this view are too striking for it to be requisite to point them out in detail, and this comparison can only serve to set in a still clearer light the validity of the developments which have been stated in this essay.

[*Note.*—To the Fucoideæ (J. Ag.) furnished with antheridia, mentioned at page 258, should be added, from Thuret's observations, *Tilopteris Mertensii*, Kg. (*Ectocarpus Mertensii*, Ag.) and *Dictyota*. The antheridia and spermatozoids of the latter genus resemble those of the Florideæ (*vide* Thuret, Ann. des Sc. nat. 4 sér. iii. 1855).

To p. 259.—An enumeration of the Florideæ in which the existence of antheridia has been demonstrated is given in the same memoir of Thuret. Al. Braun has also discovered antheridia in *Batrachospermum*, which Thuret includes among the Florideæ (Algar. Unicellul. genera nova, &c. Leipsic, 1855, p. 105).]

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* Entw. u. Fortpflanz. der *Sphæroplea*, p. 16 (Annals, ser. 2. xviii. p. 81).

† See Siebold, Vergleich. Anatomie (1840), p. 33.

TABLE II. (referred to at page 454).

Animal Kingdom.	Mono- and Dicotyledones.	Gymnospermia.	Lycopodiaceæ and Rhizocarpeæ.	Equiseta and Ferns.	Mosses.
Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.
Embryo.	Embryo.	Embryo.	Embryo.	Embryo.	Rudiment of theca.
					Theca.
Nurse or Nurse-generations*.	Vegetative shoots.	Vegetative shoots.	Vegetative shoots.	Vegetative shoots.	Protonema and vegetative shoots.
Sexual animal.	Flower-shoot.	Flower-shoot.	Prothallium (and microspore complex).	Prothallium (with antheridia and archegonia).	Flower-shoot (bearing antheridia and archegonia).

* These may be absent both in animals and plants; for example, in all plants whose terminal or lateral shoots end in flowers, which therefore present themselves as a nurse-stock, not as a stock of sexual individuals.

TABLE III. (referred to at page 456).

Animal Kingdom.	Phanerogamia.	Lycopodiaceæ and Rhizocarpeæ.	Equisetaceæ and Ferns.	Mosses.	Algæ.
Embryo.	Seed (embryo).	Megaspore and microspore.	Spore.	Spore.	Spore.
Infancy.	Vegetative sphere (leafy axis).	Prothallium bearing archegonia, and spermatozoids. *Fecundation.*	Prothallium bearing both archegonia and antheridia. *Fecundation.*	Protonema and leafy axis (vegetative sphere).	Thallus.
Puberty. *Fecundation.*	Reproductive sphere (Flower). *Fecundation.*	Vegetative sphere.	Vegetative sphere.	Reproductive sphere (antheridia and archegonia). *Fecundation.*	Antheridia and sporanges. *Fecundation.*
Formation of embryo.	Formation of seed.	Formation of spores.	Formation of spores.	Formation of spores.	Formation of spores.

[The epochs of resting periods are marked (in all the Tables) by blacker lines.]

TABLE I. (referred to at page 450).—*Comparison of the apparently equiva subdivisions of the Vegetable King*

Animal Kingdom.	Phanerogamia.		Pteridoideæ.		Mosses (pr
	Mono- and Dicotyledones.	Gymnosperms.	Selaginellæ, Isoëteæ, and Rhizocarpeæ.	Equisetaceæ and Ferns (*s. s.*).	
Fecundated ovum.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecundated germinal vesicle.	Fecund germir vesicl
Embryo or Nurse.	Embryo.	Embryo.	Embryo.	Embryo.	Theca, S Protone Bud-rudi
Morphologically developed animal.	Leafy axis.	Leafy axis.	Leafy axis.	Leafy axis.	Leafy a
Sexual apparatus.	First cell of the hermaphrodite or each of the unisexual flower-buds.	First cell of the unisexual flower-bud.	Megaspore.	Spore.	Antheri and archego
	Flower: sexes separate or hermaphrodite.	Male and female flowers*.	Microspore—complex, and prothallium.	Prothallium: sexes separate or hermaphrodite.	
Testis.	Anther.	Anther.	Sporangium of microspores.	Antheridia.	Antheri
Spermatic cysts.	Pollen-grain.	Pollen-grain.	Microspore.	Mother-cell of the antheridial cells producing the spermatic vesicles.	Mother-c the anthe cellsprod the sperr vesicle
Sperm-cells.	Contents of pollen-tube.	Contents of pollen-tube.	Spermatic vesicles.	Spermatic vesicles.	Sperm vesicle
Spermatozoa.			Spermatozoa.	Spermatozoa.	Spermato
Ovary (and uterus).	Ovule.	Ovule.	Archegonium.	Archegonium.	Archegon
Ovarian follicle (Graafian vesicle).	Embryo-sac.	Embryo-sacs, secondary.	Central cell of the archegonium.	Central cell of the archegonium	Central of the ar gonium
Unfecundated ovum.	Unfecundated germinal vesicle.	Unfecundated germinal vesicle.	Unfecundated germinal vesicle.	Unfecundated germinal vesicle.	Unfecun germin vesicl
Germinal vesicle.	Cytoblast of the germinal vesicle.	Cytoblast of the germinal vesicle.	Cytoblast of the germinal vesicle.	Cytoblast of the germinal vesicle.	Cytoblas the gern vesicl

* The latter essentially only ovule.

…s of Development, Sexual Apparatus, and Sexual Products in the different … the Animal Kingdom.

Algæ.						
…haræ.	Florideæ.	Fucaceæ.	Vaucheria.	Sphæroplea.	Bulbochæte.	Desmidieæ, Diatomeæ, and Zygnemeæ.
…pore. …ryonal …ell).	Spore ?	Fecundated spore.	(Resting-) spore (embryonal cell).	(Resting-) spore (-nurse).	(Resting-) spore (-nurse).	Conjugation-body (resting-spore).
				Zoospore.	Zoospore.	
…allus.	Thallus.	Thallus.	Thallus.	Thallus.	Thallus.	Thallus.
…heridia and …rangia.	Antheridia and sporangia ? Prothallium ?	(Conceptaculum.)	Antheridia and sporangia.	Antheridia and sporangia.	Microgonidia and sporangia.	United conjugation-cells.
…heridia.	Antheridia.	Antheridia.	Antheridia.	Antheridia.	Microgonidia and their products in germination.	First conjugation-cell.
…ternal …s of an…ridium.	Antheridial cellules.					Contents (daughter-cell ?) of the above.
…cleus of …rnal cell.						
…ermatozoa.	Antheridium-corpuscles.	Zoospore-like spermatozoids.	Spermatozoids.	Spermatozoids.	Spermatozoids.	
…poran…gium.	Sporangium. ? ?	Sporangium.	Sporangium.	Sporangium.	Sporangium.	Second conjugation-cell.
…fecund…d spore-cell.	Unfecundated spore-cell ?	Primordial (unfecundated) spore-cell.	Primordial (unfecundated) spore-cell.	Primordial (unfecundated) spore-cell.	Unfecundated spore-cell.	Contents (daughter-cell ?) of the above.
		Nucleus of spore-cell.				

† These two intermediate generations absent in the Liverworts.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

May 26, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

On the Animal and Bark of the genus Antipathes. By Dr. J. E. Gray, F.R.S., F.L.S., V.P.Z. and Ent. Soc. etc.

In the 'Proceedings' of the Society for 1832, p. 41, I described for the first time the bark and animal of *Antipathes dichotoma* from Madeira.

It is to be observed that this species has been separated from the others of the genus because the surface of the axis is smooth and not covered with a number of minute, uniform, cylindrical spines like the true *Antipathes*, and has been called for that reason *Leiopathes*; and it has been further stated, that though *Leiopathes* has a distinct bark and animal like *Gorgoniadæ*, this may not be the case with the normal species of the genus, some of which have been described by Ellis as having a very peculiar kind of animal.

To set this question at rest, I have carefully examined all the specimens of *Antipathes* which have come under my observation, and have failed to discover any traces of a bark or remains of any kind of animal matter on their surface, until a few days ago, when Mr. Samuel Stevens brought to the Museum a very fine specimen of a long simple-stemmed *Antipathes* from the Seychelles, which appears to be a new species, allied to *A. spiralis*, if more than a very fine straight specimen of that species.

This specimen is entirely covered from near the expanded base to the apex (except at certain parts where the surface has been accidentally abraded) with a very distinct bark or animal covering.

The bark is continuous, completely hiding the spinules of the surface of the axis, smooth, and showing a number of thicker, browner, irregular-shaped plates on the surface, which are separated from each other in some places only by narrow crack-like grooves, and at others by a considerable distance; and there is no appearance, in the dry state, as far as I can detect, of any apertures for the emission of the heads of the polypes.

The bark in its dry state is tough and rather rigid; when soaked in water, it becomes thick, coriaceous externally, and fleshy within; when soaked in a solution of potash, the harder plates appeared to be formed of a rather convex horny plate of irregular shape and rather twisted on the surface, and the other part of the bark is scattered with groups of very small, uniform-sized, regular-shaped, oblong plates, of a somewhat similar consistence and colour.

The hard parts of the bark are quite distinct in form and appearance from the spiculæ of the *Gorgoniadæ*. They are hard and brittle, not soluble in strong muriatic acid, nor are they affected by a strong solution of caustic potass. They are most probably siliceous.

I have not been able to discover the tentacles of the animal, though I have submitted them to the same process by which I observed them in *Leiopathes dichotoma*, as mentioned in my former paper; but I have seen sufficient of the internal structure of the animal to lead me to believe that in its general character it agrees with the other *Gorgoniadæ*.

June 9, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

Note on the Upland Goose. By Philip Lutley Sclater, M.A., F.L.S. etc.

The new "Upland Goose" recently received by the Society from the Falkland Islands, is certainly the true Magellanic Goose (*Chloëphaga magellanica*), Gmelin's name *magellanica* being founded on Buffon's Pl. Enl. 1006—a sufficiently recognizable representation of what seems to be the female of this species. See also Darwin's Zool. of the Beagle, Birds, p. 134, where "*Upland Goose*" is stated to be the name applied to this bird at the Falklands.

The bird, which has for several years, I believe, bred in the Society's Gardens, and is commonly called the "Magellanic Goose," is "The Ashy-headed Goose" (*Chloëphaga poliocephala*) of the British Museum Catalogue of Gallinæ, Grallæ and Anseres, published in 1844.

This species is well figured in Gray and Mitchell's Genera of Birds (pl. 165), under the name *Bernicla inornata*. But it seems doubtful whether this is really the true *Anas inornatus* of King (Proc. Comm. Zool. Soc. i. p. 15).

The adults of both sexes of this Goose, which are now in the Society's Gardens, are coloured as nearly as possible alike, which is rather curious, if, as appears to be the case, in the nearly allied *C. magellanica* the male and female are quite different.

There are two other fine Geese which inhabit the southern extremity of the S. American continent—namely, *B. antarctica* (Gm.) and *B. melanoptera*, Eyton. Specimens of all these four species are in the British Museum.

Description of a New Genus of Gorgoniadæ. By Dr. John Edward Gray, F.R.S., V.P.Z. & Ent. Soc., F.L.S. etc.

Acanthogorgia.

Coral branchy; branches free, cylindrical, slender, both of them almost entirely composed of transparent spicula; cells elegantly bell-shaped, contracted at the bottom, and less so rather below the aperture, spinulose, with eight equidistant lines of two or three series of diverging short spines; the mouth of the cell surrounded with numerous diverging, very slender, transparent, elongate spines, nearly as long as the cell. Axis horny, black, more slender and brown near the tips.

Acanthogorgia hirsuta, Proc. Zool. Soc. 1851, Radiata, pl. 3. fig. 2.

Coral branched ; branches nearly on the same plane, separate.
Hab. Unknown. British Museum.

This genus bears some relation to *Primnoa*, but the cell is armed externally with rows of short, thin, and its mouth with a series of delicate, elongated bristle-like spines, instead of the broad scale of that genus. From all other genera of the family it is most distinct.

The MS. description of this very curious coral was accidentally mislaid at the time at which it was read, and did not appear in the printed Proceedings of the Society. It was figured, by an error of the artist, for and under the name of *Nidalia occidentalis* in the Proceedings of the Society for 1851.

June 23, 1857.—Dr. Gray, F.R.S., V.P. Zool. & Ent. Soc., in the Chair.

Descriptions of Twelve New or Little-known Species of the South American Family Formicariidæ. By Philip Lutley Sclater, M.A., F.L.S. etc.

1. Grallaria ferrugineipectus.

Supra pallide brunnea, olivaceo induta : loris et regione oculari et auriculari fulvo tinctis : subtus flavicanti-ferruginea, collo antico medialiter et ventre toto cum crisso albis : alis nigricantibus pallido brunneo limbatis, tectricibus alarum superioribus omnino nigricantibus, inferioribus autem cum campterio ochraceis : rostri nigri basi flavicante : pedibus pallidis.

Long. tota 3·8, alæ 2·6, caudæ 1·2, tarsi ·85.
Hab. In Venezuela, in vicin. urbis Caraccas (*Levraud*).
Mus. Paris.

2. Grallaria loricata.

Supra olivacea : pileo castaneo : oculorum ambitu, loris et gula tota albidis, fulvo tinctis : stria duplici gutturis utrinque nigra : pectoris et ventris lateralis plumis omnibus medialiter fulvo-albidis, undique late nigro marginatis : ventre medio et crisso albis, hypochondriis brunnescentibus : rostro clare brunneo, basi flavida : tectricibus subalaribus pallide brunneis.

Long. tota 4·0, alæ 2·8, caudæ 0·8, tarsi 1·6.
Hab. In Venezuela, in vicin. urbis Caraccas (*Levraud*).
Mus. Paris.

These two *Grallariæ* are of smaller size and have shorter tarsi than the typical members of the genus. The bill also is shorter, broader, and more flattened, and furnished with many basal bristles. Together with Lafresnaye's *Grallaria nana*, they seem to form a subordinate group pointing towards *Conopophaga*.

3. Hypocnemis melanopogon.

♂. *Cinereus, subtus dilutior, ventre medio albicante ; gula nigra : alis brunnescenti-nigris, tectricibus omnibus albo marginatis : cauda nigra rectricibus omnibus anguste albo terminatis : rostro nigro, pedibus fuscis.*

♀ *aut* ♂ *junr. Supra mari adulto similis, subtus gutture et pectore cinereo variegatis, gastræo albo, lateraliter cinerascentiore.*

Long. tota 4·5, alæ 2·5, caudæ 1·5.

Hab. In Peruvia Orientali, Chamicurros (*Hauxwell*).

Mus. Brit. et P. L. S.

This bird nearly resembles *H. pœcilonota* and *H. myiotherina* in style of colouring, but the bill is longer and more slender, and more like that of some of the species of *Myrmeciza*. From *H. pœcilonota* it is easily distinguished by the want of the white edgings of the interscapularies, from *H. myiotherina* by the restriction of the black colour to the throat, the want of the superciliary mark, and by the white termination of the rectrices.

I have two specimens of this species in my own collection, and there is one in the British Museum, which formed part of Hauxwell's collection from Chamicurros.

4. Formicivora melæna.

Fuliginoso-niger, subtus intensior ; lateribus plumosis cum tectricibus subalaribus albis : alarum tectricibus et caudæ rectricibus albo terminatis : rostro et pedibus nigris.

Long. tota 4·0, alæ 3·1, caudæ 2·5.

Hab. New Grenada, Bogota.

Mus. P. L. S.

Obs. Similis *F. axillari*, sed colore corporis supra nigro nec plumbeo dignoscenda.

5. Formicivora urosticta.

Cinerea, subtus dilutior et magis albescens : plaga gulari elongata nigra : alis nigricanti-cinereis extus cinereo strictissime limbatis, tectricibus autem nigris, albo terminatis : cauda nigra, rectricibus omnibus albo late terminatis ; rectricis unæ utrinque extimæ tertia fere parte apicali alba, hoc colore apud alias rectrices gradatim decrescente : rostro nigro, pedibus fuscis.

Long. tota 3·5, alæ 2·0, caudæ 1·2.

Hab. In Brasilia Orientali.

Mus. Brit. et P. L. S.

Obs. A *Formicivora axillari* et aliis affinibus colore subtus dilutiore, gula nigra magis restricta et præsertim rectricum apicibus late albis distinguenda.

6. Formicivora brevicauda.

Formicivora brevicauda, Sw., Zool. Journ. ii. p. 148.

♂. *Cinereus unicolor, plaga ovali in gutture et pectore superiore nigra : alis nigricantibus extus cinereo limbatis, harum autem* *tectricibus nigris albo terminatis: cauda brevi, colore nigro-cinerea, rectricum macula subapicali nigra, ipsarum autem apicibus albidis: rostro corneo, pedibus nigris.*

♀. *Olivascenti-brunnea, subtus clarior, capite subcinereo gutture albicantiore: tectricum alarium apicibus colore dilutioribus.*

Hab. In Brasilia Orientali prope urbem Bahia (*Sw.*).

Mus. Brit. et P. L. S.

Obs. Species ab auctoribus cum *F. axillari* et affinibus confusa, sed crassitie minore, cauda breviore, colore corporis cinereo unicolore et plaga gutturali ovali bene definita facile dignoscenda.

7. Formicivora Hauxwelli.

Plumbea, subtus paulo dilutior, mento albescentiore: alis nigris, tectricibus omnibus albo terminatis, duas lineas albas formantibus; secundariis dorso proximis extus caudæ quoque tectricibus et rectricibus ipsis omnibus macula terminali alba præditis: uropygii plumis laxis, elongatis: cauda brevissima: rostro nigricanti-plumbeo, pedibus fuscis.

Long. tota 3·7, alæ 2·1, caudæ 9.

Hab. In Peruv. Orientali (*Hauxwell*).

Mus. Brit.

8. Formicivora cinerascens.

Formicivora cærulescens?, Sclater, P. Z. S. 1854, p. 112 (nec Vieill.).

Pallide cinerascens fere unicolor, subtus dilutior; interscapularium basibus albis: alis nigricanti-brunneis cinereo limbatis; tectricum apicibus albo guttulatis: cauda nigricante, rectricibus omnibus albo terminatis: rostro et pedibus nigris.

Long. tota 6·0, alæ 2·4, caudæ 2·2.

Hab. In Peruv. Orientali, Chamicurros (*Hauxwell*) et in ripis fl. Napo.

Mus. Brit.

Obs. Similis *F. cærulescenti* ex Brasilia sed rostro fortiore et longiore, cauda breviore et æqualiore, colore corporis inferioris dilutiore et campteriis non albis distinguenda.

I formerly referred this bird to Vieillot's *Form. cærulescens*, of which Menetriès has given a figure in his 'Monograph of the Myiotherinæ,' pl. 6. But a comparison of specimens of both species, which are now in the British Museum, has convinced me that these two birds, though much resembling each other in plumage, are essentially distinct, and I have given above the characters by which they may be easily separated.

The example from Chamicurros, which was part of Mr. Hauxwell's fine collection, is not quite mature, and shows brownish colouring beneath and upon the wings. Like *F. cærulescens*, this bird has only ten rectrices.

9. Herpsilochmus pectoralis.

Cinereus, dorsi medii plumis albo mixtis; pileo nigro: fronte, *superciliis et lateribus capitis albis: alis nigris, tectricum omnium apicibus albo guttatis, secundariis late, primariis stricte albo extus marginatis: cauda nigra, rectricis unæ utrinque extimæ dimidio apicali et proximarum trium apicibus gradatim decrescentibus albis; rectricibus duabus intermediis extus anguste albo marginatis et tectricum caudæ apicibus quibusdam eodem colore guttatis: subtus obscure cinereus, plaga magna in pectore antico nigro: rostro plumbeo, mandibula inferiore albicante: pedibus nigris.*

Long. tota 5·0, alæ 2·1, caudæ 1·7.

My attention was first called to this species when looking through the specimens of this family in the Museum of the Academy of Nat. Sc. of Philadelphia.

There is also a single specimen in the British Museum, which came, I believe, from the same origin as the one at Philadelphia—that is, from the Massena collection. There is no locality affixed.

In style of colouring this bird seems to come nearest to *H. pileatus*, but it is much larger in size, and the pectoral black patch renders it easily distinguishable from every bird of the family known to me.

10. Dysithamnus xanthopterus.

Dasythamnus xanthopterus, Burm. Syst. Ueb. d. Th. Bras. iii. p. 81.

♂. *Capite colloque cinereis, fronte, regione superciliari et lateribus capitis albo striolatis: interscapulio et alis extus læte rufis, illo dilutiore; dorso postico valde plumoso, colore viridescenti-rufo, hujus pennarum basibus cinereis: cauda nigricanti-cinerea, rectricibus extus rufescente marginatis: subtus albus, lateribus cervicis cinereis, ventris autem ochracescentibus: rostri nigri mandibula inferiore pallida, pedibus nigris.*

♀. *Mari similis sed pileo rufo et subtus magis fusco-flavicans.*

Long. tota 5·5, alæ 2·4, caudæ 2·0.

Hab. In Brasilia Orientali.

Mus. Brit. et P. L. S.

The British Museum possesses the male, and I have a female specimen of this *Dysithamnus*, which is easily recognizable by its deep chestnut-red wings and back; the same in both sexes. The bend of the wing and whole of the upper coverts are of this colour, and I could hardly, therefore, at first think it possible that this could be the *Dasythamnus xanthopterus* of Burmeister (Syst. Ueb. d. Th. Bras. iii. p. 81), although his description agrees with the female of my species. But recollecting that ξανθὸς, though commonly used in Natural History as synonymous with the Latin *flavus* and English "*yellow*," is also capable of bearing the meaning "*auburn*," or even "*chestnut*;" it appears to me that the name "*xanthopterus*," though eminently calculated to mislead as applied to this bird, is perhaps not sufficiently inaccurate to require to be replaced by a new name. I have therefore retained Professor Burmeister's appellation for this species. His single example was obtained in the vicinity of New Friburg in the province of Rio de Janeiro. Those in the British Museum and my own collection have the ordinary appearance of Brazilian skins, and are probably from Rio or Bahia.

I do not know what has induced Prof. Burmeister to attempt to change Cabanis's correctly formed generic term *Dysithamnus* into *Dasythamnus*; but in this, as in other instances, that author seems to undervalue the principle of priority, now universally recognized in the application of names in Natural History.

11. Thamnophilus melanothorax.

Supra intense castaneus, remigibus alarum intus nigricanti-brunneis, lateribus capitis et corpore subtus ad imum pectus atris, hoc colore in ventrem sensim dilutiore: ventre et lateribus olivascenti-brunneis rufo tinctis: cauda unicolore castanea: rostro corneo, pedibus nigro-fuscis.

Long. tota 6·5, alæ 3·2, caudæ 2·8.

Hab. In America Meridionali?

Mus. Brit.

I have never met with but the single example of this curious bird which is in the British Museum. The genus *Thamnophilus* is the only one I know of in which it can be placed; but the bill is more conical and thicker and rather shorter than in the birds of that group, which most nearly approach it in size. There are two white spots on the outer secondaries of the specimen, but these are evidently the results of an incipient albinism.

12. Thamnophilus melanoceps.

Thamnophilus melanoceps, Spix, Av. Bras. ii. pl. 39. fig. 1. p. 28.

Ferrugineo-rufus, subtus clarior: capite toto undique et collo supero nigris: rostro et pedibus nigris.

Long. tota 7·0, alæ 3·2, caudæ 2·4.

Hab. Eastern Peru, Sarayaçu on the Ucayali (*Cast.* et *Dev.*).

Mus. Paris.

I was not acquainted with this fine species of *Thamnophilus* when I wrote the article on the arrangement of those birds in the 'Edinburgh N. Phil. Journal.' I have since seen several examples in the Museum of the Jardin des Plantes, which were obtained by MM. de Castelnau and Deville at Sarayaçu on the Ucayali. The irides are marked "*orange.*"

Description of a New Species of Antelope (Oryx Beatrix) from Bombay?, lately living in the Menagerie of the Society. By Dr. John Edward Gray, F.R.S., F.L.S., V.P.Z. & Ent. Soc. etc.

The African genus *Oryx* is divided into two sections, according to the form of the horn. In one, the Kookaam, or Gemsboc (*O.*

gazella), the horns are straight; in the true Oryx (*O. leucoryx*), they are arched and recurved. The former has a black streak along the lower part of the sides, and is found over a large extent of Africa, from the Cape to Abyssinia; for *O. Biessa* of Rüppell appears to be only a small variety of *O. gazella*, the smaller size depending on some peculiarity in the climate or locality, as is the case with the *Strepsiceros kudu* found in Abyssinia by Capt. Harris, which is only half the size of that inhabiting the Cape of Good Hope. The *O. leucoryx*, on the other hand, which is confined to Senaar and Senegal, is without any indication of the lateral streak.

The animal now under consideration is intermediate between these species; it has the straight horn of *A. gazella* and the plain colour of *A. leucoryx*, but its dark legs and peculiar white feet at once separate it from either.

The animal was presented to the Society by Capt. John Shepherd of the India House; it was regarded in the Gardens as a half-grown *Oryx gazella*, and is said to have been brought from Bombay. A pair was shipped from the latter port, but the female died at sea. The male is now in the Collection of the British Museum.

Oryx Beatrix. The Beatrice.

The horns slender, straight, or only very slightly curved near the tip, annulated nearly to the tip. White; a spot on the middle of the face, a smaller spot between the base of the horns, a large patch on each cheek, extended above up to the eyes, and united together beneath under the throat; the knees and front of the fore- and hind-legs, and a large spot on the chest, dark blackish brown; the legs to the posterior grey-brown; end of the tail black.

Hab. Bombay, but probably brought from the shores of the Red Sea. Brit. Mus.

This specimen is not half the size of the Gemsboc from the Cape, and is immediately known from it by the distribution of its colours.

In form and size it resembles the true Oryx (*O. leucoryx*), but it differs in the straightness of the horn, the size and form of the cheek-spot, and especially in the dark colour of the legs, and the well-marked white ring around the fetlock joint just above the hoof.

The hair is whorled on the middle of the haunches as in the rest of the genus, and the hairs of the back in front of the withers are directed forwards.

MISCELLANEOUS.

On Circulation in Plants. By A. Trécul. (First Part.)

Before putting forward the opinion which my observations have suggested to me with regard to circulation in plants, I think it indispensable to examine the forces to which this phænomenon is generally attributed. Considering the use that has been made of the known physical forces for explaining the absorption of liquids from the soil, the ascent of the sap, and also its descending course, I was for a moment surprised that no analogous experiment had been tried in order to account for the absorption of the gases drawn from the atmosphere. Nevertheless, this latter faculty of plants, which authors have been content with indicating, is not less important than the absorption of liquids by the roots. But it has not been capable of explanation by the ordinary laws of physics. I am about to attempt to prove that the aspiration by the roots, and the movements of liquids in plants, cannot be effected under the influence of the physical forces to which such an important part is still ascribed, namely capillarity and endosmose. Even those physiologists who ascribe a great part in the ascent of the sap to capillarity, and especially to endosmose, are compelled to admit that they are incapable of raising liquids to the height of our trees, without the aid of the evaporation which takes place in the leaves, and which, as they say, draws the liquids towards those organs. For my part, I think, that if evaporation causes the liquids to rise, it must prevent them from descending: now they descend after rising; therefore evaporation does not assist in their elevation. I also think that Nature never makes use of insufficient causes like endosmose and capillarity; and on the other hand, the part attributed to endosmose is incompatible with the constitution of plants.

Suppose, for a moment, with the physiologists, that it is endosmose which causes liquids to rise by the ligneous mass, and afterwards to descend by the bark. In order that this phænomenon should be accomplished, the density of the juices must constantly increase as they rise (this is what has been observed); and this density must also increase in passing through the leaves from the ligneous mass to the bark, and in descending from cell to cell in the interior of the cortical tissue. (At the last meeting of the Academy I stated that these juices do not descend in the laticiferous vessels, which have other functions.) We could not, moreover, recur exclusively to gravitation, seeing that there are pendent branches as well as erect ones.

The botanists who admit the endosmotic theory have not remarked that they have thus, side by side, two currents of liquids of different densities; they have not noticed that the ascending sap, being less dense than the descending, would necessarily be attracted by the latter, as the membranes are permeable; they have not considered that throughout the whole length of the trunk there would necessarily be a horizontal, centrifugal current, until an equilibrium of density was established, and that then the double ascending and descending current could not exist. As this is not the case, the endosmotic theory is erroneous. A force distinct from endosmose must therefore preside over the absorption of the liquids drawn from the soil, as well as over that of the gases taken from the atmosphere. And thus there are in plants other movements than that of the ascending and descending sap. This sap, in its course, gives off, into all the cells, the substances necessary for their nutrition. These cells assimilate the elements which they require, and reject those which are useless to them. The rejected elements are taken up by the laticiferous vessels, or collected into peculiar reservoirs, like the essential oils, &c. These reservoirs, however, do not contain a liquid of greater density for which these essential oils have an affinity. Here again, therefore, endosmose has no part in the movement of the liquids.

The tendency to admit purely physical causes to explain physiological phænomena is again observed with regard to the spongiole; for this extremity of the root has been compared to a sponge, as is indicated by its name. Let us see, therefore, how far this comparison is exact.

In my memoir on the origin of roots, I have shown that the young tissues, the formation of which causes the elongation of the roots, are protected during their development by a sort of little cap, which, for this reason, I called the *pileorhiza*. It actually envelopes the extremity of the root like a cap. This organ may be easily observed, especially upon the roots of aquatic plants, because in these the development is more rapid than in most other plants. This cap adheres to the extremity of the root by the interior of its apex; it is from this point that it is renewed, whilst its outer part, which is oldest, becomes destroyed. The external cells becoming disaggregated, could alone have given the idea of a little sponge. With regard to the power of absorption, which, at least in certain plants, is much stronger at the extremity of the root than in other parts of that organ, it evidently cannot be assimilated to the capillary phænomena which cause liquids to rise in a sponge. The word *spongiole*, therefore, gives a false idea of that which really takes place in roots.

Some botanists who admit the spongiole, have nevertheless recognized the existence, on the surface of many roots, of prominent cells to which they attribute a share in absorption. I hold their opinion in this respect; and I am, moreover, led to believe that, even in the woody roots of trees, the whole of the surface is endowed with the property of absorbing liquids from the soil. In trees with a vigorous vegetation, such as *Paulownia*, I have sometimes had the opportunity of observing, I think in the spring, that the dead part of the bark was impregnated with a considerable quantity of liquids, which would probably be yielded to the living parts of the root.

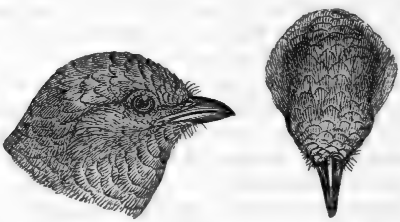
The liquids absorbed by the roots, by the agency of that force which we only know by its effects—namely life, are conveyed into the ligneous mass of these organs, and thence into that of the stem. These juices rise into the leaves, and then they descend towards the roots, describing a sort of circle. As they pass through the whole extent of the plant, I think that it would be advisable to call this the *great circulation*, and to give the name of *venous circulation* to that which, by the laticiferous vessels, conducts the substances which the cells have not assimilated to the true vessels. There is also an intracellular movement which has been observed in many vegetables.

This movement has received the name of *rotation*, because the juices appear to turn upon themselves, with more or less regularity, in the interior of each cell.—*Comptes Rendus*, Sept. 28, 1857, p. 434.

On a new Genus of Birds from Mexico. By P. L. Sclater, Esq.

CAMPTOSTOMA.

Genus novum Tyrannidarum, Tyrannulo *affine: rostrum altum, breve, valde compressum, apice acuta et dente finali nulla; culmine multum arcuato et regulariter incurvo, gonyde paulum ascendente; vibrissis rictalibus nullis: alæ modicæ, dimidium caudæ attingentes; primariis secunda, tertia et quarta inter se æqualibus et quintam paulo excedentibus, sexta his paulo breviore sed primam superante: cauda modica quadrata: tarsi breviusculi: pedes ut in genere* Tyrannulo.



C. imberbe, sp. nov.

C. supra olivascenti-fuscum, pileo semicristato, cinerascenti-fusco; alis fuscis, secundariarum et tectricum marginibus externis pallidioribus et albicantibus; cauda pallide cinerascenti-fusco unicolore: subtus cinerascenti-albidum flavo perfusum: rostri nigri mandibula inferiore basi flavicante; pedibus nigris.

Long. tota 3·5; alæ 2·8; caudæ 1·3.

Hab. In vicinitate urbis S. Andres Tuxtla in rep. Mexicana.

M. Sallé's recent collections contain a single specimen of this curious little bird, which was obtained in the neighbourhood of S. Andres Tuxtla. There is no doubt about its belonging to the *Tyrannidæ*, but the form of the bill appears to be quite different from that of any bird hitherto recognized as of that family, and to require a new generic appellation. I have therefore called it *Camptostoma* from the arched form of the culmen. The specific name *imberbe* refers to the entire absence of rictal bristles. I consider *Tyrannulus* to be perhaps its nearest-allied generic form, from which, however, it may be at once distinguished by the peculiar depth and compression of the bill. Dr. Hartlaub's *Ornithion inerme* belongs, I suspect, to this same section of *Tyrannidæ*.—*Proc. Zool. Soc.* July 14, 1857.

Discovery of Footsteps of Quadrupeds in the New Red Sandstone of Saint-Valbert, near Luxeuil (Haute-Saône). By M. Daubrée.

In reporting the discovery, in the above French locality, of the footprints described by Kaup as those of the *Cheirotherium*, and which Professor Owen has attributed to the *Labyrinthodon*, a gigantic Batrachian, the author gives the following particulars as to the occurrence and characters of these remarkable impressions. He says, "Above the great red beds which are quarried for building purposes, some thin strata of sandstone, also of a red colour, and spotted with pale green, alternate with clays of the same coloration. It is in these latter strata that I observed the impressions, at the very limit of the clay and sandstone. As at Hildburghausen, the foot first made an impression in the clay, and the relief which the sandstone presents on its lower surface is only the counterproof of the direct impression. In their form, as in their disposition, the prints just discovered in France exactly resemble those of Saxony, and belong to the same species of animal."

"By the side of the large feet there is also an innumerable multitude of small ones, turned in various directions, only presenting four toes, and somewhat resembling those of Batrachia."

"A new circumstance increases the interest of the vestiges of the *Cheirotherium* at Saint-Valbert. The mud upon which the animal walked was sufficiently plastic not only to take and preserve the exact form of the feet with their claws, but also to catch the inequalities of the skin with as much delicacy as if it had been done by a clever moulder; these latter peculiarities are even reproduced in the counterproof. Each foot, whether anterior or posterior, presents in all its parts, both on the sole and the toes, a granulation which is undoubtedly of organic origin. Beyond the footprints the surface of the slab presents nothing of the kind. This granulation is very regular, except upon some oblique ridges, where the sliding of the animal's foot has caused a slight stretching; they are small, rounded asperities, the largest of which do not attain a millimetre in diameter."

"Such an exact knowledge of the inequalities of the integument of the *Cheirotherium*, furnishes useful evidence as to the class of Vertebrata to which the animal should be referred. The lower part of the feet of Reptiles usually presents either more or less irregular scales, gradually decreasing in size to the extremity of the member, or a smooth skin with folds, or a few warts arranged in certain lines. In no existing animal of the groups of Batrachia or Chelonia does the foot appear to present inequalities of such comparatively small size, and so uniformly arranged, as in the footprints of Saint-Valbert. On the other hand, the asperities in question exactly resemble the papillæ of the sole of the foot of certain Mammalia, such as the Dog. For facility of comparison, I have had casts made, with the materials of the New Red Sandstone itself, of the feet of various quadrupeds, such as the Bear, Kangaroo, Opossum, Crocodile, Lizard, &c. It is observable that the hairs leave no traces upon the impressions of the feet of many Mammalia, any more than upon the fossil footprints in question. Thus the papilliform granulation of the skin of the *Cheirotherium* is in favour of the zoologists who have regarded it as a Mammal. Now, this last conclusion is of importance, inasmuch as it leads to the admission that Mammalia existed on the surface of the globe at the time of deposit of the most ancient strata of the Triassic period."—*Comptes Rendus*, Oct. 26, 1857, p. 646.

On two new species of Birds from Bogota. By P. L. Sclater, Esq.

Anabates striaticollis.

Olivascenti-brunneus, capite virescentiore et hujus plumis tenuissime nigro marginatis : alis nigricantibus, extus brunneo, intus autem cinnamomeo marginatis : subtus clarior et cinnamomeo tinctus ; gutture et pectore antico pallidioribus et scapis plumarum cum harum parte mediali clare flavicanti-albidis, strias obsoletas formantibus : cauda unicolore rufa : rostro flavido, culmine brunnescente, pedibus nigricantibus.

Long. tota 6·0, alæ 3·3, caudæ 2·6.

I have lately obtained a Bogota skin of this *Anabates*. Another specimen, which was previously in my collection and has been submitted to M. de Lafresnaye's examination, is marked in his handwriting "*Anabates striaticollis*, Lafr." I have therefore used that name, though as yet, I believe, unpublished. These two examples merely differ in their slightly inferior size from a third specimen marked "*Anabates olivaceiventer*" by M. de Lafresnaye some years since. I do not know whether he considers the two species indicated by these MS. names as distinct. For myself I doubt the fact. The cervical striæ, whence the name is derived, are not very well marked in my Bogota specimens.

Sclerurus brunneus.

S. supra brunneus cinnamomeo tinctus, subtus paulo pallidior ; gutture albo mixto : alarum et caudæ pennis intus nigricantibus, illarum marginibus externis dorso concoloribus : rostro nigro, basi flavicante : pedibus nigris.

Long. tota 6·0, alæ 3·4, caudæ 2·1.

I have lately obtained a single Bogota skin of a bird of this genus, to which (as I cannot associate it with any of the already-described species) I have given a new name. From *S. caudacutus* of Brazil and *S. mexicanus* (P. Z. S. 1856, p. 290) of Mexico and Guatimala, it differs in the want of the bright rufous colouring in the rump and fore neck. In this respect it would seem to resemble Hartlaub's *S. guatimalensis* (Rev. Zool. 1844, p. 370), but that bird is said to be of the size of *S. caudacutus*, to which the present species is considerably inferior in dimensions.—*Proc. Zool. Soc.* Jan. 27, 1857.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

SUPPLEMENT TO VOL. XX. DECEMBER 1857.

XLV.—*On the Natural History of the Aru Islands.* By Alfred R. Wallace.

In December 1856, I left Macassar in one of the trading prows which make an annual voyage to these islands. On January 1st, 1857, we arrived at the Ké Islands. Here we remained six days, while the natives, who are clever boat-builders, finished two small vessels our captain purchased for the Aru trade. During this time I made daily excursions in the forests, collecting birds and insects; but the weather was showery, and the coralline-limestone rocks, which everywhere protrude through the thin soil, are weather-worn into such sharp-edged, honeycombed, irregular surfaces, as to make any distant excursions almost impossible. The great Fruit Pigeon of the Moluccas (*Carpophaga ænea*) was abundant, its loud, hoarse cooings constantly resounding through the forest. Crimson Lories of two or three species were also plentiful, but were so wary that we could not obtain any. All other birds were scarce, and I only obtained thirteen species in all, many of which will, however, I think, prove new, viz.:—

Megapodius, sp., same species at Aru.
Carpophaga ænea.
Ptilonopus, n. sp.
Macropygia, sp., same at Aru.
Dicrurus, sp.
Tropidorhynchus, n. sp.?
Cinnyris, n. sp.
Zosterops citrinella, Müll.
Rhipidura, two species.
Muscicapidæ aliæ, two species.
Psittacus (*Geoffroyus*?), sp.

Among the birds offered for sale, *Eclectus Linnæi* and *Psittacodis magnus* were the most abundant. Of Mammalia I saw none, and could only learn that a wild pig and a species of *Cuscus* inhabited the island. The only reptiles I saw were lizards of two or three kinds, one of which, a very long and slender species, with a finely-pointed tail of a most brilliant blue, swarmed everywhere on the low herbage, gliding among leaves and twigs in the most rapid and elegant manner. Of insects I made a nice little collection, the natives bringing me several very fine Coleoptera. A considerable proportion appear to be quite new; those known being a mixture of New Guinea and Molucca species. It would occupy too much space to enter into any details on this extensive class; I shall therefore give only the results of my six days' work, as follows:—

Coleoptera	70	species.
Lepidoptera	50	,,
Diptera	19	,,
Hymenoptera	24	,,
Hemiptera and others	31	,,
	194	species of insects.

It was here I first made acquaintance with the Papuan race in their native country, and it was with the greatest interest I studied their physical and moral peculiarities, and noted the very striking differences that exist between them and the Malays, not only in outward features, but in their character and habits.

A day and a half's sail brought us to the trading settlement of Dobbo, situated on a sandy spit running out in a northerly direction from the island of Wamma, which here approaches to within a mile of the great island of Aru. Having obtained the use of one of the palm-thatched sheds here dignified with the name of houses, arranged my boxes and table, and put up a drying-shelf indoors and out, protected by water-insulation from the attacks of ants, I was ready to commence my exploration of the unknown fauna of Aru. I had brought with me two boys, whose sole business was to shoot and skin birds, while I attended entirely to insects, and to the observation and registry of the habits of the birds and animals I met with in my walks in the forest. The first fortnight was very unpropitious, violent gusts of wind and driving rain allowing us to do very little out of doors, and making the drying of the little we obtained a matter of great difficulty. It soon became apparent that in this small island there was a very limited number of birds, and I determined to go as soon as possible to the large island; but that was not an easy matter, and I now found that I should have brought from Macassar three men accustomed to the islands, and who could take me wherever I wanted to go. As it was, I had to get natives, and there was, as usual, all sorts of delay, and then there was an alarm of pirates, and unfortunately it was not a false alarm. A fleet of the celebrated Ilanun pirates, from the island of Maguidanao, had really arrived; they attacked a small vessel not far from Dobbo, which, escaping from them with one man wounded, brought the news. Then came messengers from one of the northern islands, telling how they had been attacked, and many taken prisoners, and the rest of the population had all fled to the mainland. Now for some time there was no more hope of my getting boats and men. Guards were set in Dobbo, and prows were got ready to go after the pirates. A few days more, and the crew of one of our captain's small vessels which had gone trading among the islands, returned stripped of everything. They had got on shore, while the pirates plundered the prow, taking everything, even to the men's boxes and clothes. They reported that the pirates were all at the east side of the islands, where the merchants send their small vessels to buy pearl-shell and tripang, and there was no danger of their returning again to this side, where they had more to fear and less to get. Now, too, I received a letter I had been expecting from the Governor of Amboyna, with orders to the Aru chief to give me assistance; and, after two months' residence in Dobbo, I succeeded in getting a boat and two natives, and set off for the great island of Aru.

I visited several localities, and at length, finding a good one near the centre of the island, I stayed there six weeks, and got, on the whole, a very fine collection of birds. Returning to Dobbo, I intended to make another short excursion; but lameness, produced by the constant irritation of insect-bites on my legs, kept me in the house for several weeks, and the east wind became so strong, and the weather so wet and boisterous, as to render travelling by sea in a small boat out of the question. A little later, one of my bird-skinners left me, and the other was laid up with intermittent fever, so I was compelled to make the best of it, and get what I could in the small island till the commencement of July, when we returned direct to Macassar.

Having thus given an outline of my journey, I shall proceed to give some account of the ornithology and general natural history of the Aru Islands, and a summary of the collections I have made there. The very first bird likely to attract one's attention at Dobbo is a most beautiful brush-tongued parroquet, closely allied to *Trichoglossus cyanogrammus*, Wagl. It frequents in flocks the Casuarina-trees which line the beach, and its crimson under wings and orange breast make it a most conspicuous and brilliant object. Its twittering whistle may be heard almost constantly in the vicinity of the trees it frequents. Almost the only other birds which approach the village are a swallow (*Hirundo nigricans*, Vieill.), found also in New Guinea and Australia, and an *Artamus*, probably *A. papuensis*, Temm., which perches occasionally on the house-tops, or on dead trees in the neighbourhood. A little black-and-white wagtail flycatcher (*Rhipidura*, sp.) may also often be seen among bushes, and on the sea-beach, chirping musically, and waving laterally its expanded tail whenever it alights.

In the forest which everywhere covers the islands, sombre and lofty as on the banks of the Amazon, a different set of birds is met with, the two most abundant being both New Guinea species, *Cracticus varius*, Gm., sp., and *Phonygama viridis*, L. The former has a loud and very varied note; sometimes a fine musical whistle; at others (principally when alarmed), a harsh, toad-like croak. It is very active, flying about from tree to tree and from bush to bush, seeking after insects, or feeding on small fruits. It is a long time before one can recognize its various cries for those of one and the same bird. The *Phonygama* is a very powerful and active bird; its legs are particularly strong, and it clings suspended to the smaller branches, while devouring the fruits on which alone it appears to feed. Its affinities seem to be with the Paradiseas rather than with the Garrulidæ. Next to these, two species of *Dacelo* are most frequently met with, and their loud monotonous cry, very much resembling the bark of a dog, most frequently heard. A large crow, with a fine sky-blue iris, and hoarse cawing cry, is also not uncommon; and now I have mentioned all the birds, except parrots and pigeons, that are common enough to be at all characteristic of the forest near Dobbo. For noise, however, the Psittacidæ surpass all others, and the Yellow-crested Cockatoo (*Plyctolophus galerita*) is an absolute nuisance. Instead of flying away when alarmed, as other birds do, it circuits round and round from one tree to another, keeping up such a grating, creaking, tympanum-splitting scream, as to oblige one to retire as soon as possible to a distance. Far more agreeable is the low cooing of the pigeons, several fine species of which are not uncommon. *Carpophaga pinon*, Q. & G., is plentiful, and another, which seems to be *C. Zoë*, Less., rather scarce; while *C. alba*, L., is common everywhere. Of the smaller and more beautiful species there are also three, *Ptilonopus perlatus*, Temm., *P. pulchellus*, Temm., and *P. purpuratus*, Lath. These birds are all very difficult to obtain in good condition, because their feathers fall so readily; but they are always acceptable, as their flesh (especially that of the smaller species) is perhaps equal in delicacy and flavour to that of any birds whatever.

In one or two excursions which I made to the mainland, immediately opposite Dobbo, I obtained the two beautiful flycatchers, *Arses telescophthalma*, Garn. & Less., and *A. chrysomela*, G. & L., as well as some species of *Ptilotis* and other small birds new to me. It was not, however, until I was regularly established in the central forests of the large island that I obtained a true insight into the ornithological fauna of Aru. Then a host of new species burst upon me, revealing the richness of the country, and its intimate connexion with New Guinea. *Paradisea apoda*, L., *P. regia*, L., *Microglossus aterrimus*, Wagl., *Brachyurus Macklotti*, Temm., *B. novæ-guineæ*, Schlegel, *Tanysiptera*, sp., *Eurystomus gularis*, Vieill., *Carpophaga*, n. s., with several small flycatchers, thrushes and shrikes, and that most magnificent of the swallow-tribe, *Macropteryx mystaceus*, Less., were what I now obtained,—almost all New Guinea species, or new, and none of them found on the smaller islands. Of the beautiful little "King Bird of Paradise," I obtained several specimens in perfect plumage and excellent condition. It feeds, I believe, entirely on fruit, frequenting lofty trees in the deep forest, where it is very active, flying from branch to branch, shaking its wings, and expanding its beautiful fan-shaped breast-plumes*. When quite at rest, or feeding, these plumes are closed and concealed beneath the wing. Of the "Great Bird of Paradise," I have recorded my observations in a separate paper. The Black Cockatoo is a very curious bird, of most disproportionate form and dimensions. Its huge head certainly weighs as much as its whole body. The legs are very long and slender for the tribe, while its wings are large and powerful. Its cry is a shrill whistle, very different from that of most other cockatoos. The bill of the male is larger, and the apex more produced, than in the female; but the crest-plumes are equally long in both. The *Tanysiptera* is a Kinghunter, feeding on insects, worms, &c., which it picks up from the ground in the damp forest. Its coral-red bill is always dirty from this cause, and sometimes so incrusted with mud that the bird seems to have been actually digging for its food. The *Syma torotoro*, Less., also occurs, but much more rarely, and seems to have very similar habits. Two species of *Megapodius* are plentiful, and the immense mounds of earth and leaves formed by them are scattered all over the forest. These mounds are generally from 5 to 8 feet high, and from 15 to 30 feet in diameter. But the giant of the Aru forests is the Cassowary (*Casuarius galeatus*, Vieill.); it is by no means uncommon, and the young are brought in numbers to Dobbo, where they soon become tame, running about the streets, and picking up all sorts of refuse food. When very young, they are striped with broad lines of rich brown and pale buff. This gradually fades into a dull pale brown, and in the old bird changes to black. They *sit* down to rest on their tibiæ, and lie down on their breast to sleep; they are very frolicsome, having mock fights, rolling on their backs, and leaping in a most ridiculous manner with all the antics of a kitten. The same species is said to be found in Ceram, and also in the small island of Goram, as well as in New Guinea. The following list shows the number of species in each of the principal tribes and families which I have observed in Aru:—

* The *Paradisea minor* was figured by Dr. J. E. Gray from life, with the breast-plumes displayed as above-described, in the 'Illustrations of Indian Zoology,' vol. i. pl. 37.

Grallæ and Natatores	12	One duck, near *Anas radjah*, Less.
Gallinaceæ	15	Twelve pigeons, *Alecthelia Urvillei*, Less.
Accipitres (Falconidæ)	4	
Psittaci	10	
Paradiseidæ	2	New Guinea species.
Cinnyridæ	5	Three New Guinea species.
Meliphagidæ	9	Six *Ptilotis*.
Sturnidæ	2	Both New Guinea species.
Corvidæ	1	
Garrulidæ	1	
Laniidæ	3	Two New Guinea species.
Turdidæ	6	
Pittidæ	2	Both New Guinea species.
Maluridæ	2	
Oriolidæ	2	
Artamidæ	1	A New Guinea species.
Muscicapidæ	13	Four or five New Guinea species.
Edoliidæ	6	
Coraciadæ	1	*Eurystomus*, same at Macassar and Lombock.
Hirundinidæ	3	One New Guinea, one Australian.
Caprimulgidæ	2	*Podargus* and *Caprimulgus*.
Alcedinidæ	11	Four or five New Guinea species.
Cuculidæ	3	*Centropus* and *Chrysococcyx*.
Total species	116	

From this list, and the preceding observations, it will be seen that many Australian genera and some species occur in Aru; while, considering the very small number of species known from New Guinea, and the necessarily very imperfect exploration of Aru in such a short time, the number of identical species is very remarkable. I believe that nearly one-half of the hitherto-described species of passerine birds from New Guinea will be found in my Aru collections, a proportion which we could only expect if all the species of the latter country inhabit also the former. Such an identity occurs, I believe, in no other countries separated by so wide an interval of sea, for the average distance of the coast of Aru from that of New Guinea is at least 150 miles, and the points of nearest approach upwards of 100. Ceylon is nearer to India; Van Diemen's Land is not farther from Australia, nor Sardinia from Italy; yet all these countries present differences more or less marked in their faunas; they possess each their peculiar species, and sometimes even peculiar genera. Almost the only islands possessing a rich fauna, but identical with that of the adjacent continent, are Great Britain and Sicily, and that circumstance is held to prove that they have been once a portion of such continents, and geological evidence shows that the separation had taken place at no distant period. We must, therefore, suppose Aru to have once formed a part of New Guinea, in order to account for its peculiar fauna, and this view is supported by the physical geography of the islands; for, while the fathomless Molucca sea extends to within a few miles of them on the west, the whole space eastward to New Guinea, and southward to Australia, is occupied by a bank of soundings at a uniform depth of about 30 or 40 fathoms. But there is another circumstance still more strongly proving this connexion: the great island of Aru, 80 miles in length from north to south, is traversed by three winding channels of such uniform width and depth, though passing through an irregular, undulating, rocky country, that they seem portions of true rivers, though now occupied by salt water, and open at each end to the entrance of the tides. This phænomenon is unique, and we can account for their formation in no other way than by supposing them to have been once true rivers, having their source in the mountains of New Guinea, and reduced to their present condition by the subsidence of the intervening land.

This view of the origin of the Aru fauna is further confirmed by considering what it is not, as well as what it is; its deficiencies teach as much as what it possesses. There are certain families of birds highly characteristic of the Indian Archipelago in its western and better-known portion. In the Peninsula of Malacca, Sumatra, Java, Borneo and the Philippine Islands, the following families are abundant in species and in individuals. They are everywhere *common birds*. They are the *Buceridæ*, *Picidæ*, *Bucconidæ*, *Trogonidæ*, *Meropidæ*, and *Eurylaimidæ*; but not one species of all these families is found in Aru, nor, with two doubtful exceptions, in New Guinea. The whole are also absent from Australia. To complete our view of the subject, it is necessary also to consider the Mammalia, which present peculiarities and deficiencies even yet more striking. Not one species found in the great islands westward inhabits Aru or New Guinea. With the exception only of pigs and bats, not a genus, not a family, not even an order of mammals is found in common. No Quadrumana, no Sciuridæ, no Carnivora, Rodentia, or Ungulata inhabit these depopulated forests. With the two exceptions above mentioned, all the mammalia are *Marsupials*; in the great western islands there is not a single marsupial! A kangaroo inhabits Aru (and several New Guinea), and this, with three or four species of *Cuscus*, two or three little rat-like marsupials, a wild pig and several bats, are all the mammalia I have been able either to obtain or hear of.

It is to the full development of such interesting details that the collector and the systematist contribute so largely. In this point of view the discovery of every new species is important, and their correct description and accurate identification absolutely necessary. The most obscure and minute species are for this purpose of equal value with the largest and most brilliant, and a correct knowledge of the distribution and variations of a beetle or a butterfly as important as those of the eagle or the elephant. It is to the elucidation of these apparent anomalies that the efforts of the philosophic naturalist are directed; and we think, that if this highest branch of our science were more frequently alluded to by writers on natural history, its connexion with geography and geology discussed, and the various interesting problems thence arising explained, the too prevalent idea—that Natural History is at best but an amusement, a trivial and aimless pursuit, a useless accumulating of barren facts,—would give place to more correct views of a study, which presents problems as vast, as intricate, and as interesting as any to which the human mind can be directed, whose objects are as infinite as the stars of heaven and infinitely diversified, and whose field of research extends over the whole earth, not only as it now exists, but also during the countless changes it has undergone from the earliest geological epochs.

Let us now examine if the theories of modern naturalists will explain the phænomena of the Aru and New Guinea fauna. We know (with a degree of knowledge approaching to certainty) that at a comparatively recent geological period, not one single species of the present organic world was in existence; while all the *Vertebrata* now existing have had their origin still more recently. How do we account for the places where they came into existence? Why are not the same species found in the same climates all over the world? The general explanation given is, that as the ancient species became extinct, new ones were created in each country or district, adapted to the physical conditions of that district. Sir C. Lyell, who has written more fully, and with more ability, on this subject than most naturalists, adopts this view. He illustrates it by speculating on the vast physical changes that might be effected in North Africa by the upheaval of a chain of mountains in the Sahara. "Then," he says, "the animals and plants of Northern Africa would disappear, and the region would gradually become fitted for the reception of a population of species *perfectly dissimilar in their forms, habits, and organization.*" Now this theory implies, that we shall find a general similarity in the productions of countries which resemble each other in climate and general aspect, while there shall be a complete dissimilarity between those which are totally opposed in these respects. And if this is the general law which has determined the distribution of the existing organic world, there must be no exceptions, no striking contradictions. Now we have seen how totally the productions of New Guinea differ from those of the Western Islands of the Archipelago, say Borneo, as the type of the rest, and as almost exactly equal in area to New Guinea. This difference, it must be well remarked, is not one of species, but of genera, families, and whole orders. Yet it would be difficult to point out two countries more exactly resembling each other in climate and physical features. In neither is there any marked dry season, rain falling more or less all the year round; both are near the equator, both subject to the east and west monsoons, both everywhere covered with lofty forest; both have a great extent of flat, swampy coast and a mountainous interior; both are rich in Palms and Pandanaceæ. If, on the other hand, we compare Australia with New Guinea, we can scarcely find a stronger contrast than in their physical conditions: the one near the equator, the other near and beyond the tropics; the one enjoying perpetual moisture, the other with alternations of excessive drought; the one a vast ever-verdant forest, the other dry open woods, downs, or deserts. Yet the faunas of the two, though mostly distinct in species, are strikingly similar in character. Every family of birds (except *Menuridæ*) found in Australia also inhabits New Guinea, while all those striking deficiencies of the latter exist equally in the former. But a considerable proportion of the characteristic Australian *genera* are also found in New Guinea, and, when that country is better known, it is to be supposed that the number will be increased. In the Mammalia it is the same. Marsupials are almost the only quadrupeds in the one as in the other. If kangaroos are especially adapted to the dry plains and open woods of Australia, there must be some other reason for their introduction into the dense damp forests of New Guinea, and we can hardly imagine that the great variety of monkeys, of squirrels, of Insectivora, and of Felidæ, were created in Borneo because the country was adapted to them, and not one single species given to another country exactly similar, and at no great distance. If there is any reason in the hardness of the woods or the scarcity of wood-boring insects, why woodpeckers should be absent from Australia, there is none why they should not swarm in the forests of New Guinea as well as in those of Borneo and Malacca. We can hardly help concluding, therefore, that some other law has regulated the distribution of existing species than the physical conditions of the countries in which they are found, or we should not see countries the most opposite in character with similar productions, while others almost exactly alike as respects climate and general aspect, yet differ totally in their forms of organic life.

In a former Number of this periodical we endeavoured to show that the simple law, of every new creation being closely allied to some species already existing in the same country, would explain all these anomalies, if taken in conjunction with the changes of surface and the gradual extinction and introduction of species, which are facts proved by geology. At the period when New Guinea and North Australia were united, it is probable that their physical features and climate were more similar, and that a considerable proportion of the species inhabiting each portion of the country were found over the whole. After the separation took place, we can easily understand how the climate of both might be considerably modified, and this might perhaps lead to the extinction of certain species. During the period that has since elapsed, new species have been gradually introduced into each, but in each closely allied to the pre-existing species, many of which were at first common to the two countries. This process would evidently produce the present condition of the two faunas, in which there are many allied species,—few identical. The great well-marked groups absent from the one would necessarily be so from the other also, for however much they might be *adapted* to the country, the law of close affinity would not allow of their appearance, except by a long succession of steps occupying an immense geological interval. The species which at the time of separation were found only in one country, would, by the gradual introduction of species allied to them, give rise to groups peculiar to that country. This separation of New Guinea from Australia no doubt took place while Aru yet formed part of the former island. Its separation must have occurred at a very recent period, the number of species common to the two showing that scarcely any extinctions have since taken place, and probably as few introductions of new species.

If we now suppose the Aru Islands to remain undisturbed during a period equal to about one division of the Tertiary epoch of geologists, we have reason to believe that the change of species of Vertebrata will become complete, an entirely new race having gradually been introduced, but all more or less closely allied to those now existing. During the same period a new fauna will also have arisen in New Guinea, and then the two will present the same comparative features that North Australia and New Guinea do now. Let the process of gradual change still go on for another period regulated by the same laws. Some species will then have become extinct in the one country, and unreplaced, while in the other a numerous series of modified species may have been introduced. Then the faunas will come to differ not in species only, but in generic groups. There would be then the resemblance between them that there is between the West

India Islands and Mexico. During another geological period, let us suppose Aru to be elevated, and become a mountainous country, and extended by alluvial plains, while New Guinea was depressed, reduced in area, and thus many of its species perhaps extinguished. New species might then be more rapidly introduced into the modified and enlarged country; some groups, which had been early extinct in the other, might thus become very rich in species, and then we should have an exact counterpart of what we see now in Madagascar, where the families and some of the genera are African, but where there are many extensive groups of species forming peculiar genera, or even families, but still with a general resemblance to African forms. In this manner, it is believed, we may account for the facts of the present distribution of animals, without supposing any changes but what we know have been constantly going on. It is quite unnecessary to suppose that new species have ever been created "perfectly dissimilar in forms, habits, and organization" from those which have preceded them; neither do "centres of creation," which have been advocated by some, appear either necessary or accordant with facts, unless we suppose a "centre" in every island and in every district which possesses a peculiar species.

It is evident that, for the complete elucidation of the present state of the fauna of each island and each country, we require a knowledge of its geological history, its elevations and subsidences, and all the changes it has undergone since it last rose above the ocean. This can very seldom be obtained; but a knowledge of the fauna and its relation to that of the neighbouring countries will often throw great light upon the geology, and enable us to trace out with tolerable certainty its past history. A consideration of the birds of Aru has led us at some length into this subject, both on account of the interest attached to it, and because we are not aware of any attempt to explain in detail how the existing distribution of species has arisen, or strictly to connect it with those changes of surface which all countries have undergone. The Birds and Mammalia only have been used for illustration, because they are much better known than any other groups. The Insects, however, of which I have made a very extensive collection, furnish exactly similar results, and were these, particularly the Coleoptera, well known, they would perhaps be preferable to any group for such an inquiry, from the great number of their genera and species, and the very limited range which many of them attain. In imperfectly explored countries, however, Birds are almost always better known than any other group, as a larger proportion of the whole number of species may be obtained in a limited time. I think it probable that I have collected more than half the birds inhabiting Aru, while I do not imagine I have obtained one fifth part of the Insects. The following is a brief summary of my collections in this class :—

Coleoptera	572	species.
Lepidoptera	229	"
Hymenoptera	214	"
Diptera	185	"
Hemiptera and Homoptera	130	"
Orthoptera and Neuroptera, &c.	34	"

Making a total of 1364 species.

Lest the conchologists should think I have quite neglected their interests, I may mention, that I have collected all the land-shells I could find or procure from the natives. I have only obtained, however, 25 species. Almost all are Helices (20 species), some pretty and some of curious forms, but I am not sufficiently acquainted with shells to say how much novelty they present. It is remarkable that I have not found a single *Bulimus*, which in Celebes was the most abundant group; the few *Cyclostomata* are also small and obscure. Reptiles are scarce. I did not see a snake six times in as many months. There are, however, on the shores many sea-snakes, whose bite is very deadly. The natives spear and eat them. Lizards are rather plentiful in species and individuals; they are almost all plant-dwellers, and run on the leaves and twigs with great agility. The coasts swarm with fish in immense variety, and mollusca innumerable. A shell-collector would obtain a fine harvest, but I have been too fully occupied myself to attend to any of these last-mentioned groups; having often found the greatest difficulty in properly drying and securing my bird and insect collections in the rude houses, boats, and sheds I have been compelled to occupy. Damp, mites, ants, rats and dogs, are all enemies which must be guarded against with ever-watchful vigilance, and from all of them I have suffered more or less severely. Bird and animal skins require daily exposure to air and sun for weeks before they are dry enough to pack away. In this time they accumulate to such an extent, that it is a constant puzzle and difficulty to find places to put them in, so as to keep them free from ants, which establish colonies inside the skin, whence they sally out to gnaw the eyelids, the base of the bill and the feet; arsenic they laugh to scorn; and there is absolutely nothing that will keep them away but water-isolation, which again requires space and constant care to keep perfect. When to these are added insect specimens by thousands, requiring still greater care, the mere labour of watching the collections during the time they must remain exposed to the air, to sunshine, and often to artificial heat, is greater than a collector in a temperate climate, and residing in weather-tight roomy houses, can have any conception of. These remarks are merely my apology for not collecting *everything*, which stay-at-home naturalists often imagine may be as easily done anywhere else as in England.

XLVI.—*Thoughts on Species.* By James D. Dana *.

While direct investigation of individual objects in nature is the true method of ascertaining the laws and limits of species, we have another source of suggestion and authority in the comprehensive principles that pervade the universe. The source of doubt in this synthetic mode of reaching truth consists in our imperfect appreciation of universal law. But science has already searched deeply enough into the different departments of nature to harmonize many of the thoughts that are coming in from her wide limits; and it is well, as we go on in research, to compare the results of observations with these utterings of her universality.

I propose to present some thoughts on species from the latter point of view, reasoning from central principles to the circumferential, and, if I mistake not, we shall find the light from this direction sufficiently clear to illumine a subject which is yet involved in doubts and difficulties.

The questions before us at this time are—

1. What is a species?
2. Are species permanent?
3. What is the basis of variations in species?

1. *What is a species?*

It is common to define a species as *a group*, comprising such individuals as are alike in *fundamental* qualities; and then by way of elucidation, to explain what is meant by fundamental qualities. But the idea of a group is not essential; and moreover it tends to confuse the mind by bringing before it, in the outset, the endless diversities in individuals, and suggesting numberless questions that vary in answer for each kingdom, class, or subordinate group. It is better to approach the subject from a profounder point of view, search for the true idea of distinction among species, and then proceed onward to a consideration of the systems of variables.

Let us look first to *inorganic* nature. From the study of the inorganic world we learn that each element is represented by a

* From Silliman's Journal for Nov. 1857; having been read before the American Association at Montreal, Aug. 13, 1857.

specific amount or law of force; and we even set down in numbers the precise value of this force as regards one of the deepest of its qualities, chemical attraction. Taking the lightest element as a unit to measure others by, as to their weights in combination, oxygen stands in our books as 8; and it is precisely of this numerical value in its compounds: each molecule is an 8 in its chemical force or law, or some simple multiple of it. In the same way there is a specific number at the basis of other qualities. Whenever then the oxygen amount and kind of force was concentered in a molecule, in the act of creation, the species oxygen commenced to exist. And the making of many such molecules instead of one, was only a repetition in each molecule, of the idea of oxygen.

In combinations of the elements, as of oxygen and hydrogen, the resultant molecule is still equivalent to a fixed amount, condition, or law, of chemical force; and this law, which we express in numbers, is at the basis of our notion of the new species.

It is not necessarily a different amount of force; for it may be simply a different state of concentration or different rate or law of action. This should be kept in mind in connexion with what follows *.

The essential idea of a species, thence deduced, is this: *a species* corresponds to *a specific amount or condition of concentered force, defined in the act or law of creation.*

Turn now to the organic world. The individual is involved in the germ-cell from which it proceeds. That cell possesses certain inherent qualities or powers, bearing a definite relation to external nature, so that, when having its appropriate nidus or surrounding conditions, it will grow, and develope out each organ and member to the completed result, and this, both as to all chemical changes, and the evolution of the structure which belongs to it as a subordinate to some kingdom, class, order, genus and species in nature. The germ-cell of an organic being developes a specific result; and like the molecule of oxygen, it must correspond to a measured quota or specific law of force. We cannot apply the measure, as in the inorganic kingdom, for we have learned no method or unit of comparison. But it must nevertheless be true, that a specific predetermined amount, or

* When we have in view oxygen and the elements, we are apt to think of their molecules as distinguished by a different *amount* and *kind* of force. But when we consider the many different compounds that may be made of the same elements (as carbon and hydrogen), in the very *same* proportions, we are led to conceive of these as differing molecularly in a different *law* of the same force or forces. When, again, we see the same element under conditions as diverse as any two compounds, as in cases of allotropism, we are still better satisfied with adopting, for the present, the most general expression—a different law of action or condition of molecular force.

condition, or law of force is an equivalent of every germ-cell in the kingdoms of life. I do not mean to say that there is but one kind of force; but that, whatever the kind or kinds, it has a numerical value or law, although human arithmetic may never give it expression.

A species among living beings, then, as well as inorganic, is based on *a specific amount or condition of concentered force defined in the act or law of creation.*

Any one species has its specific value or law of force; another, its value; and so for all: and we perceive the fundamental notion of the distinction between species when we view them from this potential stand-point. The species, in any particular case, began its existence when the first germ-cell or individual was created; and if several germ-cells of equivalent force were created, or several individuals, each was but a repetition of the other: the species is in the potential nature of the individual, whether one or many individuals exist.

Now in organic beings,—unlike the inorganic,—there is a cycle of progress involving growth and decline. The oxygen molecule may be eternal as far as anything in its nature goes. But the germ-cell is only an incipient state in a cycle of changes, and is not the same for two successive instants; and this cycle is such that it includes in its flow, a reproduction, after an interval, of a precise equivalent of the pareut germ-cell. Thus an indefinite perpetuation of the germ-cell is in fact effected; yet it is not mere endless being, but like evolving like in an unlimited round. Hence, when individuals multiply from generation to generation, it is but a repetition of the primordial type-idea; and the true notion of the species is not in the resulting group, but in the idea or potential element which is at the basis of every individual of the group; that is, the specific law of force, alike in all, upon which the power of each as an existence and agent in nature depends. Dr. Morton presented nearly the same idea when he described a species as *a primordial organic form.*

Having reached this idea as the starting-point in our notion of a species, we must still, in order to complete and perfect our view, consider what is the true expression of this potentiality. For this purpose, we should have again in mind, that a living cell, unlike an inorganic molecule, has only a historical existence. The species is not the adult resultant of growth, nor the initial germ-cell, nor its condition at any other point; it comprises the whole history of the development. Each species has its own special mode of development as well as ultimate form or result, its serial unfolding, inworking and outflowing; so that the precise nature of the potentiality in each is expressed by the line of historical progress from the germ to the full expansion of its powers, and the realization of the end of its being. We comprehend the type-idea only when we understand the cycle of evolution through all its laws of progress, both as regards the living structure under development within, and its successive relations to the external world.

2. *Permanence of species.*

What now may we infer with regard to the permanence or fixedness of species from a general survey of nature?

Let us turn again to the inorganic world. Do we there find oxygen blending by indefinite shadings with hydrogen or with any other element? Is its combining number, its potential equivalent, a varying number,—usually 8, but at times 8 and a fraction, 9, and so on? Far from this, the number is as fixed as the universe. There are no indefinite blendings of elements. There are combinations by multiples or submultiples, but these prove the dominance and fixedness of the combining numbers.

But further than this, fixed numbers, definite in value and defiant of all destroying powers, are well known to characterize nature from its basement to its top-stone. We find them in combinations by volume as well as weight; that is, in all the relations of chemical attraction; in the mathematical forms of crystals and the simple ratios in their modifications,—evidence of a numerical basis to cohesive attraction; in the laws of light, heat, and sound. Indeed, the whole constitution of inorganic nature, and of our minds with reference to nature, as Professor Peirce has well illustrated, involves fixed numbers; and the universe is not only based on mathematics, but on finite determinate numbers in the very natures of all its elemental forces. Thus the temple of nature is made, we may say, of hewn and measured stones, so that, although reaching to the heavens, we may measure, and thus use the finite to rise towards the infinite.

This being true for inorganic nature, it is necessarily the law for all nature; for the ideas that pervade the universe are not ideas of contrariety, but of unity and universality beneath and through diversity.

The units of the inorganic world are the weighed elements and their definite compounds or their molecules. The units of the organic are *species,* which exhibit themselves in their simplest condition in the germ-cell state. The kingdoms of life in all their magnificent proportions are made from these units. Were these units capable of blending with one another indefinitely, they would no longer be units, and species could not be recognized. The system of life would be a maze of complexities; and whatever its grandeur to a being that could comprehend the infinite, it would be unintelligible chaos to man. The very beauties that might charm the soul would tend to engender hopeless despair in the thoughtful mind, instead of supplying its aspirations with eternal and ever-expanding truth. It would be to man the temple of nature fused over its whole surface and through its structure, without a line the mind could measure or comprehend.

Looking to facts in nature, we see accordingly everywhere, that the purity of species has been guarded with great precision. It strikes us naturally with wonder, that even in senseless plants, without the emotional repugnance of instinct, and with reproductive organs that are all outside, the free winds being often the means of transmission, there should be rigid law sustained against intermixture. The supposed cases of perpetuated fertile hybridity are so exceedingly few as almost to condemn themselves, as no true examples of an abnormity so abhorrent to the system. They violate a principle so essential to the integrity of the plant-kingdom, and so opposed to nature's whole plan, that we rightly demand long and careful study before admitting the exceptions.

A few words will explain what is meant by perpetuated fertile hybridity. The following are the supposable grades of results from intermixture between two species :—

1. No issue whatever—the usual case in nature.

2. Mules (naming thus the issue) that are wholly infertile whether among themselves or in case of connexion with the pure or original stock.

3. Mules that are wholly infertile among themselves, but may have issue for a generation or two by connexion with one of the original stock.

4. Mules that are wholly infertile among themselves, but may have issue through indefinite generations by connexion for each with an individual of the original stock.

5. Mules that are fertile among themselves through one or two generations.

6. Mules that are fertile among themselves through many generations.

7. Mules that are fertile among themselves through an indefinite number of generations.

The cases 1 to 5 are known to be established facts in nature; and each bears its testimony to the grand law of purity and permanence. The examples under the heads 2 to 5 become severally less and less numerous, and art must generally use an unnatural play of forces or arrangements to bring them about.

Again, in the animal kingdom, there is the same aversion in nature to intermixture, and it is emotional as well as physical. The supposed cases of fertile hybridity are fewer than among plants.

Moreover, in both kingdoms, if hybridity be begun, nature commences at once to purify herself as of an ulcer on the system. It is treated like a disease, and the energies of the species combine to throw it off. The short run of hybridity between the horse and the ass, species very closely related, reaching its end *in one single generation*, instead of favouring the idea that perpetuated fertile hybridity is possible, is a speaking protest against a principle that would ruin the system if allowed free scope.

The finiteness of nature in all her proportions, and the necessity of finiteness and fixedness for the very existence of a kingdom of life, or of human science, its impress on finite mind, are hence strong arguments for the belief that hybridity cannot seriously trifle with the true units of nature, and, at the best, can only make temporary variations.

It is fair to make the supposition, that in case of a very close proximity of species, there might be a degree of fertile hybridity allowed; and that a closer and closer affinity *might* give a longer and longer range of fertility. But the case just now alluded to seems to cut the hypothesis short; and moreover it is not reasonable to attribute such indefiniteness to nature's outlines, for it is at variance with the spirit of her system.

Were such a case demonstrated by well-established facts, it would necessarily be admitted; and I would add, that investigations directed to this point are the most important that modern science can undertake. But until proved by arguments better than those drawn from domesticated animals, we may plead the general principle against the *possibilities* on the other side. If there is a law to be discovered, it is a wide and comprehensive law, for such are all nature's principles. Nature will teach it, not in one corner of her system only, but more or less in every part. We have therefore a right to ask for well-defined facts, taken from the study of successive generations, of the interbreeding of species known to be distinct.

Least of all should we expect that a law, which is so rigid among plants and the lower animals, should have its main exceptions in the highest class of the animal kingdom, and its most extravagant violations in the genus Homo; for if there be more than one species of Man, they have become in the main indefinite by intermixture. The very crown of the kingdom has been despoiled; for a kingdom in nature is perfect only as it retains all its original parts in their full symmetry, undefaced and unblurred. Man, by receiving a plastic body, in accordance with a law that species most capable of domestication should necessarily be most pliant, was fitted to take the whole earth as his dominion, and live under every zone. And surely it would have been a very clumsy method of accomplishing the same result, to have made him of many species, all admitting of indefinite or nearly indefinite hybridization, in direct opposition to a grand principle elsewhere recognized in the organic kingdoms. It would have been using a process that produces impotence or nothing among animals, for the perpetuation and progress of the human race.

There are other ways of accounting for the limited productiveness of the Mulatto, without appealing to a distinction of species. There are causes, independent of mixture, which are making the Indian to melt away before the white man, the Sandwich Islander and all savage people to sink into the ground before the power and energy of higher intelligence. They disappear like plants beneath those of stronger root and growth, being depressed morally, intellectually and physically, contaminated by new vices, tainted variously by foreign disease, and dwindled in all their hopes and aims and means of progress, through an overshadowing race.

We have therefore reason to believe, from man's fertile intermixture, that he is one in species; and that all organic species are divine appointments which cannot be obliterated, unless by annihilating the individuals representing the species.

It may be said, that different species in the inorganic world combine so as to form new units, and why may they not in the organic? It is true they combine, but not by indefinite blendings. There is a definite law of multiples, and this is the central idea in the system of inorganic nature. In organic nature, such a law of multiples, if existing, would be general, as in the inorganic; it would be an essential part of the system and should be easily verified, while, in fact, observation lends it no support, not even enough to have suggested the hypothesis.

In one kingdom, the *inorganic*, there is multiplication of kinds of units by combination, according to the law of multiples, and no reproduction; while in the *organic*, there is reproduction of like from like, and no multiplication of kinds by combination. And thus the two departments of living and dead nature widely diverge.

Neither does the possibility of mere mixture among inorganic substances afford any analogy to sustain the idea of possible hybrid mixture indefinitely perpetuated, among living beings. The mechanical aggregation of units that make up ordinary mixture, is one thing; and the combination that would alter a germ, one of the units in organic species, even to its fundamental nature, is quite another. This last is not aggregation. It is as different from mere mixture as is chemical combination, and stands somewhat in the same relation, so that the analogy has no bearing on the question.

3. *Variations of species.*

But there are variations in species, and this is our next topic. The principles already considered teach, as we believe, that each species has its specific value as a unit, which is essentially permanent or indestructible by any natural source of change; and we have, therefore, to admit in the outset, if these principles are true, that variations have their limits, and cannot extend to the obliteration of the fundamental characteristics of a species.

To understand these variations, we may again appeal to general truths.

Variation is a characteristic of all things finite, and is involved in the very conditions of existence. No substance or body can be wholly independent of every or any other body in the universe. The most comprehensive and influential law in nature, the most fundamental in all change, composition, or decomposition, growth or decay, is the law of mutual sympathy, or tendency to equilibrium in force through universal action and reaction.

The planets have their orbits modified by other bodies in space through their changing relations to those bodies. A substance, as oxygen or iron, varies in temperature and state of expansion from the presence of a body of different temperature; in chemical tendencies from the presence of a luminous body like the sun; in magnetic or electrical attraction from surrounding magnetic or electrical influences. There is thus unceasing flow and unceasing change through the universe. All the natural forces are closely related as if a common family or group, and are in constant mutual interplay.

The degree or kind of variation has its specific law for each element; and in this law the specific nature of the element is in a degree expressed. There is to each body or species the normal or fundamental force in which its very nature consists; and, in addition, the relations of this force to other bodies, or kinds, amounts or conditions of force, upon which its variations depend. One great end of inorganic science is to study out the law of variables for each element or species. For this law is as much a part of an idea of the species, as the fundamental potentiality; indeed the one is a measure of the other.

So again, a species in the *organic* kingdoms is subject to variations, and upon the same principle. Its very development depends on the appropriation of material around it, and on attending physical forces or conditions, all of which are variable through the whole of its history. Every chemical or molecular law in the universe is concerned in the growth,—the laws of heat, light, electricity, cohesion, &c.; and the progress of the developing germ, whatever its primal potentiality, is unavoidably subject to variations, from the diversified influences to which it may be exposed. The new germ, moreover, takes peculiarities from the parent, or from the circumstances to which its ancestry had been exposed during one or more preceding generations.

There is then a fixed normal condition or value, and around it librations take place. There is a central or intrinsic law which prevents a species from being drawn off to its destruction by any external agency, while subject to greater or less variations under extrinsic forces.

Liability to variation is hence part of the law of a species; and we cannot be said to comprehend in any case the complete idea of the type until the relations to external forces are also known. The law of variables is as much an expression of the fundamental equalities of the species in organic as in inorganic nature; and it should be the great aim of science to investigate it for every species. It is a source of knowledge which will yet give us a deep insight into the fundamental laws of life. Variations are not to be arranged under the head of *accidents*; for there is nothing accidental in nature; what we so call, are expressions really of profound law, and often betray truth and law which we should otherwise never suspect.

This process of variation is the external revealing the internal, through their sympathetic relations; it is the law of universal nature reacting on the law of a special nature, and compelling the latter to exhibit its qualities; it is a centre of force manifesting its potentiality, not in its own inner working, but in its outgoings among the equilibrating forces around, and thus offering us, through the known and physical, some measure of the vital within the germ. It is therefore one of the richest sources of truth open to our search.

The limits of variation, it may be difficult to define among species that have close relations. But being sure that there are limits,—that science, in looking for law and order written out in legible characters, is not in fruitless search, we need not despair of discovering them. The zoologist, gathering shells or mollusks from the coast of eastern America and that of Japan, after careful study, makes out his lists of identical species, with the full assurance that species are definite and stable existences; and he is even surprised with the identity of characters between the individuals of a species gathered from so remote localities. And as he sees zoological geography rising into one of the grandest of the sciences, his faith in species becomes identified with his faith in nature and all physical truth.

If then we may trust this argument from general truths to special,—general *truths* I say, for general principles as far as established are truths—we should conceive of a species from the potential point of view, and regard it as—

a. A concentered unit of force, an ineffaceable component of the system of nature; but

b. Subject to greater or less librations, according to the universal law of mutual reaction or sympathy among forces.

And, in addition, in the *organic* kingdom,

c. Exhibiting its potentiality not simply or wholly in any existing condition or action, but through a cycle of growth from the primal germ to maturity, when the new germ comes forth as a repetition of the first to go another round in the cycle and perpetuate the original unit; and, therefore, as follows from a necessary perpetuity of the cycle—

d. Exhibiting identity of species among individuals, by perpetuated fertile intermixture in all normal conditions, and non-identity by the impossibility of such intermixture, the rare cases of continuation for one or two generations attesting to the stability of the law, by proving the effort of nature to rid herself of the abnormity, and her success in the effort.

e. The many like individuals that are conspecific do not properly constitute the species, but each is an expression of the species in its potentiality under some one phase of its variables; and to understand a species, we must know its law through all its cycle of growth, and its complete series of librations.

We should therefore conceive of the system of nature as involving, in its idea, a system of units, finite constituents at the basis of all things, each fixed in law; these units in inorganic nature as adding to their kinds by combinations in definite proportions; and those in organic nature adding to their numbers of representative individuals, but *not* kinds, by self-reproduction; and all adding to their varieties by mutual reaction or sympathy. Thus from the law within and the law without, under the Being above as the Author and sustainer of all law, the world has its diversity, the Cosmos its fullness of beauty.

I would remark again, that we must consider this mode of reaching truth, by reasoning from the general to the special, as requiring also its complement, direct observation, to give unwavering confidence to the mind; and we should therefore encourage research with a willingness to receive whatever results come from nature. We should give a high place in our estimate to all investigation tending to elucidate the variation or permanence of species, their mutability or immutability; and at the same time, in order that appearances may not deceive us, we should glance towards other departments of nature, remembering that all truth is harmonious, and comprehensive law the end of science.

A word further upon our conceptions of species as realities.

In acquiring the first idea of species, we pass, by induction, as in other cases of generalization, from the special details displayed among individuals to a general notion of a unity of type; and this general notion, when written out in words, we may take as an approximate formula of the species. One system of philosophy thence argues that this result of induction is nothing but a notion of the mind, and that species are but an imaginary product of logic; or at least, that since, as they say (we do not now discuss this point), genera are groupings without definite limits which may be laid off variously by different minds, so species are undefined, and individuals are the only realities—the supposed limits to species being regarded as proof of partial study, or a consequence of a partial development of the kingdoms of nature. Another system infers, on the contrary, that species are realities, and that the general or type-idea has, in some sense, a *real* existence. A third admits that species are essentially realities in nature, but claims that the general idea exists only as a result of logical induction.

The discussion in the preceding pages sustains most nearly the last view, that species are realities in the system of nature while manifest to us only in individuals; that is, they are so far real, that the idea for each is definite, even of mathematical strictness (although not thus precise in our limited view), it proceeding from the mathematical and finite basis of nature. They are the units fixed in the plan of creation; and individuals are the material expressions of those ideal units.

At the same time, we learn, that while species are realities in a most important and fundamental sense, no comprehensive type-idea of a species can be represented in any material or immaterial existence. For while a species has its constants, it has also its variables, each variable becoming a constant so far only as its law and limits of variation are fixed; and in the organic kingdoms, moreover, each individual has its historic phases, from the germ through the cycle of growth. The general idea sought out by induction, therefore, is not made up of *in*variables. Limited to these, it represents no object, class of objects, or law, in nature. The variables are a necessary complement to the invariables; and the complete species-idea is present to the mind, only when the image in view is seen to be ever changing along the lines of variables and development. Whatever individualized conception is entertained, it is evidently a conception of the species in one of its phases,—that is, under some one specific condition as to size, form, colour, constitution, &c., as regards each part in the structure, from among the many variations in all these respects that are possible: mind can picture to itself individuals only and not species, and one phase at a time in the life of an organic individual, not the whole cycle.

We may attempt to reach what is called the typical form of a species, in order to make this the subject of a conception. But even within the closest range of what may be taken as typical characters, there are still variables; and moreover, we repeat it, no one form, typical though we consider it, can be a full expression of the species, as long as variables are as much an essential part of its idea as constants. The advantage of fixing upon some one variety as the typical form of a species is this,—that the mind may have an initial term for the laws embraced under the idea of the species, or an assumed centre of radiation for its variant series, so as more easily to comprehend those laws.

Again, abrupt transitions and not indefinite shadings have been shown to be the law of nature. In proceeding from special characters to a general species-idea, nature gives us help through her stepping-stones and barriers. In former times, man looked at iron and other metals from the outside only, and searching out their differences of sensible characters, gradually eliminated the general notion of each, by the ordinary logical method of generalization. But science now brings the elements to the line and plummet, and reaches a fixed *number* for iron and other elements as to chemical combination, &c. By this means, the studying-out of the idea of a species seems almost to have escaped from the domain of logic into that of direct trial by weights and measures. It is no longer the undefined progress of simple reason, with a mere notion at the end, but an appeal to definite measurable values, with stable numbers at bottom, fixed in the very foundations of the universe. So, in the organic kingdoms, where there is, to our limited minds, still greater indefiniteness in most characters, the barrier against hybridity appears to stand as a physical test of species. We are thus enabled, in searching into the nature of a species, to strike from the outside detail to the foundation law.

The type-idea, as it presents itself to the mind, is no more a subject of defined conception than any mathematical expression. Could we put in mathematical terms the precise law, in all its comprehensiveness, which is at the basis of the species iron, as we can for one of its qualities, that of chemical attraction, this mathematical expression would stand as a representative of the species; and we might use it in calculations, precisely as we can use any mathematical term. So also, if we could write out in numbers the potential nature of an organic species, or of its germ, including the laws of its variables, this expression would be like any other term in the hands of a mathematician; the mind would receive the formula as an expression for the species, and might compare it with the formulas of other species. But, after all, we have here a mere mathematical abstraction, a symbol for an amount or law of force, which can be turned into conceptions, only by imagining (supposing this possible) the force in the course of its evolution of concrete realities, according to the law of development and laws of variations embraced within it.

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

[Continued from vol. xiv. p. 33.]

Tribe OCTONOCULINA.

Family Mygalidæ.

Genus *Atypus*, Latr.

Atypus Sulzeri.

To the remarks on this species given in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. vii. p. 257) add the following particulars. Since the instances of the capture of *Atypus Sulzeri*, recorded by Dr. Leach, several females have been procured by the Rev. Hamlet Clark from the neighbourhood of Carlisle; Mr. R. H. Meade also has received specimens of it from Mr. Newman, which were found in lanes near Hastings in the autumn of 1855; and Mr. O. P. Cambridge took an adult male early in January 1857, from a rabbit-earth in Dorsetshire, which Mr. Meade afforded me an opportunity of inspecting.

Family Lycosidæ.

Genus *Lycosa*, Latr.

After *Lycosa rapax* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. vii. p. 258) add

Lycosa herbigrada.

Lycosa herbigrada, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xx. p. 285.

Two adult and two immature females of this *Lycosa* were forwarded to me in Wales, in December 1856, by Mr. R. H. Meade. The two former were discovered by Mr. O. P. Cambridge under a stone, near Pennsylvania Castle, in the Isle of

Portland, on the 29th of September 1854; and the two latter were captured in July 1854, in Morden Park, near Bloxworth House, Dorsetshire, by the same gentleman.

After *Lycosa piratica* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. vii. p. 397) add

Lycosa piscatoria.

Lycosa (*Potamia*) *piscatoria*, Koch, Die Arachn. B. xv. p. 6. tab. 506. figs. 1417–1419.

Mr. R. H. Meade took adult males and females of this species, which is closely allied to *Lycosa piratica*, in the last week of June 1856, in a swampy piece of ground in Buckinghamshire, and transmitted them to me for inspection.

Family Salticidæ.

Genus *Salticus*, Latr.

After *Salticus Jenynsii* in the supplement to the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. xiv. p. 29) add

Salticus Blackwallii.

Salticus Blackwallii, Clark, Ann. and Mag. Nat. Hist. 2nd Series, vol. xvi. p. 329.

This fine species was discovered by the Rev. Hamlet Clark in September 1855, on a gate near the sea-shore, at Southport in Lancashire.

Family Thomisidæ.

Genus *Thomisus*, Walck.

After *Thomisus erraticus* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. vii. p. 449) add

Thomisus sabulosus.

Thomisus sabulosus, Hahn, Die Arachn. B. i. p. 28. tab. 8. fig. 24.
Xysticus sabulosus, Koch, Die Arachn. B. xii. p. 64. tab. 411. figs. 999, 1000.

M. Walckenaer has placed this spider among the synonyma of *Thomisus cristatus*, from which it differs in size and in the design formed by the distribution of its colours; and on referring to M. Koch's 'Uebers. des Arachn. Syst.' erstes Heft, p. 25, it will be seen that *Thomisus sabulosus* had been confounded with *Thomisus lanio* (*Xysticus lanio*, Koch) by that arachnologist, an error which he afterwards corrected in treating on the species in the twelfth volume of 'Die Arachniden,' p. 66.

Four immature females were taken near Blandford in Dorsetshire, by Mr. O. P. Cambridge, and were forwarded to me, in December 1856, by Mr. R. H. Meade.

Genus *Philodromus,* Walck.

After *Philodromus dispar* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. vii. p. 451) add

Philodromus pallidus.

Philodromus pallidus, Walck. Hist. Nat. des Insect. Apt. t. i. p. 554.
Artamus griseus, Koch, Die Arachn. B. xii. p. 81. tab. 415. figs. 1013, 1014.

On the 8th of June 1856, I received a living adult female of this species from Mr. R. H. Meade, which had been taken on the trunk of an ash-tree in Kent a few days previously. This female, about the middle of June, fabricated in the box in which it was confined a very slight cocoon of white silk, measuring $\frac{3}{8}$ths of an inch in diameter, and deposited in it numerous spherical eggs of a pale brown colour, not adherent among themselves.

Family Drassidæ.

Genus *Drassus,* Walck.

Drassus lucifugus.

To the remarks on this species given in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. viii. p. 39) add the following particulars. Mr. R. H. Meade transmitted to me in December 1856 an adult female *Drassus lucifugus,* which had been taken by Mr. O. P. Cambridge, near Blandford in Dorsetshire.

Family Ciniflonidæ.

Genus *Ciniflo,* Blackw.

After *Ciniflo ferox* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. viii. p. 99) add

Ciniflo humilis.

Ciniflo humilis, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xvi. p. 120.

This small species of *Ciniflo* was captured by Mr. R. H. Meade in Buckinghamshire, in August 1854; two specimens of adult females have also been received from the Rev. Hamlet Clark, who took them in Northamptonshire.

Family Agelenidæ.

Genus *Agelena*, Walck.

Agelena montana.

Subjoin the following statement to the remarks on this species recorded in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. viii. p. 102). In August 1852 both sexes, in a state of maturity, were found among moss in woods on the slopes of the same mountain (Gallt y Rhyg).

Genus *Tegenaria*, Walck.

After *Tegenaria civilis* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. viii. p. 334) add

Tegenaria silvicola.

Tegenaria silvicola, Walck. Hist. Nat. des Insect. Apt. t. iv. p. 464.
Hahnia silvicola, Koch, Die Arachn. B. xii. p. 158. tab. 432. figs. 1076, 1077.

An adult female *Tegenaria silvicola* was captured in Norfolk by the Rev. Hamlet Clark early in May 1854, and another specimen was taken by Mr. R. H. Meade in Buckinghamshire in the autumn of the same year.

Family Theridiidæ.

Genus *Theridion*, Walck.

Theridion pallens.

Add the following synonym of this species to the synonyma given in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. viii. p. 445).

Theridion minimum, Wider, Museum Senckenb. B. i. p. 249. taf. 17. fig. 2; Walck. Hist. Nat. des Insect. Apt. t. ii. p. 320.

In the remarks on *Theridion pallens*, expunge the words "in a small globular cocoon of white silk of a loose texture," and substitute for them the following description:—in a pyriform cocoon having several conical prominences disposed in a circle round its greatest circumference; it is composed of a tissue of fine, compact, white silk, and measures $\frac{3}{20}$ths of an inch in length and $\frac{1}{10}$th in diameter.

Theridion flavo-maculatum.

The following particulars relative to this species should be added to those given in the supplement to the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. xi. p. 118). In confirmation of the opinion that the female *Theridion flavo-maculatum* described by M. Koch was immature, I subjoin the measurement of an adult discovered under a stone in a wood at Oakland on the 14th of August 1855. Length, $\frac{3}{20}$ths of an inch; length of the cephalo-thorax, $\frac{1}{16}$; breadth, $\frac{1}{18}$; breadth of the abdomen, $\frac{1}{12}$; length of a posterior leg, $\frac{3}{16}$; length of a leg of the third pair, $\frac{3}{20}$. The length of M. Koch's specimen was only one line.

Family Linyphiidæ.

Genus *Neriëne*, Blackw.

After *Neriëne vagans* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. ix. p. 21) add the following species.

Neriëne dentata.

Theridion dentatum, Wider, Museum Senckenb. B. i. p. 229. taf. 15. fig. 8.

Argus dentatus, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 354.

Early in May 1854, adult males of this species, which has all the characteristics of a *Neriëne*, were taken by the Rev. Hamlet Clark in Norfolk; and in the autumn of the following year Mr. R. H. Meade captured a male near Bradford.

Neriëne affinis.

Neriëne affinis, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xvi. p. 121.

Two adult males of this species were received from Mr. R. H. Meade in June 1855, one of which had been taken in the vicinity of Burton-on-Trent, and the other at Hornsea, near the east coast of Yorkshire, in the preceding year.

After *Neriëne graminicola* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. ix. p. 269) add the following species.

Neriëne cornigera.

Neriëne cornigera, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xvii. p. 233.

This remarkable spider was discovered among moss growing under trees in a wood on the northern slope of Gallt y Rhyg, in the autumn of 1854.

Neriëne montana.

Neriëne montana, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xvii. p. 234.

This spider, which was found on Ingleborough, a mountain in

Yorkshire, in September 1855, was received from Mr. R. H. Meade.

Genus *Walckenaëra*, Blackw.

After *Walckenaëra humilis* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. ix. p. 465) add

Walckenaëra vafra.

Walckenaëra vafra, Blackw. Ann. and Mag. Nat. Hist. 2nd Series, vol. xvii. p. 235.

Adult males of *Walckenaëra vafra* were discovered under stones in the woods about Hendre House, near Llanrwst, in October 1855.

Family Epëiridæ.

Genus *Epëira*, Walck.

After *Epëira calophylla* in the supplement to the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. x. p. 183) add

Epëira acalypha.

Epëira acalypha, Walck. Hist. Nat. des Insect. Apt. t. ii. pp. 50 and 501.
Epëira genistæ, Hahn, Die Arachn. B. i. p. 11. tab. 3. fig. 7.
Zilla genistæ, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 5.
Zilla decora, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 5.
Zilla acalypha, Koch, Die Arachn. B. vi. p. 139. tab. 213. figs. 530, 531.

Seven females of this species were received from Mr. R. H. Meade, who took them from their webs, which were constructed among the twigs of gorse and other bushes growing in Buckinghamshire, in the last week of June 1856.

After *Epëira diadema* in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. x. p. 188) add

Epëira angulata.

Epëira angulata, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 2; Die Arachn. B. xi. p. 77. tab. 379. figs. 892–895.
Epëira cornuta, Walck. Hist. Nat. des Insect. Apt. t. ii. p. 123.

An adult female *Epëira angulata*, and an immature male which had to undergo its final change of integument, were taken near Blandford in Dorsetshire by Mr. O. P. Cambridge, and were forwarded to me in December 1856 by Mr. R. H. Meade.

The descriptions of *Epëira angulata* given by arachnologists are, in general, so brief and imperfect as to render any attempt to reconcile the perplexed synonyma of this species almost hopeless.

Epëira tubulosa.

Add the following particulars to the remarks on this species recorded in the catalogue (Ann. and Mag. Nat. Hist. 2nd Series, vol. x. p. 249):—In December 1856 I received from Mr. R. H. Meade an adult female, which had been captured by Mr. O. P. Cambridge near Blandford in Dorsetshire.

XLVIII.—*On certain Coleopterous Insects from the Cape de Verde Islands.* By T. Vernon Wollaston, M.A., F.L.S.

The southern position which the Cape de Verde Islands occupy, with reference to the neighbouring Atlantic groups, renders any contribution towards their fauna of peculiar interest; and it is with much pleasure, therefore, that I am enabled to offer, through the liberality of my friends John Gray, Esq., and the Rev. Hamlet Clark, a few observations on the Coleoptera which they collected at St. Vincent's, during a day's sojourn there (whilst on their passage to Rio Janeiro) in December of 1856.

Considering the excessive barrenness of this the *only* island at which the mail-steamers touch, on their outward and homeward route, and the short space of time which is allowed for the passengers to go on shore, it will not appear strange that only fifteen species were the result of the combined labours of Messrs. Gray and Clark during the day that they spent at St. Vincent's. Yet, despite the poverty of the place, in an entomological point of view, it is not difficult to gather, even from these few exponents of the Coleopterous world,—if not indeed the general nature of its insect population, at any rate the important fact, that the preponderance which the *Heteromera* possess (as might, however, be anticipated), over all the other sections of the order, in this sterile spot, is quite extraordinary. Thus, of the fifteen species alluded to, whilst as many as eight are Heteromerous, only two belong to the *Geodephaga*, and but one to each of the great divisions *Brachelytra, Necrophaga, Cordylocerata, Priocerata*, and *Rhynchophora*.

The two representatives of the *Geodephaga* are *Cicindela littoralis*, Fab. (an insect of Mediterranean latitudes, occurring both in the south of Europe and the north of Africa), and an *Amblystomus*, which may perhaps* be peculiar to these islands, and

* I say "perhaps," because the species which form the subject of the paper, by Erichson, above alluded to, are professedly *from Angola*. Nevertheless I am assured by Dr. Schaum of Berlin, that the collector who amassed the materials from which Erichson's memoir was compiled, stopped at the Cape de Verdes, on his passage to the African coast; and that, as

which appears to agree sufficiently well with the description of the *Hispalis viridulus,* given by Erichson in the ninth volume of Wiegmann's 'Archiv für Naturgeschichte,' in 1843. The former of these, the *Cicindela,* I am told by Mr. Clark, was abundant in a salt locality, or marsh, immediately behind the 'Valley of Death' (so called from its having been the burial-place of the unfortunate sufferers from the cholera during the fearful visitation of 1855); whilst the *Amblystomus* occurred amongst the light soil around the roots of a small succulent plant (probably either a *Sedum* or a *Mesembryanthemum*),—much in the same manner as we often observe the *Harpali* to congregate along the sea-shores in England; and where they were most likely secreted on account of the little shade and moisture which such a position would naturally afford them.

The exponent of the *Brachelytra* is a solitary example of an *Isomalus,* Erichs.,—evidently a new species, which may be thus briefly characterized:—

Isomalus Hesperidum.

I. niger, nitidus, glaberrimus, valde depressus, ubique subtilissime alutaceus sed fere impunctatus; capite magno, plano; prothorace cordato, postice fortiter angustato, lateribus vix pone medium leviter excavatis, dentem obtusum efficientibus, in dorso latissime longitudinaliter depresso, antice intra angulos anteriores utrinque leviter notato; elytris prothorace paulo longioribus, punctulo discali impressis; antennis fuscis, basi pedibusque piceis.

Long. corp. lin. $2\frac{1}{3}$.

I believe that it was detected by Mr. Gray, but I have no note as to the precise circumstances of its capture.

The section *Necrophaga* is represented by what I conceive to be the *Dermestes lupinus,* Esch.,—a species liable to be introduced almost everywhere, and therefore well nigh cosmopolitan.

The exponent of the *Cordylocerata* is a very distinct and elegant *Saprinus,* the *S. equestris* of Erichson (Klug's Jahrb. d. Ins. S. 175; and Wiegm. Archiv, ix. 226. 43),—captured by Mr. Clark, near the sea-beach, *in stercore humano.*

The section *Priocerata* is shadowed forth by a single *Elater,* which, I am informed by Mr. Janson, may possibly belong to the genus *Monocrepidius,* but which is probably new as regards the species. It may be described thus:—

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he shortly afterwards died, the insects of the two localities were unfortunately mixed up together; and Erichson, who was not aware that he had touched at those islands at all, described the whole of them as coming from Angola. Thus an amount of confusion has been caused, which can only be dissipated by an accurate knowledge of the Coleopterous faunas of the two regions.

Monocrepidius? Grayii.

M. linearis, fusco-niger, pilis brevibus cinereis depressis ubique dense vestitus; prothorace convexo, creberrime subtilissimeque punctulato punctulisque majoribus undique crebre obsito; elytris subpunctato-striatis, interstitiis vix punctulatis; antennis, palpis (longiusculis) pedibusque læte rufo-ferrugineis.

Long. corp. lin. 6.

It was found beneath a stone on one of the highest points of the island; and I have much pleasure in dedicating it to my friend John Gray, Esq., to whose kindness I am shortly about to be indebted for the opportunity of investigating, under the best of auspices, the various portions of the Canarian Group.

The representative of the *Rhynchophora* is a curious insect allied to (though scarcely, I think, identical with) *Brachytarsus*, of which there is a solitary specimen; and it is worthy of remark that it appears to coincide, *even as regards the species*, with one taken by Mr. Clark at Blidah, in Algeria, during the previous June of the same year.

And, lastly, with respect to the *Heteromera* above referred to, the eight species are as follows:

1. A very beautiful, but variable, *Phaleria*, with a black dorsal patch behind the middle (and common to both) of its elytra; in some examples of which the patch is so largely developed as to cover the entire surface of the elytra, except the shoulders and extreme lateral margin. I would thus characterize it:—

Phaleria Clarkii.

P. ovata, ferruginea; capite plus minus infuscato; prothorace transverso-subquadrato, basi utrinque foveola brevi longitudinaliter impresso; coleopteris læte testaceis, macula magna discali sublunata nigra vix pone medium ornatis.

Var. β. Prothoracis disco elytrorumque regione scutellari ac sutura (una cum macula discali) plus minus suffuse nigrescentibus.

Var. γ. Capite, prothoracis disco, elytrisque (humeris et limbo pallidiore exceptis) nigrescentibus.

Long. corp. lin. $2\frac{1}{2}$–3.

It was discovered by Messrs. Gray and Clark (to the latter of whom I have dedicated the species) *sub stercore humano*, on the sea-beach; having buried itself in considerable numbers, at some distance below the excrement,—in the same manner as is the case with the *Phaleriæ* (when under such circumstances) generally.

2. A small insect allied to *Cerandria*, Dej., but generically distinct from it.

3. The common *Opatrum fuscum*, Hbst,—so universal in

Mediterranean latitudes, and which occurs also in Madeira and the Canarian Group.

4. A rather large insect, intermediate apparently between *Opatrum* and *Asida*, of which I have not been able as yet to determine the genus; but which (as it would seem to be abundant in those islands) is probably well known.

5. An insect, which may perhaps constitute a new genus, bearing some slight *prima-facie* resemblance to a *Pedinus*; but with much slenderer legs, distinctly clubbed antennæ, a brownish piceous hue, and a somewhat pubescent surface.

6 and 7. Two species of *Oxyura*, Sol. (=*Melancrus*, Dej.),—probably the *O. hegeteroides* and *pedinoides* of Erichson, described in Wiegmann's 'Archiv' (ix. 236, 64 and 65), amongst the supposed Coleoptera of Angola.

8. The *Hegeter elongatus*, Oliv. (=*striatus*, Latr.), an abundant insect in Madeira and the Canary Islands, which M. Deyrolle of Paris informs me that he has received, also, from Senegal, on the opposite coast of Africa; and which, moreover, has even been admitted (though I cannot but believe erroneously) into the European Catalogues.

Such are the 15 species collected by Messrs. Gray and Clark during a day's hard work in this barren island. And I can only add that their investigations, for so short a visit, may be considered as eminently successful; for I am informed by my nephew, F. W. Hutton, Esq., of the 23rd Welsh Fusiliers, who lately touched at St. Vincent's on his route to India, and who, likewise, went on shore for a day, to obtain for me all that he was able, that he only "succeeded in capturing *six* species of beetles, sundry locusts, and a lizard;" and he further adds the somewhat significant remark, that "a grave-stone sticking out of the middle of the Atlantic would be a paradise compared to it."

XLIX.—*Remarks on the* Columbinæ, *with a Description of a new Indian Pigeon, akin to the 'Stock Dove' of Europe.* By Edward Blyth*.

In no other group of birds is the difficulty of discriminating between *species* and *permanent varieties*, whatever latitude may be allowed under either denomination, so great and so constantly recurring, as in sundry genera of Pigeons. And yet each race, however slightly distinguished from certain other races, is remarkably true to its particular distinctive characters, wheresoever it be found; and it remains to show that any gradations

* From the Journal of the Asiatic Society of Bengal, No. 3, 1857.

or transitions occur from one to another, which might not be readily accounted for by intermixture, where such cognate races meet. The numerous permanent races (considered by the Prince of Canino and others as *species*) affined to *Turtur risorius* or to *T. auritus*, afford ample exemplification; and we are unaware that any of these have been known to interbreed one with another. Moreover, so far as has been observed, it would seem that the voice or *coo* differs appreciably in each race, just as the notes of other proximate but distinct species of birds do in general, to a notable extent—as familiarly exemplified by those of the British *Phylloscopus trochilus* and *Ph. rufus*, and of many others that might be cited.

In Europe, three kinds of wild Pigeon are familiarly known, in addition to the wild Turtle Dove (*Columba turtur*, L.). They are the common 'Ring-dove,' Cushat, or *Ramier* (*C. palumbus*, L.), the 'Stock-dove' or *Columbin* (*C. œnas*, L.), and the 'Rock-dove,' 'Rockier,' or *Biset* (*C. livia*, Latham): the first two of which are foresters, habitually perching and roosting upon trees; and the third is chiefly an inhabitant of sea-cliffs, and never alights on a tree. The first builds a platform-nest, which is supported by the lighter branches of trees; the second builds in the holes of trees (old pollard 'stocks' especially), and not unfrequently in rabbit-burrows; and the third resorts to the cavities and deep recesses of precipitous rocks, and especially the caverns of sea-cliffs, where it nidificates in large societies. Each is the type of a generic or subgeneric group (*i. e.* a named division), according to the Prince of Canino; and each has its immediate representative or counterpart in India.

1. Palumbus. The 'Cushats.' In the W. Himalaya a bird of this group is common, which differs so little from the European race, that the two would probably blend, were they to inhabit together. The only distinctions consist in the neck-patch, which is large and almost pure white in the European Cushat, being much contracted and of a buff-colour in that of Asia; while the primaries also of the latter are more narrowly margined externally with white. Upon these slight distinctions, the Prince of Canino designates the oriental race *P. casiotis*, and notes it from Chinese Tartary. He also remarks that the Cushats of Algeria have the white neck-patch more extended than in the European race; and distinguishes another and better characterized race, from N.W. Africa, by the name *P. excelsus*.

The only other true Cushats known are from this country, viz. *P. pulchricollis* (Hodgson), from the E. Himalaya, and *P. Elphinstonei* (Sykes), from the Nilgiris and Malabar Ghats,—

of which latter the *P. Torringtonii* (*Carpophaga Torringtonii*, Kelaart) can scarcely be considered more than a variety*, and was first indicated as such in the J. A. S. xx. 178. Nevertheless, according to Mr. Edgar L. Layard, the late H. E. Strickland "at once pronounced it to be distinct" from *P. Elphinstonei*. All will agree in admitting *P. torquatus*, *P. pulchricollis*, and *P. Elphinstonei* as good 'species;' probably also *P. excelsus*; but most systematists would prefer retaining *casiotis* and *Torringtonii* as 'permanent races,' or 'varieties,' of *P. torquatus* and *P. Elphinstonei* respectively. It will be observed, that this is a mountain type in India, being wholly unknown in the plains, save *P. Elphinstonei* rarely on the elevated table-land of the Dukhun; and perhaps the *casiotis* may prove to be a winter visitant in the Punjab, occurring probably in large flocks.

There are two other fine Indian Wood Pigeons of the same *Columbine* type (as distinguished from the *Carpophagine* series of Fruit Pigeons); each of them being recognized as the type of a separate subdivision by the Prince of Canino. They are the *Dendrotreron Hodgsonii* (Vigors), which is peculiar to the Himalayan forests, and the *Alsocomus puniceus*, Tickell, of Orissa, Central India, and also Ceylon, though seemingly more common in Arakan, and especially the island of Ramri. These are mentioned merely that it might not appear that they had been overlooked.

2. Palumbœna, Bonap., founded on *Col. œnas*, L. (*P. columbella*, Bonap.), the British 'Stock Dove,' to which the Prince has since added *P. Eversmanni*, from western and central Asia; very like *P. œnas*, but distinctly smaller, with black bill and yellow tip (*dertrum*),—the colouring of the bill having doubtless changed in drying, as will be shown presently. This should be the *Col. œnas* apud Meyendorff, from Bokhara, described as having the croup of a very pale grey, with all the feathers white at base, in which it accords with our Indian species; and it is not unlikely to prove the very same,—migrating according to season. The true *P. œnas* probably coexists with it in W. Asia; and the European bird is known to be extensively diffused over N. Africa.

P. Eversmanni (?), Bonap. (If new, *P. œnicapilla*, nobis.) Smaller than *P. œnas*, with wings and tail each 1 inch shorter, the difference in the length of tail being very conspicuous. Colouring much the same; but the croup and fore-part of the wings underneath are of a *whitish-grey* (not pure white) in the Indian bird, instead of being uniformly dark-coloured with the rest, as in the European 'Stock Dove.' The same vinaceous

* Comptes Rendus, xliii. p. 837.

tint (whence the name *œnas*) prevails on the fore-neck and breast of both species; but in the Indian it appears also on the crown, which in the other is pure dark ashy. The wings are similarly marked, except that in our presumed new species there is less black upon the winglet, and the great alar feathers (including the tertiaries) are much less dark in colour. Length of closed wing 8½ inches, and of tail 4 inches only.

Among some descriptions of birds sent for identification about ten years ago, by the late Major Boys, of the Bengal Cavalry, we find one of this Indian 'Stock Dove.' He gives the length of a fresh-killed male as 11½ in., extent of wings 24 in., and weight 7 oz. 4 dr. Mr. Selby states that *P. œnas* "measures about 14 inches, and in extent of wing nearly 26 in." "The beak," remarks Dr. D. Scott of Hansi, who has favoured us with the specimen here described, "is of a yellowish colour, and as if translucent; but this appearance is only visible in the fresh bird, as it had disappeared when the specimen became dry*. The legs also had a distinctly yellowish tinge, instead of the red of the common Blue Pigeon; but this also soon disappeared." Major Boys describes the bill and cere as grey, the skin round the eye yellow, iris buff, and legs flesh-pink; those of our common Blue Pigeon being of a deep pinkish-red.

Of the habits of the race, Major Boys merely remarks, that "These birds fly in flocks, and *affect trees*"! When at Cawnpore, last year in May, I observed every evening a large flock of Blue Pigeons to collect and roost upon some high trees within cantonments, and therefore not to be fired at; and having never observed the common Blue Pigeon of this country to roost upon trees, I was led to suspect that the birds in question were of a race of 'Stock Doves' probably different in species from the European—a conjecture which seemed to be verified by the discovery of the bird now under consideration; but I am assured, upon good authority, that the *Columba intermedia*, Strickland, does commonly roost upon trees, in which habit it would seem to differ remarkably from its very near affine the *C. livia* of Europe and N. Africa.

Of the Indian 'Stock Pigeon,' Dr. Scott remarks,—"Though I have been at Hansi nearly five years, I have never seen these Pigeons before; but others have seen them, and have assured me of their occurrence as a distinct race, different from our common Blue Pigeon which breeds in wells. Early in March there were hundreds of them about here, but they soon disappeared. They feed in the fields morning and evening, and roost in the day (and I suppose the night also) in trees, generally in

* In the dry specimen, the bill is black, with yellow *dertrum*, as in the Prince of Canino's *P. Eversmanni*.

the common 'bábul' tree, called here the 'keeker.' The natives distinguish them by the name 'kummer kulla' or 'kula,' the last word being the name of a colour*. To Europeans they are also known here as the 'Hill Pigeon,' though whether they came from the hills I cannot say." These Pigeons have hitherto been observed only in the N.W. of India.

3. Columba, L. (as restricted to the 'Rockier' group of the major continent). Of this type the Prince of Canino recognizes several nearly affined races, some of which differ more or less in habit, as well as in the details of colouring. From certain of these races all the numerous varieties of domestic Pigeons have undoubtedly descended.

The most unlike the rest is the fine Snow Pigeon of the Himalaya (*C. leuconota*, Vigors), which is confined to great elevations near the snow, and assuredly does not appear to have given origin to any domestic variety.

The European Rock Pigeon (*C. livia*, Latham), according to the Prince of Canino, is found identically the same in Europe, Egypt, the whole Barbary coast, and thence on to Senegal and the Gold coast†. It is said to abound in the islands of Madeira and Teneriffe. Northward, it is common in the Hebrides, and in the Orkney, Shetland, and Faroe Isles; but in Scandinavia is altogether confined to the island of Runnesön, on the S.W. coast of Norway, where it breeds in great numbers‡. According to Temminck, Japanese specimens do not differ in any respect. It also abounds along the rocky shores of the Mediterranean and Ægean (Italy, Sicily, Malta, Greece, &c.), and those of the Euxine and Caspian, evincing everywhere a decided and remarkable predilection for the crevices and especially the deep caverns and recesses of sea-cliffs, even where the entrance is close over the water at the height of the tide; it penetrates further into such recesses than any sea-bird is known to do. It also feeds more on the tops of plants than the domestic races do habitually§, and small *Helices* are commonly found in its craw. Though rarely, if ever, inhabiting inland, unless somewhat domesticated,

* In the chapter devoted to the rearing of pigeons in the 'Ayin Akbári,' a number of breeds or races are enumerated, concluding with the 'Komeree' and the 'Gowlah' (Gladwin's translation). These names refer to the tame Collared Turtle-dove and to the common 'Blue Pigeon' of the country (or *C. intermedia*) respectively. The latter, indeed, is stated to be "a wild pigeon, of which, if a few are taken, they are speedily joined by a thousand others of their kind."

† Comptes Rendus, xxxix. p. 1107.

‡ Nilsson, as quoted by Major Lloyd, 'Scandinavian Adventures,' ii. 336.

§ The British Cushat is a great devourer of turnip-tops, as remarked by Gilbert White.

sundry old-established dove-cots have been stocked with it in various parts of Britain, where the race is maintained pure; and as thus observed, it shows no disposition to associate with the domestic breeds in neighbouring dove-cots, although considered to be the parent race from which the latter are mainly derived. Even when eggs taken from the inland colonies referred to have been hatched, and the young brought up by domestic Pigeons, these Rockiers have been known to quit their foster-parents, as soon as they could fly strongly, to rejoin their immediate relatives and progenitors. Another characteristic of the race is, that they like to breed in extensive societies; so that the large colonies of them soon absorb any stray birds, even from a great distance.

In England there is likewise a race of wild or semi-wild Blue Pigeons which maintains itself distinct, and (though numerous in individuals) continues as true to its distinctive colouring and all other characters as does the genuine Rockier, of which it is regarded as a variety. These birds frequent inland cliffs and large buildings; being also extensively reared in dove-cots, to meet the demand for pigeon-matches. They have invariably a speckled wing, each covert being marked with a black spot on each of its webs, in addition to the black bars of the typical *livia*. The scapularies also are thus marked, and the back indistinctly. The croup is pure white, as in the ordinary *livia*; and the race is chiefly remarkable for the *permanency* of its particular markings, and for commonly inhabiting much more inland than the true *Biset* *.

Another such race in Italy (a degree, perhaps, more different) is indicated by the Prince of Canino by the name of *C. turricola*, and it has also been received from Persia; the croup being of "a pale blue-grey"—whitish-grey (?), as in the Indian 'Stock Dove'—"never pure white."

Another, again, is termed by him *C. rupestris*, from the mountainous and rocky parts of Songaria and Dauria (or Dahuria),—

* The same spotting of the wing is common among the Indian domestic Pigeons derived immediately from *C. intermedia*, and otherwise not differing from the pure wild race of the latter; but I know of no analogous wild or semi-wild race in this country, which presents this particular colouring as a constant distinction. Individuals or pairs so marked are here common among the tame flocks, with other varieties of colouring, as black, buff, pure white, pied, &c., and without variation in other characters or tendency to assume the peculiarities of the various 'fancy breeds.' These last manifest no tendency ever to return to wildness, their *domestication* being too complete; but tame Pigeons of some kind are said to have gone wild in North America, a few pairs of them breeding along the highlands of the Hudson; and whether these 'feral' birds tend to assume a uniform and typical coloration, we have not learned.

adopted from Pallas, but the particular distinguishing characters are not specified.

C. Schimperi, also, "which covers with its innumerable flocks the more desert plains of Abyssinia." It is stouter and more albescent than the common *C. livia*.

Likewise *C. gymnocyclus*, Gray, from Senegal. "Obscurior; orbitis nudis; rostro valde robustiore."

Lastly, *C. intermedia*, Strickland, of India*; the common 'Blue Pigeon' of this country, which only differs from *C. livia* by having the croup uniformly coloured with the back, as in the European 'Stock Dove,' and by a somewhat deeper and more uniform shade of ash-colour. Yet the purely wild birds continue true to this colouring, and no variation will be seen in the largest flocks of them, where unmixed with domestic Pigeons; but they most readily mingle with the latter, and scarcely require encouragement to fall into domestic habits. In the vicinity of Calcutta, the pure wild race can hardly be obtained, though there are domestic Pigeons in every ordinary flock (not of 'fancy birds') which are undistinguishable from the wild, in company with others varying more or less in colouring from the type. But even at Benares we remarked a great assemblage of these birds, nestling in the innumerable nooks about the famous mosque of Aurungzebe, and sought in vain for any variation of colouring among them, and especially for the white croup of the true *C. livia*. Col. Sykes refers this bird to *C. œnas*, and remarks that it is "the most common bird in the Dukhun, congregating in flocks of scores, and a constant inhabitant of every old dilapidated building." He saw "the same species, on board ship, on the voyage to England, brought from China;" and the Rev. J. Mason notes the occurrence of what he considers to be the same bird, wild in Burma. In Ceylon, according to Mr. Edgar L. Layard, "this species is extremely local, being confined to two places, 'Pigeon Island,' off Trincomali, and a rock of the southern coast near Barberrya†. From these it makes incursions into the interior; and I have heard," he adds, "of specimens being shot on the great central road, about 50 miles from Trincomali." Dr. Jerdon remarks, that "it abounds all over India, and is occasionally found in the more open spaces of jungles, especially in rocky districts, and in the neighbourhood of waterfalls,—but more generally in the open country, inhabiting walls of villages, pagodas, wells, and any large buildings, and breeding chiefly in old walls." Major Tickell, again, notices it as "exceedingly common in Chota Nagpur, breeding in all the steep, lofty rocks

* Comptes Rendus, xliii. p. 838.

† Resorting thus, it would seem, to sea-cliffs, wherever the latter are available.

of that country." Lastly, Capt. Hutton states that "it is found in Afghanistan, where, as in many parts of India, it builds in wells and ruined buildings; the 'Kazeezes,' or Artesian wells of Afghanistan, are sometimes crowded with them. They occur also in the Deyra Doon, and are known as the common Blue Pigeon. At Masuri, I have seen them only in the cultivated fields, low down on the sides of hills, in warm situations." Length 13 in. by 23 in. in breadth; and *C. livia* is described as measuring $13\frac{1}{2}$ in. by 22 in.; though it is doubtful if there be any real difference.

Upon other authority we have been assured that the common Blue Pigeon of Afghanistan has the white rump of the European *livia*. It is probably identical with the Kemaon bird next to be described; and both with the *C. rupestris* of the Prince of Canino.

The late Major Boys, a most experienced collector of Indian birds, whose description of the Indian 'Stock Pigeon' we have just verified, also distinguished a 'Blue Rock Pigeon,' which he procured at Hawulbagh, in Kemaon. "This Pigeon," he remarks, "differs considerably from the common Blue Pigeon, particularly in its weight and size. It is in every respect much lighter in plumage. Length of a male $12\frac{3}{4}$ in. by 25 in.; weight 7 oz. 8 dr. Bill black, the cere grey; iris red; legs pink. Top of head, chin, and sides of face, ashy-grey. Back of neck and upper part of breast glazed metallic green. Bottom of neck metallic purple, blending into ashy light grey on the belly. Flanks and vent light grey; wing-coverts and upper part of the back of the same colour. *Middle of back white*. Upper tail-coverts dark ashy-grey. Quills grey, the shafts black, darker near their tips; second quill longest; outer webs darker than the inner. Some of the larger wing-coverts, those covering the *tectrices* [tertiaries?], together with the six or seven last tertiary feathers, bear a patch of greyish-black, which, when the wing is extended, forms two indistinct and somewhat curved bands. Tail dark grey at base, *broadly tipped with black*, and having between these two colours *a broad stripe of white* (wanting in the common *C. intermedia*). Inferior coverts white, blending with grey towards the anterior margin of the wing. Length of tail 5 in.; the quills (when the wings are closed) reaching to its tip. The exterior tail-feathers are pure white from their bases on the external web, finished off at the tip with black; the inner webs being grey at the base, as obtaining in the intermediary feathers."

Any collector who has the opportunity should endeavour to verify this particular race, the habitat of which would seem to be intermediate to that of the 'Snow Pigeon' (*C. leuconota*) and that of the 'Common Blue' of the plains of India; the white rump alone would readily distinguish it from the latter.

Note on the Green Pigeons of Ceylon.

The *Columba pompadoura*, Gmelin, founded on pls. 19 and 20 of Brown's 'Illustrations of Zoology' (1776), has long been sought to be verified; and at length, it would appear, successfully by the Prince of Canino, in a small species, as originally described, of the size of *C. olax*, Temminck*. Consequently, the *Treron Malabarica* var. *pompadoura* of Mr. Layard's catalogue is a distinct bird, which may bear the specific name *flavogularis*, nobis. It is very like *Tr. Malabarica*, Jerdon, being of the same size as that species, with an equal development of the maroon colour upon the mantle of the male; but is readily distinguished by its yellowish-green forehead, pure yellow throat, and by having no buff patch on the breast of the male; it is also further remarkable, that whilst the male of *Tr. Malabarica* has the usual deep cinnamon-coloured lower tail-coverts, that of *Tr. flavogularis* has them green with broad whitish tips, as in the female, and as in both sexes of *Tr. chloroptera* of the Nicobars. *Tr. pompadoura* is a much smaller species, with the quantity of maroon colour on the mantle of the male greatly reduced, and with cinnamon-coloured lower tail-coverts, as usual in the males of this genus.

Following the Prince of Canino's classification, the following species of *Treroninæ* inhabit the island:—

1. *Crocopus chlorigaster* (Blyth).
2. *Osmotreron bicincta* (Jerdon).
3. —— *flavogularis* (Blyth).
4. —— *pompadoura* (Gmelin).

The first and second are common to Ceylon and the mainland of India, and the third and fourth peculiar to the island, so far as is known at present.—E. B.

L.—*A Description of two new Cryptogams*†. By Mr. H. O. Stephens.

[With a Plate.]

The curious production about to be described I detected on calcined bones of oxen, part of the cargo of a vessel laden with

* Comptes Rendus, xxxix. p. 875.

† Communicated by the Author; having been read at a Meeting of the Bristol Microscopical Society, Sept. 16, 1857.

hides and bones from South America. It appeared to pervade all the bones, and its red colour immediately attracted my attention.

Almost every fragment of bone was dotted with patches of various sizes, of a cinnabar- or orange-red colour.

When moistened, these became slightly turgid or elevated, and rugose or papillate on the superior surface. Under a lens of good power (a $\frac{1}{6}$th was used), they are found to consist of very numerous quadrangular cells, a little rounded at the angles, united in fours, and these, again, grouped four together. They are very minute, varying in magnitude from ·0002 to ·0003 linear.

In a growing state I think they would be found enveloped in mucilage, traces of which are even now discernible.

I am inclined to suppose, that in the perfect condition of the plant, the quaternate-celled bodies are arranged in a linear series imbedded in the mucus of the pseudo-frond. In some of the heaps I am pretty certain that traces of this structure were observed, but too obscurely defined to admit of delineation.

Mr. Berkeley has pointed out to me their resemblance to *Sarcina.* In the form and quaternary arrangement of the cells they are indeed very like the frustules of *S. Ventriculi;* but these measure about ·004 linear, and contain greenish-brown endochrome, of which there is no trace in our plant.

The cells are turned olive-brown by sulpho-iodine. Both Mr. Berkeley and myself have failed in propagating this plant.

The affinities appear to be with Palmellæ, and the alliance with *Sarcina* very close,—I believe the nearest ally to that curious Alga yet known. Mixed with the bone Algoid are globose bodies of much greater diameter than the four-celled Sarcinoid bodies, accompanied by branched threads, which, on first examination, I thought an integral part of the Alga. More careful observations have, however, convinced me they are distinct, and belong to a filamentous Fungus.

The structure of this Fungus is highly curious: it seems to emerge from the Alga in circular or radiating white spots, very minute, but of various sizes. These are made up of branched threads, bearing on their extremities, or on lateral branches, round cells or spores. A vast number of these spore-like cells are detached and free amongst the threads, the threads being sparingly produced, or at least not abundantly, when compared with the profusion of the spores.

It is evident the globose cells must be formed in rapid succession from the points of the threads; the process of formation can, indeed, be partially seen; for I observed the extremities of some of the threads to be terminated by a thickened process,—

evidently the spore-like, globose cell in its nascent state, or in progress of evolution.

Bristol, Dighton Street, Oct. 3, 1857.

Note.—Mr. Berkeley writes me:—"I believe in the end both it and the *Sarcina* of the stomach will prove the *incunabula* of Moulds." I scarcely venture to dissent from such an authority, yet there is as great difficulty *à priori* in thinking *Sarcina* to be an Alga, altered in development and its autonomous state masked by growing in an unusual or unnatural habitat, than that a similar condition affecting the growth of a mould should cause it to assume the character of *Sarcina*. Mr. Berkeley, comparing the bone *Sarcina* with his mounted specimens of *S. Ventriculi*, makes both pretty nearly correspond in size. Specimens, however, of *S. Ventriculi* in the collection of Mr. Stoddart of this city, to whom I am indebted for the measurements of the bone-plant, are fully four times the size of the latter. It appears, then, that *S. Ventriculi* varies very greatly in size; yet Mr. Stoddart, for an entire year, made careful *daily* measurements of the granules of *S. Ventriculi* from the ejectments of a patient, and found them invariably of the same size.

As the real nature and affinities of the genus *Sarcina* are as yet doubtful, the two known species may be provisionally thus characterized:—

S. Ventriculi (Goodsir). Granulis opacis, fusco-olivaceis.
Habitat in ventriculo hominis præsertim.

S. ossium (mihi). Granulis pellucidis.
Habitat in ossibus bovinis ustis ex Brasilia.

EXPLANATION OF PLATE XII.

a, a, a. Portions of bone with Cryptogams.
b, b. Cells of *Sarcina ossium*, more or less magnified.
c, c. Gelatinous matter (of frond?) and granules or cells of *Sarcina ossium*, treated with sulpho-iodine.
d. Alga, with filamentous Fungus magnified.
e, e, e. Threads and spore-like cells of ditto.

BIBLIOGRAPHICAL NOTICES.

A Manual Flora of Madeira and the adjacent Islands of Porto Santo and the Dezertas. By R. T. Lowe, M.A. Part I. Thalamifloræ. 12mo. London, Van Voorst, 1857.

The residence of so eminent a naturalist as Mr. Lowe in Madeira during twenty-six years has afforded ample time and opportunity for the acquisition of an accurate knowledge of its vegetation; and botanists have long looked to him for a good Flora of the island. He was well known to be devoting his leisure time, since his return to England, to the preparation of such a work. Unfortunately a bad state of health has again rendered a temporary removal to a warmer climate necessary. He has therefore published so much of this work as could be prepared for the press and printed before his departure. An examination of this portion of the work, extending to 106 pages, renders us only the more desirous that he may soon be enabled to return home and complete the remainder of the book. In this part we are given short, but sufficiently full characters of all

H. O. S. delt. J. Basire. Lith.

the plants found in the Madeiran Isles which belong to the Thalamifloreus Orders. The author seems to have spared no labour requisite to render his book complete. It is arranged somewhat on the plan of Babington's 'Manual of British Botany,' although usually rather fuller in detail than that work, and containing many more critical remarks than were there requisite. The European botanist will find much to study in it; and even the especially British student cannot fail to rise with profit from its perusal. According to the views of the lamented Professor E. Forbes, Madeira forms one of the remains of the ancient great Atlantic continent, and accordingly possesses a part of its flora. This book tends to show that those views were well founded; for a very large proportion of the plants here described are also natives of the south-east of Europe, and not a few of them inhabit England and Ireland.

Mr. Lowe divides the island into four zones relatively to elevation. As might be expected, we find very few British plants noticed as characteristic of the lower two of these zones, which extend from the level of the sea to an elevation of 2500 feet, and "below whose upper limit snow never lies longer than a few hours." *Viola odorata, Fragaria vesca, Agrimonia Eupatoria, Lobelia urens, Brachypodium pinnatum, Triodia decumbens, Arrhenatherum avenaceum, Agrostis canina,* and *Ceterach officinarum* may be mentioned, and all of them seem to be confined to the second zone.

Water-plants are of course almost altogether wanting in a country where all the streams are torrents.

Fumaria capreolata is not included in the flora, but is represented by the *F. muralis* (Sond.), which is probably confounded with it in Britain and other western parts of Europe. *F. Vaillantii* is perhaps incorrectly combined with *F. parviflora*: in England, they certainly seem to be distinct.

The name of *Viola sylvestris* (Lamk.) is adopted for the *V. sylvatica* (Fries), with the remark, that the latter name is very inappropriate in Madeira. Unfortunately, Lamarck's plant is the *V. canina,* and therefore his is not "the original name" of Fries's plant.

The *Tamarix anglica* (Webb) is rejoined to the *T. gallica* (Linn.), with the remark, concerning the hypogynous disk, that it is "normally 8–10-lobed, the lobes united in pairs, often indistinct or obsolete."

We are surprised to find that the only Pink is *Dianthus prolifer. Silene maritima* (Wither.) is said to pass "by a thousand intermediate gradations into" *S. inflata.*

The name *Spergularia* is employed in place of the older term, used generically, of *Lepigonum.* Many botanists seem determined to overlook the fact that Persoon (who is always quoted as the authority for it) did not consider his group *Spergularia* as a genus, and that Wahlenberg first placed the plants in a distinct genus, calling them *Lepigonum.* According to the recognized laws of nomenclature, his name ought therefore to be adopted.

The *Geranium purpureum* (Vill.) is separated from *G. Robertianum,* and the *G. Robertianum β.* (Smith) and *G. Raii* (Lindl.) quoted as synonyms of it. It is remarked, that there are "no intermediate states between it and *G. Robertianum, β. maritimum* (Bab.), although the two are found constantly growing intermixed. Few plants, in fact, are either more constant in their differences, or more easily discriminated." "In higher, shady spots, *G. Robertianum β.* retains all its hairiness; *G. purpureum* (Vill.) growing by its side becomes, on the contrary, smoother."

We have only to add a strong recommendation of this book to the notice of botanists.

The Grasses of Great Britain. Illustrated by J. E. Sowerby; described by C. Johnson. Parts 1 and 2. 8vo, London, 1857.

It is probable that this series of plates of Grasses will fulfil the object intended, namely, to supply to those who are interested in them, as agriculturists rather than botanists, the means of ascertaining the names of Grasses, and also to give an account of their value to the farmer. No pretension seems to be made to advance science by this publication, and neither the plates nor the letter-press are of much use to the botanist. We cannot avoid thinking that it was quite possible to have rendered the plates of scientific value, without detracting from their practical utility. Dissected flowers are figured, but they are not so executed as to give confidence in their scientific accuracy, and it is very doubtful if they will be of any value to the unscientific reader.

The Insect Hunters; or, Entomology in Verse. 12mo, 1857, London.

It is not often that we have to notice a scientific work written in verse,—indeed we believe that none such has ever been mentioned in this Journal. That now before us is a very clever poem, intended to present to young entomologists a concise statement of the classification of Insects. The metre is similar to that of Longfellow's well-known 'Hiawatha,' and it is wonderful to remark how well the troublesome details of science are expressed in it. A rather careful examination has convinced us that the characters of the orders and tribes of Insects are very accurately given by the author. May his hope that it will tend to popularize this interesting science, be fully realized! How far the uninitiated will appreciate it, is hard to say; but certainly those who have attained to some knowledge of entomology will read it with pleasure and profit. Although no author's name appears in the book, it may apparently be fairly referred to the pen of the well-known Edw. Newman, who has done so much for scientific entomology, and been the chief cause of the present popularity of the study of Ferns.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 23, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

Description of New Genera of Gorgoniadæ. By Dr. John Edward Gray, F.R.S., F.L.S., V.P. Z. & Ent. Soc.

1. Sarcogorgia.

The coral rather irregularly furcately branched on a single plane. The axis black, cylindrical, thick at the base, with slender flexible branchlets. The bark fleshy; in the dry state, thin, like a continuous skin, smooth, without spicula, with rather close, more or less raised cells, strengthened with a quantity of sand-like, granular spicula.

This genus is at once distinguished from all the other *Gorgoniæ* that I have seen, by its thin, smooth, skin-like bark studded with sandy, more or less raised, wart-like cells, which on the thick stem are numerous all round the surface, scarcely raised, while on the thinner branchlets they are further apart, and form prominent wart-like cells.

The axis is olive-brown, formed of concentric laminæ, which often show a space between them at the fractures. When the bark is soaked in potash it is rather thick and flesh-like, and the cells are surrounded with a single series of rather regularly disposed, nearly equal-sized, angular, sand-like, transparent particles, forming a sheath to the polype.

The tentacles of the polypes, when examined in this state, are thick, conical, and simple, without any indication of the pinnate tubercles which are to be seen in the living *Gorgonia*, according to the observations of most naturalists.

I know of only a single species of the genus, which was purchased of a dealer in natural history at Liverpool, without any habitat.

Sarcogorgia phidippus.

2. Subergorgia.

Coral furcately branched, rather compressed, with a continued sunken groove up the middle of each side. Cells rather prominent, convex, in two or three somewhat irregular series up each edge. Axis pale brown, wart-like, formed of rather loosely concentric fibrous laminæ, containing a large quantity of calcareous matter, and effervescing with muriatic acid. The bark when dry is rather thin, smooth, hard and granular within.

Subergorgia suberosa.

Gorgonia suberosa, Esper. t. 49.

This genus, and the genera *Junceella, Ctenocella,* and *Gorgonella* of Valenciennes, should be arranged with *Corallium* under the family *Coralliidæ*, characterized by having a calcareous axis.

Description of a Rabbit said to be found on the Himalayan Mountains. By A. D. Bartlett.

This animal is smaller than the domestic Rabbit, being shorter and more compact; its body is pure white, the nose, ears, legs and tail are of a dark brownish-black, the eyes dark red.

The fur is much shorter and more nearly equal in length than in the common Rabbit. The young are perfectly white all over until they are five or six weeks old, at which time the nose and tail begin to get dark-coloured; the feet soon afterwards get dark, and lastly the ears turn black.

In their movements they appear quicker than other rabbits, and they jump a considerable distance; some in my possession I have seen leap upon objects 3 feet from the ground. The first specimens of these animals that came under my notice were obtained by Mr. Baker, who informed me that they came from the Himalayas. I have since seen a large number of them, and in no instance have I observed any variation in the colour or markings. They are prolific breeders, and appear extremely hardy.

Having some recollection of hearing a furrier once speak of the skins of the Polish Rabbit, I took an opportunity a few days since to examine a large quantity of these skins at a fur warehouse, when I found that they were beyond all doubt from the animal now under notice. Upon inquiry I was told that these skins are imported into this country in large numbers, and extensively used as a substitute for ermine, which fur they much resemble. I find in Mulsant, 'Cours Elémentaire d'Histoire Naturelle,' the following:—"The fur of the White Rabbit, even that of the Polish Rabbit, is easily distinguished from that of the ermine, by its less cylindrical hairs, which are considerably longer than the down." I am also informed that they are bought at the great sale of furs that takes place annually at Leipsic; to this great fair, skins are brought from all parts of the world, and I think it highly probable that these skins are imported from the mountainous parts of Asia.

I have not at present examined the skull of this animal, but should I find sufficient difference upon comparing it with the skulls of the other known species, I shall then propose for it the name of *Lepus nigripes*, or Black-footed Rabbit.

July 14, 1857.—Dr. Gray, F.R.S., V.P., in the Chair.

Mr. Gould having returned from a visit to the United States, whither he had proceeded for the purpose of studying the habits and manners of the species of *Trochilus* frequenting that portion of the American continent, detailed some of the results of his observations.

Having arrived just prior to the period of the bird's migration from Mexico to the north, and having had ample opportunities for observing it in a state of nature, he noticed that its actions were very peculiar, and quite different from those of all other birds: the flight is performed with a motion of the wings so rapid as to be almost imperceptible; indeed the muscular power of this little creature appears to be very great in every respect, as, independently of its rapid and sustained flight, it grasps the small twigs, flowers, &c. upon which it alights with great firmness, and if wounded clings to them with the utmost tenacity: it appears to be most active in the morning and evening, and to pass the middle of the day under the shade of the thick leafy branches. Occasionally it occurs in such numbers, that fifty or sixty may be seen on a single tree. When captured, it so speedily becomes tame, that it will feed from the hand or mouth within half an hour. Successful in keeping one alive during a long railway journey, in a gauze bag attached to his breast-button, for three days, during which it readily fed from a small bottle filled with a syrup of brown sugar and water, Mr. Gould determined to attempt the bringing of some living examples to England, in which he succeeded, but unhappily they did not long survive their arrival in London, and died on the second day: had they lived, it was his intention to have sent them to the Society's Gardens, where they would doubtless have been objects of great attraction. Mr. Gould added, that he was certain that they might be readily brought to this country; that they would live in the gardens at least during the months of summer, and that the captains of any of the great steamers now voyaging between England and America would willingly render the assistance requisite to effect this desirable object.

Mr. Gould exhibited a highly interesting species of *Ceriornis*, which he had found in the Collection of Dr. Cabot of Boston, who, with the greatest liberality, permitted him to bring it to England for the purpose of comparison and description. The appearance of this bird is very singular, and the uniform buff colouring of the breast would lead to the supposition that it is merely a variety of one or other of the previously known species of the genus; but the greater length of the tarsi, and the well-defined markings of the back, forbid such a conclusion. For this new bird, forming the fourth species of the genus, Mr. Gould proposed the name of

Ceriornis Caboti.

Forehead, sides of the head, nape and chin, black; crest and sides of the neck deep red; all the upper surface mottled with black, rich chestnut, and buffy white, the latter colour assuming the form of a large circular spot at the tip of each feather; this buff mark greatly increasing in size on the scapularies and the greater wing- and tail-coverts; primaries and tail-feathers very dark brown, crossed with toothed markings of buff mottled with black; breast and under surface deep sandy buff stained with red, and black on the flanks, under tail-coverts and thighs.

Total length, $18\frac{1}{2}$ inches; bill, $1\frac{3}{8}$; wing, 10; tail, $7\frac{1}{4}$; tarsi, $3\frac{1}{2}$; middle toe and nail, $2\frac{3}{4}$.

Hab. China.

Remark.—This species is more nearly allied to *C. Temmincki* than to the other members of the genus. The specimen is believed to be unique.

July 28, 1857.—Professor Busk, F.R.S., in the Chair.

DESCRIPTIONS OF SEVEN NEW SHELLS FROM THE COLLECTION OF THE HON. SIR DAVID BARCLAY, OF PORT LOUIS, MAURITIUS. BY LOVELL REEVE, F.L.S., F.G.S.

Sir David Barclay, a gentleman resident at the Mauritius, and long known to conchologists as a zealous collector of shells, having availed himself of the occasion of visiting this country to bring a few of the rarer specimens of his cabinet for comparison, I have, at his request, examined them, and selected the following as being new:—

1. STROMBUS TAURUS. *Strom. testa ovata, crassissima, ponderosa; spira exserta, nodoso-tuberculata; anfractibus transversim striatis et tenuiliratis, ultimo superne obtuse angulato et perampliter bi- tri-tuberculato, tuberculo obliquo peramplo infra in medio ornato; columella densissime callosa, superne fere ad apicem appresse dilatata; apertura subcontracta, labro dense incrassato, tuberculis peramplis obtusis armato superne bidactylo, dactylo supremo elongato, curvato; albida, aurantio-fusco variegata et sparsim vittata, columella et apertura fauce rubido-carneo tinctis.*

Long. $3\frac{1}{2}$ poll., lat. $2\frac{5}{8}$ poll.

Hab. Amirante Islands, a group of the Seychelles.

This remarkable shell, which Sir David Barclay has for some time past known as an undescribed species, and distinguished in his cabinet by the above name, is curiously intermediate in its generic characters between *Strombus* and *Pterocera*. In detail of pattern and sculpture it resembles *S. laciniatus*, but there is a large central oblique tubercle on the back, and the lip is thickened into two very large obtuse oblong tubercles, the upper part being produced into two decided Pterocera claws, one of which is prolonged in a curved manner to the extent of an inch and a half. The specimen has rather the appearance of being malformed; but notwithstanding this seeming irregularity of growth, there is no doubt whatever of its being specifically distinct from any hitherto described form.

2. CYPRÆA BARCLAYI. *Cypr. testa pyriformi-ovata, subumbilicata; dorso elevatiusculo, extremitatibus eleganter calloso-productis, subrostratis; basi convexa; dentibus utrinque octodecim ad novemdecim fortibus tumidiusculis; interstitiis conspicue sulcatis, profundis; dentibus exterioribus super labrum decurrentibus, medianis bifidis; nitente, alba, dorso aurantio-spadiceo undique eximie punctato et lentiginoso, extremitatibus aurantio-spadiceo tinctis.*

Long. 1 poll., lat. $\frac{5}{8}$ poll.

Hab. Island of Diego Garcia, a dependency of Mauritius (taken on a block of coral dredged up from deep water).

An exquisitely delicate species in the finest possible condition, perfectly unlike any of this favourite genus hitherto known. It is of an elegantly pyriform shape, with the extremities rather produced; the teeth on each side the aperture being especially characteristic, from their strong development and deeply grooved interstices. The painting is a delicate profusion of orange-buff dots of different degrees of tone upon a shining pearl-white ground; the extremities and teeth, the outer of which extend nearly across the base, being tinged with the orange-buff in a darker and brighter hue.

3. Pyrula (Rhizochilus) De Burghiæ. *Pyr. testa pyriformi-ovata, subanguste umbilicata; spira breviuscula, turrita; anfractibus superne late angulato-expansis, ad angulum squamis subamplis plano-compressis flabellatim coronatis, infra basin versus attenuatis, undique dense liratis, liris subtilissime serratis; alba, aperturæ fauce sulcata.*

Long. $1\frac{3}{8}$ poll., lat. $1\frac{1}{4}$ poll.

Hab. China.

A beautifully turbinated pagoda-like shell, being coronated throughout the expanded angle of the whorls with large compressed fan-shaped scales. It is of the same peculiar typical form as the *Pyrula Mawæ,* the umbilicus being, however, much more contracted, and is believed to be an inhabitant of the same locality.

I have the pleasure of naming this very delicate and remarkable species in honour of Mrs. De Burgh, a lady, whose warm assiduity and zeal in collecting shells is equalled by her intelligent apprehension of their characters and correct estimation of their comparative rarity and beauty.

4. Trochus (Euchele) alabastrum. *Tro. testa subdepresso-conoidea, anguste profunde umbilicata; spira exserta; sutura peculiariter profunde excavata; anfractibus deinde concavis, et fortiter tricarinatis, carinis subirregulariter undatis et exquisite serratis; calcareo-alba, carinis punctis nigris subdistantibus peculiariter notatis.*

Long. $\frac{5}{8}$ poll., lat. $\frac{5}{8}$ poll.

Hab. Island of Diego Garcia, a dependency of the Mauritius.

Of this very striking species there is a second specimen in the collection of Mr. Cuming. It is of a pure chalk-white substance, strongly spirally grooved and keeled throughout, the keels being sparsely dotted with black.

5. Murex Barclayi. *Mur. testa trigono-ovata, canali breviuscula, recurva; spira brevi, acuminata; anfractibus transversim tenuissime serrato-liratis et striatis, longitudinaliter trivaricosis, varicibus basin versus conspicue fimbriato-laminatis, interstitiis triseriatim tuberculatis et nodatis; rosaceo-alba, purpurascente et ferrugineo-carneo tincta et maculata.*

Long. $3\frac{1}{4}$ poll., lat. $1\frac{3}{4}$ poll.

Hab. St. Brandon Shoal, near Mauritius (thrown on shore after a hurricane).

This very beautiful species is very closely allied to a shell in Mr. Cuming's collection, which has been attributed by Mr. Sowerby, in his 'Conchological Illustrations,' to *M. trigonulus*, Lamarck. It is also as closely allied to a shell in the collection of the King of Denmark, which was figured for that species by myself in the 'Conchologia Iconica.' From both, however, it is sufficiently distinct to establish its claim to rank as a new species.

6. CYCLOSTOMA TUBULUM. *Cycl. testa imperforata, turbinata; spira elevatiuscula; anfractibus rotundatis, lævibus; apertura circulari; labro eleganter expanso; lutescente-alba, nigricanti-fusco multifasciata.*

Lat. $1\frac{1}{8}$ poll.

Hab. —— ?

This very elegant species partakes of the characters of *C. Belairi* and *Boivini*, but is quite distinct from either of those species. There is no umbilicus and very little umbilical callosity. The bands are peculiar in extending over the expanded lip to the extreme edge.

7. CYCLOSTOMA EUGENIÆ. *Cycl. testa subprofunde umbilicata, subdepresso-orbiculari; spira brevi; anfractibus ad suturam leviter impressis, deinde convexis, spiraliter dense elevato-striatis, in medio acute tenuicarinatis; apertura circulari, labro (in hoc specimine) simplici; fulvescente-spadicea, infra castaneo plus minus tenue vittata.*

Lat. 1 poll.

Hab. Mauritius (found in the heights of Flacq, at the roots of a Bois-de-Natte tree).

Most nearly allied to *C. filosum*, but of lighter texture and warmer colour.

MISCELLANEOUS.

BRITISH EDRIOPHTHALMA.

To the Editors of the Annals of Natural History.

Plymouth, Dec. 16, 1857.

GENTLEMEN,—Further opportunities and more extended investigations compel me to make the following corrections in the Synopsis of the British Edriophthalma recently published in the Annals:—

1. Instead of adopting Dana's arrangement of the genus *Orchestia*, and making *Talitrus* a subgenus, it will be more in accordance with our present knowledge to divide *Talitrus* itself into two genera, as has been done by Nicolet and Stimpson, and thus adopt the genus *Orchestoidea* of the former (Gay's 'Chili'), which is synonymous with *Megalorchestia* of the latter (Proc. Nat. Hist. Society Boston, 'Crust. &c. Pacific Shores of North America').

The classification of these animals will therefore stand thus:—

Genus Talitrus,
*Orchestoidea,
Talorchestia,
Orchestia,

of which the first and last only are British.

2. *Lysianassa Chausica* in the synopsis (not Edwards's) is evidently *L. longicornis* of Lucas ('Exped. to Algiers').

3. The genus *Tetromatus*, mihi, *Pseudophthalmus*, Stimpson, is synonymous with *Ampelisca* of Kröyer. This was kindly pointed out to me by Mr. Stimpson†.

4. The term *Pontoporeides* cannot stand for that of the subfamily as arranged in the synopsis, inasmuch as *Pontoporeia* of Kröyer is itself so closely allied to *Anonyx*, that it must be placed in the subfamily *Lysianassides*. It is therefore proposed to adopt the term *Phoxides* for the subfamily that embraces the genus *Phoxus*, &c.

5. *Phoxus Kröyerii*, mihi, will be changed into *P. simplex*; the former specific name having previously been used by Mr. Stimpson in the same genus.

6. After *P. Holbölli*, read *Kröyer* instead of *mihi*.

7. The genus *Lonchomerus* is evidently that of *Lalasia* of Lucas ('Exped. to Algiers').

8. In the genus *Iphimedia*, the species *I. Eblanæ*, mihi (Nat. Hist. Review) is to be added.

9. In the note relative to *Gam. fluviatilis*, instead of to Edwards, reference should have been made to Latreille, 'Dict. d'Hist. Nat.'

10. There is to be added to the genus *Siphonocetus* of Kröyer the species *Cerapus Whitei* of Gosse: this may probably be synonymous with *S. Kröyeranus*, mihi.

11. In the subfamily *Corophiides*, *Unciola irrostrata* of Say is to be added. But from an examination of Mr. Gosse's specimen, kindly placed by that gentleman in my possession for the purpose, the species appears to be synonymous with *Glauconome leucopis* of Kröyer.

12. After *Hyperia oblivia*, read *Kröyer* instead of *Edwards*.

13. *Cyamus gracilis* (Gosse) should have been *C. Thomsoni*, Gosse, Ann. Nat. Hist. vol. xviii. 1855.

I am, Gentlemen,
Yours obediently,
C. Spence Bate.

* *Orchestoidea tuberculata* (Nicolet) is synonymous with *Talitrus insculptus* of Dana.

† "There being now no animal named *Tetromatus*, it will be desirable that the title of the subfamily *Tetromatides* should be changed into *Ampeliscades*."

On Circulation in Plants. By A. Trécul. (Second Part*.)

During the life of a plant all the liquids are in motion in each of the utricles of which it is composed, either to carry into these the elements necessary for their growth, or for the formation of the amylaceous, saccharine or albuminoid principles, &c., to which they give origin, or to remove from them those substances which have become useless and which require to be eliminated, or those which have to be carried to other parts of the plant to serve for the multiplication of the cells and the growth of the individual. It is this general movement that constitutes the circulation; but this name is usually given to definite currents, more perceptible than this general intracellular movement, which traverse the plant through its whole length from top to bottom and from the bottom to the top.

It is to this double current that I give the name of the *great circulation.* I have also indicated the *venous circulation,* which takes place, as I have stated, in the laticiferous vessels.

The great circulation is observed in all vascular plants; but the laticiferous vessels have not yet been detected in all plants which possess vessels.

The great circulation therefore consists of an ascending current of the sap, and of a descending current. Let us first of all take the former into consideration. It takes place in the vessels which receive and elaborate the juices drawn from the soil by the roots. When this ascent commences, all the cells are at work. The nutritive substances which they contain arrange themselves by assimilation. Starch, dissolved no doubt by diastase, and converted into sugar, as has been shown by MM. Payen and Persoz, is carried to the parts where the cellular multiplication is to take place. The starch of the base of the buds serves for the alimentation of the latter; that of the bark passes into the internal cells of that part of the plant, which very probably also receives some by the medullary rays. It is under the influence of these nutritive materials that the increase in diameter by the multiplication of cells commences. This multiplication at starting really takes place without the aid of the sap elaborated by the leaves, for in many of our trees the layer of young cells (generative layer, also called cambium) acquires a considerable thickness before the appearance of the leaves.

These first phænomena make their appearance with the ascent of the sap. This, in rising, undergoes an elaboration, with which I am not sufficiently acquainted to speak of it at greater length; I shall content myself with indicating the beautiful experiments of M. Biot, which have shown us the changes which sugar undergoes during the progress of this sap. During its ascent it already contains assimilable principles which may assist in the nutrition of the leaves and buds (in which the spiral vessels make their appearance from below upwards); but in the spring these buds are indebted for their first development especially to the alimentary substances amassed in the neighbouring cells.

* See Annals, Dec. 1857, p. 467.

The sap, which on its way takes part in the nutrition of the first organs developed, arrives in the leaves, in the green parenchyma of which it is submitted to a fresh elaboration, or in the chlorophyll-cells of the stem of the fleshy plants destitute of leaves. The carbonic acid of the air is absorbed and then decomposed during the day; its carbon is retained by the sap and its oxygen in great part rejected. The sap, thus modified under the influence of respiration, takes its course through the cortical cells, which it nourishes. It then aids in the multiplication of the cells of the generative layer, which are produced in horizontal series. A portion of these cells thus horizontally multiplied forms a new layer of bark, the woody fibres and medullary rays; the others are converted into vessels in the following manner. The excess of the descending sap which is not employed in the nutrition of the newly formed cells, or in thickening those first developed, descends through certain of the newly formed cells; it dilates them, perforates them, and makes them take all the characters of vessels, so that these cells, which, during the first phase of their development, resembled all the others, appear subsequently to be of a totally different nature.

It is this vascular formation, which takes place, as we see, from above downwards, at the expense of cells originating from a multiplication in horizontal series, that has led the authors of the theory of descending fibres to believe that these vessels, of which they did not recognize the nature, were true roots of the buds or leaves.

But all the sap absorbed by the old or new cells, whether for their increase in size or thickness, or for the production of starch, albuminoid substances, &c., which are to serve for subsequent growth, is not used up by the cells. These only assimilate a part of its elements and reject the rest. It is this *caput mortuum* which, in the form of resins, essential oils, &c., is collected in peculiar reservoirs, from which it is afterwards thrown outwards *; or the unassimilated matters are taken up by the laticiferous vessels, which carry them back into the vessels properly so called (this is the *venous circulation*). There these substances, which are usually destitute of oxygen, are elaborated and oxidized by the action of the oxygen derived from the air, which penetrates even to the vessels by intercellular passages; they become again fitted for assimilation. It would be from their oxidation, as I have already stated, that the carbonic acid rejected by plants during the night would be produced; that which is produced during the day being decomposed on its passage into the leaves under the influence of light; its oxygen is poured out into the atmosphere together with that arising from the decomposition of the carbonic acid taken directly from the air by respiration.

The vessels produced by the descending sap, serve in the following years for the ascent of the juices. They are filled therewith as long as the vegetation is very active, but usually empty themselves when

* It is undoubtedly emissions of this nature and of this origin that constitute what are called the *excretions* of the roots, of which agriculture seeks to turn to account in the rotation of crops.

the juices drawn from the soil become less abundant or cease altogether.

The experiments which I described in a memoir read to the Academy on the 25th of July 1853, prove in the most evident manner the course of the descending sap; for when obstacles are opposed to the progress of this sap, by means of ligatures, or of spiral, annular, or semicircular decortications, the course of the sap may be changed at pleasure. It then gives origin to very sinuous vessels, presenting vertical parts and others oblique or horizontal, which are always formed of cells elongated vertically, that is to say, parallel to the axis of the stem, and of which the form, which is not generally changed, is similar to that of the surrounding cells. The sinuosities of these vessels show the currents of the sap progressing through the cells of the generative layer, turning in all directions to find an issue, perforating the cells from above downwards or horizontally, according as the current is vertical, oblique or horizontal.

All these facts prove evidently that it is the circulation that produces the vessels,—that is to say, that it is the function that creates the organ.

Since the circulation exists before the vessels, when there are only simple cells through the walls of which the sap filters, the objection made by some anatomists to the existence of the circulation in the laticiferous vessels, an objection founded on the cellular structure of these vessels in certain plants, does not possess the importance which they assign to it, as we see the dotted and striped vessels, &c., formed by a current of sap pre-existing through imperforate cells; and moreover these anatomists should consider that there is not a living cell which is not traversed by juices, although the great majority of these cells do not present any perforation visible by means of our most powerful microscopes. And then there are laticiferous vessels which are evidently composed of superposed cells, the transverse partitions of which present very wide apertures (the laticiferous vessels of *Musa*, formed of large cells with very thin walls, are fine examples of this).—*Comptes Rendus*, Oct. 5, 1857, p. 466.

Sepia officinalis.

To the Editors of the Annals of Natural History.

Weymouth, December 14, 1857.

Gentlemen,—The beach at Weymouth was this morning strewed with the Cuttle-bone (*Sepia officinalis*). Within the space of half a mile I believe I might have gathered a thousand. In no instance could I find a portion of the animal. Apparently there has been no weather to account for such an unusual occurrence, it having been moderate for many days, with a slight southerly wind.

This mollusk is but rarely found here, though after a storm a few stray specimens of the so-called bones are thrown up.

I am, Gentlemen, your most obedient Servant,

Robert Damon.

On the Sphærobolus stellatus. By the Rev. H. H. Higgins, M.A.

The author exhibited a drawing of this plant, in various stages of development, the several processes of which the reverend gentleman had had an opportunity of witnessing. He had found the plant, a minute species of Fungus, in the neighbourhood of Huyton Quarry, on the 20th of September. It was growing on the flat surface of a stump, near the ground. He took it home, with a portion of the wood on which it was growing, and placed it on a bed of damp sand covered with a glass shade. A cluster of similar plants soon sprang up, and the mode of growth in a single specimen was this:—At first appears a little patch of reticulated fibres, the centre of which becomes elevated from beneath by the growth of the young plant, which at length bursts through the web, and assumes the colour and size of a grain of mustard-seed. Subsequently it becomes egg-shaped, and attains a height of about a line. A star-like fissure now divides the apex of the plant into five or six equal segments, which fall back like the petals of a flower, and discover the inner or lining membrane, resembling a minute egg-cup, and containing a *sporangium* or ball of spores. At the period of maturity, this inner membrane suddenly turns itself inside out, with an audible snap, projecting the sporangium to a distance of several inches. The inside of the glass shade used as a cover for the plants became spotted with forty or fifty of these sporangia, which had been ejected with such force as to flatten them against the glass.

A portion of the spore-pulp, under a high magnifier, exhibited innumerable minute particles, displaying with great activity the ordinary Brownian movements. When the pulp was taken from an unripe sporangium, there were also to be seen, by the aid of iodine and a magnifier with very good power of definition, certain other bodies of a linear or slender oblong shape, many times the size of the moving particles, and quite pellucid. These appeared to be attacked and entered by the particles; but whether the linear bodies afterwards became developed into perfect spores, the observer was not able to ascertain.—*Proc. Lit. and Phil. Soc. of Liverpool,* Nov. 17, 1856.

The Grape Disease.

To the Editors of the Annals of Natural History.

Sheffield, Dec. 9, 1857.

Gentlemen,—Without at all questioning the influence of the *Oidium* as a cause of the grape-blight, there can be little doubt that in this, as in all similar epidemics, some predisposing cause will be found, by which the vital energies of the organism affected (plant or animal) are depressed, and a vantage-point is thus offered to the disease. We know that if a vegetable be planted in soil totally deprived of some one of the necessary ingredients, it is unable to exist. If, however, instead of the missing constituent, there be found some analogous substance, the plant may continue to live, though in less perfect health. Thus potash may be to a certain extent replaced by soda, and, as has been observed in certain samples of tobacco, even by lime. In the case of the grape, no rotation of crops is possible, and the probability of exhaustion is therefore so much the greater. The juice of the grape is very rich in potash, which is deposited, on standing, in the form of crude tartar. This potash is not returned to the soil, but is consumed for manufacturing purposes. Without having had the opportunity of proving this view by analysis, I am of opinion that the soil of old vineyards will be found deficient in potash. As a means of remedying this defect, I suggest that granite should be heated to redness, plunged in water, and ground to powder. Let this be well mixed with about half its weight of lime, and the mass be exposed for some time to the action of the atmosphere. This compost may then be sparingly applied as a manure to the vines.

J. W. Slater.

On the Cause of the Rhythmic Motion of the Heart. By James Paget, Esq., F.R.S.

The author draws the following conclusions as to the most probable explanation of the rhythmic action of the heart:—

1. In the Vertebrata it is due to the time-regulated discharges of nerve-force in certain of the ganglia in and near the substance of the heart, by which discharges the muscular walls are excited to contraction.

2. In Invertebrata, the corresponding pulsatile movements of hearts or vessels are probably independent of nerve-force.

3. The time-regulated rhythmic action, whether of the nervous centres or of the independent contractile walls, is due to their nutrition being rhythmic, *i. e.* to their being, in certain periods, by nutritive changes of composition, raised, with regulated progress, to a state of instability of composition, in their decline from which they discharge nerve-force, or change their shape, contracting.

4. The muscular substance of the heart in the Vertebrata, governed in its rhythmic action by appropriate nervous centres, has a rhythmic nutrition of its own, corresponding and coordinate with theirs; the impairments of its structure during action being repaired in repose.

5. Rhythmic nutrition is a process in accordance with the general laws of organic life, very many organic processes being composed of timely-regulated alternate action and inaction, or alternate opposite actions, *i. e.* being rhythmical, with larger or shorter units of time; and all organic processes being chronometric, *i. e.* ordered according to laws of time as exact, and only as much influenced by external conditions, as are those relating to weight, size, shape, and composition.—*Proc. of Roy. Soc.* May 28, 1857.

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