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AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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

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

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

J. Taylor, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH 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. 85. JANUARY 1885.

I.—*On the Species of* Micippa, *Leach, and* Paramicippa, *Milne-Edwards.* By E. J. Miers, F.L.S., F.Z.S.

[Plate I.]

While engaged in the revision of the nomenclature of the species of these genera for the Report on the Brachyura of the 'Challenger' collection, now in course of preparation, I have recognized some errors of determination into which I have been led, in common with other students of the group; and having now subjected the whole of the material in the British Museum and 'Challenger' collections to a careful reexamination, I think it useful to publish the results of my study of the group, to redescribe the species, and present a synopsis of their arrangement, which will be found to differ in some important particulars from that given by Dr. R. Kossmann in his work on the Malacostraca of the Red Sea*, and to include references to some species and varieties described since it appeared.

* 'Malacostraca in Zoolog. Ergebn. einer Reise in die Küstengebiete des Rothen Meeres,' p. 4 (1877).

When Dr. Leach, in 1817, described the genus *Micippa* * he took as the type the *Micippa cristata* (*Cancer cristatus*, Linnæus), which had been long previously described and figured by Rumphius as *Cancer spinosus*.

Milne-Edwards in 1834 † referred a second species, designated by him *Micippa philyra* (Herbst), to this genus, and established (p. 332) the genus *Paramicippa* to include the *Micippa platipes* of Rüppell, from the Red Sea, and a new species, *P. tuberculosa*, of uncertain habitat, characterizing the latter genus principally by the non-retractile eyes, the incomplete orbits, whose postforaminal portion was not developed, and the flattened and dilated second joints of the exterior antennæ. The first two of these characters, however, fail in *Paramicippa platipes* (Rüppell), which at that time was apparently known to Milne-Edwards only from Dr. Rüppell's description and figure.

In 1856 Dr. A. Gerstäcker ‡ published some observations on the typical specimens of *Micippa philyra* (Herbst) and *M. thalia* (Herbst); he redescribed the latter species, and also described as new a species, *M. miliaris*, from the Red Sea, which is regarded by Dr. Kossmann as a variety of *Micippa thalia* (Herbst).

In 1877 Dr. Kossmann (*l. c.* p. 4) admitted the following species as well established:—1. *M. cristata* (Linn.); 2. *M. philyra* (Herbst), with the varieties *mascarenica*, Kossm., and *platipes*, Rüpp.; 3. *M. thalia*, Herbst, with the varieties *caledonica*, Kossm., *miliaris*, Gerstäcker, *indica*, Kossm., and *aculeata*, Bianconi. He also sustained the genus *Paramicippa*, taking as the type *P. tuberculosa*, M.-E. He erroneously regarded the *Micippa spinosa* of Dr. Stimpson as synonymous with *M. cristata*, this species being in fact one of the best characterized of the genus.

In 1879, in my synopsis of the families and genera of the Oxyrhyncha, not having then seen Dr. Kossmann's work, I followed some previous authors in taking Rüppell's species (*M. platipes*) as the type of the genus *Paramicippa*, and distinguished the latter genus by the less vertically deflexed rostrum and the dilated palms of the chelipedes in the male, whose fingers, when closed, meet only at the tips—characters which, perhaps, obtain only in Rüppell's species (not in *P. tuberculosa*), and, moreover, cannot be regarded as of generic importance §.

* Zoological Miscellany, iii. p. 15 (1817).

† Hist. Nat. Crust. i. p. 329.

‡ Archiv f. Naturgeschichte, xxii. p. 106.

§ Journ. Linn. Soc., Zool. xiv. p. 662 (1879). I am unaware of the

In the present revision of the genus *Micippa* six species are regarded as well established, besides several marked varieties, some of which may prove to be specifically distinct. I follow Dr. Kossmann in restricting the genus *Paramicippa* to the single species *P. tuberculosa*, with which I am able to identify the species described by myself as *Micippa parvirostris* by the aid of drawings of Milne-Edwards's type specimen, very kindly sent to me by Prof. A. Milne-Edwards, which are here published with his permission.

Micippa.

Micippa, Leach, Zoological Miscellany, iii. p. 15 (1817); Milne-Edwards, Hist. Nat. Crust. i. p. 329 (1834); Kossmann, Malacostraca in Zoolog. Ergebnisse einer Reise in die Küstengeb. des Rothen Meeres, p. 4 (1877); Miers, Journ. Linn. Soc., Zool. xiv. p. 661 (1879).

Carapace nearly oblong, depressed, rounded behind, with the dorsal surface spinose, granulated or tuberculated, sometimes with a lateral series of marginal spines or spinules. Interorbital space broad, the orbits deep, with one or two fissures in the superior margin and usually in the inferior margins, which are sometimes very incomplete. Præocular spine present or absent. Rostrum broad, lamellate, and vertically or nearly vertically deflexed, more or less distinctly bilobated, and sometimes armed with lateral marginal spines. Eyes (in the species I have examined) moderately elongated, and capable of being retracted within the orbital cavity. Antennæ with the basal joint usually very much enlarged and sometimes armed with one or two small distal spines or tubercles; it occupies the space between the base of the rostrum and the orbit and generally constitutes a part of the inferior wall of the orbit; the following joint is sometimes slightly dilated and is not concealed by the rostrum. The merus of the exterior maxillipedes is distally truncated, with the antero-external angle more or less rounded and the antero-internal angle emarginate. The chelipedes (in the male) are moderately developed or short; palm somewhat dilated and compressed or subcylindrical; fingers meeting along the inner margins when closed, or with a large intermarginal hiatus. Ambulatory legs moderately elongated, with the joints subcylindrical, sometimes granulated, but without spines or tubercles, the dactyli nearly straight, little shorter than the penultimate joints.

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distinctive characters employed by R. Neumann in his memoir entitled 'Systematische Uebersicht der Gattungen der Oxyrhynchen' (Leipsic, 1878), never having seen a copy of this work.

The species are, I believe, restricted to the shallower waters of the Indo-Pacific or Oriental region.

The species enumerated in the present revision may be distinguished by the following diagnostic characters:—

A. Rostrum armed with eight spines (three lateral spines on each side of the two distal and terminal spines).

Carapace (in the adult) with numerous dorsal spines. Chelipedes with the palms elongated, not dilated .... 1. *Micippa cristata* (Linn.).

B. Rostrum armed with four spines (one lateral spine on each side of the two distal and terminal spines). Carapace without dorsal spines.

Carapace convex. Basal antennal joint with distal spines, the next joint elongated and but little dilated distally. Chelipedes (in the adult male) with the palms but little enlarged .... 2. *Micippa mascarenica*, Kossmann.

Carapace somewhat depressed. Basal antennal joint without distal spines, the next (mobile) joint compressed and distally dilated. Chelipedes rather short, with the palms enlarged; fingers meeting only at tips, with a wide intermarginal hiatus .... 3. *Micippa philyra* (Herbst).

C. Rostrum terminating in two lobes, which have the antero-internal angles acute or toothed and the antero-external angles rounded or armed with a small tubercle or tooth.

Rostrum thin, deflexed. Carapace usually armed with dorsal spines. Chelipedes (in the adult males) with the palms short, enlarged; fingers with a wide intermarginal hiatus at base .. 4. *Micippa spinosa*, Stimpson.

Rostrum thickened, inflexed. Carapace without dorsal spines. Chelipedes with the palms not enlarged, fingers with scarcely any intermarginal hiatus 5. *Micippa curtispina*, Haswell.

D. Rostrum deeply notched or bifid, terminating in two narrow acute lobes or spines.

Carapace with or without dorsal spines. Chelipedes with the palms slender, not dilated; fingers with scarcely any intermarginal hiatus .... 6. *Micippa thalia* (Herbst).

Micippa cristata.

Cancer spinosus, Rumph, d'Amboinische Rariteitkamer, p. 15, pl. viii. fig. 1 (1741).

Cancer cristatus, Linn. Mus. Lud. Ulricæ, p. 443 (1764); Syst. Nat. p. 1046 (1766).

Cancer bilobus, Herbst, Nat. Krabben u. Krebse, p. 245, pl. xviii. fig. 98 (1790).

Maia cristata, Latreille, Atlas de l'Encycl. Méth. d'Hist. Nat. pl. cclxxx. fig. 1 (1818).

Micippa cristata, Leach, Zool. Miscell. iii. p. 16, pl. cxxviii. (1817); M.-Edwards, Hist. Nat. Crust. i. p. 330 (1834); Crustacés in Cuvier's Règne Anim. (ed. 3), Atlas, pl. xxxi. fig. 2; Adams and White, Crustacea in Zoology of H.M.S. 'Samarang,' p. 16 (1848); Bleeker, Acta Societatis Indo-Neerlandicæ, ii. p. 15 (1857); Kossmann (part.), Malacostraca in Zoolog. Ergebnisse einer Reise in die Küstengebiete des Rothen Meeres, p. 5, pl. iii. fig. 1 (1877).

The carapace is depressed and its dorsal surface is covered with granules or small tubercles, which tend to become spiniform, and with longer spines, disposed as follows:—two on the postfrontal region of the carapace between the orbits; three in a transverse series on the front of the gastric region, and one behind these; two contiguous spines on the cardiac region, four or five on each branchial region; one on the intestinal region and two on the posterior margin; the lateral margins of the carapace are armed with six long spines, and the superior margins of the orbits are also six-spined, the præocular spine being strongly developed and the postocular bifid and terminating in two spines. The rostrum is vertically deflexed, lamellate, deeply notched at the distal extremity, which is armed with two spines, behind which, on the lateral margins on each side, are three others. The basal joint of the antenna is very considerably enlarged, granulated at the distal extremity and terminating in a spine (the infraocular spine) at the antero-external angle; the following (mobile) joint is not dilated. The merus of the exterior maxillipedes is distally truncated and crenulated, with the antero-external angle subacute or obtuse. The chelipedes (in the adult male) are considerably developed, with the merus, wrist, and palm granulated; palm rather more than twice as long as broad, and but little enlarged; fingers with but a small intermarginal hiatus. The ambulatory legs are moderately developed, with the joints subcylindrical, granulated.

An adult male from Java measures as follows:—Length of carapace to base of rostrum 24 lines (51 millim.); length of rostrum $8\frac{1}{2}$ lines (18 millim.); length of a chelipede $50\frac{1}{2}$ lines (107·5 millim.); length of first ambulatory leg about $49\frac{1}{2}$ lines (105 millim.).

Hab. Indo-Malayasian seas; Philippine Islands; Java (*coll. Brit. Mus.*).

In very small specimens the spines of the dorsal surface of the carapace and the præocular spine are not developed.

Micippa philyra.

Cancer philyra, Herbst, Nat. Krabbe u. Krebse, iii. Heft 3, p. 51, pl. lviii. fig. 4 (1803).
Micippe platipes, Rüppell, Beschreib. 24 kurzschwänzigen Krabben des R. Meeres, p. 8, pl. i. fig. 4 ♀ (1830); Heller, Sitz. der Akad. Wien, xliii. (1), p. 299, pl. i. fig. 2 (1861).
Paramicippa platipes, M.-Edw. Hist. Nat. Crust. i. p. 333 (1834).
Micippa bicarinata, Adams and White, Zoology of H.M.S. 'Samarang,' Crust. p. 16 (1848).
Micippa hirtipes, Dana, Amer. Journ. of Sci. & Arts (ser. 2), xi. p. 268 (1851); Crust. in U. S. Explor. Exped. xiii. (1) p. 90, pl. i. fig. 4 (1852), var.
Micippa spatulifrons, A. M.-Edw. N. Arch. Mus. Hist. Nat. viii. p. 240, pl. xi. fig. 3 (1872), var.
Micippa philyra, var. *platipes*, Kossmann, Zool. Ergebn. einer Reise in die Küstengeb. des R. Meeres, p. 7, pl. iii. fig. 3 (1877).
Micippa philyra, var. *latifrons*, Richters, Decapoda in Möbius's Beitr. zur Meeresfauna der Insel Mauritius und der Seychellen, p. 142, pl. xv. figs. 1–5 (1880).

This form in many of its characters bears a close resemblance to the following (*Micippa mascarenica*); but adult males may, I think, always be distinguished by the following characters:—

The carapace is broader in proportion to its length and much more depressed; the rostrum is less abruptly deflexed; the spines at the distal extremity of the basal antennal joint are obsolete, and the following (mobile) joint of the peduncle is dilated and compressed. The chelipedes (in the adult males) have the palm dilated and compressed, less than twice as long as broad; the fingers with a wide intermarginal space when closed and meeting only at the distal extremities. An adult male has the following dimensions:—

Length of carapace to base of rostrum nearly 12 lines (25 millim.); breadth 10½ lines (22·5 millim.); length of a chelipede 14½ lines (31 millim.); length of first ambulatory leg 14 lines (30 millim.).

Hab. Indo-Pacific or Oriental region.

The series in the collection of the Museum is small, and the adult and fully-grown examples are all from the Red Sea and Gulf of Suez. The specimens from the Philippines, designated *Micippa bicarinata* by White, are not fully grown; a small male—length of carapace to base of rostrum nearly 4½ lines (9 millim.)—has the palm of the chelipedes nearly as in the adult specimens from the Red Sea, but the second antennal joint is less dilated, although compressed. There are also in the collection small specimens from the Fijis presenting similar characters as regards the antennæ.

Micippa mascarenica.

Micippa philyra, Leach, Zool. Miscell. iii. p. 16 (1817); M.-Edwards, Hist. Nat. Crust. i. p. 330 (1834); Guérin-Méneville, Icon. Crustacés, pl. viii. *bis*, fig. 1; A. M.-Edwards, N. Arch. Mus. Hist. Nat. viii. p. 239, pl. xi. fig. 2 (1872); Richters, Decapoda in Möbius's Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen, p. 143, pl. xv. figs. 6, 7 (1880); Miers, Crust. in Zool. Coll. H.M.S. 'Alert,' p. 198 (1884).

? *Micippa philyra*, var. *mascarenica*, Kossmann, Malacostraca in Zool. Ergebnisse einer Reise in die Küstengeb. des Rothen Meeres, p. 7, pl. iii. fig. 2 (1877); Lenz & Richters, Abhandl. Senck. Naturf. Gesellsch. xii. p. 421 (1881).

Micippa superciliosa, Haswell, Proc. Linn. Soc. N. S. Wales, iv. p. 446, pl. xxvi. fig. 2 (1880); Cat. Austr. Crust. p. 25 (1882), var.

Paramicippa asperimanus, Miers, Crust. in Zool. H.M.S. 'Alert,' p. 525 (1884), var.

The carapace is suboblong, convex, and rounded behind, deeply concave in front of the branchial regions, coarsely granulated on the dorsal surface; the lateral margins are armed with about six distant unequal spines or spinules; the orbits are completely defined, with a deep notch or fissure in the superior margin, and behind this a smaller notch; the postocular spine is well developed; the inferior margin has two fissures defining the position of the basal antennal joint; the rostrum is vertically or nearly vertically deflexed, armed at the distal extremity with four strong triangulate lobes or teeth. The basal antennal joint is very greatly enlarged; its distal margin is armed with several small spines or tubercles, and with a stronger spine at the antero-external angle, which constitutes the infraocular orbital spine; the following (mobile) joints are but little dilated. The chelipedes (in the adult male) are rather slender; palm slightly compressed and little enlarged, smooth and granulated; fingers meeting along their inner margins when closed, or with a distinct intermarginal hiatus.

Hab. Indo-Pacific or Oriental region.

An adult male in the collection of the British Museum from the Mauritius (*M. Robillard*) has the following dimensions:—Length of carapace to base of rostrum nearly 21 lines (44 millim.); length of rostrum $9\frac{1}{2}$ lines (20 millim.); length of a chelipede 25 lines (53 millim.); length of first ambulatory leg $29\frac{1}{2}$ lines (62 millim.).

This form, which I, after Milne-Edwards and Guérin-Méneville, have hitherto designated *M. philyra*, Herbst, cannot be regarded as the typical condition of that species, since Dr. Gerstäcker expressly notes that in Herbst's *Cancer philyra* the second antennal joint is short and distally dilated; and Dr. Kossmann's name for it must be adopted, since he distinctly figures it under the designation *mascarenica*.

The specimens which, with much doubt, were designated *M. asperimanus* in the Report on the Crustacea of H.M.S. 'Alert,' cannot be regarded as specifically distinct; it may be, indeed, that the examination of a series of specimens would show that *M. mascarenica* must itself, after all, be regarded (as its author considers it to be) as a mere variety of *M. philyra*.

Micippa spinosa.

Micippa spinosa, Stimpson, Proc. Acad. Nat. Sci. Philad, p. 217 (1857); Haswell, Cat. Austr. Crust. p. 26 (1882).
Paramicippa spinosa, Miers, Cat. New-Zeal. Crust. p. 9 (1876); Crust. in Rep. Zool. H.M.S. 'Alert,' p. 199 (1884).

In this species the carapace is depressed, somewhat uneven, closely and coarsely granulated on its dorsal surface, which, both in the male and female, is armed with long spines disposed as follows:—three in the median line, of which two on the gastric and one on the cardiac region, and a strong spine on the postero-lateral margins of each branchial region, between which and the well-developed postocular spine there are from six to nine smaller spines on the lateral margins of the carapace; the posterior margin is spinuliferous; the spinules usually continued in a lateral series beneath the lateral branchial spines and above the bases of the two posterior ambulatory legs. The fissures of the superior orbital margins are narrow and deep. The pterygostomian regions are granulated. The rostrum is obliquely deflexed and widens slightly from the base to the antero-lateral angles, which are broadly rounded; it is armed at its distal extremity with two small teeth, which are separated by a rather deep triangular notch. The basal antennal joint is smooth externally, but granulated on its distal margin; the next joint is not dilated; the merus of the exterior maxillipedes is broadly rounded at the antero-external angle. The chelipedes (in the adult male) are moderately developed; merus not distally carinated but granulated; carpus and palm granulated, the palm rather short and enlarged, fingers meeting only at the apices with a wide intermarginal hiatus; the ambulatory legs are hairy, merus with a small spinule at the distal extremity. An adult male has the following dimensions:—Length of carapace to base of rostrum nearly 8 lines (17 millim.); breadth of carapace nearly $7\frac{1}{2}$ lines (15·5 millim.); length of a chelipede $9\frac{1}{2}$ lines (20 millim.); of first ambulatory leg nearly 12 lines (25 millim.).

Hab. East and South Australia (in shallow water, not exceeding 15 fathoms, *H.M.S. 'Challenger'*): New Zealand (*coll. Brit. Mus.*).

Micippa spinosa, var. *affinis*.

Paramicippa affinis, Miers, Ann. & Mag. Nat. Hist. (ser. 5) iv. p. 13 (1879).

Of this variety, described by me as a distinct species in 1879, from a single female from Bass's Straits, found among the fishes of H.M.S. 'Challenger,' there are, among the 'Challenger' Brachyura, two males, also from Bass's Straits, taken off E. Moncœur Island (Station 162), in 38 fathoms.

It is distinguished by the absence of well-developed spines from the dorsal surface of the carapace, which are represented sometimes by elevated granules or small tubercles, by the form of the front, which does not widen to the distal extremity (but has parallel lateral margins) and has a very small terminal notch, and by the smoother basal antennal joint. Length of carapace to base of rostrum (in an adult male) 6 lines (12·5 millim.); breadth of carapace $5\frac{1}{2}$ lines (11·5 millim.); length of a chelipede about 7 lines (15 millim.), of first ambulatory leg about $7\frac{1}{2}$ lines (16 millim.).

This variety, together with the typical *Micippa spinosa*, will be figured in my Report on the Brachyura of the 'Challenger' expedition.

Micippa curtispina.

Micippa curtispina, Haswell, Proc. Linn. Soc. N S. Wales, iv. p. 446, pl. xxv. fig. 1 (1880); Catalogue Australian Stalk- & Sessile-eyed Crustacea, p. 25 (1882).

This remarkable species is allied to *M. affinis*, but distinguished by the form of the rostrum, which is vertically deflexed and curves inwards towards the distal extremity, which is emarginate, and by the slender chelipedes, whose merus-joints are more strongly carinated above at the distal extremity.

In the specimens in the Museum collection which I refer to this species, the rostrum is considerably thickened and the lateral distal lobes are obsolete, or nearly obsolete, so that the lateral margins converge uninterruptedly to the emarginate apex. The postocular orbital tooth is very small; the pterygostomian regions are turgid; the basal antennal joint is granulated, and the following joint is not, or is but very slightly, dilated; the merus of the exterior maxillipedes is small, and its antero-external angle less broadly rounded than in *M. affinis*; the distal carina of the merus of the chelipedes, both in the larger female and smaller male, is entire, not dentated; palm very slender, and fingers nearly straight, with scarcely any intermarginal hiatus. The larger (female) specimen has the following dimensions:—Length of carapace to base of rostrum 10 lines (21 millim.), breadth about $7\frac{1}{2}$ lines (15 millim.);

length of a chelipede 8½ lines (18 millim.), of first ambulatory leg nearly 10 lines (21 millim.).

Hab. Port Denison, 5 fathoms (*Haswell*), Torres Straits (Prince-of-Wales Channel and Thursday Island, 3–9 fathoms) (*H.M.S. 'Alert'*).

I have examined a small specimen of this species in a collection from Singapore, made by Surgeon-Major S. Archer.

Micippa thalia.

Cancer thalia, Herbst, Naturg. Krabben u. Krebse, iii. (3) p. 50, pl. lviii. fig. 3 (1803).
Paramicippa sexspinigera, White, List Crust. Brit. Mus. p. 9 (1847).
Micippa thalia, Gerstäcker, Archiv f. Naturgesch. xxii. p. 109 (1856); A. M.-Edwards, N. Arch. Mus. Hist. Nat. viii. p. 238, pl. xi. fig. 1 (1872); Miers, Crustacea in Zoolog. Coll. H.M.S. 'Alert,' p. 198 (1884).
Micippa inermis, Haswell, Proc. Linn. Soc. N. S. Wales, iv. p. 445, pl. xxvi. fig. 3 (1880); Cat. Australian Crustacea, p. 24 (1882).
Micippa pusilla, Bianconi, Mem. Accad. Bologna (serie seconda), ix. p. 205, pl. i. fig. 1 (1869).
Micippa thalia, var. *caledonica*, Kossmann, Malacostraca in Zool. Ergebn. einer Reise in die Küstengeb. des R. Meeres, p. 8, pl. iii. fig. 4 (1877).
Micippa thalia, var. *indica*, Kossmann, *l. c.* p. 8 (1877).

The carapace is moderately convex or depressed, suboblong or broader at the branchial regions; its dorsal surface is tomentose and closely granulated, and usually armed with spines upon the dorsal surface, which, when present, are disposed as follows:—A strong supraocular orbital spine, two median spines on the gastric region of the carapace placed one behind the other, and one on each branchial region, and sometimes two on the posterior margin; the upper margin of the orbit also has three spines behind the supraocular spine, and the lateral margins of the carapace are armed with from six to nine spines or spinules. The rostrum is nearly vertically deflexed, deeply emarginate, and terminates in two strong acute lobes or spines, the apices of which usually curve somewhat outwardly. The basal antennal joint is granulated and considerably dilated, but less so than in some species of the genus, and bears a spine at its antero-external angle (the infraocular orbital spine); behind this the orbit is incomplete. The chelipedes (in the adult male) are rather small; merus sometimes granulated, carpus and palm nearly smooth, the merus not carinated above; the palm slender and not enlarged; the fingers nearly straight, and without any or with but a very small intermarginal hiatus. The ambulatory legs are very tomentose, the merus and carpus joints are sometimes thickened, and the merus may have a small distal spinule, but the joints are otherwise nearly smooth, not spinuliferous.

Hab. Indo-Pacific or Oriental region (from the Red Sea and coast of Natal to New Caledonia).

In that which Dr. Gerstäcker distinguishes as the typical form of this very variable species (from an examination of Herbst's type specimen), the anterior dorsal spines of the carapace are apparently not developed, but there are distinct lateral branchial and posterior marginal spines. Length of carapace and rostrum (in a female) 18 (German) lines, breadth 12 lines.

I have seen no adult examples presenting exactly these characters, the posterior marginal spines being deficient. A small male from the coral reefs at Pa-tchu-Sau (*H.M.S.* '*Samarang*'), in the British-Museum collection, has well-developed lateral epibranchial spines, but differs in some other particulars.

Micippa thalia, var. *miliaris*.

Micippa miliaris, Gerstäcker, Archiv f. Naturgesch. p. 110 (1856).
Micippa thalia, var. *miliaris*, Kossmann, *t. c.* p. 8 (1877).

This form is apparently distinguished from the typical *M. thalia* only by the well-developed lateral marginal spines of the carapace. The second joint of the antennæ is slightly dilated towards the distal extremity.

Hab. Red Sea (*Gerstäcker*).

Micippa thalia, var. *aculeata*.

Micippa thalia, De Haan, Crustacea in v. Siebold's Fauna Japonica, p. 98, pl. xxiii. fig. 3, and pl. G (1839).
Micippa aculeata, Bianconi, Mem. Accad. Bologna, iii. p. 103, pl. x. fig. 2 (1851).
Micippa Haani, Stimpson, Proc. Acad. Nat. Sci. Philad. p. 217 (1857).
Micippa thalia, var. *aculeata*, Kossmann, *t. c.* p. 8, pl. iii. fig. 5 (1877).

This variety is distinguished by having the dorsal spines of the carapace as well as (usually) some or all of the lateral marginal spines well developed.

Hab. Seas of China and Japan (*De Haan, Stimpson*), Mozambique (*Bianconi*). An adult male from Mozambique is in the British-Museum collection, presented by Prof. Bianconi, and labelled "*Micippa cornuta*, Bianconi"*.

The dimensions of the male from Mozambique are as follows:—Length of carapace to base of rostrum $14\frac{1}{2}$ lines

* The *Cancer cornutus* of Linnæus, which Milne-Edwards considers to be a species of this genus, differs in the arrangement of the dorsal spines of the carapace from any species with which I am acquainted, except perhaps this species and *Micippa cristata*, from which latter it is apparently distinguished by the smooth, terete, naked chelipedes, &c. It may be identical with a variety of *M. thalia*.

(30·5 millim.); length of rostrum 5 lines (10·5 millim.); breadth of carapace $13\frac{1}{2}$ lines (28·5 millim.); length of a chelipede $16\frac{1}{2}$ lines (35 millim.); length of first ambulatory leg $20\frac{1}{2}$ lines (43·5 millim.).

Paramicippa.

Paramicippa, M.-Edwards (partim), Hist. Nat. Crust. i. p. 332 (1834); Kossmann, Malacostraca in Zoolog. Ergebnisse einer Reise in die Küstengebiete des Rothen Meeres, p. 5 (1877).

The distinctive characters of this genus, if restricted to the single species *P. tuberculosa*, M.-E., are as follows:—The carapace is depressed, broadly pyriform or nearly orbiculate in outline; the orbits are scarcely defined either above or below the eye-peduncles, which are slender, straight, and not completely retractile; the postocular lobe, which terminates in two spines or teeth, is well developed. The basal antennal joint is considerably enlarged, yet not dilated so greatly as in *Micippa*; it is nearly oblong in form, with the distal extremity slightly concave, and bears a small spine or tooth at the antero-external angle; the next joint, which is placed on a level with the superior margin of the front, is very short, triangulate or cordate, and dilated and flattened. The form of the chelipedes in the male is not known; the ambulatory legs are robust and rather short, and their merus- and carpus-joints are covered above with strong tubercles, which tend to become spines.

Paramicippa tuberculosa. (Pl. I. fig. 1.)

Paramicippa tuberculosa, Milne-Edwards, Hist. Nat. Crust. i. p. 333 (1834).
Micippe parvirostris, Miers, Ann. & Mag. Nat. Hist. (ser. 5) iv. p. 13, pl. iv. fig. 9 (1879).

Carapace broadly pyriform, very slightly convex, and covered with numerous tubercles, which are sometimes acute and spinuliform; lateral margins armed with six or seven short spines, which are more or less distinctly granulated on the margins. The rostrum is small, deflexed in its distal half, and divided by a median fissure into two compressed lobes, which are slightly concave at the distal extremity; the postocular lobe, as noted above, is strongly developed and terminates in two spines or teeth. The ocular peduncles are slightly enlarged at base and constricted near to the distal extremity, and project beyond the superior margin of the orbit for a distance about equal to the width of the rostrum at base. The basal antennal joint is not greatly dilated at the distal extremity the next joint is inserted between the base of the rostrum and the inner canthus of the eye, and the third joint is slender, cylindrical, and longer than the second. The merus of the exterior maxillipedes is considerably dilated at the antero-external angle. A few hairs upon the carapace and legs. Colour brownish.

Hab. ——? (South Australia, Port Lincoln: *coll. Brit. Mus.*)

The description, slightly amplified, is adapted from Milne-Edwards's work; the figure from sketches, very kindly sent by Prof. A. Milne-Edwards, of the type specimen in the Paris collection. The eye-peduncles should probably be represented as more distinctly constricted near to the distal extremity, and the second antennal joint as more dilated, as in Milne-Edwards's description and the type of *M. parvirostris* in the British Museum. This latter further differs from the figure now given only in having the penultimate as well as the antepenultimate joints of the legs sometimes armed with a few tubercles.

EXPLANATION OF PLATE I.

Fig. 1. *Paramicippa tuberculosa*, M.-Edw. Adult female, magnified (from a sketch of the type specimen in the collection of the Muséum d'Histoire Naturelle, Paris).

Fig. 1 *a*. Dorsal view of the front of the cervical region.

Fig. 1 *b*. Inferior view of part of the cervical region, showing the form of the basal antennal joint and exterior maxillipedes.

Fig. 1 *c*. Chelipede.

II.—*Observations on some Freshwater Sponges.* By Professor Franz Vejdovsky *.

Dr. W. Dybowski not long since sent me some specimens, well preserved in alcohol, of the freshwater sponge designated by him *Spongilla sibirica*, with the request that I would submit them to an examination, and prepare the figures thus obtained for his memoir relating to the above-mentioned species †. I undertook this investigation the more willingly because, since the appearance of Dr. Dybowski's work upon the freshwater sponges of the Russian empire, I was very

* Translated by W. S. Dallas, F.L.S., from a separate copy, furnished by the author, of the paper in the 'Sitzungsberichte der k. böhmischen Gesellschaft der Wissenschaften,' 1884, pp. 55–60, pl. ii.

† As Dr. Dybowski's parcel was rather late in reaching me and he had in the meantime sent his memoir to press, I publish these observations as a supplement.

anxious to convince myself as to the rank of the species in question, as also with regard to its relationships with the freshwater sponges occurring in Europe. As is well known I have compared *Spongilla sibirica* with *S.* (*Euspongilla*) *jordanensis*, while Carter has recently regarded it as identical with *Spongilla fragilis*, Leidy (*S. Lordii*, Bow.). From my examinations and comparisons of the American species with *Spongilla sibirica*, the latter proves to be really identical with *S. fragilis*, Leidy; nevertheless, in the form observed by Dybowski, some not unessential differences occur, to which I propose to refer in the following remarks, and at the same time to append some observations upon other freshwater sponges.

The specimens at my disposal are stated to be from the river Danici, in the neighbourhood of Charkow, and usually form small nodules 2–3 centim. in diameter; whilst a small irregularly triangular fragment represents a nearly flat cushion-like plate, furnished with a large regularly circular osculum and numerous smaller pores. At the surface of the nodules and of the lamella I find no gemmules; but, on the other hand, the latter occur in the interior of the nodules in great numbers and of two different forms and colours, namely:—

1. Pale whitish-yellow gemmules, which do not cohere, but appear to be irregularly scattered in the tissue of the sponge. The general form and structure of these gemmules are the same as I have indicated in the case of the young gemmules of *Euspongilla lacustris* (see my memoir on the freshwater sponges of Bohemia, p. 17, pl. ii. fig. 13). In point of fact such an immature gemmule of *Spongilla fragilis*, Leidy (*S. sibirica*, Dyb.), agrees with that of *Euspongilla lacustris*, inasmuch as it is quite naked, possesses a single horny membrane, and at the superior pole is destitute of the air-tube which is so characteristic of this species. Somewhat older gemmules indeed are still naked, but, at the pole indicated, they bear around the process which is generally regarded as an aperture a short, straight, somewhat inflated tube, which later on curves like a horn and becomes completely closed at the extremity.

2. Among the pale-coloured gemmules we find now and then, although rather rarely, an isolated brownish gemmule. On the other hand, such gemmules, generally of a dark brown colour, are present in great numbers united in groups of three or more, usually of eight, thirteen, or fifteen, but sometimes of from twenty to thirty, completely enclosed by the surrounding skeletal tissue of the sponge. In examining such

a group of gemmules, even under a low power, it is soon seen that the above-mentioned horn-like tube projects externally from each gemmule. As to the mode in which such groups of gemmules are produced, transverse sections give the most reliable evidence. Thus in a transverse section, showing five gemmules immersed in a common envelope, we see one gemmule placed in the centre of the group, while the other four lie in the periphery of the first. In other sections we may find several more gemmules both at the periphery and in the centre. Every peripheral gemmule projects outwardly by the horn-like tube from the common envelope. The walls of the tube appear much weaker than the thick, dark-brown, horny, proper enveloping membrane of the gemmules, the cellular contents of which contain very numerous elliptical starch-granules. The common envelope of a group of gemmules consists of hollow indented columns, which appear to be divided into a series of superimposed chamberlets by transverse lamellæ. We find here the same arrangement which has already been made known for one series of the freshwater sponges, especially by Carter's writings, and which I have also demonstrated in *Trochospongilla erinaceus*, and interpreted as an air-chamber layer. It probably represents a modification of the ordinary granular parenchyma-envelope which I have demonstrated in the indigenous species of *Euspongilla* and *Ephydatia*, but have also found in the exotic Spongillidæ, which I obtained by the kindness of MM. H. J. Carter and E. Potts, namely *Tubella pennsylvanica* *, *Parmula Batesii*, *Meyenia Leidyi* †, *Heteromeyenia argyrosperma*, *Carterius latitenta* and *tenosperma*, &c. In *Meyenia Leidyi* and *Tubella pennsylvanica* the parenchymatous envelope is very deep, so that the amphidisci attached to the horny membrane seem to be quite concealed. The gemmules of *Parmula Batesii* have the same form as those of species of *Ephydatia*, namely globular. On the thick horny membrane there stand three alternating series of the scutiform amphidisci, which appear to be enveloped by a deep parenchymatous layer, as already represented by Carter.

This parenchymatous layer therefore becomes modified into

* The form and arrangement of the skeletal spicules of *Tubella reticulata* agree with those represented by Marshall in his *Potamolepis Leubnitziæ*.

† *Meyenia Leidyi* certainly contains amphidisci of the same form as *Trochospongilla erinaceus*, but is by no means identical with the latter. The smooth skeletal spicules and the peculiar form of the depressed flask-shaped gemmules, flattened at the inferior pole, as well as their deep granular parenchyma-layer, are characters which mark *Meyenia Leidyi* as a distinct species.

a peculiar aerostatic apparatus, which is already well known through the older observations of Carter in *Spongilla Carteri* ("microcell-structure," 'Annals,' 1881, vol. vii. p. 83) and more recently in *S. fragilis*, but also by the careful investigations of Marshall in *S. nitens*. Dybowski also mentions this layer ("Belegmembran"), which consists of "non-nucleate, polygonal cells, from 0·006–0·09 millim. in size."

This statement is correct, for even the above-mentioned isolated brown gemmules are surrounded by the corresponding envelope; it is, however, comparatively feebly developed, inasmuch as the cell-spaces, or rather air-chambers, exist only in one layer, and appear like a network, consisting of depressed, usually six-sided chamberlets. In the groups of these gemmules this network is already united; and when several more gemmules come together to form the above-mentioned balls, the air-chambers also increase in number, and the thickness of this layer accordingly becomes more considerable. In the spaces between the gemmules especially a thick layer of air-chambers is produced, while the upper poles of the peripheral gemmules (*i. e.* the poles projecting outwards) are covered only by a single layer of chamberlets.

The coating-spicules certainly appear upon the surface and also scattered in the interior of the air-chamber layer; but for the most part they group themselves around the horny membranes of the gemmules. The peculiarities of these coating spicules are already sufficiently well known through Dybowski's memoir.

From what has just been stated it appears that the sponge from the river Danici, which Dr. Dybowski names *Spongilla sibirica*, agrees essentially with the North-American *Spongilla fragilis*, Leidy. The more detailed comparison of the two forms shows the following differences and distinctions:—

1. In *Spongilla fragilis*, Leidy, the groups of gemmules also occur in fours (var. *segregata*, Potts); but I have also found isolated gemmules, as well as groups of two, three, and up to six. Out of a hundred examples I found no such large number of gemmules in one group as in "*S. sibirica*."

2. The horny membrane in *S. fragilis*, Leidy, is always enveloped by a deep air-chamber layer, in consequence of which the true gemmules seem to be quite concealed, so that they cannot be observed from the surface. In "*S. sibirica*" the horny membranes are always to be seen distinctly.

3. The air-tube of *Spongilla fragilis*, Leidy, possesses walls of the same thickness as those of the gemmule proper.

The polar air-tube of *Spongilla fragilis* plays an important part in the existence of the gemmules. It is in direct connexion with the low superior process of the gemmule, which is generally regarded as an aperture of issue for the young sponge enclosed in the chitinous membrane. Whether it is really an aperture, however, I cannot state with certainty, as I never succeeded, either in living gemmules or in longitudinal sections, in demonstrating anything of the kind. It rather appears to be much more probable that the polar process is also completely closed by the horny membrane, by which the space within the gemmule appears to be completely cut off from the air-tube. The air-tubes of the dry gemmules of *Spongilla fragilis* are occupied by large air-bladders. A similar apparatus has been demonstrated by Carter and Marshall in *S. Carteri*, and I can confirm the statements of those naturalists from my own investigations. Moreover I am acquainted with similar arrangements in *Tubella reticulata*, Cart., in which the air-tube is inconsiderably inflated. The apparatus in question is very interesting in the remarkable North-American genus *Carterius*. In this it forms a high hollow tube, which, when the gemmules are thrown into water, is always directed upwards. The gemmules in this genus, however, are not globular, but only slightly convex above, while below they are hemispherical, so that the median longitudinal section through a gemmule resembles a little boat, the air-tube rising in the centre appearing not unlike a mast. The air-bubble enclosed within it evidently assists not a little in maintaining the gemmule at the surface of the water. In *Spongilla fragilis* the air-tubes are of comparatively more considerable dimensions than in any other species that I have examined; they must, however, contain a larger quantity of air, in order to sustain the certainly heavier groups of gemmules for a time at the surface of the water.

The memoir by Wilhelm Retzer ('Die deutschen Süsswasserschwämme,' Inaugural Dissertation, Tübingen, 1883), which probably appeared simultaneously with my previous work, contains descriptions of some freshwater sponges which had been already established by Noll ('Zoologische Garten,' 1870), but which require a fresh investigation in order to determine their rank and their relations to those described in my monograph. This applies especially to *Spongilla Lieberkühnii*, Noll, and also to *S. contecta*, Noll, which, in my opinion, must agree with *S. fragilis*. Whether *Spongilla* *mirabilis*, Retzer, is identical with the *Ephydatia amphizona* described by me cannot be decided from Retzer's description and sketchy figures; a comparison of the types described by Retzer is very desirable.

P.S.—After I had completed the manuscript of these remarks I received from Dr. Anton Wierzejski, of Cracow, some preparations of the freshwater sponges occurring in Galicia, among which, to my surprise, I also found *Spongilla fragilis*, Leidy. We must await Dr. Wierzejski's monograph of the Spongillid fauna, which is shortly to appear, for details as to the peculiarities of this freshwater sponge, which is evidently very characteristic of the Palæarctic and Nearctic regions.

III.—*Note on* Spongilla fragilis, *Leidy, and a new Species of* Spongilla *from Nova Scotia.* By H. J. CARTER, F.R.S. &c.

WITH reference to the "P.S." to Prof. F. Vejdovsky's 'Observations' (*supra*), I would here remark that Mr. Stuart O. Ridley, F.L.S., of the British Museum, has lately sent me a specimen of *Spongilla fragilis*, Leidy, as I have described it under the name of *S. Lordii*, Bk. ('Annals,' Feb. 1881, vol. vii. p. 89), which he discovered in the river Wye, about ten miles above Hereford, England, in August last, growing over the internal surface of a valve of *Unio margaritiferus*. This is the first time that this species of freshwater sponge has been recognized in England. The prolonged aperture of the chitinous coat is not turned to one side, but simply vertical, as in *S. Lordii*, with a delicate film (for the specimen is dry) of sarcode stretched across its mouth.

On the 8th August last, too, I received from A. H. MacKay, B.A., B.Sc., of the Pictou Academy, Pictou, a similar specimen growing over a small branch of wood, together with the variety called "*segregata*" by Mr. Edward Potts, of Philadelphia, which Mr. MacKay had found in MacIntosh Lake, Nova Scotia.

Further, on the 26th August following I received another collection of freshwater sponges, obtained by Mr. MacKay from the lakes near Pictou, in Nova Scotia, among which are good-sized specimens of the following:—

Spongilla lacustris, var. *lacustrioides*, Potts (the American representative of *S. lacustris*, auct.), from Lakes MacIntosh, Forbes, Lochaber, and Black Brook, East River, St. Mary's, respectively.
Meyenia fluviatilis, auct. Garden-of-Eden Lake.
—— *Everetti*, Mills. MacKay's Lake.
Heteromeyenia Ryderi, Potts. MacKay's Lake.
—— *argyrosperma*, Potts. Garden-of-Eden Lake.

Together with a specimen of another species which, until just now that I have had occasion to examine it more particularly, I thought had been *Spongilla fragilis*, var. *segregata*. However, it turns out to be very different; and being *new*, I herewith append its description under the name of

Spongilla Mackayi.

Sessile, spreading, charged with little subglobular bodies like large statoblasts, about 1-12th inch in diameter. Skeletal spicule acerate, slightly curved, sharp-pointed, more or less thickly spined, averaging 50 by $2\frac{1}{2}$-6000ths inch in its greatest diameters; accompanied abundantly by a minute birotulate flesh-spicule precisely like that of *Meyenia Everetti*, that is 3 to 4-6000ths inch long, with very thin smooth shaft about four times longer than the diameter of the rotule, which is 1-6000th inch, toothed, with the teeth recurved. Statoblast globular, consisting of a thick chitinous coat filled with the usual germinal matter, from which is very slightly prolonged an everted trumpet-shaped aperture; bearing slight traces externally of microcell-structure and the polygonal tissue; making one of twenty such which are so arranged as to form a subglobular body of the size mentioned; situated around a central cavity with their apertures *inwards*; the whole supported by statoblast-spicules of various sizes, which, intercrossing each other, form a nest-like globular capsule in which the outer parts of the statoblasts are fixed and covered; apparently (for the specimen is dry) deficient at one point, which leads into the central cavity. Statoblast-spicules acerate, sharp-pointed, like the skeletal spicules, but becoming much shorter and more coarsely spined as they approach the chitinous coats of the statoblasts, where they may be reduced to at least 27-6000ths inch in length, although often increased to 4-6000ths inch in thickness, and their spines, which are very irregular in size and situation, often as long as the spicule is broad. Size of specimen about 1-6th inch high and 2 inches in horizontal diameter.

Hab. Freshwater.

Loc. Mackay's Lake, near Pictou, Nova Scotia.

Obs. The most remarkable point presented by this species is that its flesh-spicule should be identical with that of *Meyenia Everetti*, whose statoblast is covered with a thick crust of long and large birotules, denticulated, with recurved teeth like those of *Meyenia Baileyi* &c., showing that this kind of flesh-spicule may be present in totally different species of freshwater sponges, unless it should be owing to the presence and proximity of *M. Everetti*, which, as above stated, grows in the same lake.

It is remarkable, too, that the spiculation of *Spongilla Mackayi*, both skeletal and flesh-, should be almost identical with those which I have described and illustrated of the freshwater sponge-spicules so abundant in the diluvial deposits of the Altmühl valley, in Bavaria ('Annals,' Nov. 1883, vol. xii. p. 329 &c., pl. xiv. fig. 18, *a*, *b*, *g*, *h*, *i*).

IV.—*On the wide Distribution of some American Freshwater Sponges.* By E. Potts *.

Allusion having been made to the wide distribution of certain species of spiders over the North-American continent, Mr. E. Potts, referring to the freshwater sponge-fauna of this country, said that *Spongilla fragilis*, the first species named in America, described by Dr. Leidy in 1851 from specimens collected near Philadelphia, had since been found abundantly along the Atlantic coast from Florida to Nova Scotia. It had been gathered at several points along the St. Lawrence and in the great lakes through the middle continent, and in the far west had been described by Dr. Bowerbank, in 1863, under the name of *S. Lordii*, as found in the lakes and streams flowing from the Cascade Range in British Columbia, affluents of the majestic Columbia river. The species may therefore be regarded as strictly continental in its range, and until very recently it has been distinctively American. It is a little singular that the only other place in which it has been noticed is in the neighbourhood of Charkow, in Russia, where it was discovered a few months since by Dr. L. Dybowski.

The specimens of this species from Nova Scotia had been collected by Mr. A. H. MacKay, B.A., B.Sc., of Pictou

* Proc. Acad. Nat. Sci. Philadelphia, 2nd Sept. 1884, p. 215. Reprinted from a copy sent by the author to Mr. H. J. Carter, F.R.S.

Academy, Pictou, N. S., from whom the speaker had recently received a collection of sponges, phenomenal in its character, both as regards the number of genera and species represented and the excellent judgment that had attached to most of them their proper names from apparently very insufficient data. The collection was the result of a few days' search within a limited district, "from lakes in and near the watershed of Nova Scotia, near the borders of the three counties of Pictou, Guysboro, and Antigonish," at elevations of from 100 to 700 feet above sea-level. Of the genus *Spongilla* it contains three species, *S. lacustris*, *S. fragilis*, and *S. iglooiformis*; of the genus *Meyenia* two species, *M. fluviatilis* and *M. Everetti*; of the genus *Heteromeyenia* two, *H. argyrosperma* and *H. Ryderi*; and of the genus *Tubella* one species, *T. pennsylvanica*—eight species, representing four genera. Besides these there were small specimens of another species, evidently new, but whose generic relations could not be determined on account of the absence of statoblasts.

In some respects the most important find in the collection is *Meyenia Everetti*, Mills, this being only the second instance in which the species has been discovered. The original locality was Gilder Pond, upon Mt. Everett, in Berkshire Co., Mass., at an elevation of 1800 or 2000 feet above the sea. It was there collected by Dr. F. Wolle and Mr. H. S. Kitchel, of Bethlehem, Pa., well known for their invaluable work among the desmids and diatoms, and examined simultaneously by Mr. H. Mills, of Buffalo, N. Y., and the speaker. Its most striking peculiarity is the presence all through the dermal tissues of very minute birotulate spicules, the only instance in which these have been observed as characteristic features of the dermal surface in any freshwater sponges, unless the complicated forms found in *Meyenia plumosa*, Carter, may be considered an exception.

These birotulates in the present collection average one third longer than those before examined and are in every way more robust. The speaker was gratified in finding this confirmation of a rule which he has long since observed to hold amongst the infinite variations of size and form noticeable in collections of the same species from various localities, viz. that the spicules of all species increase regularly in size and solidity as we descend from high altitudes towards the sea-level, where is found the extreme limit of the series. He does not attribute this gradation to a change of climatic conditions, but more probably to a gradual and constant improvement in the food-supply or in the siliceous constituent of the water. He has traced the workings of the rule more particularly through the very variable species *Spongilla lacustris* and *S. fragilis*, in *Meyenia fluviatilis*, in *Heteromeyenia argyrosperma* and *H. Ryderi*, and, lastly and most conspicuously, in *Tubella pennsylvanica*. The extremes in this last series differ so widely that they would hardly be taken to belong to the same species; but the intermediate grades have all been collected largely from the same stream, and as a result several species named in this and other cases have relapsed into synonyms.

V.—*Notices of Fungi in Greek and Latin Authors.* By the Rev. William Houghton, M.A., F.L.S.

It may perhaps interest some of the readers of 'The Annals and Magazine of Natural History' if I bring before them in a collected form all that I have been able to gather on the subject of fungi from the writings of the ancient Greeks and Romans. I am not aware whether anything of this kind has been hitherto attempted by any English writer; but in Germany Dr. H. O. Lenz, in his useful 'Botanik der alten Griechen und Römer' (Gotha, 1859), has collected together the scattered notices of fungi which appear in classical authors, and has added footnotes containing his own observations. The late Dr. Badham, in his 'Treatise on the Esculent Funguses of England' (London, 1863), gives a short account of their classical history; but no systematic collection has, so far as I know, been hitherto made. Although, perhaps, the subject is not one of very great importance, still it is one to which a certain degree of interest attaches itself both for the general reader and for the mycologist.

The earliest Greek writer who takes any notice of fungi is Theophrastus (circ. B.C. 300); there is no allusion to these plants in the works of Homer and Hesiod. The word *μύκης* indeed occurs in Herodotus (iii. 64), but it there means the cap of the sheath of a sword, from its conical or fungus-like form. Theophrastus (Hist. Plant. i. 1, § 11) speaks of the *μύκης* and the *ὕδνον* as having neither root, stem (*καυλός*), branch, bud, leaf, flower, nor fruit, neither again bark, pith, fibres, nor veins; but in i. 5, § 3, he speaks of the stem (*καυλός*) of the *μύκης* as being of uniform structure or evenness, without knots, prickles, or divisions. In i. 6, § 5, the *ὕδνον*, *μύκης*, *πέζις*, and *γεράνειον* (*κεραύνιον*) are mentioned as having no root. The *μύκητες* in iii. 7, § 6, are said to grow out of and near the roots of oaks and other trees. In his treatise on odours ('De Odoribus,' Frag. iv. 3, ed. Schneider) Theophrastus notes that the *μύκητες* which grow in dung have no bad smell. This is all that Theophrastus has said concerning fungi, and it is worth while to remark that this most ancient Greek writer, who professedly discourses on plants, has absolutely not left us anything sufficiently descriptive to enable us to know definitely what most of the above-named plants respectively denote. He seems to have taken it for granted that the people of his time knew what particular plants he was speaking of, and that therefore there was no need of particular definite description. We have to learn what fungi the Greek names really denote by comparing what Theophrastus has said with what other Greek and Roman writers have recorded. The question of identity of these names therefore shall wait until we have brought forward further evidence.

After Theophrastus comes Nicander (B.C. circ. 185), a physician, grammarian, and poet, who wrote on various subjects; but most of his works have been lost. His two poems, the 'Theriaca' and the 'Alexipharmaca,' in hexameter lines, have been preserved to us. In the first-mentioned poem Nicander discourses of venomous animals and the wounds inflicted by them; there is much absurd fable mixed up with his zoological remarks, and perhaps Haller was not far wrong when he described this treatise of nearly a thousand hexameter lines as being "longa, incondita, et nullius fidei farrago." The 'Alexipharmaca,' of about six hundred lines in the same metre, treats of poisons and their antidotes, and is about as valuable as his other poem. His Greek is obscure and full of out-of-the-way words. Bentley, with great truth, called Nicander "antiquarium, obsoleta et casca verba venantem, et vel sui sæculi lectoribus difficilem et obscurum."

As Nicander is very seldom read and his works are in few private libraries, it may be well to quote his lines on fungi as a sample of his style and diction :—

Μὴ μὲν δὴ ζύμωμα κακὸν χθονὸς ἀνέρα κήδοι
πολλάκι μὲν στέρνοισιν ἀνοιδέον, ἄλλοτε δ' ἄγχον,
εὖθ' ὑπὸ φωλεύοντα τραφῇ βαθὺν ὁλκὸν ἐχίδνης,
ἰὸν ἀνικμαῖνον στομίων τ' ἀποφώλιον ἆσθμα·
κεῖνο κακὸν ζύμωμα, τὸ δή ῥ' ὑδέουσι μύκητας
παμπήδην, ἄλλῳ γὰρ ἐπ' οὔνομα κέκριται ἄλλο.
'Αλλὰ σύ γ' ἢ ῥαφάνοιο πόροις σπειρώδεα κόρσην,
ἢ ῥυτῆς κλώθοντα περὶ σπάδικα κολούσας,
πολλάκι καὶ χαλκοῖο πάλαι μεμογηότος ἄνθην·
ἄλλοτε κληματόεσσαν ἐν' ὄξεϊ θρύπτεο τέφρην·
δήποτε ῥιζάδα τρῖβε πυρίτιδα βάμματι χραίνων

ἢ λίτρον, τοτὲ φύλλον ἐναλδόμενον πρασιῇσι
καρδαμίδος, Μῆδόν τε καὶ ἐμπρίοντα σίνηπυν.
σὺν δὲ καὶ οἰνηρὴν φλογιῇ τρύγα τεφρώσαιο
ἠὲ πάτον στρουθοῖο κατοικάδος· ἐκ δὲ βαρεῖαν
χεῖρα κατεμματέων ἐρύγοι λωβήμονα κῆρα.—*Alexiph.* 521–536.

"Let not the evil ferment of the earth, which often causes swellings in the belly or strictures in his throat, distress a man; for when it has grown up under the viper's deep hollow track it gives forth the poison and hard breathing of its mouth; an evil ferment is that; men generally call the ferment by the name of fungus (*μύκης*), but different kinds are distinguished by different names; but do thou take the many-coated heads of the cabbage, or cut from around the twisting stems of the rue or old copper particles which have long accumulated, or pound clematis into dust with vinegar, then bruise the roots of pyrethrum, adding a sprinkling of vinegar or soda, and the leaf of cress which grows in gardens, with the medic plant and pungent mustard, and burn wine-lees into ashes or the dung of the domestic fowl; then, putting your right finger in your throat to make you sick, vomit forth the baneful pest."

The expression "evil ferment of the earth," to denote the general name of fungus represented by the Greek word *μύκης*, is, I think, peculiar to Nicander. The scholiast explains it in various ways, which are unsatisfactory; *e. g.* "he calls the *μύκης* a ferment because it is like the ferment of the earth, that is, clay, for it is like a clod of earth;" or, "it is called a ferment because when undigested the fungus causes fermentation in the bowels." Perhaps Nicander was referring to the white mass of mycelium from which the plant grows; and the term ferment for a fungus is not far amiss. Some of the antidotes he recommends to persons who have been poisoned by fungi will be found in later writers; as Nicander was greatly esteemed as a physician in his day, his prescriptions naturally remained long in vogue; the pharmacopœia of the ancients did not admit of much variation from the old receipts. The recommendation to take vinegar after fungus-poisoning would doubtless be of use in the case of fungi containing poisonous alkalies, and no one can doubt that his proposed emetic, if taken in time, would prove efficacious.

There is no mention by Greek writers of fungi, as far as I can learn, from the date of Nicander to that of Dioscorides, the Cilician physician who probably lived in the second century of the Christian era; the word *μύκης* occurs neither in the Greek poets, tragic or comic, nor in the historians.

Athenæus, however, has preserved to us a few quotations relating to *μύκητες* from older authors, which I will notice by and by. The Latin word *fungus*, which may be taken to be the representative of the Greek *μύκης*, "a fungus of any kind," is by no means of common occurrence in Roman authors. Virgil once uses the term, but not in reference to the plant, but to the well-known growth on the wick of the lamp, which was supposed to forbode rain; and Aratus long before had spoken of these fungoid excrescences, *λύχνοιο μύκητες*. Ovid, in a little picture which he draws of the daily work of a frugal peasant woman ("parca colona") and her hardy husband, represents the former sweeping out the cottage, setting hens on eggs, and gathering green mallows and white fungi:—

> "Aut virides malvas aut fungos colligit albos."—*Fast.* iv. 697.

Ovid has one more reference to fungi. With ourselves the expression "mushroom origin or birth" is and has long been proverbial to denote one of recent date, in allusion to the rapidity with which these things spring up in our fields in favourable weather; with the people of Corinth, on the contrary, a mushroom origin went back to the earliest period—

> "Hic ævo veteres mortalia primo
> Corpora vulgarunt pluvialibus edita fungis."—*Met.* vii. 392–3.

"Here (in Corinth) the ancients record that in the first age of the world mortal bodies were produced from fungi which spring up after rains." Considering the licentious nature of the people and the extent to which the worship of Aphrodite prevailed in the city of Corinth, which in all probability was introduced by the Phœnicians, is it possible that the *Phallus impudicus* suggested the mythological tradition?

Horace, in a well-known line, refers once only to fungi:—"Pratensibus optima fungis natura est; aliis male creditur;" "Fungi which grow in meadows are the best; it is not well to trust others" (Sat. ii. 4. 20). He is evidently alluding to those which grow in woods as those not to be trusted, being probably poisonous. The meadow fungi may perhaps have been the common mushroom (*A. campestris*) and the fairy-ring champignon (*A. oreades*).

There is no doubt that the common mushroom is eaten at this day in Italy, and doubtless it was used by the ancient Romans. It is a fallacy of the late Dr. Badham to suppose that the *A. campestris* was prohibited by the market inspectors. In an interesting paper on the edible fungi of Italy, read at the Woolhope Field-club meeting at Hereford last October, Mr. A. S. Bicknell remarked :—" Perhaps the most startling statement to be found in Badham's book is the passage where he says that almost the only fungus condemned as poisonous in Rome is our common mushroom ; the words of Sanguinetti, his authority, are 'The sale is absolutely prohibited of the so-called Prateroli.' Evidently the question turns upon whether *pratiolo* means *A. campestris.* In Bologna, long a pontifical town, I saw mushrooms selling in the market for 40 c. the kil. (less than twopence per pound) ; but they are not abundant in Italy, for there are few meadows."

Celsus, who lived about the time of Augustus and Tiberius, briefly alludes to unwholesome fungi ("fungi inutiles") :—" If any one shall have eaten noxious fungi let him eat radishes with vinegar and water ("posca"), or with salt and vinegar; these may be distinguished from the wholesome kinds by their appearance, and can be rendered serviceable by a mode of cooking them; for if they have been boiled in oil or with the young twig of a pear-tree they become free from any bad quality" (De Med. v. 27. 17).

Dioscorides is somewhat more diffuse on fungi than all other ancient writers except Pliny. He mentions a practice in his time for causing edible fungi to grow :—" Some people say that the bark of the white and the black poplar when cut into small pieces and scattered over dunged spaces will produce edible fungi (μύκητας ἐδωδίμους) at all seasons" (Mat. Med. i. 109). Dioscorides appears to be the first writer who mentions the *Agaricum*, a word familiar to all mycologists under the name of agaric, though the original name stood for something quite different from the laminated agarics of modern systematists. Of the *agaricum* he writes :—

" Agaricum root is said to resemble the root of silphium (Assafœtida) ; it is not, however, thick in appearance, like silphium, but altogether slighter. One kind is male, the other female, which differs from the male in having straight fibres within (κτηδόνας εὐθείας ἐντός) ; the male is round and homogeneous in structure throughout; in taste both kinds are similar, at first sweet, then, after being swallowed, bitter. It grows in Agaria of Sarmatia; some people say that it is the root of a plant, others that it is produced in the trunks of trees that have become rotten like fungi (μύκητες) ; it grows also in Asia, viz. in Galatia and Cilicia, on cedar trees, but of a friable and weak nature. Its properties are styptic and heat-producing, efficacious against colic (στρόφους) and sores, fractured limbs, and bruises from falls ; the dose is two obols weight with wine and honey to those who have no fever; in fever cases with honeyed water; it is given in liver complaints, asthma, jaundice, dysentery, kidney diseases, where there is difficulty in passing water, in cases of hysteria, and to those of a sallow complexion in doses of one drachma; in cases of phthisis it is administered in raisin-wine, in affections of the spleen with honey and vinegar. By persons troubled with pains in the stomach and by those who suffer from acid eructations, the root is chewed and swallowed by itself without any liquid; it stops bleeding when taken with water in three-obol doses; it is good for pains in the loins and joints, in epilepsy when taken with an equal quantity of honey and vinegar; it assists menstruation and relieves flatulence in women when taken with equal proportions of honey and vinegar. It prevents *rigor* if taken before the attack; in one- or two-drachm doses it acts as a purgative when taken with honeyed water; it is an antidote in poisons in one-drachm* doses with dilute wine. In three-obol doses with wine it is a relief in cases of bites and wounds caused by serpents. On the whole it is serviceable in all internal complaints when taken according to the age and strength of the patient; some should take it with water, others with wine, and others with vinegar and honey or with water and honey" (De Med. iii. 1).

There seems to be no reasonable doubt that the agaricum of Dioscorides is the *Polyporus officinalis* of modern mycologists, which grows on larches in subalpine places of Southern Europe. That which he calls the female is the *Polyporus* in question; and probably under the name of male other *Polypori*, as *P. quercinus*, are intended. The expression that the female has straight fibres within suits the *P. officinalis*, while the bitter taste to which Dioscorides alludes is very marked in this species. An objection, however, to this identification would seem to rest on his statement that the agaricum grows on cedars, whereas the *P. officinalis* is found on the larch alone; but it should be noted that instead of the reading *ἐπὶ τῶν κέδρων,* Oribasius reads *δένδρων.* Sprengel, in his commentary on Dioscorides (*l. c.* vol. ii. p. 490), expresses wonder why agaricum should have been brought by the ancients from the remote Agarum of Sarmatia when the Romans at least could have procured it much more easily from Rhætia, Vindelicia, and Noricum, Danubian provinces of the Romans; "still, even in our time," he adds, "agaricum is sent from the remote Ural Mountains, as well as from Syria, which Europeans consider to be of a most excellent

* A drachma=about 66 gr. avdp.; obol=$\frac{1}{6}$ of drachma.

kind." We shall cease to wonder at the esteem in which this medical commodity was held by the ancients when procured from the promontory of Agarum when we reflect that this was the country of the Agari, a people skilled in medicine and said to have been able to cure wounds with serpent's venom, and that some of them attended Mithridates the Great as physicians. Hence no doubt the value attached to the fungus from such a renowned district. This once famous cure for all diseases has long since fallen into disuse, and *Polyporus officinalis* will not be found in our modern pharmacopœias; whether herbalists still continue to employ it I know not.

On edible and poisonous fungi Dioscorides writes as follows:—"Fungi (*μύκητες*) have a twofold difference, for they are either good for food or poisonous (*βρώσιμοι ἢ φθαρμικοί*); their poisonous nature depends on various causes, for either such fungi grow amongst rusty nails or rotten rags, or near serpents' holes, or on trees producing noxious fruits; such have a thick coating of mucus, and when laid by after being gathered quickly become putrid; but others, not of this kind, impart a sweet taste to sauces; however, even these, if partaken of too freely, are injurious, being indigestible, causing stricture or cholera. As a safeguard all should be eaten with a draught of olive-oil, or soda and lye-ashes with salt and vinegar, and a decoction of savory or marjoram, or they should be followed with a draught composed of bird's dung and vinegar, or with a linctus of much honey; for even the edible sorts are difficult of digestion and generally pass whole with the excrement" (Mat. Med. iv. 83).

It need scarcely be observed that the different reasons here given for discriminating edible and poisonous fungi have no basis of fact; several perfectly wholesome fungi are covered with mucus. *Gomphidius glutinosus* and *G. viscidus*, for instance, are quite wholesome, and, I think, very good eating; the same might be said of *Boletus luteus*, *B. flavus*, and many others. Their growing amongst rusty nails and rotten rags would probably not affect their qualities in any way; while of course the idea that such kinds as grow near a serpent's hole, which, as we have seen, Nicander long before makes mention of, is simply a bit of old Greek folk-lore which is quite in harmony with popular belief and prejudice. With regard to the antidotes in case of poisoning by fungi, vinegar is still employed to neutralize poisonous alkalies; but perhaps the only safe remedy employed is an emetic.

Pliny has a good deal to say on fungi, and is the only ancient writer who has given so good an account of the *Boletus* of the Romans as to enable us to identify almost certainly the species intended. The famous or infamous case of the death of the emperor Claudius by means of a dish of boleti in which some poison had been placed by his wife Agrippina was fresh in Pliny's time, and afforded material for strong declamatory language. The excessive luxury of the wealthy people of the Roman empire, especially their love of eating and drinking the most rare and costly dainties *, helped to bring fungi more and more forward as a possible incitement to the appetite and a savoury article of diet; but still people had been both purposely and accidentally poisoned by fungi, so they were regarded as "ancipites," questionable food indeed. The most interesting bit of fungus-talk which Pliny treats us to is the following: —

"Among those things which are rashly eaten I shall rightly place *boleti*, excellent food no doubt, but which have been brought into reproach by an unparalleled instance; for by their means poison was administered to the emperor Tiberius Claudius by his wife Agrippina, by which deed she inflicted another poison on the world, and especially on herself, in the person of her son Nero. Some of the poisonous kinds are easily known by a dilute red colour ('diluto rubore'), a loathsome aspect, and internally by a livid hue; they have gaping cracks ('rimosa stria') and a pale lip round the margin. But these characters are not seen in certain kinds which are dry and like nitre, and which bear on their heads as it were spots formed from their own coating; for the earth first produces a wrapper ('volva') and afterwards itself (*i. e.* the boletus) within the volva, like the yolk in the egg; the young boletus with its volva is very good for food. As the boletus grows the volva is burst; by and by its substance is borne on the stem; there are seldom two heads on one stem. Their origin is from mud and the acrid juices of moist earth, or frequently from those of acorn-bearing trees; at first it appears as a kind of tenacious foam ('spuma lentior'), then as a membranous body; afterwards the young boletus appears, as we have said. Noxious kinds must be entirely condemned; for if there be near them a hobnail ('caligaris clavus') or a bit of rusty iron or a piece of rotten cloth, forthwith the plant, as it

* The Romans were not alone in their love of costly dainties; the Greeks shared with them in this respect. Plutarch speaks of the absurdity of indulging in meats and drinks simply because they are rare, costly, and accessible only to the rich, and instances among such articles of luxurious diet "sow's udders, Italian mushrooms (μυκήτων Ἰταλικῶν), Samian cakes, and snow from Egypt" ('De tuenda Sanitate præcepta,' vol. i. pt. 2, p. 491: ed. Wyttenbach). From this passage it appears that edible fungi were sometimes exported from Italy into Greece, which is very probable, for Greece to this day is poor in fungi.

grows, elaborates the foreign juice and flavour into poison; and to discern the different kinds country-folk and those who gather them are alone able. Moreover they imbibe other noxious qualities besides; if, for instance, the hole of a venomous serpent be near, and the serpent breathe upon them as they open, because, from their natural affinity with poisonous substances, they are readily disposed to imbibe such poison. Therefore one must notice the time before the serpents have retired into their holes. . . . The whole existence of a boletus from birth to death is not more than seven days" (Nat. Hist. xxii. 22).

The boletus of the ancients, from the above description of it by Pliny, clearly belongs to the genus *Amanita* of modern mycologists, and has nothing to do with the boletus as now applied to those fungi whose hymenium consists of tubes or pores. The genus *Amanita*, of which there are several British species, is characterized by the presence of a wrapper or *volva*, which at first envelopes the fungus, and which often remains in patches on the pileus, as mentioned by Pliny. Tradition has referred the species to *A. cæsareus*, so called as being that one which was instrumental in poisoning Claudius Cæsar; and there is no reason to doubt that this is the famed boletus of the ancient Romans. Mr. Bicknell says it is now universally called *uovolo*, and is to be seen in the markets of Milan, Bergamo, Brescia, Verona, Cremona, Bologna, and other Lombard cities from the middle of September to the middle of October. He usually had it cut up and stewed or fried in butter; at the commencement of the season it is worth about one shilling the pound. Lenz gives as the modern Italian names of this fungus, *uovolo, uovolo ordinario, uovolo commune, uovolo rancio* (orange-coloured); at Verona, *fongo ovo, fongo bolado*, and *bolè*, in which two latter instances the ancient Roman name still survives, while the ordinary name of *uovolo* reminds one of Pliny's words "like the yolk in the egg." In lib. xvi. cap. 8, Pliny, among the various products of the oak, mentions *boleti* and *suilli*, which he calls the most recently discovered stimulants for the appetite ("gulæ novissima irritamenta"), as growing around their roots; he says the quercus (*Q. robur?*) produces the best kinds, and that the robur (*Q. robur*, var.?), cypress, and pine yield noxious ones. From this it would appear that boleti (*A. cæsareus*) were not much used as food before the time of the empire; *boletus* as a Latin name occurs only in the writings of Pliny, Juvenal, and Martial, and the Greek βωλίτης does not occur before the time of Galen (A.D. 130); the noxious kinds of boleti may refer to *A. muscarius* or *A. phalloides*, but this is mere conjecture;

while the assertion that certain trees produce them is probably a mere popular notion of his time. Lenz gives *uovolo malefico* as one of the modern Italian names of *A. muscarius.* The suilli will be discussed by and by. Pliny distinguishes between boleti and fungi:—"The nature of fungi is more viscid than that of boleti; there are many kinds, and they originate only from the slimy moisture of trees. The safest are those which have a red skin, but of a darker hue than occurs in boleti; the next best are the white kind, with head-stems remarkable for their resemblance to the conical caps of the Flamens ('apice Flaminis'); and thirdly there is the kind called *suilli*, very convenient for poisoning. Lately they have killed whole families and all the guests at a banquet, as, for instance, Anneus Serenus, the prefect of Nero's guard, together with the tribunes and centurions. What so great pleasure can there be in doubtful food? Some persons have discriminated the kinds of fungi from the kinds of trees on which they grow, saying that the good kinds are found on the fig, the birch, and gummiferous trees, we that the noxious kinds grow on the beech, oak (robur), or cypress as aforesaid.

"But who will give security when these things are exposed for sale in the markets? All the poisonous fungi have a livid colour, while, on the other hand, a reason for suspecting poison will be absent from those kinds which grow on trees which resemble the fig. We have already spoken of remedies against fungus-poisoning; we will add a few more remarks, for even in these products there are medicinal properties. Glaucias thinks that *boleti* are good for the stomach; *suilli* are dried and hung up, being transfixed with a rush, as in those which come from Bithynia. These are good as a remedy in fluxes from the bowels, which are called rheumatismi, and for fleshy excrescences of the anus, which they diminish and in time remove; they remove freckles ('lentigines') and blemishes on women's faces; a healing lotion also is made of them, as of lead, for sore eyes; soaked in water they are applied as a salve to foul ulcers and eruptions of the head and to bites inflicted by dogs.

"I will now make some general observations on the cooking of fungi, because this is the only food which dainty voluptuaries themselves prepare with their own hands, and thus, as it were, by anticipation feed on them, using amber knives and silver service. Those kinds which remain hard after cooking are injurious, while those which admit of being thoroughly well cooked when eaten with saltpetre are harmless; they are rendered more safe still if they are cooked with meat ('cum carne cocti') or with pear-stalks; indeed it is good to eat pears immediately after fungi. Vinegar being of a nature contrary to them neutralizes their dangerous qualities. All these products appear after showers" (xxii. 23).

Pliny mentions three different kinds of fungi which he considers to be the best for food; but identification is difficult owing to want of data. Those which Pliny calls "tutissimi qui rubent callo minus diluto rubore quam boleti" may possibly be *Russula alutacea*, as Lenz conjectures; in Verona he says this russula is still called *fungo rossetto*, and in Italy generally *rossola buona di gambo lungo*, "the good long-stemmed red fungus," which is still eaten in Italy; but as Pliny gives us no character except that of colour, which in the genus *Russula* is very variable, it is evident we cannot say what the species is. There is something more to guide us in Pliny's second-best kind, viz. "the white fungi whose head-stems are similar in form to the caps of the Flamens." Most of the forms of this cap (apex) as shown on coins or bas-reliefs of the Roman emperors are of a conical or cylindrical form, and remind one of the cylindrical pileus of the very excellent *Coprinus comatus* before it expands and deliquesces; at least I know of no other edible fungus that so much resembles the figures of these priestly caps. Badham says that *C. comatus* is "largely eaten" about Lucca; but this species is not named by Vittadini nor was it seen by Mr. Bicknell in the Italian markets. The *suillus* which we find mentioned by Martial—

> "Sunt tibi boleti: fungos ego sumo suillos."—*Ep.* iii. 60—

in an epigram, in which he complains to Ponticus that when invited to dinner there were not set before him the choicest dainties, is generally supposed to be the *Boletus edulis* of modern mycologists. Its present Italian name of *porcino*, *bolè porcin*, answers to the old Latin name of *suillus*, which has something to do with "swine"*. Tradition has appa-

* The suillus in all probability was so called because swine were fond of it. Berkeley states that pigs devour both truffles and boleti as *B. edulis*. Whether the modern English pig of the farmyard will eat boleti I know not; but by the semi-wild swine of the ancient Romans boleti were probably eagerly devoured. Various boleti and agarics often bear the impress of the teeth of small Rodentia, as the squirrel and the rabbit, which latter animal I know will eat the *A. rubescens*. Cats are sometimes fond of fungi; I have a white Persian cat which I have tried with the following species of edible fungi, all of which it eats with evident relish:—*Agaricus pratensis* (mushroom), *A. melleus*, *A. personatus*, *A. virgineus* (*Hygrophorus*), *A. oreades*, *A. comatus*, *A. butyraceus*, *Boletus edulis* and *scaber*, *Hydnum repandum*. Some known unwholesome and poisonous kinds, as *A. semiglobatus*, *A. æruginosus*, *A. muscarius*, some of the *Cortinarii*, *Boletus luridus*, &c., the cat refuses. Another of my

rently identified the species as the *B. edulis.* Mr. Bicknell, who travelled in North Italy this last autumn, says this fungus is the one most commonly sold in Italy at present. In the market of Bergamo it was sold at 40 c. per pound; at Brescia it was ten cents dearer. In Florence and Parma there was no other fungus. He adds that when cooked they are usually filled with bread-crumbs, and that they may be bought in almost any grocer's shop. It is probable that the ancient *suillus* included, besides *B. edulis*, *B. scaber*, which is also very common in the Italian markets and is also known by the name of *porcinello*, or "the little-pig fungus."

The suillus has an historical interest attaching to it similar to that which attaches itself to the boletus. Pliny calls it a genus "venenis accommodatissimum," and refers to the case of the poisoning of Anneus Serenus and a whole lot of guests; it is probable that the suillus was the medium for introducing some poison of a foreign nature into the dish in which it appeared at table*, just as was the case with the boletus which poisoned Claudius Cæsar. Anneus Serenus was an intimate friend of Seneca, and his death is referred to in one of the moralist's epistles (Ep. 63) in very touching language; but he does not say a word about the cause of his friend's death. Tacitus speaks of the part which Serenus played in regard to Nero's passion for a freedwoman named Acte, which enraged Agrippina and filled her with burning hatred. Serenus took Nero's part. Tacitus says nothing about the death of Serenus. This rests on the sole authority of Pliny; but seeing that Agrippina had already poisoned her husband Claudius, it is quite probable that she resorted to a similar mode of getting rid of Serenus and the tribunes, and that she introduced poison into a dish of suilli or *Boletus edulis.* The picture which Pliny sarcastically draws of the voluptuaries of the day is very graphic. Amber knives and silver service alone were good enough for preparing or setting on table these fungi, the preparation of which by the hands of the rich magnates themselves afforded an anticipatory feast of the dainties!

If the fashion of eating these fungi arose, as Pliny seems to say, in the time of the Roman emperors, many of whom were always eager for any fresh introduction to the luxuries of

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cats (common variety) refuses all mushrooms and other fungi, and seems to say to its Persian companion "Persicos odi, puer, apparatus," when such "apparatus" is a fungus.

* Badham considers that this case of poisoning was accidental; I interpret Pliny's account as intimating determined purpose.

the table, it soon developed into something like a mania among the rich; a passion for truffles and boleti betokened no good in the youth of those days. Hence Juvenal writes:—

> "Nec melius de se cuiquam sperare propinquo
> Concedet juvenis, qui radere tubera terræ,
> Boletum condire......didicit."—*Sat.* xiv. 6–8.

"Nor will that youth allow any relative to hope better of him who has learnt to peel truffles and to pickle boleti." The great esteem in which boleti were held is shown by Martial in his 'Epigrams.' Special vessels for cooking boleti were in use called *boletaria*, and should not be applied to baser purposes; hence one of these cooking utensils is represented as bewailing its changed lot in the functions of the Roman kitchen:—

> "Cum mihi boleti dederint tam nobile nomen,
> Prototomis (pudet heu) servio cauliculis."—*Ep.* xiv. 101.

"Although boleti have given me so noble a name, I am now used, I am ashamed to say, for Brussels sprouts."

Again, it was safer to send a messenger with gold or silver &c. than to send him with boleti, because he would probably have them cooked and eat them on the way *:—

> "Argentum atque aurum facile est, lænamque togamque
> Mittere: boletos mittere difficile est."—*Ep.* xiii. 48.

But to return to Pliny: of the Agaricum he says:—"The acorn-producing trees of the Gallic provinces more particularly produce agaricum; it is a white fungus with strong odour, useful as an antidote; it grows on the tops of trees and shines at night, by which fact its presence is known and it is gathered" (xvi. 8). This is the *Polyporus officinalis* of which Dioscorides speaks. I do not know whether luminosity has been observed in this fungus; but it is well known that certain fungi, notably the *Pleurotus olearius*, which grows on olive and other trees in the south of Europe, emits phosphorescent light, and perhaps *Polyporus officinalis* or the decayed wood on which it grows may occasionally exhibit the same phenomenon. The German tinder or amadou of commerce, at present prepared from the pileus of *Polyporus fomentarius*, was not unknown to the ancient Romans, though it is not stated whether it was steeped in a solution of saltpetre as at present. Pliny thus speaks of obtaining fire from wood:—

* Or because the possessor of such delicacies would rather keep them himself than send them to a friend.

"One piece of wood is rubbed against another, and the friction sets them on fire, which is augmented by dry tinder ("aridi fomitis"), especially by that of fungi and leaves" (xvi. 40). The fungus was probably steeped in sulphur, sulphur-matches being known to the Romans under the name of *sulfurata ramenta* or *sulfurata* (*cf.* Mart. Ep. x. 3, and i. 42).

Pliny mentions the Agaricum again, in cap. xxv. 9, as growing as a fungus "on trees round the Bosphorus: it is of white colour; it is given in four-obol doses mixed with two cyathi of honey and vinegar. That which grows in Gaul is considered an inferior kind. The male is thicker and more bitter than the female; it cures headaches: the female, which is of looser texture, is at first sweet to the taste and as it is swallowed it leaves a bitter taste." This is nothing more than an abridgment of what Dioscorides has said. Of its use in medicine Dr. Badham writes:—"The *Polyporus laricis* [*P. officinalis*], the so-called Agaric of pharmacy, is a powerful but most uncertain medicine, and has been recommended in consumption. I once administered a few grains of it in this disease, when violent pains and hypercatharsis supervened, which lasted for several hours. MM. B. Lagrange and Braconnot found it to contain a large quantity of acrid resin, to which it no doubt owes its hypercathartic properties. To judge from this single case, which, however, tallies with the experience of others, I should say that this fungus was in medicine to be looked upon as a very suspicious ally" ('Esculent Funguses,' p. 26).

Pliny (xix. 3) mentions fungi known as *pezicæ* by the Greeks; they grow without root or stalk. The Greek forms of πέζις, ιος and πέζιξ, ικος occur in Theophrastus and Athenæus. The former says nothing whatever about the πέζις, except that it has no root; but Athenæus quotes Theophrastus as saying that the πέζις, together with the ὕδνον, μύκης, and γεράνειον, has a smooth skin, λειόφλοια. Lenz, in a footnote (Botanik der alt. Gr. u. R. p. 755), writes:—"The πέζις of Theophrastus and the pezica of Pliny are without doubt the bovista ('die Boviste')." He compares the modern Italian name *vescia*, both in sound and meaning, with the Greek πέζις. The λειόφλοια of Theophrastus would seem to point to the smooth-skinned *Lycoperdon giganteum*.

Juvenal's notices of fungi are chiefly confined to the boletus which was instrumental in poisoning Claudius Cæsar, viz. the *Amanita Cæsarea* of modern mycologists; he calls all other fungi "ancipites":—

"Vilibus ancipites fungi ponentur amicis,
Boletus domino; sed qualem Claudius edit
Ante illum uxoris, post quem nil amplius edit."—*Sat.* v. 146.

"Doubtful fungi shall be served to his clients, the boletus to the lordly patron; but such a one as Claudius ate before that one which his wife gave him, after which he ate nothing more." Again in Sat. vi. 619:—

"Minus ergo nocens erit Agrippinæ
Boletus: siquidem unius præcordia pressit
Ille senis, tremulumque caput descendere jussit
In cœlum, et longam manantia labra salivam."

"Therefore Agrippina's boletus will be less hurtful (than the love potions given by Cæsonia to Caligula), for it pressed the vitals of only one old man and commanded his trembling head to descend to heaven and his lips flowing with long streams of saliva." The expression here used by Juvenal of "descendere in cœlum" is said sarcastically; it conveys the idea of the usual apotheosis of the deceased to the heavens above; but implies also, by the exact contrary expression, that he went down to his proper abode in the infernal regions. Seneca, in his play 'De morte Claudii Cæsaris,' makes use of similar language: "Posteaquam Claudius in cœlum descendit." According to Dion Cassius, Seneca called this satirical play *Apocolocyntosis*, i. e. "Pumpkinification," from ἀπό, "set apart for," κολόκυνθα, "a pumpkin;" instead of using the term ἀποθέωσις, "deification," "set apart for the society of the gods," Seneca travesties this name, using instead that of ἀποκολοκύντωσις; a pumpkin, in Latin *cucurbita*, being sometimes taken to represent "a man of weak intellect," "a fool," which the Emperor Claudius was generally supposed to be. There is not a word, however, in this so-called play ("ludus") which has reference to this idea of a pumpkin denoting a fool, nor does the term *apocolocyntosis* occur once in this curious diatribe of the Roman philosopher*. There is no allusion to the means employed by

* This 'Ludus de Morte Cl. Cæsaris' is full of sarcastically expressed hatred of Claudius, who had rendered himself an object of loathing to the people generally and to Seneca in particular, who had been exiled to Corsica by Claudius for supposed intrigues with Julia, the emperor's niece; it appears to have been written with a view to please Nero and Agrippina. The 'Ludus' is written in prose, with occasional insertions of verses in the heroic and iambic metre; it has but little merit and the text is often corrupt. Claudius is represented as being received after death into the presence of the gods; the question arises among them whether he is a fit person for their company. A council of gods is held, and the matter is debated. Divus Augustus is strongly opposed to Claudius on account of his atrocities and murders, and Mercury takes

Agrippina of getting rid of Claudius; no fungus, no boletus, is once mentioned or hinted at. I noticed above that Seneca, in his lamentation over his deceased friend Anneus Serenus (Ep. 63), says nothing of his death by a poisoned dish of boleti, of which Pliny speaks. In both cases the absence of any remarks about the cause of the death of Serenus and of Claudius Cæsar is natural; it is notorious that Seneca was privy to Agrippina's design to poison the emperor, and so he carefully avoided the use of the word boletus, fungus, or suillus.

The accounts which have come down to us generally agree that the boletus was the vehicle in which the poison was administered to the emperor, although at the time various stories were told as to where and by whom poison was given. Suetonius and Tacitus both speak of medicated boleti, poison poured into a dish of boleti. The poison was believed by some to have been put into the dish by Agrippina's own hands. Tacitus says it was prepared by Locusta. Nero, the successor of Claudius, was of course privy to the plot, and even had the impudence to make no secret of the mode of poisoning, for he used to commend in a Greek proverb boleti as food of the gods (*βρῶμα θεῶν*), sarcastically referring to the apotheosis of Claudius.

The boletus was such a relished dainty with the Emperor Tiberius that, according to Suetonius, he presented a man of the name of Asellius Sabinus with 200,000 sesterces for composing a dialogue in which boleti, beccaficos, oysters, and thrushes were supposed to contend for the honour of being considered the best food (Suet. Tib. cap. xlii.). Martial (Ep. i. 21) represents a certain host, Cæcilianus, inviting a number of guests to dinner, and eating all the boleti himself:—

> "Dic mihi quis furor est? turba spectante vocata,
> Solus boletos, Cæciliane, voras.
> Quid dignum tanto tibi ventre, gulaque precabor?
> Boletum, qualem Claudius edit, edas."

> "What brutishness is this? When friends you treat,
> They looking on, alone you mushrooms eat.
> What on such gluttony shall I implore?
> May'st Claudius' mushroom eat, and ne'er eat more!"

---

him by the neck and conducts him out of heaven down to the infernal regions, where he is punished in a Sisyphian-like way. He has to throw dice out of a perforated box, according to the sentence pronounced by Æacus:—"Tum Æacus jubet illum alea ludere pertuso fritillo; et jam cœperat fugientes semper tesseras quærere, et nihil proficere.

> "Sic cum jam summi tanguntur culmina montis
> Irrita Sisyphio volvuntur pondera collo.

Galen, the celebrated physician of Pergamus (born A.D. 130), seems to have regarded fungi generally as unwholesome diet, but the boletus as tolerably good and to be trusted, though even to the boletus (*βωλίτης*) he does not ascribe very tasty qualities. "Of fungi (*μύκης*) the *βωλίτης*, when well boiled, must be counted among insipid things; it is generally eaten with various kinds of spices, as is done with other insipid food. These fungi, after being eaten in large quantities, yield cold, clammy, noxious juices as their nourishing quantities (*φλεγματώδης δ' ἐστὶν ἡ ἐξ αὐτῶν τροφή, καὶ δῆλον ὅτι καὶ ψυχρά, κἂν πλεονάζῃ τις ἐν αὐτοῖς κακόχυμος*); the boleti are the most harmless and after them the amanitæ (*ἀμανῖται*); as for the rest, it is far safer to have nothing whatever to do with them (*μηδ' ὅλως ἅπτεσθαι*), because many persons have been poisoned by them. . . . I myself know the case of a man who ate a quantity of these badly cooked boleti, supposed to be wholesome, and was afterwards troubled with severe pains in the stomach, with difficulty of breathing, faintness (*λειποψυχήσαντα*), and cold sweats, and who was with difficulty saved by taking such remedies as are able to dissipate inspissated juices, such as vinegar and honey, either alone or with hyssop and origanum sufficiently boiled; the man partook of this remedy sprinkled with soda, and vomited up the fungi which he had eaten" (De aliment. facult. lib. ii. cap. 69).

Again, Galen remarks in his treatise 'De probis pravisque alimentorum succis':—"Of all such kinds of food fungi have the coldest, most viscid, and thickest juice; however, among them the boleti alone have never been known to cause any one's death; still, to some persons, even they cause cholera and indigestion . . . . . The best proof of the unwholesomeness of a fungus is the impossibility of drying and preserving it" (caps. iv., v., vol. vi. pp. 770, 785, ed. Kühn).

Epileptic patients must abstain from all bad food, such as fungi (*μύκης*), turnips, and other roots (Pro puero epilept. consilium, p. 368, ed. Kühn). The curious emetic which first appears in Nicander was employed sometimes by Galen. "I have heard of a physician in Mysia who administered fowl's dung to persons suffering from fungus-poisoning, and I have often myself experimented with this remedy. I have used finely powdered dung mixed with water or with honey and vinegar. The patients immediately on drinking this mixture vomited and recovered. One must observe that the dung of a fowl at liberty is more efficacious than that of one in confinement" (Simpl. Med. p. 303, ed. Kühn).

"Physicians (Æsclapiadæ) recommend the following remedies for fungus-poisoning: raw radishes in quantities, unmixed wine, lye-ashes of the vine, a mixture of soda and vinegar, ashes of burnt lees of wine mixed with water, wormwood and vinegar, rue either with vinegar or alone" (De antid. 2. 7, p. 140, ed. Kühn). Athenæus (A.D. 230), of course, has some chatty conversation about fungi, and gives quotations from authors whose works are not extant now. Most fungi require moist ground, and so Aristias says, "The stony plain stretches itself out (in vain) for fungi." Poliochus mentions, among other food, roasted fungi—*καὶ μύκης τις ἐνίοτ' ὠπτᾶτο*, "and sometimes some fungus would be roasted."

Antiphanes seems to have considered fungi hazardous food. "Who of us knows the future, what is fated for each of our friends to suffer, but quickly take and roast these two fungi gathered from the ilex." Cephisodorus quotes from the Proverbs of Antiphanes: "For I, if I eat any of your dishes, think that I am eating raw fungi or sour apples, or other choking food" (*εἴ τι πνίγει βρῶμά τι*). Athenæus continues, "Fungi are earth-produced (*γηγενεῖς*), and a few of them are good to eat; but most produce a choking sensation, hence Epicharmus joking says, 'You will be parched and choked as if by fungi.' Nicander mentions in his 'Georgics' [a lost work] some kinds that are deadly, and says that fearful calamities arise from eating from the olive, the ilex, and the oak, clammy choking lumps of fungi. He says moreover [in order to produce fungi artificially], bury the stump of a fig-tree in the ground with dung and moisten it with spring water; at the bottom harmless fungi will grow, of which you must not cut off from the root anything that is of inferior quality. And he says again, 'and then the fungi called amanitæ you may roast;' and Ephippus says, 'that I may choke you as fungi do.'"

Accidental poisoning by fungi was probably more common among the ancients than with us, who, as a rule, eat no single species except the common mushroom. From what has been said it is clear that the ancients ate various kinds, though often with hesitation and caution; accidental poisoning probably occasionally occurred from gathering the wholesome field-fungi in the dusk of the evening, as with us; the *A. semiglobatus*, known to be highly poisonous, grows frequently in the fields in close proximity to *A. campestris*, and a few of them carelessly mixed with the edible sorts would produce dangerous effects; or people may have been falsely allured into security by the smell and appearance of some particular kind, as, for instance, the very poisonous *A.* (*Amanita*) *vernus.* According to Eparchides (*apud* Athenæus), when Euripides was on a visit at Icarus, a certain woman, with two full-grown sons and an unmarried daughter, gathered some fungi from the fields, and all the family partook of them and died. Whereupon the poet made the following epigram upon them:—

Ὦ τὸν ἀγήραντον πόλον αἰθέρος ἥλιε τέμνων,
ἄρ' εἶδες τοιόνδ' ὄμματι πρόσθε πάθος;
μητέρα παρθενικήν τε κόρην δισσούς τε συναίμους
ἐν ταὐτῷ φέγγει μοιριδίῳ φθιμένους.

"O Sun, that cleavest the undying vault of heaven, hast thou ever before seen such a calamity as this?—a mother and maiden daughter and two sons destroyed by pitiless fate in one day?"

With a view probably to destroy any dangerous properties it was sometimes recommended that they should be boiled; thus Diocles, in his first book on 'Wholesomes,' says, "Certain things which grow wild, as beet, mallow, sorrel, nettles, orach, bulbs, ὕδνα (truffles), and fungi (μύκης), should be boiled."

Diphilus, a physician who lived about the beginning of the third century B.C., and who wrote a book on 'Diet suitable for persons in good and bad health,' says that "fungi (μύκητες) are of good taste, and pass easily through the bowels, and are nourishing;" but still "that they cause indigestion and flatulence, especially those from the isle of Ceos; many, however, cause death: the wholesome kinds appear to be those which are easily peeled, are smooth and readily broken, such as grow on elms and pines; the unwholesome kinds are black, livid, and hard, and such as remain hard after boiling; such when eaten produce deadly effects. A remedy for this poison is a draught of honey and water, or honey and vinegar, or soda and vinegar; after the draught the patient should vomit. It is therefore always desirable to dress fungi with vinegar, or honey and vinegar, or with honey and salt, by which means the choking properties are destroyed." Athenæus adds, "Theophrastus, in his Treatise on Plants, writes, 'Plants of this kind grow both under the ground and on the surface, such as those which some people call πέζεις, which grow together with fungi (μύκης), for these are without roots; while the μύκης has at the beginning of its attachment to the ground a stalk of some length, from which roots [the mycelium] extend themselves. Theophrastus says also, that in the sea around the Pillars of Hercules, where there is much water, fungi are produced close to the sea, which people say have been turned into stone by the sun." It is evident that he is speaking of the coral madrepores, the *Agaricia* (Lamouroux), or mushroom madrepore, from the resemblance to the fungus, or agaric with its laminated gills, which the people imagine to be a petrified fungus. It is curious to note that this reference to the madrepore is the only indication that the ancients noticed the beautiful form of the laminated hymenium of the modern genus *Agaricus*; the *suillus* is doubtless the *Boletus edulis*; but there is no notice of the porous hymenium which characterizes the genus in any of the ancient authors.

Athenæus quotes one more writer, Phanias, who wrote a book on plants: "Some kinds produce neither bloom nor any trace of generation by buds or by seeds, such as the *μύκης*, *ὕδνον*, *πτερίς* (fern), and *ἕλιξ*" (Deipnosoph. ii. 56–59).

Between the time of Athenæus (A.D. 230) and the Greek compilation known as 'Geoponica' (*γῆ* "the earth," and *πόνος* "labour") there is an interval of some hundreds of years. Neither the author nor the date of this work, which contains interesting matter on precepts relating to rural economy, is positively known. The date may be about A.D. 900. It is curious to note that there is not a single reference to any kind of fungus-plant in the works of the Roman writers on husbandry ("scriptores rei rusticæ"). In the 'Geoponica,' xii. 17. 8, it is said that if any one has eaten a poisonous boletus (*βωλίτης φαῦλος*), he must take as a remedy the juice of cabbage. The "many-coated cabbage" was recommended by Nicander, perhaps a thousand years before, and probably the prescription continued more or less in vogue for so many years. In another place (Geop. xiv. 24) myrtle-berries are recommended as an excellent remedy against poisonous fungi (*θανατοποιὸς μύκης*).

"In order to make fungi grow one must saw off the stump of a black poplar and pour sour dough dissolved in water upon the cut-off pieces. Black-poplar fungi soon appear; but if you would have fungi to grow from the ground you must select a spot of light soil on a hill where reeds grow; there you must collect together twigs and other inflammable materials, and set all on fire just before rain is expected; if the rain does not come you must artificially sprinkle the spot with pure water, but the fungi thus produced are of inferior quality." (Geopon. xii. 41.)

One is here reminded of what Dr. Badham himself witnessed at Naples. Here is his account:—"A third fungus, which we have the means of producing *ad libitum*, is that which sprouts from the pollard head of the black poplar (*Populus nigra*, var. *Neapolitana*). These heads it is usual to remove at the latter end of autumn, as soon as the vintage is over, and thus marriage with the vine is annulled; hundreds of such heads are then cut and transported to different parts; they are abundantly watered during the first month, and in a short time produce that truly delicate fungus *Agaricus caudicinus*, the *Pioppini*, which during the autumn of the year make the greatest show in many of the Italian market-places. These pollard blocks continue to bear for from twelve to fourteen years. I saw a row of them in the Botanic Garden at Naples, which, after this period, were still productive, though less frequently, and of few agarics at a crop" (Escul. Fung. p. 50). The *A. caudicinus* here mentioned is perhaps the *A. ægerita* of Fries (Epicr. p. 219, 2nd edit.), the Champ. du peuplier of Paul. p. 301; of white flesh and pleasant odour; but the fungus appears to have been confused with the *A. melleus* ("Stockschwamm" of the Germans) and the *A. (Pholiota) mutabilis*.

Mr. Bicknell throws doubt on Dr. Badham's story; he says, "I have never seen either *A. melleus* or *Ph. mutabilis* for sale, neither do I expect I shall, if I have to wait till the poplar heads are amputated"*. These poplar fungi, whatever be the species, have been known from the times of Dioscorides, through that of the compiler of the 'Geoponica,' until this day. With respect to what is stated in the 'Geoponica,' about getting fungi to grow on spots where wood has been burnt, every fungus-collector knows how prone certain kinds are to grow on charcoal-rings where wood has been burnt.

Truffles.

The Greek name for a truffle is ὕδνον, a word which has several times occurred in the course of this paper. The Latin name is *tuber*, which mycologists still retain. Linnæus, without the slightest reason, appropriated the old Greek word for a truffle, and made it into a genus (*Hydnum*), to denote the fungi which have an awl-shaped hymenium; and this unfortunately selected word retains this meaning to this day. Equally unfortunate is the use of the word *Agaricus* by Linnæus to designate fungi whose fruit-bearing surface or hymenium is lamellose; and the same may be said of the application of the *boletus* of the ancients, which, as we have seen,

* Fries says that the "Stockschwamm" of the Germans is not *A. mutabilis*, but *A. melleus* (Epic. p. 225, 2nd edit.); but the figure which Schæffer (pl. ix.) gives of the Stockschwamm of the Bavarians is clearly *A. (Pholiota) mutabilis*. Lenz, without hesitation, refers the poplar-fungus to *A. mutabilis*, Schæff., and says that the people, to this day, water the old stumps, and that the fungus is known in Italy as the *famigliola buona* (Botanik, p. 764, note).

is a lamellose agaric at first enclosed in a volva, to denote fungi whose hymenium consists of tubes or pores.

But to return to the *ὕδνον*. Theophrastus (i. 6, § 9) speaks of the *ὕδνον* which some call *ἄσχιον*, and the *οὐϊγγον* and other such subterranean things, as having no root. In i. 6, § 13, he says, the *ὕδνον* is sometimes called *μίσυ*, and is very sweet with a fleshy odour; that in Thrace it is called *ἴτον*. "With regard to these things, peculiar beliefs are held, for they say that they are produced during autumn rains, and thunderstorms especially, which are the main reason of their growing, and that they do not last more than a year, and are best for food in the spring. Some think they are produced from seed, because those which grow on the shore of the Mityleneans only appear after floods, which bring down the seed from Tiara where many *ὕδνα* are found. They grow on the shore where there is much sand. They are found around Lampsacum of Abarnis, and in Alopeconnesus (Asia), and in Elis."

Dioscorides calls the *ὕδνον* a root, and says it is roundish, without leaves and stem, inclining to yellow; that it is dug out of the ground in the spring, and is eaten either raw or cooked" (Mat. Med. ii. 174).

With respect to the Greek words *ὕδνον*, *ἄσχιον* and the Thracian *ἴτον*, and the *μίσυ*, the name of the plant near Cyrene, there is no clear etymology forthcoming. If *οἶδνον* is another form of *ὕδνον*, according to Liddell and Scott's Lexicon (but I can find no authority for its use in Theophrastus), then one would naturally refer the name to *οἰδέω* or *οἰδάνω*, "to swell," and the etymology would be sufficiently exact, answering to the Latin *tuber*. Aëtius and later Greek writers use the word *ἴτνον* for the truffle. Sibthorpe found the names *ὕδνος* and *ἴκνος* to denote this fungus in Greece, and Heldreich ('Die Nutzpflanzen Griechenlands,' p. 2) gives *ὕδανον* or *ὕδνον* for the *Tuber cibarium* in Peloponnesus, and *χοιρόψωμα* in Crete, adding that truffles occur in woody places in Greece, but are not much sought after. According to the last-named authority the ancient Greek name *ἄσχιον* for a truffle is now used for a polyporus or a fungus generally, under the form of *ἴσκα*, Pelasg. *eské*, *éska*. The *μίσυ* must remain quite unexplained. Another Greek name is apparently used by Theophrastus to signify a truffle, viz *κεραύνιον*, but given by Athenæus, who is quoting Theophrastus, as *γεράνειον*. I suspect *κεραύνιον* is the proper reading, and that it refers to the popular idea that such plants appeared chiefly after thunderstorms.

The truffle was a source of wonder to Pliny, who considered it one of the marvels of nature. "Since we have begun to speak of these marvels we shall follow them in order. Among the most wonderful of all things is the fact that anything can spring up and live without a root. These are called truffles (*tubera*); they are surrounded on all sides by earth, and are supported by no fibres or hair-like root-threads (*capellamentis*); nor does the place in which they are produced swell out into any protuberance or present any fissure; they do not adhere to the earth; they are surrounded by a bark, so that one cannot say they are altogether composed of earth, but are a kind of earthy concretion; they generally grow in dry sandy places which are overgrown with shrubs; in size they are often as large as quinces and weigh as much as a pound. There are two kinds: one is sandy and injures the teeth, the other is without any foreign matter (*sincera*); they are distinguished by their colours being red, or black, or white within; those of Africa are most esteemed. Now, whether this imperfection of the earth (*vitium terræ*)—for it cannot be said to be anything else—grows, or whether it has at once assumed its full globular size, whether it lives or not, are questions which I think cannot easily be explained. In their being liable to become rotten these things resemble wood. The following accident happened a few years ago to Lartius Licinius, a person of prætorian rank, and a minister of justice at Carthage, in Spain, as I myself know: he was biting a truffle and a denarius inside it bent his front teeth, from which circumstance it is evident that this natural production of the soil had originally assumed a globular shape, as is the case with those things which grow of themselves and are not able to arise from seed. Of a similar nature is that which is produced in the province of Cyrenaica called 'misy;' it is noted for the sweetness of its smell and flavour, and is more fleshy than the other kinds mentioned; that which is called 'ceraunium,' in Thrace, is of a similar nature" (xix. 3). Pliny then adds what has been already given from Theophrastus, mentioning the kind of fungi known by the Greeks as "pezicæ," which have no root nor stalk.

We are not anywhere informed whether dogs or pigs were ever employed in ancient times as aids in finding truffles. Dr. Badham refers to Dioscorides as stating that pigs dig up truffles in spring; but Dioscorides nowhere mentions pigs; he says simply that these products were dug up in the spring; had either of these animals been ever used in truffle-hunting we should most likely have had a notice to this effect amongst the fungus literature of the classical authors. Athenæus quotes a few words from Pamphilus about a certain grass called ὑδνόφυλλον, which was supposed to grow above the truffle and which indicated its presence (Athenæus, ii. 60).

Sprengel, in his commentary on Dioscorides (ii. p. 472), says that truffles are frequent in Laconia, and, referring to Walpole's Memoirs, states that the divining-rod used to be employed in their search. The story about the hydnophyllum is, of course, a mere fancy.

That thunder exercised some peculiar power in producing truffles was an opinion current among the ancients, and Plutarch has given us quite a long and curious dissertation in his 'Symposiacs' (book iv.) on the question, *διὰ τί τὰ ὕδνα δοκεῖ τῇ βροντῇ γίνεσθαι*, "Why truffles are thought to be produced by thunder." At a certain supper in Elis, where, as we have seen, large truffles were found, some of extraordinary size were set on the table; many of the guests seemed to wonder, whereupon some individual jokingly referred to the thunderstorms which had lately happened as being the cause of their appearance, meaning to deride the popular opinion as absurd; whereupon Agemachus, the worthy host, prayed the company not to conclude a thing was incredible because it was strange and wonderful, "for this ridiculous bulb, which has become quite a proverb for absurdity, does not escape the lightning on account of its small size, but because it has a property the exact opposite to it, just as the fig-tree and the skin of the sea-calf, as they say, and that of the hyena have, with which things sailors clothe the ends of their sailyards." After a little more dinner-talk, in which it was satisfactorily proved that truffles grow by means of a certain generating fluid contained in the thunder (*ὕδωρ γόνιμον*), which, being mixed with heat, pierces into the earth, turning and rolling it round, and produces these tubers; just as certain tumours called glands arise in the human body from some bloody humour or other; and that truffles do not resemble plants, are not nourished by rain, and have neither root nor sprout, but are quite free in the ground, and that, in consequence, they have the nature of earth which has been altered and changed in substance; after all this it was determined to change the subject of conversation from truffles, "lest," it is added, "that happen to us which once befell the painter Androcydes, for when he painted the gulf Scylla he represented the fishes with more artistic effect than anything else, so that people thought he cared more for the fishes than for his art; in like manner they will say of us, that we have discoursed about the origin of truffles simply because we take the greatest pleasure in eating them."

The influence of thunder-rains on truffles is referred to by Juvenal, who also speaks of the great estimation in which they were held :—

"Post hunc tradentur tubera, si ver
Tunc erit et facient optata tonitrua cœnas

Majores. Tibi habe frumentum, Alledius inquit,
O Libye; disjunge boves, dum tubera mittas!"—*Sat.* v. 116–119.

"Then if the spring its genial influence shed
And welcome thunders call them from their bed,
Large truffles enter; ravish'd with their size,
'O Libya, keep your grain!' Alledius cries,
'O bid your oxen to your stalls retreat,
Nor, while you boast such truffles think of wheat!'"

If Libya will only supply its splendid and far-famed truffles, Alledius cares nothing for its corn. African truffles, as we have seen, were supposed to be of the best quality.

Martial says that truffles are inferior only to boleti:—

"Rumpimus altricem tenero quæ vertice terram
Tubera, boletis poma secunda sumus."—*Ep.* xiii. 50.

"We who, with tender head, burst through the earth that nourishes us are truffles, a fruit second only to boleti." But here one would rather suppose that *tubera* denotes some fungus, not entirely subterranean, but growing, partly at least, on the surface.

Apollonius (Hist. Mir. 8. 46) quotes Theophrastus as saying that truffles (*ὕδνον*) grow harder in continued thunder weather.

Galen (De alim. facult. 2. 68, and elsewhere) says that truffles must be considered to be roots or bulbs, and that they possess little flavour, should be eaten with spices, and are harmless; have a thick but not a noxious juice. Different species of truffles were doubtless known to and eaten by the Greeks and Romans, among which, most probably, would be *Tuber æstivum*, *T. magnatum*, *T. bituminatum*, and, perhaps, *Melanogaster variegatus* (*Hypogæi*), which grows half out of the soil, and is eaten at Bath under the name of the "red truffle," and *Terfeyia Leonis**.

Mr. Bicknell often noticed truffles in the markets in N. Italy, as the *T. æstivum*, and the "Tartufi bianchi," "white truffle," which at Bologna was selling at 4 francs per pound, and is highly esteemed; this, he says, is the *T. magnatum*, Pico.

Cœlius Apicius, whoever the author of the work 'De Re Coquinaria Libri Decem' may have been, or whenever he may have lived, has not omitted fungi from his treatise. We have seen that both among the Greeks and Romans fungi

* The tubera of the ancients doubtless included subterranean or semi-subterranean edible fungi which do not belong to the order Tuberacei. Tulasne is inclined to refer the *misu* to the *Terfeyia Leonis*, which grows in April and May in oak-woods of the promontory Circeium, in Campania, which the people dig for and eat approvingly under the name of "Tartufo bianco:" it occurs plentifully in the sandy seashores about Terralba and Oristano in Sardinia. Tulasne adds, "Nil nisi radix quædam crassa fere videtur et veresimiliter immerito pro Tubere s. fungo subterraneo nonnullis habetur." *Hydnotrya Tulasnei* is dug up and eaten near Prague.

were usually eaten with various condiments; Apicius, however, is the only author who has mentioned the kinds of condiments used, and his work in filling up a gap in the domestic habits of the Romans is very valuable, notwithstanding his obscurities and the solecisms of his style. For an insight into the details of the Roman kitchen we shall look elsewhere in vain. Although his work is one of comparatively recent date, there is no reason to doubt that his cooking receipts may fairly be taken as specimens of those in use amongst the ancient Romans. He mentions *Fungi farnei* *, perhaps such as grew near ash-trees (*farnei=fraxinei*), *Boleti* and *Tubera*. Here are his receipts for cooking *Fungi farnei*:—(1) Boil them, dry hot, and serve with wine-sauce (*œnogarum*) and pepper pounded in liquor; (2) Use pepper, sweet boiled wine (*carœnum*), vinegar, and oil; (3) Another receipt:—boil in salt and serve with oil, wine, and pounded coriander seed.

For Boleti:—(1) Pour over them sweet boiled wine and add a bunch of green coriander; after boiling take out the bunch of coriander and serve. (2) Another receipt:—serve their stalks in liquor with salt. (3) Place the cut-off stalks (*tirsos*) on a dish, pour echinus eggs (?) (*uvam*) over them with pepper, lovage, a little honey, and oil.

For Tubera:—(1) Peel, boil, sprinkle with salt, and transfix with a twig (*surculo infigis*); partly roast, and place in a cooking-vessel with oil, liquor, sweet boiled wine, unmixed wine, pepper and honey; while boiling, beat up with fine flour, take out the twigs and serve. (2) Another receipt:—Boil, and sprinkle salt, transfix with twigs, partly roast, place in a cooking-vessel with liquor, oil, greens, sweet boiled wine, a small quantity of unmixed wine, pepper and a little honey, and let it boil; while boiling beat up with fine flour; prick the tubers that they may absorb, take out the twigs and serve. If you like you may surround the tubers with the omentum of a pig, then roast and serve.

Four other receipts for cooking truffle are give—mint, rue, leeks (?), cummin, seseli, and parsley being the ingredients not mentioned in the above receipts (Apicius, 'De Re Coquin. Lib. X.,' pp. 154–156, ed. Chr. T. Schuch, 1874).

Under the name of *sfonduli*, *funguli*, or *spongioli* Apicius is supposed by some writers to be referring to the Morel (*Morchella*), the modern Italian name "spongiole" preserving to us the tradition of its identity. This is most probable. Apicius gives several receipts for cooking morels, which do not differ in any particulars from those he gives for serving funguli fainei (see p. 65 of Schuch's edition).

The following Table, in which I have given the various Greek and Latin names of fungi, may be found useful:—

* Some editions read *faginei* instead of *farnei*.

Greek and Latin Names of Fungi, &c.

Greek.	Latin.	Derivation.	Species or meaning.
ἀμανῖται, ῶν (*m.*), Galen.	....	Unknown.	The general name of *A. pratensis* and other edible fungi. Mod. Grk. *μανιτάρια*.
ἀγαρικόν (*n.*).	agaricum.	From Agarum in Sarmatia.	*Polyporus officinalis.*
ἄσχιον (*n.*)*.	....	Of Lithuanian origin, Wászkas "a fungus." *Cf.* Mod. Greek ἴσκα, Pelasg. ѐské, a fungus. *P. fomentarius.*	A name of the truffle, generally called ὕδνον.
βωλίτης, ου (*m.*), Galen.	boletus.	βῶλος, "a clod," a round mass = Lat. *gleba*, perhaps in allusion to the ball-like form of the young fungus.	*Amanita Cæsarea.*
ἴτον (*n.*).	....	Unknown.	A Thracian name of a truffle.
κεραύνιον, ου (γεράνειον?) Theophrastus.	ceraunium (Pliny).	κεραυνός, thunder.	A name of a truffle which was thought to grow more especially after thunder-showers.
μίσυ, υος, & εως (*n.*).	misy (Pliny).	Of Egyptian origin; the word also denotes metallic efflorescence of copper-ore of a golden or yellow colour (Dioscor. v. 116).	The name of some highly esteemed truffle in the province of Cyrenaica.
μύκης, ητος, or ου (*m.*) (ῠ).	fungus = sfungus = σπόγγος "a sponge," *cf.* spongiole, the present Italian name of the morel (*Morchella*).	akin to μῦκος (mucus), "slime."	The general Greek and Latin name of any kind of fungus.
πέζις, ιος (*f.*). πέζιξ, ικος (*f.*).	pezicæ (Pliny).	πέζα, "the foot," "bottom," "base," that which rests on its base, "sessile."	Various kinds of Puff-balls, *Bovista* and *Lycoperdon*. *Cf.* the modern Italian name of *rescia*, "toadstool," "puff-fist."

* According to Wharton ('Etyma Græca,' pp. 30 and 61), ἄσχιον is etymologically allied to ἰξός, "bird-lime," Lat. *viscum*, English "wax;" with this idea the Greek word μύκης, "a slimy sticky thing," may be compared.

One more Latin name, viz. Helvella, requires a short notice. Helvella or Helvela, which the grammarian Festus etymologically explains as "olera minuta," *i. e.* small garden herbs (helus=olus), is used by Cicero (Ep. ad Fam. vii. 26) apparently to denote some kind of fungus. From Cicero's letter to Gallus it would seem that the fashion of eating fungi, which, as we have seen, is considered by Pliny to have been one of rather recent date, originated from a desire to substitute some dainty kind of food for that which the "Lex sumptuaria" (the act which regulated the expenses of the table) forbade in the case of certain expensive articles of animal diet. Products of the soil were not included in the act; hence, as Cicero tells us, the dainty feeders of his day devised all modes of cooking vegetable food in order to make it tasty; and the great orator accounts for an illness which troubled him by a too free use of such rich diet. The "Lex sumptuaria," simple enough apparently, was, after all, a fraud in his case; he had abstained from oysters and murenæ, but not from highly-seasoned vegetables. "Nam dum volunt illi lauti terrâ nata, quæ lege excepta sunt, in honorem adducere, fungos, helvellas, herbas omnes, ita condiunt, ut nihil possit esse suavius." "While those elegant eaters wish to bring into high repute the products of the soil which are not included in the act, they prepare their fungi, helvellæ, and all vegetables with such highly seasoned condiments, that it is impossible to conceive anything more delicious." It is not improbable therefore that the extensive use of fungi as a favourite article of food among the rich Romans is to be attributed to some extent to the "Lex sumptuaria," which is ascribed by Aulus Gellius to M. Licinius Crassus in the year of Rome 643, and that in the time of the emperors the fashion became still more common.

The use of the word *helvella*, proposed by Linnæus and retained by modern mycologists, to denote the genus which it represents, is as arbitrary and irrelevant as the other words which he has transferred from classical writers.

VI.—*Descriptions of some new Asiatic Longicornia.* By Francis P. Pascoe, F.L.S.

Mr. H. Pryer having recently sent a small collection of insects from Ellopura, in North Borneo, containing a few undescribed Longicorn beetles, I have taken the opportunity in publishing them of adding a few unnamed eastern species from my collection. Among other rare and handsome species from Ellopura were *Peribasis pubicollis*, *Calpazia vermicularis*, *Xoanodera trigona*, *Ephies dilaticornis*, *Gnatholea subnuda*, &c.

The following is a list of the species described below :—

Lamiidæ.

Agelasta polyspila. Naas Island
Cereopsius arbiter. Labuan.
—— spilotus. Labuan.
—— satelles. Sarawak.
Diallus guttatus. Kaioa, &c.
Mesosa incongrua. Ellopura.
Sthenias lunulatus. Ellopura.
Sybropis frontalis. Ellopura.

Cerambycidæ.

Dymasius vitreus. Ellopura.
Xoanodera amœna. Ellopura.
Ceresium coronarium. Bouru.
—— rotundicolle. Ceylon.
Sotira flexuosa. Kaioa.
Stromatium signiferum. Ceylon.
Cymaterus torridus. Ellopura.
Artimpaza formosa. Ellopura.
—— bicolor. Andaman Islands.
Clytellus olesteroides. Andaman Islands.
Distenia Pryeri. Ellopura.

Agelasta polyspila.

A. nigrescens, guttis pube albida formatis, notata; capite leviter punctato; antennis corpore vix longioribus, articulis quatuor basalibus nigris, cæteris albo-pubescentibus; prothorace transverso, utrinque rotundato, obsolete punctato, pilis albidis adsperso; scutello semilunare; elytris leviter punctatis, margine basali maculisque, plurimis majoribus, albidis; corpore infra glabrato, nigro, margine segmentorum piloso; pedibus omnino nitide nigris. Long. 8–9 lin.

Hab. Naas Island (Sumatra).

Allied to *A. irrorata*, but the prothorax not tuberculate at the sides, antennæ not ringed, the tarsi entirely black, and the elytra not spotted with black, show it to be a very distinct species.

Cereopsius arbiter.

C. ater, nitidus, maculis magnis niveo-pilosis ornatus; capite nigro, parce albo-piloso; antennis nigro-fuscis, subtilissime pubescentibus; prothorace impunctato, ad latera macula magna nivea, basi cinereo-piloso; elytris, humeris exceptis, fere impunctatis, his punctis sparse impressis, a medio stria juxta suturam munitis, apicibus extus dentatis, maculis duobus magnis lateralibus niveis; pedibus et corpore infra leviter pubescentibus, segmentis abdominis margine fimbriatis. Long. 9 lin.

Hab. Labuan.

The elytra are shorter in proportion than in *C. luctuosus* and *C. tricinctus*, and the punctures are confined to the shoulders; in the former the prothorax is entirely black, in the latter it is crossed by a broad white band.

Cereopsius spilotus.

C. opacus, capite parce ochraceo-piloso; antennis rufulis, subtilissime pubescentibus; prothorace nigrescente, ad latera macula magna roseo-alba ornato; elytris basi parce punctatis, apicibus subtruncatis, singulo maculis duabus magnis et una parva versus apicem sitis, roseo-albis; corpore infra femoribusque infuscatis, tibiis tarsisque rufulis, subtiliter pubescentibus. Long. 7 lin.

Hab. Labuan.

In this species the apices of the elytra are not spined; in the example before me the elytra are of a dark claret-colour and the spots pale rose-white.

Cereopsius satelles.

C. niger, opacus; capite subtiliter albo-pubescente; antennis articulis duobus basalibus nigris cæteris rufescentibus, pube leviter vestitis; prothorace ad latera macula magna fulvescente ornato; elytris, humeris exceptis, impunctatis, apicibus extus dentatis, macula magna rotundata ante alteraque oblonga pone medium flavescentibus, interdum cinereo-plagiatis; metasterno utrinque macula alba munito, femoribus infuscatis, tibiis tarsisque rufescentibus. Long. 7 lin.

Hab. Sarawak.

Allied to *C. exoletus*, but with proportionally shorter elytra, the punctures confined to the shoulders, and with different but not very dissimilar coloration. The scutella in the three species are triangular, rounded more or less at the apex.

Diallus guttatus.

D. niger, subnitidus, niveo-maculatus; capite postice genisque niveo-pilosis; antennis brunneis leviter griseo-pubescentibus; prothorace parce punctato, in medio linea elevata transversa munito, maculis connexis, vittas tres niveas formantibus, ornato; scutello semicirculari; elytris sat vage punctatis, singulo maculis niveis bene determinatis, circa tredecim, ornatis; pedibus nigris, sat dense albido-pilosis; corpore infra nigro, margine metasterni segmentisque abdominis basi utrinque albido-pilosis. Long. 4–5 lin.

Hab. Kaioa, Batchian.

Smaller than *D. lachrymosus*, with narrower and more cuneiform elytra, the spots more distinct, and with an elevated transverse line on the prothorax. One of Mr. Wallace's captures.

Mesosa incongrua.

M. nigra, pube ochracea albo-maculata vestita; capite fronte sat elongato, inter oculos modice convexo; lobo inferiore oculi majusculo; antennis corpore plus duplo longioribus, articulis primis, duobus nigris exceptis, albis; prothorace transverso, rude punctato, in medio bicalloso; scutello majusculo, apice late rotundato; elytris subdepressis, ad latera modice punctatis, basi granulatis, apice rotundatis, ante medium maculis albis quatuor, quarum tribus posterioribus connexis, et versus apicem maculis fasciatim dispositis, notatis; corpore infra pedibusque rufescentibus, leviter pilosis; tarsis articulis primis duobus dimidio basali albis. Long. 5 lin.

Hab. Ellopura.

It may be that this species is not correctly referred to *Mesosa*; the larger lower lobe of the eye and the conspicuous cicatrix is rather opposed to those characters in that genus. But I do not see any better place for it.

Sthenias lunulatus.

S. fuscus, vix nitidus, leviter pubescens: capite pone antennas tuberculis duobus obliquis munito; antennis corpore brevioribus, gracilibus, obscure annulatis; prothorace rude punctato, in medio bicalloso; scutello transverso, majusculo; elytris subcylindricis, vage punctatis, parce granulatis, apicibus subtruncatis, ad latera in medio plaga albo-pilosa notatis, pone medium lunula alba distincta; abdomine segmentis tribus basalibus densius pilosis; pedibus pilis longis adspersis. Long. 4 lin.

Hab. Ellopura.

A small species, shorter in proportion than *S. griseator*, with more slender antennæ, a straggling pubescence, &c.

SYBROPIS.

Sybra congruit, sed tibiæ intermediæ haud emarginatæ.

The only exponent of this genus resembles in its greyish spots and broader outline *Sybra purpurascens*. One of the characters of *Sybra* is to have the intermediate tibiæ emarginate, or notched, on their lower and outer part—a character which, in some groups, is thought to be of more than generic importance.

Sybropis frontalis.

S. ovata, fusca, supra fortiter confertim punctata, et parce griseo-pubescens, pube hic illic maculatim condensata; capite brevi, inter oculos macula magna dense albo-pilosa notato; antennis corpore haud longioribus, articulis tertio quartoque fere æqualibus; prothorace transverso, utrinque rotundato; scutello dense piloso; elytris subampliatis, ad latera gradatim rotundatis, basi granulatis, apice rotundatis; femoribus valde clavatis; articulo ultimo tarsorum elongato. Long. 5 lin.

Hab. Ellopura.

Dymasius vitreus.

D. angustus, piceus, elytris pube nitide sericante griseo tectis; prothorace oblongo, ad latera rotundato, disco utrinque sulcato et in medio nigro-vittato; elytris infuscatis et postice singulatim annulo infuscato notatis, apicibus subtruncatis; corpore infra pedibusque piceis, subtilissime pubescentibus. Long. 7 lin.

Hab. Ellopura.

One of the characters of M. Thomson's genus *Dymasius* is to have the elytra "four-spined." My genus *Imbrius*, of a somewhat later date, has its elytra not so spined; but this is not, I think, of generic value. The female in this and other allied genera has the antennæ serrated; in the male the antennæ are longer, the joints more cylindrical, the third and fourth more or less knotted at the apex. This new species is allied to *D. micaceus*, but, *inter alia*, it has a much broader prothorax and longer elytra, tapering, although slightly, from the base to the apex; the silky reflections are also different, not forming longitudinal patches.

Xoanodera amœna.

X. picea; capite antennisque fulvido-pubescentibus, his corpore vix longioribus; prothorace in medio fortiter canaliculato, lateribus rude sculpturato, interrupte fulvido-piloso; scutello cordiformi; elytris dense albido-pilosis, parce punctatis, lateribus et humeris usque ad medium macula determinata læte fusca et grosse punctata, munitis, apicibus fuscis, oblique truncatis, margine extus dentatis; corpore infra pedibusque dense griseo-pubescentibus. Long. 8 lin.

Hab. Ceylon.

Generically this pretty Longicorn agrees perfectly with *Xoanodera*, and there is an agreement to a certain extent in coloration with *X. trigona*; nevertheless the two species in *facies* are by no means alike. The hairs on the prothorax in both species are confined to the raised portions, appearing as little tufts.

Ceresium coronarium.

C. angustum, rufo-testaceum, pilis albis adpressis aliis longis adspersis, vestitum; capite inter oculos macula albida magna, in medio divisa, notato; antennis testaceis, longe pilosis; prothorace oblongo, rugoso-punctato, maculis quatuor albidis ornato; scutello albido; elytris sat confertim punctatis, basi granulatis; propectore rugoso-punctato; corpore infra pedibusque minus pilosis. Long. 5 lin.

Hab. Bouru.

A stouter species than *C. cretatum*, and without spots on the elytra.

Ceresium rotundicolle.

C. oblongum, rufo-testaceum, pilis griseis adspersis; prothorace elytrisque obscure fulvo-maculatis; antennis corpore vix longioribus; prothorace utrinque rotundato in medio subdepresso, ad latera quadrimaculato; scutello cordiformi, fulvo; elytris punctatis, basi granulatis, maculis circa undecim notatis, quarum una communi oblonga basali, cæteris dispersis; corpore infra pedibusque subtilissime pubescentibus; propectore rugoso. Long. 4 lin.

Hab. Ceylon.

C. cretatum is a remarkably narrow form with a cylindrical prothorax and snow-white spots; nevertheless there is a certain resemblance between it and the above.

SOTIRA.

Caput breve, subverticale; palpi maxillares elongati, articulo ultimo securiformi. *Oculi* magni, grosse granulati. *Antennæ* corpore longiores, basi distantes. *Prothorax* subdepressus, rotundatus. *Elytra* prothorace latiora, depressa. *Femora* clavata, basi attenuata; tibiæ rectæ; tarsi graciles; unguiculi divaricati. *Mesosternum* triangulare. *Abdomen* breve, segmentis inæqualibus.

With some hesitation I refer this genus to Lacordaire's "Hesperophanides." Except that the intermediate cotyloid cavities are angulate externally it might have been placed with the "Callidiopsides."

Sotira flexuosa.

S. oblonga, depressa, testacea, subtilissime albo-pubescens; capite inter oculos linea nigra impressa; antennis pilosis; prothorace subsericeo, lateribus solis punctatis; scutello majusculo, subquadrato; elytris sat vage punctatis, in medio planatis, versus latera angulatis, apicibus rotundatis, fasciis tribus flexuosis fuscis notatis, fascia pone medium latiore, tertia inconspicua vel maculiformi; abdomine nitido; tibiis setosulis. Long. 4–5 lin.

Hab. Kaioa, Amboyna.

The irregular bands on the elytra will be found to vary; in one of my specimens the basal band forms two O-shaped marks just touching the middle one.

Stromatium signiferum.

S. elongatum, fuscum, parce griseo-pilosum; elytris quadri-flavo-maculatis; capite prothoraceque subtiliter punctatis, hoc subtransverso, utrinque modice rotundato; antennis corpore longioribus, longe pilosis, articulo primo punctato basi constricto; scutello majusculo, transverso; elytris apicem versus gradatim paulo angustioribus, confertim punctatis, apice rotundatis, muticis, basi maculis duabus flavescentibus et fere in medio duabus obliquis majoribus, notatis; corpore infra pedibusque subtilissimo pubescentibus. Long. 7 lin.

Hab. Ceylon.

This is rather a suspicious *Stromatium*; but I can find no generic difference except the absence of the sutural spine—too slight a character to justify its separation.

CYMATERUS.

Caput exsertum, antice productum. *Antennæ* breves, crassæ (♀). *Prothorax* breviter ovatus. *Elytra* breviuscula. *Coxæ* anticæ separatæ. *Abdomen* breve, subconicum.

The characters of this genus are nearly identical with those of *Erythrus*, but in *facies* the two genera are essentially different. The shorter elytra and abdomen, the latter narrowing gradually behind and not depressed, compared with the long elytra and abdomen parallel at the sides and below the level of the sterna, show, however, that they belong to different types. The sculpture of the prothorax is unique.

Cymaterus torridus.

C. niger, opacus; prothorace, vittis duabus exceptis, humerisque saturate rubris; capite antice rufo-piceo, confertim punctato, in medio annulo profunde impresso; antennis fortiter serratis (♀), articulo primo rude punctato; prothorace transversim undulato-sculpturato, nigro-bivittato, apice paulo angustiore; scutello scutiformi, fulvo-sericeo; elytris confertim punctatis, lateribus fere parallelis, apicibus subobliquo truncatis; corpore infra dense argenteo-piloso. Long. 6 lin.

Hab. Ellopura.

Artimpaza formosa.

A. nigra, nitida; capite pone oculos et prothorace in medio metallico-cupreis, hoc fere impunctato, postice chalybeato et confertim punctato; antennis articulis tribus basalibus, tertio apice excepto, luteis, cæteris nigris; scutello nigro; elytris longe cuneatis, apicibus acutis, singulo in medio vitta, fere impuctata, conformi, subaurea, notato, cætero elytri chalybeato, sat grosse punctato;

corpore infra pedibusque posticis glabris chalybeatis, intermediis et anticis luteis. Long. 8 lin.

Hab. Ellopura.

This handsome species is very distinct from its only congener (*A. odontoceroides*, Thoms.) in its stouter form and different coloration. The only specimen I have seen is a female, in which the antennæ extend only in a slight degree beyond the prothorax. *Artimpaza*, the name given to the genus by M. Thomson, is the name of the Scythian Venus, and is one of the many names to which the authors of the excellent 'Catalogus Coleopterorum' attached a doubtful or no meaning.

Artimpaza bicolor.

A. nitide rufescens, elytris nigrescentibus; capite rude punctato; antennis corpore longioribus (♂), linearibus, articulo secundo longiusculo, tertio ad septimum apice, cæteris omnino, infuscatis; prothorace antice glabro, in medio parce punctato, postice depresso; scutello oblongo albo-tomentoso; elytris parallelis, sat confertim punctatis, apicibus obtusis; femoribus posticis ad apicem abdominis fere protensis; tarsis infuscatis; corpore infra glabro. Long. 6 lin.

Hab. Andaman Islands.

The antennæ in my specimen agree with the description of M. Thomson of those of the male of *A. odontoceroides*, the type; but it is so different from those of the female that I should have hesitated about placing them in the same genus. This species wants the vitreous stripe on the elytra, the apices of which are not pointed; the posterior femora also are longer, reaching nearly to the end of the abdomen.

Clytellus olesteroides.

C. niger, subnitidus; capite verticali, antice argenteo-pubescente, inter oculos lobo bifido erecto instructo; antennis nigris; prothorace elongato, postice valde constricto, antice gibboso, in medio linea modice elevata munito; scutello oblongo, albo-piloso; elytris parallelis, in medio constrictis, humeris prominulis, subtiliter punctatis, fascia mediana apicibusque albo-sericeis; corpore infra sericeo-argenteo. Long. 3 lin.

Hab. Andaman Islands.

As in *C. Westwoodii*, there are no tubercles at the base of the elytra, the absence of which and the "non-perpendicular" head seemed to Lacordaire to indicate a separate genus. The former character appears to me to be scarcely more than specific, and I see no difference in the latter independent of the setting of the specimen. This species is very interesting, as it "mimics" another insect belonging to a different family and to another zoological region—the *Olesterus australis* of Gorham (Cleridæ), from Australia. The type of the genus, *C. methocoides*, Prof. Westwood compared to a genus of ants (*Methoca*).

Distenia Pryeri.

D. elongata, fusca, sat dense subtiliter albido-pubescens; capite inter oculos lineatim longitudinaliter impresso; antennis leviter pilosis; prothorace subtilissime confertim punctato, disco quadrituberculato, apice tubulato; elytris longe cuneatis, seriatim punctatis, punctis postice gradatim obsoletis, apice singulorum bispinoso, spina exteriore longiore; pedibus sparse pilosis, pilis longis adspersis; femoribus muticis. Long. 11 lin.

Hab. Ellopura.

In its uniform coloration this species is allied to *D. japonica* *, but is at once differentiated by its two-spined elytra. The fine whitish pubescence on its brown derm makes a clear dark greyish colour. I have named this graceful Longicorn after Mr. H. Pryer, who is an observer as well as a collector.

VII.—*Note respecting Butterflies confounded under the name of* Delias belladonna *of Fabricius.* By Arthur G. Butler.

For some years past it has been maintained by most lepidopterists that *Papilio belladonna* of Fabricius, figured by Donovan in the 'Naturalist's Repository,' is the female of *Delias Horsfieldii* of Gray's 'Insects of Nepal;' on the other hand, I have always insisted that, however bad Donovan's figure might be, it represented a brown and not a black species, a male and not a female, and certainly a species in which the whole abdominal border of the secondaries was yellowish white, not partly white and partly yellow.

Amongst the Lepidoptera of the late Mr. Charles Horne, collected in the North-west Provinces of India, I found a single specimen of a *Delias* which, after comparison with Donovan's figure, I am satisfied represents the true *D. belladonna*; it is a brown, not a black insect, it is a male, not a female, and the abdominal border of the secondaries is wholly creamy

* *D. japonica*, Bates (1873), is said to be synonymous with *Apheles gracilis*, Blessig (1872), from Amur-land; the species should therefore stand as *D. gracilis* (Blessig).

white; the yellow spot at anal angle is also perfectly separate from the yellow commencement of the discal macular band, as in the figure by Donovan; the shape and markings of the primaries are quite as in that figure, and therefore quite dissimilar from *D. Horsfieldii* ♂.

I think therefore that we may conclude that *Delias belladonna* is a species confined to the North-west Provinces, that *D. Horsfieldii* is confined to Nepal, and that other forms allied to these may yet be expected to turn up. The two following have been confounded with *D. Horsfieldii* :—

Delias Hearseyi, sp. n.

♂. Nearly allied to the Nepalese *D. Horsfieldii*, slightly smaller; the yellow patch at base of secondaries duller and of a more orange colour; the yellow patch on abdominal area only represented by a dull yellowish nebula at the extremity of the white area, which is restricted owing to the anal angle being broadly black-bordered; the yellow spot near anal angle represented by a few white scales, whereas in *D. Horsfieldii* it is always present as a squamose yellow spot subconfluent with the abdominal patch: on the underside all the yellow spots are of a dull chrome-yellow, not bright gamboge, as in *D. Horsfieldii*; they are also rounded and narrower than in that species, so that they are in consequence smaller and further apart. Expanse of wings 79 millim.

Barrackpore (*Sir John Hearsey*). B.M.

Delias Boyleæ, sp. n.

♂. Form and size of *D. Horsfieldii*, but in the coloration of the wings much nearer to *D. ithiela*, the ordinary markings being represented by internervular grey streaks, upon which the submarginal spots of the primaries and three or four small spots on the disk of all the wings alone show white; base of secondaries almost brick-red (or dull orange); basal half of abdominal area grey, anal half bright chrome-yellow: below all the spots smaller and much more restricted than in *D. Horsfieldii*; all the yellow spots duller, chrome-yellow. Expanse of wings 84 millim.

Darjiling (*Mrs. R. V. Boyle*). B.M.

Females in this group seem to be very rare; of the four species here mentioned we only have male examples in the British-Museum series.

VIII.—*Description of a new English Amphipodous Crustacean.* By the Rev. Thomas R. R. Stebbing, M.A.

[Plate II.]

Cyproidia damnoniensis, n. sp.

In the fourth volume of the 'Proceedings of the Linnean Society of New South Wales' (1880), Mr. W. A. Haswell instituted the genus *Cyproidia* with two species (*C. ornata* and *C. lineata*), which he placed in the family Gammaridæ. In his 'Catalogue of Australian Crustacea' (1882) he has assigned the genus to a subfamily Cyproidides, defined as having the first two side-plates of the peræon very small, the next two very large, and the two following small. Of the genus itself he gives the following description:—

"Body broad. Pereion and pleon of equal length. Coxæ of gnathopoda very small. Coxæ of the first and second pairs of pereiopoda enormously developed and cemented together to form broad and deep lateral shields, concealing almost entirely the gnathopoda and pereiopoda, and extending forwards to the sides of the cephalon, and backwards as far as the posterior border of the sixth segment of the pereion, excavated posteriorly for the shallow coxæ of the third pereiopoda. Coxæ of the last two pairs of pereiopoda very small. Antennæ subequal, superior without an appendage. Mandibles with a palp. Maxillipedes unguiculate; both basos and ischium armed with small squamiform plates. Gnathopoda subcheliform. Pereiopoda slender. Posterior pleopoda biramous. Telson single." To this he appends a note:—"The coxæ of the third and fourth pereiopoda are not amalgamated, as erroneously stated in the original description, but that of the fourth pair is entirely rudimentary and covered by that of the third."

In the year 1882 the genus *Stegoplax* was founded by Prof. G. O. Sars, and assigned to his family Amphilochidæ, which coincides with the subfamily Amphilochinæ of Axel Boeck's classification. This genus, like *Cyproidia*, is characterized by the enormous development of the third and fourth pairs of side-plates in the peræon and the rudimentary structure of the first and second pairs; to which characters are added the narrow linear form of the first or basal joint in the third and fourth peræopods. The mandibles are described by Professor Sars as having a tolerably large molar tubercle, but a minute palp.

It is, I think, tolerably obvious that the two genera *Cy-*

proidia and *Stegoplax* ought to be united, in which case, by priority of date, *Cyproidia* will take precedence. Whether the peculiar development of the side-plates justifies the establishment of a new family or subfamily to receive the genus may be for the present left open to consideration. The general aspect of the animals recalls the Stenothoinæ, but the maxillipeds exclude them from that group, while there is nothing in the characteristics of the Amphilochinæ to make their admission into that group impossible. The cementing together of the third and fourth side-plates, and the covering up of the sixth by the fifth, of which Mr. Haswell speaks, do not appear to be characters of the European species. The English species, unlike that described by Prof. Sars, has the first joint of the fourth peræopod dilated.

The species now to be described I received, along with some very prettily mounted Copepoda, from Mr. C. W. Parker, of Warren Cottage, Starcross, in Devonshire. In answer to my inquiry, Mr. Parker said that he collected the specimens at low tide at Straight Point, and that my friend the Rev. A. M. Norman, to whom he had also sent specimens, promptly recognized them as the fellows of one which he had himself previously found, but which was not yet described.

The eyes are small, round, red, with about twenty components. The rostrum is small.

The upper antennæ have a stout peduncle, the first joint as long as the other two united, each joint successively being thinner as well as shorter than the preceding. Of the flagellum the first joint is stout, fringed below with seven long, divergent, not tapering, setæ; of the three remaining joints the third is the longest and thinnest, prettily coloured with purple. The secondary flagellum is minute, one-jointed.

In the much slenderer lower antennæ the fourth and fifth joints of the peduncle are nearly equal in length; the flagellum consists of four tapering joints.

The upper lip is incised at the extremity, one lobe being larger than the other.

In both mandibles the molar tubercle is strongly developed, with sinuous rows of minute sharp teeth. The spine-row consists of six curved spines. The cutting-edge is divided into eight or nine unequal irregular teeth, minute but sharp. In one mandible, but, I think, not in the other, there is a secondary plate, also sharply toothed. The palp is small, three-jointed, so delicately transparent as to be difficult to see.

The first maxillæ are slender, having the outer plate topped with some eight spines, the two-jointed palp with four. The inner plate has not come under my notice.

The second maxillæ are also slender, the outer plate a little overtopping the inner, each being surmounted with three or four spines.

In the maxillipeds the inner plates are elongate, with incised, not sloping, distal margins; the outer plates, of somewhat oval shape, do not reach to the end of the second joint of the palp. They have a relatively large apical spine, and along the upper part of the inner margin excessively fine spines. The third joint of the palp is somewhat longer than the first or second, with an inner lobe at the base of the finger. The finger is well developed, curved.

Among the peræon segments the second is narrower than any of the others.

The two gnathopods are nearly alike in structure, except as to the hands. That of the first gnathopod narrows distally, has no distinct palm, and carries spines or hairs on the palm-margin. In one specimen there were two small groups, in another four spines spaced at equal intervals along the margin. In the second gnathopod the hand widens towards the palm, which is defined by a broad tooth-like process in which are inserted two relatively strong spines, between which the finger closes down. The margin of the palm is convex. In both hands the strong curved finger has on the concave margin three little teeth followed by a larger one, after which comes the sharp-pointed nail.

The side plates of the first three peræopods are neatly fitted together, forming almost an oval, truncate on the upper side. Of the three, the side-plate of the second peræopod is much the largest, with a convex front and an excavated hinder margin, the excavation being filled in by the small plate of the third peræopod.

The first, second, and third peræopods are similar in structure, with long and slender first joints; the third joints a little dilated, more so proximally than distally; the fifth joints a little longer than the fourth; the fingers fairly strong, curved. In the third peræopod, however, the four last joints are all respectively a good deal shorter than those in the first peræopod. The fourth peræopod has the first joint winged with a dilatation so transparent as easily to escape notice, except in a good light. It is shorter than the first joint of the preceding leg. In the fifth peræopod the dilated first joint has a sinuous lower margin. It may be roughly regarded as quadrangular, but the sides are not straight and the lower part is rather broader than the upper.

The three first segments of the pleon are longer than any of those of the peræon except the fifth. They carry pleopoda of no great strength. The third pleon segment is produced backwards in a rounded lobe formed by the hinder and lower margins. The three following segments are very small, carrying slender uropods, decreasing in size from the first to the third pair. In all the rami are minutely serrate. In the first pair the peduncle is long, but in the third it is very short.

The huge boat-shaped telson reaches as far back as the tip of the shorter branch of the third pair of uropods.

The colour in the mounted specimens was a beautiful red in some parts and purple in others; the size, a tenth of an inch, agrees with the diminutive proportions of the other species of this curious genus.

EXPLANATION OF PLATE II.

Full figure, side view of specimen less than $\frac{1}{10}$ inch in length. Antennæ and *gn.* 1 A from another specimen, the remaining figures from a third (dissected) specimen, drawn under the $\frac{1}{4}$-inch power, eyepieces A and B, of Beck's popular microscope.

a. s., flagellum of superior antenna.
a. i., antenna inferior.
l. s., labium superius.
l. i., labium inferius.
m. m., mandibles: figure on the left with cutting-edge and spine-row: figure on the right with cutting-edge and secondary plate, more highly magnified.
mx. 1, first maxilla.
mx. 2, second maxilla.
mxp., maxillipeds.
gn. 1, first gnathopod.
gn. 2, second gnathopod.
prp. 1, 3, 4, 5, first, third, fourth, and fifth peræopods.
T, telson, with third and second uropods.
ur. 1, first uropods.
n. s., natural size.

BIBLIOGRAPHICAL NOTICES.

British Oribatidæ. By Albert D. Michael, F.L.S., F.R.M.S., &c. Vol. I. 8vo. London: Printed for the Ray Society, 1884.

In the Preface we are told "that this book is the record of work done in the scanty leisure of a very busy man." The author has for some five years turned his attention to the Oribatidæ, a family of Acarina commonly known as "Beetle-mites," in allusion to their usually convex beetle-like form and the hardness of their integuments. Little was known of them or of their earlier stages, for, like many other Mites, they undergo a series of changes after emerging from the egg, or, in other words, they pass through larval and nymphal stages to the imago, so that in the majority of cases "it would be impossible to identify the nymph with the adult except from knowledge." Thus it was necessary to watch the animals from the egg to maturity. "The creatures," says our author, "are minute, scarcely visible at all to the naked eye. When in the cage (or cell) every inspection must be made under a microscope of some sort; the creatures hide in the moss or blotting-paper, which it is necessary to put into the cell (for they must be fed and kept damp), and yet they must be examined to see what is going on. . . . Many of them take months to have their changes traced; indeed I have had a single specimen alive in the cage for over a year before its changes were complete, so that I might say with certainty to what species the larva or nymph belonged. During this time the cage must be examined every day, and it must be ascertained that the proper hygrometric condition is maintained. . . . I have often had fifty such cages in action at one time, each with its inhabitant; the cages must accompany the observer in every journey, as a few days' neglect would kill all the specimens." It was to Mrs. Michael's "patient attention to them, and to her skilled hand in moving them," that the author owed his "success in rearing them."

The Oribatidæ are vegetable-feeders, of sluggish habits, and "sham dead" in presence of an enemy. Their distribution is probably world-wide: they are found in Spitzbergen as well as in Egypt and Chili; one from Franz-Joseph Land is identical with our *Oribata setosa*. In one place—the Land's End—the author detected "what appears to be a local fauna."

To show how complete the author's treatment of his subject is we may give the headings of the various chapters. The first part contains:—(1) Introductory, (2) Terminology, (3) Literature of Oribatidæ, (4) Classification of Acarina, (5) Classification of Oribatidæ, (6) Development, (7) Habits, (8) Collecting and Preservation, (9) Anatomy of exo-skeleton, (10) Internal Anatomy. The second part is devoted to descriptions of the genera * and species; but of this we have here only a first instalment, including one half of the genera recognized by the author as represented in Britain. Forty species are described, seven of them as new, while several of the others are discoveries of the author's, previously described by him in the 'Journal of the Royal Microscopical Society.'

The plates are admirable works of art, and their accuracy may be depended on, as the figures were nearly all drawn from living examples by the author. There are twenty-two coloured and six plain plates, the latter illustrating chiefly the anatomy.

We must congratulate the author and the Ray Society very heartily upon the production of this beautiful volume. No such thorough and reliable work has been done anywhere upon any family of that most difficult group the Mites; and certainly as regards the British species of the group it must be considered as inaugurating a new era. It is to be hoped that the second volume, completing the descriptive portion of the work, will not long delay its appearance, and that the Council of the Ray Society may see their way to furnish us with similar treatises upon other families of the Acarina.

* The name of one of the genera—*Leiosoma*—had been previously used, as might be expected, when Nicolet wrote. *Hoplophora* too, which is retained in the table of genera, had been given to two genera before it was taken up by Koch.

Antiquity of Man, as deduced from the Discovery of a Human Skeleton during the Excavations of the East- and West-India Dock-extensions at Tilbury, North Bank of the Thames. By Sir Richard Owen, K.C.B., F.R.S., &c. 8vo. 32 pages; with 5 plates. Van Voorst: London, 1884.

Herein the author describes in detail some of the bones of the skeleton found, in 1883, in excavating the new docks at Tilbury, at a depth of 34½ feet below the level of the marsh, and 41 feet below Trinity highwater-mark. In the frontispiece a diagram gives the following section of the ground, beginning at the top:—

	ft.
1. Clay	6·04
2. Mud	10·76
3. Mud and peat	1·70
4. Peat	1·08
5. Mud	3·86
6. Peat	3·58
7. Mud	1·76
8. Mud and peat	3·24
9. Sand and decayed wood	0·82
10. Sand	1·71
Level at which the remains were found.	
11. Sand	10·76
12. Ballast-gravel.	

The author finds the bones to have belonged to an old—perhaps very old—robust man, of low intelligence. All the areas of muscular attachment on the bones indicate a very strong and active muscular system; the forehead is low and narrow, with prominent frontal sinuses, and "the eminences and depressions indicative of cerebral convolutions are few and feebly indicated." The lower jaw is senile, the alveolar process of the molars absorbed, and the remaining teeth show signs of local decay. The ridged and rough muscular regions on the skull, the lower jaw, a humerus, and a femur are especially noticed; and, in particular, the rough, obliquely prominent upper portion of the gluteal ridge on the left thigh-bone (not nearly so much developed on the fellow femur, exposed in the Mammalian Saloon of the British Museum), which prominence the author likens to the "third trochanter" "in most perissodactyle quadrupeds." The tibias are not described in detail; but they appear to be *platycnemic*, as seen in the glass case in the Museum, though not quite so sharp-edged as in some of the other prehistoric skeletons already known.

The author does not enter into the bibliographic history of the remains of prehistoric man: he only alludes to the remains found in the cave at Bruniquel, and to M. Quatrefages's summary on fossil man and savages; and he makes some reference to the doubtful existence of *Tertiary* man.

With regard to the head-characters of the "ancient British aboriginal" from Tilbury Marsh, Sir Richard says:—"These are exceptions to the cranial outline in the educated humanity of the actual or recent period, whilst the 'Tilbury skull' may accord with the rule in the Palæolithic range of time. But the bimanal characters of the skeleton are distinct from quadrumanal ones in the earliest as in the latest and highest races of mankind" (p. 24). In this statement we do not find anything new.

Whether the old man of Tilbury (evidently endowed with great brute force, though perhaps with a low intellect) was one of the *earliest* of men is very doubtful. The cursory popular sketch of the history of the river-deposits at Tilbury (pp. 24–27) does not carry much geological weight; for the history of the order and changes of deposition and transportation of débris, and of the local accumulation of peat in the lower reaches of a large river must be very exact before definite conclusions can be arrived at; nor can the indefinite "mud," which alternates with the peat, yield much information to either the geologist or the general reader. The gravel at the bottom of the section may, on one hand, be a deposit made by the river at an early period, when the land stood higher than at present, and may have been either fluviatile or estuarine. On the other hand, the river may have scooped out a deep channel more or less suddenly at a late period and left a bedding of gravel at the subsidence of that activity. In either case, if any "palæolithic" implements be found in that gravel, they must have been either washed in from older deposits or dropped by man *then* living on the banks, fishing, canoeing, or crossing the ice. The sand, 12 feet thick, with the bones, lying on that gravel, may have been deposited after a long or a short interval of time. It is not stated that the man imbedded in the upper part of this sand-bed had any *palæoliths* with him to prove his contemporaneity with the deeper gravel, "known as 'ballast,' in which flint implements (? palæoliths) are more commonly found" (p. 22), or with any really palæolithic deposit.

The author sketches the life and habits of a prehistoric Briton, with his "unpolished adze of flint" (pp. 14-17), or "a British palæolithic riverside man;" and he takes for granted that, of the horizons in brick-earths, sands, and gravels, at which Mr. W. G. Smith and others have found palæoliths near London, some at least must be the same as that of the sand in which the Tilbury man has been met with. For this supposed correlation there is really no ground. Mr. W. G. Smith expressed a hope (in the 'Transactions of the Essex Field-Club,' 1883, p. 142) that bodily remains of the river-drift men, who inhabited the area marked by the "palæolithic floor" (stretching across the ancient surface of a great part of Middlesex and adjoining lands before the valleys were cut out to their present levels) would be some day found. To this skeleton at Tilbury Sir Richard seems to believe that he can point, as one of the desiderated men older than those of the caves, and "who lived on the river-margins, and others who lived before the present rivers flowed" (W. G. Smith, *loc. cit.*).

Whatever may be the geological value of the argument, we have to thank the author for the trouble he has taken to put on record all that he knows about this prehistoric man, and for the minute description and excellent plates (by Erxleben) of the calvarium, lower jaw, and teeth (plates i., ii., and iii.), and the femur (pl. iv.) of this ancient representative of the aborigines formerly living on the old Thames bank.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 5, 1884.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On a new Deposit of Pliocene Age at St. Erth, 15 miles east of the Land's End, Cornwall." By S. V. Wood, Esq., F.G.S.

The deposit described in this paper occurs about 5 miles north-east of Penzance, and consists of a tenacious blue clay with shells, resting on sand, and passing upwards into a yellow unfossiliferous clay, which is overlain unconformably by the earth with angular fragments, under which the ancient beaches of the British Channel (with which beaches, however, the deposit now described has no connection) are buried. It has been excavated for the underlying sand at intervals during the last fifty years, but has been disused since 1881–82, when it was temporarily worked to supply the yellow part of the clay for the Penzance dock-works.

The author has got together, partly from correspondents in Cornwall and partly from his own researches in clay consigned to him, upwards of 40 species of Mollusca, inclusive of a few of which only fragments have as yet occurred, and of several minute species. Among these, besides some that are apparently altogether new, are some particularly characteristic species of the Red Crag not known living, such as *Cypræa* (*Trivia*) *avellana*, Sow.; *Melampus pyramidalis*, Sow.; and *Nassa granulata*, Sow. (or else *N. granifera*, Dujardin), as well as other characteristic Crag species that still live, but not north of the coast of Spain, such as *Turritella triplicata*, Brocchi (*T. incrassata*, Sow.), and *Ringicula buccinea*, Brocchi.

The most interesting feature of the fauna, however, consists in the six species of *Nassa* that the deposit has hitherto yielded, of which all but one, *N. granulata*, Sow. (or *granifera*, Dujardin), are unknown from any formation of Northern Europe, and occur, whether in the living or fossil state, only in the southern half of Europe*. One of these is *Nassa mutabilis*, Linné, which now lives

* *N. conglobata*, a species of a group near to that of *mutabilis*, has occurred in the Red Crag; but, so far as the author is aware, neither that shell, nor any of the group to which it belongs, has occurred in any other formation of Northern Europe.

throughout the Mediterranean, but outside that sea not north of Cadiz (lat. 36° 30′); and two others are new species of this exclusively southern *mutabilis*-group. Another seems to be a rare Italian Upper-Pliocene species of the *reticulata*-group, *N. reticostata*, Bellardi; while the sixth is the Lower Pliocene and Upper-Miocene species, *N. serrata*, Brocchi. This shell, in the variety of form it presents at St. Erth (where it is one of the most frequent shells), seems to connect the Red-Crag *N. reticosa*, Sow., with the Italian *N. serrata*, while the shorter forms of it are identical with the Italian Lower-Pliocene *N. emiliana*, Mayer. The fauna is altogether southern, no exclusively Arctic shell having as yet occurred in it.

The author regards the bed as clearly Pliocene, and inclines to the opinion that it is rather Newer than Older Pliocene; that is to say, it is coeval with the Red Crag, but its affinities are more with the Pliocene of Italy than with the Pliocene of the North-Sea region; and this seems to show that during its deposition there was no communication between the Atlantic and the North Sea, except round the north of Britain, the refrigeration of the water by the nine degrees of latitude, through which Britain extends northwards from St. Erth, preventing the access of the Italian group of *Nassæ* to that sea. This view is also strengthened by the absence of any close agreement between the fauna of St. Erth and that of the not far distant Pliocene of Normandy, the faunal affinities of both the older and newer parts of that Pliocene (the Conglomérat à Térébratules and Marnes à Nassa, regarded by geologists as of the age of the Coralline and Red Crags respectively) being more with the North-Sea Crag than with the St.-Erth bed.

As regards the geography of the immediate neighbourhood during its accumulation, the bed is the deposit of a strait that joined the sea on the north of Cornwall (St. Ives Bay) to that on the south of the county (Mounts Bay); and which insulated the high ground of the Land's-End district from the rest of Britain. The elevation of the shell-bearing part of the clay, as ascertained for the author by a set of levels run by Mr. Nicholas Whitley of Truro, C.E., who first brought the bed to public notice in the 'Transactions of the Royal Geological Society of Cornwall,' is 98 feet above mean-tide mark in the Hayle estuary, near to it, the surface of the ground being about 15 feet higher. Angular stones of small dimensions (none yet met with by the author exceeding 3 cubic inches) occur occasionally in the clay along with the shells, in amount of about one pound to a hundredweight of the clay, indicating, apparently, the drift of coast-ice over the strait during the deposit; but the author has only noticed one rounded pebble in the clay he has searched through.

Dr. Gwyn Jeffreys expressed his regret that the author of this important communication was prevented by illness from being present at the meeting, and said that the paper exhibited indications of the great energy possessed by the author notwithstanding his bad state of health. Great credit was also due to Mr. Robert Bell for his share of the work. After careful examination Dr. Jeffreys recognized 50 species among the fossils obtained from the deposit at St. Erth; but from the number given by Mr. Wood he deducted 5 for duplicates, and one which he thought was not a mollusk. There were thus 44 or 45 species, out of which 11 or 12 are recent and 33 or 34 extinct. Of the latter 11 only are known to him from Tertiary deposits, 4 being of Miocene age, and all of them Pliocene. 22 species were unknown to him either as Tertiary or recent. For the accurate determination of the species the collection, when more complete, would have to be critically compared with recent forms, and the necessary allowance made for that slight divergence which was always observable in the shells of species whose existence extended over a long period of time. Dr. Jeffreys thought that the author had not quite sufficient knowledge of recent Mollusca for his determinations to be thoroughly accurate. The list of shells needs a careful re-comparison with the species contained in the Tertiary collections of Europe.

He further remarked that no deposits of Glacial age have hitherto been found in the south of England. He was not clear whether the St. Erth deposit was of older Pliocene or possibly of Upper Miocene age. *Nassa serrata*, Brocchi, was one of the few species in the list identical with Crag forms, namely *Buccinum reticosum* of Sowerby. The deposit did not seem to him to be connected with any Crag bed. A bed near Antibes, in the South of France, seemed to him to resemble the St. Erth deposit in many of its characters, and the mollusca of these two deposits should be critically compared.

Prof. Prestwich said that this discovery of Mr. Searles Wood was the most interesting that had been made upon the southern coast of England for many years. It was the first clear evidence from fossils of a depression in Cornwall since Palæozoic times, as the beds near St. Austell contain no organic remains. The high- and low-level beaches in Jersey and Guernsey are also unfossiliferous. He felt the same difficulty as Mr. Wood in correlating the beds in Brittany. The beds at Boscq d'Aubigny, in Normandy, present many points of analogy with those of St. Erth. There is the same preponderance of Subapennine and Mediterranean species, with many Crag fossils, but the species are different.

Mr. Etheridge thought that the author had been rather hurried in drawing his conclusions, and that more stratigraphical and geographical evidence as to the distribution of the bed, and a careful survey of the neighbouring coast were requisite. He said that Mr. Solly had tried to make out the succession of the clays, and Mr. Bell had done much with the fossils, but no doubt many more fossils were yet to be found, and the Foraminifera, which are numerous, had not been determined. For his own part, he had much faith in Foraminifera, when properly determined, as a means of settling the age of such deposits.

2. "The Cretaceous beds at Black Ven, near Lyme Regis, with some supplementary remarks on the Blackdown Beds." By the Rev. W. Downes, B.A., F.G.S.

The author described a new exposure of the Cretaceous deposits at Black Ven, and stated that the Cliff-section measures 300 feet in height, of which the Lias occupies 200 feet, and the Cretaceous beds the remaining 100 feet. Of the latter the lower 25 feet consist of black loamy clay, passing up into yellowish-brown non-calcareous sands 75 feet thick, capped with chert-gravel. From one point in the clay the author obtained a few fossils, the most abundant being *Lima parallela*. The overlying sands, of ordinary Greensand type, furnished no fossils, although traces of their former existence occurred in some abundance. The only species identifiable from the casts in loose sand was *Cyprina cuneata*. At about 50 feet, nearly in a straight line above the point in the Gault-clay where the author had obtained fossils, he discovered a small patch or nest of mostly fragmentary silicified fossils, with a somewhat ferruginous matrix. The most abundant species were *Cyprina cuneata* and *Gervillia rostrata*; the associated forms were *Cytherea caperata*, *Trigonia scabricula*, *Cucullæa glabra* and *fibrosa*, *Cardium proboscideum*, *Pecten orbicularis* and *quinquecostatus*, *Turritella granulata*, *Exogyra*, *Phasianella*, *Serpula*, and *Siphonia*. Only one species is doubtfully common to the two horizons from which the fossils were procured, namely, *Turritella granulata*.

The author regards the fauna of the sands, thus revealed, as approaching the Blackdown fauna, and the sands as the equivalent beds. The absence of *Pectunculus umbonatus* and *sublævis* might serve to indicate that the sands at Black Ven were Lower Blackdown; but *Cyprina cuneata*, at Blackdown, characterizes a bed intermediate between those containing the above two *Pectunculi*. The evidence, in the author's opinion, seems to show an alternation of specific horizons, an inosculation due to changing littoral conditions, but with a general thinning-out to the westward, from which he concluded that the conditions of deposition were such that it will be impossible to recognize in the Cretaceous beds of the West of England the subdivisions of Gault and Upper Greensand which are so well marked to the eastward.

In conclusion, the author noticed some additions to his list of Blackdown and Haldon fossils, published in the 'Quarterly Journal' for 1882.

3. "On some Recent Discoveries in the Submerged Forest of Torbay." By D. Pidgeon, Esq., F.G.S.

The submerged forest of Torbay has been described by several geologists, among others by De la Beche, Godwin-Austen, and Pengelly. The latter, who has paid particular attention to the deposit, has inferred that a depression of 40 feet has taken place since the forest grew, and that the growth of the forest was at a period when the mammoth existed, a molar of that animal having been dredged at a depth of five or six fathoms, and having been apparently derived from the Forest-bed.

The submerged forest rests upon a considerable thickness of clay, evidently the soil in which the trees grew. The clay rests upon Trias, a breccia of Devonian fragments intervening in places. This breccia appears to be of glacial age.

The gales of the winter of 1883–84 caused the exposure of considerable areas of the clay between tide-marks; and in one place, resting upon the breccia, two aggregations of rolled trap pebbles were found. These pebbles were shown to have probably served as smelting-hearths. In their neighbourhood an ingot of copper, a fragment of a second, some tin slag, a piece of glass, flint implements, and other articles were found, together with remains of piles driven into the ground. These traces of human work apparently belong to the bronze age. In Goodrington Bay pewter vessels, apparently of Roman date, were found by the writer's son in a bed 10 feet below high-tide mark, or at a lower level than that of the bronze-age relics.

After referring to the occurrence of some estuarine shells (*Scrobicularia*, *Hydrobia*, *Littorina*, and *Melampus*) in the clay near Redcliffe Towers, at the level where similar mollusca now exist (an occurrence which may, however, be due to a recent mixing of deposits), the author pointed out that as the coast is known to have undergone no change of level for nearly 2000 years, it is unlikely that it can have been raised 40 feet, and again depressed to the same extent, since the beginning of the bronze period, not more than about fifteen centuries earlier. It is more probable that the clay bed was deposited in a shallow mere or marsh, of land-water kept back by the sea-beach, which was then some hundreds of feet further to seaward, and that the forest, which consisted chiefly of willows, grew on the marsh. The mammoth tooth may have been derived from an older deposit, all other remains of mammalia obtained from the Forest-bed belonging to animals still existing.

MISCELLANEOUS.

Contributions to the Biology of Spiders. By Dr. Friedrich Dahl.

In the first part of the next (ninth) volume of the 'Vierteljahrsschrift für wissenschaftliche Philosophie' an attempted representation of the psychical processes in spiders will be published by me. As certain points in the work may also be interesting to zoologists, I venture here to communicate very briefly the chief results of my investigations, referring to the above-mentioned memoir for further details and proofs. In that memoir I have first of all treated of the sensorial perceptions and then passed to the higher mental life.

The sense of sight is imperfect in spiders because all accommodation seems to be deficient. At a short distance *Attus arcuatus*, Bl., regards a ball of paper borne on a fine wire, or in fact anything that moves, as a fly. At a distance of about 1–2 centim., on the contrary, it is quite able to distinguish a fly from a bee of the same size. The geometrical spiders, in consequence of this short-sightedness, are almost exclusively dependent on the sense of touch, which certainly is developed in an astonishing manner.

Meta segmentata, Bl., *Zilla x-notata*, &c., not only feel that an object has got into their net, but they can even feel upon which radius it is, when they pull upon this radius from the centre. If they have captured a fly, and a second gets into the net at the moment, they must go to the central point or to the radius to which the new fly is suspended in order to find it, even though it may be in their immediate vicinity.

The senses of smell and hearing are also well developed. I have to add to my previous statements * that *Epeïra patagiata*, Bl., for example, can even distinguish different odours. Thus the smell of oil of turpentine is much more disagreeable to it than that of ammonia.

Among instinctive proceedings I have especially observed the manufacture of the geometrical web more particularly. First the outer framework is spun; then, alternately from different sides, the rays, and simultaneously with these the round shelter in the middle; then a spiral extending nearly to the outer margin, which gives the whole firmness, and serves as a bridge during the further work; and finally a spiral thread, set with little drops, from the outer framework nearly to the middle shelter. During the making of the last-mentioned portion the dry spiral is for the most part destroyed. Some geometrical spiders, as is well known, complete their web and then lie in wait for prey upon the central shelter, sitting with the head downwards. (The webs are more or less vertical, because otherwise an insect would too easily drop out of them.) Others keep, at least in the daytime, in a dwelling placed near the web, connected by a signal-thread with the central shelter of the web; and others leave one sector unwoven for the signal-thread. Among the latter is *Zilla x-notata*, Bl., which I particularly made use of for my observations. It is remarkable that the first web that a young spider of this species prepares is always perfectly geometrical, and that its dwelling-place at first is the central shelter. The second web in rare instances already shows the defective sector. Generally, however, this form first appears after the preparation of *several* complete geometrical webs, although, as a rule, before the first change of skin. Sometimes we find as an intermediate step a complete geometrical web with a dwelling beside it. The transition to the second form is, however, very rarely quite smooth. It can, however, by no means be dependent upon external conditions or upon changes of the organs. We have before us here, therefore,

* Zool. Anz. 1883, p. 267, and Arch. f. micr. Anat. Bd. xxiv. p. 1 (Ann. Mag. Nat. Hist. Nov. 1884, p. 329).

a passage through earlier stages of the development of instinct, such as has long been known in the development of organs.

It has often been asserted that the geometrical spiders do not repair old webs. This, however, is true only in a limited sense. The outer framework and some of the radii which have already become nearly free from transverse threads are probably always used again by *Zilla x-notata* and others. The rest is gathered up, worked into a ball with the mouth, and thrown away. If the spider removes a lifeless object from the web, and damages the latter in so doing, it certainly sometimes reproduces the destroyed portion of the framework, the radii, and the central shelter. If we interrupt a spider in the formation of its web, by tearing away a portion of it with the corresponding part of the outer framework, all will be completed up to the part that has remained uninjured. In this case the completion of the framework is especially interesting, as this unaccustomed work is not usually successfully performed at once. Here we see very distinctly how reflection comes into play. I was still better able to ascertain reflection, or, what is the same thing, actual inference, in the case of *Attus arcuatus*, Bl., when I offered it flies touched with oil of turpentine. Sometimes the spider despised the species of fly employed (*Homalomyia canicularis*, L.), whilst it attacked other insects (e. g. *Chironomus tendens*, Fab.) just as before. This spider also draws similar conclusions in those cases in which it cannot overcome insects in consequence of their chitinous armour being too hard. These it usually attacks only once, and is then for a long time forewarned. Dangerous insects, however, such as small bees, it avoids, without having seen their sting. Here therefore we have an instinctive dread. Bee-like flies are equally dreaded.

I have also attempted to give a new explanation of the secondary sexual differences of many spiders, which are to be ascribed to changes by means of sexual selection.—*Zool. Anz.* no. 180, p. 591.

On the Classificatory Position of Hemiaster elongatus.

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

Gentlemen,—You were good enough to admit a reply on the part of Mr. Percy Sladen and myself to a criticism of Prof. Sven Lovén, upon the classificatory position of *Hemiaster elongatus*, nobis, in your number for October last. I have received, in consequence, a very cordial reply from the Professor, in which he acknowledges that the form is not a species of *Palæostoma*, and points out how these latter forms of *Hemiaster* depart from the Mesozoic types of Desor, Wright, and Cotteau, in the extension of the madreporite and in the diminution in the number of the ovarial pores. He suggests that we should place our species in a new genus. The consideration of this proposed splitting up of the genus *Hemiaster* we must defer for a while, for it is a matter that concerns M. de Loriol also; and, moreover, we can hardly determine the propriety of the step until we have completed our description of the Echinoidea of the Tertiaries of Sind.

Yours &c.,

Dec. 1, 1884. P. Martin Duncan.

On the Development of the Spongillæ.
By Dr. A. Götte.

The following statements relate to the *Spongilla fluviatilis* of the harbour of Rostock, the developmental forms of which have been investigated both intact and in sections.

The segmentation leads to the formation of a *sterroblastula*, the cells of which are not placed radially around a central point, but irregularly in several layers, and at first present no regular distinction of sizes. The latter makes its appearance comparatively late, when the peripheral cells in one hemisphere diminish rapidly and close up into the form of a membrane. Gradually a thin cylinder-epithelium is developed from this, and it completely surrounds the remaining coarsely cellular mass. Thus is produced a completely closed *sterrogastrula*, with an epithelial *ectoderm* and a moderate *endoderm*.

The cells of the former gradually become smaller, and it is at last ciliated. In the middle of the endoderm a cavity is produced by the separation and not by the fusion of the cells, and this is enlarged towards the broader end of the oval gastrula, and finally passes into it altogether. By this means the endoderm in this anterior or superior hemisphere (according to the subsequent position of the larva) becomes a thin loose layer applied to the ectoderm, arching over the cavity and attached by its margin to the posterior thick mass of endoderm.

In this state the *larva* escapes, and after a time attaches itself by the anterior end. In this process the *ectoderm* is ruptured, and the amœboid endodermal cells, reticulately united, attach themselves to the supporting body. By a simple continuation of this process the whole endoderm spreads into a flat cake, upon which the torn and already partially detached ectoderm rests loosely like a mantle; or the larva, after the first attachment, lies down upon the whole of its side-length, so that a part of the ectoderm comes to lie under the cake of endoderm. The whole organism then usually slips away from this basal disk of endoderm, leaving it to dissolve; in other cases it disappears by atrophy of the endodermal mass. The superficial ectodermal mantle, below the margin of which, all round, the attachment by means of the amœboid endodermal cells takes place, usually breaks up into larger and smaller pieces which are exfoliated; or it disappears by atrophy, the cells and nuclei becoming indistinct and finally disappearing, so that the underlying endoderm is freely exposed.

About the time of the escape of the larva (but the sequence of all the developmental phenomena of the *Spongillæ* is remarkably variable), the transformation of the *endoderm* with the excentric cavity commences. By the flattening and extension of the cells of its convex portion, the margin of the latter glides back over the more coarsely cellular endodermal mass, and coats it, just as an ectoderm does the endoderm, in a sterrogastrula. Possibly this is only apparent, the peripheral cells of the posterior mass merely joining themselves to the anterior convex layer by a corresponding metamorphosis. At any rate the endoderm of the larva, shortly before its attachment, consists of a sacciform thin layer posteriorly enclosing the coarsely cellular mass, and anteriorly the cavity; at its inner surface it secretes a distinct cuticle, by which it is always recognizable. Its cells also provide for the above-described adhesion of the larva, especially in the periphery of the flat disk; from this marginal zone the layer becomes condensed by the approximation of its loosely reticulate mass of cells beneath the vanishing ectoderm, to form an epithelium as the cuticle of the sponge. The *osculum* and the *pores* originate in exactly the same way as enlarged spaces between the cells.

During the attachment of the larva the whole arch of the *endodermal cavity* becomes compressed, and, on the other hand, the inner endodermal mass advances into it, until it disappears with the exception of a fissure-like space between the cuticle and that mass, extending more or less distinctly over the whole upper surface of the sponge. In the middle of the still disciform body, however, this fissure-space becomes enlarged into a deep round pit beneath the strained cuticle by the depression of its bottom formed by the above-mentioned inferior parenchyma. This cavity becomes lined by some free cells with an epithelium resembling the cuticle, and acquires one of the above-mentioned apertures in its covering (cuticle). Around it there are then produced some similar pits, in part also furnished with similar apertures, of which the osculum is characterized by its margin being elevated like that of a crater. Although all these pits originally communicate with each other as depressions of the subepidermal fissure-space, they are afterwards entirely or partially separated from each other by their linings, which extend up to the cuticle (afferent and efferent canal-system).

In the meantime, however, the *flagellate chambers* are produced in the parenchymatous endodermal mass. They are genetically quite independent of the above cavities, as their separated rudiments already exist in the larvæ. These foundations originate from particular endodermal cells, around the primitive nucleus of which several *new small nuclei are produced without any recognizable phenomena of division.* Corresponding to these nuclei buds of the mother-cells are produced, and from these cell-aggregates, which arrange themselves in capsules and usually coalesce in groups to form more or less closed hollow spheres. These spheres, which are afterwards ciliated within, unite, sometimes directly with the above-described cavities, sometimes with inward diverticula from them, or with irregular canals, which, like the cavities, originate as intercellular spaces lined with pavement epithelium, but independently in the parenchyma of the endoderm, and at once enter into communication with them.

This parenchyma, or the whole non-epithelial cell-mass of the sponge, has essentially the same structure as in the larva; the rounded or stellate cells are suspended, by means of their mutual attachments, in a fluid, which at first also occupied the great endodermal cavity and its processes, but afterwards becomes somewhat condensed within the tissue, while, in the cavities which open outwards, it is displaced by water. The *spicules*, which always originate intracellularly, are also already present in the larva.

A brief recapitulation of the described facts shows that—

1. The bilamellar embryo is a sterrogastrula, which afterwards acquires an endodermal cavity.

2. The ectoderm entirely disappears during the attachment of the larva; the future sponge, with all its parts, proceeds entirely from the endoderm.

3. This early divides into a peripheral layer, which becomes an epidermis in place of the ectoderm, and a compact interior mass, the foundation of all the other tissues.

4. In the latter the incurrent and exhalent cavities and the flagellate chambers, as well as their linings, originate separately without any common foundation, so that the distinction of an enteroderm from a mesoderm is not possible.

5. The *Spongillæ*, as indeed all the sponges, originate from "bilamellar" ancestors; but at present develop their whole organization from a single germ-plate.—*Zoologischer Anzeiger*, December 15, 1884, p. 676.

Note on the Reproduction of the Monotremata.

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

Gentlemen,—*A propos* of Sir Richard Owen's paper in the Ann. & Mag. Nat. Hist. for December last "On the Impregnated Uterus and on the Uterine Ova of *Echidna hystrix*," accompanied by a copy of a letter from the 'Sydney Herald' announcing Mr. Caldwell's most interesting confirmation of Owen's researches by anatomical proof of the oviparous reproduction of the Monotremata, I beg to send you the following extract from the 'Illustrated Melbourne Post' of September 24, 1864, which was reproduced in the 'Zoologist' for 1865, p. 9431:—

"*Eggs of* Ornithorhynchus.

"About ten months ago a platypus (*Ornithorhynchus paradoxus*) was captured, and is in possession of Mr. Rumley, gold-receiver, of Woods Point. It has laid two eggs, which were white, soft, and without shell. It is to be regretted that no opportunity was afforded of examining them more minutely, as they were soon afterwards thrown away. It has hitherto been a matter of dispute among naturalists as to whether this extraordinary animal, the connecting-link between birds and mammals, produced living young or whether it laid eggs. It may now, however, be considered as a settled question. [Valeat quantum! E. N.]"

THOMAS SOUTHWELL.

Norwich,
December 5, 1884.

A Scorpion from the Silurian Formation of Sweden.
By Dr. G. LINDSTRÖM.

The remarkable discovery has been made of a fossil scorpion in the Upper Silurian (Ludlow) of the island of Gotland. The specimen is well preserved and shows clearly the delicate brown or yellowish-brown chitinous cuticle, compressed and wrinkled by the pressure of overlying beds; the cephalothorax, the abdomen with seven dorsal plates, and the tail composed of six segments, of which the last contracts and becomes pointed to form the poison-dart. The sculpture of the surface is exactly as in recent scorpions, and consists of tubercles and longitudinal ridges. One of the stigmata is visible on the right side, proving clearly that the animal respired air, as, indeed, its whole organization demonstrates that it lived upon dry land.

In this scorpion, named *Palæophonus nuncius* by MM. Torell and Lindström, we have therefore the most ancient known terrestrial animal; the dragon-flies, which hitherto claim the highest antiquity, having been found in the Devonian strata of Canada.

In the construction of this scorpion a very important feature is observable, furnished by the four pairs of thoracic legs, which are stout and pointed like those of the embryos of many other Tracheata, and of forms like *Campodea.* This form of leg no longer exists in the fossil scorpions of the Carboniferous formation, in which those appendages resemble those of living scorpions.—*Comptes Rendus*, December 1, 1884, p. 984.

[Dr. Hinde has kindly informed us that, according to letters received by him from Dr. Lindström, a fossil scorpion was obtained last year by Dr. Hunter, of Carluke, from the Upper Ludlow beds of Lesmahago, in Lanarkshire. The specimen was sent to Mr. B. N. Peach in Edinburgh, but owing to that gentleman's ill-health he was unable to do anything with it, until the receipt of a photograph from Dr. Lindström showed that the Scotch and Swedish specimens agreed so closely that they might well be referred to the same species, certainly to the same genus. Dr. Lindström's example shows the dorsal surface of the animal, Dr. Hunter's the ventral surface; the latter is a female, while the Swedish specimen is inferred to be probably a male.]

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IX.—*The Origin of the Fauna and Flora of New Zealand.* By Capt. F. W. Hutton, F.G.S.*

II. The Antarctic and North-Temperate Elements†.

In my address last year I pointed out that the immigrant part of our fauna and flora could be divided into five elements, viz.:—(1) Australian, (2) Polynesian, (3) South American, (4) Antarctic, and (5) North-Temperate. I explained that of these elements the first three had invaded New Zealand together from the north at three different epochs. The first invasion was in the Lower Cretaceous, when New Zealand formed part of a large South-Pacific continent ‡, extending from New Guinea to Chili. The second was in the Eocene period, the third in the Pliocene, during both of which times New Zealand was an island, although considerably larger

* From advance sheets communicated by the Author from the 'New Zealand Journal of Science,' vol. ii. p. 249.

† Annual Address to the Philosophical Institute of Canterbury, delivered 6th November, 1884. For Part I. see Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 425.

‡ M. A. Milne-Edwards appears to have advocated in 1874 the hypothesis that New Zealand had formerly been joined to some islands of Polynesia, while it remained separated from Australia. I have not seen his paper. (See N. Z. Journ. Sc. i. p. 258, footnote.)

than at present; but I had to postpone the proof of the Pliocene upheaval. We now come to the consideration of the two remaining elements—the antarctic and the north-temperate—and we have to inquire at what time they came.

The antarctic element, as we shall presently see, must have invaded New Zealand from the south. It consists of plants, sea-birds, freshwater fishes, marine fishes, marine Crustacea, and marine shells. There are also a few insects, such as the beetles *Heterodactylus* and *Pristancylus* of the Auckland Islands, but no land birds or land Mollusca. A very large portion of the north-temperate element no doubt came with the antarctic forms; for, as we saw in my last address, the percentage of endemic species of plants belonging to each element is almost identical. These probably travelled to the southern hemisphere by the chain of the Andes, and then spread with the Fuegian plants. But several of our plants, insects, and arachnids are allied to northern forms, and have no near relations in South America. These probably migrated to us direct by the mountains of the Indian archipelago at the same time that we were invaded by the Australian and Polynesian floras. This latter portion I shall leave out of consideration, and shall confine my attention solely to the invasion from the south by both the antarctic and north-temperate elements.

Now in dealing with this part of our fauna and flora we have to take into consideration two means of dispersal, at present going on, which are not found, or only to a very limited extent, in the tropical parts of the ocean. In the first place the almost constant westerly winds travelling round the globe in high southern latitudes cause an easterly current which must necessarily drift to great distances the detached masses of kelp which are commonly seen floating in these seas, and the kelp might easily convey marine Crustacea and Mollusca with it. In the second place the larger petrels range widely over the southern ocean, and might sometimes carry seeds in their plumage. I leave icebergs out of consideration, for they would not assist marine animals in migrating, and I do not see how any of our insects or freshwater fishes or the seeds of any of our flowering plants could get upon them. Capt. Cook thus describes the vegetation of South Georgia, between lats. 54° and 55° S.:—"Not a tree was to be seen, not a shrub even big enough to make a toothpick. The only vegetation we met with was a coarse strong-bladed grass, growing in tufts, wild burnet, and a plant like moss, which sprang from the rocks" *. No flowering plant

* 'Voyage round the World, 1772–75,' vol. ii. p. 213.

has been found south of 62° S. The most southerly land on which vegetation occurs is Cockburn Island, one of the South Shetlands, in lat. 64° 12′ S., and here there are but a few mosses and lichens. Sir J. Hooker landed on Possession Island, in 71° 56′ S., and on Franklin Island, in 76° 8′ S., and did not find a fragment of vegetation on either *.

But if marine currents, petrels, and the wind have been the only, or, indeed, the chief means of transport, we ought to find that the diffusion of plants and animals bears some relation to the distances of the land-masses from each other. Now the distance of South Africa from Tasmania is about the same as that of New Zealand from South America, and between Africa and Tasmania there are several possible halting-places; so that we should expect that the connexion of New Zealand with South Africa, brought about by these means, would at any rate be nearly as great as that between New Zealand and Patagonia. This is really the case in our marine fishes and marine Mollusca, in each of which about the same number of species belong to South Africa as to South America; while about six times as many are found in Tasmania, which is about one fifth of the distance of Patagonia and one sixth of the distance of the Cape of Good Hope. But such is by no means the case in the marine Crustacea, for here as many of our species are found in South America as in Australia, while only one third of the number occur in South Africa. The species of flowering plants common to New Zealand and antarctic South America are three times as many as those common to New Zealand and South Africa. The species of antarctic flowering plants (excluding the grasses) common to New Zealand and Australia (including Tasmania) are only twice as many as those common to New Zealand and South America, while the grasses are only three times as many. Even the sea-weeds do not agree in distribution with the marine fishes, for while the number of species common to New Zealand and South America is rather larger than the number common to New Zealand and South Africa, the species common to New Zealand and Australia are only about twice as numerous as those common to New Zealand and South America. The freshwater fishes show the same thing; five are common to New Zealand and Australia and two to New Zealand and South America. Evidently then the

* Icebergs are said to be formed in the Gulf of Penas, in Chili (lat. 47° S.); but such an isolated occurrence need not be taken into account in the dispersal of plants, for these icebergs could not drift far without melting.

communication between New Zealand and Patagonia has been easier for marine Crustacea, freshwater fishes, and plants at some former period than it is now; and this could only have been caused by some intermediate land having formerly existed.

This is quite in accordance with the opinion of Sir J. Hooker, who thinks that possibly the "plants of the Southern Ocean are the remains of a flora that had once spread over a larger and more continuous tract of land than now exists in that ocean, and that the peculiar antarctic genera and species may be the vestiges of a flora characterized by the predominance of plants which are now scattered throughout the southern islands" *. And again, "The supposition that more land formerly existed along the parallels between Fuegia and Kerguelen's Land, possibly in the form of islands, remains the forlorn hope of the botanical geographer" †. Mr. Moseley also considers more land to be necessary to account for the almost identical floras of Kerguelen's Land, the Crozets, and Marion Islands ‡; and Mr. Wallace comes to the same conclusion in his 'Island Life.'

As some doubt may still remain as to the necessity of supposing a greater extension of land in former times, it will be as well to compare the floras and faunas of New Zealand and Tasmania. We know that the high lands of both these places have never been submerged during the whole of the Tertiary era, and that, although at present separated by about 900 miles of ocean, they have probably approached to about 600 miles. A comparison therefore of their floras and faunas will furnish a very instructive example of the powers of dispersion of plants and animals across the sea.

Baron von Müller enumerates 948 species of Tasmanian flowering plants, while the South Island of New Zealand has 688 species, and of these 103 are common to both, *i. e.* about $6\frac{3}{4}$ per cent. of the whole. According to Dr. Buller's 'Manual' (1880) 97 land birds have been recorded from New Zealand. Of these 53 are perching birds and 44 are waders or rails. In Tasmania, according to Mr. E. P. Ramsay (1877), there are 107 land birds, viz. 78 perchers and 29 waders or rails. Of these only 6 perching birds § and 15 waders are common to both places. There have also been found in New Zealand 1 Australian perching bird (*Eurystomus pacificus*) and 7 waders,

* Flora Nov. Zeal., Intr. p. xxi (1853).

† Phil. Trans. vol. clxviii. p. 13 (1879).

‡ Linn. Journ. xv. p. 485.

§ *Circus Gouldii*, *Hylochelidon nigricans*, *Graucalus parvirostris*, *Zosterops cærulescens*, *Anthochæra carunculata*, and *Chalcites plagosus*.

none of which are known in Tasmania. Of these perching birds, *Z. cœrulescens* first appeared in New Zealand about thirty years ago; *H. nigricans*, *A. carunculata*, *E. pacificus*, and *G. parvirostris* are occasional stragglers, not naturalized; while *C. plagosus* migrates annually to and from Australia. There are also two freshwater fishes, both of which go to the sea to breed, common to Tasmania and New Zealand. No freshwater shells and no land-shells, with one doubtful exception *, are known to inhabit both places; no sphinx moths and but very few insects of any kind, some of which may have been introduced. If we were to include allied species, the list of plants would be increased, but not very much. On the other hand, some of the plants, birds, and insects may have migrated into both Tasmania and New Zealand from the north, and may never have crossed the intervening ocean; while some of the birds and insects may have been helped across by ships, and are not therefore fair examples of natural dispersal. On the whole we may well be astonished that, notwithstanding the strong westerly cyclones and the special facilities afforded by petrels, no animals except a few birds and insects and but few flowering plants have been able to cross this very ancient barrier of from 600 to 900 miles of ocean. This is the more remarkable when we remember that the floras of Kerguelen's Land, the Crozets, and Marion Islands are almost identical, although the islands are more widely separated than New Zealand is from Tasmania, and they are of much smaller dimensions. The conclusion is that this antarctic group of islands must either have been connected or else separated by channels much less than 600 miles across at some former period.

I have already said that the greater part of the north-temperate plants spread over the southern hemisphere with the antarctic plants; and there can be no doubt that they migrated from the north to the south along the great meridional chains of mountains in a "continuous current of vegetation," as first shown by Sir J. Hooker, and subsequently advocated by Sir C. Lyell, Darwin, and Wallace. But I think that too much stress has been laid on the necessity for a series of alternating glacial epochs in each hemisphere to enable the plants to pass over the equatorial regions. Mr.

* *Paryphanta Milligani.*—A large species with a wide aperture, living in damp woods, and not at all likely to stand a voyage. New Zealand and Tasmanian specimens have not been compared, and the dentition of both is unknown. In New Zealand the species has been found in one locality only.

Wallace, who is the latest exponent of this view, says that the "causes [which produced the continuous current of vegetation from north to south] were the repeated changes of climate, which, during all geological time, appear to have occurred in both hemispheres, culminating at rare intervals in glacial epochs, and which have been shown to depend upon changes of eccentricity of the earth's orbit and the occurrence of summer or winter in aphelion, in conjunction with the slower and more irregular changes of geographical conditions; these combined causes acting chiefly through the agency of heat-bearing oceanic currents and of snow-and-ice-collecting highlands" *.

An inhabitant of the southern hemisphere may well ask in surprise, "Where is the evidence for this comprehensive statement?" And Mr. Wallace himself, in the ninth chapter of his book, argues lucidly in favour of there having been no changes of any importance in the climate of the northern hemisphere between the Triassic and Pleistocene periods. All the information we obtain from Mr. Wallace is the following:—"That there was such a greater accumulation of ice [in the southern hemisphere] is shown by the traces of ancient glaciers in the Southern Andes and in New Zealand, and also, according to several writers, in South Africa, and the indications in all these localities point to a period so recent that it must almost certainly have been contemporaneous with the glacial period of the northern hemisphere" †. And further on he says, "We may further assume that what we know took place within the Arctic circle also took place in the Antarctic—that is, that there have been alternations of climate during which some portion of what are now ice-clad lands became able to support a considerable amount of vegetation" ‡. This is all I can find in Mr. Wallace's book, and it must be allowed that it is very unsatisfactory. Let us therefore try to estimate fairly what the evidence really is.

The only evidences in the south of former temperatures higher than at present are:—(1) The Miocene fauna which I discussed in my former address, and (2) The fossil trees of Kerguelen's Land and the Crozet Islands, which must once have formed part of a luxuriant forest. But at the present time Fuegia, which is considerably south of Kerguelen's Land, supports luxuriant forests §, and so also might the Crozet

* 'Island Life,' p. 484. † *Loc. cit.* p. 157.

‡ *Loc. cit.* p. 490.

§ Dr. Coppinger says that in the museum of Santiago there is a section

Islands and Kerguelen's Land if they were of larger extent. The influence of land in mitigating the effect of the icy ocean is well shown by a comparison of New Zealand with St. Paul's Island, in lat. 38° 10′ S., on which the largest tree is only a few inches in diameter. The Kerguelen trees therefore do not imply a higher temperature than at present, but only a greater extension of land, which we have already seen must at one time have existed. We now turn to the evidence of cold periods in the southern hemisphere, and we will take New Zealand first.

It was Dr. von Haast who first pointed out that the New-Zealand glaciers had been far more extensive at some former period than they are now*; and the evidence he brought forward has been admitted by all. For example, there is no doubt that at one time, not geologically remote, the glaciers of the Waimakariri and of the Rakaia reached the Canterbury Plains, and that a branch from the Upper Rakaia passed through Lake Heron and joined the glacier coming down the Rangitata. This former great extension of our glaciers has been aptly called by Dr. von Haast our "*Glacier* Epoch," to distinguish it from the "*Glacial* Epoch" of Europe, with which probably it had no connexion. But we have evidence of another and much earlier glacier epoch than the one just mentioned. At Lawrence, in Otago, there is a small rock-basin filled up with a conglomerate, the stones of which have come from the west, and some of them are distinctly marked by glacial striæ. This conglomerate can be traced in a south-east direction to the Tokomairiro Plains, proving that a glacier at one time descended a valley running from the Tapanui Mountains to Kaitangata, quite across the present drainage of the country. The lower part of this valley has been filled up with rocks of Oligocene age, and we have here, therefore, the proof of an Eocene glacier epoch †. At Wharekauri, or Big Gully Creek, in the valley of the Waitaki, there is also another rock-basin filled with Oligocene rocks; and at Castle Hill, on the road from Christchurch to Hokitika, there is evidence of a third and still earlier glacier epoch in a rock-basin, some eight miles long, which has been

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of a beech tree from Magellan which is more than 7 feet in diameter ('Cruise of the Alert,' p. 91).

* "Notes on the Geology of the Province of Canterbury," Cant. Proc. Gov. Gazette, 24th Oct. 1862.

† 'Geology of Otago,' p. 93, and Cox, Geol. Reports, 1878–9, p. 47.

partly filled by marine Upper Cretaceous rocks, upon which lie Oligocene and Miocene strata.

What now has been the cause of these three glacier epochs in New Zealand? Are we to attribute each of them to a general lowering of the temperature of the southern hemisphere—that is, to a true glacial epoch? Or are we to refer them to some other cause? According to Mr. Wallace our last glacier epoch was due to a general lowering of the temperature, brought about by changes in the eccentricity of the earth's orbit, in combination with geographical changes, as explained by Dr. Croll. It will therefore be necessary to say a word on this subject.

It is well known that, owing to the varying attractions of the planets, the mean annual velocity of the earth in its orbit is not the same year by year; and as the earth has to complete its annual revolution round the sun in a fixed time, the distance it travels in each year varies. When the mean velocity increases the orbit increases, and *vice versâ*. But as the length of the major axis of the orbit must remain constant, a greater or less length of orbit is obtained by an increase or decrease of the minor axis. So that when the average speed of the earth is great the orbit becomes more nearly circular, and when the average speed is small the orbit becomes more oval. But the sun must always occupy one of the foci of the orbit. Therefore as the orbit gets flatter the position of the sun continually recedes from the centre; or, in other words, the orbit gets more and more eccentric. As the annual amount of heat received by the earth from the sun varies inversely as the length of the minor axis, it follows that the greater the eccentricity the greater is the total amount of heat received from the sun. But when the eccentricity is great the earth is much nearer the sun in perihelion and further away from it in aphelion than when the eccentricity is small. Consequently that hemisphere of the earth which has its winter in aphelion and its summer in perihelion during a time of great eccentricity will have its seasons exaggerated, a long and very cold winter being followed by a short but very hot summer; while the other hemisphere will have a short warm winter followed by a long and cool summer. Owing, however, to the combined action of precession of the equinoxes and revolution of the apsides, the hemisphere which has its winter in aphelion is changed every 10,500 years, and as a period of great eccentricity will last longer than this, these alternations of climate will recur perhaps three or four times before the eccentricity is greatly diminished.

These facts, which have been well known for many years, were first brought prominently before geologists by Sir J. Herschel in his address to the Geological Society of London in 1832. From them we know that the earth's orbit has varied in past time, and we infer that these variations must have caused considerable changes in climate. But what these changes were and to what extent they were carried are speculative deductions from the laws of physics, and are difficult to verify. The well-known hypothesis of Dr. Croll was the first of these speculations. It is very ingenious and worked out with great skill; but it must of course be subject to all the complexities and uncertainties in which all meteorological phenomena are involved.

He maintains that the large quantity of snow that would fall in the winter of each year on that hemisphere whose winter was in aphelion would not be all melted during the hot but short summer that followed, and consequently it would accumulate year by year and bring on a glacial epoch. His reasons for thinking that the whole snowfall would not be melted in summer are:—(1) that, as snow can never rise in temperature above 32° F., the direct radiation from land covered with snow and ice would cool the air and lower the temperature of all surrounding bodies; (2) that the rays of the sun falling on the snow and ice would to a large extent be reflected back again into space; and (3) that thick fogs and cloudy skies would effectually prevent the rays of the sun from reaching the earth. If a reduction of the summer temperature by these means is allowed, he then urges that great changes would take place in the oceanic currents, which would tend still further to lower the temperature of that hemisphere on which snow was accumulating.

I need not allude to the objections that have been urged against this hypothesis. It is sufficient for my purpose to point out that, according to Dr. Croll himself, all depends upon the snow falling on land, for without land there will be no snow to radiate, to reflect, or to form fogs and clouds. Now in the antarctic regions there is no great extent of land that is not already covered with snow. During the long cold winter of a high eccentricity the snow would fall into the sea, would be melted, and work its way towards the equator. Consequently there would be no accumulation, and a high eccentricity would not bring on a glacial epoch in the southern hemisphere. On the contrary, greater cold would probably precipitate the moisture more to the north, and so lessen the snowfall in high antarctic latitudes where alone there is land.

Possibly therefore the ice would be reduced in quantity. Both Mr. Wallace and Dr. Croll * allow that high eccentricity alone would not bring on a glacial epoch unless the geographical conditions were favourable; and so they would no doubt allow on reconsideration that no severe glacial epoch could occur in the southern hemisphere under the present conditions. In New Zealand more snow might fall in winter, but probably it would be all melted again by the greater heat of summer; and, as the mean annual temperature would be higher with greater eccentricity, it is not likely that our glaciers would be much larger at that time than now. Under the present geographical conditions greater eccentricity might produce a greater precipitation of moisture in the form of snow or rain in winter and greater floods in summer, and therefore a diluvial epoch, but not a glacial epoch.

Now there is no reason to suppose that any very important geographical changes occurred in the southern hemisphere during the Pleistocene period; on the contrary, as will appear presently, the insular floras prove long isolation; but there are several reasons for thinking that a diluvial epoch has occurred in New Zealand at a comparatively late date—that is, during the depression which, as we shall presently see, followed our last great glacier epoch. These reasons I have lately given in a paper sent to the Geological Society†, and I need not reproduce them here; but the evidence is not confined to New Zealand alone.

The Pampæan formation of South America, so ably described by Darwin, which contains the remains of an enormous number of huge terrestrial mammals, is much like the so-called "loess formation" of Banks peninsula and Oamaru, and in both cases violent and often-recurring floods sweeping down to the sea torrents of mud and the bodies of drowned animals seem necessary to account for the phenomena. Also in a letter to me (dated June 1884) Prof. R. Tate says that strong evidence is afforded by the distribution of *Diprotodon* that Australia has passed through a pluvial period. So that there is evidence in New Zealand, in Australia, and in South America to show that the last high eccentricity of the earth's orbit may have produced in the southern hemisphere a diluvial epoch; but we shall see directly that there is no evidence at all of its having produced a glacial epoch ‡.

* Phil. Mag., Feb. 1883, p. 81.

† "Sketch of the Geology of New Zealand."

‡ For evidence of a diluvial epoch in South Africa see Stow, Quart. Journ. Geol. Soc. xxvii. p. 543.

Although there is no reason to suppose that any very important geographical changes occurred in the southern hemisphere during the Pleistocene period, it is almost certain that during earlier Tertiary times there was a greater extension of the antarctic continent between South America, South Africa, and New Zealand. What effect this had on climate is doubtful. According to Mr. Wallace it produced a long persistent more or less glaciated condition *; while Dr. Martin Duncan invokes the same antarctic continent as the cause of a warm Miocene sea.

Other hypotheses depending on cosmical causes, and therefore affecting the whole world—such as a change of obliquity in the ecliptic or a decrease in the heat derived from the sun—have been put forward to account for the European glacial epoch; but as these hypotheses have very few adherents, they need not be discussed here, especially as I believe it to be possible to bring forward sufficient evidence to prove that our great glacier epoch was not due to a general reduction of temperature in the southern hemisphere, and therefore was not due to any cosmical cause affecting the whole earth.

In the first place there is no palæontological evidence of any great change of climate in the southern hemisphere during the Pliocene and Pleistocene periods. In South America, according to Mr. Darwin, the raised beaches contain the same species of Mollusca as at present live in the neighbourhood. The same is the case in New Zealand both with the Pleistocene and Pliocene deposits; and no one has ever proved that any difference is to be found in South Africa. So the evidence of migration from polar regions towards the equator, which forms such a cogent part of the proof of a European glacial epoch, is altogether wanting in the southern hemisphere.

In the second place, our glaciers were always confined to valleys, and there is no proof that they ever reached the sea. There are no tills or boulder-clays and no stratified moraines. There are no true erratics, *i. e.* blocks brought from some other drainage-system, and no marine shells have ever been found in any of the glacier deposits, even in those which are now at the sea-level. Dr. von Haast certainly adduces the fact that marine shingle or sandspits are found *between* some of the moraines on the west coast of the South Island as a proof that those glaciers entered the sea †; but this might well be due to the subsidence after the glacier epoch, of which, as I shall presently point out, we have many independent

* 'Island Life,' p. 193.

† Geol. of Canterbury and Westland, p. 378.

proofs. If these glaciers had reached the sea, their moraines would show traces of having been deposited in water quite as much as the shingle spits between the moraines.

In the third place, the cold that would be necessary to bring back our glaciers to their former dimensions would be sufficient to exterminate throughout New Zealand all but the more cold-loving species of plants and animals *. But we find, as I showed in my last address, that the principal part of our subtropical fauna and flora was introduced before the Miocene period, and has flourished ever since. It has, however, been lately suggested that the survival of our terrestrial fauna and flora through a cold glacial epoch may have been due to the sea standing at that time at a lower level than at present, and so affording room for the plants and animals to retire to †. No doubt Sir W. Thomson has calculated that the ice-cap covering northern Europe and America during the glacial epoch might have caused, by its attraction, a rise of the ocean of some 380 feet at the north pole and a lowering to the same extent at the south pole ‡, and that the amount of water taken from the ocean to form the ice might have lowered the level 120 feet all over the world, thus reducing the rise at the north pole to perhaps 260 feet and increasing the fall at the south pole to 500 feet at most; that is, a fall of about 300 feet in the latitude of New Zealand. But this fall would occur when the ice-cap was on the northern hemisphere. If the ice-cap shifted to the south the ocean would stand about 70 feet *higher* instead of lower round our islands, and consequently there would be no low-lying land for the plants and animals to retreat to. It is no doubt true, as mentioned by Dr. A. Geikie, that the Pleistocene raised beaches and shore deposits of New Zealand indicate a greater elevation of the southern than of the northern parts of the country §; but our knowledge on this subject is not yet sufficiently exact to enable us to draw any conclusions. At present it appears as if these deposits indicated an elevation of 10 feet near Auckland,

* Trans. N. Z. Institute, viii. p. 385.

† Dr. v. Haast, Geol. of Canterbury and Westland, p. 381.

‡ Archdeacon Pratt and the Rev. O. Fisher make it more, but only on the supposition that the interior of the earth is fluid. Mr. Belt's calculations on this subject are of no value, as the enormous simultaneous ice-caps supposed by him to have occurred are quite incredible.

§ 'Text-book of Geology,' p. 280. Dr. von Haast, however, who is the authority quoted by Dr. Geikie, is of the opposite opinion. He says, "One fact, however, is certain—namely, that the land in Post-pliocene times in the northern part of the province [of Canterbury] along the east coast stood at a *lower* level than at the central and southern portions" (Geol. Cant. p. 366).

rising to 800 in Canterbury and Otago; and if this be true, the Pleistocene submergence could hardly be due to displacement of the sea caused by the attraction of an ice-cap on the south pole, for the rise is too great and too rapid.

That the former extension of our glaciers was not caused by a cold period is, I believe, acknowledged by all New-Zealand geologists, and also by the late Dr. von Hochstetter*. Instead of a glacial epoch four other hypotheses have been put forward to account for the phenomena:—(1) The first is the elevation of the land, in combination with a more plateau-like form of the mountains, which would thus collect more snow †. (2) The second is elevation, in combination with the subsidence below the sea of Central Australia ‡. (3) The third is the plateau hypothesis alone, the land being at the same level as now. It is supposed that these plateaux have been reduced to sharp ridges by the erosion of the glaciers, and thus the retreat of the glaciers is accounted for §. (4) The fourth is elevation alone, the retreat of the glaciers being caused by subsequent depression ||.

These hypotheses resolve themselves into three, viz. subsidence of Central Australia, broad plateaux, and elevation—taken either singly or in combination. We will examine each of them.

The subsidence hypothesis is thus explained by its author:—"One cause of the greater extent of the New-Zealand glaciers . . . . . is that the elevation of the New-Zealand mountains was probably coincident with the submergence of the low land in the interior of Australia, which is covered with a Post-pliocene marine formation. The equatorial north-west winds would thus impinge on the New-Zealand Alps without, as at present, being deprived of a large amount of their aqueous vapour by passing over the arid plains of Australia, and the

* 'New Zealand' (1867), p. 505.

† Hector, "Geological Expedition to the West Coast of Otago," 'Otago Provincial Gazette,' 5th Nov. 1863, and Trans. N. Z. Inst. vi. p. 374 (1873).

‡ Hector, in a letter to Sir J. Hooker, dated 15th July, 1864, in Lyell's 'Principles of Geology,' 12th ed. vol. i. p. 243; and Trans. N. Z. Institute, vi. p. 385 (1873).

§ Haast, Q. J. G. S. xxi. p. 135 (1864), and 'Geology of Canterbury and Westland,' pp. 372–4 (1879). In his 'Geology of Canterbury' (p. 376) Dr. v. Haast says that I was the former chief exponent of the theory that the extension of our glaciers occurred during a partial submergence of the land. I do not know to what Dr. v. Haast alludes. The submergence that I have always advocated was in the Pleistocene, after the glacier epoch was over.

|| Dobson, Trans. N. Z. Inst. iv. p. 340, and vi. p. 294; Travers, Trans. N. Z. Inst. vi. p. 299.

condensation of snow by the mountains would be therefore very much in excess, and consequently the glaciers much larger than at present" *. This hypothesis is similar to one long ago proposed to account for the former extension of the Swiss glaciers by the submergence of the Sahara. But in our case it has been shown that the hot north-west winds, as well as the cold south-west winds, are parts of westerly cyclones †, and that they are saturated with moisture when they reach New Zealand. That our north-west winds owe their heat and dryness to local causes and not to the arid plains of Australia has been explained by Dr. Knight ‡ and by Mr. Barkas §. The subsidence of Central Australia might possibly decrease their temperature and therefore *decrease* the amount of aqueous vapour held by them; but this could not possibly increase the amount of snow on the mountains.

The plateau hypothesis was proposed many years ago by Rendu to account for the former extension of the glaciers of Switzerland; but it never obtained many adherents. It was shown that the effect of plateaux is to diminish, not to increase, the size of glaciers; and Prof. J. D. Forbes cites in proof the fact that, while the snowfall in both places is about the same, "the largest glacier in Norway (Lodal) may be rudely estimated to have only *one seventh* of the surface of the Aletsch glacier of Switzerland, tributaries in both cases being excluded; but the snow-field connected with it may cover 400 English square miles at least, which probably exceeds in extent anything in the Alps. The perpetual snows of the Fondalen are much larger, and those of Sulitelma not inferior" ‖. The size of glaciers therefore is not proportional to the size of their snow-fields, as supposed by the advocates of the plateau hypothesis. Neither is the denuding power of the snow so great as supposed. Of course the snow-fields themselves *preserve* the rocks that lie below them; it is only when the snow gets pressed into ice and begins to descend the valleys that any erosion can take place; but even this erosion has, I think, been greatly over-estimated by the advocates of the plateau hypothesis. On this point I gladly avail myself of the opinion of Sir A. Ramsay, whom no one will accuse of underrating the amount of glacier erosion. In a discussion at a meeting of the Geological Society of London

* Trans. N. Z. Inst. vi. p. 385.

† "On the Principles of New Zealand Weather Forecast," by Commander Edwin, R.N., Trans. N. Z. Inst. xii. p. 40.

‡ Trans. N. Z. Inst. vii. p. 470.

§ N. Z. Journ. of Science, i. p. 576.

‖ 'Norway and its Glaciers,' p. 232.

in 1875 he said that "he thought that the effects of glacial action had been immensely exaggerated, and believed that all the great features of the country existed before the glacial period;" * and in the following year, in his paper on the history of the river Dee, he says that "by far the greater part of the valley-excavating work was performed between Permian and Pre-glacial times, and that the work of the glaciers of the latter period somewhat deepened, widened, smoothed, and striated the outlines of the mountains and valleys, and excavated many rock-bound lake-basins, but on a grand scale did not effect any great changes in the pre-existing larger contours of the country" †.

In our own case we must remember that, even if glacier erosion is as great as claimed by the advocates of the plateau hypothesis, there have been in New Zealand, in the Lower Cretaceous and Eocene periods, two earlier and probably quite as extensive glacier epochs, which must have reduced to ridges the supposed plateau, if it ever existed. We must also remember that the New-Zealand Alps have been undergoing subaerial denudation without interruption from the Jurassic period to the present day; and we have conclusive proofs that most of the valleys had been hollowed out nearly as deeply as now in the Eocene period, because we find all the large river-basins partly filled with Oligocene, or, in some cases, even with Upper-Cretaceous rocks. I will limit myself to one example in illustration. In the middle Rakaia, on the right bank of the river opposite the south end of Lake Coleridge, there is an outlier of Oligocene Limestone, called Red Cliff. It is lying in its original plane of deposition, and is no doubt a fragment of a set of beds which once filled all this part of the valley. At present it is restricted to a patch occupying a sheltered side valley on the south side of the river; but it again appears at the river-bed as an apparently detached fragment separated from the main mass in the valley by river-gravels. This isolated portion is known as Castle Rock. Now the first thing to be noticed is that this Oligocene limestone descends to below the present level of the river, proving conclusively that the Rakaia is now running at a higher level than it did in the Eocene period before the limestone was deposited. The second thing to be noticed is that the junction up the side valley between the limestone and the Palæozoic rocks on which it rests must mark the limit of the

* Quart. Journ. Geol. Soc. xxxii. p. 204.

† Quart. Journ. Geol. Soc. xxxii. p. 227. See also Dr. Knight, in Trans. N. Z. Inst. vii. p. 479.

Rakaia valley at the time when the limestone was deposited. If therefore any great lateral denudation had taken place since that time, the line of junction ought to stand out as a prominence. But, on the contrary, it is in a valley, apparently much in the same position with regard to the other parts of the valley as when the limestone was formed. Consequently no great plateau on the south of the Rakaia can have been removed.

Many other instances could be cited, but this one must suffice, for it alone is sufficient proof that the denudation which has taken place during the comparatively short time that has elapsed since the commencement of our last great glacier epoch cannot have affected the shape of the mountains to such an extent as to make it worth while to take this cause into consideration, even if it acted in the direction supposed. That the large river-valleys were more or less filled to a height of 3000 or 4000 feet above the present sea-level by Tertiary rocks, most of which have been since removed, is no doubt true; but as this is below the line of perpetual snow, which is estimated by Dr. von Haast and Mr. M'Kerrow to be between 7000 and 8000 feet, this filling up of the valleys, if it affected the level of the snow-line at all, would raise it by radiation in the same way that the plateau of Thibet raises the height of the snow-line on the northern slopes of the Himalaya.

As therefore both the subsidence- and the plateau-hypotheses are quite untenable, we must fall back on elevation of the land as the main if not the only cause of the former extension of our glaciers; and it is strongly confirmatory of this hypothesis that the two earlier glacier epochs each occurred at a time when we have independent proof that the land stood at a far greater height than at present. With regard to the last glacier epoch, it has been estimated that an elevation of between 3000 and 4000 feet would be quite sufficient to bring back the glaciers to their former dimensions *.

But if our last glacier epoch was caused by elevation of the land, it is easy to prove that it must be of an older date than the glacial epoch of Europe, because while our islands are separated by a strait only 500 feet deep, the difference between their floras and faunas is far greater than the difference between the floras and faunas of England and Europe, which were separated in the Pleistocene period immediately after the glacial epoch. In the South Island we have six different kinds of birds represented by different species in the North

* Trans. N. Z. Inst. xiii. p. 385.

Island*, and this cannot be due to difference of climate, because some parts of the South Island are further north than parts of the North Island. Of the plants I am not competent to speak, but a comparison of the floras on each side of Cook's Strait would be of great interest †. Consequently the two islands of New Zealand must have been separated during, at least, the whole of the Pleistocene period. But an elevation of 500 feet would join them, and an elevation of 1100 feet would lay bare the whole of Cook's Strait, so that we are driven to the conclusion that this amount of elevation has not occurred during the Pleistocene period, and consequently our glacier epoch must have been earlier than the European glacial epoch. On the other hand, the similarity of the land-shells, insects, plants, birds, &c. forbids our placing the last separation before the Pliocene. That is to say, New Zealand must have stood more than 500 feet higher than at present during some part of the Pliocene period; for, if not, the plants and animals on the two islands would have been more differentiated than they are.

But there is other and independent evidence that our glacier epoch is older than the glacial epoch of Europe and North America. First, there are the glacier phenomena themselves. Several of the older lakes, such as those of the Rakaia and of the central parts of Otago, have been completely filled up; while others, such as the lake in the Upper Dillon, Lake Heron, Lake Tekapo, and Lake Pukaki, are approaching their end. Glacier striæ are generally absent, although the rocks still retain their rounded form; and in the district of Central Otago masses of rock 10 or 12 feet in thickness have been removed from the mountains by ordinary atmospheric weathering since the ice passed over them ‡. In the second place, the drainage-system has been much altered since the glacier epoch; the gorges of the Kawarau, Dunstan, Mataura, and Upper Taieri in Otago §, and that of the South Ashburton in Canterbury, having been entirely cut since then.

* South Island.		North Island.
Myiomoira macrocephala	represented by	*M. toitoi.*
Myioscopus albifrons	,,	*M. longipes.*
Turnagra crassirostris	,,	*T. Hectori.*
Glaucopis cinerea	,,	*G. Wilsoni.*
Ocydromus australis	,,	*O. Earli.*
Apteryx australis	,,	*A. Mantelli.*

† In the Trans. N. Z. Inst. xvi. p. 466, Mr. W. T. L. Travers gives an interesting table showing the distribution between the islands of sixteen genera of plants; but as no attempt is made to distinguish the differences due to different station and climate from those due to isolation, it is not available for my present purpose.

‡ 'Geology of Otago,' p. 91. § *Ibid.* p. 94.

Let us now see what palæontological evidence there is to fix the date of this upheaval. Marine strata belonging to the Pareora system, and containing, so far as we know at present, from 20 to 45 per cent. of living species of Mollusca, are found throughout New Zealand from Southland to Auckland. These may be considered as of Miocene age. The next series, in ascending order, shows a very different assemblage of fossils. It is called the Wanganui system, and is widely spread over the North Island. The marine beds contain a number of shells, of which from 70 to 90 per cent. are still living. This system must therefore be referred to the newer Pliocene. No fossiliferous marine rocks of this system are known as yet in the South Island, but it is represented by thick masses of unfossiliferous gravels. Marine deposits with shells of still living species, and therefore of Pleistocene age, are found at various places in both islands, from Auckland to Oamaru and Dunedin*, and, in addition, there are many unfossiliferous shore-deposits and other indications that a gradual elevation was going on during the whole of the Pleistocene period all round the coasts south of Auckland. While therefore we have ample evidence in fossiliferous rocks that the land stood at a lower level than at present during the Miocene, Newer Pliocene, and Pleistocene periods, there is a break in our geological record in the Older Pliocene of which we have no trace in marine strata. This can only be accounted for by one of two suppositions: either (1) that all the beds of that age have been covered up or have been removed by denudation; or (2) that during this period New Zealand stood at a higher level than at present, in which case the marine beds would be deposited at a level which is now below the sea, and consequently inaccessible to us. As we have both Miocene and Newer Pliocene beds in abundance, there is no reason for thinking that the first supposition is correct; while we have good reasons, in the distribution of our fauna and in our old glacier marks, for believing that New Zealand was considerably elevated in the Pliocene period. The conclusion therefore is, that our last great glacier epoch was caused by an elevation of the land that took place during the Older Pliocene; or, more precisely, in the interval between the marine beds of the Pareora and Wanganui systems. Possibly this elevation may have continued in the South Island during the whole of the Pliocene, but it was certainly over before the advent of the Pleistocene. In my address

* See Trans. N. Z. Inst. v. p. 387; 'Geology of Otago,' pp. 70, 78; M'Kay, Geol. Reports, 1878–79, p. 84; Von Haast, 'Geology of Canterbury,' p. 366; Percy Smith, Trans. N. Z. Inst. xiii. p. 398.

last year I mentioned this elevation as necessary to explain the flora of the Kermadec Islands, but I had to postpone the proofs of it until now.

It appears therefore that, so far as New Zealand is concerned, Mr. Wallace is incorrect in his statement already quoted, that the traces of ancient glaciers "point to a period so recent that it must almost certainly have been contemporaneous with the glacial epoch of the northern hemisphere."

Let us now turn to Australia. In Tasmania there appear to be several glacier lakes, but I have seen no description of any moraines. Lake Omeo, in the Australian Alps, may also have had the same origin; but it must not be forgotten that in a dry climate like Australia the wind may excavate rock-basins. A glacial epoch, however, is not required to account for rock-basins among mountains. Whether Australia has undergone the rigours of a glacial epoch is a moot question with Australian geologists. Mr. Tenison-Woods* and Mr. Howitt† can find no traces of it; while Prof. R. Tate is of the contrary opinion, and instances striated rock-surfaces and small granite erratics *on the beach* at Black Point, Holdfast Bay, near Adelaide‡, but he considers all these to be of Pliocene age. This is in lat. 35° S., only one degree south of Sydney. Prof. Tate also describes parallel grooves and scratches running east and west in the rocks in the bed of the Inman, Cape Jarvis; and on these grooves Mr. Selwyn had previously remarked that they strongly reminded him of similar grooves he had so frequently seen in the mountains of North Wales. Mr. G. S. Griffiths has also lately read a paper to the Royal Society of Victoria, "On the Evidences of a Glacier Epoch in Victoria during Post-Miocene Times." Mr. Griffiths allows that the evidence is not altogether satisfactory, consisting as it chiefly does of the wide distribution of clays with gravels and boulders, for the most part well water-worn; but he considers that a *Pliocene* glaciation offers the best explanation of the facts. If the glacial theory is rejected, he says, "we shall have to believe that since the Pliocene era commenced Victoria has been elevated and depressed to a considerable extent at least five or six times" (p. 26). It seems to me, however, that one subsidence, varied with several slight upward oscillations, is all that is required; and as in Victoria marine Pliocene rocks occur up to 1720 feet above the sea§,

* Proc. Linn. Soc. of N. S. Wales, vii. p. 382.

† Quart. Journ. Geol. Soc. xxxv. p. 35.

‡ Trans. Roy. Soc. S. Australia, 1878–79, Anniversary Address.

§ Lock's 'Gold,' p. 931, quoted by Mr. Griffiths, p. 22.

I think that this last hypothesis presents far fewer difficulties than the former, especially when we remember that there are no true glacial phenomena in New Zealand. It is indeed hard to believe that these supposed glacial marks are due to a general cold period in the southern hemisphere; for if such had been the case the South Island of New Zealand must have been covered with snow and ice, and almost all life would have been destroyed, a supposition which Mr. W. T. L. Travers has shown it is impossible for us to allow*.

We come now to South Africa. Mr. Wallace says that, "according to several writers," there are traces of ancient glaciers in the Transvaal. But so far as I know only two writers (Mr. Stow and Capt. Aylward) have expressed this opinion from a personal knowledge of the country; and Mr. Wallace has forgotten to mention that, at the meeting of the Geological Society at which Mr. Stow's paper was read, Mr. Griesbach, who had examined the district, "disputed the possibility of any of the gravels (of the Vaal) being of glacial origin"†. Again, Mr. Wallace says that "we have here *all* the chief surface phenomena characteristic of a glaciated country"‡. But this is not quite correct. The only phenomena mentioned are striations, rounded hills, and unstratified gravels and clays, with boulders, called by Mr. Wallace morainic matter. There are no perched blocks, no terminal moraines, no glacier lakes. Now rounded hills occur in many places where no ice has ever been, various marks have often been mistaken for glacial striæ, and tumultuous accumulations of gravel with boulders occur in all mountainous countries liable to floods. The only unmistakable evidences of ancient glacier action—viz. terminal moraines and lakes—are absent. It is true that Dr. Shaw mentions abundant lacustrine deposits along the Vaal River§, and these may occupy old glacier lakes. But if so, these deposits clearly do not "point to a period so recent that it must almost certainly have been contemporaneous with the glacial period of the northern hemisphere." On the contrary, they point to a time older, perhaps, than the glacier epoch of New Zealand. There is also another and quite distinct line of argument, which leads to exactly the same conclusion. The mountain-system of the Transvaal, in lat. 25° S. to 27° S., may be compared to the New-Zealand Alps, between the latitudes 44° S. and 45° S. The South-African mountains are certainly not higher,

* Trans. N. Z. Inst. vii. p. 409.
† Quart. Journ. Geol. Soc. xxviii. p. 27.
‡ 'Island Life,' p. 158, footnote.
§ Quart. Journ. Geol. Soc. xxviii. p. 26.

and the rainfall on them is certainly not greater. But this portion of the New-Zealand Alps has no glaciers at all comparable to the large ones supposed to have formerly existed in the Transvaal, although it is 18° further south, and is much nearer to the sea, so that a reduction of temperature sufficient to bring glaciers to the Transvaal would be equivalent to moving it *at least* 20° further south. Now Kerguelen Land, situated in 48° S., would also be virtually removed 20° further south —that is to a latitude where, as I have already mentioned, no vegetation, except perhaps a few mosses and lichens, could exist. If this has been so, the whole of its present phanerogamic flora must have been introduced since this glacial epoch. But as out of its twenty-one species of flowering plants there are two genera and eleven species found only there or in the neighbouring islands, we cannot suppose that its flora dates from the Pleistocene. Consequently this glacial epoch, if it ever took place, must have been long anterior to the glacial epoch of Europe.

Proofs of a former extension of glaciers undoubtedly occur in South America as far north as 42° S., which is about the northerly limit of glacier-marks in New Zealand. But in South America there is no evidence as to their date. This is, however, unnecessary, for we have already seen that the ancient glaciers of New Zealand, of Australia, and of South Africa (if any) belong to periods very different from the glacial epoch of Europe. Mr. Wallace therefore was hardly justified in assuming, without making a personal examination, that "the close similarity in the state of preservation of the ice-marks and the known activity of denudation as a destroying agent, forbid the idea that they belong to widely separated epochs"*; and consequently his argument that "if we reject the influence of high eccentricity as the cause of this almost universal glaciation, we must postulate a general elevation of *all* these mountains about the same time"†, falls to the ground.

I believe that almost all New-Zealand geologists are now agreed that our last great glacier epoch was in the Pliocene period‡; and it seems that an elevation of the land in Pliocene times affords the only satisfactory explanation of the phenomena. The question now arises, Did the Pliocene extension of land-area include the outlying islands? This is a

* 'Island Life,' p. 504. † *Loc. cit.* p. 504.

‡ Travers, Trans. N. Z. Inst. vi. p. 302; Dr. von Haast, Geol. of Canterbury, p. 372; Dr. Hector, Geol. Reports, 1883, p. xiii; S. H. Cox, Geol. Reports, 1883, p. 9. Mr. Dobson alone would put it later, Trans. N. Z. Inst. vii. p. 440.

question which has been lately much discussed in France. M. Blanchard maintains that all were included; M. Alph. Milne-Edwards thinks that the Chatham Islands only were connected with New Zealand; and Dr. H. Filhol, while allowing a former land extending down to the Auckland Islands, doubts whether Campbell Island ever formed part of it *, his reasons being partly geological considerations which compel him to think that this island only appeared above the sea at the close of the Pliocene, and partly the absence of all land-birds and lizards. Mr. Wallace says, "Whether this early land extended eastward to the Chathams and southward to the Macquaries we have no means of ascertaining; but as the intervening sea appears to be not more than about 1500 fathoms deep, it is quite possible that such an amount of subsidence may have occurred "†. To try to form an opinion of our own we must examine the faunas and floras of these islands.

Chatham Islands.—Distant 400 miles from New Zealand, the fundamental rock of the main island is a micaceous slate ‡, upon which lie Miocene limestone and volcanic rocks. Pitt's Island is composed of volcanic rocks and limestone, with some lignite and shale. It is more than 600 feet high, while the main island does not attain to that altitude. There appear to be no raised beaches or other signs of recent elevation §. There are twenty-one species of land-birds, of which six are endemic, and of these four are representatives of New-Zealand species ‖. The gold cuckoo is identical with that of New Zealand and Australia. It migrates annually to and from the islands, and Mr. Potts informs me that it has been seen on the beach at the north-west point of the island, quite exhausted and wet with sea-spray. This was in October, the month in which the bird always arrives. There is, I believe, no proof that *Apteryx*, *Stringops*, or *Ocydromus* ever lived on these islands, and no moa-bones have been found there. But on Pitt's Island there is a flightless rail (*Cabalus modestus*)

* See N. Z. Journ. of Sci. i. pp. 251, 259.
† 'Island Life,' p. 455.
‡ Haast, Trans. N. Z. Inst. i. p. 180.
§ Travers, Trans. N. Z. Inst. iv. p. 63.

‖

Chatham Islands.		New Zealand.
Anthornis melanocephala	represents	*A. melanura.*
Sphenœacus rufescens	"	*S. punctatus.*
Gerygone albofrontata	"	*G. igata.*
Myioscopus Traversi	"	*M. albifrons.*
Rallus Dieffenbachii.		
Cabalus modestus.		

allied to *Ocydromus*. There is one species of lizard on Pitt's Island, identical, I believe, with the common *Mocoa zelandica*. Also a slug (*Janella bitentaculata*) and a land-shell (*Thalassia neozelanica*), both of which are common in New Zealand. The flora has been tabulated by Mr. Buchanan in Trans. N. Z. Inst. vol. vii. From this list I find that sixty-seven species of flowering plants are known, of which twelve, or 18 per cent., are endemic. There is also one endemic genus.

Now, when we remember that no lizards or land-shells have passed between Tasmania and New Zealand, and that very few plants are common to the two, although the distance is not much more than twice that of the Chatham Islands, it becomes evident that our connexion with these islands must at one time have been much closer than it is now; and the presence of the flightless rail and the slug point strongly to an absolute connexion between the two lands. This is again confirmed by the occurrence of the migratory cuckoo; for, as Mr. Darwin has pointed out, there are no migratory birds on true oceanic islands, that is on islands which have never formed part of the main land *.

The Antipodes Islands.—Distant from New Zealand 450 miles. They appear to be entirely volcanic, and attain an elevation of 700 feet. The only land-bird known is a paroquet, and the only plant known is *Phormium tenax*.

Auckland Islands.—Distant from New Zealand 240 miles. According to Dr. Hector these islands are composed of granite, with Tertiary sandstones, lignite, and volcanic rocks †. They rise to 2000 feet above the sea. The land-birds are *Harpa novæ zealandiæ*, *Anthornis melanura*, *Myiomoira macrocephala*, *Myioscopus albifrons*, *Anthus novæ zealandiæ*, *Platycercus novæ zealandiæ*, var. *aucklandicus*, *P. auriceps*, and a rail said to be identical with *R. brachipus* of Tasmania. There is also a flightless duck (*Nesonetta aucklandica*), belonging to an endemic genus, and a species of *Mergus*. There is a slug (*Janella bitentaculata*), and three species of land-shells (*Patula unguiculus*, *Amphidoxa zebra*, and *Thalassia neozelanica*, var. *antipoda* and var. *aucklandica*). All but the last variety occur in New Zealand.

Campbell Island.—Distant from New Zealand 420 miles. According to Dr. Hector, the rocks are blue slate and sandstone, like our Lower Mesozoic beds, as well as chalk with flints, and volcanic rocks‡. Dr. H. Filhol, however, does not mention any sedimentary rocks except limestone. Its highest

* Appendix to Mr. Romanes's 'Mental Evolution in Animals,' p. 359, footnote.

† Trans. N. Z. Inst. ii. p. 179.

‡ *Ibid.* p. 176.

point is 1600 feet above the sea. According to Mr. H. Armstrong, a ground-lark and a small bird like a wren (probably *Zosterops*) are found here, but Dr. Filhol saw no land-birds. It has one endemic land-shell (*Helix campbellica*), and two endemic flowering plants.

Macquarie Island.—Distant from New Zealand 600 miles. The rocks are said to be greenstone, sometimes veined with quartz, occasionally amygdaloidal, and containing mesotype and analcime*. The land-birds are *Platycercus novæ zealandiæ*, var. *erythrotis*, an endemic rail (*Rallus* (?) *macquariensis*), and a species of *Ocydromus* (probably *O. brachypterus*).

The floras of the southern group of islands—Auckland, Campbell, and Macquarie—are so closely connected that they must be taken together. They have between them 111 species of flowering plants, of which 25—*i. e.* 22 per cent.—are endemic. There is also one endemic genus and seven antarctic species, which are not known from New Zealand. We may therefore conclude that the evidence given by the birds and land-mollusca is decidedly in favour of the Auckland Islands and Macquarie Island having been connected with New Zealand. Whether Campbell Island formed part of this land, or whether it dates from a still later time, may remain for the present an open question. But the possession of an apparently endemic species of land-shell and two endemic species of flowering plants is in favour of the former supposition. It is remarkable that the floras of the Chatham Islands and of the southern group of islands have each become differentiated by about the same amount, and we must infer from this fact that their isolation from New Zealand was pretty nearly contemporaneous. I mentioned in my last address that the flora of the Kermadec Islands, judging from the very scanty collections that have been made there, contains only 14 per cent. of endemic species, and its isolation may therefore date from about the same time. It appears probable that all were connected, or nearly connected, with New Zealand during the Pliocene period; and, if this be correct, it follows that the differentiation of the flora since then has been about 20 per cent., which is not very different from the rate of change in the marine mollusca.

We now come to the question, By what route did the antarctic plants reach New Zealand? As the Auckland Islands, Campbell Island, and Macquarie Island all contain antarctic species which do not occur in New Zealand, it is evident that their floras are not altogether derived from New Zealand, but that the antarctic plants came through them and

* Prof. Scott, Trans. N. Z. Inst. xv. p. 487.

spread northward. It is true that there are also antarctic species in New Zealand which are not found in the southern islands; but this is only what we should expect, when we consider the relative size of the places, and reflect that these islands are merely the remains of a more extensive land. But granting that these plants came to New Zealand from the south, did they spread from South America to the east or to the west? Mr. Wallace says that the route by which the Fuegian plants may have reached New Zealand is "easily marked off." It is by South Shetland Islands, Graham's Island, the Antarctic Continent to Victoria Land, thence to Adelie Island, Young Island, and Macquarie Island *—thus passing from Graham's Land in a westerly direction at the high latitude of more than 70° S. to Victoria Land, along a coast where no vegetation now exists. He gives, however, no reasons for adopting this route, and it does not seem to be quite consistent with his previously expressed opinion of a "long-persistent more or less glaciated condition" of the southern hemisphere. On the other hand, Sir J. Hooker points out that there are five groups of islands between Fuegia and Kerguelen Land, then none to Macquarie and Campbell Islands, and none across the whole Pacific Ocean from Campbell Island to Fuegia. He says that "Tierra del Fuego and the neighbouring southern extremity of the American continent appear to be the region of whose botanical peculiarities all the other antarctic islands, except those in the vicinity of New Zealand, more or less evidently partake. It presents a flora characterizing isolated groups of islands extending 5000 miles to the eastward of its own position. Some of these detached spots are much closer to the African and Australian continents, whose vegetation they do not assume, than to the American, and they are all situated in latitudes and under circumstances eminently unfavourable to the migration of species, save that their position relatively to Fuegia is in the same direction as that of the violent and prevailing westerly winds"†. But in a footnote he says that too much stress has been laid upon winds in spreading plants, pointing out that both in the Pacific and in the North Atlantic plants have spread against the prevailing wind.

Of the form of the basin of the Southern Ocean we know very little; but it appears to be shallow, getting deeper towards the north. The 2000-fathom line passes close to Cape

* 'Island Life,' p. 489.

† 'Flora Antarctica,' ii. p. 211.

Horn, but keeps some distance to the south of the Cape of Good Hope. Tristan d'Acunha and Kerguelen Land stand upon submarine plateaux which extend nearly to lat. 30° S., but it is uncertain whether either of them is connected with the antarctic plateau which surrounds the pole. The New-Zealand plateau is said by Mr. Wallace to be connected with the antarctic plateau; but other geographers make a deep channel between Campbell Island and Macquarie Island, and another south of Macquarie Island. From what is known of the geology of the antarctic islands it appears that all are volcanic, except South Georgia, which is part of an old slate-mountain range, and Kerguelen Land.

If we examine the faunas and floras of the islands along this track we find that Tristan d'Acunha, although three times as far from Fuegia as it is from the Cape of Good Hope, has its flora much more nearly allied to that of Fuegia than to that of Africa. Kerguelen Land also has its flora much more related to that of Fuegia than to that of the Auckland Islands, although the distance is half as far again. This island has also fifty-eight species of marine mollusca, of which thirteen are found in South America, six or seven in New Zealand, and only four at the Cape of Good Hope; and it has one endemic land-shell—*Helix Hookeri*. Its fauna and flora must therefore have come from the west and passed on by the east to New Zealand. We have already seen, in the early part of this address, that more land communication than at present exists is necessary to explain the migration of the antarctic fauna and flora; and we have therefore in the antarctic plateau, stretching from near South America in an easterly direction to Victoria Land, and either connected with, or but slightly separated from, land that extended to 30° S. in the South Atlantic and Indian Oceans, the probable position of the continent along which the migration took place, but which was always separated from New Zealand by a broad and deep channel south of Macquarie Island.

There remains now only the question, What was the date of this migration into New Zealand? It is evident that it could not have taken place, as a whole, in the Pliocene or later, because we have already seen that the floras of the outlying islands have only differentiated some 20 per cent. in species since the Pliocene; while the New-Zealand antarctic flora, as I mentioned in my last address, has differentiated by about 65 per cent. in the species. Also it must, as a whole, have been before the Eocene, as since then the differentiation of species has been at least 90 per cent. The main immigration must therefore have taken place either in the Miocene, when New Zealand was reduced to a number of islands*, or else part must have arrived in the Pliocene and part in the Eocene, at both of which times New Zealand extended much further to the south. Let us try to see which of the two is the more probable.

It would be a great mistake to suppose that our alpine flora is almost exclusively composed of plants of antarctic or north-temperate origin. Of 189 species of alpine plants belonging to 64 genera, I find that 48 per cent. are of antarctic (including north-temperate) origin, 37 per cent. are subtropical, and 15 per cent. belong to endemic genera. As about 44 per cent. of the total flora is antarctic, 48 per cent. subtropical, and 18 per cent. endemic, it would appear that the special adaptation of antarctic plants to cold regions has not availed them very much. For, composing 44 per cent. of the whole vegetation, they have only attained to 48 per cent. of the alpine flora. Some of our alpine species belong to quite subtropical genera, as *Myrsine*, *Cyathodes*, *Dacrydium*, and *Phyllocladus*; but there is no large genus in New Zealand that is not represented by alpine forms. On the other hand, only about 35 per cent. of the antarctic species are alpines, the other 65 per cent. living on the lowlands; and out of 56 antarctic genera, about one half have no alpine species at all. Again, out of 189 New-Zealand alpine species only 13 are found elsewhere (9 in Australia or Tasmania, and 4 in Fuegia) so that 93 per cent. are endemic. Out of 64 alpine genera only 17 are confined to the Alps, and 7 of these are endemic. These facts show that our alpine flora has, on the whole, grown out of the lowland flora, and that the arrival of alpines, as alpines, has been quite exceptional. The ancestral forms have arrived on the lowlands and their descendants have gradually worked their way up the mountains. Mr. Wallace has remarked that alpine plants are particularly well placed for dispersal, on account of the high winds so common in mountains. This is quite true, and explains their migration from mountain-top to mountain-top along a chain; but it will not apply to the spread of plants to distant islands, because, although more seeds of alpine than of lowland plants would be blown away, all would arrive on the island at or near sea-level, and thus the alpines would not find their accustomed station, while the fewer seeds blown or carried by birds from lower levels would have a better chance of living

* There is evidence that an elevation occurred between the deposition of the Oamaru and Pareora systems; but this elevation was slight, and New Zealand was probably of no greater extent at that time than it is now.

in their new home. Alpine plants might succeed if they were blown into higher latitudes, but they would have less chance than lowland plants in a migration towards the equator. So that in the case of a migration between New Zealand and an antarctic continent, alpine plants of the former would more readily pass to the latter than the antarctic plants to New Zealand.

From these considerations it appears evident that antarctic plants would have but a slight chance of establishing themselves in New Zealand if it were of smaller dimensions than at present, and especially if the surrounding seas were warmer, as appears to have been the case in the Oligocene and Miocene periods. These plants must therefore have come either during cold periods, of which there is no evidence, or else they must have come during those periods of elevation in which New Zealand stretched more to the south. This last supposition is certainly the more reasonable, and it agrees well with the proportion of endemic species found in the antarctic and north-temperate elements. There must therefore have been a greater continuity of land between Fuegia, Kerguelen Land, and New Zealand in both the Eocene and the Pliocene than there is now. Whether this land was always a series of islands, as it must have been in its earlier and its later stages, or whether it once was nearly continuous, is a matter of speculation. Of the twenty-one species of flowering plants of Kerguelen Land, three (or 14 per cent.) are found there only; while eleven (or 50 per cent.) are confined to Kerguelen, the Crozets, Marion Island, and Heard Island. I should therefore judge, from what we know of the flora of New Zealand, that this group of islands separated from Fuegia in the Miocene, and that the islands themselves were not separated from each other until late in the Pliocene. The distribution of the petrels also points to the ancient date of the present oceanic conditions of the southern hemisphere. It is the only group of birds which has originated in the south and spread to the north. The albatross, fulmar, and shearwater of the north are all representatives of southern species, while the south has several genera not represented at all in the north—e. g. *Ossifraga*, *Pterodroma*, *Daption*, *Prion*, *Pelecanoides*. The only genus better developed in the north than in the south is that of the shearwaters (*Puffinus*), which is hardly ever seen out of sight of land. All the truly oceanic petrels are of southern origin*. From this it seems probable that an antarctic continent south of Africa, and including Tristan d'Acunha and Kerguelen Land, may have existed

* Hutton, 'Ibis,' 1865.

from the Eocene to the Pliocene period, that it was submerged before the Pleistocene, and that we now see remnants of it in Graham's Land, Enderby Land, and Victoria Land. During the time this land existed it is possible that colder and warmer periods may have occurred when the eccentricity of the earth's orbit was great; but this I consider a mere speculation unsupported by any evidence, for changes of climate are not required to account for any of the phenomena.

It is evident from what has been said, that the north-temperate plants came to New Zealand before the Pleistocene period, and consequently they could not have migrated along the Andes during the glacial epoch of Europe. Either there have been many other glacial epochs, or else glacial epochs are not necessary for this meridional migration. I believe the latter to be the more correct view, because there is no evidence of glacial epochs in the southern hemisphere, and because the physical changes necessary to elevate or depress a chain of mountains for a few thousand feet are far less than those which are now acknowledged by nearly all geologists to be necessary for bringing about profound alterations in climate over immense districts of the globe. No one has as yet been sufficiently bold to advocate a glacial climate in New Guinea and Borneo, and yet the evidence of plant migration from Asia into Australia is as strong as that for a migration along the Andes; and, as it is very unlikely that an elevation of the Indian archipelago coincided in time with the glacial epoch of Europe, so it is very unlikely that glacial epochs are necessary for the meridional migration of plants. It follows that if plants have travelled from the northern hemisphere to Australia and New Zealand, some must have passed through the tropics and into temperate climates again without undergoing any change of generic importance. In the same way the subtropical and temperate plants of New Zealand have invaded the snow-clad regions of the South Island, and have become alpines, without undergoing any generic change. And just as the occurrence of alpine species of subtropical genera does not prove that the tops of our mountains are warm, so the occurrence of species of tropical genera in the European Miocene does not necessarily prove it to have been tropical in temperature. As these plants migrated towards the equator they would gradually accustom themselves to altered conditions without losing the marks of their affinities.

I will now summarize in as few words as possible the results we have arrived at in both addresses. New Zealand, which formerly existed as the southern part of a continent extending through Australia to India *, was isolated from Australia towards the close of the Jurassic period †, but was attached to a South-Pacific continent and received a stream of immigrants from the north. None arrived from the south, because Fuegia was not then in existence. In the Upper Cretaceous the land shrank to a size considerably smaller than at present. In the Eocene, elevation took place and New Zealand extended outwards in all directions, but remained isolated from other lands. Plants and animals came in both from the north and from the south. In the Oligocene and Miocene periods New Zealand was, except for a short interval, a cluster of islands, but was upraised once more, and obtained more immigrants from north and south during the Pliocene; after which subsidence occurred, and the land throughout the South Island and southern half of the North Island sank considerably below its present level, to be again elevated during the Pleistocene period.

It has been objected that we have no right to infer that because elevation or subsidence can be proved to have occurred in one particular district of the earth's surface therefore this elevation or subsidence extended over neighbouring areas. But the more the geology and palæontology of large geographical regions, like North America or Europe, are studied, the more clearly we see that subterranean movements have affected large regions simultaneously, or nearly simultaneously, and that the local deviations from uniformity are comparatively small. So it comes about that we have in each large geographical area a series of rock systems which are nearly synchronous over the whole area, although not synchronous with those in other and distant areas. I think that our knowledge of the palæontology of Australasia is already sufficient to show that we have here also another of those large geographical areas which, when viewed on a large scale, has been moved uniformly; and therefore that the rock-systems of New Zealand can be correlated with those of Australia, and perhaps, in the earlier periods, with those of the peninsula of India.

Of course it is not denied that a scattered immigration may have been going on ever since the Cretaceous period; but it is asserted that this immigration has been small and almost inappreciable in comparison with the rushes that took place from the north in the Lower Cretaceous, and from both north and south in the Eocene and Pliocene periods. The emigra-

* This is the Indo-oceanic continent of Mr. H. F. Blanford (Quart. Journ. Geol. Soc. xxxi. p. 535).

† I need hardly say that I use these terms with very wide margins.

tion from New Zealand has, I think, been small. Probably no land existed in the Antarctic Pacific to convey plants and animals from New Zealand to South America, and a northern migration of New-Zealand plants is almost out of the question. A few stragglers may have been carried by birds to Tasmania or to temperate Australia, but that perhaps is all that can be allowed. Our fauna and flora is indeed a standing protest against the views of those naturalists who would make the winds scatter abroad insects and seeds of plants over hundreds of miles, and who imagine land-shells and lizards to float about on logs for days and weeks together without being killed.

Notes to Part I.

1. Mr. Etheridge, as mentioned in the text, was the first to suggest that the Desert Sandstone of Australia was a lacustrine deposit; but it was a mere suggestion. Prof. Ralph Tate arrived at the same conclusion quite independently, and brought forward facts to support it. (See Anniversary Address, Roy. Soc. of South Australia, for 1878–79, p. lx.)

2. At the meeting of the Linnean Society of New South Wales, held on 30th July, 1884, Mr. Ratte exhibited fossils of the genera *Rostellaria*, *Fusus*, *Pleurotomaria* (?), *Belemnites*, *Venus*, and *Nautilus*, from the interior of New Caledonia, together with a fragment of bone. He observed that these fossils were characteristic of the Upper Cretaceous period, and were likely to identify these New-Caledonia beds with some already known in New Zealand. He also exhibited an *Inoceramus* from the Neocomian of Noumea.

3. Before this Address was delivered, Mr. A. Agassiz had come to the conclusion that the specialization of the Atlantic and Indo-Pacific faunas began soon after the end of the Cretaceous period. (Report on the 'Blake' Echini, part i. p. 83, September 1883.)

4. Since this Address was in type I have come across an article in the 'Geological Magazine' for 1882, by Mr. J. S. Gardner, in which several of the views maintained in my two Addresses are enunciated.

X.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia.* By H. J. Carter, F.R.S. &c.

[Plate IV.]

Having through the kindness of Mr. J. Bracebridge Wilson, M.A., F.L.S., of the Church of England Grammar School, Geelong, Col. Victoria, received a great number of spirit-preserved and dry specimens of Sponges which have been forwarded simply in the hope that they might afford material for the advancement of our knowledge of this branch of Natural History, I propose in return to carry out his views in this respect to the best of my ability, and thus shall commence with the following descriptions.

Hitherto I have had very few opportunities of examining any but dried specimens from this coast of South Australia, and these, from their worn appearance, have evidently been picked off the beaches there; but now I am in possession of 359 specimens which have been taken direct from their natural habitat, out of which 59 have been dried, and all dredged in the neighbourhood of Port Phillip Heads, at the beginning of 1884; besides which, another consignment has been sent to me by Mr. Wilson which I am expecting every day, that is, as soon as the ship ('Sarah Grice') in which they have been forwarded shall have arrived.

Of the spirit-preserved specimens Mr. Wilson states that the galvanized iron boxes with wide circular apertures and covers (like tea-chests), in which they are contained, having been partly filled with methylated spirit, were thus kept ready in the boat to receive the sponges as they were being brought up by the dredge; but before they were cast into it, each specimen was numbered on vellum, in black-lead pencil, and the number entered in a note-book together with the colour of the sponge at that moment, its locality, and the depth of water in which it was dredged, while copy of this was also sent to me by post, and the sponges not disturbed again until the boxes, subsequently filled up with spirit and hermetically sealed down, came into my possession. Thus it may be assumed that they reached me in very good condition, which is the case. On the other hand, the *dried* specimens, after having been taken on shore, were carefully soaked in fresh water until their sea-salt was entirely extracted, and then dried, so that they, as specimens, are infinitely superior to those picked up on the beaches; still the latter method has its advantages, for in no way can we get the fibrous skeletons, especially of the keratose sponges, so clean and favourable for description as when they have been thoroughly washed out by putrefaction of the sarcode and subsequent exposure to the friction of the waves on the sea-shore.

I will now commence the "descriptions," to which I have above alluded, with

Esperia parasitica, n. sp. (Pl. IV. fig. 1, *a–h*.)

Parasitic, growing over the sand-cored or sand-axiated fibre of a dead Psammonematous sponge so as to entirely conceal it under cover of an Esperian structure. Specimen oblong, somewhat compressed, square as if cut off (? by the dredge) at one end, rounded at the other. Consistence elastic, puffy like a hair-stuffed pillow, from the elastic nature of the Psammonematous structure inside. Colour grey. Surface even; with small elevations and close reticulated tissue. Pores in the interstices of the reticulation. Vents large, disposed in line, along the round end. Internally cavernous, from the parenchyma of the *Esperia* being chiefly confined to the sand-cored fibre of the old Psammonematous structure. Spicules of four forms, viz.:—1, skeletal, acuate, smooth, slightly curved, head oval, elongated, *Esperia*-like, constricted, passing on to a fusiform shaft which is wider than the head, ending in an obtuse point, 78 by $1\frac{1}{2}$-6000ths in. in its greatest dimensions (fig. 1, *a*); 2, inequianchorate, in which the free end is small and composed of *four* teeth that tend towards horizontal rather than vertical extension, shaft long and much curved, fixed end, which is also small, quadrilateral in appearance, total length 11-6000ths in. (fig. 1, *b*, *f*, *g*, *h*); 3, bihamate, simple, the only one seen (in the preparation) and that broken off at one end, which has been supplied in the representation (fig. 1, *c*); 4, minute inequianchorate with elongated, spine-like process prolonged from the small end, about 4-6000ths in. long (fig. 1, *d*). No. 1 is plentifully distributed throughout the tissue with Nos. 2 and 4; the former, that is the large inequianchorate, chiefly *en groupe* or in the so-called "rosette" form (fig. 1, *e*). Size of specimen about 4 in. high by 5×2 in. horizontally in its greatest dimensions.

Hab. Marine, growing over the skeletal fibre of a dead Psammonematous sponge.

Loc. Port Phillip Heads, South Australia. Depth &c. not given.

Obs. This species is chiefly characterized by the free end of the large inequianchorate (No. 2) being furnished with *four* teeth; by "free" here is meant that end which *en groupe*, that is, in the globular rosette-form, is outside (fig. 1, *e*). The presence of the minute inequianchorate with spine-like end (fig. 1, *d*), although not peculiar, is uncommon (see 'Annals,' 1882, vol. ix. pl. xi. fig. 16, *e*, *f*, erroneously written "*equi*-anchorate" at p. 298).

Had not Dr. Bowerbank's inequianchorate from an "undescribed species of *Hymeniacidon* from Freemantle, Australia," which was also "parasitical," been "tridentate" (Mon. Brit. Spong. vol. i. pp. 49 and 249, fig. 135, pl. vi.), I should have identified it with that of *Esperia parasitica* from its great resemblance; at the same time I must at least observe that a *tri*dentate form of inequianchorate could never present its teeth in the position given to them in Dr. Bowerbank's figure!

Forcepia colonensis, 1874. (Pl. IV. fig. 2, *a–e*.)

Specimen massive, irregularly circular and truncate (? cut off by the dredge) at the base, rising into several thick, conical processes above. Consistence firm. Colour, when fresh, "brilliant scarlet," now violet-grey. Surface smooth, wrinkled. Pores in the dermis generally. Vents large, scattered over the upper part, one at the end of each conical process. Internally, dermis thick; subdermal cavities large, furnished with circular folds which are continued on to the surface of the excretory canals beneath. Parenchyma dense, traversed by the branches of the excretory canal-systems, which terminate at the vents mentioned. Spicules of two forms, viz.:—1, skeletal, consisting of a cylindrical more or less undulating, smooth shaft, passing into a globular inflation at each end, which is a little wider than the shaft, 101 by $2\frac{1}{2}$-6000ths in. in its greatest dimensions (fig. 2, *a*); 2, flesh-spicule, consisting of a cylindrical shaft, bent forceps- or hairpin-like, terminating abruptly in round or pointed extremities, thickly spined throughout, spines all recurved towards the bend, 22 by $1\frac{1}{2}$-6000ths in. in its greatest dimensions (fig. 2, *b*). Both forms plentifully present throughout the structure, the latter most abundant on the surface. There are traces also (in my preparation) of minute equianchorates, triradiates, and bihamates (fig. 2, *c*, *d*, *e*), but not sufficiently numerous to be characteristic of, if even part of, the spiculation. Size of specimen $3\frac{1}{2}$ in. high by 4 to $4\frac{1}{2}$ in. in diameter at the base.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. In 1874 ('Annals,' vol. xiv. p. 248, pl. xv. fig. 47) I described and illustrated the flesh-spicule of this species, which was obtained loosely from dredgings near Colon, Panama, and then provisionally proposed the above name for the sponge to which they might have belonged, and which has now been found to exist also, in the form above described, on the south coast of Australia.

As above stated, there are minute equianchorates, tricurvates, and bihamates present; but although such forms characterize the spiculation in some of the other species of *Forcepia*, their existence here is so insignificant, from their scantiness and smallness, that they have not been enumerated in the spiculation. I have often noticed that in sponges where there are more than one form of flesh-spicule, the development is very unequal; that is, that one appears to be greatly increased in size at the expense of the others, which may be the case in

Forcepia colonensis, at least this is exemplified in the next species, viz. *F. crassanchorata*, wherein the *anchorate* is the most prominently developed.

Forcepia crassanchorata, n. sp. (Pl. IV. fig. 3, *a–g*.)

Specimen dry, round, cake-like, compressed, bearing the appearance of a beach-rolled specimen. Consistence now light. Colour fawn. Surface rough, reticulated. Pores not seen (? dried up). Vents scattered here and there. Internal structure like "crumb of bread." Spicules of four forms, viz.:—1, skeletal, acuate, often subpinlike, curved, smooth, abruptly sharp-pointed (fig. 3, *a*); 2, also skeletal, slightly curved, smooth, fusiform, inflated pin-like at *each* end (fig. 3, *b*), both about the same size, viz. 66 by 2-6000ths in. in their greatest dimensions; 3, forceps-like spicule, very thin, microspined on the body, smooth and finely pointed at the extremities, arms of equal length, 19-6000ths in. long, extremities very close, that is, separated only for about 1-6000 in. (fig. 3, *c*); 4, equianchorate, very short and very stout, nearly as broad as long, arms ?-petaloid, 6-6000ths in. long by 5-6000ths in. broad (fig. 3, *e*, *f*). All the spicules equally abundant throughout the tissue, together with a minute equianchorate about 3-6000ths in. long (fig. 3, *g*), and a paraboliform spicule like a bihamate about the same length (fig. 3, *d*); but not being satisfied that these are independent forms, as they may be ill-developed ones of No. 4, I have not included them in the spiculation. Size of specimen, $6\frac{1}{2} \times 5 \times 3$ in.

Hab. Marine.

Loc. Port Elliot, South Australia.

Obs. This specimen, which is among the dry sponges purchased by the Trustees of the British Museum from the Executors of the late Dr. Bowerbank, must, when fresh, have probably been 12 in. in diameter, as in desiccation a fresh sponge shrinks to about half its natural size. From its rolled or rounded form it was evidently a beach-specimen, and coming from Port Elliot, was obtained from the same coast, and not very far from that last mentioned. In appearance and structure it very much resembles our *Halichondria incrustans*. Of course the forcipiform flesh-spicule is the most characteristic feature, but instead of being very large, like that of *F. colonensis*, it is very minute, fine, and delicate, while it is in such abundance and lying so close together, that it looks as if it had been developed in groups in a cell, after the manner of a tricurvate, and might be easily mistaken for "trichites." So delicate and fine are the shaft and its spination, that it is with difficulty seen under a power of 250 diameters. On the other hand, the characteristic anchorate is so short and robust that it forms by far the most prominent object among the flesh-spicules. There is also, as above stated, a small equianchorate and a paraboliform spicule like a bihamate; but as it is possible that these may in some way be related to the robust equianchorate, I have here also not included them among the spiculation, although the representations to which I have alluded are given, but these are for the use of future observers. The arms of the large equianchorate, too, are stated conjecturally to be "petaloid," because their transparency and their refraction of the light as it passes through them renders their real forms so indistinct.

Halichondria scabida, n. sp. (Pl. IV. fig. 4, *a–p*, and 5, *a–g*.)

Specimen globular, compressed, sessile (fig. 4, *a*). Consistence tough, fibrous. Colour now brown externally, yellowish internally. Surface even, undulating, consisting of a dense, smooth dermis, more or less covered with suboval and subcircular areas like small scars, separate, or together in juxtaposition (fig. 4, *b b*); area circumscribed by a slightly raised rim, subtended by a delicate cribriform layer of the dermal sarcode, varying in size under $\frac{1}{4}$ in. in diameter (fig. 4, *k*, *l*, *m*). Pores confined to and synonymous with the holes of the cribriform areas, each pore about 1-300 in. in diameter (fig. 4, *k*, *m*). Vents here and there. Internally, subdermal cavities strongly developed, consisting of a cancellated fibrous structure, in which the folds occupied by spiculous fibre, arching over and intersecting each other, support the pore-areas above (fig. 5, *a b*), which thus open into the excretory canals below (fig. 5, *c*), through which the arching or circular folds (fig. 5, *d*) are continued to the vents in the opposite direction (fig. 5, *g*). Parenchyma fibro-pulpy, of a yellow colour, traversed plentifully by the branches of the excretory canal-systems. Spicules of five forms, viz.:—1, skeletal, acuate, slightly curved, head oval elongated, with contracted neck, passing into a fusiform shaft, which terminates gradually in a sharp point, 51 by 1-6000th in. in its greatest dimensions, head a little less in diameter than the shaft (fig. 4, *d*); 2, subskeletal, simply acuate, curved, gradually sharp-pointed, spined throughout, especially about the obtuse end, 43 by $1\frac{1}{2}$-6000ths in. (fig. 4, *e*); 3, the same, but much smaller, viz. 20 by $1\frac{1}{2}$-6000ths in. (fig. 4, *f*); 4, flesh-spicule equianchorate, with slightly angulated, curved fusiform shaft, and three diverging knife-shaped arms or flukes at each end, 7-6000ths in. long (fig. 4, *g*, *i*); 4, ?-small size of same (fig. 4, *h*). No. 5 abounds throughout the tissue generally, but especially in the dermis; No. 1 in the fibre of the subdermal cavities, and, with Nos. 2 and 3, throughout the spiculo-fibre of the parenchyma. Size of specimen about $1\frac{4}{12}$ in. high and $1\frac{8}{12} \times \frac{9}{12}$ horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, S. Australia. Depth &c. not given.

Obs. This is an extremely interesting specimen, because the pore-areas are circumscribed, and open, through the subdermal cavities, *directly* into the *large* excretory canals, which present the circular folds to which I have alluded throughout their course, so that by these folds they can be unmistakably traced from the pore-areas to the vents, that is, from one end to the other (fig. 5). In this respect too they correspond with *Grayella cyathophora* ('Annals,' 1869, vol. iv. p. 192, pl. vii. fig. 5); the spiculation, however, is more like that of *Halichondria pustulosa* ('Annals,' 1882, vol. ix. p. 285, pl. xi. fig. 1 &c.), which is a branched sponge with similarly circumscribed pore-areas, from the South Atlantic Ocean about the Falkland Islands; while there is a large dried specimen of *Grayella cyathophora* in the British Museum (No. 15, registered 71. 6. 5. 1) which came from the neighbourhood of the Cape of Good Hope. Dr. Bowerbank's term "angulated" is applied to an equianchorate whose shaft has apparently a triple curve, viz. a large one in the centre and a small one at each end.

Suberites Wilsoni, n. sp.

Massive, pyramidal, tending towards compression. Consistence hard, solid, heavy. Colour bright carmine-red. Surface more or less unevenly reticulated, with irregular, depressed intervals, or generally nodulated; or covered with oculiform areas in juxtaposition, like *Rhaphyrus Griffithsii*, Bk. Pores in the interstices of the dermal reticulation, or confined to the pupillary aperture of the oculiform areas. Vents scattered over the surface generally. Internally composed of cancellated sarcode, half filled with fine and coarse sand-grains together with other foreign microscopic objects, which make the specimen so heavy; traversed by the branches of the excretory canal-system, terminating at the vents mentioned. Spicule of one form only, viz. pin-like, consisting of a smooth, curved, simple acuate, more or less globularly or elliptically inflated, near to, but at a variable distance from, the large end, sometimes so slightly as to reduce the form to a simple acuate; diminishing gradually towards the thin end, which is not only obtusely pointed, but often absolutely round or blunt, 75 by $1\frac{1}{2}$-6000ths in its greatest dimensions; disposed plentifully throughout the sarcode, more massively than fibrously. Size of largest specimen, of which there are several both wet and dry, 15 in. high by 10×5 in. at the base.

Hab. Marine.

Loc. Port Phillip Heads, S. Australia. Depth 19 fath.

Obs. This is the species to which I have alluded in the 'Annals' for 1882 (vol. xi. p. 350) as being "without flesh-spicule," thus differing, among other things, from the specimen of *Alcyonium purpureum*, Lam., in the British Museum, which bears the nos. "42" and "29." Like *A. purpureum*, it retains its beautiful carmine colour after drying, and this is so abundant that, although it parts with sufficient to tinge other sponges which may be in contact with it when preserved in spirit, this in no degree appears to affect its brilliancy on desiccation. I have named it after Mr. J. Bracebridge Wilson, who obtained it from the place mentioned, and sent it to me with the other specimens to which I have above alluded, requesting at the same time that, if any new species were found among them, types of the same might be deposited in the British Museum, where the "largest specimen," whose measurements are above given, together with two others, may be found, bearing the Register nos. "84. 10. 10. 3–5." The habit of enclosing foreign microscopic objects is so common with the Suberites that it is almost a character.

Acanthella cactiformis, n. sp. (Pl. IV. fig. 6, *a*, *b*.)

Specimen dry. Erect, flat-branched, stipitate, thorny, cactus-like; stem and branches much compressed, interuniting as they divide, so as to leave large, fenestral intervals. Consistence firm, chiefly from the thick, gluey character of the sarcode when dry, together with the density of the stems. Colour when fresh "dull red," now grey in the spirit-preserved specimen (for there are two), horny brown in the dry one. Surface of the larger branches covered with thorny processes, which, by branching, grow into proliferous portions like miniature specimens of the whole mass, but whose fenestral intervals between the interuniting branches are tympanized by the thick, dermal sarcode, which also webs together the thorn-like bundles of spicules on the surface. Neither pores nor vents seen, probably on account of their having become closed by the contraction of the thick, dermal sarcode during desiccation. Internally, structure hard and compact in proportion to its distance from the surface; consisting, under the thick, glutinous, brown dermis, of a dense accumulation of spicules held together by a minimum of sarcode, contrasting strongly, by its whiteness, with the brown translucent colour of the superincumbent dermis, and constituting the chief supporting element of the branches. Spicules of two forms, both skeletal, no flesh-spicules, viz.:—1, acuate, simple, smooth, curved, abruptly sharp-pointed, 75 by 2-6000ths in. in its greatest dimensions (fig. 6, *a*); 2, acerate, smooth, curved, rather flexuous, gradually sharp-pointed, a little longer than No. 1 (fig. 6, *b*); apparently modifications of each other, as specimens of all sizes and transitionary forms may be found among them; equally and plentifully distributed throughout the dermis; forming in bundles the axes of the thorn-like projections, and constituting, as before stated, the chief indurating element of the stem and branches. Size of specimen 16 in. high by $16 \times 2\frac{1}{2}$ in. horizontally.

Hab. Marine.

Loc. Port Phillip Heads, S. Australia. Depth 19 fath.

Obs. This genus was established by Schmidt in 1862 for two species found in the Adriatic ('Die Spong. d. Adriatisch. Meeres,' p. 64, Taf. vi. fig. 7 &c.), in which the acuate is long and very flexuous or undulatory, while that of the Australian species is comparatively short and simply curved; otherwise there is not much difference between the two species, so little indeed that I am in doubt whether the above-described ought not to be termed a "variety." The specimen has been deposited in the British Museum, where it bears the Register no. "84. 10. 10. 2."

Compactness and hardness of the stem are peculiarly characteristic of my order Echinonemata, arising from condensation of the spicular element of the sponge in these parts.

Chalina polychotoma, var. *trichotoma*, n. v.

Specimen dry. Solid, caulescent, digitations long, round and dichotomously branching at first, then ending in expanded, compressed extremities, more or less trichotomously divided, all arising from a single, short, round stem. Consistence resilient. Colour now light sponge. Surface uniformly even, covered with dermal sarcode, corresponding in its reticulation with the subjacent fibres on which it rests. Pores in the interstices of the reticulation. Vents in line along the branches, or scattered over one side especially of the expanded extremities. Internally, structure open, fibro-reticulated, smaller, firmer, and more compact on the surface. Spicule of one form only, viz. acerate, curved, smooth, fusiform, sharp-pointed, *very* minute and thin, about 8-6000ths in. in length, chiefly confined to a line running through the centre of the fibre; the same form in the sarcode external to the fibre, but a little larger. Besides the latter, the sarcode is plentifully charged with small, nucleated, granuliferous, spherical cells, about 3-6000ths in. in diameter, like ovules. Size of specimen, 19 in. long, consisting of about 50 caulescent digitations, forming a bundle about 12 in. in diameter.

Hab. Marine.

Loc. Port Phillip Heads, S. Australia. Depth 19 fath.

Obs. The typical form of all the caulescent Chalinas which belong to my group "Digitata" ('Annals,' 1875, Classification) is Esper's *Spongia polychotoma* = *S. oculata*, Lam., = *Chalina oculata*, Bk., which latter is the British species, and perhaps the feeblest representative of a form which seems to me to abound all over the world, often in far larger specimens than those of this country, but with very little difference in form, and always with the same kind of acerate spicule. In the present instance the latter is remarkably small, while the keratose element of the fibre is proportionally greater, which, together with the trifid extremities of the branches, characterizes the variety. On the coast of Arabia, when fresh, this species is of a reddish-purple colour; remains of which I have often noticed in the dried specimens at the British Museum, but I have not noticed it in any of Mr. Wilson's spirit-preserved specimens, of which there are several, although, *when fresh*, some of these also appear from his Catalogue to have been so coloured. I have also often noticed the plentiful presence of the little "nucleated, granuliferous, spherical, cell-like ova" in this kind of Chalina. The above variety has been deposited in the British Museum, where it bears the Register no. "84. 10. 10. 1."

EXPLANATION OF PLATE IV.

N.B.—Figs. 1 *a–d*, 2 *a–e*, 3 *a–g*, and 4 *a–h* are drawn to the scale of 1-24th to 1-6000th inch, fig. 6 to the scale of 1-48th to 1-6000th inch, and fig. 7 to 1-48th to 1-1800th inch. The rest are more or less enlarged, and more or less diagrammatic, views of particular parts.

Fig. 1. *Esperia parasitica*, spiculation of. *a*, skeletal spicule; *b*, inequianchorate; *c*, bihamate; *d*, minute inequianchorate; *e*, "rosette," showing the way in which the inequianchorates are developed *en groupe*; *f*, *g*, *h*, free ends of inequianchorates, more magnified, to show the *four* teeth.

Fig. 2. *Forcepia colonensis*, spiculation of. *a*, skeletal spicule; *b*, forcipiform flesh-spicule; *c*, minute equianchorate; *d*, minute tricurvate; *e*, minute bihamate.

Fig. 3. *Forcepia crassanchorata*, spiculation of. *a*, skeletal spicule, acuate, subpin-like; *b*, skeletal, globularly inflated at each end; *c*, forcipiform flesh-spicule; *e*, front view of the stout equianchorate; *f*, lateral view of the same; *g*, minute equianchorate; *d*, bihamate-like spicule.

Fig. 4. *Halichondria scabida*, outline of the specimen and its spiculation &c. *a*, outline of the specimen; *b b*, pore-areas; *c*, part of the dermis without pore-areas; *d*, skeletal spicule; *e*, subskeletal spicule; *f*, still smaller form; *g*, large form of equianchorate; *h*, small form of the same; *i*, more magnified view of large form, to show the teeth, arms, or flukes, as they have been called, of the extremities; *k*, pore-areas magnified four diameters; *l*, rim; *m*, pores; *n*, still more magnified view of the pores in a fragment of the sarcode charged with the small form of anchorate (*h*); *o*, pores; *p*, sarcode charged with the anchorate.

Fig. 5. The same. Diagram to show the *direct* connexion of the pore-areas with the excretory canal. *a*, pore-areas; *b*, subdermal cavities or structure; *c*, excretory canal; *d*, circular folds, more or less extending round the surface of the excretory canal; *e*, apertures of the smaller branches in this canal; *f*, filament introduced to show the *direct* communication of the pore-areas with the excretory canal; *g*, vent, with arrow showing the direction of the current.

Fig. 6. *Acanthella cactiformis*, spiculation of. *a*, acuate form; *b*, acerate form.

Fig. 7. See explanation in connexion with the paper which it illustrates, p. 122.

XI.—*Mode of Circulation in the Spongida.* By H. J. Carter, F.R.S. &c.

[Plate IV. figs. 5, *a–g*, and 7, *a–p*.]

In the month of July 1857, when my observations "On the Ultimate Structure of *Spongilla*" were published ('Annals,' vol. xx. p. 21, pl. i.), I thought there could be no doubt about the course of the circulation in the Spongida, as the minute portion of *Spongilla* developed from the statoblast (gemmule or seed-like body) is so small and yet so perfect that it can be easily kept under the microscope, while the red particles of carmine-paint that may be brought into contact with it are taken in and discharged before the eye. By being "so perfect," I mean that it consists of only one "person" (Häckel), that is, it is a minute epitome of sponge-structure in which there is only one vent and therefore only one excretory canal-system; hence a view of the whole portion which is translucent can be easily commanded by the aid of a microscopic power of 250–300 diameters (in water of course).

Under such circumstances (I must here revert to my original nomenclature and diagram, *op. et loc. cit.* pl. i. fig. 1) the particles of carmine-paint may be seen to pass through the holes of the "investing membrane" (pore-dermis) into the so-called "cavity" of this membrane (subdermal cavities), and from thence into the parenchyma or semiopaque structure of the body, where they finally come into contact with the spongozoa ("Geisselzellen") of the ampullaceous sacs ("Geisselkammern"), and there rest for about fifteen minutes, when there is a cessation of the circulation, during which the vent is closed and the tubular process on which it was projected is retracted. After the expiration of the time mentioned the "tubular process" is again put forth, and the vent at the end of it opened, when the red particles, now probably separated from their gummy constituents, may be seen to pass from the ampullaceous sacs into the large branches of the excretory canal-system, and so finally out at the vent.

All this is plain; but as stated (*l. c.*) I could not follow the particles from the cavity of the investing membrane through the parenchyma, although I could see when they arrived at the ampullaceous sac, and by tearing the latter to pieces, that the spongozoa had finally taken them into their bodies.

This view continued in much the same state until 1877, when Dr. F. E. Schulze, of Gratz University, began to publish those illustrated descriptions in the Zeitschr. f. wiss. Zool. which have made a notable epoch in the advancement of spongology (Bd. xxviii.–xxxv.), wherein he shows that, in *Halisarca lobularis* (Bd. xxviii. Taf. ii. fig. 13), there is a *plurality* of small holes in the ampullaceous sac, and especially in *Spongelia avara* (Bd. xxxii. S. 134, Taf. viii. fig. 5), where "20–30" might be numbered in addition to the large aperture which communicates directly with the branch of the excretory canal-system; while in the Chondrosidæ, the Aplysinidæ, and *Corticium candelabrum* only two apertures are represented, viz. an afferent and an efferent aperture. Schulze also pointed out in 1875 that similar small apertures existed in the chamber-walls of *Sycandra raphanus* (Bd. xxv. Suppl. Taf. xviii. fig. 1).

Thus it might be inferred that there is a distinct pore-system which carries the particles of nutriment *direct* from the dermis to the spongozoa, as direct as that which takes them away; but this we shall see is not so, for the particles that are taken in with the water through the pores of the dermis fall *directly* into the subdermal cavities, and pass thence into the large excretory canals, from which they are afterwards *deflected* to their destination through smaller branches, whose apertures may be seen in the walls of the former (Pl. IV. fig. 5, *e*).

This I pointed out in 1869 ('Annals,' vol. iv. p. 192, pl. vii. fig. 5) in *Grayella cyathophora*, where the pore-area, which is pustuliform and circumscribed on the surface, opens through the subdermal cavities *directly* into a large branch of the excretory canal-system, so that the particles of nutriment which enter the sponge with the water must be deflected afterwards by some means through the small canals (fig. 5, *e*) which branch off from the larger excretory canal, and thus do not reach their destination "direct," as above stated.

There is evidently then a selection here, and probably another when the particles arrive at the spongozoa in the cavity of the ampullaceous sac, where the afferent and efferent currents meet and where there must also be another selective separation, by which the excrementitious particles are drafted back into the excrementary canal. I have pointed out this too in *Axos spinipoculum* ('Annals,' 1879, vol. iii. p. 287, pl. xxv. figs. 4, 5, &c.); but my attention has been more particularly drawn to it lately by anatomizing the structure of some South-Australian sponges dredged in the neighbourhood of Port Phillip Heads in January last, which were preserved in spirit through having been directly thrown into the latter as they were brought up in the dredge by Mr. J. Bracebridge Wilson, M.A., F.L.S., of the Church of England Grammar School, Geelong, who kindly obtained and sent them to me.

This perhaps is best seen in *Teichonella labyrinthica* ('Annals,' 1878, vol. ii. p. 37, pl. ii. fig. 6 &c.), wherein the chambers (Pl. IV. fig. 7, *a–p*), which are arranged in juxtaposition perpendicularly to the lamina of which the sponge is composed, thus pass directly through it from one side to the other, having therefore on one side the pores or pore-dermis (fig. 7, *b*), and on the other the vent (fig. 7, *i*); in short exactly like those of *Grantia compressa*, only there is no cloaca *. We must, however, regard this chamber as at once ampullaceous sac and excretory canal; for the pore-dermis being at one end or side of the lamina and the vent at the other, the circulation passes into the former and out at the latter, through the chamber, where the nutritive particles are instantly taken up by the spongozoa lining its cavity (fig. 7, *h*). Hence the holes in the walls of the chamber (fig. 7, *g*), which are very numerous, may serve for the purpose of intercommunication, where the walls of the neighbouring chambers are in direct contact with each other, or for the purpose of allowing

* I find by the spirit-preserved *Teichonella labyrinthica* (for there are fine specimens of both *T. prolifera* and *T. labyrinthica* in Mr. Wilson's collection) that in my original description of the latter (*op. et loc. cit.*) I have omitted to notice the quadriradiate spicule, which, of course, still more closely allies it to *Grantia compressa*.

the ova developed in the intercameral tissue (fig. 7, *n*, *o*) to pass into the chamber and thus be expelled. Therefore these holes would seem to have more functions than those ascribed to them in the wall of the ampullaceous sac of the so-called "siliceous sponges," ex. gr. *Spongelia avara* (Schulze, *l. c.*).

Returning to the latter then I find two undescribed species of my order Psammonemata among Mr. Wilson's dredgings, in which what I have above stated respecting the mode of circulation is particularly well illustrated, not only on account of the fact itself, but on account of its being present in two totally different structures. These species, which I have respectively named *Geelongia vasiformis* and *Hircinia solida*, will be more particularly described in another paper for future publication, but may here, for convenience, be briefly noticed as follows:—

Geelongia vasiformis.

Vasiform, stipitate, $6\frac{1}{2}$ inches high by 6 inches across the brim, diminishing to the stem, which is $2\frac{1}{2}$ inches long and $1\frac{1}{4}$ inch in diameter, ending in a root-like expansion; with a thickness of wall at the bottom amounting to 5-8ths inch, diminishing gradually to the brim, which is even and round; covered externally by a thick dermal layer of sarcode charged with sand, in which are the pores and a few small scattered vents; and internally, with a layer of the same kind, in which there are larger vents *alone*, that is with no pores, which are numerous and, in one specimen, uniformly spread over the *upper half only* of this surface, the lower part being entirely smooth. *No* conuli on either side.

Hircinia intertexta.

Compressed, oblong, flat, sessile, 12 inches high by 6 inches wide, with irregularly undulating, rounded margin on all sides, and a thickness of $1\frac{1}{2}$ inch below, which diminishes to about $\frac{3}{4}$ inch in the upper part; covered on both sides with a soft, reticulated, dermal layer of sarcode *without foreign bodies*, in the interstices of which the pores are situated, the whole being thrown up into obtuse conuli or monticular elevations, in bold relief, by the projection of the subjacent keratose fibre; and the vents, which are small and scantily scattered over both sides, are largest and most numerous on the upper border. Conuli on both sides.

With these two distinct forms come two distinct arrangements of the internal structure—that is, in *Geelongia vasiformis* the direction of the fibres and the excretory canals is across or perpendicular to the planes of the wall; while in *Hircinia solida* it is the opposite, that is, they are longitudinal or parallel to them. Hence in the former the great excretory canal runs from the pore-surface or subdermal cavities on one side to the vents on the other, much as the "chamber" in *Teichonella labyrinthica*; while in *Hircinia solida* the great excretory canals run along the whole length of the sides *just under* the subdermal cavities, more like those in *Teichonella prolifera*, finally opening at the large vents in the upper end or border; but in their course sending off in both instances small canals transversely into the sponge-structure (*ex. gr.* Pl. IV. fig. 5, *e*). Thus, in both cases also, the great excretory canals first receive the water and its nutrient particles from the pores through the subdermal cavities, when the latter, at least, are deflected through the small lateral canals just mentioned, to the spongozoa and ampullaceous sacs. From this point to the ampullaceous sacs they have yet to be traced.

Although it may be inferred that each pore-hole in the ampullaceous sac of *Spongelia avara*, as represented by Schulze (*l. c.*), is connected with an afferent, tubular canal, this is only represented in that of *Halisarca lobularis* (*l. c.* Taf. ii. fig. 13), but its further continuation (that is, its connection with the branch coming from the great excretory canal) has yet to be shown; although the efferent opening in the ampullaceous sac, which is connected with the excretory canal, on the other side, was verified by myself, as above stated, from the commencement ('Annals,' *l. c.*).

We might now appropriately consider how the rush of water through the great excretory canals is produced, viz. whether it is effected by the cilia of the epithelial cells only, or by some other means, or by both. The other means to which I allude is the presence of circular folds more or less extending round the surface of the canal, which are not induced by the presence of the apertures on the surface, since they often occur without this, as may be seen by the illustrations of *Grayella cyathophora* and *Axos spinipoculum* respectively ('Annals,' 1869, vol. iv. pl. vii. fig. 5, *g*, *h*, *i*, and 1879, vol. iii. pl. xxv. fig. 5), while, of course, the presence of the folds alone would be no indication of their having any effect upon the circulation, had it not been proved by dissection in the spirit-preserved specimen of *Axos spinipoculum*, wherein the excretory canal-system is strongly developed, that the wall of the excretory canal is composed of two layers like that of the human intestine, viz. an epithelial layer of cells (*l. c.* pl. xxv.

fig. 9), and underneath this a layer of ?-muscular fibrillæ partly longitudinal and partly transverse (fig. 6).

Thus, assuming that the cells had been monociliated they must have had some office; while assuming that the fibrillous layer was muscular (and I do not see what else it could have been), this would have the effect of circular and longitudinal motion respectively. Hence, supposing that the circular folds, more or less extending round the surface, were influenced by this motion, it would have the same effect upon the contents of the excretory canal as that of the intestine upon its contents, which would be to propel them onwards to the vent (or the reverse, if necessary), and thus resemble the "*valvulæ conniventes*" of the latter. Of course, the transverse and longitudinal fibrillæ of the excretory canal can no more be expected to be identified by the so-called "*striped*" appearance than the muscular fibres of the intestines.

Still, it might be observed that, although this can be demonstrated in *Axos spinipoculum*, it may not be the case in other sponges; but if we are to deny the existence of motory structure in moving objects because it cannot be demonstrated by the highest microscopic powers, we might as well deny that there is any structure in glass because it is transparent!

EXPLANATION OF PLATE IV.

Fig. 5. *Halichondria scabida*, diagram showing the direct connection of the pore-areas with the excretory canal. *a*, pore-areas; *b*, subdermal cavities; *c*, excretory canal; *d*, circular folds, more or less extending round the surface of the excretory canal; *e*, apertures of branches in this canal; *f*, filament introduced to show the direct communication of the pore-areas with the excretory canal; *g*, vent.

Fig. 7. *Teichonella labyrinthica.* Perpendicular section of a chamber, with all its parts drawn to scale, viz. about 1-48th to 1-1800th inch, the arrows indicating the direction of the circulation. *a a*, Chamber; *b*, pore-dermis, leading into *c*, subdermal cavity, and the latter leading *into* "*a a*," the chamber; *d*, subdermal tissue; *e*, surface view of pore-dermis; *f*, opening of subdermal cavity, as seen through the pore-dermis; *g*, pores in the wall of the chamber; *h*, spongozoa in the same; *i*, vestibule of the vent; *k*, sphincter of the vent and opening through the same, shown by the arrow; *l*, interoscular tissue; *m*, end view of sphincter, surrounded by interoscular tissue, and arrow showing the direction of the current; *n*, diagram, to show horizontal section of the chambers in their natural position, with the intervals between them; *o*, chambers; *p*, intervals or intercameral tissue in which the ova are developed, and in which the branches of Häckel's "intercanal system" are situated.

XII.—*On a new Species of* Idotea. By Charles Chilton, M.A. (New Zealand).

[Plate V. A. figs. 1–3.]

In the 'New Zealand Journal of Science,' vol. i. p. 332, Mr. G. M. Thomson gives a complete list of the New-Zealand species of Idoteidæ, altering some of the names by which the species were previously known, in accordance with Mr. Miers's elaborate revision of the family*. Of the seven species mentioned in this note I have only seen two—*Idotea ungulata*, Pallas (previously known as *I. affinis*), and *Idotea elongata*, White. Both of these are fairly common in Lyttelton Harbour, and I have also specimens of *Idotea elongata* from Akaroa, collected by Mr. R. M. Laing. My specimens of *Idotea ungulata* were all taken on green seaweed, which they closely resemble in colour; while *Idotea elongata* I have found only on brown seaweed, and it is itself of the same colour. In a note published in the 'New Zealand Journal of Science,' vol. i. p. 517, I recorded the fact that in the mature female of *Idotea elongata* the thorax with the brood-pouch is expanded and attains its greatest breadth in the third segment, which is twice as broad as long; I find, however, that this had been previously observed by Mr. Miers †.

I am now able to add to the list another species of *Idotea*, which appears to be new. It comes under Mr. Miers's section ii. a^* [see *l. c.* p. 25], but is quite distinct from the species he mentions under that section. It was taken at Sumner, Canterbury, N. Z., on the under surface of a boulder, which was at the time not covered with water, since it was low tide. I have only the one specimen. I append a detailed description.

Idotea festiva, sp. nov. (Pl. V. A. fig. 1.)

Body not very convex, oblong oval, length about two and a half times the greatest breadth. Head transverse, produced upwards and forwards into a rounded prominence divided into two lobes by a median depression, which is continued nearly to the posterior margin; remainder of the head variously sculptured and with two raised ridges towards the lateral borders. First five segments of the thorax of nearly equal length, sixth and seventh shorter, seventh shorter than the

* 'Journal of the Linnean Society,' vol. xvi. p. 1.
† *Loc. cit.* p. 55.

sixth. First segment produced into rounded antero-lateral lobes, which reach to the eyes. Two raised ridges, one near each lateral border, run throughout the whole length of the thorax, and extend nearly to the end of the postabdomen. There is also a less perfect median ridge formed by the posterior portion of each segment being raised into two short converging ridges, like the letter V; this ridge is well marked in the postabdomen and extends right to the end. Between the lateral ridges and the median ridge, but nearer to the former, are various sculptured markings. Postabdomen about as long as the five preceding segments of the thorax, composed of three distinct segments, the first two short, the third with the lateral sutures of another segment. Postabdomen gradually narrowing until about one third of its length from the end, when it suddenly contracts and converges with slightly sinuous margins to the extremity, which is subacute. Eyes small, situated on the lateral margin of the head at the postero-lateral angle. Antennæ reaching nearly to the end of the third segment of the peduncle of the antennule; penultimate segment expanding distally, terminal segment very small. Antennules as long as the head and first two segments of thorax; last segment of peduncle longer than the preceding, but slightly shorter than the flagellum, which is composed (in my single specimen) of seven joints, of which the first is considerably longer than any of the succeeding. Epimera of only the last three segments of thorax visible in dorsal view; in side view they are all rectangular, those of second and third segments not reaching to the anterior end of the epimeron of succeeding segment. Opercular plates subtriangular, with slightly raised border on inner margin; terminal plates very small, triangular, ending acutely. Legs short, not visible in dorsal view. Colour greyish.

Length 10 millim.; breadth (about) 4 millim.

Hab. Sumner, Canterbury, New Zealand.

A single specimen, taken on the under surface of a boulder exposed at low tide.

EXPLANATION OF PLATE V. A. figs. 1–3.

Fig. 1. *Idotea festiva*, dorsal view, × 10.
Fig. 2. The same, side view, × 10.
Fig. 3. The same, opercular plates, × (about) 13.

XIII.—*On the Reproduction and Development of* Rotifer vulgaris. By Dr. Otto Zacharias *.

[Plate V. B.]

Rotifer vulgaris, as its name implies, is one of the commonest of the Rotatoria. Spallanzani observed it and made interesting experiments upon its faculty of reviving after complete desiccation. It is to be met with abundantly throughout the whole year in ponds, ditches, and pools. But notwithstanding the constant opportunity presented for its examination, *Rotifer vulgaris* has not yet been accurately investigated with regard to either its anatomical structure or its developmental history.

In the following pages I give a detailed report of the results of an investigation of this Rotifer commenced in February and continued until the middle of July in the present year (1884).

I. *Historical.*

Thirty years ago it was regarded as unsettled whether the Rotatoria are of separate sexes or hermaphrodites. The standpoint of investigation at that time will be best characterized by a passage from Siebold's 'Comparative Anatomy,' which I will here cite verbatim. It runs as follows:—"As the Rotatoria are provided with such distinct *female* sexual organs, one might also justly infer the existence of *male* generative organs in these animals; but notwithstanding the most careful endeavours, no satisfactory result as to the true nature of their male sexual apparatus has hitherto been attained, so that it is still doubtful whether the Rotatoria are hermaphrodites or possess separate sexes" †.

While these words were being published and read in Germany, the English naturalist, Brightwell ‡, discovered the small misshapen male of a Rotifer allied to Ehrenberg's genus *Notommata*, previously altogether overlooked. This was an epoch-making discovery, the importance of which was immediately recognized by Dalrymple and further developed by him in a detailed special investigation. The last-named naturalist furnished the proof that the male of *Notom-*

* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xli. pp. 226–251.

† Vergl. Anat. p. 184 (1848).

‡ Ann. & Mag. Nat. Hist. ser. 2, vol. ii. p. 153 (1848).

mata anglica possessed neither jaws, nor pharynx, nor stomach, but lived solely for amatory purposes *. Brightwell and Dalrymple are entitled to perfectly equal shares in the merit of this most important discovery, but hitherto only the latter has been mentioned by name in the text-books.

Some years afterwards (1854) Prof. Franz Leydig found himself in a position to demonstrate separate sexuality in a second example, a Rotifer newly discovered by him (*Notommata Sieboldii*). The female of this new species has a great similarity to that of *Notommata anglica*, but the male is very differently constructed. It is especially by the presence of four lappet-like arms (one pair situated at the neck, the other issuing from the middle of the body) that this male is distinguishable from that of the English Rotifer. In this case also it was proved that the male of *Notommata Sieboldii* possessed neither pharynx, jaws, nor stomach.

By these fortunate and important discoveries the notion was gradually established that separation of the sexes occurs throughout the Rotatoria; and Leydig expressed his (certainly not merely individual) opinion upon this point in the following terms. He says:—" In their structure the Rotatoria manifest too great a harmony for us not to draw the conclusion from the sexual difference of *Notommata anglica* and *Notommata Sieboldii* that the other genera also have the sexes separated upon two individuals " †.

The acumen and circumspection of Leydig soon succeeded in diagnosing other male forms from the descriptions and figures given by other naturalists. Thus Leydig established as clearly as possible that Ehrenberg's genus *Enteroplea hydatina* was erroneously described as a distinct genus, its representative really being only the male of *Hydatina senta*. Leydig also thought, and correctly, that *Notommata granularis* would prove to be the male of *N. brachionus*. This supposition, as is well known, was verified by F. Weisse (St. Petersburg).

By the Breslau naturalist Prof. Ferdinand Cohn, who has occupied himself in the most thorough-going manner with the organization of the Rotatoria, the reproduction of these animals was in 1854 made the subject of a special publication ‡. This is especially valuable, because Cohn was so fortunate as to be able to confirm Leydig's inferences by experiment, and thus the incontrovertible proof was furnished

* Phil. Trans. ser. 2, vol. iii. (1849).

† " Ueber Bau und die systematische Stellung der Räderthiere," Zeitschr. f. wiss. Zool. vi. 1855, p. 98.

‡ Zeitschr. f. wiss. Zool. vii. (1855), pp. 431–436.

that *Enteroplea hydatina* was the male of *Hydatina senta* and *Notommata granularis* that of *N. brachionus*.

Three years later (1858) F. Cohn communicated the results of his further investigations in an interesting memoir which appeared under the title of "Remarks on the Rotatoria," in the ninth volume of this 'Zeitschrift.' In the concluding pages of this publication Cohn expresses the opinion that in the Rotatoria a peculiar form of alternation of generations occurs, thus constituted:—"the fecundated females alone deposit hard-shelled ova, which pass through the winter, while the unfertilized summer eggs are developed, from which proceed directly either females again or, at certain seasons, males also."

Valuable information as to the anomalous structure of many Rotatoria was given in a memoir by Metschnikoff which was published in 1866 *. It treats of *Apsilus lentiformis*, the most remarkable peculiarity of which consists in the absence of any vibratile apparatus. This Rotifer also has separate sexes. This fact was first ascertained by Prof. R. Leuckart. Here also it was proved that the male is destitute of all traces of the digestive organs, while, on the other hand, the aquiferous system shows a considerable development.

It was ascertained by W. Salensky, who observed the embryonic evolution in *Brachionus urceolaris* (1871), that in this Rotifer the development of the two sexes takes place quite concordantly in the first stages. Only at a later period does the intestinal canal, which originally occurs as an invagination on the ventral surface in both males and females, undergo in the former a retrogressive metamorphosis and become aborted †.

Quite recently (1883) a memoir by Karl Eckstein ‡ upon the Rotatoria of the neighbourhood of Giessen has been published, containing numerous valuable observations. With regard to *Rotifer vulgaris*, however, even this memoir gives us very little information, and in the following statements I find myself thrown principally upon my own observations.

II. *The Material*

for my observations I obtained in two ponds situated directly in front of my house at Curmersdorf. Subsequently I obtained it from the "Froschgraben" which stretches between the town of Hirschberg and the village of Grunau, a locality which, after Von Flotow's and F. Cohn's investigations upon

* Zeitschr. f. wiss. Zool. xvi. (1866), pp. 346–356.
† *Ibid.* xxii. (1872), pp. 455–466.
‡ *Ibid.* xxxix. (1880), pp. 343–443.

Hæmatococcus pluvialis and *Stephanosphæra pluvialis*, must certainly be well known to a wide circle of naturalists. The last-mentioned interesting Volvocinean occurs in great abundance in the stagnant water of this ditch.

At almost all seasons the Froschgraben possesses an abundant fauna. Besides numerous species of *Chironomus*-larvæ, Cyclopidæ, Entomostraca (*Lynceus*), Nematoda, and Infusoria, three different species of Rotatoria are to be found here, viz.:—

1. *Philodina roseola.*
2. *Eosphora najas.*
3. *Rotifer vulgaris*:
   - (*a*) in a very large form (0·75 millim.), with reddish cuticle;
   - (*β*) in a smaller form (0·50 millim.), with perfectly colourless cuticle.

As I needed a great number of specimens I have experimented with the smaller *Rotifer*; the other two species did not occur in sufficient abundance, and I employed them chiefly only to obtain a more accurate notion of the characters of the Rotatorian organism. I found the large *Rotifer* cited under "3 *a*" specially adapted for this purpose; from its shagreened cuticle it might be characterized as *Rotifer granularis*.

III. *The Anatomy of* Rotifer vulgaris.

The external boundary of the bilaterally symmetrical body of our *Rotifer* is formed by a finely longitudinally striated, transparent cuticle, the interior, softer portion of which (hypodermis) consists of a homogeneous ground-mass with scattered granules. Leydig, who was the first to notice the existence of this second layer, describes it as the granular layer. The telescopically extensible foot (like the cervical process or proboscis) is to be regarded as merely an extension of the cuticle, not as an organ articulated to the latter. Division into segments, in the sense in which it occurs in the Arthropoda, is no more to be discovered in *Rotifer* than in the other Rotatoria. By this, however, it is by no means intended to deny that a sort of superficial segmentation divides the body in the Rotatoria into several segments placed one behind the other; this is undeniably the case, but no metamerous arrangement of the internal organs corresponds to these apparent segments. Bütschli therefore has rightly come to the conclusion that the jointing of the Rotatoria is typically different from the segmentation of the Annelida*.

* Zeitschr. f. wiss. Zool. xxvi. (1876).

In *Rotifer*, as in the other Philodineæ, the buccal aperture is *ventral*, and the anal opening *dorsal*.

The reception of nourishment is effected by means of the so-called "rotatory organ," from which the whole group of animals has obtained its name. In *Rotifer* this organ consists of two lobes, situated before the mouth and directed outwards like wings, which bear a strongly vibratile circlet of cilia, and have the office of whirling in nutritive material. The optical impression received by the observer of the incessant ciliary movement is that of two rapidly revolving wheels, and hence the name of "Wheel-animalcules" applied to them. This organ, which can be protruded and retracted at pleasure by the Rotifers, forms the true cephalic extremity; and the vermiform anterior third of the body, which bears the carmine-red eye-spots, may justly be regarded as a proboscidiform elongation. When the rotatory organ is retracted, a system of radiately arranged folds indicates the place where it is hidden in the body-cavity. When it is to be protruded, the animal shortens its anterior extremity about one half, and throws it quite back upon the neck, much as shown in fig. 2. During this sudden backward movement the border of the rotatory organ issues, already vibrating, and the motor muscles of the latter protrude the two "præoral lobes" completely. The play of the cilia begins immediately, and numerous swarm-spores of Algæ, Diatomaceæ, Infusoria, &c. are carried down into the *œsophagus*, which is also lined with cilia.

This latter leads into the so-called pharynx [mastax], which contains the two denticulated jaw-plates, and possesses a strong apparatus of muscles. When the rotatory organ is unfolded these plates are in constant movement and ready to crush whatever comes within their reach. By the older observers (Leeuwenhoek, Joblot, Fontane) the masticating apparatus of the Rotifera was erroneously regarded as a heart. If we examine a specimen of *Rotifer*, lying with the ventral surface upwards, under a microscope of good definition with a power of 750 diameters, we see the lower surface of the pharynx, which is turned towards us, furnished with three gland-like appendages. The third and largest one pushes itself, like a wedge, between the two smaller ones, which converge towards one another, and thus is produced a glandular complex which occupies the whole lower surface of the pharynx. Eckstein (*l. c.* p. 445) thinks that in *Rotifer* and *Philodina* no separate lobes are to be distinguished in the glandular mass. I can explain this statement, which differs completely from the results of my own observations, only by supposing that the Giessen observer has examined the pharynx of a *Rotifer* only from the dorsal side. In this case the glandular mass protruding on each side certainly appears *un*lobed; but it is in reality not so, as the application of the microscope to the ventral surface of the animal proves. The three glandular lobes then at once catch the eye. As regards the minute structure of these glands (which may best be distinguished as *stomach-glands*), their contents consist of a pale glandular mass containing clear nuclei (with nucleoli). There can hardly be any doubt that these organs are destined to pour into the stomach a secretion subservient to digestion. As is well known, a similar provision occurs also on the pharynx of many insect-larvæ, especially in the larvæ of *Chironomus*, in which a whole circlet of such stomach-glands is always to be met with.

In the region where the œsophagus opens into the pharynx, but upon the ventral side, there are always two large cells (furnished with a nucleus), which are placed close together and apparently partially amalgamated. Frequently, instead of one, we see *two* fine round nuclei in each of these two cells.

From the pharynx the food, crushed and mixed with the glandular secretion, passes into the *chyle-intestine* (stomach), which, in the Rotifera that I have examined, possesses a distinctly perceptible intima. This is very probably to be regarded as a direct continuation of the chitinous lining of the pharynx. It also passes into the intestine and is there particularly strongly developed. This intima is surrounded by a finely granular mass, which again is enclosed by a delicate-walled tube. This mass appears to be the seat of an *absorbent* faculty, for, according to the nature of the food taken into the stomach, it immediately acquires a greenish, brownish, or reddish colour. If the animals are left to starve the granular mass gradually becomes quite decolorized, and acquires a shining grey appearance. From its function it is evidently to be compared with the epithelial cell-layer of the middle intestine of many insect-larvæ (e. g. *Chironomus*). As in these, so in *Rotifer*, the source of fat-globules is to be recognized in this absorbent layer. With abundance of nourishment extraordinarily large oil-drops make their appearance in the interior of the intestine of *Rotifer*.

The intestine, as already mentioned, possesses a very thick wall, and is generally tightly packed with excrement. It opens outwards, together with the so-called "*contractile vesicle*," into the dorsally-placed cloaca.

This vesicle, on which a considerable muscular coat is recognizable, morphologically represents only a dilated part, corresponding to the point of union, of the two *excretory* *vessels* ("respiratory canals"), which run on both sides in the interior of the body-cavity of *Rotifer* into the vicinity of the rotatory organ. These canals have throughout a lumen of equal width and a tolerably strong wall; upon them are seated at various parts the so-called tremulous organs or cilio-faculæ, about the structure of which there is still much dispute. I will here briefly state what I have been able to see in them.

In *Rotifer*, in which I counted five such organs upon each side, I have ascertained, by the employment of an excellent homogeneous immersion-lens from the workshop of E. Leitz, in Wetzlar (focus $\frac{1}{16}$ inch), with a moderate eyepiece, that each tremulous organ has the form of a cylindrical beaker, seated by its tapering extremity upon the excretory vessel. The beaker is open above, and the broad cilium inserted at its bottom projects a little beyond the aperture. I know very well that my description is imperfect, and that it differs from the representations given by other authors; but every one can say with a good conscience only what he *believes* he has observed. We are here on the limit of microscopic vision, and the probability of error is very great. I see, however, that Metschnikoff gives a similar description of the tremulous organ in *Apsilus lentiformis*, saying with regard to that Rotifer, "On each side there are two funnels opening into the body-cavity. In the base of each funnel is seated a long lobe vibrating in an outward direction" *. From my observations I must perfectly agree with the Russian naturalist, although so distinguished an observer of the Rotifera as Leydig states that in the tremulous organs observed by him the direction of the oscillation is *inwards*. Even under a power of 1500 diameters (Leitz's homogeneous immersion of $\frac{1}{16}$ inch and ocular no. 3) the condition of things appeared to me not otherwise than as above described. I saw that the oscillation of the cilia was so violent that the beakers surrounding them were kept in constant tremulous movement.

After these observations I determined to bring the tremulous organs of a female of *Brachionus urceolaris* into comparison. A fine large specimen was soon found, and this I examined under exactly the same power as my *Rotiferi*. The result obtained, however, was not of such a kind that I could employ it in support of my observations on the tremulous organs of *Rotifer vulgaris*. I will here merely describe what I observed, without troubling myself as to how it is to be brought into accordance with the previous observations upon *Rotifer*. I took the greatest trouble to discover a contour

* Zeitschr. f. wiss. Zool. xvi. p. 349 (1866).

which *might* be construed as indicating an aperture; but in this endeavour I did not succeed. It even appeared that the direction of oscillation was *inwards*, and that the cilium, which beat much more violently than in *Rotifer*, was attached to the upper closed end of the organ.

I repeated my observations upon this point a few days afterwards, but came again to the same result.

Now I find from Eckstein's memoir that this naturalist has made observations upon the tremulous organs of *Rotifer vulgaris* which differ considerably from mine, and rather agree with what I believe I have seen in *Brachionus*. I say expressly that for my own part I indeed entertain the conviction that I *could* see nothing else in the material at my disposal; but this does not exclude the possibility that other observers may have had the advantage of more favourable objects, and perhaps made more numerous observations than myself.

According to Eckstein the tremulous organs of *Rotifer vulgaris* are of a clavate form and attached by the thinner end to the lateral canals. At the upper end they are closed by a hemispherical lid, to the middle of which the long cilium is attached. Beneath this lid Eckstein thought he detected an oval aperture, which, however, does not extend to the free extremity of the cilium. In his opinion, which is identical with that of Leydig, the waste fluids of the body are carried from the body-cavity into the excretory ducts by the vibrating cilium, passing from them into the contractile vesicle, and thence outwards.

I leave this observation to stand on the same footing that I claim for my own. Eckstein certainly only states what he has seen. In the presence of such diverse observations, however, one may inquire into the cause of the diversity, and this, in my judgment, is to be found in the influence which the quicker or slower motion of the oscillatory cilium exerts upon our visual organs. In *Rotifer*, in which the cilium oscillates more slowly, I had the impression that the beaker-like organ was open at the top. But in the tremulous organ of *Brachionus*, in which the cilium shows a strong flickering motion, and oscillates in short undulations, the resulting motion from this, in combination with the recognition of the *convergent* lateral contours of the organ, is that the latter must be closed above. This conclusion we arrive at quite against our will, because a briefly undulating cilium, projecting somewhat above the margin, simulates the optical section of a cap-like operculum, which really does not exist. That K. Eckstein has recognized a "hemispherical operculum" also in *Rotifer* may perhaps be due to the individual constitution of his visual organ or to the circumstance that his specimens of *Rotifer* were furnished with more rapidly vibrating cilia (*i. e.* fresher) than mine.

It is waste of time to dispute about this. All observations in which we must approach the limit of microscopic vision are precarious. Consider only the question as to the general constitution of the striated muscular fibre, as to which the observations of investigators are often diametrically opposed. Wherever the diffraction phenomena of light come into play microscopic anatomy must put a bridle upon its desire of knowledge.

I proceed now with the exposition of the anatomical characters of the body of *Rotifer*. On each side of the chyle-intestine, about the hinder third of the body, are situated the fusiform ovaries. One of them is usually considerably larger than the other; but each of them is enveloped by a thin transparent membrane, which is drawn out at each end of the organ into a solid cord. The posterior and thicker of these cords passes into the foot and is attached in the vicinity of the contractile vesicle; the other is longer and more delicate, so that its point of attachment in the anterior part of the body can with difficulty be determined. It is not to be denied that this mode of attachment of the ovaries has a striking similarity to those which occur in the still undeveloped ovaries of the larvæ of *Chironomus plumosus*, *Corethra*, &c. As is well known the above-mentioned Dipterous larvæ, shortly before their escape from the egg (frequently also even earlier), already possess, in the last segment but three, on each side a distinctly recognizable, fusiform sexual rudiment, which, indeed, is frequently concealed by the adipose body, but is never wanting in the portion of the body indicated. In *Rotifer* and the other Rotatoria each ovary consists of a finely granular colourless substance, in which are imbedded large dark nuclei, surrounded by lighter spaces. Leydig has interpreted the nuclei as germinal spots and the light zones around them as germinal vesicles. In the smaller ovaries I count five or six, in the larger ones from twelve to fifteen such structures. Frequently the ovaries seem nearly to disappear; at least I have observed that in many examples of *Rotifer* they are scarcely a fourth of their original size.

In the description of the body-cavity of *Rotifer* it must also be mentioned that it is seldom quite free from embryos. Usually three are contained in it, one of which is generally pretty far developed, while the other two are only in course of formation. During the movements of the parent-animal the progeny are driven to and fro in the most reckless fashion, stuck up on their heads, pushed on one side, and in general their existence is so completely ignored that it is wonderful how, under such circumstances, the young Rotifers manage to get developed. But in spite of the observer's wonder this takes place, according to the temperature of the water, in from five to eight days after the separation of the ovum from the ovarium. The actual birth I have never been able to observe, and it is to me quite a mystery through what portal the young animal quits the body-cavity of the mother.

We have still to glance at the anterior portion of the body of *Rotifer*, which bears the two carmine-red eye-spots, each furnished with a crystalline body. When examined from the dorsal surface this section shows, in the first place, the triangular *ganglion*, placed immediately in front of the masticatory apparatus. In *Philodina roseola* the eye-spots are situated immediately over this triangle (in the nape), and it looks exactly as if the animal carried about with it upon its back the drawing of a fox's head with the snout in front. The resemblance is striking, and by no means depends upon a subjective notion. In *Rotifer* the anterior angle of the triangle emits two hardly visible branches towards the two eye-spots. Besides these there seems to me to be a union of the same angle with the retractile organ which exists at the extreme anterior end of the body, and bears a circlet of short cilia, together with two long tactile setæ. The so-called *cervical lobe* (erroneously named "respiratory tube") is also united with the cerebral ganglion by a commissure. Here, no doubt, we have to do with a sense-organ, as is proved by the fact that the animal (before passing from the contracted to the extended state) protrudes this lobe to feel about, and quickly retracts it again if a *Paramœcium* or a *Daphnia* comes in contact with it in swimming by. At its superior extremity the organ bears a tuft of tactile setæ. In fig. 3 I give a superficial and lateral view of the anterior extremity of the body in *Rotifer*, from which the reader may easily understand the conditions which occur.

When the rotatory organ is retracted it appears in the dorsal view in the form of two semicircular plates, of which the middle part refracts the light less strongly than the margin, which appears somewhat inflated. On each side there is in anatomical connection with the posteriorly directed horn of these plates, a lobiform mass of substance, as to the interpretation of which I am not quite clear. When the rotatory organ is protruded the two lobes in question move somewhat further forward, so that they appear to be half taken into that organ. Have we to do here with salivary glands (besides the above-mentioned stomachal glands)? This I do not know.

I have still to say a few words about the *muscular system* and the "*pedal glands*." As to the function of the latter we have only recently ascertained anything. With Ehrenberg these "clavate, turbid, elongated bodies" were problematical organs. In interpreting them he hesitated between muscles and sexual glands. We now know that they are the seat of a secretory activity, and secrete a sticky product, which serves to attach the animal to smooth surfaces. As regards the muscles, I shall content myself with stating that the masticatory apparatus and contractile vesicle possess special muscles, while elsewhere longitudinal and transverse muscles are present. The latter were regarded by Ehrenberg as blood-vessels. In *Rotifer* we observe in the region of the head a complex ramification of muscular fibres, which cannot be specially traced. There is no circulatory apparatus for the blood in any *Rotifer*. The *blood* occupies the body-cavity quite freely, and its movement is maintained by the contractions of the body. True blood-cells cannot be recognized; but at all times fine fusiform and rounded elements are suspended in the body-fluid, which very probably functionally represent blood-cells.

IV. *The Embryonic Development of* Rotifer vulgaris.

When we have a great number of specimens of *Rotifer* at command, we always find one or more of them in which the *constriction of the ovum from the ovary* may be traced. There is first produced a small swelling on the latter. On close observation this proves to be densely packed with vitelline granules, so that the gradually increasing raised portion stands out clearly by its darker and granulated appearance against the ovary, which remains clear. It now appears as if all the vitelline formative material collected together at a single point of the ovary. Something of the same kind must also have been recognized by previous observers in other species of Rotatoria. Thus Leydig describes the ovary of *Notommata centrura*, and says:—"Only one half of it has vitelline granules, among which again numerous darker spots of accumulation are to be recognized." Upon the horseshoe-shaped ovary of *Pterodina patina* the same author also remarks as follows:—"In one limb we distinguish the germinal vesicles with their germ-spots and the finely granular vitelline mass between them; the other limb displays scarcely anything but vitelline substance, the molecules of which are here larger." Similar observations were also made by Prof. Leydig upon the ovaries of *Brachionus*, *Noteus*, and *Euchlanis*, from which that naturalist thinks he may draw the conclusion that in the ovaries of the Rotatoria in question we have an approximation to those forms of ovaries in which (as in Hexapoda and Asellina) the production of the germinal vesicles and of the yelk-mass devolves upon different parts of the ovary*.

According to what I have quite definitely observed in my *Rotifer* I cannot adopt this view. It certainly *appears* as if a separate vitelligenous focus existed in such ovaries; but we soon see the germinal vesicle come into sight in the midst of the swelling and take its place outside the ovary. The swelling, which is originally sessile upon the ovary, increases gradually in size and becomes more and more sharply constricted off from its place of origin. Finally the conditions are reversed: the maturing ovum gradually attains its definitive size, and then we see the much-diminished ovary attached to the ovum, while previously the reverse was the case.

The separation by constriction is at last completed (in about three or four hours), and the ovum, in which the germinal vesicle with the germinal spot is distinctly visible, drops into the body-cavity, where it is driven to and fro in the most unceremonious manner by the contractions of the animal. The process of separation is so effected that a portion of the enveloping membrane of the ovary is separated with it and transferred to the ovum, so that the embryo in its development lies in a completely closed hyaline vesicle, which, from its origin and function, is to be regarded as a real *uterus* ("*poche de maturation*," Joliet). Under a magnifying-power of 700 diameters, with good definition, the envelope surrounding the embryo (the presence of which has often been disputed) may be recognized with the greatest distinctness.

The *segmentation* of the egg of *Rotifer* is very difficult of observation, because the animals suitable for investigation cannot at pleasure be brought to repose and prevented from creeping about. The application of a compressorium is injudicious, as the least pressure exerted upon the objects under observation causes their contraction. There is nothing for it therefore but to arm one's self with patience and to take care to keep the egg constantly in the field of vision by suitable movements of the object-slide. Very often, however, the desirable circumstance occurs that the animalcules attach themselves with the foot, unfold the rotatory organ, and remain for ten or twenty minutes in this condition. This happens, however, only when they feel quite comfortable, and the illumination is not too bright.

* Zeitschr. f. wiss. Zool. vi. (1855), pp. 37, 47, and 94.

The following is what I have been able to ascertain by the investigations of months (February to July 1884) upon the development of *Rotifer vulgaris*. After its separation from the ovary the egg shows a centrally-placed germinal vesicle with a distinct germinal spot. The development of the embryo commences by the contours of the germinal vesicle becoming indefinite, until it fades away and finally becomes quite invisible. When this has taken place the yelk-granules show a tendency to accumulate in the middle of the egg, so that a darker central mass and a lighter peripheral layer may be distinguished. In from twenty to twenty-five minutes, however, the egg-contents gradually clear again, and under suitable illumination we discover that a division of the germinal vesicle has taken place. The latter has certainly only a little diminished in size, which no doubt is to be explained by its substance having been replaced from the yelk. From the recent observations of Ludwig Will*, according to which masses of nucleus-substance issue from the germinal vesicle and become converted into yelk-substance, the reverse of this process is also conceivable. The arrangement of the products of division and the original germinal vesicle is usually such that the latter are placed in the vicinity of one pole of the egg, and the daughter vesicles in the region of the other pole.

I have never been able to observe directly in the egg of *Rotifer* the mode of segmentation; but as the daughter vesicles are always smaller than the original nucleus, it is probable that the former proceed from the latter by a process of gemmation. Something like this, as is well known, occurs also in the segmentation of the egg of *Rhodites rosæ*, in which (according to Weismann's observations) the so-called "posterior pole-nucleus" likewise increases by gemmation †.

It is worthy of note that the vitelline elements do not immediately group themselves around the progeny of the germinal vesicle, but there is rather a lapse of a certain time (several hours!) before the commencement of a blastomere-formation is to be recognized. So far as I know, this fact has previously been indicated only by Leydig, who, as long since as 1855, puts the following question with regard to it:—"Are we to conclude that the germinal vesicle in the ovarian egg has become converted directly by continual division into many nuclei . . . . . or do the winter-eggs perhaps, even at their origin in the ovary, enclose a number of nuclei (germinal

* Zool. Anzeiger, 1884, nos. 167, 168.

† Beiträge zur Kenntniss der ersten Vorgänge im Insektenei, pp. 85 *et seqq.* (1883).

vesicles), in opposition to other eggs, which always possess only one nucleus?" *

By my observations a clear light is thrown upon the occurrence of a considerable number of nuclei in the eggs of many Rotatoria, inasmuch as I have been able to ascertain that between the blastomere-formation and the increase of the original nucleus (by gemmation) there is an interval of several hours. Accidentally I once met with an egg with *four* daughter-nuclei, although no trace of the commencement of segmentation was to be observed. Generally the grouping of the vitellus into blastomeres commences when *three* nuclear buds have separated. As we shall see by this the foundation of the *epiblast* is already provided. By the formation of grooves, the progress of which is scarcely perceptible, three blastomeres are finally formed, each of which contains within it a daughter-nucleus. These are seated like a saddle upon the still unsegmented larger half of the egg, and appear then to increase at the expense of the latter (which visibly becomes smaller). The result of this increase is at the same time an envelopment of the half of the egg which has remained undivided by the products of division of the original three blastomeres—a process which leads to formation of a so-called *hood-gastrula*. The *outer* lamella of this is represented by the enveloping cell-mass, the *inner* one by the at first passive half of the egg, which, however, begins to be segmented when the envelopment has advanced so far that only a small aperture (blastopore) still remains to be closed.

When this closure has taken place the protoplasm of the blastomeres, which have in the meanwhile increased in number and diminished in size by repeated division, becomes fused together, and then is produced a tolerably dense layer, furnished with numerous nuclei, which no longer allows us to trace the fate of the great hypoblastic cell. But there can be no doubt that morphologically this must be regarded as the equivalent of an inner lamella, if we consider the details of the process of segmentation in the egg of a wheel-animalcule (*Philodina roseola*) nearly allied to *Rotifer vulgaris*.

In the Riesengebirge, and especially in the neighbourhood of Hirschberg (near the village of Grunau), we have a very large species of the above-mentioned *Philodina*, the eggs of which are quite peculiarly adapted for embryological observations. The intestinal canal of this animal is of a cinnabar-red colour, and we find the same pigment also in the vitelline granules of the egg, a circumstance which is of particular importance, as I remarked more and more as I continued my

* Zeitschr. f. wiss. Zool. vi. p. 102 (1855).

studies from day to day. I cultivated great quantities of these animals in two small aquaria filled with rain-water. Swarm-spores of Algæ served as their food. Early in the morning (at 4 or 5 o'clock) I constantly found, seated at the margin of the aquarium, colonies of the size of a pin's head, which, on microscopic examination, proved to consist of 30–40 individuals. Among them were to be seen 50–60 eggs, either freshly deposited or already in course of development, which one of course has to make use of at once. That so many observers of Rotatoria have failed (as appears from the memoirs on the subject) in obtaining eggs *just deposited* is due simply to the fact that they did not get up early enough. So far as I can judge, the deposition of eggs in *Philodina roseola* takes place only very rarely during the later hours of the morning, and not at all in the afternoon. This condition has its analogue among the lower forms of plants. To the botanist it is well known that the conjugation of many Algæ takes place only in the earliest hours of daylight.

While the mature egg of *Philodina roseola* is still in the body-cavity of its parent, the germinal vesicle always lies at that pole which is turned towards the anal aperture. I was never able to detect a germinal spot in *Philodina roseola*.

Upon the first stages of development I have to state what follows. In the deposited egg the germinal vesicle immediately disappears, and, just as in *Rotifer*, the vitelline granules accumulate around a central point, so that a peripheral layer of protoplasm, with but few granules, makes its appearance in the egg. Gradually, however, the contents of the latter become homogeneous, but only for a time, for very soon the yelk becomes clearer at two neighbouring points of the long axis of the egg, and between these is produced the first groove, by which the contents of the egg are divided into two unequal parts. In proportion as the deepening of the groove proceeds, the nuclei of the first two segments also appear with more distinct contours. That the first segmentation-nucleus is developed by gemmation from the nucleus of the egg I have several times directly observed in *Philodina roseola*. For the elucidation of this I refer to fig. 4, in which four consecutive stages of the process of gemmation in question are represented. At the commencement of the gemmation the true viscous nuclear substance within the fine envelope containing it performs amœboid movements (stage 1, fig. 4). But within a few minutes the budding daughter-nucleus distinctly appears (stage 2). Immediately after its production this divides into two or three equivalent structures (stage 3), and I have even observed a case in which the whole nucleus (including the bud) in this stage acquired the form of a rosette (fig. 4, 4), and gave origin simultaneously to five daughter-nuclei. In the formation of the other blastomeres the origin of the daughter-nuclei belonging to them from the original germinal vesicle may almost regularly be observed.

It is worthy of mention that in the egg of *Philodina roseola* the occurrence of a small *segmentation-cavity* may be definitely recognized. *I have been able to recognize this structure, not only in isolated cases, but in all the eggs of which I witnessed the first stages of development.*

After the formation of the first *smaller* segment, the segmentation advances as follows:—Two other blastomeres are produced from the larger half of the egg, take the original first divisional piece between them, and become amalgamated with this superficially.

As in *Rotifer vulgaris*, so also here, we observe that the first three blastomeres now also divide and begin to grow round the hypoblastic half of the egg. In the latter, in the meanwhile, more vitelline granules have accumulated than in the foundation of the epiblast, by which means, as we shall see, it becomes possible to keep the hypoblastic cell in view during the subsequent development. By degrees the still unsegmented very granular portion of yelk is regularly flowed round by the dividing blastomeres, and surrounded as with a hood. But before the blastopore of the latter is completely closed two smaller portions separate off from the hypoblast, and these are distinctly marked by the great abundance of granules they contain. They are of a *deep red colour*, and lie just within the blastopore. I do not hesitate to interpret these red cells as the rudiment of a *mesoblast*, from which the ovaries, the muscles, the excretory vessels, and the clavate organ (in the foot) originate.

The developing mesoblastic rudiment does not form a layer, but only a *cell-cord*, which grows from each side towards the anterior end of the body (between the epiblast and hypoblast). It is impossible to trace this growth in detail, because finally the larger hypoblastic cell begins to divide, and then the differentiation of the middle from the inner lamella becomes illusory. But by turning the egg upon its long axis we see that the mesoblastic cell-cord does not take a central course, but is more approximated to one half of the egg than to the other.

I do not think I am mistaken in regarding the first-mentioned red cells as those "primordial cells of the mesoderm," the occurrence of which in the development of the Annelida (in *Criodrilus*) was long since observed and described by Hatschek *.

Hatschek's fig. 1, pl. i. of the memoir cited, shows the cells in question exactly in the same position, with regard to the two primary lamellæ, in which I have met with them in the egg of *Philodina roseola*. In the latter object I could also ascertain beyond doubt *that the mesodermal rudiment takes its origin in the form of a portion cut off from the hypoblast.* When Hatschek says of these mesodermal cells "that they show a nearer relationship to the entoderm than to the ectoderm," it is correct and easily intelligible, as they stand in no genetic connexion with the latter.

By the evidence adduced by me the Rotatoria also show a significant relationship to the larva of *Polygordius* (the *trochophora*), of which we know that it possesses mesodermal streaks of exactly the same cellular constitution as the embryo of *Philodina roseola*.

Very probably the presence of a similar mesodermal rudiment would be ascertained also in *Rotifer vulgaris*, if we had any means of tracing the hypoblast in this animalcule more distinctly. It is, however, quite impossible in the case of *Rotifer* to ascertain anything about its further fate (after the ectoderm has grown over it). I obtained no result even by staining it (with methyl-green).

As regards the subsequent development of the embryos of *Rotifer vulgaris*, in the first place a cephalic and a caudal portion are constituted by a transverse furrow which early makes its appearance upon the ventral side. On the former the delicate outlines of the rotatory organ very soon appear in the form of two semicircular folds, which meet together in a middle line, the future œsophagus. At the same time we observe on the caudal (or pedal) portion some shallow emarginations by which the subsequent superficial segmentation of this section of the body is already expressed.

In the early developmental stages of *Rotifer* not the least trace of the internal organs is to be discovered; but their presence and their perceptibility certainly do not occur at the same moment. For no doubt the intestine is already present when the outlines of the pharynx and its denticulated jaw-plates begin to show themselves, which, as is well known, happens rather early. That at this period we are still unable to detect the digestive canal is probably due only to the fact that the difference between its refractive power and that of

* 'Studien über Entwicklungsgeschichte der Anneliden,' 1878, pp. 3 and 92 *et seqq.*

the surrounding tissue is considerably less than that which exists between the latter and the chitinous lining of the pharynx. It is therefore to the accidental existence of such a difference that we must ascribe the particularly early recognition of the pharynx in *Rotifer*.

Then there is in the posterior part of the embryo a small vacuole-like cavity, the early existence of which must be recognized. At the spot where this cavity is to be observed in embryos of *Rotifer* we see in young animals of *Lacinularia*, *Stephanoceros*, *Floscularia*, &c., small aggregations of granules (so-called "urinary concretions") which seem to be enclosed in a special vesicle. I am uncertain whether from the existence of these concretions the presence of a primordial kidney may be inferred, and only mention the interesting fact that Aubert also has observed in the embryo of *Aspidogaster conchicola* "two remarkable black points or spherules," of which he says that they strongly refract the light, have a stratified appearance, and constantly occur at the same spot (between the ventral sucker and the intestine) *. This is evidently perfectly analogous to the cases above referred to in connexion with the Rotatoria.

When the embryo of *Rotifer vulgaris* has advanced so far that it presents an exact likeness of its parent on a smaller scale, it begins to move briskly, and during this the uterine vesicle (*poche de maturation*) in which it is enclosed is in course of time ruptured. It is now quite free between the intestine and the body-wall, which space constitutes a sort of nursery for it after it has undergone the first act of its birth. We see such embryos, *i. e.* young Rotifers, creep about actively within the body of the parent, and frequently also the jaw-plates of the young animals are in clapping movement. In some cases I have seen such embryos with perfectly unfolded rotatory organs, making experimental vortices within the body-cavity of the parent. But this has occurred only two or three times during my investigations of many months.

I have already mentioned that I have never been able to see how the mature embryo escapes from the body of the mother, and is, so to speak, born for the second time. I doubt that the portal through which the young creature quits the narrow domain of its development is to be found in the cloacal aperture. The terminal intestine and the contractile vesicle alone open into this aperture. It must remain for other students of the Rotatoria to solve the mystery of the

* Zeitschr. f. wiss. Zool. vi. (1855), p. 370.

birth of these animals. I confess my complete ignorance upon this point.

V. *The Reproduction.*

On the 15th February, 1884, I found in one of my glasses some examples of *Rotifer* which showed eggs of the known size and form floating in the body-cavity, but besides these bore, attached to the inner surface of the cuticle, other egg-like structures, which seemed to derive their origin (by gemmation) from Leydig's "granular layer."

This was to me an extremely unexpected and startling sight. On closer examination the whole of the Rotifers in the glass in question proved to be furnished with such ova of the second kind. By selecting suitable examples it was possible to follow the progress of the process of budding with the greatest distinctness. Every drop of water that I placed upon an object-slide contained ten or twelve Rotifers. In these the budding-ova could be observed in all possible stages of maturation.

But were they really "ova" that here presented themselves to observation? This question naturally occurred to me, and I examined the literature that I had at my disposal in connexion with this point. But nowhere could I find any statement from which I could infer that before me any one had observed such budding-ova in *Rotifer*. Unexpectedly there came into my hands a note in the 'Archiv für Naturgeschichte' (1871, Bd. ii. p. 468), according to which Ganin had ascertained the formation of eggs by budding in *Callidina parasitica* (a Philodinid parasitic in *Gammarus pulex*). According to Ganin's report the egg-buds originate from the matrix of the cuticle, surround themselves immediately with a structureless membrane, become further developed, and then separate by constriction. But, together with these, true ova capable of development are also produced by the same wheel-animalcule.

This note agreed admirably with my own observations. I had seen the development of the buds from the granular layer (= matrix). I had accurately ascertained that these gradually grow into ellipsoidal structures, which, in external form, exactly agree with the ovarian ova of *Rotifer vulgaris*. However, the matrix-ova observed by me remained in connexion with their place of origin even after they had attained their definitive size. It was only in a few instances that I found them floating in the body-cavity like the ovarian eggs. Otherwise they always had their anterior extremity imbedded in the granular layer, and a small process even passed into the interior of the chitinous cuticle. Seen from the surface they appeared somewhat differently. I now ascertained that the cuticle immediately over the egg *was perforated*, and that the micropyliform opening thus produced appeared to be surrounded by a small annular wall (fig. 5) *.

I have seen such "eggs" attached from within both at the anterior and posterior ends of the body in my Rotifers. That any definite position was preferred for their attachment could not be perceived. Nevertheless it sometimes seemed as if the anterior part of the body-cavity (on the right) and the posterior part (on the left) more frequently bore "eggs" attached to them than other places. The appearance of the structures in question, when they have attained their definitive size, is shown by fig. 6. The whole forms an oval hyaline vesicle, at one pole of which there is a globular finely granular structure; while in the neighbourhood of the micropyloid aperture a vacuole-like cavity has been developed. I think I have observed that the vacuole can change its place within the vesicle; in many cases I have seen it in the immediate neighbourhood of the globular structure. The latter appeared to me to be capable of certain amœboid movements; I have seen it sometimes furnished with knobs and blunt diverticula, which, however, were retracted after a short time.

Up to this point I had made my observations under a power of only 550 diameters, but now it occurred to me to examine the vacuole, which, under this power, appeared quite light and clear, with a Leitz oil-immersion objective (of $\frac{1}{16}$-inch focus and a numerical aperture of 1·25). The employment of this objective gave a power of 900 diameters.

When I now glanced into the microscope my astonishment was great. The vacuole showed in its interior numerous swarming filaments, and, indeed, most of them were accumulated at the side where the wall of the vacuole touched the globular body (fig. 7). What were these filaments?

Since I became acquainted with Ganin's previous observation I had no other thought, *à priori*, but that I had before me true (although differently formed) eggs of *Rotifer*, and in

* On a careful examination of fig. 1 (*Stephanoceros Eichhornii*) on the first of the four plates which Prof. Leydig has appended to his fine memoir on the structure and systematic position of the Rotatoria, I see a structure, marked with the letter *h* (on the right at the fore part of the animal), of which the distinguished histologist confesses that its significance was unknown to him. He describes it as "a group of limpid vesicles which open on the cuticle by a duct, which, although short, is distinct in a suitable position." Have we not here a similar observation to that which I have frequently made in *Rotifer*?

accordance with this nothing was more natural than to regard the motile filaments in the interior of the vacuole as *spermatozoids*.

There was yet another circumstance that strengthened me in this conviction. Thus one day I observed that some of my examples of *Rotifer* were endowed with remarkable sac-like *appendages*, which were always situated exactly at the spot where the micropyloid aperture of the "egg" passed out through the cuticle. I observed these little sacs for hours, but could not at first arrive at any conclusion as to their nature. I only obtained an idea of how firmly they must adhere to the *Rotifer*, because they kept their position, as if firmly rooted, in spite of the rapid movements of the animals through whole masses of algal growth. After some time I happened to make a few preparations (merely in order to see whether the glass vessels still had living inhabitants), and then I succeeded in observing the following process in one of the saccules:—

In the apparently homogeneous contents of this a vacuole suddenly made its appearance (fig. 8, *a*), and moved downwards (towards the micropylar structure) pretty rapidly. The passage of the vacuole through the opening in the cuticle actually took place, and then immediately there appeared within the "egg" a small vesicle of the same kind, only rather smaller (fig. 8, *b*). A portion of the original vacuole remained behind in the neck of the micropylar orifice. Where the vacuole first appeared in the saccule a sharply contoured fissure made its appearance, which, however, soon showed dissolving margins, and finally disappeared altogether. Two minutes afterwards a new vacuole formed at the same spot as before; but this immediately broke up into two smaller ones (fig. 8, *c*), and both these again took their course towards the micropyle. This time *both* passed into the vesicle, so that now three such structures were present in it. Two of these, however, soon fused together, and then only two remained; but in about fifteen minutes these also united and caused the formation of a single larger cavity in the interior of the ovate vesicle.

All these remarkable processes I believed to be connected with a hitherto overlooked sexual mode of reproduction in *Rotifer vulgaris*, and this the more because the saccules vividly remind one of the spermatophores of many Crustacea (Cyclopidæ).

Prof. Ehlers (of Göttingen), however, called my attention to the fact, that years ago (1872) Prof. Friedrich von Stein (of Prague) described, before the meeting of naturalists at Leipzig, an Infusorial parasite belonging to the order Suctoria (and therefore allied to the Acinetina and Opalina), which my description of the egg-like structure in the body-cavity of *Rotifer vulgaris* suited most exactly. Prof. von Stein was now consulted with regard to the present case, and he had the kindness to compare my representation with his own previous observations. From this it became exceedingly probable that I had again met with the same parasite which Prof. von Stein had formerly discovered and described under the name of *Trypanococcus rotiferorum*.

Prof. von Stein, in the discourse which he delivered before the above-mentioned meeting of naturalists, made very detailed statements upon the organization of *Rotifer* and the structure of *Trypanococcus*, but unfortunately he did not prepare a report upon it for the 'Tageblatt.' This explains why *Trypanococcus* is not so well known as it certainly deserves to be.

What I regarded as a cavity (vacuole) filled with spermatozoids in the supposed "egg," is, according to Stein, the body-cavity of the parasite, which is lined with delicate, constantly vibrating cilia. From this body-cavity a canal (œsophagus) is supposed to go to the repeatedly-mentioned micropyloid aperture, which then would acquire the significance of a mouth. Upon this, however, I have to remark that I have *never* observed the presence of such an œsophagus even when employing the oil-immersion lens. If I had recognized any canal of the kind I should hardly have arrived at the notion that the structures in question were to be interpreted as "eggs." On the other hand, I must admit that a stomach with cilia on its inner wall very well explains the visual impression which I referred to a vacuole filled with swarming filaments. The globular structure in the vesicle of *Trypanococcus* is regarded by Stein as the nucleus of the Infusorial parasite.

The question now arises, however, as to what is represented by the *saccules*, the presence of which I have quite indubitably ascertained, and in which I was able to detect such peculiar phenomena of contraction with formation of vacuoles. Prof. von Stein declares that he never saw such sacciform appendages upon his Rotifers; but he is of opinion that they may very well be interpreted as a phenomenon of reproduction. Possibly a ciliated offshoot may be produced by gemmation, from which, finally, the motionless and parasitic *Trypanococcus*-vesicle proceeds. It is unfortunate that Prof. von Stein has no facts relating to the actual course of such a bud-formation, and that, in consequence, we can here proceed only upon hypothetical grounds. It was precisely these saccules, which appeared to me to be attached (connected) from without, that supported me in my notion of a sexual form of reproduction in *Rotifer*, although I should have been at a loss to indicate in this group of animals any organ which presumably might have the function of a male sexual gland.

The objections of Prof. von Stein to any other view than that in the present case we have to do only with *Trypanococcus*, are certainly of great weight. Nevertheless the matter is not yet fully elucidated, and it is of the greatest interest that all naturalists who occupy themselves seriously with the anatomy of the Rotatoria should look out for the presence of *Trypanococcus*, by which means we may by degrees obtain more accurate information as to the history of the reproduction of this remarkable Infusory.

For the elucidation of the question of egg-gemmation it would also of course be of great importance if Prof. Ganin would have the kindness to give further details of his observations, made in the year 1871, upon *Callidina parasitica.* He has no doubt already done this in no. 6 of the 'Transactions of the University of Warsaw,' but the memoir in question is written in Russian, and therefore not generally accessible.

With regard to the *reproduction* of *Rotifer vulgaris* I have therefore only been able once more to confirm the long-known fact that it takes place *parthenogenetically.* That besides the ovarian eggs, which are developed *without* previous fecundation, others are from time to time produced (by gemmation) which undergo fecundation, is rendered very doubtful by what Prof. von Stein has objected against my observations. Whether the previous observations of Prof. Ganin, which certainly seem to be in favour of a second kind of egg-formation in Philodinidæ, are really so well founded as to exclude all doubt, I am unable to judge. As already said, it is very desirable Prof. Ganin should speak out upon this point.

The subject under consideration is both biologically and physiologically of the greatest possible importance.

EXPLANATION OF PLATE V. B.

(A selection of figures from the author's plate. The original numbers are indicated in brackets.)

Fig. 1 [1]. An adult example of *Rotifer vulgaris*, seen from the ventral surface. *Auf*, eye-spots, shining through; *ro*, rotatory organ; *gs*, grey substance (salivary glands?); *z*, paired cells; *ka*, masticatory apparatus; *dr*, stomachal glands; *i*, inner membrane of the intestine; *eg*, excretory system of vessels; *zo*, tremulous organs (ciliated funnels); *ov*, ovary, with an ovum in course of constriction; *cbl*, contractile vesicle; *fdr*, pedal gland; *fe*, protrusible extremity of the foot.

Fig. 2 [2]. Anterior extremity of the body of *Rotifer vulgaris*, with the rotatory organ protruded. *k*, the cephalic end of the animal thrown up upon the back; *nz*, cervical lobe ("respiratory tube" of authors); *gngl*, cephalic ganglion; *ro*, rotatory organ.

Fig. 3 [3]. The anterior end of the body of *Rotifer vulgaris*, with the rotatory organ retracted. 3 *a*, from the side; and 3 *b*, from above; *tb*, tactile setæ. The other letters as in figs. 1 and 2.

Fig. 4 [6]. Production of daughter-nuclei by budding from the primary nucleus in *Philodina roseola*.

Fig. 5 [7]. *Trypanococcus*-vesicles in the body-cavity of *Rotifer*. *mkrp*, micropyloid external aperture.

Fig. 6 [8 *e*]. A perfect *Trypanococcus*-vesicle produced by growth from the granular layer (=matrix). *v*, vacuole; *kg*, globular body (nucleus).

Fig. 7 [9]. A vacuole adherent to the nucleus, with motile filaments in the interior (*flf*).

Fig. 8 *a, b, c* [11 *a, b, c*]. *Trypanococcus*-vesicles with "saccules," and the formation of vacuoles in the latter.

XIV.—*Notes from the St.-Andrews Marine Laboratory* (*under the Fishery Board for Scotland*). By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

I. *On the British Species of* Cyanea, *and the Reproduction of* Mytilus edulis, *L.*

Two species of *Cyanea* have been familiar to British zoologists, and both are very common at St. Andrews, where Prof. Häckel worked at them in 1879. They are described in the latter author's fine work* as *Cyanea capillata*, Eschscholtz, and *Cyanea Lamarckii*, Péron and Lesueur. The following observations, however, would lead us to believe that the latter is only the young condition of the former.

On the 12th of June not a single example of *Cyanea* appeared on the surface of St.-Andrews Bay; but the trawl in a few fathoms' water was laden with the purplish-blue form which Häckel and other authors would call *Cyanea Lamarckii*, Pér. and Les. Most of them were of small or moderate size, ranging from 2 or 3 inches in diameter to 6 or 7. The colour was the same in all, though it might vary a little in depth. No trace of any tendency to pass into a brownish tint was visible. The earliest appearance of these Medusæ on our shores in numbers seems to have been about the end of May, when they were procured off Aberdeen under similar circumstances, viz. at a depth of several fathoms; indeed, invisible from the surface. The sixteen Ephyra-lobes of these and the interrupted concentric striæ from the muscles are characteristic.

* Syst. Medus. Acraspedæ, pp. 528–530.

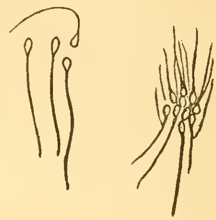
As none were procured during the winter months, these were, in all probability, either developed from the Scyphistoma-stage (*Hydra tuba* of Dalyell), so abundant on the rocky shores, or from suitable sites in deeper water, and carried by tides and their own movements where they were found. As the season advanced a few appeared (*e. g.* at the beginning of July) on the surface of the sea off the Yorkshire coast; but this month was well advanced before they came in numbers to the surface of St.-Andrews Bay. Very smooth water and evening seemed to be favourable; indeed they have been observed swimming about a fathom or more under water by day and then rising to the calm surface as evening approached. Then their contractions were visible as tremors on the glassy surface at a considerable distance. Their hues still remained of the same fine purplish blue. In August a general increase in size was noticeable in the crowds of this form, often observed at and near the surface. Many, moreover, exhibited a decided change in colour, being brownish pink and brownish, leading on, in short, to the fine brownish shade of *Cyanea capillata*, Esch., which occasionally came up in the trawl from deep water, or was captured amongst the others near the surface. Some of the larger forms showed the transition clearly, being for the most part of the chocolate-brown hue with just a trace of the purplish tint here and there. Vast numbers were thrown on the west sands in September, chiefly the developing forms, though some very large adults were amongst them, one, about the beginning of October, measuring 26 inches across the disk. So far as could be observed, the structure of the two forms above mentioned is identical. The reproductive organs in the purplish forms examined were mostly female, while in the case of the large brown examples males alone occurred. This, however, is probably accidental.

The mussel (*Mytilus edulis*, L.) differs from the common oyster in the complete separation of the sexes, each example being either male or female. In the undeveloped condition the structure of the organs seems to be similar in both sexes, while in the mature the shape of the valves gives no reliable distinction. Comparatively small specimens are found with fully developed sexual organs. Thus a male measuring in length $1\frac{1}{4}$ inch had spermatozoa as fully formed as a large example, and so in regard to the ova in a female measuring $1\frac{3}{4}$ inch. The reproductive elements are developed in the mantle.

The mussels were examined from January to July, with the following preliminary results:—Compared with an undeveloped specimen, the mantle in January is considerably thicker.

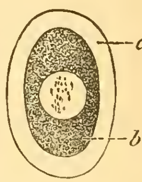
A male measuring $3\frac{1}{2}$ inches in length presented in the thickened generative region of the mantle large pale round sperm-sacs filled with minute spermatozoa (fig. 1), which have minute ovoid bodies with finely filamentous tails. They are lively and tenacious of life. Thus specimens examined at 11 A.M. were allowed to remain on the slide till 1 P.M., at which period no movement was discernible in the partially dry preparation. On adding some of the limpid fluid from an adjoining mussel active motion was resumed. The same was repeated at 4 P.M., with a similar result. Twenty-four hours' exposure, however, seemed to be fatal.

Fig. 1.



The females had the same region of the mantle crowded with a prodigious number of minute ova (fig. 2). In shape these are ovoid, with a transparent investment and an inner granular yolk with a pale circular area.

Fig. 2.



As the month (February) advanced the mantle, especially in the neighbourhood of the organ of Bojanus, increased considerably in thickness, so that the region hung downward like a pouch or flap on opening the valves. The whole surface of the mantle becomes speckled in both sexes with the reproductive elements. On puncturing the enlarged region at the organ of Bojanus in a male on the 17th February a milky fluid composed of sperms exuded. The mantle in this case had increased in thickness about three eighths of an inch, and the development of the sperm-sacs seemed to proceed from the dorsal to the ventral edge of the mantle. Even in specimens in which the shell has been injured and the mantle remains thin at certain places an immense number of ova are developed.

After full maturity is attained, as in April, the orange mantle is richly marked in an arborescent manner by racemose sperm-sacs and ducts, especially towards the margin, and when the mantle is swollen with water the sperm-sacs project like bunches of grapes. In the female this appearance is not so evident, for the ova are grouped in masses of a circular or ovoid form and densely packed.

About the middle of May the activity of the spermatozoa seemed to be diminished, but the size and appearance of the ova remained unchanged. On the 24th the sluggishness of the spermatozoa was marked in most males, and certain sperm-sacs appeared to be undergoing degeneration. The females at the end of May now contained comparatively few ova, and the mantle had diminished considerably in thickness. Much granular brownish pigment, moreover, was present in the latter. The ova remaining in the mantle presented no structural change.

On the 9th June the female mussels still showed some ova in the thickened dorsal region of the mantle, but the margins were pale and thin. As before, much brownish pigment was present, and those parts of the mantle devoid of ova were cellular or areolar. Throughout this month the sexual elements steadily diminished.

Finally, in July the dendritic appearance of the salmon-coloured mantle was less marked, and neither ova nor spermatozoa could be distinguished microscopically. The general stroma was granular and minutely cellular, as if a general resolution of the tissue were taking place; and the characteristics of the sexes were absent.

The early stages in the development of the mussel had therefore to be examined by aid of the tow-net on the surface near the mussel-"beds" of the Eden, or in specimens kept in sea-water in the laboratory (for at this time no pipes had been fitted).

On the 31st of May the keeper of the mussel-"beds" procured a number of minute mussels, about a line in length, from the under surface of his boat, which had not been scraped since last season. These had assumed the elongated outline characteristic of the adult, and, in all probability, small as they were, must have been the young of the previous season or very early products of this. The ground for supposing that they pertained to the previous season is the fact that the surface of St.-Andrews Bay in July and August swarmed with minute mussels (much less than the foregoing) of a somewhat circular outline, that is, they had not yet assumed the elongated outline above mentioned. They were much younger than the forms procured by Lacaze-Duthiers* in the Mediterranean, as they were settling on the blades of the sea-weeds and similar structures within tide-marks, and which showed four branchial processes behind the foot. At a later stage they fix themselves by the byssus all round the margin of the rocks, on wrecks, wooden stakes, crabs, and other objects.

The countless multitudes of these young forms in St.-Andrews Bay show that there is a fine field for extending

* Ann. des Sc. Nat. Zool. sér. iv. tom. v. (1856).

mussel-culture, besides indicating the importance of such organisms in regard to the nourishment of young food-fishes. The increase of mussels on the rocks at the exit of the main sewage-pipe of the city is also a feature of moment which will subsequently be examined.

MISCELLANEOUS.

On the Development of the Chelifers. By J. Barrois.

The development of the Chelifers differs from that of the other Arachnida by the existence of a larval state which is still but little known, and which Metschnikoff has described as presenting—(1) externally a muscular lip, two pairs of limbs, and a rudimentary abdomen; and (2) internally a mass of nutritive vitellus. My researches have led me to recognize a more complex structure.

The number of pairs of limbs is really five. All the future pairs already exist except the first, but they are completely unfit for locomotion, and consist only of simple projections of the ectoderm.

The nutritive vitellus is surrounded by a layer of large ectodermal cells and preceded by a voluminous suctorial apparatus formed by two adpressed chitinous plates, which separate from each other under the action of a powerful muscular mass placed in front (the muscular lip of Metschnikoff). This suctorial apparatus opens on the ventral surface between the two large chelæ (second pair) by a buccal orifice furnished with a pair of peculiar glands, and very different from the definitive mouth. All this constitutes a digestive apparatus ready to function in the mature larva, and which actually functions in passing the nutritive liquids derived from the maternal organism into the interior of the larva. The latter is therefore a true parasitic organism which lives at the expense of its mother, upon the ventral surface of which it is fixed.

Later on this suctorial apparatus is destined to be cast off. The mode in which it is got rid of constitutes one of the most characteristic features of the development.

In the Chelifers the nervous groove, instead of forming a single continuous band, from the head to the tail, as in the other Arthropoda, consists of two separate bands, one placed in front of, and the other behind, the suctorial organ. Subsequently these bands grow together, passing to meet one another above the suctorial apparatus, which they thus completely surround, pressing it downwards; they thus gradually exclude it from the body of the embryo. When the two bands are finally united into a single continuous band the sustorial apparatus is pushed entirely outside; at last it is attached to the embryo only by a slender cord inserted below the definitive mouth, and falls off at the same time as the larval envelope.—*Comptes Rendus,* December 15, 1884, p. 1082.

Notices of Fungi in Greek and Latin Authors.

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

Gentlemen,—Please allow me to correct on page 46 (text and note) of my paper on Classical Notices of Fungi (Ann. & Mag. Nat. Hist., January 1885) the word *Terfeyia*, which ought to be *Terfezia*. This name has been used for a genus of *Fungi hypogæi* by Tulasne (p. 177), being a Latinized form of the Arabic word *Terfez*, which stands for some light-coloured truffle in Leo Africanus's 'Description of Africa.' *Terfezia Leonis*, therefore, is Leo's Terfez. On referring to Freytag's 'Lexicon Arabico-Latinum' (i. p. 190) I find the word *tirfās* explained by "tubera terræ." According to Leo, *terfez* was the name used by the rustic Arabs for a truffle, *Camha* and *Thama* being those employed by medical authors. Freytag gives other Arabic names for a white truffle, the most common one apparently being *Kamā*, Leo's *Camha* doubtless; and from the meanings of the verb *kama* (such as "to give truffles to eat," "to abound in truffles," "to collect truffles"), it would seem that this name *Kamā* was the commonest one for this fungus, which was extensively used as an article of food by the people of North Africa; to this day *Kamā* is in modern Arabic the name of a truffle and a mushroom. There seems to be no doubt that Tulasne's identification of this truffle with the truffle of Dioscorides is correct, and that the *Terfezia Leonis* is the species of tuber referred to by classical writers as an African kind which was much prized. Tulasne, in his valuable work, has given figures of this species, which is found from the size of a nut to that of a man's fist; it is flesh-coloured outside and white within; the odour is said to be not unpleasant, but some people think otherwise, and that it has a soapy flavour; others again, and the majority, consider the flavour exquisite. Tulasne mentions that the surface of the base of *Terfezia Leonis* often bristles with sand, which also gets into the substance of the plant; and this reminds one of what Pliny says on this subject (see p. 44 of my essay).

On the question of the plant *hydnophyllum*, Tulasne writes:—"It is probably the *Terfezia Leonis* which the Spaniards of the kingdoms of Castille, Granada, and those of the neighbourhood of Salamanca (kingdom of Léon) call, according to the report of L'Ecluse, by the name of *Turmas*. This author, in course of the description of his *Cistus annuus* (*Cistus salicifolius*, Linn. Spec. 742), remarks that the Castilians call this plant *Turmera*, '*quia forsan*,' he adds, '*ubi hæc nascitur, tubera quæ ab illis* Turmas *dicuntur* crescant; *Granatenses* Yerva del quadrillo *vocant. An Hydnophyllum, herba quam Pamphylus in glossis, teste Athenæo (lib. ii. Deipnosoph.), tradit supernascentem tuberibus, cujus indicio subesse tubera cognoscunt?*' (Clusii, Rar. Plant. Hist. p. 77: Antuerpiæ, 1601, in fol.). Thus, as we have said above, the *Cistus halimifolius*, L., points out to the inhabitants of Algeria the ordinary locality of *Terfez*; but it is probable that the *Cistus tuberaria*, L., renders them still as formerly the same service" (Fungi Hypogæi, p. 174). It appears that this fungus has been found commonly growing under the shade of *Cistus halimifolius* near La Calle and Constantine (N. Algeria) by collectors, and thus some interesting light has been thrown on tho truffle-indicator or *hydnophyllum*-plant mentioned by Pamphilus in Athenæus. It is true he calls the plant a grass (πόα), but this is no objection to a *Cistus* being the plant probably intended; with ourselves the *Parnassia palustris* is the Grass of Parnassus. I was unable to get access to Tulasne's work in time for my last paper, or should not have said (p. 45), with unwarrantable haste, that the story about the hydnophyllum is, of course, a mere fancy.

Your obedient servant,
W. Houghton.

Preston Rectory,
Wellington, Salop,
January 22, 1885.

On the Classification of the Moles of the Old World.
By M. A. Milne-Edwards.

The resemblance of external form is so great in the Insectivorous mammals known under the general name of *Moles*, that after a superficial examination one often confounds species which are really very different.

On the contrary, when we take into consideration their osteological characters, and especially their dentition, it becomes easy to recognize among these animals a certain number of very distinct groups.

Zoologists thus divide the Moles into several genera:—1. The genus *Talpa*, Linné, of which the dental formula is as follows:—

$$\text{I. } \frac{3-3}{3-3}, \text{ C. } \frac{1-1}{1-1}, \text{ PM. } \frac{4-4}{4-4}, \text{ M. } \frac{3-3}{3-3}, = 44 \text{ teeth.}$$

This includes only four species:—The Common Mole (*Talpa europæa*, Linn.), the area of dispersion of which stretches from Western Europe to Japan; the Blind Mole (*Talpa cæca*, Savi), which lives in Italy and Southern Europe; the Long-nosed Mole (*Talpa longirostris*, A. M.-Edw.), from Thibet and China; and, lastly, the Short-tailed Mole (*T. micrura*, Hodgs.), from Northern India.

2. The genus *Morgera*, Pomel, is distinguished from the preceding by the absence of the last pair of small anterior and inferior teeth representing the canines; thus the dental formula is—

$$\text{I. } \frac{3-3}{3-3}, \text{ C. } \frac{1-1}{0-0}, \text{ PM. } \frac{4-4}{4-4}, \text{ M. } \frac{3-3}{3-3}, = 42 \text{ teeth.}$$

A single species, only met with in Japan and the island of Formosa*, presents these characters; it is *Mogera Wogura*, Temm.

3. The genus *Parascaptor*, Gill, is characterized by the absence of one of the upper premolars. The dental formula must therefore be written thus:—

$$\text{I. } \frac{3-3}{3-3}, \text{ C. } \frac{1-1}{1-1}, \text{ PM. } \frac{3-3}{4-4}, \text{ M. } \frac{3-3}{3-3}, = 42 \text{ teeth.}$$

* The variety of this species which inhabits Formosa is called by Swinhoe *Talpa insularis*.

It is represented by two species—one, *Parascaptor leucuras*, Blyth, found in Tenasserim and Sylhet; the other, *P. lepturus*, Thomas, discovered in China.

4. The genus *Scaptochirus*, which I made known in 1867, consists only of a single species, forming part of the collections made in China by the Abbé A. David. It is *Scaptochirus moschatus*. It is characterized by the number of premolars, which is reduced to three in each jaw. Its dental formula is therefore—

$$\text{I.}\ \frac{3-3}{3-3},\ \text{C.}\ \frac{1-1}{1-1},\ \text{PM.}\ \frac{3-3}{3-3},\ \text{M.}\ \frac{3-3}{3-3},=40\ \text{teeth.}$$

The investigation that I have just made of various species belonging to these groups has proved to me that, in giving them the rank of genera, we have exaggerated their zoological value, and that they must be regarded only as subgenera. The discovery of a new species, intermediate in its characters between *Scaptochirus* and *Parascaptor*, would indeed suffice to prove this.

This species was discovered in the neighbourhood of Akbès, on the confines of Syria and Asia Minor, by the Abbé A. David. By the number of its premolars it resembles *Scaptochirus* and differs from *Talpa*; but the form of the molars, the small development of the last premolar, and the narrowness of the face approximate it to the Moles, and especially to *Parascaptor*. The lower jaw presents an anomaly, which shows how little importance should be attached to the number of the small incisiform teeth, including the true incisors and the canines. In fact, on the right side there are four of these teeth, and on the left side we can only count three; so that, on the right, the arrangement of the anterior teeth is that of the Common Mole and of *Scaptochirus*, while on the left it is identical with that of *Mogera*.

I have named this species *Scaptochirus Davidianus*, to recall the name of our learned Correspondent; it differs very little in its aspect from the European moles. Its size is smaller, an adult male individual only measuring 0·12 metre; the tail is short, its length being 0·02. The muzzle is pointed; all over the body the hair is thick, velvety, and of a grey colour, approaching black. The habits of this animal are the same as those of our mole; but it is completely blind; the eyelids do not open, but extend over the globe of the eye, the dimensions of which are much reduced, as in the Italian *Talpa cæca*.—*Comptes Rendus*, December 29, 1884, p. 1141.

Biological Evolution of the Aphides of the Genus Aphis. By M. Lichtenstein.

I have at various times brought before the Academy the evolutional cycle of various Aphides of the tribes Phylloxerinæ and Pemphiginæ, and have indicated, in the case of the latter, curious migrations from the galls of trees to the roots of grasses. Recently, in the 'Comptes Rendus' of November 10, 1884, I described the biology of the maple Aphis (*Chaitophorus aceris*), which, without quitting the tree on which it was born, passes three months under an anomalous form, benumbed in a lethargic slumber, only to become developed towards the autumn and produce sexual individuals.

At the same time I have carefully examined various other Aphides of the group of true Aphidinæ with long 7-jointed antennæ. The following is what I have observed:—

The false female, or *foundress pseudogyne*, which issues from the egg in the spring, always remains apterous. In from twenty to thirty days it produces living young, most of which continue apterous, while some acquire wings. These two forms, which are generally deficient among the Pemphiginæ, become fitted to bud in their turn in about the same length of time (about a month), and then all the individuals produced either by the apterous or by the winged forms acquire wings and quit the cradle of the family.

Where they go I have not yet been able to discover; but the fact is, that at the end of June all the Aphidinæ have disappeared and none or very few of them are to be found on the trees and bushes.

Although I have been unable to trace this *emigrant pseudogyne*, which leaves a regrettable gap in the evolution, I have in autumn met with the *pupiferous pseudogyne*, which, just as in the case of the Pemphiginæ, returns to convey the sexual forms to the tree upon which they are to copulate and leave the eggs which will produce the *foundress* in the ensuing spring.

The Aphides that I have been able to observe are as follows:—

Aphis atriplicis, *A. avenæ*, *A. craccivora*, *A. donacis*, *A. evonymi*, *A. frangulæ*, *A. mali*, *A. padi*, *A. persicæ*, *A. pyri*, *A. viburni*, *Siphonophora absinthii*, *Rhopalosiphum persicæ*, *Hyalopterus pruni*.

Quite unlike the sexual forms of the Pemphiginæ, little creatures without either wings or rostrum, the sexual forms of the Aphidinæ have a rostrum, and, with rare exceptions (*A. mali*, *S. absinthii*), the males are winged, but the females are always apterous and lay several eggs, while among the Pemphiginæ and Phylloxerinæ the egg is single.

I should not have made this incomplete communication to the Academy if M. Kessler, of Cassel, who is occupied with the same studies as myself, had not made a communication to the Leopoldino-Caroline Academy upon the same subject *. His observations are identical with mine, and relate in great part to the same insects:— *A. padi*, *A. evonymi*, *A. viburni*, *A. mali*, *A. pyri*, *A. sambuci*. As he does me the honour to adduce these facts as a confirmation of my theory of the biological evolution of the Aphides, I must say, in my turn, how happy I am to see such earnest observers as M. Kessler bringing their aid to the investigation of those terrible enemies of our crops which are known as Aphides.—*Comptes Rendus*, December 29, 1884, p. 1163.

* Nova Acta Acad. Leop.-Carol. Nat. Cur. xlvii. no. 3.

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XV.—*Description of a new Species of Crinoids with Articulating Spines.* By George Jennings Hinde, Ph.D., F.G.S.

[Plate VI.]

In the 'Proceedings of the American Philosophical Society' for 1883 Prof. Henry S. Williams described a crinoid with movable spines under the generic and specific term of *Arthroacantha ithacensis.* The forms described were merely impressions of the organism in fine sandy shales, the objects themselves having been dissolved away; but, according to Prof. Williams, the impressions were so perfect that the minutest structural details could be readily ascertained. Notwithstanding this circumstance, some little doubt was felt whether these spines might not have been of a similar character to those which in many other Palæocrinoids project from the surface of their plates, and are but solid continuous extensions of the plates themselves, and with them are immovably fixed in the body-wall of the crinoid. The specimens in my possession, however, which I now propose to describe, conclusively show that Prof. Williams had correctly interpreted the impressions and casts of the spines and plates in the Devonian shales, and that, however novel the feature of movable spines may be in the history of the Crinoidea, no doubt can be entertained of the fact.

My specimens, consisting of eleven more or less perfect bodies and numerous fragments of stems, are from calcareous shales of Middle Devonian age at Arkona, Province Ontario, Canada. They were collected by myself between 1875 and 1878, and though fully conscious of the remarkable character of the articulating spines which they possessed, other investigations prevented me from describing them till now; and it is only since beginning to work at them quite recently that I became aware that Prof. Williams had already described a form with similar spines from a higher geological horizon in the Devonian series at Ithaca, in the State of New York.

Though the specimens are somewhat crushed and distorted, so that no single individual exhibits all the characters, yet they possess the distinct advantage over those described by Prof. Williams in that the objects themselves, and not merely their casts, are present; and by collating the different specimens I have been enabled to ascertain that, while there can be no doubt that they possess the same essential features as the type of the genus, they yet vary sufficiently, in many important features, to constitute a distinct species. The characters shown in these specimens make it necessary to extend and modify Prof. Williams's description of the genus based on the casts of *A. ithacensis*.

Before referring to these, however, I may state that the name *Arthracanthus* was employed by Schmarda* in 1854 for a genus of Rotatoria. The term *Arthroacantha*, applied by Williams to this genus of crinoids, is derived from the same Greek words, and is essentially similar to Schmarda's, though less correctly rendered. I consulted independently two eminent scientific authorities who are specially familiar with questions of nomenclature, and they agreed that the term later employed was invalid, from its resemblance to that previously used by Schmarda, and I propose therefore to substitute in its place the term *Hystricrinus* †. As it will be necessary to make reference to the new species described below, I may here apply to it the name of *Hystricrinus Carpenteri*, in honour of my friend Dr. P. Herbert Carpenter, M.A.

HYSTRICRINUS = *Arthroacantha*, Williams, emend.

Generic characters.—Body of crinoid inversely conical or

* Denkschr. k. k. Akad. d. Wiss. Wien, vol. vii. 1854, p. 22.
† Ὕστριξ, a porcupine.

cup-shaped, with distinct bilateral symmetry. The surface covered irregularly with minute tubercles, to which were articulated delicate spines, similar to those of an *Echinus.*

The base of the calyx is open cup-shaped, consisting of three equal or subequal plates, which, at their margins, form a six-sided figure. There are three series or zones of radials (3×5). The first or true radials (R^1) are large, subequal, flattened, quadrangular plates, and, like a spade, are wider at their summits than at their bases. Their distal margins are either straight or slightly elevated towards the centre, which is considerably thicker than the rest of the plate and has a semicircular excavation, with a finely ridged facet for the reception of the second radial. This so-called second radial (R^2), the first brachial (br.^{1}) of Zittel, is a short four-sided joint or plate, which reaches very little above the margin of the first radial, in which it is inserted. The third radial (R^3) or axillary, the br.^{2} of Zittel, is pentagonal, and either shorter or longer than the second. On each of the facets of its upper surface it bears an arm (*ar*), so that there are ten arms altogether. The plates or joints of the lower portion of the arms are in a single vertical series, whilst higher the joints are wedge-shaped and disposed alternately in a double series. The pinnules (*pi*) consist of five or more joints each. A single inter-axillary plate (*int*) is present between the lower arm-joints.

A large anal plate (*A*), nearly resembling in outline the first radials, but narrower at the distal margin, is inserted on the posterior side of the body between the two first radials. Its summit is on a level with that of the radials. The anal inter-radial area, or the space immediately above the anal plate and between the second and third radials and the lower arm-joints on either side, is occupied by three vertical zones of small plates, with six or seven plates in each zone (*Ib.A*). The anal aperture is not shown in any of the specimens yet discovered.

In each of the other areas bounded by the distal margins of the first radials below, the second and third radials and the lower arm-joints on either side, and the true plates of the vault above, there are three vertical zones of plates with three, and occasionally four, plates in each zone (*Ib*). The middle plate of the lower zone is clearly larger than the rest. These plates are distinctly interradial in position, and might be termed interradial plates; but as their lateral margins connect only with the second and third radials (which are merely radials in a conventional sense) and with the lower arm-joints, I prefer to follow Zittel in designating them interbrachial plates. Both these and the anal interradial plates are of the same character as the primary radials and basals of the calyx, and quite distinct from the vault-plates with which they connect above, and they enclose and unite together the second and third radials and the lower arm-joints into one solid immovable cup with the lower radials and basals.

The vault is depressed, convex, and is formed of a peripheral b order of numerous minute relatively thick plates, and a central portion of larger plates covered with sinuous grooves and tubercles.

The column or stem is cylindrical, with alternately larger and smaller joints. The rim of the larger joints is extended into a sharp-edged flange. At irregular intervals there are nodes, each bearing a whorl of five cirri. The central canal of the stem is cylindrical and moderately large.

The main differences between the characters assigned to the genus by Prof. Williams and those above given consist in the number and position of the interbrachial plates, the absence of a series of smooth radiating plates in the vault, and the nodal cirri of the stem.

Prof. Williams does not directly mention interradial or interbrachial plates, but states * merely that "along the upper rim of the calyx is a row of small plates which lack the tubercles," without further particulars as to their number. In the fig. 1 of the plate accompanying his paper four of these plates are shown in one interbrachial area, and but three in another, and the plates of the vault apparently connect with their upper margins. Nothing is stated or shown in the figure of the plates above the anal plate. I am of course unable to determine whether this notable difference in the number of the interbrachial plates in *H. Carpenteri* and *H. ithacensis* arises from the imperfect condition of preservation of this latter species or is really existent; but I should think it probable that the vault-plates in Prof. Williams's specimens have been pressed down over the higher zones of the interbrachial plates, and thus concealed them from observation.

With regard to the radiating rows of smooth plates in the vault, which Prof. Williams observed in the cast of a single crushed specimen of *H. ithacensis*, I am fairly confident that there are no similar rows of plates in *H. Carpenteri*. The apparently smooth character of the plates may arise from the partial obliteration by wearing down of the tubercles, which occurs in several of my specimens, so that they can only be seen by careful observation with a lens, and the smooth plates may therefore be really due to this cause.

* *Op. cit.* p. 84.

Prof. Williams does not refer to the stem of the generic type beyond giving its thickness; but the small portion of it shown in his fig. 1, in close proximity to the body of the crinoid, resembles the stem of *H. Carpenteri* in consisting of alternating larger and smaller joints; and it is very probable that nodes with cirri were also present, as in this latter species. The other fragments figured by him as portions of the stem (figs. 7 and 8) are so entirely different in the thickness of the stem itself and of the individual joints, as also in their smooth and uniform characters, that in the absence of confirmatory evidence one cannot regard them as belonging to the same species.

Apart from the possession of articulating spines the relations of *Hystricrinus*, as already noted by Williams *, are very close to *Hexacrinus*, Austin †, a genus of crinoids which, according to Wachsmuth and Springer ‡, is almost exclusively limited to the Devonian formation in Europe, only fragments of a single species having been discovered in America. The number and arrangement of the basals, the first radials, and the anal plate are very similar in the two genera; but a comparison of the other features is rendered difficult on account of the uncertainty which prevails as to the definite characters of *Hexacrinus*. According to Zittel § this genus resembles *Platycrinus* in having a single axillary above the first radial, although rarely another intermediate so-called radial is present, and interradials are wanting. Wachsmuth and Springer ‖, on the other hand, state that there is one axillary above the first radial, that the anal plate supports two or three plates, and that the interradial series is composed of a single large plate which rests within a notch between two radials. An examination of the characters of *Hexacrinus interscapularis*, Phill. sp. ¶, the type of the genus, does not avail conclusively to solve the question, for unfortunately the number of radials above the first is not shown in Phillips's and Austin's figures; the arms and stem are wanting, but there are two zones, of two plates each, in the anal interradial area, and of three plates each in the other interbrachial or interradial areas, so that in this last feature the typical example of the genus differs from both Zittel's and Wachsmuth and Springer's

* *Op. cit.* p. 82.

† Mon. Rec. and Foss. Crinoids, 1843, p. 252.

‡ "Revision of the Palæocrinoidea," part ii., 'Proceedings of the Academy of Natural Sciences of Philadelphia,' 1881, p. 253.

§ Handb. der Pal. vol. i. p. 365.

‖ "Revision," ii. p. 253.

¶ Pal. Foss. Cornw., Geol. Surv. Mem. 1841, p. 28, pl. xiv. fig. 39.

definition. But undoubted examples of *Hexacrinus interscapularis*, in better preservation than the Devonshire specimens, have been figured by L. Schultze * from the Devonian of the Eifel; and though the arms are wanting in these, yet they distinctly show (judging from the figures) four so-called radials above the first radial, thus markedly differing not only from *Hystricrinus*, but from nearly all the other species which by Schultze and Wachsmuth and Springer are included in *Hexacrinus*.

The genus *Hystricrinus* differs from *Hexacrinus*, as exemplified by the typical species, in possessing only three radials and in having a greater number of interbrachial plates both in the anal and other interradial areas; but more particularly in the striking feature of the articulating spines and the stem with its whorls of cirri. But whilst by some authorities the differences in the somewhat inconstant characters of the number of the radials and the interbrachial plates would not be deemed sufficient to constitute a generic distinction, the presence of the articulating spines, which have hitherto not been discovered in any other genus of crinoids, either fossil † or recent, and which constitute another link of relationship between the Crinoidea and Echinoidea, might be regarded as indicating a greater than generic difference, and, provisionally at least, this genus may rank as the type of the family of the Hystricrinidæ.

I now pass on to describe in detail the specific characters of *H. Carpenteri*.

Hystricrinus Carpenteri, n. sp.

Body cup-shaped, widest at the summit of the first radials, then slightly contracting by the curving inwards of the interbrachial plates. The vault is flat or slightly convex. The

* Denkschr. k. k. Akad. d. Wiss. Wien, Bd. xxvi. 1867, Taf. viii. fig. 5.

† It is a noteworthy circumstance that the aberrant Blastoid, *Astrocrinites Benniei*, R. Etheridge, Jun., described and figured in the Quart. Journ. Geol. Soc. vol. xxxii. 1876, p. 103, pls. xiii., xiv., appears to have possessed articulated spines. A small spine was discovered by Mr. Etheridge adhering to one of the specimens, though not in position on the tubercle; and in a subsequent paper on this form Messrs. R. Etheridge, Jun., and P. H. Carpenter record the fact that some at least of the peculiarly ornamented tubercles, which thickly cover the surface of this species, were perforated at their summits, which renders it highly probable that they supported movable spines (Ann. & Mag. Nat. Hist. April 1883, p. 236).

Dr. Hambach, of St. Louis, also states that he possesses a specimen of *Pentremites granulatus*, Römer, on which the coarse granules show very distinct sockets for the articulation of spines (Trans. Acad. Sci. St. Louis, vol. vi. no. 3, 1884, p. 543).

height of the calyx, measuring to the distal margin of the interbrachial plates, varies from 18 to 23 millim. in different specimens, and is slightly less than their width, which varies between 20 and 25 millim.

Basals.—The base of the calyx has the form of an open shallow cup, the margin of which is hexagonal in figure, with indistinct angles. The lower exterior portion where it connects with the stem is circular, about 5 millim. in diameter, with a slightly projecting collar, the edges of which are finely grooved (Pl. VI. fig. 2). Within this is a slight depression and at the bottom of it a small circular aperture communicating with the interior of the calyx. The base is formed by three equal plates of a pentagonal form. The basal plates

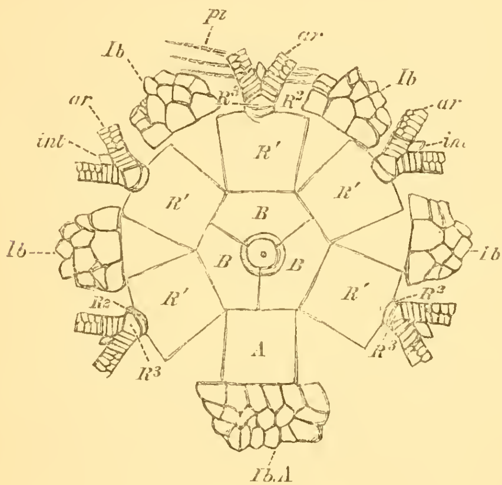

Diagram of *Hystricrinus Carpenteri*, natural size.

A, anal plate; *ar*, arms; *B*, basals; *Ib*, interbrachial plates; *Ib.A*, interbrachial anal plates; *int*, interaxillary plate; *pi*, pinnules; *R′*, first radial; R^2, second radial; R^3, third or axillary radial.

vary from ·3 to ·6 millim. in thickness near their upper margins, whilst near their bases they are from 1 to 2 millim. in thickness. The base itself varies from 5 to 7·5 millim. in height, and is thus about one third the entire height of the calyx; it is from 14 to 21 millim. in width. The upper margins connecting the basals with the radials are not exactly straight, but rudely crenulate, the edges slightly overlapping the radial margins.

Radials.—The first or true radials are relatively large flattened plates, spade-shaped or trapezoidal in form, varying from 10 to 12 millim. in height, 8 to 11 millim. in width at their bases, and between 10 and 14 millim. at their summit-margins. They are about ·75 millim. in thickness, but in the central upper portion increase to 2 millim. The basal and the two lateral margins are straight, whilst the distal is in some cases straight and in others is slightly elevated towards the centre, where there is a shallow semicircular excavation with radial ridges and grooves for the reception of the second radial. The sutural surfaces of the first radials, by which they connect with each other and the basals, are covered with very delicate transverse ridges and grooves (Pl. VI. fig. 5), whilst those of their distal margins, which connect with the interbrachial plates, run in a longitudinal direction (Pl. VI. fig. 4).

The second and third so-called radials are short thick plates or joints, whose united length varies from 2·5 to 3·25 millim., and they are about 3·5 millim. in width. The lower and shorter of the two has an oblong or trapezoidal outline, and varies in different specimens from ·8 to 1·25 millim. in height, whilst the third or axillary * radial is a small pentagonal joint 1·7 to 2 millim. in height. There are one or two spines on the dorsal surfaces of each of these upper radials. Laterally the upper radials are united by sutures to the interbrachial plates.

Arms and Pinnules.—The two sloping upper facets of the axillary radial each support a single arm. The first four joints of each arm are subequal, with four unequal sides, and approximately semielliptical in transverse section. They are disposed in a single vertical series, and their united length is 3·2 millim. The sutural facets of these joints are strongly grooved radially. The inner lateral faces of the first two joints of each arm are bevelled and grooved and suturally connected with the corresponding arm-joints springing from the adjoining axillary facet. The next two joints in each arm diverge from those of the corresponding arm; but they are nevertheless united together by an elongate tongue-shaped interaxillary plate. Above the fourth joint in each arm the joints become wedge-shaped and form a double alternate vertical series. The inner edges of these joints are dovetailed into each other, so that the sutures form a zigzag line

* An abnormality occurs in one of the radial series of one of the specimens, which has two joints or plates between the first radial and the axillary, thus exhibiting four radials altogether.

on the dorsal surface of the arm. The separate joints are about ·7 millim. in height and 3·2 millim. from the dorsal to the ventral edge.

The two lowest arm-joints above the axillary radial are suturally united to the interbrachial plates, and thus bound up with the calyx; the joints above these appear to have been free, with the exception of the third and fourth, which are connected together by the interaxillary plate. There are from two to three spine-bearing tubercles on each of the arm-joints.

The pinnules consist of elongate compressed joints, horse-shoe-shaped in transverse section. The longest joint measures ·3 millim. and the terminal about 1·8 millim. They are about ·5 millim. from the dorsal to the ventral edge. In one or two cases the canals on the ventral surface can be distinguished. There are apparently six, if not more, joints in each pinnule; the facets between the joints are smooth and even. The outer surface of the joints is also smooth and free from tubercles. I am unable to determine with accuracy the lowest joint of the arms which is furnished with pinnules, but they appear to commence on the fourth or fifth above the axillary radial. In none of my specimens are there more than eight arm-joints preserved.

Anal Plate.—This is nearly oblong in form, very slightly wider above than below; it differs from the first radials, between two of which it is inserted, in not increasing in width to the same extent above and in the absence of the central notch and tumidity (Pl. VI. fig. 1, *A*). Its upper margin is nearly straight and in a line with that of the first radials. The plate varies from 8·5 to 10 millim. in width, and from 10 to 12 millim. in height.

Anal Interbrachials (Pl. VI. fig. 1, *Ib.A*).—The area covered by these plates is nearly half as large again as that in the other interbrachial spaces. In the best-preserved specimens it is 15 millim. in width at the base and at least 7·5 millim. in height. There are three vertical zones of plates exposed; the space above these is concealed from view. In the lowest zone six plates are present; the two connected with the upper radials on each side are trapezoidal in form, whilst the intermediate four plates are subequal, pentagonal, with straight bases and sides and angular summits. These plates are each about 2·5 millim. in width and from 3 to 4 millim. in height. Seven plates are present in the second series; these are polygonal, with the lower angles accurately fitting into the angles of the lower series. The upper series is also of seven plates, of a similar character to the series below them. The entire series of plates are suturally attached together and also to the distal margins of the first radials and anal plate below, and laterally to the upper radials and the two lowest arm-joints on each side, so that they form a compact slightly incurving shield over the area. These plates are not so abundantly provided with spines as the anal and radial plates, and they are usually much smoother. There are from one to five spine-bearing tubercles irregularly disposed on each plate. The anal aperture is concealed; it is probably slightly above the third zone of plates.

Interbrachials.—The space covered by these plates is from 8·75 to 10·5 millim. in width in different specimens; it also varies somewhat even in the same example; the plates reach from 6 to 9·5 millim. above the distal margin of the first radials. The plates of the lower of the three zones are always three in number; they are all larger than the plates of the higher zones, and the middle of the three is very prominent. This is usually, but not invariably, situated centrally above the distal margins of the first radials; its base is generally straight, but in the rare cases in which there is an entering angle at the union of the first radials the base of this plate is angular and accurately fits into the space. Strictly, therefore, this middle plate of the lower zone is an interradial plate. This plate is from 3 to 4 millim. in width and about 4 in height. The lateral plates of the lower zone are relatively wider and shorter than the central plate; their outer margins are suturally attached to the sides of the second and axillary radials, even sometimes reaching to the lowest arm-plate. The middle zone consists of three or four polygonal plates, varying from 2 to 3 millim. in width and height, which dovetail into the open angles of the lower series, and their own summit-angles are similarly filled by the top series, usually of four plates. In one specimen there are one or two partially detached plates above the third zone; but I cannot tell whether such were generally present.

These interbrachial plates, like those of the anal area, have comparatively smooth surfaces; in some no tubercles can be detected, probably from obliteration, whilst in others there are from one to three spine-bearing tubercles. The plates are about ·5 millim. in thickness, and their sutural surfaces are furnished with longitudinal minute ridges, of which there are from four to five. In none of the specimens is the contact of the distal margins of these plates with the plates of the vault actually shown; but the vault-plates are in such close proximity (Pl. VI. fig. 10) that there can be no doubt of their original union with them.

Vault.—In none of my specimens is the vault complete;

but portions of it are *in situ*, and there are also numerous detached plates in the interior of an individual whose roof has collapsed. It was composed of a solid massive layer of numerous small polygonal but relatively thick plates, very intimately united together, so that the partitions between them cannot in many instances be detected *. Their contact-surfaces in some cases show minute longitudinal ridges and grooves of a similar character to those of the interbrachial plates, but finer; in other cases the contact-surfaces appear to be quite smooth. The plates throughout the vault are about ·9 millim. in thickness, and thus nearly double as thick as the interbrachial plates. Those of the peripheral area (Pl. VI. fig. 10) are not more than 1 millim. in width; their upper surfaces are now relatively smooth, but on each there are from one to four spine-bearing tubercles of two different sizes. The plates of the central portion of the vault are thickly covered with minute blunted fixed spines or tubercles, with some articulated spines as well, and also short sinuous ridges (Pl. VI. figs. 11, 12). I am unable to ascertain definitely the form and number of the plates in this central portion; some were clearly larger than those of the peripheral area, and there is a detached united mass, evidently belonging to the central area, which may be of only two or three large plates; but no divisions are perceptible in it.

Tubercles and Spines.—The tubercles are minute truncated cones which project slightly from the surface of the plates. Their narrow summits are perforated by a minute circular aperture or pit, from ·1 to ·15 millim. in width; their sides gradually enlarge towards the base, which varies from ·3 to ·5 millim. in width, and merges into the general surface of the plate without any distinctive collar or depression. In the best-preserved examples there is no prominent rounded knob at the summit of the tubercle. They appear to be very liable

* Prof. Williams (*op. cit.* p. 88) considers it probable that the detached spine-bearing plates described and figured under the name of *Lepidocentrus eifelianus* by Joh. Müller from the Devonian at Rommersheim, may have belonged to the vault of a crinoid similar to *Hystricrinus*. From Müller's description of these plates in the Abhandl. der königl. Akad. d. Wiss. Berlin, 1856, p. 259, it appears that their edges are bevelled and adapted to fit over each other like fish-scales. This character, and the fact that nearly similar plates have been discovered in position, forming part of the test of a *Palæchinus*, by Schultze (Denkschr. königl. Akad. d. Wiss. Wien, Bd. xxvi. 1867, p. 124, Taf. xiii. fig. 1), satisfactorily show that Müller's specimens could not have belonged to a crinoid. Their relatively large size also renders it improbable. At the same time it should be acknowledged that the simple form of the tubercles and spines and their attachment to each other in *Lepidocentrus* and also in *Pholidocidaris*, Meek and Worthen, are of the same character as in *Hystricrinus*.

to be worn down to the surface of the plate, so that in many instances they look like so many minute rings, and their real characters would scarcely be recognized in this condition.

The spines are elongate, cylindrical in section, with a slightly prominent ring or collar at their basal extremity (Pl. VI. fig. 8). The base is perforated with a minute circular pit. Just above the basal collar is a slight contraction or neck, beyond which the spine gradually increases in thickness to near its middle and then tapers to an obtuse or, in some cases, a sharp point. In some examples the spine is thickest near the base, the collar is not perceptible, and it tapers regularly to its distal end. The surface of the spines, when examined under the microscope, is seen to be ornamented with minute longitudinal parallel ridges, which do not appear to be continuously even with its surface, but at intervals project outward at a small angle; these ridges are about ·025 millim. apart. The spines vary from 1·5 to 4 millim. in length, and from ·25 to ·35 millim. in thickness. Those on the basals and first radials are tolerably uniform in size, and average 2·5 millim. in length, whilst those of the vault-plates are only 1·5 millim. in length, but nearly as thick as those of the calyx (Pl. VI. fig. 9). The spines on the arms appear to be very slender.

The excavated basal faces of the spines are approximately of the same dimensions as the summits of the tubercles, and could therefore but very slightly have overlapped or clasped these latter, and they would consequently be mainly held in position by the ligament passing between the cavity in the tubercle and that in the spine.

There is no apparent regular distribution of the tubercles and spines on the plates of the calyx. In some few cases there are rows of tubercles which seem to be parallel with the margins of the first radials; but, as a rule, the tubercles are irregularly scattered over the plates, sometimes being in close proximity or only about ·2 millim. apart, whilst not unfrequently there is an interval of 1 millim. between two of them. They are most thickly grouped on the upper tumid portion of the first radial, just below the excavated surface on which the second radial rests. There are as many as seventy-three spine-bearing tubercles on the surface of a large first-radial plate, and from fifty to sixty on smaller plates. A large basal plate has sixty-five tubercles, whilst an unusually small plate possesses only twenty-seven. The tubercles and spines of the radial and basal plates are approximately equal in size, but there are two distinct sizes of tubercles on the smaller vault-plates. The interspaces on the plates between the tubercles appears to be smooth. It is a curious circumstance that in several instances in which the spines remain on the calyx-plate they do not lie irregularly crossed over each other, but in one nearly parallel direction, as if their attaching ligaments had simultaneously given way, and some gentle uniform influence had acted on the spines, so that they all fell in the same direction (Pl. VI. figs. 6, 7).

Stem.—Attached to the bases of two of my specimens (Pl. VI. figs. 1, 6) there are five or six of the upper joints of the stem, which show its characters and enable the numerous detached fragments, which are abundant in the same beds with the crinoids themselves, to be identified. I have collected thirty of these fragments, but the longest does not exceed 21 millim.

The stem is cylindrical, with a moderately large cylindrical central canal (Pl. VI. figs. 13, 14). It varies from 3 millim. in diameter in a very small form, to 6·3 millim. in a large one ; in the majority of specimens it is from 4·5 to 5 millim. in thickness, including the exterior flange. The inner canal of the stem is from 1·5 to 2·8 millim. in width (Pl. VI. fig. 15). The constituent joints or rings are of two kinds, with intermediate forms. In the larger joints the peripheral margin expands into a flange with thin edges, and the joints are nearly as thick again as the smaller intermediate joints, in which the projecting flange is either entirely absent or but very slightly developed. The larger are between ·4 and ·7 millim. in thickness, and the smaller from ·2 to ·5 millim. In some portions of the stem there are three of the smaller rings between each of the larger, which are then about 1·5 millim. apart, and the central of the smaller rings exhibits an incipient flange, whilst in others the larger are only about 1 millim. apart, with a single intervening narrow ring. The facets of the rings are even and furnished with numerous, fine, equal, radiating grooves and ridges, which extend from the exterior margin to the inner edge (Pl. VI. fig. 15). The number of these varies partly with the size of the ring. In a small ring, 3 millim. in diameter, there were sixty-four ridges, and an equal number were present in a ring 4·25 millim. in width. The face of the ring in another detached stem, 3·75 millim. in width, had seventy-five ridges, while there were only seventy-seven with a thickness of 5 millim. As a rule, these minute ridges are simple, but rarely there is a slight bifurcation or notch in them near the outer margin. There is no special delimitation of the inner margin of the stem-joints round the central canal.

At irregular intervals on the stem, whorls of cirri are developed (Pl. VI. figs. 13, 14). The distance between the whorls varies from 5 to 14 millim., but with only the short detached fragments which I possess it is not easy to determine satisfactorily if there were regular intervals between the whorls. The whorls are unequal in size; and whilst in some the cirri, or their bases, are large and apparently full-grown, in others the cirrus-bases are very small and apparently imperfect. In several instances there is a distance of about 14 millim. between the whorls or nodes of perfectly developed cirri, and between each of these, though not centrally, there is a node of imperfectly developed cirri (Pl. VI. fig. 13). It would thus appear that in this genus whorls of cirri are developed on some of the intercalated joints between the larger nodes, which indicates a different mode of growth from that which prevails in the recent Pentacrinidæ. According to Dr. P. Herbert Carpenter* the youngest nodes are always at the top of the stem in this family, and all the joints subsequently intercalated between them are internodal.

As a rule there are five cirri in each whorl, but in some cases only four are developed; the space, however, in which the fifth should appear is vacant and marked by a slight cicatrix. Though normally the cirri of the same whorl are at the same horizontal level, yet instances occur in which one or more of the cirri are situated on joints higher or lower on the stem than those bearing the others. Similar abnormalities have been shown by Dr. P. H. Carpenter to be present in the recent Pentacrinidæ. Thus in *Pentacrinus decorus*, Wyv. Thomp.†, and in *Metacrinus cingulatus*, H. Carp.‡, the absence of a single cirrus is not at all unfrequent; and further, in *Pentacrinus alternicirrus*, H. Carp.§, the cirri of a whorl are distributed on two nodal joints, and in a much more regular manner than appears to be the case in *Hystricrinus*.

The whorls in this genus are not, as is usually the case in the Pentacrinidæ, developed nearly entirely on the lateral surface of a single, in some respects specially modified, stem-joint; but the individual cirrus appears to commence its growth on one of the smaller joints or rings (which must have been penetrated by the cirrus-canal), and then extends above and below it, so as to cover over the space between two or three of the larger rings and the intervening smaller ones. In the whorls of the larger cirri the stem-joints are nearly entirely concealed by the cirrus-sockets, but they

* Report on the Crinoidea. Voyage of H.M.S. 'Challenger,' p. 16.

† See Report on the Crinoidea, p. 12, pl. xxxvi. fig. 1.

‡ *Id.* p. 349. § *Id.* p. 12, pl. xxv.

can be clearly distinguished beneath the smaller cirri. This extension of the cirrus-sockets over more than a single stem-joint occurs also in other Palæocrinoids, and is well shown in *Poteriocrinus rostratus*, Austin*; it is also the case in some of the recent Pentacrinidæ, as, for example, in *Metacrinus nobilis*, H. Carp.†, in which both the joint above and that below the nodal joint share in the formation of the cirrus-socket.

The nodal portion of the stem is somewhat expanded, but the increased thickness is rather owing to the cirri than to an enlargement of the stem itself. The sockets of the cirri are slightly sunk below the surface of the stem. Only the lowest four or five joints of the cirri are preserved in any of the specimens; they have a slightly oblique direction in relation to the stem, but I cannot say whether upwards or downwards. The faces of the joints are circular; they vary in diameter from 1 to 1·5 millim. in the smaller cirri, and about 2·5 millim. in the larger, and the joints are about ·4 millim. in thickness. The cirrus-joints are united to each other by radiating unequal ridges and grooves, which are proportionally larger and less numerous than those uniting the joints of the stem (Pl. VI. fig. 16). There are from twelve to fourteen ridges, which extend nearly to the centre of the face, most of which bifurcate about halfway to the margin leaving a deep groove between, and there are also short ridges between the larger. There is a minute central canal in the cirri about ·15 millim. in width, which is bordered by a slightly elevated collar.

The cirri in the same whorl are not horizontally equidistant from each other, and, at first sight, their disposition appears to be altogether irregular; but closer consideration shows, in many instances, an appearance of a bilateral arrangement. Thus frequently there are two cirri in a whorl in close proximity, whilst a considerable space separates the remaining three from this pair and from each other. Now, if a line is drawn between this pair through the stem, it bisects the base of the cirrus on the opposite side; and this cirrus, which I regard as the anterior one (Pl. VI. fig. 14), has the remaining two of the five at about equal distances on either side of it. As this disposition can be traced in several instances, it can hardly be of an accidental character. In each of the horizontal interspaces between the cirri of the larger whorls, with the exception of that between the paired cirri, there are usually two laterally compressed blunted spines, one

* Monogr. Rec. and Foss. Crinoids, pl. ix. fig. 2 *a*.
† *L. c.* p. 14, pl. xli. fig. 5.

above the other (Pl. VI. fig. 14). These spines are really portions of the thin flanges of the larger rings of the stem, and they indicate the position of the larger rings, which have been covered over by the cirrus-bases.

The points of difference between this form and *H. ithacensis*, as described by Prof. Williams, clearly indicate that it is a distinct species. The calyx is nearly twice the size, and whilst the tubercles on the corresponding plates are nearly thrice as numerous, the spines themselves, particularly those of the vault plates, are not more than one third the length of those of *H. ithacensis*. The interbrachial plates are also more numerous, and there are no indications of smooth rows of plates in the vault, as is stated to be the case in this latter species. Hitherto no cirri have been discovered in connexion with the stem of *H. ithacensis*, but it is probable such will be found to be present in this species as well.

Prof. Williams compares *H. ithacensis* with specimens of an undescribed form in the Museum of Cornell University, of which, he states, Prof. Hall has privately distributed the photograph with a name attached. As no description of these specimens has ever been published, and as I have not the opportunity, like Prof. Williams, of examining them, I cannot institute any comparison between them and *H. Carpenteri*.

An interesting feature in connexion with this species is the fact that out of eleven examples which have been discovered there are three in which a gastropod shell of the genus *Platyceras*, Conrad, is attached to the vault of the crinoid, which it nearly entirely covers. Though the shells have been somewhat displaced by the compression of the crinoids, there is clear evidence that the sinuosities of their margins, when in their original positions, very closely fitted to the surface of the crinoid vault. It is also noticeable that, in all three instances, these shells have a similar very definite position in relation to the anal aperture of the crinoid, so far as it can be determined by the situation of the anal plate; and they are so placed that the front margin of the gastropod shell would just project over this aperture. There can be no doubt that the gastropod derived its support from the materials rejected by the crinoid, whilst, at the same time, the position it had taken up does not appear to have in any way injured the crinoid; at all events, the specimens to which the shells are attached are larger and more perfect than the others.

The *Platyceras*-shells belong to two species: one, with the surface smooth, merely showing sinuous lines of growth, is closely related to *Platyceras erectum*, Hall*; whilst the other

* See Palæont. New York, vol. v. p. 5, pl. ii. figs. 4, 11.

species was provided with spines, and appears to be the small variety of *P. dumosum*, Conrad*, which is of frequent occurrence in the same beds as this crinoid.

In conclusion, I desire to express my grateful sense of the kind assistance which Dr. P. Herbert Carpenter most willingly afforded me in tracing out the relations of this crinoid, and my thanks are also due to Dr. Henry Woodward, F.R.S., for permitting me to examine the fossil crinoids in the British Natural-History Museum.

Distribution. Middle Devonian, Hamilton group, Arkona, Ontario, Canada.

EXPLANATION OF PLATE VI.

Fig. 1. *Hystricrinus Carpenteri.* A slightly compressed specimen, showing the anal plate (*A*) with the anal interbrachial plates above it (*Ib.A*). Attached to the vault of the crinoid is a specimen of *Platyceras erectum*, Hall. Natural size.

Fig. 2. The base (imperfect at the margin) of a small individual, viewed from the exterior, showing the facet by which it connects with the top of the stem, and the central canal. Natural size.

Fig. 3. A detached first radial, with the second and axillary radials and the lower joints of the arms. Natural size.

Fig. 4. The sutural surface of the distal margin of part of a first radial, showing longitudinal grooves and ridges where it connects with the interbrachial plates, and radiating grooves where it unites with the second radial. Enlarged three times.

Fig. 5. The sutural surface of the lateral margin of two of the first radials, showing oblique ridges and grooves. Enlarged three times.

Fig. 6. An imperfect specimen, with its surface partially covered with spines. Natural size.

Fig. 7. A portion of the surface of the same specimen, enlarged three times, showing the spines, now prostrate, and the perforated tubercles to which they were articulated.

Fig. 8. A spine of the calyx, enlarged twelve times, showing interrupted striæ and microspines.

Fig. 9. A spine of one of the vault-plates, similarly enlarged.

Fig. 10. An imperfect individual, showing the smaller plates of the peripheral portion of the vault and some of the interbrachial plates. Enlarged twice.

Fig. 11. A single plate, with wrinkled ridges and grooves, from the central portion of the vault. Enlarged five times.

Fig. 12. Plates from the central portion of the vault, covered with short blunted tubercles and spines, similarly enlarged.

Fig. 13. A fragment of the stem, enlarged twice, with two whorls of mature cirri and an intermediate whorl of smaller cirri.

Fig. 14. Another fragment of the stem, enlarged three times, showing the socket of an anterior cirrus.

Fig. 15. A facet of a stem-joint, enlarged four times.

Fig. 16. A facet of a cirrus-joint, similarly enlarged.

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* Third Annual Report, New York Survey, Pal. Dept. 1840, p. 205.

XVI.—*Notes on the Palæozoic Bivalved Entomostraca.*—No. XIX. *On some Carboniferous Species of the Ostracodous Genus* Kirkbya, *Jones.* By T. RUPERT JONES, F.R.S., and JAMES W. KIRKBY, Esq.

[Plate III.*]

THIS genus was established in 1859 for the reception of the species, *K. permiana*, Jones, from the Magnesian Limestone of Sunderland. The Carboniferous species, *K. Urei*, Jones, discovered by the Rev. David Ure near Rutherglen, about the year 1793, was at the same time recognized as belonging to this group†.

Previous to this, Professor M'Coy, in 1844, had described and figured, as *Cythere costata*, another and very characteristic member of the genus, from the Carboniferous Yellow Sandstone of Ireland‡.

In 1854, Prof. Dr. A. E. Reuss figured and described his *Kirkbya Rœssleri* (as a *Cythere*) from the Lower Zechstein of Bleichenbach §; and in the same year Count Keyserling figured and described, as *Cythere Schrenkii*, *C. sticta*, and *C. grapta*, three *Kirkbyæ* from the Permian strata on the Pinega in North-eastern Russia‖.

Somewhat later, in 1860, M. E. d'Eichwald described and figured *Beyrichia umbonata* and *B. striolata*, two species which we refer to *Kirkbya*, from the Carboniferous Yellow Shale of Russia ¶.

In 1867 nine species of *Kirkbya* were given in our List of Entomostraca occurring in the Carboniferous rocks of Scotland. Six of these were new**.

In 1869 one species, *K. fibula*, Jones and Holl, was described from the Silurian rocks of Malvern††.

Kirkbyæ are also referred to in Mr. Smith's list of Silurian Entomostraca (1881, Geol. Mag. dec. 2, vol. viii. p. 73), and in Mr. Vine's (1882, Quart. Journ. Geol. Soc. vol. xxxviii. p. 48).

* This Plate has been drawn with the aid of a grant from the Royal Society for the illustration of the fossil Bivalved Entomostraca.

† Trans. Tyneside Field-Club, vol. iv. p. 129.

‡ Syn. Char. Carb. Foss. Ireland, p. 165, pl. xxiii. fig. 11; Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. 1866, p. 43.

§ Jahresb. Wetterau. Gesellsch. Naturk. Hanau, 1851–53, 1854, p. 70, pl. O. fig. 11 *a*, *b*.

‖ In A. G. Schrenk's 'Reise nach dem Nordosten d. Europ. Russlands,' part 2 (8vo, Dorpat, 1854), p. 112, pl. 4. figs. 37–39.

¶ Lethæa Rossica, I. vii. p. 1347, pl. 52. fig. 10, & p. 1348, pl. 52. fig. 14; Ann. & Mag. Nat. Hist. ser. 4, vol. xv. 1875, pp. 53, 54.

** Trans. Geol. Soc. Glasgow, vol. ii. pp. 213–228, and vol. iii. Suppl. 1871, p. 28.

†† Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 224, pl. xv. fig, 9.

At various times the genus has been referred to incidentally, or in general terms, by one of us in papers on Palæozoic Bivalved Entomostraca—as in the Proceed. Geologists' Assoc. 1869, Palæoz. Entom. p. 8, and in the 'Monthly Microscopical Journal,' vol. iv. 1870, p. 192, where a generic description was given, and *K. Urei* figured (pl. 61. fig. 15) as a representative of it.

During the whole of this period, from 1859 to the present time, materials and information relating to *Kirkbya* have been accumulating with us; and of these ultimately we hope to make full use in our account of the Carboniferous Entomostraca for the Palæontographical Society. But in consideration of the genus having gradually become important as to the number of its species, as well as being a type of the Ostracoda especially distinctive of the Carboniferous period, we venture to offer, without more delay, the accompanying brief account of the more important (the majority) of the forms known to us.

Our knowledge of these forms is greatly due to the help we have obtained, in specimens, from numerous friends and correspondents. Among these may be named Mr. John Young, of the Hunterian Museum, Glasgow; Messrs. David Robertson, James Armstrong, James Thomson, and others of the same city; Mr. James Bennie, of the Geological Survey, Edinburgh; the late Mr. Charles Moore, of Bath, and others.

Most of our specimens of *Kirkbya* are from the marine shales overlying, underlying, or otherwise associated with the calcareous beds of the Carboniferous series. In Scotland they are equally common in the Upper and the Lower Limestone series; and some of the species are found in the thin limestones well down in the Calciferous Sandstones. In England they occur in the marine shales of the Yoredale rocks*, and in the shaly partings of the Scar or Mountain Limestone. The Irish specimens that we have seen are from the Lower Carboniferous Shales.

We have no examples of any of the species from the upper portion of the Carboniferous series, either Coal-measures or Millstone-grit, although in the Permian limestone, overlying the Coal-measures, in Durham and Yorkshire, one species (*K. permiana*) reappears, and ranges from the lowest beds to near the top of the formation.

In most cases the individuals of the different species occur rather sparingly, or but moderately plentiful, with the Brachiopods, Polyzoans, Crinoids, and other marine fossils usually associated with them. This is the rule; but in a few in-

* G. R. Vine, Proceed. Yorksh. Geol. Polyt. Soc. 1883, p. 239.

stances we have seen them numerous enough to be the prevailing fossils, and sometimes in such numbers as to be gregarious. *K. spiralis*, J. & K., offers the most notable example of this. In a thin, impure limestone of the Calciferous Sandstones, near Pittenweem, Fifeshire, it is found in great numbers; and, again, just as abundantly in a local intercalation of shale, in the Scar Limestone, at Meathop, Westmoreland. *K. costata* also appears to be about as plentiful in a Lower-Carboniferous deposit at Plashetts, Northumberland, if we may judge from the numbers of specimens that occur in a washing sent to us from that locality by our friend Mr. James Bennie. These instances, however, are exceptional in our experience.

The generic characters of *Kirkbya* were noticed in a former paper by one of us, as before mentioned (p. 175). They may be restated here concisely as follows:—

Carapace oblong, subovate, or ark-shaped; flatly convex or compressed. Valves usually thick-shelled, and generally higher behind than before; impressed with a subcentral pit, and ornamented with longitudinal or concentric wrinkles, riblets, ribs, or ridges, and often with surface-reticulation; the dorsal border is always straight; the ventral border is nearly straight, or slightly convex in its middle third, and boldly curved at the ends; and the extremities are more or less rounded, though somewhat angulate at their junction with the dorsal border; one end is generally more obliquely rounded than the other. The hingement is simple. The ventral edge of the dextral valve slightly overlaps that of the other.

The subcentral pit is sometimes above and sometimes below the median line of the valve, and it varies greatly in relative size; sometimes it is obsolete. In its typical form it is oval or nearly round; but in some species and varieties it becomes irregular in outline, and passes, by gradations, almost into the ordinary sulcus of *Beyrichia*.

In the Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 225 a list of the then-known *Kirkbyæ* was given, and it was there remarked by one of us, concerning the so-called varieties, that "some, if not all, of these may be distinct species; for the soft parts may have varied more than the carapace." The probability of this being really the case grows upon us, and we now regard the "varieties" *glypta*, *Rœssleri*, *Schrenkii*, *sticta* (=*Richteriana* *), and *grapta* as species. (See also Ann. & Mag. Nat. Hist. for Nov. 1884, p. 340, footnote.)

* This is the same as the "*K. Rœssleri*" described and figured by Dr. R. Richter, Zeitschr. deutsch. geol. Ges. vol. vii. 1855, p. 528, pl. 26. figs. 1–5.

List of Species and Varieties of Kirkbya.

	Permian.			Carboniferous.					
	Upper Magnes. Limest.	Middle Magnes. Limest.	Lower Magnes. Limest.	Coal-Measures.	Millstone-grit.	Carbonif. Limest. (Upper).	Carbonif. Limest. (Middle).	Carbonif. Limest. (Lower).	Calcif. Sandstone.
Kirkbya permiana, *Jones*	*	*	*	..	..	*	..	*	*
—— Schrenkii (*Keyserling*)	..	..	*						
—— sticta (*Keys.*) [=Richteriana, *Jones*]	..	..	*						
—— grapta (*Keys.*)	..	..	*						
—— Rœssleri (*Reuss*)	..	..	*						
—— glypta, *Jones*	*	*	*						
—— umbonata (*D'Eichwald*)	..	..	..	..	..	..	..	*	
—— ——, var. radiata, *Jones & Kirkby*	..	..	..	..	..	..	..	*	
—— oblonga, *J. & K.*	..	..	..	..	..	*	..	*	
—— annectens, *J. & K.*	..	..	..	..	..	..	..	*	
—— ——, var. bipartita, *J. & K.*	..	..	..	..	..	..	.	*	
—— plicata, *J. & K.*	..	..	..	..	..	..	..	*	*
—— spiralis, *J. & K.*	..	..	..	..	..	..	..	..	*
—— spinosa, *J. & K.*	..	..	..	..	..	*	..	*	
—— costata (*M'Coy*)	..	..	..	..	..	..	..	*	*
—— ——, var. Mooreana, *J. & K.*	..	..	..	..	..	..	..	*	
—— scotica, *J. & K.*	..	..	..	..	..	*	..	*	
—— rigida, *J. & K.*	..	..	..	..	..	*			
—— Urei, *Jones*	..	..	..	..	..	*	..	*	
—— striolata (*D'Eichwald*)	..	..	..	..	..	..	..	*	
—— fibula, *Jones & Holl* } Silurian.									
—— spp., *Smith & Vine* } Silurian.									

K. umbonata, *permiana*, *spiralis*, and *costata* have been found in the Scar Limestone of the North-west of England, and *K. plicata* in the Carboniferous Limestone of the South-west of the same country. How far these rocks may be in part equivalent to the Calciferous Sandstone or Lower Carboniferous series of Scotch geology we are unable to say; but to some extent they undoubtedly are so (as already suggested by other writers), though we may probably have to go lower than the base of the Scar Limestone to find anything on the same horizon as the Lower Calciferous Sandstone beds of the South-east of Scotland.

1. *Kirkbya permiana*, Jones. (Pl. III. fig. 1.)

Dithyrocaris permiana, Jones, 1850, in King's 'Monograph of Permian Fossils' (Palæont. Soc.), p. 66, pl. 18. figs. 1*a–d*.

Ceratiocaris? permiana, Jones, in Morris's Catal. Brit. Foss. 1854, p. 103.
Leperditia? permiana, Kirkby, 1858, Ann. & Mag. Nat. Hist. ser. 3, vol. ii. p. 434, pl. xi. figs. 5–13.
Kirkbya permiana, Jones & Kirkby, 1859, Trans. Tyneside Field-Club, vol. iv. p. 129, pl. viii. A. figs. 1, 2, 3, and 5 (figs. 4 and 7, *K. glypta*), pl. x. figs. 5, 7, 9–12 (figs. 6 and 8 *K. glypta*).
Kirkbya permiana, Kirkby, 1861, Quart. Journ. Geol. Soc. vol. xvii. p. 308.
Kirkbya permiana, Jones & Kirkby, 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 28.
Kirkbya permiana, Armstrong and others, 1876, Catal. Western-Scottish Foss. p. 44.
Kirkbya permiana, J. & K. 1880, Quart. Journ. Geol. Soc. vol. xxxvi. p. 588.

This species, as a Permian "recurrent," was fully described in the 'Annals and Magazine of Natural History' for Nov. 1858; and again, in more detail, in the 'Transactions of the Tyneside Field-Club' for 1859. The descriptions and figures there given of Permian specimens from the Magnesian Limestone of Tunstall Hill would do equally well for most of the many Carboniferous examples of the species that have come under our notice; but, for convenience, we describe it from the latter as follows:—

Carapace ark-shaped or suboblong, flatly convex or compressed, height half the length or rather more. Dorsal border straight, sometimes the full length of the valve, sometimes rather less, according to the relative boldness of the curve of the extremities; ventral border faintly incurved, straight, or gently convex in its middle third, and boldly curved at the extremities, the anterior extremity being the most acute. The extremities and ventral portion of each valve are bordered by two parallel, concentric rims or expansions, which project a considerable distance beyond the surface of the valve. A small oval pit occupies a subcentral position on each valve, and the surface is beautifully reticulated. Length $\frac{1}{25}$ inch.

The Carboniferous specimens of this species vary considerably in character. The drawing here given (Pl. III. fig. 1) is that of an average good specimen; other illustrative figures would have been given had circumstances allowed.

The outline of the valves is usually as described above; but sometimes the extremities and ventral margin almost approximate the curve of a semicircle in the regularity of their contour; from this extreme the ends by degrees become more abruptly sloped, and the ventral border straightened, until an oblong figure is approached.

Many examples have the valves much depressed, others have them moderately convex (and so form a carapace of fair capacity); and there are some few where the regularity of their surface is interfered with by one or more lobe-like swellings. In this feature it resembles *K. Schrenkii*, Keyserling*; but the latter has a rounded, and not ridged, ventral margin.

The ventral rims vary in development, and are apparently largest in old individuals. In some cases the mesh-walls on the reticulated surface show a tendency to run in faint riblets within and parallel to the marginal ridges.

The reticulation of the surface is relatively large, in most cases with a more or less angular form of mesh, and is very beautiful in well-preserved specimens.

The subcentral spot is often obsolete or not to be seen.

Kirkbya permiana is of common occurrence in the marine shales of the Carboniferous-Limestone series of Scotland and the north of England. It is found in a similar shale in the upper portion of the Calciferous Sandstone of Fife.

As a Permian species it is met with in the Magnesian Limestone of Durham and Yorkshire, also in Germany.

Some of its British localities are as follows:—

Scotland. Calciferous Sandstone: coast west of Pittenweem, Fife. Carboniferous Limestone (Lower): Brockley, Calderside Quarry, Brankumhall Quarry, in Lanarkshire; Galabraes, Whitebaulks, in Linlithgowshire; Corrieburn, Scullengour, Craigenglen, in Stirlingshire; Fullerton, Currielee Lime-works, Darcy Limestone Quarry, Magazine Limeworks, Hillhead Quarry, near Cockmuir Bridge, in Edinburghshire; Catcraig, near Dunbar, Burlage Quarry, East Salton, in East Lothian; coast near Abden, Glenniston Quarry, Inverteil Quarry, Ladedda Quarry, Wilkieson, Cults, Teasses, in Fife; Carlops, Whitefield, in Peeblesshire. Carboniferous Limestone (Upper): Robroystone, Orchard, Kennox Water, Auchenbeg, in Lanarkshire; River Avon below Kinneil, in Linlithgowshire; &c.

England. Carboniferous-Limestone series: Scremerston, Ridsdale†, Ancroft, in Northumberland; Barnard Castle, Durham; Wyebourne, Calees, in Cumberland; in the Scar Limestone at Stainton Quarry, Lancashire.

As a "recurrent" in Permian strata it is found in the following localities:—

In Lower Magnesian Limestone: Westoe, Eldon, East Thickley, Walworth, Morton Tinmouth, Summerhouse, and

* In Schrenk's 'Reise Nordost. Russl.' &c. 1854, p. 112, pl. 4. fig. 37.

† Mr. G. R. Vine quotes this species, also *K. umbonata* and *bipartita*, from Ridsdale, and from Hurst, Yorkshire (Proc. Yorksh. Geol. Polyt. Soc. for 1883, p. 237).

Langton, in Durham; railway-cutting at Chapel Houses (west of Pierce Bridge), Crakehall, Thornton Watlass, Nosterfield, and Hampole, in Yorkshire. In Middle Magnesian Limestone: Tunstall Hill, in Durham. In Upper Magnesian Limestone: Byer's Quarry, and cliffs to the south of Marsden, on the Durham coast.

2. *Kirkbya umbonata* (D'Eichwald), and var. *radiata*, nov. (Plate III. fig. 2.)

Beyrichia umbonata, D'Eichwald, 1860, Lethæa Rossica, livr. vii. p. 1347, pl. lii. fig. 10.

Kirkbya umbonata, Jones & Kirkby, 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; and 1871, vol. iii. Suppl. p. 29.

Kirkbya umbonata, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Ark-shaped, with a central umbo and a wide ventral frill or marginal radiated expansion to each valve; height about half the length or more. Dorsal border straight; ventral border usually boldly curved; extremities rounded, the posterior being the larger and more obliquely curved than the other. The umbo is near the dorsal border, oval in shape, about a third of the valve's length and half its height in size; it is often awry or placed obliquely on the valve. There is a lamellar expansion or radiate frill round the ventral and extreme borders of each valve, which in older specimens has considerable development; these frills are plaited or ruffle-like, and have more or less scalloped edges. The surface is reticulated in some specimens, and in others finely papulose. Length $\frac{1}{25}$ inch.

This species is subject to some variation. Younger individuals more especially look different, owing to greater regularity of outline, the smaller size and pap-like form of the umbo, and the absence or meagre development of the frills. In the Russian specimen, described and figured by D'Eichwald, from the Yellow Carboniferous Shale of Sloboden, Government Toula, the surface is said to be finely striated and pitted, the space between the umbo and the margin is raised into nearly regular concentric rolls or rounded ridges, and the frilling is absent, as in some of our specimens.

It is undoubtedly a near ally of *K. permiana*, with which it has much in common. It is usually, however, to be distinguished from the latter by its greater relative height, the more *Leperditia*-like truncation of the valves, by its irregular hump or umbo, and by the character of its ventral rims. The surface-reticulation also differs somewhat, not being so definitely meshed like network. The frill-less form occurs in Scotland

and in Westmoreland, and it has the umbo quite regular sometimes. The frill may be obsolete, or easily lost perhaps, as in the fringed *Beyrichiæ*.

K. umbonata occurs in the following localities:—

Scotland. Carboniferous Limestone (Lower): Brockley and Hairmyers, in Lanarkshire; Craigenglen, in Stirlingshire; Whitefield and Carlops, in Peeblesshire; Hillhead Quarry, near Cockmuir Bridge, in Edinburghshire; Kidlaw Quarry, Catcraig, Burlage Quarry, East Salton, in East Lothian; Wilkieson, Ladedda, Charleston, Cowdens Quarry, coast east of St. Monans, in Fifeshire.

England. Carboniferous-Limestone series: Scremerston, Barmoor Redhouse (Lowick), Ridsdale, in Northumberland; Calees, in Cumberland. In the Scar Limestone: at Arnside and in a railway-cutting near Heversham, Westmoreland.

3. *Kirkbya oblonga*, Jones & Kirkby. (Pl. III. fig. 3; and varieties, figs. 4, 5, and 6, *a*, *b*.)

Kirkbya oblonga, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; 1871, vol. iii. Suppl. p. 28.

Kirkbya oblonga, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 44.

Oblong-ovate, convex; height (which is uniform in the central third) equal to half the length or more. Dorsal border almost straight, but rather concave; ventral border usually straight in the central third; extremities boldly rounded and almost alike. In some cases the regular convexity of the valves is scarcely broken except by a slight medio-dorsal depression; in others this depression is more pronounced and the valves become rather humped towards the extremities; and in some specimens a circular boss appears in the centre. A slight rim bounds the free margins of the valves; in certain specimens a second is added, and occasionally the reticulation of the surface shows a tendency to develop itself into other less regular concentric wrinkles. Lateral contour subovate. Subcentral pit oval, often obscure. Surface covered with rather large hexagonal reticulation. Length $\frac{1}{30}$–$\frac{1}{25}$ inch.

This species was discovered by our friend Mr. John Young, of Glasgow. It is a near ally of *K. permiana*; but, although the latter sometimes takes on a curved subcentral riblet (see Trans. Tyneside, 1859, pl. x. *a*. fig. 5 *a*), yet it never loses its marginal rims or its strong dorsal angles.

Localities.—Scotland. Carboniferous Limestone (Lower): Brockley, Lanarkshire; Craigenglen, Stirlingshire; coast east of St. Monans, Fifeshire. Carboniferous Limestone (Upper): near Kinneil Mill and Orchard Quarry.

Under this name (*K. oblonga*) we also place certain specimens that occurred to us first from the Carboniferous-Limestone series of Fife (figs. 4 and 6). The character of their reticulated surface, central pit, and ventral riblets sufficiently identify them with *Kirkbya*. We describe them thus:—

Varying from subreniform to suboblong and subquadrate in outline, often compressed; height two thirds of the length. Dorsal border straight for from about a third to a fourth less than the maximum length; ventral border curved or straight in central third; extremities rounded, the anterior being slightly the more acute. Surface reticulated (hexagonal or pentagonal meshes) and with two or more faint concentric riblets (including a slight marginal rim) below. Length $\frac{1}{27}$ inch. Edge view (lateral contour, fig. 6 *b*) is acute-oval.

Discovered by Mr. James Bennie in the Lower-Carboniferous Limestone, on the coast near Seafield Tower, Fifeshire.

Figs. 5 *a*, 5 *b*, represent a form that Mr. Robertson has from Williamswood, near Glasgow. It is relatively shorter than *K. permiana*, and the dorsal line is only about two thirds of the total length; it is thus nearly oblong, with rounded ends. The valves have each a slight marginal rim, are humpy towards the ends, or faintly lobed, and more coarsely reticulated than is usual with *K. permiana*; and there is a weak submedial riblet in some individuals. We figure it so as to keep it in view, as it is a form requiring further study. A somewhat similar short form, but more convex and more definitely ridged, we have seen in Mr. C. Moore's collection from Steeraway, Salop. Probably they are all closely allied to *K. oblonga*.

4. *Kirkbya annectens*, Jones & Kirkby. (Pl. III. figs. 7, *a–d*; and var. *bipartita*, figs. 8, *a*, *b*.)

Kirkbya annectens, J. & K., 1866, Ann. & Mag. Nat. Hist. ser. 3, vol. xviii. p. 42.

Kirkbya annectens, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; and *bipartita*, 1871, vol. iii. Suppl. p. 28.

Kirkbya annectens and *K. bipartita*, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 44.

Valves suboblong in outline, rather convex and lobed, height half the length or more. Dorsal border straight or slightly incurved, and about two thirds of the maximum length; ventral border either straight or slightly incurved, or as slightly convex; extremities rounded and in some specimens nearly alike, in others the anterior is the more acute.

The medio-dorsal portion of the valve is depressed, and in front is a rounded boss-like lobe, and behind is another lobe or tubercle, usually smaller than that in front; the ventral portion of the valve is swollen, and traversed longitudinally by a curved ridge or rib. Lateral contour subcuneiform. Shell rather thin. Surface smooth so far as known. Length $\frac{1}{30}$ inch. Edge view (figs. 7 *b*, *c*, and 8 *b*, lateral contours) compressed, ovate.

The above description applies more correctly to the Irish members of this species. Scotch examples show some differences; instead of two lobes or tubercles they sometimes have three, either all on the dorsal region of the valve or with the middle one rather lower down than those at the ends, and two (or at times three) strong ridges sweep across the valve concentrically with the extreme and ventral borders; the uppermost of these is occasionally fully above the median line of the valve, and the lowermost often takes the form of a marginal rim. The surface also, in some examples at least, is reticulated. It may be that these specimens represent a Scotch form specifically distinct from the others. This is a point for further investigation. For the present we designate it *K. annectens*, var. *bipartita*.

The Irish specimens we have seen were collected and submitted to our inspection by the late Sir Richard Griffiths. They are very uniform in character, all of them having the two bosses or tubercles, one towards each extremity of the valve, and but a single ventral rib. They have rather a Beyrichian look, and undoubtedly come nearer that genus than other members of the group under description.

Localities.—Ireland. In Lower-Limestone Shales, Drumard, Londonderry; Cultra, Down; Larganmore, Mayo.

Scotland. Carboniferous Limestone (Lower): Brockley, Lanarkshire; Orchard, Gare, in Lanarkshire; River Avon below Kinneil Mill, Linlithgowshire.

England. Hurst, near Richmond (*bipartita*), Yorkshire, on the authority of Mr. G. R. Vine (Proc. Yorksh. Geol. Polyt. Soc. 1883, p. 237).

Dr. C. W. Gümbel's *Kirkbya alpina*, figured in his 'Kurze Anleitung zu geol. Beobacht. in den Alpen,' 1878, p. 83, fig. 28, has a distant resemblance to *K. annectens*, but is much more like *Beyrichia arcuata* (Bean), as far as the little woodcut shows. It is from the Bellerophon-limestone, a passage-bed from the Palæozoic to the Mesozoic (between the Permian and the Trias).

5. *Kirkbya plicata*, Jones & Kirkby.
(Pl. III. figs. 9 and 10, *a*, *b*.)

Kirkbya plicata, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 221; 1871, vol. iii. Suppl. p. 28.
Kirkbya plicata, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.
Kirkbya plicata, Kirkby, 1880, Q. J. G. S. vol. xxxvi. p. 588.

Ovate to subovate, compressed, and considerably over half as high as long. Dorsal border straight, and two thirds (or more) of the maximum length; ventral border boldly arched; anterior extremity rounded and decidedly the smaller, sloping below; posterior extremity boldly and obliquely rounded. The subcentral pit is deep, transverse, and usually placed rather posteriorly. A narrow but prominent rim bounds the valves, and two sinuous ribs of equal size to the rim cross the valve from their point of junction near the antero-centre to near the hind margin or the postero-ventral angle, where they again approach very nearly together. These ribs divide the valve into dorsal, central, and ventral areas. The edge-view (lateral contour) varies in different specimens from flatly lenticular to subcuneiform (fig. 10, *b*). Surface smooth in most of our specimens, but in a few cases finely reticulated. Length $\frac{1}{23}$ inch.

Some few examples of this species show a third rib not far from the ventral border (fig. 9). The subcentral pit varies in size; sometimes it is not seen at all, and occasionally it takes more the form of a sulcus.

K. plicata was discovered by the late Mr. Charles Moore, of Bath, in the Carboniferous Limestone of Backwell, Somerset, where it appears to be not at all rare.

Localities.—England. Carboniferous Limestone: Backwell, Charterhouse, Weston-super-Mare, in Somerset.

Scotland. Calciferous Sandstone: Randerstone, Fife; Craiglockhart Quarry and Camps, in Edinburghshire; Larriston Quarry and Penton Bridge, in Roxburghshire. Carboniferous-Limestone series: Campbelltown, Argyleshire; Whitefield New Quarry, Peeblesshire.

6. *Kirkbya spiralis*, Jones & Kirkby.
(Pl. III. figs. 11, *a*, *b*.)

Kirkbya spiralis (J. & K. MS.), Kirkby, 1880, Quart. Journ. Geol. Soc. vol. xxxvi. pp. 564, 568, 573, 588.
Kirkbya spiralis, Jones, 1884, Proc. Berwicksh. Nat. Club, vol. x. p 323, pl. ii. figs. 12, 13.

Carapace subovate or oblong, highest behind, compressed, slightly lobate; height half the length or more. Dorsal border straight and about two thirds of the valve-length; ventral border incurved and sloping downwards to maximum height, which is in the posterior third; extremities rounded, the posterior being the larger and more projecting. The subcentral pit, which is transverse, is placed somewhat nearest the dorsal and posterior portions of the valve. A marginal rim bounds each valve, and is continued as a ridge from the dorsal centre downwards, and concentrically with the margins to or near the subcentral pit; within the central area thus formed is a longitudinal and somewhat sinuous ridge, which is free at the ends. Edge view (fig. 11, *b*, lateral contour) narrow, ovate, and rather constricted near the centre. Surface smooth. Length $\frac{1}{22}$ inch.

This species does not vary among individuals much in character, except perhaps a little in relative length.

It appears to be confined to the lower portion of the Carboniferous series, where it is very abundant at some horizons, as already noted (p. 176).

K. spiralis has been described by one of us in the 'Proceedings of the Berwickshire Naturalists' Club,' from somewhat imperfect specimens collected by the late Mr. George Tate, of Alnwick.

Localities.—England. Lower Carboniferous: Tweedmouth, Northumberland. Scar or Mountain Limestone: Meathop (near Grange-over-Sands), Westmoreland; Calces, Cumberland.

Scotland. Calciferous Sandstone: on the coast near the following places:—east of Pittenweem, Billow Ness, Kilminning, Randerstone, and Kingsbarns, in Fifeshire; Oakbank Sandstone Quarry, Linlithgowshire.

7. *Kirkbya spinosa*, Jones & Kirkby. (Pl. III. figs. 12 *a*, *b*.)

Kirkbya spinosa, J. & K., 1867, Trans. Geol. Soc. of Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 29.

Kirkbya spinosa, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Ovate-oblong, oblique at the ends, swollen in front, rather compressed behind, less than twice as high as long. Dorsal border straight, and a fourth less than maximum length; ventral border curved; anterior extremity rounded and most prominent above; posterior extremity obliquely rounded and most prominent below. The anterior portion of the valve is much the thickest. The subcentral pit is sometimes longitudinal, sometimes transverse and almost a sulcus, which is occasionally divided by the upper ridge. Two, and even three, ridges traverse the valve longitudinally, one either above or across the pit, the others below; the upper and mid ridges terminate in strong spines, which curve upward and forward. A very delicate rim bounds the free margins. Edge view (lateral contour) subcuneiform (fig. 12, *b*). Shell thin; surface smooth (?). Length $\frac{1}{25}$ inch.

In some specimens (probably old and worn) the ridges are almost obsolete; otherwise this species seems subject to little variation. Mr. James Thomson discovered this species.

Localities.—England. Carboniferous-Limestone series: Steeraway, Salop; Calces, Cumberland; Scremerston and Ridsdale, Northumberland; Holker Park, Lancashire.

Scotland. Carboniferous Limestone (Lower): Craigenglen, Scullengour, in Stirlingshire; Garpel Water, Ayrshire; Paiston Quarry, East Lothian. Carboniferous Limestone (Upper): Ravenscraig, Fifeshire.

8. *Kirkbya costata* (M'Coy). (Pl. III. figs. 13 *a*, *b*, 14 *a*, *b*; var. fig. 15.)

Cythere costata, M'Coy, 1844, Syn. Char. Carb. Foss. p. 165, pl. xxiii. fig. 11.

Kirkbya costata, J. & K., 1866, Ann. & Mag. Nat. Hist. ser. 3, xviii. p. 43.

Kirkbya costata, J., K., & B., 1884, Monogr. Brit. Foss. Biv. Entom. Pal. Soc. p. 89, pl. 7. fig. 17.

Subovate or ovate-oblong, flat-sided, rather highest behind, height more than half the length; thick-shelled, and strongly ribbed with subconcentric ridges. Dorsal border straight or nearly so, and over two thirds of the maximum length; ventral border more or less convex; extremities rounded, the anterior smaller than the other, and both somewhat angular above. Subcentral pit circular, rather above the median line, and showing internally as a raised spot. Edge view (lateral contour) long-ovate with flattened sides (fig. 13 *b*, 14 *b*). The extreme anterior portion of each valve is smooth, but from near the centre of that portion spring two strong ribs, one curving abruptly up and the other down, and then passing along the valves rather obliquely and sinuously to near the postero-ventral angle, where they curve to each other and join; between them are two or three somewhat smaller but similar ribs, also free at their anterior ends, but connected at the other. Other ribs come in below, more or less parallel to the lowest of those just described; and others come in above and fill up the triangular space between the upper large rib and the dorsal border, the highest being nearly as strong as the two first-mentioned. There is considerable variation in the curvatures and connections of the riblets. Surface not reticulated so far as known. Length $\frac{1}{24}$–$\frac{1}{20}$ inch.

The above description is taken from specimens which we identify with Prof. M'Coy's *Cythere costata*, but which do not exactly agree with the figures of the species in his 'Synopsis of the Characters of the Carboniferous Fossils of Ireland.' In all probability his specimens may not have been so perfect as ours; or the latter may possibly differ somewhat from the Irish examples. However this may be we think it well to assume that the highly costated species now described is the same as M'Coy's.

Localities.—England. Carboniferous-Limestone series: Steeraway, Salop; Weston-super-Mare, Somerset; Railway-cutting near Heversham, Westmoreland; Cam Beck, Cumberland; Plashetts, Northumberland.

Scotland. Carboniferous Limestone (Lower): Brockley, Lanarkshire; Cults Lime-works, Fifeshire.

8*a*. Var. *Mooreana*. (Pl. III. fig. 15.)

From Weston-super-Mare we have seen another costated *Kirkbya*, rather resembling the present species, but relatively much shorter and more subquadrate in outline, the height being two thirds of the length. The costation likewise is slightly different; and the subcentral pit takes more the form of a transverse slit. This may possibly be a distinct species; for the present we term it *K. costata*, var. *Mooreana*. It was collected by the late Mr. Charles Moore, of Bath.

9. *Kirkbya scotica*, Jones & Kirkby.
(Pl. III. figs. 16 & 17.)

Kirkbya scotica, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 28.

Kirkbya scotica, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Subrhomboidal, compressed, uniformly highest in the central third; height more than half the length. Dorsal border straight and over two thirds of the maximum length; ventral border slightly convex; extremities obliquely rounded, the posterior having the longest curve above, and the anterior below. Lateral contour (edge view) compressed-oblong. Subcentral pit roundish oval, and nearly in the centre of the valve in most cases. Valves covered with numerous (twelve or more) sinuous and inosculating ribs, somewhat concentric lengthwise and obliquely arranged. The ribs become less concentric and more parallel in some cases, as in fig. 17. Surface otherwise smooth, so far as known. Length $\frac{1}{35}$ inch.

This species, which was discovered by Mr. James Thomson, of Glasgow, is allied to *K. costata*. It is about the smallest member of the genus; and it is rare, having as yet occurred only in two localities, both of which are north of the Border.

Localities.—Scotland. Carboniferous Limestone (Lower): Campbelltown, Argyleshire. Carboniferous Limestone (Upper): Linlithgow Bridge, Linlithgowshire.

10. *Kirkbya rigida*, Jones & Kirkby. (Pl. III. fig. 18.)

Beyrichia rigida, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; 1871, vol. iii. Suppl. p. 26.

Beyrichia rigida, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 43.

Elongate, nearly oblong, compressed, height half the length and less. Dorsal border straight, and not much less than the maximum length; ventral border more or less concave in most cases; extremities abruptly rounded and nearly alike, the anterior being slightly the smaller. The valves are very flat, and have two flanges or rims round the extreme and ventral borders; the inner one is usually the larger, projecting beyond the slight convexity of the carapace; the other, more truly marginal, is smaller. They are more or less sparsely denticulated in many specimens. Two narrow vermiform ridges descend from the dorsal border across half or two thirds of the valve, at about a third of the length of the valve from each extremity. Edge view (fig. 18, *b*, lateral contour) is elongately oblong, much compressed. Subcentral pit circular, small or obsolete. Surface reticulated, but very often more or less incrusted. Shell moderately thick. Length $\frac{1}{35}$–$\frac{1}{30}$ inch.

This species varies in relative height and length, but is generally elongated, and much compressed at the sides. The anterior end is usually slightly the smaller, and the posterior is sometimes rather obliquely rounded, projecting most below. The two ribs are curious features, and, at first sight, might almost be looked upon as foreign bodies incrusted on the valves. As a rule, they are placed rather nearest to the anterior end; but they are not constant in position, and occasionally one of them is much stronger than the other. Seen from below, the carapace, with its ventral flanges, presents an elongated figure, four or five times as long as wide, with parallel or slightly concave sides, and abruptly truncate ends and attenuate corners (fig. 18, *b*), the ends being fully wider than the centre. In the dorsal view, the sides are decidedly concave and the ends much the widest part of the figure.

We formerly looked upon this species as referable to the genus *Beyrichia*; but the general outline of the carapace, its compressed sides, marginal ridges, reticulated surface, and subcentral pit lead us now to place it, without much hesitation, in *Kirkbya*, whilst its vertical ridges find an analogy in the median ridges of the next species.

It was discovered by Mr. John Young, of Glasgow, in the Carboniferous-Limestone series (Upper) of Orchard, near Thornliebank, Renfrewshire; and it also occurs in the same position at Kinneil Mill, Linlithgowshire.

11. *Kirkbya Urei*, Jones. (Pl. III. fig. 19.)

Kirkbya Urei, Jones, 1859, Trans. Tyneside Field-Club, vol. iv. p. 136.
Kirkbya Urei, J. & K., 1867, Trans. Geol. Soc. Glasgow, vol. ii. p. 220; and 1871, vol. iii. Suppl. p. 29.
Kirkbya Urei, Jones & Holl, 1869, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 225.
Kirkbya Urei, Jones, 1870, Monthly Microscop. Journ. vol. iv. p. 185, pl. lxi. f. 15 *a*, *b*.
Kirkbya Urei, Armstrong and others, 1876, Catal. W.-Scot. Foss. p. 45.

Oblong, with ends rounded and nearly alike, and of equal height to the rest of the valve, height equal to two thirds of the length, strongly ribbed concentrically, thick-shelled. Dorsal border straight and four fifths of the maximum length; ventral border straight or very slightly concave, and sloping evenly up into the curvature of the extremities. There are three strong concentric ridges on each valve; the two outermost of which (speaking of the single valve) are marginal, and follow more exactly the contour of the valve, while the third forms, as it were, an escutcheon in the centre and is attached to the second, or inner one of the two marginal dorsal ridges; within the escutcheon is usually a more delicate, sharply bent ridge, U- or V-shaped, with the subcentral oval pit at its base. The surface is strongly reticulated, the meshes often being more or less rounded and irregular in size. Edge view (lateral contour) compressed ovate or suboblong, with the anterior end the narrower. Viewed from below, little is seen of the carapace but the four ventral ridges with intermediate reticulated spaces and the ridges of the escutcheon; the view from above (fig. 19, *b*) shows a broad obtusely angulated dorsal area, widest at the posterior end; along this area the two marginal ridges are continued (in less strength), single rows of meshes separating them from each other. Length $\frac{1}{55}$–$\frac{1}{35}$ inch.

This is one of the smaller forms of the genus. Some specimens are relatively longer than others, and some have the extreme dorsal and ventral regions well rounded, and so are more oval and less rectangular in figure than in perhaps more typical examples. The ridges vary in strength and sharpness, being sometimes very high and wall-like; the central concentric ridge, or escutcheon, as we have termed it, is occasionally imperfect ventrally. There are also other slight variations, as in all the *Kirkbyæ*; but, on the whole, this is a well-marked and characteristic species. It is of interest also on account of its having been discovered by the Rev. David Ure, of Rutherglen, in the Carboniferous-Limestone series of Western Scotland, so far back as 1793 or before. Specimens of it, along with other Microzoa, were sent by him to his friend Dr. John Hunter, in London, who placed them in his Museum, now the Hunterian Museum, Royal College of Surgeons, where they were noticed by one of us more than sixty years afterwards.

Localities.—England. Carboniferous-Limestone series: Dun Quarry near Lowick, Skellygate (Ridsdale), Scremerston, in Northumberland; Holker Park, Lancashire.

Scotland. Carboniferous Limestone (Lower): Brockley, High Blantyre, Head of Mouse Water, Capelrig Quarry, Brankumhall Quarry, and elsewhere in Lanarkshire; Craigenglen, Stirlingshire; Murrayfield Old Pit, Whitebaulks Quarry, Linlithgowshire; Burlage Quarry, East Lothian; Darcy Limestone Quarry, Edinburghshire; Inverteil Quarry, Coast near Abden and Seafield Tower, Wilkieston Quarry, Coast east of St. Monans, Sunnybank Quarry, Glenniston Quarry, in Fifeshire. Carboniferous Limestone (Upper): Robroystone.

Besides the foregoing species there are some other forms which additional material and further study may show to belong to *Kirkbya*. Certain of these forms (from the Lower Carboniferous beds) are rather perplexing in their double and almost equal relationship to *Beyrichia* and *Kirkbya*. To these we shall recur at some future opportunity.

Note.—In the Zeitschrift deutsch. geol. Gesellsch. 1867, Dr. R. Richter has figured and described *Kirkbya Richteriana* (p. 224, pl. v. figs. 1–3) and *K. collaris*, sp. nov. (p. 225, pl. v. figs. 5, 6), from the Zechstein of the neighbourhood of Saalfeld.

EXPLANATION OF PLATE III.

(The figures are all magnified 25 diameters.)

Fig. 1. *Kirkbya permiana*, Jones. Left valve. Carlops.
Fig. 2. *Kirkbya umbonata* (D'Eichwald), var. *radiata*. Right valve.
Fig. 3. *Kirkbya oblonga*, Jones and Kirkby. Right valve. Kinneil Mill.

Fig. 4. *Kirkbya oblonga*, J. & K., var. Right valve. Near Seafield Tower.

Fig. 5. *Kirkbya oblonga*, J. & K., var. *a*, left valve; *b*, ventral view. Williamswood.

Fig. 6. *Kirkbya oblonga*, J. & K., var. *a*, left valve; *b*, ventral view. Orchard Quarry.

Fig. 7. *Kirkbya annectens*, J. & K. *a*, left valve; *b*, ventral edge; *c*, dorsal edge; *d*, end view. Cultra.

Fig. 8. *Kirkbya annectens*, var. *bipartita*, J. & K. *a*, right valve; *b*, edge view. Gare.

Fig. 9. *Kirkbya plicata*, J. & K. Right valve. Weston-super-Mare.

Fig. 10. *Kirkbya plicata*. *a*, left valve; *b*, edge view. Randerstone.

Fig. 11. *Kirkbya spiralis*, J. & K. *a*, right valve; *b*, ventral view. Randerstone.

Fig. 12. *Kirkbya spinosa*, J. & K. *a*, right valve; *b*, ventral view. Craigenglen.

Fig. 13. *Kirkbya costata*, M'Coy. *a*, left valve; *b*, dorsal view. Cam Beck.

Fig. 14. *Kirkbya costata*. *a*, left valve; *b*, ventral view. Steeraway.

Fig. 15. *Kirkbya costata*, var. *Mooreana*, J. & K. Right valve. Weston-super-Mare.

Fig. 16. *Kirkbya scotica*, J. & K. Right valve. Linlithgow Bridge.

Fig. 17. *Kirkbya scotica*. Left valve. Campbelltown.

Fig. 18. *Kirkbya rigida*, J. & K. *a*, left valve (?); *b*, ventral view. Kinneil Mill.

Fig. 19. *Kirkbya Urei*, Jones. *a*, left valve; *b*, dorsal view. Burlage Quarry.

XVII.—*A List of Reptiles and Batrachians from the Province Rio Grande do Sul, Brazil, sent to the Natural-History Museum by Dr. H. von Ihering.* By G. A. Boulenger.

In the course of the last three years Dr. H. v. Ihering has transmitted to the Natural-History Museum numerous specimens of Reptiles and Batrachians collected by him in the province Rio Grande do Sul. The following list, which contains the names of all the species sent by Dr. v. Ihering, will be useful as completing our knowledge of the herpetological fauna of that district, which rested almost entirely upon the accounts published by Hensel in the 'Archiv für Naturgeschichte' for 1867 and 1868, and will also serve as a verification of some of that author's determinations. I have therefore indicated in synonymy the names given by Hensel whenever they differed from those employed by me; the species unknown to Hensel are preceded by an asterisk.

REPTILIA.

Chelonia.

1. *Platemys Geoffroyana*, D. & B.

Crocodilia.

2. *Alligator latirostris* (Daud.).

Lacertilia.

3. *Urostrophus Vautieri*, D. & B.

*4. *Enyalius Iheringii*, sp. n.

Distinguished from *E. catenatus* (Wied) in the following points:—Nostril nearly equally distant from the orbit and the tip of the snout. The scales on the vertebral region relatively larger, subrhomboidal, flat, distinctly keeled. Limbs shorter; tibia shorter than the head; the adpressed hind limb reaches the anterior border of the orbit in the male, the angle of the mouth in the female. Purplish brown above, the male uniform, the female with an alternating series of black spots on the vertebral region and, on each side from nape to base of tail, a broad yellow band; lower surfaces brownish or purplish.

	♂. millim.	♀. millim.
Total length	292	297
Head	25	26
Width of head	18	20
Body	67	71
Fore limb	50	50
Hind limb	80	76
Tail	200	200

Two specimens, ♂ ♀.

*5. *Liolæmus azureus* (Müll.).

Tropidocephalus azureus, F. Müller, Verh. nat. Ges. Basel, vii. 1882, p. 161, pl.

This species is closely allied to *L. pectinatus* (D. & B.), which it resembles strikingly in coloration. It is, however, easily distinguished by the longer digits, the nearly equal length of the third and fourth fingers, and the strongly keeled ventral scales. The species was originally described from Uruguay, whence the Natural-History Museum has also received a specimen, hitherto confounded with *L. pectinatus*. A fine specimen from near the coast was sent by Dr. v. Ihering.

*6. *Liolæmus occipitalis*, sp. n.

Near *L. multimaculatus* (D. & B.). Snout short, rounded; nostril superior, above the canthus rostralis; tympanum hardly as large as the eye-opening, without denticulation anteriorly; upper head-scales smooth; an enlarged oblique scale on each side of the forehead; a series of transversely-enlarged supraoculars; occipital larger than the tympanum; six or seven upper labials, separated from the infraorbital by two series of scales. Sides of neck strongly plicate. Dorsal scales small, smaller than ventrals, as large as gulars, strongly keeled, not mucronate; lateral scales smaller, smooth; ventrals smooth, obtusely pointed. The adpressed hind limb reaches the tympanum; no enlarged postfemoral scales. Tail slightly depressed, a little longer than head and body. Grey above; a series of darker spots on each side of the vertebral line; two darker bands on each side from axilla to groin, separated by a white streak; lower surfaces uniform white.

	millim.
Total length	82
Head	10
Width of head	7
Body	26
Fore limb	14
Hind limb	23
Tail	46

A single half-grown specimen from near the city of Rio Grande.

Well distinguished from *L. multimaculatus* by the larger occipital and the larger dorsal scales.

7. *Ophiodes striatus* (Spix).

8. *Tupinambis teguixin* (L.).

9. *Teius teyou* (Daud.).

Acrantus viridis, Hens.

10. *Pantodactylus Schreibersii* (Wiegm.).

11. *Amphisbæna Darwinii*, D. & B.

Amphisbæna vermicularis, Hens. nec D. & B.

12. *Anops Kingii*, Bell.

Amphisbæna Kingii, Hens.

Besides a half-grown specimen Dr. v. Ihering transmitted several ova, obtained from ants' nests. These are of special interest, as nothing was previously known concerning the reproduction of the Amphisbænoids. The egg is cylindrical, measuring 35 millim. longitudinally and 10 millim. transversely; its envelope is thin, leathery-brown in spirit. The fœtus, which has reached maturity, measures 105 millim.

OPHIDIA.

*13. *Elapomorphus lemniscatus*, D. & B.

Also a variety, hitherto unrecorded, without the black vertebral band.

14. *Liophis Merremii* (Wied).

*15. *Liophis cobella* (L.).

*16. *Liophis almadensis* (Wagl.).

Liophis conirostris, Gthr.
Liophis Wagleri, Jan.

*17. *Coronella anomala*, Gthr.

Coronella pulchella, Jan.

*18. *Coronella Jægeri*, Gthr.

*19. *Coronella pœcilopogon* (Cope).

Rhadinæa pœcilopogon, Cope.
Enicognathus elegans, Jan.

*20. *Coronella obtusa* (Cope).

Rhadinæa obtusa, Cope.

*21. *Coronella Iheringii*, sp. n.

Hinder maxillary teeth not grooved. Head small, not distinct from neck; snout short; rostral moderate; seven upper labials, third and fourth entering the eye; one preocular, two postoculars; a single anterior temporal; seven inferior labials, five in contact with chin-shields; latter, hinder pair longest. Scales in 17 rows. Ventrals 172 to 178; anal divided; caudals 47 to 58. Grey-brown above; a black band on each side of the head, passing through the eye, uniting with a broad transverse black band on the occiput, covering the posterior half of the parietals; the rest of the upper surface of the head with black variegations or almost entirely black; a triangular light spot behind the eye and two roundish ones close together behind the angle of the frontal; the black band across the occiput edged with lighter posteriorly; a blackish longitudinal nuchal line, sometimes continued along the back as a vertebral series of small spots, and a roundish dark spot on each side behind the head; lower surfaces pale yellow; two black dots on the side of each ventral, and one on the side of each caudal; a few other minute dots scattered on the ventrals; gular region brown, with yellowish black-edged spots.

Three specimens; the largest measures 600 millim., into which the tail enters for 120.

*22. *Dromicus melanostigma* (Wagl.).

Dromicus Pleii, Gthr. nec D. & B.

23. *Philodryas æstivus* (D. & B.).

24. *Philodryas Schottii* (Fitz.).

25. *Spilotes variabilis* (Wied).

26. *Heterodon D'Orbignyi*, D. & B.

27. *Helicops carinicaudus* (Wied).

28. *Oxyrrhopus petalarius* (L.).

29. *Thamnodynastes Nattereri* (Mik.), var. *lævis*.

? *Thamnodynastes punctatissimus*, Hens. nec Wagl.

Agrees with the typical form of *T. Nattereri* in the length of the tail, which is less than one fourth of the total, with *T. punctatissimus* in the perfectly smooth scales. Ventrals 142 or 143, caudals 62 or 63†.

*30. *Leptognathus Mikanii* (Schleg.).

31. *Elaps lemniscatus* (L.).

BATRACHIA.

1. *Engystoma ovale*, var. *bicolor*, Val.

*2. *Pseudis mantidactyla* (Cope).

*3. *Ceratophrys dorsata* (Wied).

4. *Ceratophrys americana* (D. & B.).

5. *Paludicola falcipes* (Hens.).

Leiuperus falcipes, Hens.

6. *Paludicola gracilis*, Blgr.

Paludicola gracilis, Blgr. Ann. & Mag. Nat. Hist. (5), xi. 1882, p. 17.
Gomphobates notatus, Hens. nec Reinh. & Lütk.

† Other specimens of this form in the Natural-History Museum show that it reaches as far north as the Guianas, the typical *T. Nattereri* being apparently restricted to the southern half of Brazil, reaching as far south as Buenos Ayres. The number of ventrals varies between 138 and 150, of caudals between 58 and 68.

7. *Leptodactylus gracilis* (D. & B.).

Cystignathus gracilis, Hens.

8. *Leptodactylus mystacinus* (Burm.).

Cystignathus mystaceus, Hens.

9. *Leptodactylus ocellatus* (L.).

Cystignathus ocellatus, Hens.

10. *Bufo arenarum*, Hens

11. *Bufo marinus* (L.).

Bufo agua, Hens.

12. *Bufo crucifer*, Wied.

Bufo dorsalis, ornatus, melanotis, Hens.

13. *Bufo D'Orbignyi*, D. & B.

14. *Hyla faber*, Wied.

Hyla maxima, Hens. nec Laur.

*15. *Hyla pulchella*, D. & B.

16. *Hyla bracteator*, Hens.

In concluding, I must observe that this list is by no means complete, as Dr. v. Ihering informs me that he has not sent specimens of all the species found by him.

XVIII.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

I began the description of Mr. Wilson's Sponges from South Australia, in the last number of the 'Annals,' with certain species which, during a hasty examination of the whole, seemed to demand more immediate notice than the rest; hence they are mixed up indiscriminately as regards classification. But now I intend to go on regularly with the remainder, according to my proposed arrangement in the 'Annals' of 1875 (vol. xvi. p. 128 &c.), beginning with the first order, viz. the

Order I. CARNOSA.

There are only two species of this order in Mr. Wilson's collection, viz. a *Halisarca*, which is new, and a single specimen of *Chondrilla nucula*, Sdt.; but of the former species there are several specimens, which will be named and described as follows:—

Fam. 1. **Halisarcida.**

Halisarca australiensis, n. sp.

Thin and spreading, or contracted, sessile and massive. Consistence soft, elastic, and tough, but yielding like dough to the slightest pressure. Colour cream or pinkish yellow. Surface even, smooth, covered uniformly with a meshed fibro-reticulation, which contrasts strongly by its whiteness with the darker colour of the interstices, but is sometimes in the opposite condition, and sometimes so delicate as to be only seen well under the microscope, if even then. Pores in the interstices of the reticulation. Vents sparse, projecting here and there. Parenchyma consisting of a fibrous reticulation connected with that on the surface, which thus dips down into the interior, holding together the ampullaceous sacs (Geisselkammern); the whole traversed by the branches of the excretory canal-systems. Fibre throughout consisting of delicate transparent filaments twisted together rope-like. Size variable. Largest *spreading* specimen about 2 in. in diameter by 1-8th in. in its greatest thickness, thinning towards the advancing circumference; largest *massive* specimen, which is subglobular with crevices on the surface, about 3-4ths in. each way.

Hab. Marine. Apparently extending itself over everything with which it comes in contact.

Loc. Port Phillip Heads, South Australia. Depth 20 fath.

Obs. As this species becomes hard by contraction in alcohol, so in pure water it becomes flaccid, hence the specimens vary in size a little when subjected to these conditions respectively. The most striking part about it is the fibro-reticulated structure of the surface, which, when well developed, is very beautiful. It appears to be particularly prone to extend itself over a species of *Boltenia* (stalked Ascidian).

Boltenia australiensis (provisional).

There are three or more specimens of this *Boltenia* in the collection, together with a sessile Ascidian of the common stalkless form, all covered with a layer of this *Halisarca*, about 1-24th in. in thickness; but there is only one *Boltenia* in which the stem is perfect, and here it is 17 in. long with a diameter of 7-24ths in. where it joins the head, and one of 1-4th in. below, where it ends in a root-like expansion; while the head, which is nodosely tubercular all over except towards the lower part, is 3 in. high by $2 \times \frac{1}{4}$ in. in its greatest dimensions; and yet the whole, from top to bottom, is covered by a layer of the *Halisarca.* Both the head and stem are composed of firm whitish cartilage, and the nodosely tuberculated surface of the former covered by the *Halisarca* tends greatly to obscure the position of the openings of the Ascidian. Internally the head is smooth, corresponding with the form of the Ascidian which it contains, so all the rest must be viewed as the test, connected only with the Ascidian itself by vascular extension from the latter, which *here* most strikingly manifests its presence by two large vessels (? artery and vein) which, side by side, longitudinally and centrally extend throughout the stem. But the most remarkable part of the stem is that, being almost entirely composed of the white or colourless cartilage, it has imbedded in its structure a thin cylindrical layer of reticulated, anastomosing, keratose, solid, laminated, amber-coloured fibre, so similar to that of a keratose sponge, that, if the two were placed together, it would be almost impossible to distinguish between them. This is situated just inside the circumference of the stem in the midst of the white cartilage, where, by its amber-yellow colour, it contrasts strongly with the latter. It extends from one end to the other of the stem, to which it appears to be confined, disappearing equally towards the head and in the branches of the root-like expansion. Nowhere does the presence of the *Halisarca* appear to influence the form of the test, which is as smooth over the nodosely tuberculated head as it is over the even surface of the cylindrical stem. How far the Ascidian itself may be identified with Prof. Herdman's *Boltenia pachydermatina* ('Challenger' Reports, pt. xvii. p. 89) I am not prepared to say; but as I find specimens of *both* in Mr. Wilson's collection, I can with confidence state that there is considerable difference between the forms of the tests and the composition of their stems generally. That which corresponds to the description of *Boltenia pachydermatina* is not covered with *Halisarca*, while the smooth, wrinkled, and horn-like corrugated stem presents no keratose fibre, but is charged with little calcareous spicules extending inwards for about 1-180th in.; inside which the cartilage and the two longitudinal vessels are the same as in my *Boltenia australiensis*. In general form, composition, and appearance the spicule is like that of the Alcyonaria, while it more particularly resembles that from the stem of *Boltenia reniformis*, as represented by the late Prof. Quekett ('Lectures on Histology,' 1852, p. 264, fig. 148); that is, consisting in its most perfect state of a short thick shaft, terminated at each end by a rosette of five globular tubercles arranged quincuncially, the whole about 8 by 7-6000ths in. in greatest dimensions.

Synascidia bolteniformis (provisional).

Besides the above there is another *Boltenia*-shaped specimen in the collection, of much the same size as the foregoing, but unfortunately imperfect, as the upper part of the head appears to have been cut off and only a few inches of the stem remain. Resemblance in form here, however, goes for nothing, for the whole consists of a stalked cormus of a *compound tunicated Ascidian,* in which the head is paved over with a layer of Synascidians. That part of the head which remains is not tuberculated, but unequally quadrilateral, oblong and smooth, about 2 in. high by 1 in. in horizontal diameter, after which follows a round and also smooth portion (like in shape to that of *Boltenia australiensis*), which becomes contracted towards its union with the stem, where it is half an inch in diameter; that which remains of the stem, which is cylindrical and corrugated transversely, being $4\frac{1}{2}$ in. long by $\frac{1}{4}$ in. in diameter at the end, where it has been broken off from apparently a similar continuation. While, however, the head *alone* is covered with a tough, transparent, colourless membrane beset with little circular spaces, through the centre of each of which the branchial aperture of the Synascidian slightly projects; the intervening portion between the head and the stem itself, together with the latter, is incrusted with sand, which is imbedded in the subcartilaginous tissue of which it is composed, to the extent of about 1-24th in., within which again this tissue is longitudinally traversed by a number of tubes which in a transverse section resembles that of monocotyledonous wood. The Synascidians which cover the head or corme are irregularly disposed in juxtaposition, and not in colonies or groups; nor could I see any common openings or cloacæ among them; while the interior of the head, which is composed of a solid mass of subcartilaginous, translucent tissue, is apparently more or less charged with ova. But all further investigation of this species I must leave to others, if it has not before been described, as my object here is only to point out that such a specimen exists in Mr. Wilson's collection.

Since the above was written, the ship 'Sarah Grice,' to which I have alluded (*antea*, p. 108), has arrived, and the "consignment" therein mentioned has safely reached me, wherein I find, among numbers of other interesting specimens, several of which are new, still another bolteniform specimen of a Synascidian, which may be named and described as follows :—

Synascidia cauliculata, ? n. sp.

Cormus or head obversely conical, flower-pot shaped, somewhat compressed now; gelatinous flaccid, semitranslucent, surfaced by sixteen or more ridges, each about 1-12th in. in its broadest or upper part, which extend upwards from the contracted or fixed end, more or less parallelly, to the free margin of the cormus, over which they bend inwards towards the centre, which is rather depressed; each ridge bearing a double row of synascidians, one on each side, increasing in size upwards as they become more and more developed, until they reach the upper part of the head where this is completed. Colour that of grey semitransparent gelatine, cuticled. Head about $1\frac{1}{4}$ in. high and 1 in. its broadest diameter, that is at the free or upper margin. Stem round, corrugated transversely, smooth, leathery, of a yellowish shining colour, decreasing gradually in size from its union with the cormus to its lower extremity, which is terminated by a root-like expansion; composed of a tough, yellow, smooth cuticle circumferentially, followed by a thin layer of granular cells: the rest made up of double circular cells or holes, like the figure "8," separated by a thin septum, each cell about 1-300th in. in diameter, imbedded in granuliferous gelatinous cartilage. Stem 6 in. long, by 1-6th in. in diameter, close to the cormus, and 1-24th in. at the other end. Synascidian not examined further than was sufficient to determine the nature of the object.

Hab. Marine.

Loc. Port Phillip Heads, South Australia.

Fam. 2. **Gumminida.**

The specimen of *Chondrilla nucula*, to which I have alluded, is subglobular, lobate, about $\frac{3}{4}$ in. high and 2 in. in horizontal diameter now in its spirit-preserved state; if dried this would be considerably less. When fresh the colour was much the same as it is now, viz. "dark grey, nearly black." In short, it is precisely the same as the Adriatic species first described by Schmidt, which I find to be world-wide in distribution.

It may be remembered here that I have already described and illustrated a species of *Chondrilla* of a buff-colour from Port Jackson, under the name of *C. australiensis* ('Annals,' 1873, vol. xii. p. 23, pl. i. figs. 10–15). In appearance and colour, besides growing over all bodies with which it comes in contact, this much resembles *Halisarca australiensis*, but here again the resemblance ceases, for *Chondrilla australiensis* is *corticate* and possesses spicules; while *C. australiensis* not only differs from *C. nucula*, Sdt., in colour, but slightly in spiculation also, as the *genuine* specimen of *C. nucula*, Sdt., above mentioned in Mr. Wilson's collection well demonstrates.

Order II. CERATINA.

Fam. 1. **Luffarida.**

There are three specimens of *Luffaria* in Mr. Wilson's collection, of which two are simply digitate and branched, and the other palmodigitate, but all of the same species, which, being new, may be named and described as follows :—

Luffaria digitata, n. sp.

Specimen digitate, branched, rising from a short single stem ; digitations solid, simple, cylindrical, long, and branched, or expanded palmately at first, and then subdivided irregularly into smaller branches of unequal size and length afterwards. Consistence loose, soft, in the spirit-preserved specimen. Colour, when fresh, "enamel pink," now pinkish grey. Surface cactiform, consisting of long conuli about $\frac{1}{4}$ in. apart, each terminated by a single or bifurcated filament of the skeletal fibre, which makes them look still longer, held together by an intervening thick, well-marked fibro-reticulated dermis, in which the fibrous part is fleshy and soft, and the whole devoid of any foreign material. Pores in the interstices of the reticulation. Vents here and there chiefly situated on projecting processes. Fibrous structure of the interior loose, widely reticulated ; fibre itself composed of a stout cylinder of dark amber-coloured keratine, cored or axiated, as usual, with a grey granulo-flocculent substance ; core *less* in diameter than the thickness of the keratose wall, producing a corresponding wide and loose parenchyma, of which the sarcordic laminæ tympanizing the interstices of the fibro-reticulation are thick, fleshy, soft, and traversed by a reticulation of soft fibre like the dermis. Size of specimen 9 in. high by 4×2 horizontally. Palmate expansion of the largest branch 2 in. broad by $\frac{1}{4}$ in. thick, shrinking from its loose open structure to a comparatively insignificant size when dried.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 20 fath.

Obs. The comparative absence of lateral fibre here, the smallness of the core compared with the thickness of the keratose wall of the fibre generally, the coarse open fibrous reticulation of the skeleton, and the red fleshy sarcode characterize this species. To say that it never goes beyond the size or consistence mentioned would be premature, since there are many skeletal specimens of this family from Australia in the British Museum which far exceed these in dimensions as well as in compactness of structure. Then it should be remembered that the older the growing specimen is, the thicker the fibre, which, of course, is especially seen at the base. Thus in two small specimens (? of a new species), received from the same source, since the above was written, each about 4 in. long, one of which is club-shaped and the other bifurcated, the fibre commences in a thick, round, furrowed, skeletal stem about 1-12th in. in diameter, which throws out buds from its surface and ultimately branches into a dendritic form to support the sarcode of the head, which is of a brown colour. Why the colour should be brown in one specimen of the same species and red in another, while the soft fleshy fibro-reticulation of the dermis is equally charged with ?-pigmental cells in all, I am ignorant.

Fam. 2. **Aplysinida.**

Darwinella australiensis, n. sp.

Massive, sessile, lobate; lobes simply convex, or compressed and elongated horizontally into meandriniform, thick, erect, and branching ridges. Consistence soft, resilient. Colour, when fresh, " venetian red," now dark grey flesh-colour. Surface conulated, conuli about 1-8th in. apart, terminated respectively by a single filament or fibre, which gives a hairy appearance to the whole, supported in the interval by a beautifully soft and fleshy fibro-reticulated dermis charged abundantly with triradiate *keratose* spicules, whose rays intercross and lie parallel to each other respectively, so as to leave interstices in which the pores are situated. Vents numerous on the prominent parts of the convex lobes and along the ridges of the compressed ones. Fibrous structure loose, widely reticulated; main or vertical branches composed of a thin cylindrical wall of dark amber-coloured keratine, cored, as usual, with a light grey granulo-flocculent substance, but with the " core " *much greater* in diameter than the thickness of the keratose wall, so that the fibre collapses on desiccation, which is the opposite to that which obtains in the Luffarida; hence this is the chief distinction. Lateral or small fibre very scanty, its place being supplied by the triradiate keratose spicules with which the parenchyma is as much supplied as the dermis; the whole traversed by the branches of the excretory canal-systems which terminate respectively in the vents mentioned. Triradiate, keratose spicule, whose angles are equal and arms about 85-1800ths in. long by 4-1800ths in. wide at the base, cored throughout by a canal which is formed of conical layers of keratine given off successively from a granuliferous cell in the centre, diminishing in size with the diameter of the ray, generally presenting the commencement of a fourth ray in the centre in the form of a minute tubercle, which is a *bud* of the central cell, and, although most frequently of microscopic size, is sometimes fully developed, thus causing the spicule to become quadriradiate; while, on the other hand, sometimes only two rays are developed from the central cell, viz. in opposite directions, which gives it the so-called "monactinellid" or acerate form. Size of the largest specimen, of which there are several and all comparatively small, about 2 in. high by 2×2 in. horizontally.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. This undoubtedly is a *Darwinella*, like the species from the N.W. coast of Spain, which, ignorant at the time of Fritz Müller's discovery, I described and illustrated under the name of "*Aplysina corneostellata*" ('Annals,' 1872, vol. x. p. 105, pl. vii.). The Australian species chiefly differs from the others in the prevailing number of the rays being *three* instead of four or more.

I must observe here, however, that, although I have alluded in the 'Annals' of 1881 (vol. viii. p. 118) to the observations of Fritz Müller, who first described and illustrated *Darwinella* from a specimen found on the shore of Desterro, in Brazil (Archiv f. mikroskop. Anat. Bd. i. S. 344), chiefly for the purpose of opposing his and Oscar Schmidt's theory, that the evolutionary development of the *mineralized* spicule was preceded by the simple keratose form, yet I must admit that, in the examination of the Australian species, the keratose stellates or triradiates, in their great abundance and arrangement, especially on the surface, together with their origin respectively in a *single central cell* (the "horn-cell," as I have heretofore termed it), so closely resemble the tri- and quadriradiates of a Calcisponge in these particulars that, however much we may be inclined to question the validity of Fritz Müller's theory, these spicules, while they appear to supply the place of the "lateral fibre" in *Darwinella*, not only assume the office of the tri- and quadriradiates in the Calcisponges, but in size too are about the same as the large tri- and quadriradiates of our British *Leuconia Johnstonii.*

Aplysina lævis, n. sp.

Specimen smooth, solid, cylindrical, curved, compressed; in form something like the free end of a large black leguminous pod; free end round, the other truncated or broken off, as if it were the upper portion of a much longer curve. Consistence hard. Colour dark black-purple outside, lighter within. Surface smooth, covered with a thick almost leathery dermis charged with sand or foreign microscopic objects; without conuli saving a slight trace of obtuse elevations, becoming corrugated when dry. Pores scattered plentifully over the surface, but closed by contraction, and therefore not easily distinguished. Vents also not seen, from the same cause probably. Fibre stout but scanty, composed of dark amber-coloured keratine cored with the usual grey granulo-flocculent substance, which, on shrinking under desiccation, leaves a hollowness; but the fibre itself, from its thickness, does not collapse. Sarcode of the parenchyma inspissate, densely charged with foreign microscopic objects like the dermis, traversed by the branches of the excretory canal-systems, which, participating, probably, in the general contractile nature of the soft parts, present a small appearance. Size of specimen $3\frac{1}{2}$ in. high by $2 \times 1\frac{1}{2}$ in. horizontally.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth?

Obs. The most striking point about this species of *Aplysina* is its *smooth* surface and leathery dark dermis, being without conuli and any projecting filaments of the fibro-skeletal structure; after which, and perhaps not less remarkable, is the large amount of foreign microscopic material with which the species is charged; and, lastly, its form, although this may differ in other specimens. The fibre does not collapse on drying, on account of the keratose cylinder being so thick, which, of course, lessens the diameter of the core, and thus makes it as much like the fibre of a *Luffaria* as that of an *Aplysina*, which, in other respects, its characters most resemble, and hence its name and location. Liq. potassæ at first heightens, and then dissolves out the colouring-matter.

Fam. 3. **Pseudoceratida.**

Pseudoceratina durissima, n. sp.

Massive, sessile, lobed, somewhat compressed. Consistence solid, intensely hard. Colour, when fresh, "blue-black," now black-mulberry. Surface uneven but smooth, consisting of a thin, hard, compact fibrillous dermis spread over low conular elevations of the subjacent tissue, with an indistinct reticulation between them; fibrillæ of the dermis colourless, plentifully accompanied by minute dark pigmental cells. Pores in the interstices of the dermal reticulation now (probably from contraction) only discernible under the microscope. Vents scattered over the surface, but small, probably from the same cause. Parenchyma chiefly composed of fibrillose sarcode structurally blended with the fibrillæ of the dermis, but, from the comparative absence of pigmental cells, much lighter in colour; charged more or less with grains of sand and other foreign microscopic objects, which, in some parts, are surrounded by layers of amber-coloured keratine, so as to form unconnected and ill-defined short fragments or traces of genuine fibre, which is otherwise absent. Size of specimen 2 in. high by 4 × 2 in. horizontally at the base.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. The dark purple colour of the surface with the subconular elevations, together with the fragmentary character of genuine fibre produced here and there by the development of keratine laminæ round some of the foreign objects of the interior, appear to me to ally this remarkable sponge to the third family of the Ceratina more than to any other group; while its intense wood-like hardness and the fact that, when cut into, the interior is yellow, but rapidly changes before the eye to green and lastly lead-colour or grey, after the manner of the poisonous *Boletus*, viz. *B. luridus*, are peculiarities which cannot fail to point out the species.

Moreover, I now find, from having such a well-preserved and large specimen to deal with, that the small dried fragment from Australia that I described and represented with the Trincomalee species under the name of *Aplysina purpurea* ('Annals,' 1881, vol. viii. pp. 103, 104, pl. ix. fig. 2, *a*, *b*, *c*), should not have been included under this name, but, being identical with that in Mr. Wilson's collection, should, on the contrary, be considered as a specimen of *Pseudoceratina durissima*.

Pseudoceratina crateriformis (provisional).

Massive, sessile, wide, conical, wrinkle-ridged, truncated at the summit by the opening of a large cloacal crateriform vent. Consistence resilient. Colour, when fresh, "greenish grey;" the same now. Surface deeply wrinkled with high ridges more or less interunited by ramification; the whole covered with a sandy incrustation in the form of a minutely reticulated or sieve-like structure, whose interstices are tympanized by the dermal membrane. Pores in the interstices of the retiform incrustation. Vent single on the summit, large and circular, about $\frac{3}{4}$ in. in diameter at the orifice, contracted inwardly by a thick, sarcodic, fleshy fold of the dermal membrane. Main fibre cored with foreign microscopic objects, sand, &c.; lateral or interuniting fibre cored only with the grey flocculent substance, the former *psammonematous*, the latter *luffarid*, both enclosed within the same kind of amber-coloured keratine. Sarcode of the interior thick and inspissate, scantily charged with foreign material; grey in colour, supported by the fibre just described, and traversed by the branches of the excretory canal-system, which open into a general or cloacal cavity terminating in the vent at the summit. Size of specimen $2\frac{1}{2}$ in. high by $2\frac{1}{2}$ in. in diameter at the base, which is circular.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth?

Obs. While the presence of the luffarid "interuniting fibre" seems to ally this species to the Ceratina, the large wrinkled surface covered with the reticulated or cribriform incrustration, the single large terminal vent preceded by the cloaciform interior, and the fleshy character of the sarcode about the vent, equally ally it to *Halispongia choanoides*, Bk.,=*Stelospongos*, Sdt., and especially to the "wrinkled" surface of that specimen respresented and described by Dr. Bowerbank in the 'Proceedings of the Zoological Society' for 1872 (p. 123, pl. vi.) under the name mentioned. Hence my generic appellation should be considered "provisional."

As the "granulo-flocculent grey substance" which characterizes the core of the fibre in the Ceratina appears to me to be the same as that within the keratose cell ("horn-cell"), and may often be seen mixed up with the foreign objects which form the core of the fibre in the Psammonemata, it seems to me not improbable that this is the substance which first of all brings the foreign material into *line* for the formation of the fibre in the latter; and that, failing to do this, the "granulo-flocculent substance" alone remains, which leads to the production of the *genuine* fibre of the Ceratina; while this failure taking place *partially*, may produce the mixture which is characteristic of that family of the Ceratina for which I have proposed the name of "Pseudoceratida."

Order III. PSAMMONEMATA.

As an examination of Mr. Wilson's specimens has suggested to me much that indicates a necessary revision of this order, and I find that it can be done best by beginning with the lowest forms and building upwards, instead of following the arrangement given in my classification, which is the reverse, I shall pursue this course after having premised the following introductory remarks:—

It is desirable, when about to introduce anything new, to state such generalities as may not only facilitate its understanding, but, if possible, curtail length of description, in order that the student may of himself be able to supply the former, which otherwise might become tedious repetition in the latter.

Twenty-six years have passed since my observations on the growth of the young *Spongilla* from the statoblast were published, and although much has been done since in structural description, yet a key to a great part of this might be found in my illustration of a minute but entire specimen of *Spongilla*, whose component parts were then drawn to the same scale, "in order that their relative proportions might be preserved as much as possible" for diagrammatic purposes in teaching; but I question if such use was ever made of it ('Annals,' 1857, vol. xx. pl. i. fig. 1).

In this figure, it may be observed that the parenchyma, of which the body of the sponge is composed, is surrounded by a dermal membrane, which is kept at a certain distance off by the projection of conical bundles of spicules issuing from the parenchyma, thus leaving a hollow between the two, subsequently termed by Dr. Bowerbank the "subdermal cavity."

This "dermal membrane," or cuticle, I named at the time "investing membrane," and the *interval* between it and the parenchyma the "cavity" of the "investing membrane." I also then stated that the "investing membrane" was pierced by "apertures" or pores (*ib.* p. 22), and that the parenchyma was traversed throughout by the branches of the excretory canal-system, which ended in a single tubular vent that passed directly through the cavity of the investing membrane (*l. c.* pl. i. fig. 1, *g*), to terminate a little distance beyond the latter, with which it was intimately connected at the point of its passage, so that the contents of the excretory canal-system could not get into the cavity of the investing membrane. Thus all the *main features* of sponge-structure were foreshadowed.

Now it is evident, as shown in the figure to which I have alluded, that if the "investing membrane" should sink *in towards* the parenchyma by collapse or otherwise, the points of the bundles of spicules which support it would become conical, and hence the features thus produced have been termed the "conuli," while the space between the conuli would be more or less occupied by the "apertures" or pores. Still the conuli are by no means present on all sponges, and they are especially absent on the slippery surfaces of the Carnosa, while they are perhaps most typically developed on some of the Psammonemata; but the former is the exception.

Again, they are of course subject to variety in *composition*, being spiculiferous in the spiculiferous sponges, simply keratose in the Ceratina, and areniferous in the Psammonemata. Also subject to variety in *form*, since they may consist of a simple point, and this may be single or grouped; or obtusely pointed singly or *en groupe*; or by extension in line and uniting with one another form a reticulation which may be more or less general; but in all cases the points are originally covered by the dermal sarcode, that is, in their natural state, although often naked and protruding afterwards.

It is necessary to be prepared for all these modifications, or the same thing may be described indefinitely under different names.

The same may be said of the "investing" or dermal membrane itself, which in the spiculiferous sponges may or may not be charged with spicules (chiefly the minute or flesh-spicules) which are more or less arranged in a reticulated form, so that the pores may be in the interstices; or it may be traversed by a soft fleshy fibrous reticulation, as in the Ceratina; or charged with foreign microscopic bodies (sand, fragments of sponge-spicules, &c.), as is often the case in the Psammonemata, where they may assume a similar form; but in all instances the reticulation may become so thickened as to obliterate the interstices and so pass into a simple incrustation, wherein, however, holes for the pores are always preserved, because these are essential to the existence of the sponge.

As regards the mineral element, this may be produced by the sponge itself or borrowed from the exterior; the former is the case with the spiculiferous sponges and the latter with the psammiferous ones. Of course in the spiculiferous sponges the spicules, which have been termed "proper," are all of one or more forms and all *entire*; whereas in the borrowed material, which has been termed "foreign," they are generally of many kinds and mostly fragmentary, more or less mixed up with other microscopic objects, such as grains of sand &c.; but the predominance of one more than the other will depend upon the prevailing element in the locality where the sponge may be growing. At the same time it cannot be denied that, in some instances, the sponge itself appears to manifest a power of selection or preference in this respect.

With reference to the development of the keratose fibre in the dermal membrane, it may be observed that this originates chiefly in the conuli which are the growing terminations of the main or vertical fibre of the sponge, from each of which it extends outwards and downwards radiatingly, like the ropes of a tent, so that, as the fibre diminishes in size by branching and subdividing, the subdivisions not only become united between themselves, but meet and become continuous with the like from the neighbouring conuli, whereby an interuniting fibrous reticulation is formed in the dermal sarcode between the conuli, in whose interstices the pores are situated and protected; while the keratose fibre may be cored or not with mineral elements, as already noticed.

Again, what has been stated of the external parts of the sponge applies *cæt. par.* to the internal ones or parenchyma; for as the sponge grows by the addition of layers to its circumference, that is radiatingly, so the surface of to-day becomes part of the internal structure of to-morrow, and thus somewhat modified it passes into a cancellated form, which is the parenchyma; that is to say, the fibrous skeleton, cored by mineral material or not, becomes a solid mass of reticulation, in which the interstices are tympanized by the *still* poriferous sarcode (as may be seen in a dried specimen), and the cancellated chambers thus completed. Lastly, the whole is traversed by the branches of the excretory canal-systems. I use the latter in the plural number, because generally every vent indicates a system.

Still another condition arises from the *amount* of keratine developed, which may be entirely absent in the lowest forms of the Psammonemata (for I must confine myself henceforth to this order, as we are now more immediately concerned with it), where the *sarcode* retains its delicate pristine nature; or it may be diffused throughout the sarcode generally, so as to give it a horny consistence, as if the sarcode itself had passed into this state, which is better seen in the *dry* than in the wet specimen, when it presents a light amber colour, while it is all grey together in the wet one; so in the production of fibre the mineral element, that is the foreign objects, may be held together by a mere film of keratine, while on other occasions the investiture of keratine may not only exceed the core of foreign objects in thickness, but assume the consistence and toughness of horn; then as regards colour, the keratine, which is generally yellow and transparent like amber, may in some species be as transparent and colourless as glass.

Lastly the keratose fibre may be generally or partially cored with foreign objects, in which case the vertical fibre is generally the most, and the lateral the least so; but it is a remarkable fact that, throughout the Psammonemata, the arenaceous fibre is frequently so thinly clad with keratine as in many instances to appear to be nothing more than a simple chain of foreign objects. The terms "vertical" and "lateral" are synonymous with Dr. Bowerbank's "primary" and "secondary" fibre.

With these preliminary remarks let us now enter upon the revision of the order Psammonemata after the manner to which I have above alluded, that is beginning with the lowest forms first and working upwards, in which it should be remembered that I am chiefly limited in this respect here to what Mr. Wilson's specimens indicate, as I want to point out, by them too, what is to be found on the south coast of Australia.

After noticing that which I considered to be the *Dysidea Kirkii* of Dr. Bowerbank ('Annals,' 1881, vol. vii. p. 374), a summary was given of what had been stated of this as well as the British species *Dysidea fragilis*, in which was quoted the following passage from Dr. Bowerbank's 'Monograph of the British Spongiadæ' (vol. i. p. 212), viz.:—"In our British species, *Dysidea fragilis*, Johnston, the primary fibres are often as abundantly arenated as those of the Australian species (*Dysidea Kirkii*), while the secondary ones are only partially filled with extraneous matter." Thus both species were *fibrous*, and both the "primary" and "secondary" fibres were arenated, that is contained foreign objects. In short, both species were fibrous and *all* the fibres arenated, although not equally so, which is what I want to insist upon here. Hence I was wrong in stating that *Dysidea fragilis* and *Spongelia pallescens*, Sdt., were the same; for by consulting Schulze's representation (Zeitschrift f. wiss. Zoologie, Bd. xxxii. Taf. vi. fig. 5), which I am able to confirm by having a type specimen of Schmidt's *S. pallescens*, it will be observed that "all" the fibre here is *not* "arenated," but that the lateral or secondary fibre is mostly keratose and homogeneous, *i. e.* clear or not cored with foreign bodies, while the vertical or primary fibre *is completely* cored or arenaceous. My mistake arose from the conulated surface of *Dysidea fragilis* when dried in its *natural* state being precisely like that of *Spongelia pallescens*. Thus Hyatt was right in separating *Dysidea* from *Spongelia*, i. e. *S. pallescens* (Mem. Boston Soc. Nat. Hist. 1877, vol. ii. pt. 4, p. 539). Both

Dysidea fragilis and *Dysidea Kirkii* therefore are *fibrous*, and *all* the fibre arenated; while on microscopically examining the fibre itself it will be found to represent the lowest degree of it above mentioned, viz. that in which the fibre is composed of foreign objects held together by the merest minimum or film of keratine, and hence its delicate and fragile nature, from which Johnston's designation "*fragilis*" was derived; but still it is *fibre*.

However, leaving this subject for the present, Mr. Wilson's specimens from the neighbourhood of Port Phillip Heads, South Australia, have brought me acquainted with a still lower form, viz. that in which there is absolutely *no fibre*, but where the foreign material is diffused, and so far held together by being imbedded in the delicate flakes of the parenchymatous sarcode generally; where, traversed by branches of the excretory canal-systems, it thus forms the skeletal or supporting structure of the sponge, and under this condition may assume many different sponge-like forms, which may distinctly vary according to the species or variety, but at the same time are all developed out of the same kind of structure and composition *through the specific agency of the "sponge-sarcode" in which the whole originates and which in all cases throughout the class of Spongida determines both the form and the composition of the sponge.*

For this group I would propose the term "*Holopsamma*," under the following diagnosis, viz.:—

Holopsamma, nov. gen.

Char. Arenaceous sponges without fibre, whose composition consists of foreign microscopic objects (sand, fragments of sponge-spicules, &c.) diffused in the flakes of the parenchymatous sarcode; traversed by the canals of the excretory system; assuming a variety of sponge-like forms, perhaps chiefly massive, in which respectively the surface may consist of the pore dermal membrane under any of the forms above mentioned, that is, simple, continuous, and smooth, or rendered more or less uneven and interrupted by the presence and projection of the sandy element above the common level.

1. *Holopsamma crassa*, n. sp.

Form of specimen massive, variable. Consistence hard, heavy, gritty, friable. Colour, when fresh, "bright orange-yellow," now light brown, varying with that of the sand of which it is composed. Surface more or less uneven, according to the form assumed by the subdermal sand. Pores in the intervals between the dermal projections, wherein the sarcode may or may not be charged with foreign material. Vents numerous and large, chiefly situated on the most projecting parts or ridges, or on the opposite side to that of the pores. Structure coarse from the large size of the grains of sand of which the species is composed. Size variable.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth variable, under 20 fath.

Obs. Examined both in the wet and dried states. The specimens of this species, which are very numerous, vary so much in shape and size that it is hardly possible to give more than the above general description of them, in which the most striking character is the coarseness and grittiness of the sand; hence the designation.

2. *Holopsamma lævis*, n. sp.

Specimens very irregular in form, which is massive and more or less variably lobed, spreading horizontally while it rests upon a number of points over which it may be arched, so as to present an upper and a lower surface. Consistence light, gritty, friable. Colour grey externally, orange yellowish or grey internally. Surface even, consisting both above and below of a dermal layer of sarcode more or less charged with foreign objects, which, being principally fragmentary sponge-spicules, give it a white colour when dry. Pores in juxtaposition throughout the dermal layer, but chiefly on the upper surface. Vents numerous and large on the prominent parts, but chiefly on the lower surface. Structure less coarse than that of the foregoing species, and therefore looser and lighter, being generally composed of much smaller grains of sand. Size variable.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth varying under 20 fath.

Obs. Examined both in the wet and dried state. Designated from its comparatively light, not heavy, structure. Of this species also there are several specimens, in most of which the sarcode internally is orange-yellow and more or less charged with ova of the same colour, but much deeper.

3. *Holopsamma laminæfavosa*, n. sp.

Specimen hemispherical, globular, elongate, sessile or contracted towards the base. Consistence tender, friable, coarse, gritty. Colour dark brown. Surface consisting of the edges of the laminæ, often passing into a honeycomb form by transverse interuniting processes. Pores indistinct, on the surface of the laminæ. Vents also small, on their margins. Structure columnar, radiating, laminar; laminæ thin, undulating, closely applied to each other, like the leaves of a book, or thicker, further apart, and interunited by transverse processes, producing the honeycomb-like structure. Size variable.

Hab. Marine.

Loc. Port Phillip Heads. Depth 20 fath. and under.

Obs. The globular, elongated, or hemispherical structure radiating laminiferously or in the form of a honeycomb, together with the dark brown colour, characterizes this species, to which may be added another variety, where the laminæ are grouped irregularly, irregular on the surface, and irregularly notched or denticulated on the margin: also another form in which the lamina is branched digitato-chalina-like.

4. *Holopsamma fuliginosa*, n. sp.

Form of specimen massive, sessile, contracted at the base, consisting of erect compressed lobes about $\frac{3}{8}$ in. thick, with irregular margins, more or less united together centrally or proceeding from each other proliferously. Consistence hard, coral-like. Colour dark neutral tint outside, lighter within. Surface smooth, irregularly papillated. Vents and pores not seen, probably closed by desiccation. Structure very compact; texture small-grained. Size of largest specimen, for there are two, 8 in. high by 6×5 in. horizontally.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth?

Obs. Examined in the *dry* state only, as there is no spirit-preserved specimen. The remarkably stony, hard, coral-like form and appearance of this species, together with the black colour, renders it almost unmistakable; and, although there are no vents to be seen on the surface, the internal structure is plentifully traversed by the branches of the excretory canal-system.

5. *Holopsamma turbo*, n. sp.

Turbinate, like a peg-top, solid; presenting a circular depression in the centre of the summit, passing into a round attenuated stem below, which terminates in a root-like expansion. Consistence soft, resilient. Colour, when fresh, "terra-cotta red, with a coating of grey," now grey outside and orange within. Surface smooth, consisting of an areniferous dermis. Pores plentifully scattered all over the dermis. Vent single at the bottom of the depression in the summit. Parenchyma cancellous, areniferous, without fibre. Size of the largest specimen, for there are two, $3\frac{3}{4}$ in. high by $1\frac{1}{2} \times 1$ in. in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 18 fath.

Obs. It is the peculiarity in shape more than anything else which characterizes this species. Mr. Wilson has compared one of the specimens to "a ripe fig." The colour of the sarcode internally is orange-yellow, like that of many specimens of *H. lævis*.

Sarcocornea, nov. gen.

Char. The same as that of *Holopsamma*, but with the sarcode inspissated, voluminous, and more or less transformed into keratine, that is, rendered horny.

Sarcocornea nodosa, n. sp.

Specimen dry, massive, sessile, contracted towards the base, somewhat compressed, lobulated on both sides. Consistence, when dry, extremely hard, chiefly owing to the thickness of the dermal sarcode. Colour dark grey-brown on the surface, lighter internally from the presence of the white particles of foreign material. Surface smooth, even, consisting of the thick glutinous dermal layer. Pores in juxtaposition in the thick dermal membrane, leading down (as seen in the section) by vertical canals into the subdermal cavities. Vents very numerous, marginate, situated all over the crest and on the prominent parts of the lobes of the specimen. Structure internally compact, glutinous; parenchymatous sarcode more or less keratose; charged diffusively with arenaceous foreign material; the whole traversed by the branches of the excretory canal-systems. Size of specimen 5 in. high by $7\frac{1}{2} \times 3$ in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth?

Obs. There is but one specimen of this kind which has been dried, and therefore the inspissated keratose sarcode hardened by contraction almost into the consistence of dry dark-brown glue, which is the chief character of the species.

It seems desirable for more immediate reference that, before going further, I should insert here the following copy of the tabular view of my proposed classification of the order Psammonemata, given in the 'Annals' of 1875 (vol. xvi. pp. 188 and 189), in order that the revision suggested by Mr. Wilson's specimens may be the better followed and understood :—

Order.	Families.	Groups.
III. PSAMMONEMATA.	1. *Bibulida*	1. Euspongiosa.
		2. Paraspongiosa.
		3. Hirciniosa.
	2. *Hircinida*	4. Callhistia.
		5. Penicillata.
		6. Rigida.
		7. Subrigida.
		8. Foliata.
		9. Dactylifera.
		10. Fenestrata.
		11. Platyfibra.
		12. Peraxiata.
		13. Incrustata.
		14. Otahitica.
		15. Sarcocornea.
		16. Arenosa.
	3. *Pseudohircinida*	17. Pseudoarenosa.
		18. Chalinohircinina.
		19. Armatohircinina.

Gen. DYSIDEA, Johnston.

Char. emend. Fibrous arenaceous sponges, in which the fibre is chiefly composed of foreign microscopic objects (sand, fragmentary sponge-spicules, &c.), held together by a mere film of keratine, supporting the flakes of the parenchymatous sarcode; traversed by the branches of the excretory canal-system; assuming a variety of sponge-like forms, on which the pore-dermis may be continuous and smooth, or rendered more or less uneven and rough by projection of the subjacent fibre, according to the species.

1. *Dysidea fragilis*, Johnston.

Massive, sessile, simply convex or lobed. Consistence soft and resilient when fresh, firm when dry. Colour, when fresh, faint violet or whitish grey, sponge-yellow when dry. Surface conulated in much relief; conuli held together by a soft reticulated fibrous membrane. Pores in the interstices of the reticulation. Vents here and there, chiefly on the most prominent parts. Structure fibro-reticulated; interstices tympanized by the parenchymatous sarcode traversed by the branches of the excretory canal-systems. Fibre arenaceous throughout. Size variable.

Hab. Marine.

Loc. British coasts generally.

Obs. The above description chiefly applies to the living or fresh state of the sponge, which, after the specimen has been torn off the rocks and the sarcode washed out by the waves, may be found on the beach in the *fragile* condition, and this probably led Johnston, who might not have seen it under other circumstances, to give it the above designation. When gathered from the rocks and dried directly it presents the conulated state above mentioned, which renders it, as before stated, very much like *Spongelia pallescens* under similar circumstances. Inserted for comparison.

For a short description of the variety in which the conuli are turned into round arenaceous balls, and for which I have proposed the name of "*Dysidea granulosa*," see 'Annals' of 1881 (vol. vii. p. 376).

2. *Dysidea Kirkii*, Bk.

Massive, sessile, more or less contracted towards the base, simple or lobate; lobes convex, mamilliform, digital, sub-branched or indefinitely varied in their forms. Consistence firm, but easily broken, light. Colour grey externally, generally orange-yellow internally. Surface smooth and even or more or less rough, consisting of the dermal membrane, raised or not into small conuli by the projection of the subjacent arenaceous fibre. Pores in juxtaposition, uniformly continued over the dermal membrane, or interrupted in their continuity by the projections of the subdermal fibre. Vents numerous and large, situated on the prominent parts, at the ends of the mamilliform lobes, or along the borders or ridges of the crested growths. Structure fibro-reticulate; fibre arenaceous, tympanized in its interstices by the parenchymal sarcode traversed by the branches of the excretory canal-systems. Size variable.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth variable.

Obs. When fresh this sponge, although firm, is easily broken, on account of the minimum of keratine which holds together the arenaceous material of the fibre. I have assumed that it is the species alluded to by Dr. Bowerbank, because out of a great number of specimens in Mr. Wilson's collection, as well as in the British Museum, I can find no other meriting the term "*Dysidea*," and Dr. Bowerbank does not appear to have gone beyond the description of its fibre, while it is certain that it was among the Australian sponges which Mr. Kirk sent to him about the end of 1840 (Trans. Microscop. Soc. Lond. vol. i. p. 32).

3. *Dysidea hirciniformis*, n. sp.

Specimen a caulescent chaliniform bunch of solid stems, each about $\frac{1}{2}$ in. in diameter, rising from a common contracted origin, dichotomously divided two or three times, and ending in pointed extremities. Consistence soft, delicate. Colour, when fresh, "pale buff, inclining to purple at the tips," now delicate flesh-colour generally. Surface conulated in strong relief. Pores between the conuli. Vents scattered here and there. Vertical and lateral fibre, all arenaceous. Size 5 in. long.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. This species in its conulated surface resembles *Dysidea fragilis*, but is much coarser in general structure, especially in the flat spreading forms, where the dark rich flesh-colour of the sarcode is very striking, and recalls to mind the "rosy" tint of *Spongelia avara*, Sdt.

4. *Dysidea chaliniformis*, n. sp.

Caulescent, branched, stipitate; consisting of a compressed bunch of solid cylindrical stalks rising from a common stem; branches numerous, small and simple *below*, some not more than $\frac{1}{8}$ in. in thickness, ending in a sharp point, which is sometimes bifurcated; increasing in size upwards, dividing and interuniting; the whole most irregularly. Consistence light, fragile, compressible. Colour reddish brown. Surface even, but minutely wrinkled from the sinking of the dermal pore-membrane upon the subjacent arenated fibre. Pores plentifully scattered throughout the dermal membrane. Vents also numerous, scattered over the flattened portions of the branches or in a line along them. Structure fibrous, fibre arenated throughout; texture fine. Size of specimen about 12 in. long by 5×1 in. horizontally. Great diversity in the size of the branches, of which the largest and longest are $\frac{3}{4}$ in. in diameter, while the smallest do not exceed $\frac{1}{8}$ of an inch.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. The caulescent character of this species, together with the solid, cylindrical, simple, and subdivided condition of the branches and the arrangement of their vents, would, at first sight, lead to the supposition that it was a specimen of

Chalina polychotoma, Esper, = *Chalina oculata*, Bk., such is the tendency, as before stated, of the sponge-sarcode throughout the class to produce the same kind of forms whatever the composition may be; so that here, although the form is like that of a caulescent *Chalina*, the characteristic toughness and resiliency of the latter, which arises from the presence of a large amount of keratine, is absent in *Dysidea chaliniformis*, where the opposite state renders it so brittle that, when wet, it is almost impossible to handle the specimen without a piece coming off, and in drying it breaks down under the slightest force.

There is another chaliniform specimen in the collection, but here the increased development of keratine, of which the lateral fibre is exclusively composed, not only lessens the amount of brittleness, but necessitates its being relegated to another genus, in which it will be found hereafter.

Let us pause here for a moment and revert to the "tabular view" which I have inserted at p. 215, in which it will be observed that the third and last family of the Psammonemata is termed "Pseudohircinida," of which it may be simply stated here that, not being intended for the genuine species of the order, *its* consideration may be postponed for a more convenient opportunity; meanwhile to proceed with our revision, I find it also desirable to suppress the fifteenth group in my original classification, viz. the Sarcocornea, and its present diagnosis *altogether*, and make it a genus in the sixteenth group, viz. the Arenosa, under the diagnosis just mentioned. Thus we should have three genera in the group "Arenosa;" but, inasmuch as further alterations will presently show that these sponges should have a distinct family name, I would propose for this the term "Arenida," when the whole would stand as follows:—

Family.	Group.	Genera.
Arenida	*Arenosa*	1. Holopsamma. 2. Sarcocornea. 3. Dysidea.

We now come to Psammonematous sponges in which *part of the fibre only* is cored or axiated with foreign material, the other part being clear, that is, composed of keratine only, the former belonging to the vertical and the latter to the lateral, which is merely an extension laterally of the vertical fibre in an exclusively keratose state, as it is almost exclusively arenaceous in *Dysidea*. But, as this diagnosis alone applies more or less to all the remaining Psammonemata, it will be necessary to adopt a character if possible by which the genus *Spongelia* may be distinguished. Hence as the typical composition of the vertical or areniferous fibre in *Spongelia* consists of foreign objects enveloped in *a layer of keratine which can hardly be seen with the naked eye*, and in all the species above it for the most part this layer is the most *predominant* part of the fibre, it seems to me that this character, which I grant is only one of degree, is the most useful for the occasion that I can adopt.

I have already alluded in the introductory part of this communication to the *general* character of the fibre in *Spongelia*, as evidenced by Schulze's representation of a fragment of the skeleton of *S. pallescens* (*l. c.*), confirmed by a typical specimen of the same species which came direct *from* Schmidt, who established the genus; therefore I have only to extend Schmidt's original diagnosis to meet our present requirements, which will thus stand as follows :—

Gen. SPONGELIA, Nardo ap. Schmidt.

Char. emend. Form massive, simple or lobed, sessile or stipitate. Consistence soft and resilient when wet, firm when dry. Colour violet when fresh, sponge-colour when dry. Surface conulated in bold relief or entirely smooth. Pores restricted to the dermal membrane, tympanizing the intervals between the conuli or dispersed generally where there are none. Vents on the prominent or projecting parts. Internal structure loose, fibro-reticulate; vertical fibre arenaceous, lateral fibre chiefly keratose.

Obs. If this diagnosis be followed, then *Spongelia avara*, Sdt., according to Schulze's representation (*op. et loc. cit.* Taf. vi. fig. 4), and my own typical specimen, would *not* come under it, but under that of *Dysidea*. I have not had an opportunity of examining the other species of "*Spongelia*" mentioned by Schmidt; but a typical specimen of the preceding genus, viz. *Cacospongia cavernosa*, indicates from its hollow thin-walled fibre, together with other characters, that it is an *Aplysina* rather than a Psammonematous sponge.

There is only one specimen of *Spongelia* in Mr. Wilson's collection, which may be named and described as follows :—

Spongelia stellidermata, n. sp.

Specimen erect, thick, spatulate, compressed, stipitate, thinning from the centre towards the upper margin and sides, which are irregularly serrated, thickening towards the stem, which is round and truncated (? cut off by the dredge). Consistence soft, resilient, in its wet state. Colour, when fresh, "reddish buff," now grey outside, reddish buff within. Surface covered with a densely poriferous cuticle, beneath which is a thick layer of intercrossing and interuniting curvilinear, soft, fleshy fibre without foreign bodies, which contains the subdermal cavities, and which, on the outside, presents a stelliform pattern, wherein the centres of the stellæ correspond to the ends of the fibre internally, which, however, do *not* come through the dermis. Pores numerous throughout the cuticle. Vents on the processes respectively which form the serration on the sides and upper margin. Internal structure fibroreticular, consisting of thick arenaceous vertical fibre, enveloped in an indistinct layer of keratine, interunited by much lateral fibre, chiefly formed of keratine; the whole constituting a massive reticulation whose interstices are filled with pulpy parenchymatous sarcode of a bright orange-yellow colour, very much like that in *Holopsamma lævis* &c. Size of specimen 4 in. high by 2 × 1 in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 3 fath.

Obs. When dried the surface becomes contracted, corrugated, and of a dark brown colour from the thickness of the dermal layer, in the midst of which whitish points may be seen, indicating the position of the ends of the arenaceous fibre beneath. The entire form and arrangement of the vents recalls to mind the skeletal specimens of Psammonemata in the British Museum &c., for which, from their fine and delicate structure, I have proposed the name "Callhistia." The species, described and photographed by Hyatt under the name of "*Spongelia incerta*" (*l. c.* p. 533, pl. xvi. fig. 32), which came from the same neighbourhood, viz. "Phillip Is.," is very much like the one I have noticed; and many of his other photographs under the same *generic* appellation, viz. fig. 13, pl. xv., and figs. 12, 13, 15, and 15 *a*, pl. xvii., from the same locality also, are very like the fine skeletal specimens in the British Museum, all of which are said to have come from Australia.

Although the chief distinguishing character for *Spongelia* which I have adopted places it *below* the remaining groups of Psammonemata in my original classification, it at the same time places it *above* all those in the family Arenida just mentioned, so that, belonging to neither, its *position* is thus indicated, while, to increase the facility of finding it, a family name is required, which for the present, or provisionally, might be "SPONGELIDA," with "Spongelina" for the group, and "*Spongelia*" for the single genus, "with power to add to it," as they say. Thus:—

Family.	Group.	Genus.
SPONGELIDA	*Spongelina*..........	Spongelia.

The next group in my original classification above the Sarcocornea, now embodied in the Arenida (see pp. 215 and 218), is no. 14, the "Otahitica," so named from Ellis's representations of three "Otaheite" sponges in 1786 (Nat. Hist. Zoophytes, Ellis and Solander, tab. lix. figs. 1–3), afterwards called by Esper "*Spongia otahitica*," which term I adopted for a vast number of species and varieties of this kind unnamed and undescribed, but well sketched structurally and morphologically in my original diagnosis of the group. They are all strongly characterized by their papyraceous form, seldom exceeding $\frac{1}{8}$ in. in thickness, and sometimes as thin as writing-paper itself; hence Hyatt's term "PHYLLOSPONGIADÆ" (Mem. Bost. Soc. Nat. Hist. 1877, p. 540) for the "family" is very appropriate and acceptable, for, from what I have just stated, the group will in all probability hereafter have to be subdivided, and then a family name must be supplied, so at once I would propose "PHYLLOSPONGIDA," Hyatt, merely altering the patronymic affix to suit my terminology.

Of this family there is only one specimen in Mr. Wilson's collection to show that it is represented on the south coast of Australia; but this is otherwise abundantly confirmed by several specimens from thence having passed through my hands, as well as by the three species described by Hyatt (*op. et loc. cit.* p. 543) under the generic name of "*Carteriospongia*." As, however, my object at present is, as before stated, chiefly to record, through Mr. Wilson's specimens, what is to be found on this coast for future identification, this specimen, which also appears to me to represent a new species, may be named and described as follows:—

Carteriospongia caliciformis, n. sp.

Specimen dry, thin, shallow, cup-like, with wide undulating brim, short thick stem, and small, erect, proliferous crest in the bottom. Consistence firm. Colour now light grey. Surface arenaceous, uniformly granulated. Pores on the outer and vents on the inner side of the cup among the granulations. Wall almost entirely composed of short-jointed keratose fibre of a sponge-yellow colour, in which there is very little sand, and that chiefly towards the surface, while there is a great deal *outside* the fibre in the adjoining sarcode. Size of specimen 6 in. across the brim, 1 in. deep in the centre, $\frac{1}{4}$ in. through the wall in the centre, diminishing towards the circumference.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth?

Obs. The pores being in the dermal incrustation outside, while the vents are immediately opposite, in the dermal incrustation of the cup inside, causes the wall, when the incrustations on both sides are washed off, to present a sieve-like structure.

[To be continued.]

XIX.—*Diagnoses of new Species of Cephalopoda collected during the Cruise of H.M.S. 'Challenger.'*—Part I. *The Octopoda.* By William E. Hoyle, M.A. (Oxon), M.R.C.S., F.R.S.E., Naturalist to the 'Challenger' Commission.

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Octopus, Lamarck.

Octopus verrucosus, n. sp.

The *Body* is rounded, but so distorted by compression that no further details can be given. The *mantle-opening* extends fully halfway round the body, terminating a little below and behind the eye. The *siphon* is long, evenly conical, and pointed, and extends nearly halfway to the umbrella-margin.

The *Head* is short, not so broad as the body, and with *eyes* but slightly prominent.

The *Arms* are unequal in length, the second pair being considerably the longest, and almost six times as long as the body; they are comparatively stout and taper gradually. The *umbrella* extends about one fifth up the longest arms. The *suckers* are fairly close, deeply cupped and marked with radial grooves, between which are numerous very minute papillæ. About four suckers on each lateral arm opposite the umbrella-margin are larger than the others; beyond these they gradually diminish. The *hectocotylus* is present in both specimens and is very minute (about 2 millim. long in the larger); it is acutely pointed, and the median groove has three transverse ridges.

The *Surface* of the back, dorsal surface of the head, and umbrella is covered with irregular closely set warts, which attain a maximum diameter of several millimetres in the nuchal region; the warts extend on to the ventral surface of the body, where they become much smaller, more even, and average less than 1 millim. in diameter. Above each eye there seems to have been a short cirrus, but these have been rather damaged.

The *Colour* is a dull purplish grey, very dark above, much lighter below.

Hab. Inaccessible Island, Tristan da Cunha. Two specimens, ♂.

Octopus Boscii (Lesueur), var. *pallida*, nov.

The *Body* is evenly rounded, with a slight depression in the median ventral line. The *mantle-opening* extends less than halfway round the body, terminating immediately below the eye, and further from it than from the base of the *siphon*, which is long and pointed, has rather a small opening, and extends two thirds the distance of the umbrella-margin.

The *Head* is short, and not so broad as the body; the *eyes* are only slightly prominent.

The *Arms* are subequal, nearly four times the length of the body, and taper evenly to fine points. The *umbrella* extends one third up the arms and is a little wider laterally than dorsally. The *suckers* are closely set, deeply cupped, and marked with regular radial grooves; their biserial arrangement commences immediately after the first. One arm bears a supernumerary sucker in the largest specimen. The *circumoral lip* is low and narrow.

The *Surface* is covered with warts, which are largest and most numerous on the dorsal surface of the body, head, and umbrella, and dorsal aspects of the arms, where they have a quadrifid or quinquefid form, usually with a small wartlet in the centre, each forming a figure like a star or rosette. Towards the ventral surface and on the sides of the arms the warts are simple and much smaller. On the back are about ten long cirri, which are rough with small warts, and above each eye is a very large arborescent cirrus with six or seven smaller ones beside it.

The *Colour* is a pale purplish grey, shading off to a creamy white on the ventral surface.

Hab. Off East Moncœur Island, Bass Strait, 38 fathoms (Station 162). One specimen, ♀.

Off Twofold Bay, Australia, 150 fathoms (Station 163 A). Two specimens, 1 ♀, 1 juv.

Octopus australis, n. sp.

The *Body* is rounded, and wider behind than in front; depressed, and with a well-marked ventral median groove. The *mantle-opening* extends nearly halfway round the body. The *siphon* is of medium size, at first the lateral margins are parallel and then taper rapidly to a blunt point; it extends less than halfway to the umbrella-margin.

The *Head* is narrower than the body, and the *eyes* somewhat prominent, dorsally rather than laterally.

The *Arms* are unequal, the lateral being slightly the longest, and about three times as long as the body; they are slender and tapering. The *umbrella* is longer than the length of the body, larger ventrally than dorsally, and largest of all laterally. The *suckers* are prominent and closely set; they are altogether larger on the lateral arms, and extend in a double row to the centre; the radial grooves are deep and extend quite to the margin. The *hectocotylus* is absent.

The *Surface* of the back of the body, head, and dorsal aspects of the umbrella and arms is covered with thick-set hemispherical pimples, which are also found on the inner side of the membrane between the two dorsal arms, and on the inner surface of the arms between the suckers; they are smaller and more sparse on the ventral surface of the body. A large rough cirrus and a few larger pimples are found over each eye. A raised ridge passes backwards from the base of the siphon along the ventro-lateral margin of the body, meeting its fellow of the opposite side at the posterior extremity*.

The *Colour* is deep purplish on the back, mottled on the sides, and cream below.

Hab. Port Jackson, Australia, 6–15 fathoms. Two specimens, 1 ♀, 1 juv.

Octopus hongkongensis, Steenstrup, MS.

The *Body* is rounded, with a median ventral furrow, and depressed (? from pressure). The *mantle-opening* is slightly less than half the circumference, and terminates midway between the siphon and the eye, and a little behind the latter. The *siphon* is comparatively short and conical, and extends one third the distance to the umbrella-margin.

The *Head* is comparatively broad, almost as broad as the body, and the *eyes* appear to have been prominent.

* I have considerable doubt whether this be really one of the specific characters; but as it occurs in both specimens, I have thought it well to mention it.

The *Arms* are unequal, the ventral considerably shorter than the dorsal and dorso-lateral, on an average six times as long as the body, stout and tapering very rapidly towards the ends. The *umbrella* reaches up one fifth of the length of the dorsal arms, and is a little wider between the lateral and a little narrower between the ventral arms. The *suckers* are not closely packed and not enlarged on the dorsal arms, notwithstanding the sex of the specimen. The *hectocotylized arm* is very short, but the modified extremity is long and narrow, with parallel sides tapering only at the extremity to a blunt point; a narrow fillet runs between the two marginal ridges.

The *Surface* of the body is sprinkled dorsally with minute hemispherical warts, which become smaller and gradually disappear on the sides and lower surface; they are also found on the dorsal surface of the head and of the umbrella. Above each pupil stands a small cirrus, immediately behind which is a larger one.

The *Colour* is a dull red on the dorsal surface, lighter and brighter below, sprinkled with dull reddish-brown dots.

Hab. The *Hyalonema*-ground south of Japan, 345 fathoms (Station 232). One specimen, ♂.

Octopus tonganus, n. sp.

The *Body* is rounded, depressed, and broader than long, with a marked but shallow median groove on the ventral surface. The *mantle-opening* extends about one third round the circumference of the body, terminating nearer to the funnel than to the eye. The *siphon* is short and conical, and extends rather more than halfway to the umbrella-margin.

The *Head* is small and the *eyes* prominent.

The *Arms* are unequal, the order being 3, 2, 4, 1; on an average they are nearly ten times as long as the body, and taper gradually to very fine points. The *umbrella* is very small and slightly narrower dorsally than laterally. The *suckers* are for the most part small and closely packed, the first four are arranged in a single row; in the male there are four large ones on each lateral arm opposite the margin of the umbrella, beyond which they gradually diminish. The *hectocotylus* is very minute.

The *Surface* is in general smooth; the back bears a few small papillæ, but owing to the compression of the specimens it is impossible to make out their exact number. There are three minute cirri over each eye.

The *Colour* is on the whole grey, paler below; this is due to dark specks sprinkled more or less closely over a cream-coloured ground. One specimen has a purplish patch at either side of the mantle-opening.

Hab. The Reefs, Tongatabu. Three mutilated specimens, 1 ♂, 2 ♀.

Octopus vitiensis, n. sp.

The *Body* is nearly oblong, but becomes somewhat narrower posteriorly. The *mantle-opening* extends nearly one third round the body, and terminates some distance below and behind the eye. The *siphon* is long and acutely pointed, and extends about halfway to the umbrella-margin.

The *Head* is broader than the body, with large laterally prominent *eyes*.

The *Arms* are subequal, the two lateral pairs being a little longer than the others; on an average they are nearly three times as long as the body, and taper rather rapidly about the middle of their length and then evenly to fine points. The *umbrella* extends nearly one third up the arms, least along the dorsal pair. The *suckers* are sunken, comparatively large, with a dark margin and very well-marked radial grooves. The first two on each arm are in a single row, owing to the compression of the arms laterally; there are no enlarged suckers on the lateral arms. The *hectocotylus* is not developed.

The *Surface* of the dorsum of the body bears a few minute warts scattered here and there; over each eye there is a rather large branched cirrus, with a few small ones scattered round it. The internal surfaces of the arms are covered with minute hemispherical warts, so as to resemble shagreen.

The *Colour* is very dark grey, almost black on the dorsal surface and outside the arms; paler grey below and on the inner surfaces of the arms. The dark covering of the body is not continued over the inner surface of the membrane covering the two dorsal arms.

Hab. The Reefs, Kandavu, Fiji. One specimen, ♀.

Octopus duplex, n. sp.

The *Body* is short and evenly rounded, with the merest trace of a median ventral groove. The *mantle-opening* extends about half round the circumference, and terminates halfway between the siphon and the eye. The *siphon* is relatively long, conical and pointed, and extends about halfway to the umbrella-margin.

The *Head* is small and the *eyes* rather prominent.

The *Arms* seem to have been unequal, the lateral a little the longest, but so many have been mutilated that it is difficult to be certain; they are about four times the length of the body. The *umbrella* extends about one third up the arms, furthest between the lateral pairs. The *suckers* are large, close, and prominent, with a narrow margin marked off from the basal portion ; the radial grooves extend to the margin and form notches in it. The *hectocotylus* is not present ; the third right arm has been mutilated, but the stump shows no groove running up the outer ventral margin.

The *Surface* is smooth ; an interrupted ridge starting from the base of the siphon passes backwards along the ventro-lateral margin of the body, probably due to contraction. There are three small papillæ above each eye.

The *Colour* is a pale bluish grey above, shading into cream below.

Hab. Off Twofold Bay, Australia, 150 fathoms (Station 163 A). Two specimens, 1 ♀, 1 juv.

Octopus bandensis, n. sp.

The *Body* is rounded and depressed (? from pressure), and with a slight ventral groove. The *mantle-opening* terminates immediately below and behind the eye. The *siphon* extends as far as the umbrella-margin, and is acutely pointed.

The *Head* is broader than the body and flattened by compression ; the *eyes* are very prominent.

The *Arms* are unequal, the third pair being much the longest and stoutest; on the average they are four times as long as the body ; they taper gradually at first and then more rapidly. The *umbrella* is very small. The *suckers* are prominent, the first form being disposed in a single row, and none are enlarged on the lateral arms. The *hectocotylus* is not developed.

The *Surface* is smooth in general, but there are about twelve warts on the back and sides of the body and a large cirrus over each eye, with several small ones near it.

The *Colour* is deep black, apparently owing to treatment with osmic acid.

Hab. Banda. One specimen, juv.

Octopus marmoratus, n. sp.

The *Body* is round, not depressed, and a little longer than wide. The *mantle-opening* extends somewhat less than half-way round the body, terminating nearer to the siphon than to the eye and considerably behind the latter. The *siphon* is small and acutely conical, and extends about one third the distance to the umbrella-margin.

The *Head* is narrow and the *eyes* are prominent where they have not suffered from compression.

The *Arms* are subequal, eight times as long as the body; they are very long and slender, the last property being more marked in the females than in the male; they taper more rapidly at first than near the extremities, which are much attenuated. The *umbrella* is very wide, especially in the male, where it extends almost one third up the arms; in the females its extent is only one sixth. The *suckers* are rather large and closely set; in the male a few suckers opposite the umbrella-margin are slightly, but not markedly, larger than the others. The *hectocotylus* is small and has about ten small transverse ridges.

The *Surface* appears to have been smooth, except for a few short ridges placed longitudinally on the back and sides; but the skin is shrivelled by the action of the spirit, so that it is difficult to be certain. A conical cirrus is situated above and slightly behind each eye; but in some cases this has been destroyed.

The *Colour* is a stone-grey, with dark pigment disposed in veins like those of marble on the dorsal surface of the body, head, and umbrella; the male is much darker, so that the marbling is almost concealed. Traces of an oval spot are seen in front of and below the eye on both sides of one female specimen and on one side of the other; but this spot is concealed by the dark colouring in the male, even if it exist.

Hab. On the reefs, Honolulu, Sandwich Islands. Three specimens, 1 ♂, 2 ♀.

Octopus bermudensis, n. sp.

The *Body* is spheroidal, acuminate behind, and with a median groove ventrally. The *mantle-opening* extends rather less than half round the circumference of the body, and terminates some distance behind and a little below the eye. The *siphon* is long and smooth, and attached by nearly all its length to the head; it extends fully halfway to the umbrella-margin.

The *Head* is much narrower and more depressed than the body; the *eyes* are scarcely at all prominent.

The *Arms* are unequal, in the order 1, 2, 3, 4, about six times as long as the body; they are very long and slender, tapering but slightly. The *umbrella* is small. The *suckers* are small, prominent, and closely set, and the first four stand in a slightly zigzag line. The *hectocotylus* is absent.

The *Surface* is smooth for the most part, but the skin is wrinkled over the posterior acuminate extremity, owing to the action of the spirit; there is one very small wart over each eye.

The *Colour* is yellow-ochre, with two pale sienna patches on the back and on the head.

Hab. Bermuda. One specimen, ♀ juv.

Octopus levis, n. sp.

The *Body* is oblong, depressed, and bulges a little at the sides; the *mantle-opening* extends about one third round the circumference, terminating about midway between the siphon and the eye. The *siphon* is short and small, extending scarcely one third the distance to the umbrella-margin.

The *Head* is almost as broad as the body, and the *eyes* are large, spheroidal, and prominent, with very small circular apertures.

The *Arms* are subequal and short compared with the body, being about three times its length; they taper gradually to moderately fine points. The *umbrella* is large, extending about one third up the arms. The *suckers* are small and prominent and arranged in two rows from the commencement; a narrow well-marked groove runs across the arm between each two suckers (possibly due to contraction). The *hectocotylus* is well developed, short, and tapering rapidly to a blunt point; the median groove has about ten transverse bars. The *circumoral lip* is unusually thick.

The *Surface* appears to have been perfectly smooth, but is now covered with wrinkles, due to the action of the spirit.

The *Colour* is a dull grey, inclining to stone-colour below.

Hab. Off Heard Island, Southern Ocean, 75 fathoms (Station 151). Four specimens, 1 ♂, 1 ♂ juv., 2 ♀ juv.

Octopus januarii, Steenstrup, MS.

The *Body* is rounded, widening a little posteriorly; the ventral groove is very faint. The *mantle-opening* terminates just below the eyes. The *siphon* is bluntly conical and extensively attached to the umbrella; it extends less than halfway to the umbrella-margin.

The *Head* is small and the sides are entirely occupied by the enormous *eyes*, which are swollen and globular, but with very small palpebral openings. The skin covering them is so thin that the dark pigment within is distinctly visible.

The *Arms* are unequal, the dorsal pair being the largest; on an average they are four times as long as the body. The *umbrella* is about equally wide all round, except that it is a little shorter between the two ventral arms. The *suckers* are comparatively small, prominent, and separate; more widely in one specimen than in the other, probably owing to its being less contracted by spirit. None of the suckers on the lateral arms are enlarged, notwithstanding the sex. The *hectocotylus* is well developed; it is broad, and tapers rapidly to an acute point; in one specimen about seven transverse ridges can be counted in the proximal half of the median groove; in the distal half and in the other specimen they are indistinct.

The *Surface* is perfectly smooth all over.

The *Colour* is a pale purplish pink, deeper above than below.

Hab. Off Barra Grande (Station 122), one specimen, ♂; (Station 237), one specimen, ♂.

Eledone, Leach.

Eledone rotunda, n. sp.

The *Body* is spheroidal, very little longer than broad, and the ventral groove is not marked. The *mantle-opening* extends one third round the body, ending some distance directly below the eyes. The *siphon* is slightly tapering, and extends one third the distance to the umbrella-margin.

The *Head* is short, nearly as broad as the body, and the *eyes* are round and rather prominent.

The *Arms* are equal and about twice as long as the body; they are very stout, and taper gradually to blunt points; their section shows a triangle projecting inwards and a rounded surface looking outwards, the former much more prominent than the latter. The *umbrella* is wide, extending one third up the arms, a little further dorsally than ventrally. The *suckers* are comparatively small, closely set, and deeply cupped. There is no trace of a *hectocotylus*.

The *Surface* is perfectly smooth.

The *Colour* is dull purple, palest on the body and deepest on the inner surface of the umbrella.

Hab. The Southern Ocean, 1950 fathoms (Station 157); one specimen, sex? South Pacific, 2225 fathoms (Station 298); one specimen, arms only, sex?

Eledone brevis, n. sp.

The *Body* is short, rounded, and depressed; blunt behind and deeply grooved below. The *mantle-opening* extends one third round the animal and terminates immediately below the eyes. The *siphon* is short, acutely pointed, and extends less than halfway to the umbrella-margin.

The *Head* is very short and nearly as broad as the body. The *eyes* are spheroidal and very prominent.

The *Arms* are equal and about half as long again as the body; they are short, stout, and taper gradually to blunt points. The *umbrella* extends halfway up the arms, rather more in the largest specimen. The *suckers* are round, prominent, and deeply cupped, and there are about 30 on each arm. The *hectocotylus* is not developed.

The *Surface* is smooth, with the exception of three cirri arranged in a triangle over each eye. Behind the left eye in the largest specimen the skin is elevated into a number of small papillæ, and a few similar ones are seen on the back of the medium-sized specimen.

The *Colour* is a dull purplish grey above, inclining to pale ochre below.

Hab. South Atlantic, 600 fathoms (Station 320). Three specimens, ♀.

JAPETELLA *, n. gen.

The *Body* is gelatinous in consistency and semitransparent, and more or less oblong in form. The *mantle-opening* is very wide.

The *Arms* are unequal, the longest (the third pair) being only about equal in length to the body. The *umbrella* is small and the *suckers* arranged in a single row.

Japetella prismatica, n. sp.

The *Body* is of gelatinous consistency and semitransparent; it is somewhat longer than broad, flat on the dorsum, and with the median ventral region raised into a prominent ridge, which gives the body a prismatic form. The *mantle-opening* appears to have been wide and to have terminated behind the eyes; but as it has been torn away from the head dorsally, it is impossible to be certain of this. The *siphon* extends almost to the margin of the umbrella, and is but slightly conical, with a broad truncated extremity. There is *no median septum* in the branchial cavity.

The *Head* is about as broad as the body; the *eyes* are rounded and prominent laterally, the spherical lens protruding from the middle of each.

The *Arms* are unequal, the third being the longest, one quarter longer than the body and about one third longer than the fourth, which is slightly longer than the second, and this than the first, so that the order of length is 3, 4, 2, 1. The arms are stout and taper gradually to blunt points. The

* Named in honour of Professor Japetus Steenstrup.

umbrella extends about halfway up the dorsal arms and one fourth up the ventral arms, its extent being intermediate between these extremes in the case of the other arms. The *suckers* are round and prominent, and in many cases show a double margin, due to a thin membrane surrounding the thickened edge of the sucker; they commence one sucker's breadth from the oral margin, and become gradually larger and wider apart as far as the middle of the arm, where they are one sucker's breadth apart, after which they are smaller and closer, and towards the extremity stand in contact. There is no trace of a *hectocotylus.*

The *Surface* of the body appears to have been perfectly smooth; it is covered with torn remains of epithelium, but there are neither warts nor cirri.

The *Colour* is a pale yellowish grey, and there are numerous reddish-brown chromatophores.

Hab. Off the Rio San Francisco, Brazil (Station 125), probably surface. One mutilated specimen, sex?

Japetella diaphana, n. sp.

The *Body* is gelatinous and semitransparent; it is ovoid in form and considerably longer than broad. The *mantle-opening* is very wide, extending up behind the eyes on either side. The *siphon* extends two thirds of the distance to the umbrella-margin, and is truncated at the extremity. There is a *median septum* in the branchial cavity.

The *Head* is nearly as broad as the body, and the *eyes* are large and prominent; they consist of a larger darkly pigmented spheroid, from which protrudes the smaller opaque white spherical lens.

The *Arms* are unequal; the longest (the third pair) are almost as long as the body and are nearly twice as long as the fourth, which are the shortest, the order of length being 3, 2, 1, 4; they taper rapidly to fine points. The *umbrella* is very small, extending about one fourth up the dorsal and ventral arms, a little further up the dorso-lateral and lateral arms, and being least developed in the space between the ventral and ventro-lateral arms. The *suckers* have assumed, owing to shrinking, a quadrangular or triangular form; they are prominent and marked by two constrictions, one at the base, separating them from the arm, the other rather more than halfway up. There is no trace of any *hectocotylus.*

The *Surface* appears to have been smooth originally, but the epithelium has been to a great extent stripped off.

The *Colour* is a very pale yellowish grey, marked with numerous longitudinally disposed oblong chromatophores.

Hab. North of Papua (Station 220), surface. One specimen, sex?

CIRROTEUTHIS, Eschricht.

Cirroteuthis magna, n. sp.

The *Body* is oblong, about twice as long as broad, and rather broader than deep. The *mantle-opening* is circular, but little larger than the base of the siphon, and its margins are continuous with two ridges on the sides of the latter. The *siphon* is conical and slightly swollen at the tip; it is not connected to the head by ligaments. The *fins* are obovate in form, about four times as long as broad, and thickened along the posterior margin. The *dorsal cartilage* is saddle-shaped and elongated from side to side, not antero-posteriorly.

The *Head* is directly continuous with, and somewhat narrower than, the body; the *eyes* are spheroidal, the lens spherical, and the palpebral opening circular.

The *Arms* are subequal, three and a half times as long as the body; they are slender and more resemble thickenings of the web than independent arms; they are thickest about two thirds the distance along them, and terminate in a delicate slender tip, which projects beyond the web. The *umbrella* is a thin delicate membrane, very largely developed, and when fully expanded its diameter was probably nearly three times as large as its depth. It extends from the tip of the ventral arm on either side backwards and becomes gradually narrower, so that it only extends along the proximal two thirds of the next arm, beneath which it passes, to be attached in a crescentic line to the outer surface of the web, which similarly passes backwards from the tip of this arm; this arrangement is usually described by saying that the arm does not lie in the umbrella for the proximal two thirds of its length, but is joined to it by a vertical web; but this does not so correctly represent the arrangement. The umbrella stretches across from tip to tip of the two dorsal arms, and between the proximal two thirds of the two ventral arms. The *suckers* commence about 1 centim. from the oral margin, and the first four lie pretty close together within a space of less than 2 centim., after which they gradually become further apart, an interval of 2–3 centim. intervening between each two; about two thirds along the arm they stand closer together and are very large, but after this they again become smaller and stand in close contiguity with each other. The proximal suckers are small, prominent, and rather soft, and seem to contract by folding the lateral margins over towards each other, so as to present the appearance of a half-closed eyelid; but the largest suckers are firm and muscular, and consist of a globular basal portion imbedded in the arm and a short cylindrical projecting portion. The *cirri* commence between the fourth and fifth suckers as very minute prominences which gradually increase in length until halfway along the arm they attain a maximum length of 8 centim., after which they decrease rapidly, and cease opposite the attachment of the web to the ventral aspect of the arm.

The *Surface* of the body has been entirely denuded of epidermis, so that it is impossible to ascertain its nature; the web is perfectly smooth.

The *Colour*, so far as preserved, is a dull madder.

Hab. Between Prince Edward Island and the Crozets; 1375 fathoms (Station 146). One specimen, sex ?

Cirroteuthis meangensis, n. sp.

The *Body* is much distorted, but appears to have been subglobular in form. The *mantle-opening* is very small, and fits closely around the base of the *siphon*, which is small and bluntly conical, with a still smaller pimple-like extremity; on either side there extends from the dorso-lateral base a curved fold of membrane, which loses itself in the mantle. The *fins* are about equal in length to the breadth of the body, narrow and pointed at the extremity, and thickened towards the posterior margin. The *dorsal cartilage* is elongated transversely.

The *Head* is exceedingly short, and the *eyes* large and spheroidal.

The *Arms* are subequal and about three times as long as the body in the present shrunken condition of the specimen; they taper rather rapidly to slender points. The *umbrella* extends on the dorsal side of each arm to within 1 centim. of its extremity, whilst on the ventral side it reaches only four fifths along it; the arms lie in the umbrella and are not united to it by any intermediate vertical web. The *suckers* are about sixty to seventy in number, small and subequal; they are at equal intervals for the greater part of the arm, but closer near the extremity. The *cirri* are short, stout, and conical, the largest 2 millim. in length; on the ventral arms they commence between the fourth and fifth suckers and extend to the fiftieth sucker, beyond which there are twenty-one, which gradually decrease; on the dorsal arms the cirri commence between the sixth and seventh suckers and continue to the fifty-fifth, beyond which there are nine.

The *Surface* is smooth.

The *Colour* of the body is creamy white, of the arms and umbrella deep madder-brown. The suckers and cirri are paler.

Hab. Off the Meangis Islands, near the Philippines, 500 fathoms (Station 214). One specimen, sex?

Cirroteuthis pacifica, n. sp.

The *Body* is almost entirely absent. The *fin* is obovate in form and thickened along the posterior margin, thin and membranous at the extremity and along the anterior margin. The proximal end of its cartilage is exposed and presents a long grooved articular surface. One *branchia* is visible and presents the appearance of a spheroidal nodule with meridional grooves. The *mantle-opening* is circular, and closely embraces the base of the *siphon*, which is long, thin, and conical.

The *Head* is exceedingly short, and the *eye* appears to occupy all the available space between the fin and the arms.

The *Arms* are subequal, thick, rounded, and soft, and taper rapidly towards the extremities. The *umbrella* is attached directly to the arms, which are somewhat more prominent on its inner than on its outer surface; it is attached to the dorsal aspect of every arm almost to the tip, and to the ventral aspect for somewhat more than half its length, and at its attachment is a firm cartilaginous (?) nodule. The *suckers* are about fifty-two in number and commence close to the oral lip, and the first half-dozen stand near together; halfway up the arms they are further apart, and the largest are situated opposite the attachment of the membrane to the ventral aspect of the arms; they are prominent, but not so hard and firm as those of *C. magna*. There are faint radial markings upon them. The *cirri* commence on the dorsal arms between the seventh and eighth suckers, and continue till the last; on the ventral arms they commence between the sixth and seventh, and here also are continued to the tips of the arms. They begin as small papillæ, gradually increase in length, attaining their maximum about halfway along the arms.

The *Surface* is smooth.

The *Colour* is a deep purplish madder, paler outside the umbrella and on the fin.

Hab. Pacific Ocean, between New Guinea and Australia, surface (Station 181). One mutilated specimen, sex?

AMPHITRETUS, n. gen.

Amphitretus pelagicus, n. sp.

The *Body* is short, rounded, of gelatinous consistency, and semitransparent. The *mantle* adheres to the sides of the siphon, so that the *mantle-opening*, which is single in all other known Cephalopods, is here divided into two pocket-like openings, which lie one beneath each eye. The *siphon* is very long and narrow, and extends forwards anteriorly to the margin of the mantle, for a distance almost equal to the length of the body, and is a little swollen at the extremity.

The *Head* is undistinguishable from the body except by the possession of the *eyes*, which are situated near together on the dorsal surface; they consist of a larger basal spheroid, through the walls of which pigment is clearly visible, upon which stands a smaller, very prominent spheroid, white, opaque, and of glistening surface.

The *Arms* are equal and rather more than twice as long as the body; they are slender, and taper at first gradually and then more rapidly to comparatively blunt points. The *umbrella* extends more than two thirds up the arms, and is thin, delicate, transparent, and much damaged. The *suckers* are firm, muscular cups embedded in the softer tissue of the arms, as in *Cirroteuthis*; there are about twelve placed at some distance apart on that portion of the arm up which the web extends, and eleven closely set and showing a tendency to biserial arrangement on the free extremities. There are no *cirri* nor is there any trace of the formation of a *hectocotylus*.

The *Surface* appears to have been quite smooth originally; there is no sign of any cirri or warts.

The *Colour* is a dull yellow, apparently due to preservation in picric acid, and the mantle and umbrella are thickly sprinkled with small brown chromatophores.

Hab. Near the Kermadec Islands, South Pacific; on the surface (Station 171). One specimen, sex?

XX.—*Note on the Structure of the Skeleton in the Anomocladina.* By Prof. Sollas, D.Sc., F.G.S.

As considerable difficulty appears to exist with regard to the constitution of the skeleton of the Anomocladina it may be useful to publish at once a short account of the results of some observations which appear to remove all doubt. Full particulars, with illustrations, will appear in my paper on *Vetulina*, now in the hands of the Royal Irish Academy.

The Anomocladina, one of the four families of Lithistid

Sponges established by Zittel*, were originally defined by him as distinguished by their "unregelmässig ästige Skeletkörperchen deren Aeste in einem knotig verdickten Centrum zusammenstossen. Da dieselben an ihren Enden nur mässig verzweigt sind, so entsteht ein maschiges Netzwerk, das in manchen Fallen grosse Aehnlichkeit mit dem Gittergerüst gewisser Hexactinelliden erhält," &c.

Oscar Schmidt† subsequently described an existing representative of this group, previously only known in a fossil state, and confirmed and extended Zittel's observations. He recognized the branched corpuscles and two kinds of nodes in the network which they form by their union, one kind provided by the centrum of the corpuscle, the other formed by the union of the ends of its rays with those of adjoining corpuscles.

Quite recently Zittel ‡, being unable to find more than one kind of node in the network, and that formed by a union of the ends of the rods, concludes that he was mistaken in supposing that the corpuscles consisted of a centrum and radiating arms, and proposes an amended definition of the Anomocladina, as follows:—"Skeletal elements consisting of simple, generally straight, but sometimes curved rods, more or less strongly branched at the two extremities. The branched ends of several (4–9) neighbouring rods meet together, and by their amalgamation form the nodes."

By the method which I find most successful in studying Lithistid skeletons (boiling in caustic potash) it is easy to completely isolate the corpuscles of *Vetulina*, and they are then found to exhibit the characters which Zittel first assigned to the corpuscles of the Anomocladina, and which were subsequently seen by Schmidt. Further, by my method of cutting frozen sections § it is possible to obtain a layer of the skeletal network only one corpuscle thick (less if needful), and then one clearly perceives that there is, as a rule, but *one kind of node*, only this is not produced by the union of the ends of the corpuscular rays, but by the centrum of the corpuscles, against which the rays of neighbouring corpuscles abut. About the place of abutment the centrum throws out numerous branched spines, which, except in successful sections, make interpretation of the structure difficult. In some cases the

* Zittel, 'Studien über fossile Spongien,' ii. Abth., Lithistidæ, 1878, p. 23.

† O. Schmidt, 'Die Spongien des Meerbusen von Mexico,' 1879, p. 29.

‡ Zittel, "Ueber Astylospongidæ und Anomocladina," JB. Mineral. 1884, ii. p. 75. Translated by W. S. Dallas, 'Annals' (5), xiv. p. 271.

§ Sollas, "An Improvement in the Method of Using the Freezing Microtome," Quart. Journ. Micr. Sci. n. s. xxiv. p. 163.

centrum gives off rays on one side only and on the other side receives rays only. It then, when isolated, much resembles the stellates of *Holasterella*, Carter.

The accompanying rough sketch, made by camera lucida, illustrates this mode of union. In some parts of the section, marked *o*, the razor has cut away the centrum of a corpuscle, leaving, however, the spines, which thus remain to indicate its position. As the specimen from which the section was taken had been boiled in caustic potash, the rays of the corpuscles shown in the figure are not so long as in untreated specimens; in my extended paper careful drawings will show the rays complete up to their natural terminations.

XXI.—*Lepidoptera collected by Mr. C. M. Woodford in the Ellice and Gilbert Islands.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The species here enumerated were obtained in Nukufetau (Ellice group), and Tarawa and Tapetewea (Gilbert group). They are chiefly interesting as adding to our knowledge of the fauna of these islands.

Rhopalocera.

Nymphalidæ.

1. *Junonia villida.*

Papilio villida, Fabricius, Mant. Ins. ii. p. 35. n. 366 (1787); Donovan, Ins. New Holl. pl. 25. fig. 3 (1805).

♂. Nukufetau and Tapetewea.

2. *Hypolimnas rarick.*

Apatura rarick, Eschscholtz, in Kotzeb. Reise, p. 203, pl. 5. fig. 10 (1821).

♀. Tapetewea, Gilbert Islands.

Mr. Woodford took four females of this species, but omitted to capture males, under the impression that there was no difference in the males from various localities, and that consequently the whole of the species of this group of *Hypolimnas* were mere varieties of a widely distributed polymorphic type.

Heterocera.

Sphingidæ.

3. *Chœrocampa erotoides.*

Gnathothlibus erotoides, Wallengren, Wien. ent. Monatschr. iv. p. 43. n. 44 (1860).

♂. Tarawa, Gilbert Islands.

The only example taken is entirely denuded of scales; but nevertheless I have not the slightest doubt of its identity with this species.

4. *Cephonodes hylas.*

Sphinx hylas, Linnæus, Mantissa, i. p. 539 (1771).

♂. Tapetewea.

Three examples were obtained; its distinctness from *C. Cunninghamii* is rendered doubtful by the fact that both forms occur together both in Australia and India.

Lithosiidæ.

5. *Deiopeia pulchella.*

Tinea pulchella, Linnæus, Syst. Nat. 1, ii. p. 884. n. 349.

Nukufetau, Ellice Islands, and Tapetewea.

The specimens are large, and the red spots on the primaries show a stronger tendency to confluence than is usual; nevertheless we have similar specimens from other parts of the world.

Apamiidæ.

6. *Prodenia retina.*

Neuria retina, Herrich-Schäffer, Eur. Schmett. ii. p. 292.

. Tapetewea.

One example has very pale markings on the primaries, even more so than in the type of *P. subterminalis*, thus rendering the distinctness of the latter from *P. retina* extremely doubtful.

7. *Amyna octo.*

Perigea octo, Guénée, Noct. i. p. 233. n. 377 (1852).
Amyna axis, Guénée, *l. c.* p. 407. n. 378 *b* (1852).

Nukufetau and Tapetewea.

Both forms of this species were obtained in the Ellice and Gilbert Islands. It is new to the Museum collection, and is the smallest species hitherto described.

Heliothidæ.

8. *Heliothis armigera.*

Noctua armigera, Hübner, Noct. pl. 79. fig. 370 (1805–24).

Tapetewea.

Evidently common in the Gilbert Islands. The specimens are generally smaller than those from Europe, and should perhaps be referred to the form named *H. succinea* by Mr. Moore.

Catephiidæ.

9. *Catephia linteola.*

Catephia linteola, Guénée, Noct. iii. p. 44. n. 1375 (1852).

♂. Tarawa, Gilbert Islands.

Ophiusidæ.

10. *Achæa melicerte.*

Phalæna-Noctua melicerte, Drury, Ill. Exot. Ent. i. p. 46, pl. 23. fig. 1.

♀. Tapetewea.

Remigiidæ.

11. *Remigia translata.*

Remigia translata, Walker, Cat. Lep. Het. Suppl. iii. p. 1015 (1865).

♀. Tapetewea and Nukufetau.

Steniidæ.

12. *Marasmia creonalis.*

♀. *Botys creonalis*, Walker, Lep. Het. xviii. p. 579. n. 55 (1859).
♀. *Botys neoclesalis*, Walker, *l. c.* p. 635. n. 153 (1859).
♀. *Botys suspicalis*, Walker, *l. c.* p. 667. n. 212 (1859).
♀. *Botys convectalis*, Walker, *l. c.* Suppl. 4, p. 1411.
♂. *Marasmia cicatricosa*, Lederer, Wien. ent. Monatschr. vii. pl. xii. fig. 8 (1863).

♀. Tapetewea, Gilbert Islands.

Margarodidæ.

13. *Erilita modestalis.*

Erilita modestalis, Lederer, Wien. ent. Monatschr. vii. pl. xvi. fig. 3 (1863).

Nukufetau, Ellice Islands.

This species usually has a black spot at the end of the cell of secondaries; it is not, however, represented in Lederer's figure, and is absent in a specimen from Mysol in the Museum collection.

14. *Margaronia Woodfordii*, sp. n.

Nearest to *M. pomonalis*; of a brilliant emerald-green colour: primaries above with a narrow golden-ochreous costal border, edged in front towards apex with blackish; all the wings with a narrow ochreous external margin, dotted with brown at the extremities of the veins and bounded externally by a blackish line; fringes snow-white, unequally spotted with blackish, so as to give an angulated appearance to the wings: secondaries with a narrow tapering interno-median streak and the abdominal border snow-white: palpi rich velvety sap-green, tipped with red-brown; antennæ white, with the basal half above tinted with green; sides of abdomen whitish; subterminal segment of male and anal segment of female tipped with golden; anal segment of male clothed with black hair. Under surface paler: base of primaries and entire surface of secondaries whitish: body below pearly (Veronese) green, deepest on the front of the thorax: under surface of legs and the whole of the tarsi pure white; anterior tibiæ brown, terminating in a fan-shaped fringe of hair, across the base of which runs a pale bar. Expanse of wings 31 millim.

♂ ♀. Tapetewea.

Nine examples of this beautiful little species were obtained. It is more brilliant in colour than any of the green *Margaroniæ* known to me.

Asopiidæ?

15. *Rinecera mirabilis.*

Rinecera mirabilis, Butler, in 'Account of Collections of U.S. Eclipse Expedition.'

This interesting species is larger than *R. viola* (*Pyrausta viola*, Butl.), which was described from a female insect, and the oblique band beyond the cell is sinuated and strongly dentated; the genus was founded principally upon the male characters, which are very peculiar, the antennæ being curved and knotted somewhat as in *Ceratoclasis*, Led., and the costal margin of the primaries sinuous and with a grooved projection at the basal third; the tibiæ of the anterior legs are flattened and gradually expanded towards the distal extremity, and in both the anterior and middle legs are more or less grooved below.

♂. Nukufetau, Ellice Islands.

Three examples were obtained.

Galeriidæ.

Harpagoneura, gen. nov.

Allied to *Melissoblaptes*; the body very similar: primaries elongate triangular; costa slightly sinuous; costal border somewhat depressed, so as to form a strong ridge at costal vein; outer margin truncate, transverse, deflexed, rounded off at external angle; the inner margin nearly straight, inarched at the base; costa on under surface very deeply grooved; costal vein running to second third of margin; subcostal with five branches, the first emitted at about the middle of the wing, running parallel to the costal vein and reaching the costa just beyond it; the four other veins crowded together upon a thickened glandular patch close to apex, the second joining the third halfway between the cell and apex, thus forming a narrow elongated postdiscoidal cell; discoidal cell extremely long and broad; upper radial continuous with upper discocellular, which is long and united by a short elbow to the subcostal; lower discocellular short and oblique; the lower radial emitted as a fourth median branch; the third and fourth median branches converging towards outer margin; the median vein widely arched, so as to approach the inner margin: secondaries emitting a long but scanty pencil of hairs from the base above; costal margin long and sinuous, outer margin obliquely arched, inner margin rather short and nearly straight; costal and subcostal veins closely approximated to beyond the cell, where they coalesce for a short distance and then fork to costa; in other respects the subcostal is normal; discoidal cell open; median, submedian, and internal veins quite normal.

16. *Harpagoneura complexa*, sp. n.

Whity brown, sericeous; the secondaries almost white and semitransparent; pectus pearly snow-white. Expanse of wings 25 millim.

Nukufetau, Ellice Islands.

Only one example of this extraordinary insect was obtained.

XXII.—*Descriptions of two new Species of* Chalcididæ. By W. F. Kirby, Zoological Department, British Museum.

My valued correspondent, Prof. Berg, of Buenos Aires, has just forwarded to me for examination a small box containing three species of Chalcididæ. One of these is apparently identical with *Chalcis Mnestor*, Walk. (Ent. i. p. 219, 1841), the others I describe here as new. My colleague, Mr. C. O. Waterhouse, will figure the *Leucospis* shortly in his 'Aid to the Identification of Insects.' Prof. Berg has also called my attention to the fact that *Smicra Burmeisteri*, Kirb., was not taken in the Argentine Republic, as I had supposed, when I described it, but was bred by Mr. Burmeister in Rio Janeiro from a species of *Caligo*.

Leucospis coxalis.

Exp. al. 9 lin., long. corp. 4 lin.

Female. Black, thickly and closely punctured, and with fine silvery-grey tomentum; head with green reflections above, brightest between the antennæ, and (narrowly) round the eyes, and more coppery behind; the face, which is deeply impressed, nearly as in *Metallopsis cayennensis*, is likewise greenish, especially above; thorax black, with very slight greenish reflections; prothorax bordered with rufous on the sides, and in the middle in front, and bordered with yellow behind; mesothorax with a transverse yellow stripe (?) behind (obliterated in the middle by the pin); tegulæ rufous; antennæ broken (first three joints black above, reddish below, scape with an oblong yellow spot beneath); scutellum bordered behind with a yellow crescent; abdomen with the first segment constricted; black above, with three yellow stripes near the extremity, the last two bordering the base of the ovipositor on each side, the slenderer portion of the ovipositor rufous and recurved nearly to the scutellum; mesopleura black, with a slight greenish reflection and with a yellow streak beneath; metapleura with an oblique rufous streak, yellowish above, running to the base of the hind coxæ; legs mostly rufous, varied with brown, and tibiæ streaked with yellow; hind coxæ rufous above the middle, this colour being bordered above and below with yellow; lower half dark brown; hind femora cupreous on the outside, bordered, except at the base and tip, with yellow, and armed beneath with numerous small teeth; fore wings clouded, inner margin and hind wings lighter.

Allied to *L. tomentosa*, Kirb., by the constricted first segment of the abdomen, but in coloration more like *L. canadensis*, Walk., and allies.

Buenos Aires.

Smicra (?) *Bergi.*

Long. corp. circa 3 lin.

Male. Black, punctured, sparsely clothed with short bristles; antennæ livid; face and orbits mostly yellow; scutellum unarmed, yellow, completely bisected by a longitudinal black line; legs yellow; hind femora and base of hind tibiæ blackish, the former mostly yellow above and below, and armed beneath with numerous small teeth; abdomen subsessile, rather long and pointed, with three interrupted transverse yellow lines; wings subhyaline, with yellowish nervures. In a second specimen the yellow markings are more extended, the thoracic sutures being marked with yellow, and the pleuræ also with small irregular yellow markings; the hind femora are yellow, black at the tip, this colour extending to the base of the hind tibiæ; and there is a large blackish blotch in the middle, hardly connected with the black at the tip, and shading into smoky brown on the edges.

Female. Similar to the first specimen; antennæ black above; the thorax with small scattered yellow markings; abdomen with four yellow uninterrupted belts.

Buenos Aires. Parasitic on *Œceticus platensis*, Berg.

Not very closely allied to any other species known to me. It somewhat resembles *Conura* in shape, and should perhaps be referred to that genus.

XXIII.—*Contributions towards a General History of the Marine Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. xiv. p. 285.]

[Plates VII., VIII., IX.]

XIV. POLYZOA FROM NEW ZEALAND AND AUSTRALIA.

Suborder CHEILOSTOMATA.

Family **Bicellariidæ.**

DIACHORIS, Busk.

Diachoris elongata, n. sp. (Pl. IX. fig. 1.)

Zoœcia large, elongate, somewhat narrowed towards the oral extremity, suberect, slightly separated, overlapping one another considerably, entirely open in front; oral valve arched above, straight below; two tall and stout spines at the top of the cell, slightly divergent, and five or six on each side, of which the uppermost pair is stouter than the rest and erect, the others slender, acuminate, bent inwards over the area; connecting-tubes six, short; on one side (originating between the second and third spines) an articulated *avicularium*, borne on a rather tall peduncular support, somewhat cup-shaped, expanding very slightly upwards, not swollen below, subtruncate above, the beak but little developed and the projecting extremity not hooked, mandible short, triangular, surface smooth and glossy; dorsal surface convex, smooth, destitute of spines, radical fibre given off from a small tubular projection towards the upper part of the cell. *Oœcium* (?).

Loc. Napier, New Zealand (*Miss Jelly*).

In this species the large size of the cells and the two conspicuous prong-like spines at the summit are characteristic points. But the most striking feature is the avicularium (fig. 1 *a*), which is of a peculiar type, and from the feeble development of its anterior portion (or beak) presents much less of the appearance of a bird's head than is usual amongst the articulated forms. It consists of a cup-like structure of about equal width throughout, from the truncate upper extremity of which the beak projects very slightly; the peduncle is rather long. In form it offers a striking contrast to the avicularium of *D. spinigera*, MacGillivray, a kindred Australian species (Pl. IX. fig. 3).

Diachoris quadricornuta, n. sp. (Pl. IX. fig. 2.)

Zoœcia placed very closely together (smaller and more compact than those of the last species), slightly expanded below, narrowed above, overlapping (but not so much as in *D. elongata*), entirely open in front; at the top four moderately sized blunt spines, and on each side from six to nine, set very closely together and bending inwards, with the exception of the two uppermost, which are larger than the rest and suberect; connecting-tubes six, very short; a little below the top on one side an articulated *avicularium* of the same type as that of *D. elongata*, but smaller; peduncle very slender; beak more prominent than in the last species, sloping upwards towards the free projecting extremity; mandible pointed, rather long and slender. Dorsal surface smooth, without spines. *Oœcium* (?).

Loc. Australia (*Miss Jelly*).

This is a smaller species than the last, and the cells are more closely packed together than in *D. elongata*, and less erect. There is a great difference in the spinous armature of the two forms, and their avicularia are unlike. At the same time the two species are closely allied.

Diachoris costata, Busk. (Pl. IX. fig. 4.)

I have received specimens of this species from the Falkland Islands (the station at which it was obtained by the 'Challenger' expedition), growing on one of the red weeds. They exhibit a peculiarity which is not noticed by Busk. Gigantic avicularia are present here and there on the marginal or outside cells, two or three times as large as those which are borne on the inner cells. This is common amongst the *Bugulæ*, to which *Diachoris* is most closely allied. These avicularia are short and very thick, and of equal width throughout; the beak is not prominent, rising very little above the top of the subjacent chamber (Pl. IX. fig. 4 *a*). There seems to be a certain definiteness in the mode of growth in this form (as in other species of *Diachoris*), which, indeed, we might expect.

Diachoris Magellanica, Busk. (Pl. VIII. fig. 2 *a–d*.)

Busk describes the mouth of this species as circular, with a thickened, annular peristome*. As Waters has already pointed out, this is an error †; the orifice is arched above and straight below. But when the operculum, which has a thickened edge on the *inner* side, is thrown open, it presents exactly the appearance described by Busk (Pl. VIII. fig. 2 *c*), and probably this may be the explanation of the mistake.

The avicularium of this species is very remarkable; it is of great length, slender, and with very graceful outline. The anterior portion is carried out into a long neck-like extension, slightly bent at the extremity. The mandible is long, with a triangular base and attenuated above. The area behind the mandible is very large.

The genus *Diachoris*, as originally defined by Busk, must be regarded as a purely artificial division. But most of the forms which have been ranked under the name present well-marked characters, of much significance, and are properly associated as a natural group. They have the cell of *Bugula* and are furnished with the capitate and articulated avicularium so characteristic of that genus. Indeed it is very questionable

* Brit. Mus. Catalogue, part i. p. 54; 'Challenger' Polyzoa, part i. p. 59.

† "Bryozoa of the Bay of Naples," 'Annals' for Feb. 1879, p. 121.

whether there is any valid ground for separating them from it. The disjunct cells and the more or less decumbent habit are the only characters that could be relied on as distinctive. The first and more important of these would seem to have little real significance, for it occurs as an occasional condition in species the cells of which are normally continuous. We have an instance of this in the disjunct form of the well-known *Microporella Malusii*, described in this paper. The second of the characters referred to is absolutely unimportant. Probably the natural relationships would be best represented by ranking the true forms of *Diachoris* as a subsection of the genus *Bugula*.

One of the species hitherto referred to it, merely because its cells are disjunct, and without any regard to its other and much more important characters, is the *Eschara patellaria* of Moll (=*Diachoris simplex*, Heller), which is an undoubted *Membranipora*. The short connecting processes between the cells vary in number; there are sometimes six of them, sometimes (as in the form *multijuncta* of Waters) nearly a dozen.

So far as this portion of the structure is concerned, there is no essential difference between *Eschara patellaria* and *Schizoporella argentea*, mihi (noticed in this paper), or the disjunct form of *Microporella Malusii*, before referred to.

Busk, in his 'Catalogue,' places the genus *Diachoris* in the family Flustridæ, and holds to this arrangement in his 'Challenger' monograph; but, in my judgment, it has much closer affinity with the Bicellariidæ. The purely membranous, more or less boat-shaped cell agrees exactly with that of *Bugula*, whilst the articulated avicularium is an essentially Bicellarian character. In the Flustrine group this appendage exhibits a much humbler structure and the simplest primary forms prevail.

I add a list of the known species and varieties of *Diachoris* as just defined :—

Diachoris crotali, *Busk*.
—— Magellanica, *Busk* (=D. Buskei, *Heller*).
—— ——, var. distans, *Busk* ('*Challenger' Monograph*).
—— inermis, *Busk*.
—— costata, *Busk*.
—— hirtissima, *Heller* (Chaunosia, *Busk*).
—— ——, form robusta, *Hincks*.

Diachoris armata, *Heller*.
—— spinigera, *MacGillivray*.
—— decumbens, *MacGillivray**.
—— Buskiana, *Hutton*.
—— bilaminata, *Hincks*.
—— distans, *Hincks*.
—— intermedia, *Hincks*.
—— elongata, *Hincks*.
—— quadricornuta, *Hincks*.

* MacGillivray places this form under *Beania*; but the presence of avicularia and the mode in which the cells are united, which differs essentially from that which is met with in the latter genus, seem to connect it with *Diachoris*.

Family **Membraniporidæ**.

MEMBRANIPORA, De Blainville.

Membranipora valdemunita, n. sp. (Pl. VII. fig. 2.)

Zoœcia pyriform, quincuncial, of a delicate vitreous material, area occupying more than three fourths of the front, elongate-oval, wholly membranous, with a slightly thickened and crenulate margin, on each side a little below the top a single spine, cell produced below the area, and on this portion of it a prominent central knob or (occasionally) two, one on each side. *Oœcium* rounded, surface smooth, a subtriangular space in front bounded by raised lines, a median line passing from the centre of the oral arch backwards. *Avicularia* distributed amongst the cells and replacing them, occasionally about as large as the cell, usually much smaller, elongate, narrow, subspatulate, margin thin and elevated round the sides and anterior extremity; a strong denticular process on each side at the origin of the mandible.

Loc. Napier, New Zealand (*Miss Jelly*).

In many cases the produced portion of the cell below the area is wanting, or nearly so, and it then appears simply elongate-oval in form, but normally it would seem to be distinctly pyriform, as stated in the diagnosis. The avicularia are generally placed singly, but sometimes occur in clusters of three.

Membranipora hians, n. sp. (Pl. VII. fig. 5.)

Zoœcia quincuncial, short, arched and contracted above expanding slightly downwards, or subquadrate, sides much elevated, minutely granular, margin thin, not beaded, on each side, at the top, a stout spine; front wall wholly membranous, oral valve very large, arched above, straight below, bordered by a chitinous edging, and with a broad membranous expansion round the upper part of it; on the lower margin of the area a broad slightly projecting lobe bearing numerous minute spines or prickles, enclosed by the membranous wall. At the base of the cells (on an intercellular space) a pointed *avicularium* (sometimes two) borne on a prominent umbo. *Oœcium* massive, very much broader than high, with a wide and shallow oral arch; surface uneven, often bearing one or two pointed *avicularia*.

Loc. New Zealand (*Miss Jelly*).

In this species the wall surrounding the area is much elevated, and the membranous covering appears depressed. There is a peculiarity in the oral valve; it is placed some way below the top of the area and is supplemented by a broad membranous extension, which closes in the upper part of the cell. The prickly lobe on the lower margin is nearly concealed by the membranous wall of the area, which overspreads it.

Membranipora acuta, n. sp. (Pl. VII. fig. 6.)

Zoœcia more or less distant and commonly separated by reticulated interspaces, clavate or pyriform; area regularly oval, or elongate-oval, wholly covered in by membrane, orifice at the very top of it, margin moderately raised and very delicately beaded; the cell produced below the area and terminating in a pointed extremity (this is often concealed, and the zoœcium appears simply oval); at the summit of each cell an *avicularium*, with triangular mandible, directed upwards, borne on a tubercle, which often occupies the centre of the reticulated interspace (Pl. VII. fig. 6). *Oœcium* rounded, about as broad as high; surface smooth, a thickened border round the oral arch, which is rather high and slightly receding; at the base of the ovicell and partly imbedded in it one of the avicularian tubercles.

Zoarium vitreous and subhyaline.

Loc. New Zealand (*Miss Jelly*).

The interspaces are frequently not reticulated, or very slightly so. In some cases they are of large size and occupied by a number of tubercles, with an orbicular orifice on the summit; the usual aviculiferous tubercle is also present. Frequently a line passes backward from the oral arch of the oœcium, and gives a somewhat bilobate appearance to the front of it; but this appearance is much exaggerated in the figure (Pl. VII. fig. 6, *a*). The pointed lower extremity of the cell (Pl. VII. fig. 6, *b*) is often concealed.

Family **Microporellidæ**.

Microporella, Hincks.

Microporella Malusii, Audouin, form *disjuncta*.
(Pl. VII. fig. 4.)

Zoœcia disjunct, each of them connected by very short processes with six others; surface smooth, glossy, and porcellaneous; one of the anterior oral spines frequently forked.

Loc. New Zealand (*Miss Jelly*).

Microporella diadema, MacGillivray, form *angustipora*.
(Pl. VIII. fig. 3.)

In this variety the pore is placed vertically, and is very narrow and slit-like, with a slight border surrounding it. The surface of the cells is strongly areolated, the areolations radiating from the base towards a prominent ridge, which crosses the cell just below the pore, and partially shuts it in. There is an avicularium on one side or on both, a little below the orifice, with produced pointed mandible directed almost straight outwards.

There is a remarkable change in the shape of the pore in this variety. In the normal state it is placed transversely, and is elliptical in form, sometimes slightly flattened on one side, and altogether of larger size (Pl. VIII. fig. 3 *a*) *; here it is a mere slit and directed vertically. There are differences, too, in the size and position of the avicularia, which in the variety are of very considerable length, placed high up on the cell, and directed outwards. In the more usual form they are smaller, some way below the orifice, and directed obliquely downwards. The sculpture in the present variety is also very striking.

Family **Myriozoidæ**.

Schizoporella, Hincks.

Schizoporella biserialis, n. sp. (Pl. VII. fig. 3.)

? *Schizoporella arachnoides*, MacGillivray, 'New or Little-known Polyzoa,' part iii. p. 2, fig. 4.

Zoœcia ovate (irregular in form), ventricose, deeply sutured, whitish, surface thickly covered with small punctures; orifice arched above, straight below, with a central sinus of moderate size, rounded below and not contracted at the opening; peristome not raised, bearing 14–16 tall erect spines, set closely together; on each side (almost in a line with the lower margin) frequently a single detached spine at a short distance from the orifice; round the base of the cell at its upper extremity, and not extending below the orifice, a second series of spines (about ten), tall, slender, and recumbent. *Avicularia* none. *Oœcium* subglobular, surface smooth and dense, three spines on each side in front of it.

Loc. Napier, New Zealand (*Miss Jelly*).

Schizoporella cribrillifera, n. sp. (Pl. VIII. fig. 5.)

Zoœcia small, short-ovate, very irregularly disposed (turned in all directions), decidedly convex, distinct, surface roughened and furrowed, often strongly areolated, the areolations radi-

* This figure is taken from a cell which (in common with the whole colony to which it belonged) was very slightly calcified.

ating from the base to a point below the sinus, which is sometimes occupied by an umbonate projection, the dividing lines prettily beaded; orifice arched above, lower margin straight, with a deep narrow sinus in the centre, slightly enlarged below and not contracted at the opening; peristome elevated round the top and sides of the orifice; many *avicularia* (of various sizes), elongate, subspatulate, scattered amongst the cells, mandible flattish. *Oœcium* large, of considerable breadth (broader than high), rounded above, extended in front so as to enclose the orifice, bearing a cribrillated area, surrounded by a raised border, elongate or semicircular; the surface immediately around the perforated area smooth and lineated longitudinally, the rest roughened.

Zoarium white and glassy; surface rendered uneven by the prominent zoœcia.

Loc. Cook's Straits, New Zealand, investing the stems of a *Sertularella* (*Miss Jelly*).

In this species the surface is roughened by the prominent cells of the superficial layer, which stand out like little hillocks upon it. Amongst these are numerous deep shaft-like openings, at the bottom of which the orifices of the subjacent cells are visible. The surface of the zoœcia is glistening, granulose, traversed (commonly) by radiating and beaded ridges, which mark the course of the areolæ. There is no regularity of arrangement; the cells are strewn about without definite plan, scarcely two are placed alike. The orifice, with its very characteristic sinus, is walled in, except in front, by the elevated peristome, which frequently rises into mucronate projections at the sides. The enclosed and perforated area on the front of the ovicell is a curious feature. The opening is traversed by a central rod, giving off short branches at intervals, which pass to the sides and thus form a number of small orifices, through which the water must have free access to the interior of the oœcium (Pl. VIII. fig. 5). Jullien describes * a somewhat similar structure in his *Schizoporella Fischeri*; but in this case the oœcial opening seems to be closed by a simple plate pierced with minute holes.

Schizoporella scintillans, n. sp. (Pl. IX. fig. 7.)

Zoœcia quincuncial, highly calcified, ovate, moderately convex (sutures shallow, the boundaries obliterated in the older portions of the colony), front wall depressed below, rising gradually towards the oral region; surface porcella-

* "Dragages du Travailleur: Bryozoaires," Bull. de la Soc. Zool. de France, t. vii. (1882).

neous, thickly covered with nodular risings, highly polished and glistening, more or less punctured round the margin; orifice arched above, lower margin straight, with a rather deep central sinus, rounded below and not contracted above; peristome extended and elevated in front, so as to form a semicircular wall immediately below the sinus stretching from side to side; oral spines six or seven, the foremost on one side (? or on both), antenniform, composed of pieces fitting one into the other; frequently a raised circular *avicularium* towards one side of the orifice, sometimes replaced by one with an elongate pointed mandible, which stretches up alongside the orifice. *Oœcium* rounded, imbedded towards the base in the nodular crust, sloping steeply down from the summit towards the orifice, and produced in front into a lobe (slightly hollowed on the sides), which completely shields the entrance; surface smooth, glassy, delicately lineated.

Zoarium white; the crust piled up to a great thickness in the older portions, so that the cell-boundaries disappear and the orifices are deeply immersed.

Loc. New Zealand, on shell (*Miss Jelly*).

Schizoporella lucida, n. sp. (Pl. IX. fig. 5.)

Zoœcia ovate, depressed, bounded by raised lines; surface roughened and minutely punctured, silvery; orifice much broader than high (elongated transversely), arched above, lower margin straight, with a small rounded sinus in the centre; peristome thin, elevated round the upper part of the orifice; on each side, a little below the inferior margin, a blunt spinous process. *Oœcium* large, rounded above, very much broader than high (almost reniform), the basal portion invested by a belt of dull whitish calcareous crust; on the front surface a semicircular space, smooth and silvery, with a line of punctures round the border and a few scattered over the area; the orifice in the ovicelligerous zoœcia walled in at the sides by an extension of the peristome, and in front by two calcareous plates or lobes, which bend inwards and unite above, leaving a circular foramen below. *Avicularia* none.

Loc. Australia, on weed (*Miss Jelly*).

There is a great difference in appearance between the cells which are furnished with the oœcium and those which are not; the former are eminently picturesque. The two solid spinous processes below the orifice are scarcely apparent when the ovicell is present, but they are a notable feature in the younger cells.

Schizoporella circinata, MacGillivray. (Plate VII. fig. 1.)

Loc. Napier, New Zealand (*Miss Jelly*) ; Victoria (*MacGillivray*) ; off Inaccessible Island, Tristan d'Acunha ('*Challenger' Exped.*).

The figure of this species was prepared before I had recognized the identity of the New-Zealand form with MacGillivray's species. Indeed the specimens which I have examined differ in some important particulars from his description and figure.

Instead of the single line of punctures round the margin there is usually a belt of them on each side of the cell, the central portion remaining smooth *. The peculiar avicularium is not noticed by MacGillivray, nor is the broad ridge-like mucro, rising into a point in the centre, which crosses the cell a little below the orifice. The ovicell is peculiar in shape, elongate, prominent, much elevated behind, narrowing off rapidly towards the very small orifice, perfectly smooth, faintly areolated round the margin (Pl. VII. fig. 1, *a*). Busk ('Challenger' Monograph, p. 166) describes a "curious movable appendage jointed to the operculum," with which a "minute fasciculus of muscular fibres" is connected.

Hippothoa, Lamouroux.

? *Hippothoa*, n. sp. (Pl. VIII. fig. 4.)

The form represented in the figure referred to above bears a very close resemblance to the northern *H. expansa*, Dawson, if it be not identical with it. It also reminds us of some of the numerous forms of the ubiquitous *Schizoporella hyalina* which Prof. Smitt associated with *Hippothoa*. I must defer further consideration of it for the present and merely call attention now to the curious secondary cells (?) with which it is furnished. These are minute, somewhat clavate in figure, with a small roundish orifice at the extremity, and are attached in considerable numbers to the normal cells. Frequently one is placed on each side of the orifice.

It is difficult to conjecture what their function may be, but they may remind us of the rudimentary cells, often very small, which are present on *S. hyalina*, though these are much more highly developed.

Loc. Napier, New Zealand.

* My own figure is incorrect in representing the punctures as generally distributed over the surface. The central portion of each cell is usually occupied in great part by the oœcium of the cell below it, or by the large avicularium, and (as a consequence probably) is always imperforate and smooth.

Family **Escharidæ** (part.), Smitt.

LEPRALIA, Johnston (part.).

Lepralia cincta, n. sp. (Pl. VIII. fig. 6.)

Zoœcia quincuncial, subovate, or linear oblong, or six-sided, wide in the middle and narrowing off towards the top and bottom, surrounded by conspicuous raised lines, slightly convex (sutures shallow), depressed below, rising towards a very prominent umbo immediately below the orifice; surface punctured and nodulated; orifice arched and expanded above, contracted below, constricted by a denticle on each side, just above the lower margin, which curves slightly outwards; operculum black and glossy; frequently a small pointed *avicularium* on the umbo. *Oœcium* shallow, but of great width, the oral margin almost straight, surface uneven, punctured, sometimes bearing an umbo, extended in front so as to form a prominent wall-like enclosure round the orifice, with a circular foramen in the centre of it.

Zoarium of a dark brown colour.

Loc. Napier, New Zealand (*Miss Jelly*).

Lepralia subimmersa, MacGillivray. (Pl. VIII. fig. 1.)

The figure shows the structure of the orifice. In the specimen from which it was taken the surface is beautifully reticulato-punctate. The species forms large spreading crusts of a rich orange colour.

Loc. Warrnambool (*Watts*); Port Phillip Heads (*J. B. Wilson*).

XV. CHEILOSTOMATA.—MISCELLANEOUS.

Family **Myriozoidæ.**

SCHIZOPORELLA, Hincks.

Schizoporella argentea, Hincks. (Pl. IX. fig. 6.)

['Annals,' for Feb. 1881, pl. ix. fig. 6.]

An examination of the dorsal surface of this beautiful species shows that it presents a peculiar and very curious structure, and that its mode of attachment must be different from that which is usual amongst its congeners. The cells (at the back) are separated and isolated by a deep suture and elongate-oval in form. The surface is smooth, glassy, and shining; an elliptical opaque white patch occupies the centre (Pl. IX. fig. 6 *a*); set round the edge are six prominent tubular projections, with which probably some chitinous appendage may be connected. In the suture between the cells are six rather large foramina, which pierce through the zoarium and open out on the front surface, so that the zoœcia may be regarded as, to some extent, disjunct, and attached to one another by six broad connecting processes. The connecting portions (which are within the suture) are prettily areolated or scalloped.

Loc. Africa, Tahiti (*Miss Jelly*).

Family **Membraniporidæ**.

Membranipora, De Blainville.

Membranipora trifolium, form *minor*, Hincks.
(Pl. VIII. fig. 7.)

['Annals' for July 1880, pl. xi. fig. 6.]

In the account of this variety in a previous paper I have described the avicularium as pointed, but I had only a worn and imperfect specimen to deal with, and I am now convinced that this was an error. Miss Jelly has supplied me with a fine example of the same form from Tahiti, in which the avicularia are undoubtedly oval. In this respect it differs from *Membranipora trifolium*, Busk, as well as in the greater abundance of the avicularia (which are placed at the bottom of the cells) and the smaller size of the zoœcia. The oœcium I have not seen. On the whole it seems better to regard it, for the present at least, as a variety of the Crag species.

Loc. Bahia; Tahiti (*Miss Jelly*). *M. trifolium* has the following range:—Great Britain (north); Labrador; St. Lawrence; Spitzbergen, Greenland, Norway; Coralline Crag.

Family **Escharidæ**, Smitt.

Lepralia, Johnston (part.).

Lepralia gigas, n. sp. (Pl. IX. fig. 8.)

Zoœcia gigantic, quincuncially arranged, separated by delicate raised lines, rather irregular in shape, often elongate and rectilinear-oblong, or rounded and expanded above, narrowing off towards the truncate base, sometimes comparatively short, much depressed, almost perfectly flat; surface covered thickly with rather large punctures, which are surrounded by small nodular risings; orifice ample, placed some way below the top of the cell (the border surrounding it strongly granulated), arched above, the lower margin curved slightly outwards, constricted a short distance above it, opercular denticles prominent; peristome not elevated, unarmed. On one side of the orifice, about halfway between the upper and lower margins, an *avicularium*, with shallow subtriangular mandible, directed outwards. *Oœcium* (?).

Loc. Trincomalee (own collection).

The avicularium of this species is furnished with a shallow mandible, which is blunt above, and has much the appearance at first sight of being semicircular; it is, however, correctly described as subtriangular.

The large size of the cells and the flat surface are characteristic points.

Lepralia vestita, n. sp. (Pl. IX. fig. 9.)

Zoœcia ovate, quincuncial, convex (sutures rather deep), surrounded by a very slight interstitial line, completely invested with a glossy brown epidermis, beneath which the surface is white and granular (the granules show as indistinct spots through the epidermis); orifice taller than broad, arched above, the lower margin curved outwards, a slight constriction immediately above it; peristome much elevated round the orifice, suberect (forming a kind of shaft), margin white, thin, unarmed; on one side of the orifice or on both sides a pointed *avicularium*, leaning against the peristome and directed obliquely upwards. *Oœcium* rounded, very broad, moderately convex, placed behind the subtubular peristome, and covered by the shining epidermis.

Loc. Tahiti (*Miss Jelly*); Fiji Islands, on *Pinna* (own collection).

In a young state the cell is covered with minute punctures.

Lepralia Poissonii, Audouin.

Two forms of this species occur; in one the vibracula are situated below the orifice and are placed horizontally, in the other they are vertical and placed at the side of the orifice near the top of it and close to the margin. There are also slight differences in the oœcium, but they are unimportant. In a specimen from the New-Zealand Tertiaries the orifice is very small and the vibracula are placed a good way down the cell, with a prominent central umbo between them. In the original figure by Savigny the vibracula are represented *below* the orifice, and the ovicells as traversed by lines (? ridges) radiating from the top towards the opening. These variations are interesting, but have no special significance.

There are as many as from twelve to fourteen of the tall slender spines round the base of the cell in perfect specimens.

Loc. Bass's Straits (*Capt. Warren*); Tahiti (both forms); New Zealand (both forms); New-Zealand Tertiaries, var. (*Miss Jelly*).

Note.—Since the foregoing was in type I have received a paper from Mr. MacGillivray, in which he notices several variations in the pore of *Microporella diadema.*

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. *Schizoporella circinata*, MacGillivray. Zoœcia, showing the avicularia and the suboral ridges. [The punctures are represented as distributed over the whole surface of the cell; but in reality the central portion is destitute of them and perfectly smooth, as in figure 1 *a.*] 1 *a.* Cell with oœcium.

Fig. 2. *Membranipora valdemunita*, n. sp. 2 *a.* Cell with oœcium.

Fig. 3. *Schizoporella biserialis*, n. sp.

Fig. 4. *Microporella Malusii*, Audouin, form *disjuncta*, n.

Fig. 5. *Membranipora hians*, n. sp.

Fig. 6. *Membranipora acuta*, n. sp. 6 *a.* Cells with oœcia. [The bilobate appearance of the ovicell seems to be a mere abnormal peculiarity; it does not occur generally.] 6 *b.* Cells, showing the prolongation below the area.

Plate VIII.

Fig. 1. *Lepralia subimmersa*, MacGillivray. 1 *a.* Oœcium.

Fig. 2 *a.* *Diachoris Magellanica*, Busk. Cell with avicularia. 2 *b*, 2 *d.* Avicularia, showing structure. 2 *c.* Orifice, closed and open.

Fig. 3. *Microporella diadema*, MacGillivray, form *angustipora*, n. 3 *a.* Normal.

Fig. 4. *Hippothoa* ? sp., showing the secondary cells.

Figs. 5, 5 *a.* *Schizoporella cribrillifera*, n. sp.

Fig. 6. *Lepralia cincta*, n. sp. 6 *a.* Oœcium.

Fig. 7. *Membranipora trifolium*, Busk, form *minor*, Hincks.

Plate IX.

Fig. 1. *Diachoris elongata*, n. sp. 1 *a.* Avicularium.

Fig. 2. *Diachoris quadricornuta*, n. sp. 2 *a.* Avicularium.

Fig. 3. *Diachoris spinigera*, MacGillivray. Avicularium.

Fig. 4. *Diachoris costata*, Busk. *a.* Marginal avicularium. *b.* One of the small avicularia on the inner cells.

Fig. 5. *Schizoporella lucida*, n. sp. 5 *a.* Zoœcium, showing the form of the primary orifice and the suboral processes.

Fig. 6. *Schizoporella argentea*, Hincks. A cell showing the arrangement of the granules on the surface, the form of the avicularium, and two of the intercellular perforations. 6 *a.* The dorsal surface of the zoœcium.

Fig. 7. *Schizoporella scintillans*, n. sp. 7 *a.* Oœcium, showing the screen-like lobe in front. 7 *b.* Pointed avicularium.

Fig. 8. *Lepralia gigas*, n. sp. [This figure is drawn to a much lower scale than the rest.]

Fig. 9. *Lepralia vestita*, n. sp.

BIBLIOGRAPHICAL NOTICES.

Manual of Geology, Theoretical and Practical. By John Phillips, LL.D., F.R.S. In Two Parts.—Part I. *Physical Geology and Palæontology.* By Harry Govier Seeley, F.R.S. With Tables and Illustrations. 8vo. Pp. xiv and 546. London: Charles Griffin & Co., 1885.

This is preeminently the age of geological text-books. Within the past few years we have had most elaborate manuals from two of the leading geologists on either side of the Atlantic, to say nothing of several excellent text-books from the pens of other writers. From time to time also the standard works of Lyell and of Murchison have been brought up to date. But, until the present work came out, no one thought of bringing the manual of the late Prof. Phillips into line with the modern advance of the science. Some may have thought the experiment a dangerous one, savouring, it might be, of putting new wine into old bottles, with the usual risk to both attendant on the process.

Despite the great advances which have been made in geological studies during the last thirty years, the general principles and philosophy of geology had been pretty well laid down by the year 1855, which was the date of the last edition of this work. Hence the author of the present volume (Physical Geology and Palæontology) has done well to retain every page of the original work which appeared to him in any way valuable, so that the spirit of the old book might be preserved. The late Professor Phillips had a wonderfully pleasant way of putting things, and it would scarcely have been doing justice to his philosophy and erudition to have omitted more than was absolutely necessary except in those cases (inevitable in a growing science) where subsequent investigation had shown that he was not quite correct in his conclusions.

"In endeavouring to sustain that part of the titlepage which describes the manual as *theoretical*," Professor Seeley says, "I have drawn to some extent upon theoretical views enunciated in my lectures during the ten years from 1860 to 1870, for which Professor Sedgwick deputed to me the practical teaching of Physical Geology and Palæontology in the University of Cambridge. . . . . . The work will be found *practical* too; for it aims throughout, by indicating localities where phenomena may be seen, at enabling every one to verify, and study in nature, the statements and ideas which are herein set forth."

As an appropriate introduction to Physical Geology we have a chapter on the earth's density, shape, structure, and origin. A useful *résumé* of the leading facts bearing on these points is given, the last subject conducting inevitably to cosmical speculation. The author, bearing in mind that he is writing for students, speaks of Mr. Croll's climate-in-time theory, which is based on the excentricity of the earth's orbit, as an hypothesis, which on astronomical grounds is speculative, but not impossible, and deserving of attention. The inferences derived from the study of meteorites are not without interest; since, in truth, these bodies seem to be messengers sent direct from Kosmos.

Chapters III. to VIII. inclusive deal with the rocks from a lithological and petrological point of view. Dismissing the subject of chemistry with extreme briefness, and not entering into that of crystallography at all, the author details (1) the mineral substances which constitute the *aqueous rocks,* and (2) those which form the *igneous rocks*, in a series of very useful tables. The principal rock-forming minerals are divided into family groups, which have a certain naturalness, although such grouping might not in all cases suit a fastidious mineralogist.

Next comes the "nature and origin of crystalline and igneous rocks," and the "nature, composition, and origin of water-formed rocks." In dealing with the first Prof. Seeley adopts what may be termed the views of the metamorphic school; but when he speaks of the easy solubility of carbonate of lime in heated water as one of the agents of such changes he appears to have left out the carbonic acid. In a somewhat similar way he tells us that "clay, slate, gneiss, granite, felstone, rhyolites may exist simultaneously as different conditions of the same rock." There are not many clays that would make a rhyolite, we apprehend, without more of the solid protoxide bases than usually belongs to clays. The primary divisions of Basic and Acidic are artificial, but convenient. He divides all igneous rocks into those which contain orthoclase and those which contain plagioclase, further subdividing each into quartz-bearing and quartz-free. Under this arrangement the olivine-enstatite rocks or peridotites would seem to have no location. The author is disposed to believe that the materials of igneous rocks were originally the materials of stratified formations: the sorting power of water gives a different composition to every mile of a formation as it recedes from the shore. When all this was melted up the parts nearest the land would yield acidic rocks, the parts more distant from land would form the so-called basic rocks. Previously (p. 35) he was disposed to regard the separation as in part effected by the solvent action of water. Doubtless both causes may exercise an influence in bringing abont this singular result, for which Durocher was obliged to suppose two separate magmas.

Coming now to the water-formed rocks, Prof. Seeley says that clay has very nearly the same composition as the mineral felspar. Surely not! The alkalis have in the main been removed. This is a most important difference, and one which bears upon the questions previously discussed. Kaolin rather than felspar must be regarded as the basis of most clays. Under the head of Limestones the author states that the oolite of the Secondary rocks was due to evaporation at the surface of the sea, so that a film was formed round some shell-fragment, which continued to increase in size as it fell through the water till it sank to the bottom. This explanation, he says, will also account for the uniform size of the grains in the same stratum. As a rule, the amount of calcium salts in the water of existing seas is small, so that, unless the Jurassic seas were differently constituted in this respect, the granules must have fallen through an immense depth before a mere film could have become an oolitic grain. All evidence, such as that of reef-building corals &c., goes to show that the oolitic seas were shallow, at least in England. This chapter terminates with a table of the chief British strata, with indications of the prevalent mineral character of the beds, &c. This is a useful table, though the major divisions are very unequal. For instance, the Trias, Permian, and Carboniferous are undivided, but the Jurassic system is split up into Lias, Lower Oolites, Pelolithic, and Psammolithic (part), an arrangement which few teachers would recommend to their pupils. The fact is that Professor Seeley is a law unto himself, a kind of geological nonconformist; and in this instance he seems to have taken a pleasure in defying the rules of the International Geological Congress.

Under the heading of "Petrology" he deals with the phenomena of stratigraphy, and under that of "The Physical and Mineral History of Stratified Rocks" he again discusses the subject of sands, clays, limestones, &c., not forgetting such concretionary bodies as flints. A short chapter on coral-reefs closes this section of Physical Geology.

The two succeeding chapters deal with Physiographic Geology, including the study of coast-lines and their origin, and the general features of scenery in their relation to geological phenomena: and this again leads, in a third chapter (xi.), to that part of dynamic geology which relates to the action of water in modelling the outer crust of the earth. There is probably no more interesting branch of geological science than this, certainly none more popular. Although much is theoretical, especially when we come to deal with subjects of past geographies, yet there is so much that is practical about it, that almost every intelligent tourist can, up to a certain point, make some portion of this branch of the science his own. Professor Seeley gives a sketch of the physical history of the British Islands and the Channel, and treats generally of the origin of geographical features, such as islands, plains, valleys, &c.

As the origin of lakes has given rise to much discussion in recent years, it may not be without interest to note the views of an author like Professor Seeley on the points involved:—(1) "Nearly all the great lakes of the world," he says (p. 134), "owe their existence to direct upheaval of the ocean floor." As instances he gives the great Russian lakes Ladoga and Onega, which are merely prolongations of the Gulf of Finland, leading northward to the White Sea, and are the remains of a channel partly dried up. Consideration of the lakes of Central Asia, many of which are salt from evaporation, serves to demonstrate how recent the last elevation of the country from the sea has been. Lake Baikal is a freshwater lake, yet it contains a large number of salt-water types of animals. Hence it may be concluded that Lake Baikal was originally a portion of the great Central-Asian sea, and was one of the deepest pools in its bed, previous to the elevation of the mountain-axis of the old world.

(2) A second group of lakes has been produced as a consequence of compressions which have thrown the rocks into parallel folds on a smaller scale; when these are closed by tilting, so as to have no outlet for the drainage, fiord-like lakes, such as those on the west coast of Scotland and elsewhere, are the result. (3) A third group is also exemplified by some in Scotland, where the waters lie along anticlinal folds or saddles. (4) The fourth group of lakes comprises those which have been excavated by ice; some are dammed up at their lower end, but others lie in depressions excavated in the solid rock. Several of the lakes of Cumberland, he says, are susceptible of explanation in this way. A very neat woodcut representing Grasmere adorns this page, whence we may suppose that Professor Seeley regards this lake as a case in point. But no allusion is made in the text to the figure, and this practice obtains occasionally throughout the book.

A very large portion of the manual is devoted to volcanic phenomena. After a sketch of the nature and origin of volcanic energy, the author records the manifestations of volcanic action, and then he plunges once more headlong into the rocks. Chapter XIV. Nature and Origin of Igneous Rocks. Chap. XV. The Granitic or Plutonic Group of Rocks. Chap. XVI. History of British Plutonic Rocks. Chap. XVII. The History of Volcanic Rocks. By no means the least interesting chapter in the book is that devoted to the history of volcanic activity in Britain. The literature of this subject, one may say, is peculiarly the growth of the last twenty years or even less, so that many rocks, whose nature was unknown in the days of Prof. Phillips, are now recognized as having had a volcanic origin. The pre-Cambrian volcano of St. David's has the place of honour at the head of the list, and the great volcanic masses of Lower Silurian age (Cambrian according to Prof. Seeley's classification) in North Wales and the Lake District are duly recorded, whilst Scotland and Cornwall appear to have been the principal seats of volcanic forces in Devonian times. Scotland was again uneasy during portions of the Carboniferous epoch. The Secondary period was not one of marked vulcanicity in these islands, though there are many interesting volcanic rocks near Exeter and in other parts of Devonshire associated with the Triassic strata of that county. The Tertiary volcanic rocks of the north of Ireland and west of Scotland and their results are dealt with in the concluding portions of the chapter.

After stating some of the results of volcanic energy from a dynamical point of view, Prof. Seeley for the third time plunges into the rocks. Accordingly we have a chapter on metamorphism, and one on the distribution of gneiss and mica-schist; and he concludes the section of physical geology with the history of mineral veins, and an account of the chief mineral deposits in Britain. Under the head of British copper-mines we note that the "Carboniferous Limestone" of Parys Mountain in Anglesey has long been productive of copper. The age of the strata in Parys Mountain may still be a matter of dispute; but this is the first time we ever heard of those beds being referred to the Carboniferous Limestone. The views of Daubrée as to the origin of cassiterite and its associated minerals are quoted at some length.

Physical Geology, of which a brief and inadequate notice has been given above, occupies 436 pages of the entire volume, and no small portion of this, as we have seen, is devoted to the more intimate study of the rocks. Prof. Seeley has, in fact, been deeply bitten by that love of petrology (using this term also to include lithology) which is so characteristic of the present day. We notice here (as, indeed, throughout the whole of this portion of the work) the results of diligent and careful inquiry carried on in a philosophical and unbiassed spirit. Some critics might perhaps demur to the general arrangement as being rather complex; but of the excellence of a large portion of the matter there can be no doubt. Considering that the chief scope of Prof. Seeley's studies has hitherto lain in quite another direction, his grasp of petrological questions is remarkably good. It would be most ungenerous not to admit this to the full, even though some unimportant errors may be demonstrable.

The two remaining chapters are devoted to Palæontology, concluding with a review of the succession of animal life. As may be supposed, this portion of the work is full of interest, though parts of it read more like an essay than a text-book. In common with most modern authors, Prof. Seeley considers that existing creatures are the descendants of a long chain of preexisting creatures, and thus Palæontology becomes the history of the succession of life on the earth. "It begins with a remote past, when the great groups of organisms were already characterized, and many surviving genera were in existence."

Dealing with the question of the "Origin of Species," he points out the logical defect in Darwin's original argument, since that author did not explain the cause of structural variation. Prof. Seeley claims that as far back as 1862 he had already indicated, in the 'Transactions of the Cambridge Philosophical Society,' that the fundamental active principle in evolution is physiological causation, which, though not uninfluenced by external conditions, is more dependent upon circumstances of function. This view has of course presented itself to most biologists, and some have gone even further to the length of expressing their surprise that, on the whole, the process of structural change has been so slow throughout the successive ages—so slow, indeed, that some existing forms are almost identical with those of a tolerably remote past. This subject is well treated of under the head of "Persistent Types of Life." The author considers that the direction of physiological variation is always towards increased complexity of structure; but the direction of variation under external influences is often towards increased simplicity of structure. Hence, apparently, the two tendencies serve partly to balance each other.

The author, bearing in mind that he is writing a text-book, observes that "every fossil, like every plant and animal, must be referred to its 'genus' and 'species,' and we need to have clear ideas of the nature of the facts indicated by these terms." He even defines a "genus," and illustrates the definition by reference to the characteristics of certain genera of Lamellibranchs, showing their mutual relations. We do not find, however, that he has ventured on the definition of "species." The fact is that, when once the doctrine of evolution is admitted in all its entirety, the ideas attaching to such expressions as "genus" and "species" lose somewhat of their definition. Nevertheless they are necessities in classification; and even if they do not absolutely exist in nature, it becomes necessary, as by a sort of legal fiction, to presume that they do exist, for purposes of scientific arrangement. But the palæontologist has to deal with the element of time in addition to his other difficulties, and thus for him, far more than for the simple student of recent life, does it become necessary not to place too rigid a definition on "genus" and "species." There are occasions when we must dare to be illogical.

After describing some of the varieties of deposit, Prof. Seeley discusses the phenomena attendant upon Life, such as its succession in time, migration, the origin of faunas, extinction of species, homotaxis, &c., concluding with an account of the existing distribution of life, and the relations of living to fossil forms. Of the collateral subjects in this connexion he alludes to the climatal conditions of ancient seas, which he considers must rest on physical evidence. "Ice-scratched stones, glaciated rocks, and boulder-clay may prove conditions of great cold; but we are acquainted with no physical evidence that would demonstrate heat as a climatic condition of the earth." This may be so, but surely there exists biological evidence of temperature in the presence of reef-building corals, which now require an isochryme not lower than 69° F. Such an inference has been held legitimate by Prof. Dana, in common with most geologists; and it is certainly a singular coincidence that a life assemblage presenting some analogies with that of the Jurassic should, at the present day, be found in and about Australia, where reef-builders abound. Prof. Seeley is a bit of an iconoclast, and few things give him more pleasure than to upset, or try to upset, a prevalent belief. We say nothing about such a case as that of the Stonesfield mammals, for it is in dealing with the Mammalia that the most erroneous inferences as to climate have been drawn, as is very aptly pointed out by the author in the case of the mammalian remains of our valley-gravels.

Finally, we are presented with a brief abstract of the succession of life on the earth in geological time—not the least useful portion of the entire volume, and certainly the most suitable for a manual, since there is a great amount of condensed information well brought up to date, and less of the theoretical than elsewhere. The figures too are instructive and germane to the subject. It is almost unnecessary to add that the portion devoted to the Vertebrata is particularly good.

Many of the views which have been developed and perfected in the present work were originally brought forward by the author in the 'Annals.' From early days he gave evidence of a powerful and eminently original genius, and he has continued to develop on these lines until he has arrived at his present eminent position as a practical geologist and philosophic writer. We may confess to a suspicion that such a high-stepper is not best seen in the harness of a text-book: nevertheless the present work is full of instructive matter, whilst the philosophical spirit which it displays will doubtless charm many a reader. No one has shown more convincingly than the author that, in all ways, the past contains within itself the interpretation of the existing world—a truth which biologists should lay to heart. At the same time the geographer is taught to seek an explanation of existing phenomena in the physical revolutions (not necessarily catastrophes) of successive ages.

On a Method to be followed in Prehistoric Studies. [*Sur une Méthode à suivre dans les Etudes Préhistoriques.*] By Eugène van Overloop. 8vo. 114 pp., with three Maps. Brussels: Muquardt, Merzbach, and Falck, 1884.

In this interesting memoir, dedicated to the Anthropological Society of Brussels, the author insists upon the recognition of the natural surroundings of early man being highly necessary for a knowledge of his ways and habits, and quite indispensable, however much a study of his stone implements and their probable uses may help the inquirer. To this end he has applied himself to a careful examination of a special district, where such relics of prehistoric (or, as he prefers, "premetallic") people are abundant—namely, a part of Flanders to the east of the Terneuzen Canal (Canal de Terneuse).

The general flatness of this country and the complicated intersection of its streams and waterways have not hindered M. van Overloop in his work. Using the ordnance-survey or military map of the district (pl. i., on a scale of $\frac{1}{10000}$), to some extent, with its contour-lines and other indications of the existing condition of the country, the author has carefully examined this particular region (of about 4000 hectares), and mapped the higher grounds as distinct from the alluvial flats (pl. ii., scale $\frac{1}{10000}$), and marked the spots (always on one or other of the plateaus or patches of rising ground) where stone implements have been found. In this he has also judged for himself, by the consideration of natural features, geological characters, the modes of cultivation and occupation, and the run of former channels of the natural drainage, as recorded in old maps and histories. He has also carried his observations on the altered river-courses further to the south-west, and a portion of the national map (scale $\frac{1}{160000}$) is appended for reference. The actual condition of the fauna and flora, forests and marshes, dry land and rivers, wild beasts, birds, and fisheries of the district under notice in early historic times, as noticed in old writings, is detailed; and what was known of the former population by the Romans and others is carefully noted.

Such, then, constitute the data on which the author says that our ideas about primitive peoples can be formed, supplemented by what we can learn about the probable uses and applications of their stone implements, the sole actual memorials of those early men. M. van Overloop's suggested "method of study" is not new to archæologists; but it is here carried out with great care, and illustrated with precision, over a considerable tract of a very interesting country.

Annual Report and Proceedings of the Belfast Naturalists' Field-Club for 1883–4. (Twenty-first Year.) Ser. 2, vol. ii. part 4. 8vo. Pp. 215–258, with 18 plates: 1884. With Appendix VIII.: 1885. A. Mayne: Belfast.

Several pleasant and instructive excursions of the Club to places in the North of Ireland are duly recorded, and the proceedings of the Meetings during the Winter Session. At one of these evening meetings a valuable paper "On the Age of the Basalts of the North-east Atlantic," as deduced chiefly from a study of the fossil plants found associated with them, was read by J. S. Gardner, F.L.S., F.G.S., &c. (pp. 254–290, with a plate, illustrating *Taxus Swanstoni, Pinus Bailyi, P. plutonis, Tsuga Heerii, Cupressus Pritchardi,* and *Cryptomeria Sternbergi*). A meteorological summary for 1884 is given at pp. 293-296. An Appendix (No. VIII. of the series) contains Mr. A. C. Haliday's (1) Notes on Irish Coleoptera, edited by Mr. S. A. Stewart; (2) The Cromlechs of Antrim and Down, by Mr. W. Gray, containing valuable notes on the meaning of the word and on cromlechs generally, and on sixteen cromlechs in the County Antrim and fourteen in County Down; these, figured in fourteen sketches, fill seven plates; (3) Notes on the Prehistoric Monuments at Carrowmore, near Sligo; and the Battlefield of the Northern Moytura, by Mr. C. Elcock, illustrated by seven figures in four plates.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 19, 1884.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "Note on the resemblance of the Upper Molar Teeth of an Eocene Mammal (*Neoplagiaulax*, Lemoine) to those of *Tritylodon*." By Sir Richard Owen, K.C.B., F.R.S., F.G.S.

In this paper the author referred to the genus *Neoplagiaulax*, described by M. Lemoine from the Eocene of Rheims, as presenting premolars so like those of the Mesozoic genus *Plagiaulax* as to have suggested the above name, while the true molars in the upper jaw resembled those of his South-African genus *Tritylodon* even more nearly than those of *Microlestes* and *Stereognathus*, with which the latter were compared. The lower molars of *Neoplagiaulax* have only two, instead of three, longitudinal series of tubercles; and the author suggested that this may have been the case also in *Tritylodon*; and that the detached molars, on which the genus *Microlestes* is founded, may also belong to the lower jaw.

2. "On the Discovery in one of the Bone-caves of Creswell Crags of a portion of the Upper Jaw of *Elephas primigenius*, containing, *in situ*, the first and second Milk-molars (right side)." By A. T. Metcalfe, Esq., F.G.S.

The specimen exhibited to the Society and now described was obtained from one of the Creswell bone-caves before the commencement of their systematic exploration by a Committee of the British Association. The bone-caves are in the Lower Magnesian Limestone of the Permian, not far from the southern limit of that deposit near Nottingham. The locality was described, and it was shown that the ravine in which the caves occur has been cut in the limestone by the little river Wollen, which probably began by excavating a cavern the whole length of the ravine. The roof of this cavern must have fallen in, and the minor lateral caverns, in which bone-deposits are found, are now similarly being converted into side ravines.

The fossil was found in "Pin-Hole Cave," the most westerly on the north or Derbyshire side of the ravine, about 6 inches below the base of the surface-soil, here 4 inches deep. The cave has been described in the Society's Journal (vol. xxxi. p. 679), by Rev. J. M. Mello, who in 1875 obtained from this spot bones of the Arctic fox (*Canis lagopus*). As the particular mammoth teeth (first and second milk-molars of the upper jaw) occurring in the fossil were wanting in the National Collection, the author has undertaken to present the specimen to the British (Natural History) Museum.

3. "Notes on the Remains of *Elephas primigenius* from the Creswell Bone-cave." By Sir R. Owen, K.C.B., F.R.S., F.G.S., &c.

The author noticed the various descriptions by Cuvier and himself of milk-molars of *Elephas primigenius*, and pointed out that all hitherto known were found detached. The present is the first known occurrence of the two earliest milk-molars *in situ*. The specimen discovered by Mr. Metcalfe is a portion of the fore part of the maxilla of a very young Elephant with the teeth of the right side preserved, the corresponding teeth of the left side and their sockets having been broken away. Of the two teeth thus obtained descriptions and measurements were given. The first tooth is much worn, but only the anterior portion of the second has undergone wear, the two hindmost divisions of this tooth not having risen into use.

It is shown that these first teeth of *E. primigenius* differ much less from the corresponding milk-molars of the Indian Elephant than the later teeth do, the thickness of the constituent enamel-plates being but little less in proportion, and the principal distinction being the greater relative breadth of the second molar, especially towards the base of the crown.

4. "On the Stratigraphical Position of the Lower and Middle Jurassic *Trigoniæ* of North Oxfordshire and adjacent districts." By Edwin A. Walford, Esq., F.G.S.

The author spoke of the value of the *Trigoniæ* as stratigraphical guides and of the wealth of the Oolitic deposits of North Oxfordshire in number of species as well as of individual forms. He alluded to the recent discovery by Northampton geologists of *Trigonia literata** and *T. pulchella* in the centre of their county. By the presence of certain *Trigoniæ* as well as of corals and bored stones he endeavoured to prove the extension of a stratum at the base of the *Clypeus*-grit at Fawler, as far as Hook Norton, also in North Oxfordshire, where the bulk of the Inferior Oolite was of an altogether different type. In Mr. Walford's list were nearly thirty species and varieties from the Bajocian beds. To the lower horizons there belonged but one local form and no species of special stratigraphical value. The presence of a few other fossils supposed to be characteristic was the only evidence of beds below the zone of *Ammonites Murchisoniæ*. Series C, which appeared to be of the age of the lower *Trigonia*-grit, had yielded the greater part of the *Trigoniæ* mentioned, several of them being peculiar to the horizon, whilst others were local species. The higher beds had yielded some apparently undescribed forms, whilst hitherto unrecorded species were quoted from the Great Oolite and Forest Marble. One Oolitic species (*T. Lycettii*) was described as new.

December 3, 1884.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Lower Eocene Plant-beds of the Basaltic Formation of Ulster." By J. Starkie Gardner, Esq., F.G.S.

The paper commenced with a brief outline of the physical features of the basaltic area in Ireland. The beds whence plants have been obtained form a quadrilateral, the angles of which are Ballintoy, Glenarm, Ballypalady, and Lough Neagh. The Ballintoy beds are very incompletely explored, and have so far yielded few species. The Glenarm beds are situated in a disused mine, filled with water, which was drained by the author. The plants are well preserved in a matrix of white sandy clay. The Ballypalady plants are less

* The author subsequently came to the conclusion that this was a distinct species, which he has described under the name of *T. northamptonensis*.

perfectly impressed in a matrix of ochreous earth. Many of the plants are common to both; but Ballypalady possesses a whole group of conifers, including a cypress, yew, many pines and firs, not met with elsewhere; while Glenarm is richer in leafy trees. Among the plants in common are two which still exist, *Cryptomeria* and a peculiar *Pteris* with reticulated venation. Among extinct plants the presence of *Macclintockia* especially points to their age being the same as the Heersian flora of Gelinden in Belgium, a stage very low in the Eocene. The Lough-Neagh beds are estimated to be as much as 500 feet thick, and their flora shows them to be interbasaltic, and therefore Eocene instead of Pliocene as hitherto sometimes supposed. The great extent these beds formerly held is shown by the area over which silicified wood derived from them lies scattered. The basalts, here as elsewhere, have been enormously denuded; and the author believes that the horizon of the Mull leaf-bed is not anywhere present in Ireland. The Mull bed is regarded in this paper as probably of about the same age as the Woolwich and Reading series of the London Basin; it was deposited on the flat banks of a river liable to inundation; while the Irish beds are fluviatile, not lacustrine, with the probable exception of those of Lough Neagh, which may be lacustrine.

December 14, 1884.—W. Carruthers, Esq., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. "On the Recent Discovery of Pteraspidian Fish in the Upper Silurian Rocks of North America." By Prof. E. W. Claypole, B.A., B.Sc. Lond., F.G.S.

The fossils now described from Pennsylvania are the first authentic remains of fishes found in the Silurian rocks of America, and some of them are the oldest undoubted vertebrates yet discovered. Previously fish had not been detected in America below the Devonian Corniferous Limestone of Ohio, and the Lower Devonian of Canada.

The most important fish-remains hitherto known from beds of Silurian age are from the bone-bed of the Upper Ludlow rocks, one specimen, the oldest in Europe with the exception of Pander's doubtful Conodonts, having been recorded from the Lower Ludlow. The fossils now described are closely allied to the two Ludlow types and consist of the spines known as *Onchus*, and the shields referred to *Scaphaspis* and belonging to the peculiar family Pteraspidæ.

The author entered into a detailed comparison of the English Silurian Pteraspids as described by Professors Huxley and Ray Lankester, and those now discovered in America. He described the three layers of which the shields of the Pennsylvanian Pteraspids are composed, and proposed for their reception a new genus, *Palæaspis*. He considers the Pteraspidæ in which no bony structure has been detected, a distinct family from the Cephalaspidæ, which exhibit that structure.

He then proceeded to correlate the American beds yielding *Palæaspis* with the Ludlow beds of England. The American fish were chiefly found in the Bloomfield Sandstone at the top of the middle division or variegated shale of the fifth group of Rogers. This fifth group of the Pennsylvanian Survey immediately underlies the Water-lime, corresponding to the English Lower Ludlow, and has been shown by the writer to represent the Onondaga shale of New York. The position of the latter in the series is shown by the following sections taken from Prof. James Hall:—

New York.	Great Britain.
Lower Helderberg	Wanting.
Water-lime	Lesmahago beds.
Onondaga salt group	Wanting.
Niagara group	Wenlock Limestone.

The last two were considered representative by Sir R. Murchison, and this view has never been disputed.

It therefore appears that the Pennsylvanian Pteraspids from the Bloomfield Sandstone are older than *Scaphaspis ludensis* of the Lower Ludlow by the time required for the deposition of 200 feet of strata. But 1000 feet below the horizon just named comminuted fish-scales are found in beds containing *Leperditia alta*; and again, 700 feet lower, in the iron sandstone near the middle of the Clinton group, which corresponds to the English Upper Llandovery beds; and 200 feet below the Ore Sand-rock, broken plates, with the superficial striation of *Palæaspis* and a few fine spines of *Onchus* (described as *O. Clintoni*) are met with. The horizon is well defined, for the Ore Sand-rock contains *Beyrichia lata*, *Calymene Clintoni*, *Ormoceras vertebratum*, and other characteristic fossils. The iron sandstone also contains white pellets, apparently of coprolitic origin, and containing 32 per cent. of phosphate of lime.

Previously reported discoveries of fish in American Silurian rocks were discussed, and their supposed age shown to be erroneous. The paper concluded with the description of two species of *Palæaspis* (*P. americana* and *P. bitruncata*), of *Onchus pennsylvanicus* from the Bloomfield Sandstone, Onondaga group, and of *Onchus Clintoni* from the iron sandstone of the Clinton group.

2. "Notes on species of *Phyllopora* and *Thamnis us* from the Lower Silurian Rocks, near Welshpool, Wales." By George Robert Vine, Esq. (Communicated by Prof. P. Martin Duncan, F.R.S., F.G.S.)

In this paper a species of *Phyllopora* from the Caradoc beds of Wern-y-scadog, Llanfyllin, was described as *P. tumida*, and a *Thamniscus* from the volcanic ash of Middleton Hill, near Welshpool, probably of Bala age, as *T. antiquus*, both from a collection sent by Mr. J. B. Morgan, of Welshpool, to Prof. Lapworth for identification. A list of the species of *Phyllopora*, hitherto described from Lower-Silurian beds, and of both Upper and Lower Silurian forms of *Thamniscus*, was added, and the relations of the various known species to those described in the present paper were discussed at some length.

January 28, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On some new or imperfectly known Madreporaria from the Great Oolite of the Counties of Oxford, Gloucester, and Somerset." By R. F. Tomes, Esq., F.G.S.

The main object of the present paper, which is supplementary to one already published in the Quarterly Journal (vol. xxxix. p. 168), was to describe a section of the Great Oolite at Milton, in Oxfordshire, another at the Lime-kiln quarry near Cirencester, and some outcrops of the same beds in the neighbourhood of Bath, on Farley Down, Combe Down, and Hampton Down, the localities from which so many of the types of corals described by MM. Milne-Edwards and Haime had been derived. Lists of the corals obtained from particular beds in each of the sections mentioned were given, and several of these corals were described as new, remarks being appended as to a few previously described forms. In conclusion, a brief description was added of the conditions under which the coralliferous deposits in the neighbourhood of Bath had been formed, and of their probable correlation with the Great-Oolite strata of Oxfordshire.

MISCELLANEOUS.

On a new Genus of the Family Sarcopsyllidæ. By Wladimir Schimkewitsch.

In the month of May 1884, N. A. Majew sent me from Turkestan a considerable number of specimens of a still undescribed flea, which attaches itself, after the fashion of a mite, to the bodies of cattle, and causes an exceedingly serious injury to the herds feeding in the mountain-valleys of the Tjan-Schan. The statements published in the Turkestan journals, and likewise communicated to me by Majew, run as follows:—The distribution of this parasite is confined to the valleys of the Tjan-Schan and the Baissaur mountains (the source of the river Tschilika). It also frequently occurs in Taschkent and Tsischgent, upon cattle driven there for sale. The parasite appears in the autumn, when snow is already lying upon the mountains, and it is to be observed in the greatest abundance during severe frosts. This flea is parasitic upon horses, sheep, camels, and horned cattle, in which it produces great debilitation of the organisms, and in the young animals even death. The Kirgise name it *Alakurt*, *i. e.* motley worm or motley insect, for originally the *Alakurt* is nearly black in colour, but when distended it becomes white with variegated bands.

The examination of this parasite convinced me that it belongs to the family Sarcopsyllidæ, forming a new genus of that family. In consideration of the worm-like form of the body of a distended parasite I propose to name it *Vermipsylla*, and for a specific name I let its local denomination, *Alakurt*, stand. All the specimens of *Vermipsylla Alakurt* that I have received prove to be females, from which we may conclude that the males do not attach themselves to the bodies of the cattle and become distended. Even the manner of the distention exactly resembles that of *Rhynchopsylla pulex*—that is to say the chitinous rings of the abdomen separate from each other, during which they retain their proper distribution, but no longer touch one another, while at the same time the subchitinous membrane situated beneath the chitinous scales of the abdomen becomes extended.

I now pass to a brief description of this form. The length of the strongly distended female attains 6 millim. The colour of the head and thorax and of the abdominal rings is dark brown; the subchitinous membrane is milk-white. The head is of considerable size; it is rounded off on the dorsal surface, and slopes strongly from behind forward. The antennal pit is situated nearly in the middle of the head, and the eyes, which are pretty large, are situated in the anterior half of the head near its inferior margin (compare *Rhynchopsylla*). The maxillæ have the form of triangular lancet-like plates, pointed in front, but the apex is not bent backwards, as is the case in *Rhynchopsylla*.

The formula of the maxillary palpi is 3 : 1 : 2 : 4. In the organization of the labium *Vermipsylla* deviates from both the families of Aphaniptera. The palpiform parts of the labium are divided into false joints of uncertain number, varying between eleven and fourteen. Each false joint bears at its anterior extremity a pair of minute hairs, of which the outer one is much more developed. The basal joint, which is much longer, bears on each side a pair of equally developed hairs; and the terminal joint, which is also longer, bears two tufts of short blunt setæ. The upper edge of the tongue is quite smooth. The mandibles have at the extremity only two claw-like teeth, which are directed outwards. The mandibles, labium, and tongue are of equal length, and more than twice as long as the maxillary palpi. The second joint of the antennæ has a cup-like form, and bears at its outer margin (in the position of rest) a row of very long hairs which entirely cover the third joint. This latter has no emarginations, but it has some folds. The anterior margin of the antennal pit is thickened, but the row of hairs is deficient on the posterior margin. The pronotum is very feebly developed, the mesonotum is rather longer, and the metanotum exceeds in length both the preceding taken together.

In the organization of the pleuræ and of the wing-like scales of the metathorax no particular deviations from the typical forms are to be observed. The formula of the tarsus of the anterior legs is 4 : 3 : 1 : 2 : 5; that of the intermediate legs is the same; in the posterior tarsi the formula is 4 : 3 : 2 : 1 : 5.

The coxæ of the intermediate legs are more developed than those of the anterior pair, and those of the posterior legs are still more developed. Between the metanotum and the dorsal plate of the first abdominal segment there is a quadrangular chitinous plate without hairs, which may perhaps represent the rudiment of an additional abdominal segment. The first abdominal segment is represented by a quadrangular dorsal plate. Every following segment, from the second to the seventh inclusive, consists of a dorsal plate, the lower margins of which extend backward in a wing-like process, and of two ventral plates, which are united in the middle line. The ventral plates are crescentiform, with the convex margin directed forward.

On the second segment the ventral plates are nearly quadrangular. The eighth segment has no dorsal plate, and is represented only by two ventral plates, which are of much more considerable size than the preceding ones, and these are separated from each other below. These plates are also crescentiform, with the convexity directed downwards. On the anterior branch of the crescent is placed the stigma of the eighth segment, and on the posterior one an oval surface, which is densely clothed with hairs. The ninth segment is represented by a dorsal plate, the anterior part of which bears a surface covered with very minute hairs, which stand upon specially circumscribed clear spots; the hinder part of this plate is entirely without hairs.

There are also belonging to the ninth segment two ventral quadrangular plates soldered together in the middle line, and these are covered with small hairs. The anus is situated in the eighth segment in front of its ventral plates.

In the distribution of the stigmata we observe no deviation, except in the case of the stigma of the eighth segment. Two pairs of small stigmata are placed upon the pro- and mesothorax, one pair of similar small stigmata upon the ventral plates of the eighth segment. Upon the wing-like scales of the metathorax and upon the anterior lower angles of the dorsal plates of segments 2–7 of the abdomen there are stigmata of considerable size beset with small hairs at the margins.

With respect to the clothing of hairs and setæ the following is to be remarked. On the lower surface of the head there are no spines, and the crest of spines on the pronotum is also deficient. On the head the hairs are situated in front of the eyes and behind the antennal pits. On each side of the mouth there is a seta, which exceeds the maxillæ in length. On the dorsal plates of the thorax and abdomen the clothing is as follows:—The posterior hairs, which are much longer, are distributed in regular rows, and the anterior hairs, which are of smaller size, are scattered without any particular order. A similar distribution is to be observed upon the ventral plates of the ninth segment. On the other ventral plates the little hairs show no particular arrangement, and the ventral plates of the second segment are quite without hairs. The superior extremities of the pleuræ of the meso- and metathorax, as also the wing-like scales, are clothed with hairs, arranged upon the pleuræ in two, upon the scales in three rows. Further, the unpigmented cuticle of the abdomen is covered with transversely arranged rows of the smallest possible hairs. The coxæ of the first pair of legs are covered with hairs only in front, as also the coxæ of the other legs. The trochanter, the femur, the tibiæ, and the tarsus have their whole surface covered with little hairs. Much larger hairs are to be noticed at the anterior lower angle of the coxæ and trochanter in each leg. The femora have at their hinder angles two curved setæ. In the distribution of the spines upon the tibiæ and tarsi no deviations are to be remarked.—*Zoologischer Anzeiger*, February 9, 1885, p. 75.

Completion of the History of Chaitophorus aceris, *Fabricius.* By M. J. Lichtenstein.

In the 'Comptes Rendus' of the 17th June, 1867, MM. Balbiani and Signoret gave the history of the brown Aphis of the maple. These observers traced only half the biological evolution of the insect; M. Ritzema of Leyden, and Mr. Buckton in England, have added some details to those furnished by the French naturalists; and I can now give the complete series of the curious metamorphoses of this animal.

The ova of *Chaitophorus aceris,* concealed during the winter beneath the buds or in the fissures of the bark of the maple (here *Acer monspessulanum*, Linn.), are hatched in the early days of March: they furnish an apterous false female or *pseudogyne*, which, without concourse with the male sex, and after four moults at six days' intervals, or in from twenty to twenty-five days, brings forth some young Aphides, a portion of which acquire wings, and which spread for longer or shorter distances, according to their powers of locomotion, over the maples of the neighbourhood. This second phase, to which I have given the name of the *emigrant pseudogyne*, is agamic like that which preceded it, undergoes, like it, four changes of skin, and produces not only two, but three different forms of Aphides—one like itself, the second furnished with long hairs, and the third adorned with leaflets around its periphery.

All this has been told by MM. Balbiani and Signoret, at least in part, for it is especially to these latter forms that they paid attention. They say that they could not trace them further, and inquire what may be the significance of these abnormal individuals of *Aphis aceris* deprived of the faculty of reproduction.

Applying to these insects my theory of the biological evolution of the Aphides, this third phase must also be a *pseudogyne*, and by following it patiently I could not but succeed in obtaining sexual individuals. This has been the case, but not so quickly as I expected.

At first the Aphides, which resembled their progenitor, increased in size normally; in twenty days they produced broods of embryos furnished with long hairs, exactly like those which I had obtained in the preceding brood. The forms with leaflets, observed by the entomologists of Paris and the north, were wanting here at Montpellier, upon the maple that I observed. But after the end of May or the first days of June, all the normal forms had disappeared, and I had left only embryos collected in groups upon the leaves, as figured by Réaumur in the third volume of his 'Mémoires.'

June, July, and August passed without my nurselings increasing in size or moving; at the beginning of September the leaves began to fall, which became troublesome in the pursuit of my observations. Fortunately I observed that when the fallen leaf ceased to furnish them with nourishment, my little animals were well able to quit it and seek their fortune elsewhere. I profited by this observation to transfer these embryos from a yellow to a green leaf, fastening with a pin the withered leaf to the fresh one. In a few hours all my Aphides were attached to the latter.

By this means I had the pleasure, on the 12th September, of seeing the skin of these hairy embryos split and again furnish me with an Aphis of normal form and of a uniform light yellow colour, which grew very quickly, and began, in the first days of October, to produce young of different dimensions. Smaller and more elongated than any of their predecessors, these insects, which were at first green, but afterwards became blackish brown, ran over the branches of the maple, and showed that I had before me the two sexes, for the copulations were frequent, the same male evidently fecundating several females.

But this is not all. Pushing polymorphism to the extreme point, I saw among numerous apterous males some which were winged, and just as we have seen the second phase composed of *emigrant pseudogynes* partly winged and partly apterous, we witness here a production of apterous males to fecundate the females upon the same tree, and of winged males which can go to a distance in search of females which have fallen down or the wind has carried away.

Soon after copulation the female deposits her ova under the buds or in the fissures of the bark of the maples; they are at first light yellow, but soon become bright shining black. These are the ova which hatch in the spring and furnish the *foundress pseudogyne* of the colony.—*Comptes Rendus*, November 10, 1884, p. 819.

Urnatella gracilis.

Prof. Leidy remarked that Mr. E. Potts had given to him, in

October 1883, a fragment of a tree-branch on which were many groups of *Urnatella*. The fragment, 3 inches by $\frac{1}{3}$ of an inch, was obtained in the fore bay at Fairmount. Around its middle, for about an inch in length, there were thirty separate groups of *Urnatella*, in nearly all consisting each of two stems, of unequal length, and devoid of terminal polyps. The stems diverged and curved downward and were quiescent, but were evidently living, as they exhibited slight sensitiveness to disturbance. The specimen was placed in an aquarium, exposed to the north light of a window, and in this position, at the moderate temperature of usual living-rooms, was kept during the winter. In March, the stems were observed all to have developed polyps at the distal end, in which condition they continue at the present time (April). Most stems are terminated by a single polyp, but a few exhibit a smaller polyp, supported on a cylindrical joint springing from the antepenultimate joint of the stem, including the terminal polyp. The stems are quite irritable and bend in graceful curves from each other on the slightest disturbance. The longer stems even hang their heads in a single spiral turn. The longest stems consist of a dozen joints and measure about one eighth of an inch. The shortest stems exhibit one third the number of joints. The stems appear alternately white and black, the former colour corresponding with the thicker portion of the joints, the latter with the constricted portions. Many of the mature joints exhibit traces of the cup-like remains of attachment of branches, in most cases on one side only.

These specimens appear to indicate that, as in the other freshwater Polyzoa, the polyps die on the approach of winter; but the headless stems appear to remain, securely anchored, and ready to reproduce the polyps in the spring. If portions of the stem are destroyed, the remaining joints are capable of reproducing the polyps, commonly from the summit of the terminal joint. Branches usually spring from the last one or two joints, newly produced from that which immediately supports the terminal polyp. Specimens also show that heads may start laterally from old or mature joints. Thus the latter appear to serve as the statoblasts of other freshwater Polyzoa, but ordinarily they do not become isolated from one another. As no specimens have been seen with stems consisting of more than a dozen joints, perhaps, after reaching this condition, the polyps become detached, to establish new groups.—*Proc. Acad. Nat. Sci. Philad.*, Nov. 18, 1884, p. 282.

Note on the Intelligence of a Cricket parasitized by a Gordius.

Dr. Henry C. McCook said that some remarks upon the habits of the cricket published by him had called forth an interesting communication from Mrs. C. W. Conger, of Groton, New York, the substance of which is as follows:—

"Some twenty-four years ago my husband and myself took possession of a large old frame house on a farm which was a homestead for the largest, blackest, and most musical of the cricket kind. Early in the fall I began to be annoyed by finding one or more hair-snakes in the water-pail. Though I knew that there positively was nothing of the kind in the pail when it came in, yet a few minutes or an hour generally provided us with a more or less lively specimen. I had a horror of them, because of the dread lest the children should imbibe one with their frequent nips of the water; so I sat down one warm afternoon to watch the pail, to try to learn how the snakes came. In about ten minutes I saw a particularly plethoric cricket mount upon the edge of the pail, and, after some uneasy movements, bring the tip of the abdomen just beneath the water, and, with a few violent throes, expel a black mass, which fell slowly through the water and before it reached the bottom resolved itself into one of the worms. The cricket seemed exhausted by the horrid birth, and did not find strength to draw itself up on the edge of the pail for about eight minutes, and when it finally did so it tumbled to the floor and crawled off in a very rheumatic manner. After this discovery we used to amuse leisure hours by watching like operations until frost killed the crickets. I sometimes would crush large crickets, generally with the result that a tightly-coiled snake would be thrust out of a rupture just above the tip of the abdomen; but, whether the snake was not sufficiently developed, or because of its needing water rather than air to vitalize it, none of the snakes so produced showed any signs of life."

The water-snake alluded to is, of course, a species of our common *Gordius*, the same probably as that described, a number of years ago, by our distinguished President, Prof. Jos. Leidy. The fact that this animal is parasitic within the grasshopper the speaker had himself observed; it has been said also to be parasitic within spiders, and doubtless has for its host many of the Orthopterous genera. The point of greatest interest in the letter, Dr. McCook thought, is the fact that the crickets had evidently learned that the parasite infesting them required the water in order to make its egress, and had deliberately sought the suitable place and assumed the proper position (by inserting the abdomen beneath the surface of the water) necessary to insure that egress. It is a curious psychological question, How did the cricket obtain this knowledge? And the knowledge having been obtained, the cricket's subsequent behaviour presents an interesting fact in the study of insect intelligence.—*Proc. Acad. Nat. Sci. Philad.*, Nov. 25, 1884, p. 293.

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XXIV.—*Further Remarks upon the Morphology of the Blastoidea.* By P. HERBERT CARPENTER, D.Sc., Assistant Master at Eton College.

IN a short paper * that appeared in the 'Annals' rather more than three years ago, I discussed some of the theories respecting Blastoid morphology which had been recently enunciated by certain American palæontologists, and more especially by Mr. G. Hambach, of St. Louis †. I was led to speak a little strongly upon the subject, because it appeared to me that some of the theories in question could not have been put forward by any one who had even an elementary knowledge of the morphology of recent Echinoderms, and that they were of a kind which would hinder rather than advance the progress of scientific knowledge. In the following pages I shall attempt to show that this opinion was justified.

I have the strongest conviction that the would-be interpreter of extinct fossil forms starts at a very serious disadvantage if he does not commence by obtaining the best possible information about the morphology of their nearest living representatives. In order to understand, even with an approximate degree of correctness, extinct groups, such as the Blastoids, Merostomata, Dinosauria, and others, a far more

* "On certain Points in the Morphology of the Blastoidea," Ann. & Mag. Nat. Hist. ser. 5, vol. viii. 1881, pp. 418–424.

† "Contribution to the Anatomy of the Genus *Pentremites*, with Descriptions of new Species," Trans. St. Louis Acad. Sci. vol. iv. no. 1, 1881, pp. 145–160, pls. A and B.

extensive acquaintance with the recent members of the same subkingdom is necessary, than for the interpretation of fossil Brachiopoda, sponges, corals, Mollusca, and fishes, the morphology of which cannot have differed in any important respect from that of the recent species. Without such a preliminary study no collector, however zealous, can hope to arrive at any rational conclusion about the functions of the different structures which he may discover by the careful examination of his fossils.

We have been told, for example, how it is evident from simple inspection that the valvular orifice of the Palæocrinoidea is the mouth, and altogether disconnected from the radial system of water-vessels; that the calcareous "supplemental pore-plates" described by Römer on the ambulacra of *Pentremites* are the remains of collapsed soft and membranaceous tentacles, such as occupy the pores of the ambulacral field in Echinoderms; and that these tentacles communicated not with a single median water-vessel, as in other Echinoderms, but with the hydrospire-apparatus placed at the sides of the ambulacra *.

No educated palæontologist believes the first of these assertions, which have been put forward, not as expressions of individual opinion, but as positive facts; and I am convinced that the other two are equally untrue, as I shall endeavour to show subsequently. I merely adduce them here as instances of the errors which I believe to be due to an insufficient knowledge of the morphology of recent types.

I endeavoured in my previous paper to distinguish between the observations which Mr. Hambach had recorded and the conclusions which he had permitted himself to draw from them. Many of the former I have been able to confirm; from most of the latter I entirely dissent. In a reply to my criticisms, which he has recently published †, he says, "Mr. Carpenter not only expresses great doubts as to the correctness of my statements, but has the assurance to refer the results of my observations to a 'wonderful power of imagination.'" I freely admit the use of this last expression, not, however, in reference to the result of any *observation*, which would be impossible from the nature of the case (as Mr. Hambach has never seen a living Blastoid), but to one particular theory which he has still further developed in his recent paper, viz. the supposed "collapse" of the tentacles into limestone plates ‡.

* See the woodcut, *infrà*, p. 293.

† "Notes about the Structure and Classification of the *Pentremites*," Trans. St. Louis Acad. Sci. vol. iv. no. 3, 1884, pp. 537–547.

‡ See p. 292, *infrà*.

So far was I from disputing the general accuracy of his observations, that I spoke of being "able to give a general confirmation to his results;" of being "inclined to think that he is right;" of one of his figures being "in some points more correct than any which has yet been published;" of his "valuable observations," &c. It will be seen therefore that the points in which we differ are not so much facts of observation, as the interpretation of those facts and the inferences which we have respectively drawn from them. In many cases, if Mr. Hambach will pardon me for saying so, his style is so involved and his terminology so loosely applied that his meaning is not a little obscure *; and though the subject is not unfamiliar to me, I have frequently had considerable difficulty in understanding his descriptions. The consequence has been that in one case, when I put my difficulty into the form of a question and asked for information, the answer has been a charge of trying to misrepresent his statements.

With all due deference to Mr. Hambach, I must still decline to believe in the existence of the zigzag plated integument, which he describes as covering the whole ambulacral field, and as "probably of an elastic nature during the lifetime of the animal" †. What I said in 1881 I say again, viz. that the supposed integument is nothing but a surface-marking of the calcareous plates. According to Mr. Hambach ‡, however, "Likewise is the zigzag plated integument preserved which covers the ambulacral field, incredible as this may seem to Mr. Carpenter, whose incredulity, however, is no evidence to the contrary. . . . . The ambulacral field which is marked ϵ in Römer's fig. 2 on pl. I. of his 'Monographie der Blastoideen' indicates the existence of a layer or integument covering the same (although not described as such). The sutures, or at least the longitudinal sutures between lancet and foral pieces (*sic*) would be visible if it was only a surface ornamentation of the calcareous shell, as supposed by Mr. Carpenter."

I can see nothing in this figure of Römer's to justify the inference which Mr. Hambach draws from it. The ambulacral field is crossed by a series of parallel lines which are the expression of the transverse ridges and furrows on the surface of the lancet piece. The ridges correspond in position with the pore-plates at its edge, and the intervening furrows with the sutures between the pore-plates. This was well

* The reader will be able to judge of this for himself from the various extracts from Mr. Hambach's writings which are quoted further on.

† Trans. St. Louis Acad. vol. iv. p. 150.

‡ *Ibid.* p. 539.

described by Römer*, who expressly stated that the sutures between the pore-plates and the lancet plate only become visible when the surface of the ambulacral field has undergone a certain amount of weathering. This explains the absence of the suture in the "entirely well preserved specimens" mentioned by Mr. Hambach. His dictum that the sutures would be visible if the markings in question were only surface-ornamentation, will not accord with the experience of those palæontologists who are continually obliged to rub away the surface-ornamentation on the bodies of Crinoids and Urchins in order to see the sutures between the plates. Mr. Hambach attempts to prove the correctness of his assertion respecting the preservation of an elastic integument covering the ambulacra by the following argument †, which I quote in full, in the hope that others may be able to understand it better than I can:—"Or, how would Mr. Carpenter explain the presence of those large and strange bodies in the interior of the calyx, which are frequently found in *entirely perfect* and *undisturbed bodies*, if the acute points of the integument were not flexible? Such and similar specimens, I should think, would afford sufficient proof of the correctness of my assertion."

It will be remembered that in Mr. Hambach's first paper‡ he made the somewhat comprehensive statement that the central summit-opening of the *Pentremites* "was never closed by additional plates, as intimated by some authors." The existence of a group of minute plates in this position had been described and in some cases figured by Owen and Shumard§, Billings||, C. A. White¶, Meek and Worthen**, and

* 'Monographie der fossilen Crinoiden-Familie der Blastoideen, und der Gattung *Pentatrematites* im besondern' (Berlin, 1852), pp. 13, 14.

† Trans. St. Louis Acad. vol. iv. p. 540.

‡ *Ibid.* p. 150.

§ "Descriptions of one new Genus and twenty-two new Species of Crinoidea from the Subcarboniferous Limestone of Iowa," Report Geol. Survey of Wisconsin, Iowa, and Minnesota, 1852, p. 592. See also B. F. Shumard, "Descriptions of new Species of Blastoidea from the Palæozoic Rocks of the Western States, with some Observations on the Structure of the Summit of the Genus *Pentremites*," Trans. St. Louis Acad. Sci. vol. i. 1858, p. 243, pl. ix. fig. 4; and likewise Palæontological Report to Swallow's First and Second Ann. Reports Geol. Survey, Missouri, 1855, p. 186, pl. B. fig. 1 *c*.

|| "Notes on the Structure of the Crinoidea, Cystidea, and Blastoidea," Ann. & Mag. Nat. Hist. ser. 4, vol. v. 1870, p. 265.

¶ "Observations on the Summit Structure of *Pentremites*, the Structure and Arrangement of certain Parts of Crinoids, and Descriptions of new Species from the Carboniferous Rocks at Burlington, Iowa," Boston Journ. Nat. Hist. vol. vii. 1862, pp. 481–488.

** 'Palæontology of Illinois,' vol. v. 1873, p. 466, pl. ix. figs. 2 *a*, 5.

by Wachsmuth and Springer *, all of them skilled palæontologists and of acknowledged ability as accurate observers. Mr. Hambach's reasons for denying the existence of the summit-plates described by these authors were partly theoretical and based upon the supposed resemblance of *Pentremites* to "*Echinoderms*," by which he apparently meant the Echinoidea. He has replied to my criticism of his views, which he has elaborated somewhat more fully than before. I propose to discuss them further on, and will only remark at present that theoretical morphology is not a very safe guide as regards questions of fact †.

Mr. Hambach's second argument against the existence of these summit-plates was founded upon the fact that he possesses specimens in which the supposed plates "prove to be *Bryozoa* or ovulum-like bodies" ‡. He now explains § that the last expression had reference to the oolitic character of the rock in which the *Pentremites* were imbedded, and he totally denies the accuracy of Shumard's figure of a *Pentremites conoideus* ‖ in which the central opening is closed by a group of six plates, a central one and five others disposed interradially around it. Is he prepared in like manner to question the accuracy of Römer's description and figure of the summit of *Elæacrinus Verneuili* ¶, in which there is a central hexagonal plate surrounded by six others, two of which are in the anal interradius and one in each of the remaining interradii? He admits that "the condition of life was undoubtedly a similar one throughout the whole class" of the Blastoidea**; and as he totally denies the existence of summit-plates in *Pentremites*, he is bound to give some explanation of those described by Römer in *Elæacrinus*. Are they ovulum-like bodies, Bryozoa, or what? I have myself examined a good many specimens of *Elæacrinus*, and am convinced that Römer's description is correct and that the

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See also "Remarks on the Blastoidea, with Descriptions of new Species," Proc. Acad. Nat. Sci. Philad. 1869, pp. 84, 85.

* "Revision of the Palæocrinoidea, Part II.," Proc. Acad. Nat. Sci. Philad. 1881, p. 207, pl. xix. fig. 3.

† A good illustration of this is the nervous nature of the axial cords of a Crinoid, which is now generally admitted, although it has been strenuously denied on theoretical grounds, because there was no place for it in the established archetype of an Echinoderm.

‡ Trans. St. Louis Acad. vol. iv. p. 150.

§ *Ibid.* p. 541.

‖ *Ibid.* vol. i. pl. ix. fig. 4.

¶ *Op. cit.* p. 58, Taf. v. figs. 1 *b*, 1 *e*.

** Trans. St. Louis Acad. vol. iv. p. 547.

summit-plates are an integral part of the organization of a Blastoid.

Not content with impugning the accuracy of Shumard's figure of *Pentremites conoideus*, Mr. Hambach now asserts that "Shumard's original specimen of *Pentremites Sayi* *, which was figured by F. B. Meek and is now in the collection of the Washington University, proves to have only a covering of minute calc-spar crystals on the summit, leavings of the surrounding matrix, which could easily be removed by applying a moist camel's-hair brush to them." Not having seen Shumard's specimen, I can offer no opinion as to the respective merits of the descriptions of it which have been given by him and by Mr. Hambach. But I have carefully examined several examples of this species with the summit closed, and the covering of the central opening does not consist in any case either of "leavings from the surrounding matrix," "ovulum-like bodies," or Bryozoa. *Granatocrinus Norwoodi* and *Orophocrinus stelliformis* occur in the same formation (the Burlington Limestone †), and in both of them a group of summit-plates has been described and figured by Messrs. Meek and Worthen ‡. I have seen it in both these species, and have not the smallest doubt that the structure in question is a natural covering and not a merely accidental one. I do not dispute that there may be Bryozoa, ovulum-like bodies, or any other accidental coverings on the specimens which Mr. Hambach has seen; but it is scarcely logical for him on the strength of these observations to make the somewhat sweeping assertion that the central opening was *never* closed by additional plates. Theory counts for nothing in such a case; while the observations of Römer and of the best American palæontologists are directly at variance with Hambach's dictum.

Mr. Hambach § also tells us that his reason for not mentioning the covering of the ambulacral furrows of the Blastoids was "that I always found them in such a form or condition as to make on me the impression that they were mere accidental coverings, nor did I see any good reason for their presence;" and he goes on to say that his specimens "prove

* Geol. Surv. Missouri, 1855, pl. B. fig. 1 *c*.

† *G. Norwoodi* and *Schizoblastus* (*Pentremites*) *Sayi* occur in the upper division and *O. stelliformis* in the lower division of this limestone.

‡ 'Palæontology of Illinois,' vol. v. p. 466, pl. ix. figs. 2 *a*, 5; and Proc. Phil. Acad. 1869, pp. 84, 85.

§ Trans. St. Louis Acad. vol. iv. p. 540.

that the covering consists only of fragments of broken-up pinnulæ, which were washed into the ambulacral furrows and remained there." This is quite possible; but it is no argument whatever against the existence of these covering-plates in other specimens in the form of a double series of minute alternating pieces, as described by Meek and Worthen*. The covering is not often preserved, but I have seen it in a few individuals of *Granatocrinus Norwoodi* and of *Orophocrinus stelliformis*, and best of all in a fine example of *Pentremites sulcatus* kindly lent me by Mr. Wachsmuth. In this specimen, which is more than usually well preserved, there are no openings on the summit at all, for it is covered by a large number of plates in an irregular group. Minute pentagonal plates gradually differentiate themselves in the re-entering radial angles of this covering, and extend downwards on to the ambulacra in an alternating double row, which roofs in the food-groove as completely as do the covering-plates on a pinnule of the recent *Pentacrinus asteria* or of any Palæocrinoid. The form of the plates is so regular, and the manner in which their apices interlock is so very marked, that there can be no question about their being in their natural position, and not of merely accidental occurrence. I cannot therefore agree with Mr. Hambach in the inference which he draws from the specimens which he has examined, with respect to the unimportance of these plates.

Mr. Hambach's exposition of his views respecting the morphology of the Blastoidea is supplemented by "a few words about the proposed new classification of Mr. Carpenter. He says, 'The basis of the classification which we have been led to adopt is the morphology of the hydrospires and of their external openings, the so-called spiracles,' etc. The general rule which governs the classification of our fossil Echinodermata is the difference in the number and composition of pieces forming the exoskeleton. But, contrary to this rule, Mr. Carpenter considers the hydrospires as very characteristic and of much systematic value, although I believe he agrees with Billings in considering them respiratory organs."†

In the expressive language of Mr. Hambach the word "etc." stands for the following sentence:—"We find that the structure and distribution of these organs, together with the arrangement of the various elements composing

* Proc. Philad. Acad. 1869, p. 85.

† Trans. St. Louis Acad. vol. iv. p. 543.

the ambulacra, present characters of much systematic value" *.

Now in the first place I never said that I consider the hydrospires as very characteristic or of much systematic value; and secondly, even if I had said so, I do not see how the fact of their being respiratory organs can in any way affect the merits of a classification which is *partially* based upon their structure and distribution. It is at any rate better than one which depends upon "the number and composition of pieces forming the exoskeleton" of a *Pentremites*; for this number is always the same, as Mr. Hambach admits†. He appears to ignore the fact that other genera ‡ of Blastoidea have been established besides *Pentremites*, *Codaster*, and *Orophocrinus* §; and he entirely forgets that while Mr. Etheridge and myself were writing about the classification of *all* the Blastoids his remarks are simply entitled "Notes about the Structure and Classification of the *Pentremites*." But even with this restriction I am at a loss to know how Mr. Hambach can follow his own rule and classify the various types which have been described under the generic name *Pentremites* by the number and composition of the pieces forming their exoskeleton. For he says ‖:—"The exoskeleton, *i. e.* the calcareous parts forming the calyx, as also the relative position of each, is the same in all *Pentremites* as well as in those recently separated from them (whether they are of a globose, truncate or clavate form, with small or broad ambulacral fields), and is certainly of far greater importance than the mere softer interior organs, to which belong the hydrospiric sac and other vessels. The calcareous portion of the ambulacral field consists only of lancet pieces and poral pieces."

Thus, then, every so-called *Pentremites* has the same number of basals, radials, deltoids, and lancet pieces; and as Mr. Hambach does not believe in the existence either of the summit-plates or of the covering-plates to the ambulacra, I

* R. Etheridge, Jun., and P. H. Carpenter, "On certain Points in the Morphology of the Blastoidea, with Descriptions of some new Genera and Species," Ann. & Mag. Nat. Hist. ser. 5, vol. ix. 1882, p. 214.

† Trans. St. Louis Acad. vol. iv. p. 547.

‡ These are *Elæacrinus*, *Eleutherocrinus*, *Astrocrinus*, and *Stephanocrinus*, besides those proposed by Mr. R. Etheridge, Jun., and myself, to some of which Mr. Hambach takes exception.

§ Mr. Hambach still persists in calling this type *Codonites*, "contrary to" the recognized rules of priority in zoological nomenclature. In this respect he has much to learn from his countrymen Messrs. Wachsmuth and Springer.

‖ Trans. St. Louis Acad. vol. iv. p. 547.

do not understand what numerical difference he does take into account in his classification of the *Pentremites*, unless it be the difference in the number of pore-plates in the ambulacra, a most unreliable character, as every Echinoderm student is aware. If the bodies of all *Pentremites* have the same number of plates arranged in the same relative positions, what are the characters of the exoskeleton which render it of such great importance in classification as Mr. Hambach asserts?

I am also at a loss to know how differences in the "composition" of the plates can be of any classificatory value, as stated in "the general rule which governs" Mr. Hambach's classification of the fossil Echinoderms; for I have always imagined that these plates consist principally of carbonate of lime, and are therefore of a tolerably uniform composition. Perhaps Mr. Hambach will say that I am misrepresenting him, and that he did not use the word "composition" in its chemical sense. But it would be desirable to know what meaning he does attach to it in the general rule already referred to. I do not imagine that he can have employed it as denoting the relative shapes and sizes of the calycular plates. For he tells us * that "it is arbitrary and without any good reason to form of a certain number of species a new genus (see Carpenter, *loc. cit.*) because their base plates are small and depressed or elongated, or having a narrow, short or long sinus in the fork pieces, which, if such is the case, must necessarily give a different aspect to the individual, and cause them to be respectively either globose, elliptical, pyriform, or clavate, which forms are met with in both those having a broad or narrow ambulacral field. The number of hydrospiric plicas can hardly be of any consequence, as shown above."

It may be well to state here that in speaking of the structure and distribution of the hydrospires as being of much systematic value I was *not* alluding to the number of folds which occur at the sides of the ambulacra. There is much variation in this respect within the limits of genera, and sometimes even of species, e. g. *Codaster acutus* and *C. trilobatus*.

Mr. Hambach omits to give any reference to the new genus which I am said to have established for certain species upon the characters which he mentions; and I am therefore constrained to ask him either for its name or for the missing reference to the page on which it was described. Unless he

* Trans. St. Louis Acad. vol. iv. p. 547.

can make good this omission he has no right to speak of my proposal of any new genus as "arbitrary and without any good reason."

I shall await his reply with interest, as I have utterly failed to discover the passage to which he alludes. Whenever I have been led to establish a new genus I have invariably supplemented the diagnosis of its characters by a further exposition of its "essential points of structure" or of "the most important morphological differences" between it and preexisting genera; and in no one case is there any allusion of this nature to the minor details which are mentioned by Mr. Hambach. They are frequently of value for specific discrimination, though quite useless so far as genera are concerned.

Going back for a moment to the classificatory value of the "composition" of the exoskeletal plates, I have sometimes thought it possible that Mr. Hambach's use of the word may be explained by the following passage *:—"Now, if we consider the second point, *i. e.* the external openings, the so-called spiracles, we will find that Mr. Carpenter is very inconsequent in his argument; for he says, 'Mere differences in the relative sizes of the calyx-plates are of very little systematic value,' etc. But, it seems, Mr. Carpenter forgets that the differences in the external openings are caused by the very differences in the relative sizes of the deltoid and lancet pieces."

In reply to this, I can only say (1) that I do not understand how any one who has even glanced at my account of the structure of the spiracles in *Schizoblastus*, *Granatocrinus*, and *Troostocrinus* respectively † can speak of my having forgotten the share which the deltoids and lancet pieces take in their formation. (2) The relative *sizes* ‡ of these plates have nothing to do with the differences in the structure of the spiracles. In *Granatocrinus derbiensis* almost the whole of the body is formed by the deltoids, as the radials are only just sufficiently high to enclose within their sinuses the distal ends of the ambulacra. On the other hand *G. Norwoodi* possesses very large radial plates, extending from the edge of the hollow base almost to the very apex of the calyx, and correspondingly small deltoids. The size and general relations of the lancet piece are the same in both types; and although the deltoids differ so much in relative size, yet Mr. Hambach

* Trans. St. Louis Acad. Sci. vol. iv. p. 544.

† Ann. & Mag. Nat. Hist. ser. 5, vol. ix. April 1882, pp. 238, 244–246, 248.

‡ If Mr. Hambach would substitute the word "shape" for "size" I should be disposed to agree with him.

places these two species in the same division of the genus *Pentremites*, which he describes as follows *:—"The third division would comprise all those species in which the deltoid pieces are perforated, because the lancet pieces do not reach far enough to the summit to enter into the composition of the spiracle openings."

As the large deltoids of *Granatocrinus derbiensis* and the small ones of *G. Norwoodi* are both perforated by the spiracles, Mr. Hambach should tell us what characters of these openings in the two species respectively *are* due to this very considerable difference in the relative sizes of the deltoids. But he does not mention them at all; and they cannot be so important as he makes out, for he places the two species in the same genus, just as has been done by the older palæontologists and by Mr. R. Etheridge, Jun., and myself.

Although we are in accordance upon this point, I cannot admit the truth of Mr. Hambach's teleological argument as to *why* the deltoids of *Granatocrinus* are perforated. But in the absence of proper figures it is useless to discuss this point, about which Mr. Hambach is as positive as if he had personally assisted at the evolution of a *Granatocrinus*.

In spite of all his criticism of my views he gives a classification of the so-called *Pentremites* which is essentially based upon the structure of the spiracles; and it therefore corresponds somewhat closely with that which has been already proposed by Mr. R. Etheridge, Jun., and myself †. He says ‡, "Still, if we suppose such a classification, according to the differences in the spiracle openings, was desirable and necessary, we could only (according to their external aspect and arrangement) divide them into three divisions."

It is not quite clear from the above passage what it is which Mr. Hambach proposes to divide into three divisions, the genus *Pentremites*, about which he is supposed to be writing, not having been mentioned since the middle of the previous page. Upon examining the list of species which he gives under each division, however, I find that in No. 1 are included those which Mr. Etheridge and myself refer to *Pentremites* and to *Troostocrinus*. No. 2 corresponds to our *Schizoblastus*, together with two species which have puzzled us considerably on account of their somewhat generalized characters; while No. 3 is identical with *Granatocrinus* as we understand the genus. It is not a little gratifying to us

* Trans. St. Louis Acad. vol. iv. p. 545.

† Ann. & Mag. Nat. Hist. ser. 5, vol. ix. pp. 219–248.

‡ Trans. St. Louis Acad. vol. iv. p. 544.

to find that Mr. Hambach has so closely followed our classification of the various types hitherto referred to *Pentremites*.

He further admits that the perforation of the deltoid pieces may render it desirable to separate *Granatocrinus* from *Pentremites* *:—"But then the name *Granatocrinus* ought not to be chosen, as has been done by some of our American writers and now repeated by Mr. Carpenter, as it will confuse matters rather than make them more clear. The type specimen for which Dr. Troost proposed the generic name *Granatocrinus*, is *Granatocrinus cidariformis*, Troost = *Pentremites granulatus*, Römer. But this species differs very materially from *P. Norwoodii*, Owen and Shumard, as it possesses no perforated deltoid pieces (the chief characters for this genus, according to Mr. Carpenter), besides other peculiarities in the ambulacral field."

It has been already explained by Mr. Etheridge and myself † that neither *Granatocrinus* nor *G. cidariformis* was ever described by Troost, so that they have no zoological value except as MS. names, while *Pentremites granulatus* was only described by Römer from an internal cast ‡. Under these circumstances we were obliged to seek for another species which should serve as a type of the genus, and we believed that "this may be most readily found in *Pentremites Norwoodi*, Owen and Shumard, not only from its general acceptance as a typical *Granatocrinus*, but as one of the species first referred to this genus." With all due deference to Mr. Hambach's dictum as that of an authority on the rules of zoological nomenclature, I believe that in following the principles adopted by Hall §, Meek and Worthen ||, and Wachsmuth and Springer ¶, we were taking a course which was far less likely to lead to confusion than the establishment of a new generic type for *Pentremites Norwoodi* and its allied species, which have been referred to the genus *Granatocrinus* since the year 1862.

After practically admitting the generic value of the type represented by *Pentremites Norwoodi* as distinguished from that of the ordinary *P. Godoni* **, Mr. Hambach states that

* Trans. St. Louis Acad. vol. iv. p. 545.

† Ann. & Mag. Nat. Hist. ser. 5, vol. ix. 1882, p. 237.

‡ *Op. cit.* p. 44, Taf. iii. fig. 13.

§ "Contributions to Palæontology," 15th Ann. Report New York State Cabinet of Natural History, 1861–62, p. 118.

|| 'Palæontology of Illinois,' vol. v. pp. 473, 509.

¶ 'Revision of the Palæocrinoidea,' part i. p. 8.

** This is the *Pentremites florealis* of Say, a later name than that proposed by De France; but in spite of this fact Hambach persists in using Say's name, which is transformed on p. 544 into *P. forealis*.

he sees no good reason for separating the first division (type *P. florealis*) from the second (type *P. melo*). In reply to this I can only say that Meek and Worthen thought differently *, and that the reasons which induced Mr. Etheridge and myself to follow their lead and establish the genus *Schizoblastus* appear to me to be as valid now as they were three years ago. No detailed criticism of them has yet been offered by Mr. Hambach or by any other writer, and it is therefore not necessary for me to go into the subject again.

Mr. Hambach proceeds to tell us † that "all described *Pentremites* (except those which belong to the genus *Codaster* or *Codonites*) can easily be distributed in either one or the other of these three divisions; it is therefore impracticable to divide the genus *Pentremites* into four or five new genera, as has been proposed by Mr. Carpenter." In this last sentence we have another erroneous statement of Mr. Hambach's. I have *not* proposed to divide *Pentremites* into four or five new genera. I retain this name for *Pentremites Godoni* and allied species: while, on Hambach's own showing, *Granatocrinus* dates back some years. D'Orbigny proposed *Pentremitidea* in 1849; Von Seebach pointed out the distinctness of *Orophocrinus* in 1864; and Shumard suggested the separation of *Troostocrinus* in 1865. I am only responsible for *two* new genera—*Phænoschisma* and *Schizoblastus*.

Mr. Hambach continues:—"For instance, the difference of *Troostocrinus clavatus*, according to Carpenter, = *Pentremites clavatus* Hambach‡ and *P. pyriformis* Say, consists mainly in the different length of the base and fork pieces, and there is certainly a closer relationship between these two species than between *P. clavatus* and *Reinwardtii* or *lineatus*." I

* "Descriptions of new Palæozoic Fossils from Illinois and Iowa," Proc. Acad. Nat. Sci. Philad. 1861, p. 142.

† Trans. St. Louis Acad. vol. iv. p. 546.

‡ As Mr. Hambach commits himself to a generalization about "all described *Pentremites*," it is not unreasonable to suppose that he must be at least acquainted with their names. But he appears both to have been, and to be still, altogether unaware that a *Pentremites clavatus* was described by Schultze so long ago as 1866, in his well-known "Monographie der Echinodermen des Eifler Kalkes" (Wiener Denkschriften, xxvi. Bd. p. 113, Taf. xiii. fig. 7). Mr. Etheridge and myself have referred this species to *Pentremitidea* ('Annals,' April 1882, p. 223), and have also mentioned the later *P. clavatus*, Hambach, as one of the species which will probably be comprised in *Troostocrinus* (ibid. p. 249). But Mr. Hambach admits neither of these genera, referring them both to his first division of *Pentremites*, along with *P. Godoni* and *P. sulcatus*. He must therefore find another name than *P. clavatus* for the species which he described in 1881. I do not see the necessity of it myself; but it is an inevitable result of the views which Mr. Hambach holds respecting the subdivision of the original genus *Pentremites*.

am sorry to have to give Mr. Hambach so much trouble; but as in a previous case (*ante*, p. 285), I really must ask him where I have made the statement which he paraphrases. It is certainly not in my account of the genus *Troostocrinus* on pp. 247–249 of the 'Annals' for April 1882, of which he has a copy. I have never spoken of *Troostocrinus clavatus*. I did say, however, that "the most important morphological difference between *Troostocrinus* and *Pentremites* lies in the structure of the spiracles." But this is very different from Mr. Hambach's account of my views, which is hopelessly inaccurate, and not supported by any reference whatever to my published papers. Many of Mr. Hambach's observations are more accurate than those of his predecessors. It is unfortunate that he cannot carry on a discussion with the same care as he evidently bestows on the examination of his *Pentremites*.

His assertion that all described *Pentremites* outside *Codaster* and *Orophocrinus* (*Codonites*, Hambach) "can easily be distributed" in one or other of the three divisions which he defines, is a somewhat comprehensive generalization. It could only be made with any approach to accuracy by an observer who had personally examined "all described *Pentremites*," or, at any rate, had provided himself with accurate descriptions and figures of those which were inaccessible to him. One is therefore naturally led to inquire how far Mr. Hambach's generalization is applicable to some of the European Blastoids which have been described under the general name *Pentremites*: for example—(1) *Pentremites inflatus*, Sow., *P. pentangularis*, Bronn, *P. Waterhousianus*, De Koninck, *P. Orbignyanus*, De Kon., and *P. puzos*, Münster; (2) *Pentremites acutus*, Phillips, and *P. caryophyllatus*, De Kon. Not one of these is mentioned by Mr. Hambach at all, nor do their characters in any way accord with either of his descriptions of the three divisions into which he groups the species of *Pentremites*. The first five of them have been referred by Mr. Etheridge and myself* to *Orophocrinus* or *Codonites*, as Mr. Hambach prefers to call it; and it may be that he accepts this identification, though he nowhere alludes to it. But even if this be the case there remain the two species *Pentremites acutus* and *P. caryophyllatus*, for which there is absolutely no place in Mr. Hambach's classification. They are excluded from his third division by having imperforate deltoid pieces; from the second division, which have broad deltoid pieces, and ten distinctly visible spira-

* 'Annals,' ser. 5, vol. ix. p. 252.

cles, by the fact that the deltoids are very small, inconspicuous, and always confined to the summit. They are thus invisible in a side view, while the hydrospires communicate directly with the exterior, as in *Codaster*, without the intervention of any spiracle openings. The same characters distinguish these two species from Mr. Hambach's first division of *Pentremites*, in which are included *P. Godoni*, *P. sulcatus*, and their allies, with well-defined deltoid plates and distinct spiracular openings.

What grounds, then, has Mr. Hambach for asserting that these two species "can easily be distributed" in either one or the other of his three divisions of *Pentremites*? Römer has published a good figure of *P. caryophyllatus* *, with which Mr. Hambach is probably acquainted; and Billings remarked upon it, "I do not think that such species can be referred to *Pentremites*; and if I had specimens before me instead of figures only, I should most probably institute a new genus for their reception"†.

But it is in reference to *Pentremites acutus* that Mr. Hambach's assertion appears most surprising. The two original specimens described by Phillips have been in the British Museum for years. They have not been seen by Mr. Hambach, and there is no record of the discovery of any others. On the other hand, he cannot but be aware that Billings's suggestion respecting the generic difference of De Koninck's species from the ordinary *Pentremite* type has been adopted by Mr. Etheridge and myself ‡; that we have proposed the name *Phænoschisma* for the reception of such species as *P. acutus* and *P. caryophyllatus*; that we gave a diagnosis of the genus and discussed its affinities; and, lastly, that its validity has been recognized by Wachsmuth §. And yet Mr. Hambach, without having seen a specimen of *Pentremites acutus* at all, or even an acurate figure of it ‖, calmly asserts that it "can easily be distributed" in one of his three divisions of the old genus *Pentremites*!

It is fortunate for science that this method of classification

* *Op. cit.* Taf. iv. fig. 16 *c*.

† 'Annals,' ser. 4, vol. v. pp. 262, 263.

‡ 'Annals,' ser. 5, vol. ix. p. 226.

§ "On a new Genus and Species of Blastoids, with Observations upon the Structure of the Basal Plates in *Codaster* and *Pentremites*," Palæontology of Illinois, vol. vii. 1883, p. 252.

‖ The small figures given by Sowerby and Phillips, even if Mr. Hambach has seen them, do not show the most striking characters of this species, and are of no use whatever for classificatory purposes.

is not the one usually adopted by systematic zoologists, who are generally careful to obtain the fullest possible knowledge of a species before committing themselves to a positive statement about its generic affinities.

Mr. Hambach's morphological doctrines are equally open to criticism. In his former paper* he gave an entirely new interpretation of those limestone plates at the sides of the ambulacra of *Pentremites* which Römer designated as supplemental pore-pieces; for they are "the remnants of collapsed tentacles preserved in the poral openings." Further on, again, he speaks of "the poral fissure from whence the tentacles originate, leaving the interior of the calyx through the poral openings, and forming in their collapsed state the supplementary poral plates of Dr. Römer."

Mr. Hambach describes these statements as "the results of my observations"†. Most readers would prefer to regard them as expressions of individual opinion; for he cannot possibly have observed the supposed tentacles of a living Blastoid and the form which they assume when collapsed. Under these circumstances I ventured to remark ‡ that Mr. Hambach "must have a wonderful power of imagination; for he actually believes that 'soft and membranaceous organs, such as occupy the pores of the ambulacral field in Echinoderms' can have been preserved (in a collapsed state, it is true) through all the ages between the Carboniferous period and the present time."

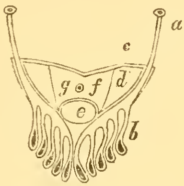
His reply § was as follows:—"The shape in which these hydrospiric plicas are found, as well as the difference in colour between them and the adjoining opaque calcareous substance of the shell, together with the physiological function ascribed to them (respiratory, according to Billings), denote the once elastic nature of these organs as well as of the tentacles, which communicate with the hydrospiric sac through the poral openings. . . . They form in their collapsed state the supplementary poral plates of Römer, which, to the great surprise of Mr. Carpenter, are actually found preserved in an open condition from the Carboniferous period to the present time."

These assertions are of such an absolutely positive nature that one is naturally led to ask, what possible proofs of them can be offered by Mr. Hambach besides his statement that "the interior circumference of a poral opening is lined by

* Trans. St. Louis. Acad. vol. iv. p. 151. † *Ibid.* p. 537.
‡ 'Annals,' ser. 5, vol. viii. p. 423.
§ Trans. St. Louis Acad. vol. iv. p. 539.

a membranaceous integument"*. Even if we admit, for the sake of argument, that such is really the case, there are other possible explanations of the fact than that put forward by Mr. Hambach.

In my former criticism of this doctrine I made the following remark †:—"It is certainly a very singular phenomenon that the 'collapsed tentacles' of *Pentremites obliquatus* and of *P. crenulatus* respectively should have assumed shapes *in limestone* which are so very different, but yet constant for those particular species." I purposely selected these two types, because good figures of their ambulacra are given by Römer ‡, and must therefore be tolerably well known; but I might readily have chosen two other species which would



Transverse section of a restored ambulacral field:—*a*, tentacle; *b*, hydrospiric sac; *c*, integument covering ambulacral field; *d*, poral piece; *e*, duct beneath the lancet piece; *f*, lancet piece; *g*, canal perforating the same; *s*, nervous (?) canal.

The above is an exact copy of Mr. Hambach's fig. 1, together with his explanation of it. It will be seen that there is no *s* in the cut, although this letter appears in the explanation below it. On the same page (p. 538), however, where he is speaking of the canal within the lancet piece (*g* of his figure), he says, "As these canals are perforating entirely solid calcareous substance and apparently in no direct communication with the hydrospiric sac, I suppose that they served for the reception of the nervous system." It has been suggested by Mr. R. Etheridge, Jun., and myself ('Annals,' April 1882, p. 218) that these canals lodged the radial water-vessels; but we do *not* believe that the latter had any lateral tentacular branches.

present a still greater difference in the characters of their supplemental pore-plates. The bearing of these facts on Mr. Hambach's theory is self-evident; but he has not attempted to explain them, although he has had an opportunity of doing so. On the contrary, he has published a figure, which I reproduce, showing a transverse section of a restored ambulacral field. The tentacles are here represented as communicating

* Trans. St. Louis Acad. vol. iv. p. 152.
† 'Annals,' ser. 5, vol. viii. pp. 423, 424.
‡ *Op. cit.* Taf. iii. fig. 11 *b*, and Taf. iv. fig. 15 *d*.

with the hydrospiric sac through the poral openings. I do not deny that this *may* have been the case in *Pentremites* and its allies, which had marginal pores to the ambulacra; though I need scarcely say that I do not believe it to have been so. But I should like to ask Mr. Hambach one question. He has stated*, and in my opinion quite rightly, that "the condition of life was undoubtedly a similar one throughout the whole class, therefore it cannot very well be called an arbitrary assumption to suppose the presence of certain organs with the same physiological functions in all these animals." Hence if the sides of the ambulacra of *Pentremites* were fringed with tentacles communicating through the marginal pores with the hydrospiric sacs, similar tentacles must also have been present in *Orophocrinus*, *Phænoschisma*, *Heteroschisma*, and *Codaster*; but where were the pores through which they could have been protruded?

Römer† pointed out long ago that the ambulacra of *Codaster* were not provided with marginal pores; and his statements have been confirmed by Rofe ‡, Billings §, and by Mr. Etheridge and myself ||. In this genus, too, the hydrospires open directly upon the external surface of the body between the ambulacra, their number varying from six to ten on each side. Will Mr. Hambach tell us how the communication was effected between the tentacles of *Codaster* and the hydrospiric sacs? The same difficulty presents itself in the case of *Phænoschisma* and *Orophocrinus*.

The absence of pores in *O. inflatus* and *O. Waterhousianus* was noticed by Rofe ¶; while Meek and Worthen ** mentioned the same peculiarity in *O. stelliformis*. Mr. Etheridge and myself have alluded to it as a character of *Phænoschisma* ††, and Wachsmuth has done the same for *Heteroschisma* ‡‡. The hydrospires of all these types, however, must have had tentacles in connexion with them, if Mr. Hambach is right in his restoration of the ambulacra of *Pentremites*.

He makes great use of these supposed tentacles of *Pentremites* in trying to establish the close relationship of this genus with the Echinoidea; but he entirely fails to see that if he is correct in regarding the tentacles of *Pentremites* as communicating with the hydrospiric sacs which terminate in the

* Trans. St. Louis Acad. vol. iv. p. 547. † *Op. cit.* p. 62.

‡ "Notes on some Echinodermata from the Mountain Limestone," Geol. Mag. vol. ii. 1865, p. 250.

§ 'Annals,' ser. 4, vol. v. p. 263. || *Ibid.* ser. 5, vol. ix. p. 232.

¶ *Loc. cit.* p. 250. ** 'Palæontology of Illinois,' vol. v. p. 463.

†† 'Annals,' ser. 5, vol. ix. p. 227.

‡‡ 'Palæontology of Illinois,' vol. vii. p. 356.

spiracles round the mouth, he is in reality widening the gap between a Pentremite and an Urchin. The ambulacral tentacles of an Urchin are supplied by lateral branches of a single median water-vessel, which does not open to the exterior in the neighbourhood of the mouth, but unites with its fellows into the oral ring. These features are eminently characteristic of all Echinoderms and not merely of the Echinoidea, in which group Mr. Hambach finds the nearest allies of *Pentremites*; though from his description of the tentacular apparatus of the latter type it must be entirely different from that of any living Echinoderm.

I believe, however, not only that *Pentremites* and the Blastoids generally had radial vessels and an oral ring homologous with those of the other Echinoderms, but also that their hydrospires are represented in some recent types, though not by the tentacular apparatus, as supposed by Mr. Hambach. For it appears to me that Ludwig* was not far wrong in his comparison of the elongated slits at the sides of the ambulacra of *Orophocrinus* to the ten interradial clefts on the under side of the disc of Ophiurids, which lead into the genital bursæ. He says, for example, "Meine Ansicht gründet sich auf die Uebereinstimmung in der Lage der Hydrospiren der Blastoideen mit den Bursæ der Ophiuriden, sowie auch auf die in beiden Organen in gleicher Weise vorkommende Faltenbildung an der der Leibeshöhle zugekehrten Seite."

If then, as I believe to be the case, the hydrospires of *Orophocrinus* correspond to the genital bursæ of an Ophiurid, this view may be extended to all the Blastoids; and it is surely a more rational one than that which postulates the existence of a tentacular apparatus at the sides of the ambulacra of *Pentremites*, with altogether different morphological characters from the water-vascular system of other Echinoderms. Then, again, the genital slits of the Ophiurids are ventral in position as the hydrospiral clefts are in the Blastoids, and not dorsal like the ovarian apertures of the Echini, to which Mr. Hambach compares the spiracles of the Blastoids. This is only one of many anomalies which appear throughout his comparison of an *Echinus* and a *Pentremites*. He formerly† spoke of the "oroanal" surface of a Pentremite as being on the dorsal part of the shell; but he now tells us‡, "That portion which I had termed 'dorsal half' should perhaps have been called better 'apical' or 'ambulacral system;'

* "Beiträge zur Anatomie der Ophiuren," Zeitschr. f. wiss. Zool. Bd. xxxi. 1878, p. 388.

† Trans. St. Louis Acad. vol. iv. p. 151.

‡ *Ibid.* p. 542.

it would correspond to the ocular plates and ambulacral field in *Echinus*, and consists of deltoid pieces and ambulacral field in *Pentremites.* The ventral portion perhaps also had better be called actinal or interambulacral system, and would correspond to the genital plates and interambulacral field, and consist of basal plates and fork pieces in *Pentremites.*"

The following remarks occur to one on reading this passage:—

1. The deltoid plates of a Pentremite are interradial, *i. e.* situated between the ambulacra. They cannot therefore possibly correspond to the ocular plates of an *Echinus*; for these are situated radially and receive the distal ends of the ambulacra, in very much the same way as the fork pieces or radials of a Pentremite enclose a greater or less portion of the outer ends of the ambulacra.

2. "Interambulacral" is not used as a synonym for "actinal" by any writer on Echinoderm morphology.

3. If Mr. Hambach will consult the writings of Prof. Alexander Agassiz * upon the structure of Echinoderms, he will find the genital plates described as belonging to the abactinal and not to the actinal system; while Götte's observations † prove that the basal plates of a stalked Echinoderm are likewise abactinal in position, and not actinal as they are called by Mr. Hambach. He is right, however, in calling them interambulacral, and in comparing them to the genital plates of *Echinus*. But his parallel between the interambulacral field of an *Echinus* and the fork pieces or radial plates of a Pentremite is at variance with every principle of Echinoderm morphology. Like the basals, and also the genital and ocular plates of an Urchin, the radials constitute a fundamental element of the abactinal, or apical system, as it has been well designated by Agassiz and Lovén.

The nomenclature of Echinoderm morphology is doubtless somewhat difficult; but if the fundamental difference between radial and interradial, or ambulacral and interambulacral, on the one hand, and between actinal and abactinal on the other, be carefully borne in mind, much that seems obscure is readily understood. Mr. Hambach, however, uses these terms in the loosest manner, and the result is that abactinal plates in which the ambulacra of *Pentremites* terminate (the radial or fork pieces) are described by him as actinal and interambulacral! Is not this rather hard upon the unfortunate student

* 'Revision of the Echini,' Cambridge, U. S. 1872–74, p. 635; and 'North American Starfishes,' 1877, pp. 38, 62, 93.

† "Vergleichende Entwickelungsgeschichte der *Comatula mediterranea*," Arch. f. mikrosk. Anat. Bd. xii. 1876, p. 595.

of the future who reads Mr. Hambach's papers after a preliminary study of the works of Johannes Müller and Alexander Agassiz?

Mr. Hambach's discussion* of the affinities of Blastoids, Echinids, and Crinoids commences as follows:—

"In regard to the relationship of Echinus and Pentremites I would say that it seems quite strange to seek for their nearest allies among the Crinoideæ; nevertheless they have been regarded and classified as a suborder to Crinodeæ (*sic*), even Bronn, in his 'Klassen und Ordnungen des Thierreichs,' puts them below the Crinoideæ, as was done by most of the authors before, and is still done by others, although Say remarks already, that 'in a natural series these bodies constitute the link between the Crinoideæ and the Echinidæ.'"

He further says that I "certainly cannot point out a Crinoid which bears a stronger resemblance to a Pentremite than a Pentremite does to an Echinus." I fully admit that there are many points of resemblance between *Pentremites* and *Echinus*, as will be evident from the Appendix to my Report on the Crinoidea of the 'Challenger' Expedition†. But like Leuckart, Römer, Huxley, Wyville Thomson, Zittel, Wachsmuth, and many others, I consider the presence or absence of a column as of much greater morphological importance than Mr. Hambach is disposed to attribute to it; and I therefore believe the resemblance between *Pentremites* and such a Crinoid as *Cupressocrinus* to be far stronger than that between *Pentremites* and *Echinus*. *Cupressocrinus* had a series of minute pinnules along the ambulacra, very closely similar to those of a Blastoid, and altogether different from the pinnules of an ordinary Crinoid; while there is much reason to think that it was also provided with a hydrospiric apparatus. But these structures (and also the stem), which are so characteristic of a Pentremite, are altogether unrepresented in *Echinus*, and the passage of tentacles through the ambulacral pores of *Pentremites* is, to put it mildly, an open question.

Before concluding this communication I should like to correct some errors that unfortunately appeared in the first‡ of the two papers on the Blastoids which have been communicated to the 'Annals' by Mr. R. Etheridge, Jun., and myself. I am bound to admit that they ought never to have found their way into print; and the only excuse I can offer for their having been published is, that the final revise of our paper was delayed in the post office, and did not reach the printers until the necessity of punctual publication of the

* Trans. St. Louis Acad. vol. iv. p. 542.

† Zool. Chall. Exp. part xxxii. p. 413.

‡ 'Annals,' ser. 5, vol. ix. April 1882, pp. 213-252.

'Annals' had compelled the printing off of our communication in its uncorrected form.

1. Page 219, six lines from bottom, for "each arm forms the floor of a passage" read "each half forms the floor of a passage."

2. Page 241: the last paragraph should commence as follows:—"In the type species, *G. Norwoodi*, the central aperture is closed by a group of small plates."

This last error has been pointed out by Mr. Hambach * in the following characteristic passage: "But not, as misrepresented by Mr. Carpenter, is this cone-shaped integument preserved on *P. Norwoodi*."

In conclusion, I must beg of Mr. Hambach that if he should wish to refer to my papers on any future occasion, he will take a little more care than he has hitherto exercised to retain the sense of the original, when he gives it in his own words and not in mine.

Some cases of this kind have been noticed already; but there are two of a much more serious nature.

On page 544 † Mr. Hambach quotes me as saying, "Mere differences in the relative sizes of the calyx-plates are of very little systematic value" ‡. Two pages further on, however, he discusses the differences between the two groups of so-called *Pentremites*, which are referred by Mr. Etheridge and myself to *Pentremites* and to *Schizoblastus* respectively; and he says, "I see no good reason to separate the first division from the second, because the number and relative position of these plates to each other remains the same, and, as differences in the size of the calyx plates (as Mr. Carpenter remarks) are of no systematic value, they should not be separated."

Is Mr. Hambach here referring to the passage which he has quoted in full on page 544? If so, one of his two versions of it must be wrong, and it is not the first one; and if not, I will thank him to give me the exact reference to the statement which he paraphrases on page 546.

In Mr. Hambach's first paper § he gave the following description of the lancet-plate of *Pentremites*:—"Its anterior side is smooth and slightly convex, whereas the posterior is concave, semilunar, and grooved in its whole length for the reception of some duct or vessel . . . . . . In the majority of the species, or at least in the typical ones, as *Pentremites florealis*, *sulcatus*, *pyriformis*, etc., the width of the lancet piece is half as great as that of the ambulacral

* Trans. St. Louis Acad. vol. iv. p. 541. † *Ibid.* vol. iv.

‡ "Remarks upon the Structure and Classification of the Blastoidea," Report of the York Meeting of the British Association, 1882, p. 635.

§ Trans. St. Louis Acad. vol. iv. p. 149.

field, being also pierced through the centre in its whole length by a very fine canal, which led Mr. Rofe to suppose that it was composed of two pieces."

Two pages further on Mr. Hambach proceeds "to the description of the softer parts or organs which were protected by the calcareous shell, though both are so intimately connected with each other that one could not exist without the other. If we examine these parts, which, in some cases, are very beautifully preserved, we shall see that they are placed below or above each other *; and if we commence with that portion which is placed immediately under the lancet piece of the ambulacral field (see Plate *a*. Fig. 9 *a* †), we will here find a longitudinal duct or vessel resting in the concave furrow of the lancet piece, and running from the apex of the ambulacral field to the summit, where it connects with a circular duct (œsophageal ring?) surrounding on the interior side, the central orifice or *annulus centralis*. This I have been so fortunate as to obtain entire from a well-preserved specimen of *Pentremites Norwoodi*; though, being probably composed of a very fine and delicate tissue or membrane, it is destroyed in most cases, and therefore very rarely observed."

In the endeavour to summarize these statements ‡ I wrote as follows:—"Dr. Hambach, on the other hand, figures a section of a ray (of *Granatocrinus Norwoodi?*), the lancet piece of which is not only 'pierced through the centre in its whole length by a very fine canal,' but also has a posterior (*sic*) side which is 'concave, semilunar, and grooved in its whole length for the reception of some duct or vessel.' At the summit this duct or vessel 'connects with a circular duct (œsophageal ring?), surrounding on the interior side the central orifice or *annulus centralis*.' Thanks to the kindness of Mr. Wachsmuth, I have been enabled to examine many beautiful internal casts of *Granatocrinus Norwoodi*, a well-preserved specimen of which is the original of Dr. Hambach's description; but, despite this advantage, I am at a loss to understand his meaning, and can only hope for a further explanation of it in his forthcoming monograph."

Here is Mr. Hambach's version § of this passage:—"Mr. Carpenter says on p. 419 of his paper, I had figured and described a section of a ray of *Granatocrinus Norwoodi*, but, in spite of all advantages for examining beautiful specimens, *even the original which served for my description* ||, he is at a loss to understand the meaning. If Mr. Carpenter will go to the

* I do not express "great doubts as to the correctness" of this statement.

† In the explanation of fig. 9 we read: (*a*) fork piece.

‡ 'Annals,' ser. 5, vol. viii. p. 419.

§ Trans. St. Louis Acad. vol. iv. p. 537.

|| The *italics* are mine.

trouble of reading my little paper carefully he will be convinced that the figures were not taken from *Granatocrinus Norwoodi*, but that I distinctly said, 'at least in the typical ones, as *Pentremites florealis*, *sulcatus*, *pyriformis*, *etc.*' My Fig. 9, on plate A, represents an oblique section through a fork piece and ambulacral field of *P. sulcatus*, Fig. 14 an interior view of the same, Fig. 16 an interior view of an ambulacral field alone. Both figures are taken from *P. sulcatus*, and show the longitudinal furrow of the lancet piece very well, which has been already observed and described by Römer.

"As to the second statement he makes, that of having examined the original serving me for my description, I must doubt very much the possibility of this, as I never sent one of my type specimens away or missed them from out of my collection."

There are two points in the above passages on which I would comment. 1. It is all very well for Mr. Hambach to tell us now that figs. 9, 14, & 16 on Pl. A of a paper published in 1881 represent portions of *Pentremites sulcatus*, but it would have been better had he done so before. In his explanation of pl. A*, figs. 1, 2, 3, 8, 10, and 17 are referred to this species, and no specific name at all is appended to the other eleven figures. Neither is there any mention in the text on the two occasions when he refers to fig. 9, of the species which it illustrates. Seven lines above one reference he alludes to three species of *Pentremites*, viz. *florealis*, *sulcatus*, and *pyriformis*; and seven lines below the other there occurs the name *P. Norwoodi*. Which, if any, of these species furnished the section represented in fig. 9? It seemed to me more probable, from the context in the second case, that Mr. Hambach was referring to *Pentremites* (*Granatocrinus*) *Norwoodi*; and so I put the name between brackets with a note of interrogation after it. But it now appears that I was wrong; and for this error of judgment on my part I tender Mr. Hambach my apologies.

2. If Mr. Hambach "will go to the trouble of reading my little paper carefully he will be convinced" that I never claimed to have had the advantage of examining the original specimen which served for his description, as he makes out. Several internal casts of *P. Norwoodi* have been found besides the "well-preserved specimen" described by him, but not seen by me; and by the liberality of Mr. Wachsmuth I have been enabled to examine a good many of them. But I was never quite so foolish as to state that I had seen Mr. Hambach's original, although, in spite of having the best of reasons to the contrary, he twice charges me with having done so!

* Trans. St. Louis Acad. vol. iv.

XXV.—*Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia, continued.* By H. J. Carter, F.R.S. &c.

[Continued from p. 222.]

Remaining Groups of the Hircinida.

Referring to the tabular view (p. 215) we may observe that there are eleven groups still remaining in the family Hircinida, beyond whose diagnosis ('Annals,' 1875, vol. xvi. p. 132), viz. "Solid fibre chiefly cored with foreign objects," there is nothing in their respective descriptions (*ib.* p. 136 *et seq.*) to lead to their determination, for I have already stated that *form alone* among the Spongida is of no value in this respect, and most of them are simply characterized by their forms, as may be learnt from the nomenclature.

Still all that I could do at the time, when a quantity of Psammonemata that would alone fill several square yards was presented to me for arrangement—in which, with very few exceptions, nothing but bare skeletons (beach specimens) remained for my guidance—was to heap them together hurriedly, and name the heaps chiefly in accordance with the forms they contained as preliminary to future distribution, when such time should arrive that they might be studied with their sarcode on as well as off. This "time" must, of course, be very long, as in all other branches of natural history; but still it will progress if advantage be taken of the opportunities offered for this purpose, such, I may instance, as those afforded by Mr. Wilson's collections. But it never can be done at a distance so well as on the spot, where the species, from its abundance and its varieties, may be studied under all its phases, and a multiplication of useless specific names thus avoided. Much therefore in this way may be hoped for from Dr. R. von Lendenfeld, now at Melbourne, who, educated under one of the best spongiologists of the present day, viz. Prof. E. Schulze, of Gratz, has already turned his attention most successfully in this direction.

Although, however, the skeletons of the Psammonematous sponges thus deprived of their sarcode are almost indispensable in classification, as may be learnt from Prof. Hyatt's beautiful photographs and careful descriptions (*op. et loc. cit.*), yet when we come to see many of them which have been skilfully preserved either in the dried or wet states *directly after having been dredged up from their natural abodes*, their aspect is so different that, had the former not familiarized me with their character, the latter would hardly enable me to recognize the species. Thus Schmidt's genus *Stelospongos* would never have become known to me by his illustrated description of the arrangement of the fibre *alone*, if it had not been for Hyatt's photograph of an *entire* form, viz. *S. levis*, from South Australia (Mem. Bost. Soc. Nat. Hist. vol. ii. p. 530, pl. xv. fig. 16), of which form there is an abundance in the British Museum.

It is true that, in the "key" of illustrations to my classification ('Annals,' *l. c.* p. 192), I have also given some of Schmidt's species of *Hircinia*, Nardo, to illustrate the group "Hirciniosa;" but it will be found, by referring to Schmidt's arrangement (Spong. Adriatisch. Meeres, p. 30 &c.), that these, as well as others, are all placed under his Filifera, that is that the sarcode in all was more or less replaced by the presence of the parasite *Spongiophaga communis*, so that, as genuine illustrations of the "Hirciniosa," neither of these can be admitted. Again, *Halispongia choanoides*, Bk., = *Stelospongos*, Sdt., is not an illustration of the group Callhistia, as I had thought, whose skeleton is much finer, as will be more particularly noticed hereafter; while *Sarcotragus fœtidus*, Sdt., which was adduced to illustrate the form of the fibre in the group "Platyfibra," is in the same condition as regards the sarcode as Schmidt's *Hirciniæ*. This parasitic (?) transformation is so prevalent in the *Hirciniæ* that it is difficult to find a specimen without it; and hence Lieberkühn made it a specific character, which of course was a mistake, especially as *it is not confined to the* Hirciniæ *only*.

Thus, as I have just stated, there is absolutely nothing that has been hitherto laid down to lead the student to the recognition of any species contained in the groups in my classification to which I have alluded, and therefore it becomes desirable to see how far this want may be supplied by Mr. Wilson's specimens.

Setting aside then all attempt to interfere with these groups so far as their names are concerned, I would divide the whole into conulated and unconulated Psammonematous sponges, proposing to *retain* the term "HIRCINIDA" for the former, and *adding* that of "LIOCHROTIDA" for the latter family, with which we will begin.

Fam. Liochrotida *.

Char. Psammonematous sponges on which there are no

* λειόχρως, smooth-skinned.

conuli, but in which the keratose fibre is strongly developed and more or less cored with sand and foreign microscopic objects.

Stelospongus levis, Hyatt (*op. et loc. cit.*).

Of this species, to which I have just alluded, there are several specimens in Mr. Wilson's spirit-preserved collection, while the great number of dried ones from the southern coast of Australia that have come under my notice indicates that it is not only abundantly plentiful, but that it is more so than any other species in that locality; yet, with the exception of Dr. Bowerbank's representations of a spirit-preserved specimen from Freemantle under the name of "*Halispongia choanoides*" (Proc. Zool. Soc. 1872, pl. vi.), and Mr. Stuart O. Ridley's observations on *Stelospongus excavatus* from Port Molle, in Queensland (Zool. Coll. of H.M.S. 'Alert,' Brit. Mus. pub. 1884, p. 383), viz. that "the colour in spirit is greyish white (putty colour)," and that "the dermis conceals all the skeleton but the ends of the primary fibres, which appear as low points over the whole of the outer surface and just inside the margins of the pits," there is no description of anything more than the dried skeleton, which Schmidt, who established the genus (Spong Atlantisch. Gebiet. p. 29, Taf. iii. figs. 13 and 14), only illustrates by two fragments of the fibre, which Hyatt fortunately has identified with an *entire* form from Port Phillip Heads, Australia, under the name above mentioned (*op. et loc. cit.* pl. xv. fig. 16).

Returning then to Mr. Wilson's spirit-preserved specimens of this species, we find them pyriform, stipitate, smooth, consisting of a subglobular body presenting typically a single large vent on the summit, terminated by an attenuated stem and root-like expansion in the opposite direction. Consistence resilient. Colour, when fresh, "grey," as it is now. Surface smooth, covered uniformly by dermal sarcode charged with sand, which in its natural, that is unworn, state entirely conceals the subjacent fibre under a sieve-like structure, which is well represented by Dr. Bowerbank (*op. et loc. cit.* pl. vi. fig. 2), in which the reticulation is densely arenaceous, and the interstices, which are more or less uniformly circular, tympanized by the dermal sarcode alone. Pores in the interstices of the dermal reticulation. Vent very large, generally single, and situated a little excentrically on the summit of the body, supported on a tubular extension of the fibre, which is better seen in the dried skeleton than in the fresh specimen, where it is covered by a lip-like fleshy fold of the dermal sarcode, whose arenaceous and poriferous structure ceases at the margin, after which it becomes homogeneous and smooth, as it lines a large cloacal cavity into which the great canals of the excretory systems empty themselves; oftentimes the vent is double, and sometimes accompanied by one or more subsidiary ones. Internally the fibrous structure radiates upwards and outwards from the stem, consisting of main and interuniting fibre, of which the former is cored with sand &c. and the latter simple, forming a reticulated mass whose interstices are tympanized by the parenchymatous sarcode, traversed by the branches of the excretory canal-systems, which finally open into the cloaca. Size variable, under 5 in. high and 3 in. in diameter horizontally in its widest part.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. When acquainted with the typical form of this species with its sarcode *off*, that is with the dried washed-out skeleton, it is not difficult to recognize it with the sarcode *on*; but the two are necessary for identification. Hence the necessity of knowing both, which, unfortunately, is the case with most of the Psammonemata, on account of the sameness of the fibre, the variety of structure even in the same species, and the absence of any particular form of "proper spicule" to characterize the individual. I say "unfortunately," because the species are so numerous, so very varied in their forms, and so seldom obtained in both the conditions above mentioned, that it will, as above stated, be a long time before they can be fully and faithfully recorded for practical utility.

In many of the dried skeletal specimens in the British Museum the walls, made up of the columnar fibre described by Schmidt, present a distinctly hexagonal or honeycomb structure, extending inwards towards the centre, and in some instances three or more pyriform individuals have grown together; the vents, too (as before stated), are by no means always single, and are sometimes supplemented by smaller ones; but the varieties in form and structure of the entire sponge, and even the state of its dermal surface, are so great that, if each has to be particularly described, I doubt whether Schmidt's description of the fibre *alone* will suffice for identification.

With reference to nomenclature, it might be observed that Dr. Bowerbank called his specimen "*Halispongia choanoides*" in 1872 (*l. c.*) *after* Schmidt had established the generic name "*Stelospongos*" in 1870 (*l. c.*); to which, however, it should be added that the former did this only provisionally, although, as the context shows, evidently without any allusion to, if acquainted with, what Schmidt had done previously, which certainly, as I have before stated, would have been of very little use to *myself* without Hyatt's photograph.

Another species of this genus appears to be represented in Mr. Wilson's dried collection by *three* specimens, which may be named and described as follows :—

Stelospongus flabelliformis, n. sp.

Compressed, wide, fan-shaped, stipitate; ribbed radiatingly from the stem, which is long and terminated by a root-like expansion, to the circumference, which is comparatively thin; ribs or rather ridges bifurcating once or twice in their course to the circumference, corresponding to the divisions internally of the excretory canal-systems; interunited irregularly on both sides by sub-ridges, which thus give rise to a number of concave depressions such as might have been caused by the specimen having grown between two beds of small pebbles, ending at the circumference in a series of processes, which give the margin a denticulated form, each process being a tubular extension of a vent, and the whole arranged Pandean-pipe-like along the circumference. Consistence now hard, more or less resilient. Colour grey externally (that is the colour of the incrustation), dark sponge-colour immediately underneath, lighter within. Surface smooth, covered with a cribriform sandy incrustation, whose minute interstices present great uniformity. Pores in the dermal sarcode tympanizing the interstices of the incrustation. Vents in the position mentioned. Structure internally compact, consisting of massive fibro-reticulation, in which the interstices are tympanized by the parenchymatous sarcode; fibre of two kinds, viz. axiated or cored with foreign objects, and simply keratose, the former vertical and the latter interuniting or lateral; the whole traversed by the branches of the excretory canal-systems. Size of largest specimen 7 in. high by $8 \times \frac{1}{2}$ in. horizontally; stem $3\frac{1}{2}$ in. long.

Hab. Marine.

Loc. Port Phillip Heads, South Australia.

Obs. In one of the "three" specimens the body is much more inflated, being 3 in. thick; there are no ridges, and the denticulated margin is very irregular; in short the whole looks like a coarse clumsy form of the above description. The pebble-like impressions, to which I have above alluded, are well represented in Hyatt's photograph of his *Spongelia Farlovii*, which came from the same neighbourhood (*op. et loc. cit.* pl. xvii. fig. 14), and are the same as the "depressions" on the surface of *Taonura flabelliformis* ('Annals,' 1882, vol. x. p. 108). They appear to be produced by linear elevations of the structure *over* subjacent branches of the excretory canal-systems, like the radiating ridges; thus circumscribing the "depressions."

Finally, there is a spirit-preserved specimen of this species of a globular form, elongated laterally, which appears to be intermediate between the last-mentioned and *Stelospongus levis*, and in which there are nine unmarginated vents of different sizes, large and small, irregularly scattered over the upper part. It is 6 in. high, including the stem, by 5×3 in. horizontally; stem $2\frac{1}{2}$ in. long. Same locality, in 7 fath. This as a variety might be termed *Stelospongus latus* for convenience.

Stelospongus tuberculatus (provisional).

Specimen globular, tuberculated, stipitate, consisting of short dividing and interuniting branches, terminating in round knobs on the surface, which altogether assume a globular form; rising from a hard, cylindrical, truncated stem (? cut off by the dredge). Consistence firm. Colour, when fresh, "grey;" the same now, that is from the sandy exterior. Surface even, consisting of a thick arenaceous incrustation spread uniformly over the tuberculated head, concealing the subjacent fibre, and presenting a reticulated structure in low relief and of a white colour when dry, which arises from a heaping up together of the sand-grains &c. of which it is composed. Pores in the interstices of the reticulation. Vents numerous but *small*, chiefly confined to the more prominent parts respectively of the tuberculiform processes. Fibre of two kinds, viz. cored or axiated with foreign bodies, and simply keratose, the former vertical and the latter lateral. Size of specimen 5 in. high (including the stem, which is $1\frac{1}{2}$ in. long) by $3 \times 2\frac{1}{2}$ in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 18 fath.

Obs. I am not certain of the proper location of this species in point of classification, for although it closely resembles *Stelospongus levis* in the structure of the sandy incrustation &c., the general form, like that of a knotted *Chalina*, is so different that I have thought it best only to name it "provisionally," chiefly to record its description. Then the general form of sponges is so little to be depended upon that, after all, the difference in form may go for nothing in a specific point of view.

Geelongia vasiformis, n. g. & sp.

Specimen vasiform, deep, conical, stipitate, wide at the brim, narrowing gradually towards the stem; margin or brim undulating, round. Consistence firm, tough. Colour "brown-grey" when fresh, much the same now. Surface of the excavation a little smoother than that of the outside, which is slightly uneven, consisting of the dermal sarcode charged with sand, especially on the outside, which, together with the layer of subdermal cavities, is about 3-48ths in. thick. Pores plentifully scattered over the dermal incrustation outside. Vents uniformly scattered over the whole of the inner surface of the vase or only halfway down, also a few on the outer surface, but none on the margin. Structure consisting of sand-cored and clear keratose fibre of an amber colour, supporting in its reticulation the sarcodic elements of the parenchyma, traversed by the branches of the excretory systems, whose large canals are directed *across* the wall, that is from the subdermal pore-cavities on the outside to the vents on the inner side of the vase, giving off a number of small branches in their course in the opposite direction; while the main branches of the *fibre*, following the same course as the large canals, indicate a transverse structure generally, in contradistinction to that of another species (viz. *Hircinia intertexta*) that will be described presently, in which the structure is *longitudinal* or parallel to the wall. Size of specimens, total height 9 in., including the stem, which is $2\frac{1}{2}$ in. long and $1\frac{1}{4}$ thick; width across the brim 6 in.; wall near the stem $\frac{5}{8}$ in. thick, gradually diminishing upwards.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 20 fath.

Obs. Examined in the wet state. Generic name taken from that of the town near the place where Mr. Wilson's dredgings were carried on. There are two specimens of this species, in one of which the vents only extend halfway down the surface of the excavation, while in the other they are continued to the bottom; but otherwise they are much the same. Both specimens are in halves, which, by being doubled, enable me to give the dimensions above mentioned. This is the first species which I have briefly described in my observations on the "Circulation in the Spongida" (*anteà*, p. 120) as affording an example of the opening of the pores through the subdermal cavities directly into a large excretory canal, &c.

Such vasiform Psammonematous sponges are not new to me, as there are five dry specimens in the British Museum, all of which belong to the same species, and, all being more or less alike, afford the most satisfactory instance that has come under my notice of the replacement of the natural sarcode by

Spongiophaga communis, for in three of these the *whole* of the soft parts are transformed into the filaments of this supposed parasite, and in the other two, which are almost exactly like them, the natural sarcode remains *intact* by it; the former bear my running no. "177" and the latter "547;" but being dry, and therefore much altered in appearance, I am unable to say with certainty that they are specimens of *Geelongia vasiformis*; at the same time for descriptive purposes it may be observed that they are all smooth internally, but ribbed externally by ridges which extend more or less parallelly although radiatingly from the base to the circumference, while they now average 9 in. high by 9 in. across the brim, which is about $\frac{1}{4}$ in. thick; so that, when fresh, they must have been very nearly double in all these measurements. All are said to have been brought from Australia, and being remarkable in shape have been mounted on wooden stands for exhibition; thus they are analogous to the great Suberite "Neptune's Cup," = *Rhaphiophora patera*, Gray, = *Poterion*, Harting.

Abnormally-developed Ova in situ *in* Geelongia vasiformis.

In both the specimens of *Geelongia vasiformis* there are a great number of isolated ova, scattered singly throughout the tissue in distinct cysts of the same shape, so loosely that, on breaking open a cyst, which is firmly attached to the surrounding tissue, they fall out in their entirety, when they appear to be in different stages of development, of which the earliest consists of a delicate spherical colourless envelope filled with granuliferous nucleated yelk-cells of a faint yellow colour, averaging 20-6000ths inch in diameter, while the entire envelope, which at this period is very thin and delicate, is about 1-20th in. in diameter; and the latest or most advanced development is of a subglobular tuberculated form, rendered more or less irregular by the budding-forth of several short processes, some of which may be once divided. While, however, the contents are the same, the envelope and the processes into which it has been prolonged have become transformed into a keratose laminated structure of an amber colour about 4-6000ths in. thick, having very much the appearance of the laminated keratose fibre of the sponge itself; thus between these extremes of sphericity and subglobularity there are ova of every degree of form and colour.

What the signification of this development may be I am unable to conceive further than that it may be a normal one of the ovum in an abnormal position; hence, provisionally, I have headed this "Abnormal development of the ovum *in* *situ*," for the development of the ovum in the Psammonematous sponges beyond the ciliated stage—in which I observe the same kind of yelk-cells (see Schulze, Zeitschrift f. wiss. Zool. Bd. xxxii. Taf. xxxviii. figs. 2–4, 1879, for comparison)—has not been published, if indeed followed.

Here I might notice that similar kinds of ova exist in a specimen of *Hircinia?* in the same collection, wherein all the other soft parts have been transformed into the filaments of *Spongiophaga communis*, thus apparently indicating a protective power much greater than that of the sarcode, as I shall more particularly notice hereafter.

Dactylia chaliniformis, n. sp.

Caulescent, solid, digitiform branches, rising from a single stem ; branches thick, irregularly cylindrical, more or less dichotomously divided, slightly enlarged, fig-like towards the ends. Consistence resilient. Colour, when fresh, "dark brown, buff at the tips." Surface even, minutely reticulated in low relief, with points passing into high relief at the extremities of the branches. Pores abundant, situated in the interstices of the dermal reticulation. Vents numerous, pustuliform, scattered unequally over the surface. Internal structure radiating obliquely upwards and outwards ; main fibre sand-cored, interunited by clear but smaller fibre, all amber-coloured ; supporting the sarcodic elements of the parenchyma ; traversed by the branches of the excretory canal-system. Size of specimen 8 in. high, and the whole bunch 6 in. in diameter at its widest part ; branches rather compressed, about 1 in. in diameter at their largest or swollen part.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. This is a distinctly digito-chalina-like sponge, simulating a *Chalina* in form as well as in structure as much as the material would allow, being otherwise skeletally Psammonematous. It is thus another instance of the same form being produced with totally different elements ; pointing out the uniformity of plan in this part of the development of the Spongida.

Dactylia impar, n. sp.

Specimen caulescent, stems solid, cylindrical, branching off successively from one side of the largest and longest, which extends to the end of the specimen, like the barbs on one side of a feather ; short and interunited pan-pipe-like below, becoming separated and more or less bifurcated upwards. Consistence firm. Colour white, from the abundance of colourless foreign objects with which the specimen is incrusted. Surface even or indistinctly granulated, consisting of the incrustation just mentioned. Pores abundant between the granules, irregularly grouped. Vents small, scattered over the surface, chiefly on one side of the stems. Internal structure radiating from the axis upwards and outwards; main fibre sand-cored, interunited by clear but smaller fibre, all amber-coloured, supporting the sarcodic elements of the parenchyma, traversed by the branches of the excretory canal-systems. Size of specimens about 7 in. long by $3 \times \frac{1}{4}$ in., being very much compressed, and all the branches on the same level.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 6 fath.

Obs. The chief characters of this species are its "frosted" whiteness, arising from a thick incrustation of foreign objects, which appears exclusively to consist of hyaline grains of quartz, its digito-chaliniform stems, and one-sided growth.

Dactylia palmata, n. sp.

Specimen stipitate, palmate, digitate, consisting of a bunch of compressed, solid branches proceeding from a short thick stem, becoming dichotomously divided into digito-chaliniform processes. Consistence resilient. Colour, when fresh, "dull reddish orange," now grey. Surface even, slightly arenaceous. Pores plentifully scattered over the surface generally. Vents also scattered over the expanded portions, more in line along the cylindrical branches; main fibre sand-cored, lateral fibre clear. Size of specimen 9 in. high by 6×2 horizontally; hence the whole form is rather compressed.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 16 fath.

Obs. This appears to be only a more flattened, *i. e.* palmate, variety of *Dactylia chaliniformis*.

Fam. **Hircinida.**

Char. Psammonematous sponges which *are* conulated on the surface. Otherwise the same as in the family Liochrotida.

Hircinia solida, n. sp.

Specimen long, thick, erect, compressed, tongue-shaped, sessile; margin obtuse, free end pointed, fixed end spreading or more or less contracted. Consistence, when wet, soft, fleshy, resilient, firm. Colour, when fresh, "dark grey above, yellowish green below," now dark grey, almost black when dry, lighter internally. Surface uniformly consisting of obtuse conuli, in each of which there is a plurality of points corresponding to the ends of the subjacent sandy fibre, grouped together irregularly, about 1-8th inch apart; bound down by a soft, fleshy, fibro-reticulated dermis in which there are *no* foreign objects; dermal fibre made up of short, fusiform, granuliferous cells or bodies, transparent fibrillæ, and a few elliptical pigmental cells; tympanized in its interstices by a thin transparent layer of sarcode in which the pores are situated. Vents small, but numerous and indistinct, scattered generally over the surface among the conuli. Internal structure dense, consisting of a mass of short-jointed, reticulated, keratose fibre, in which the foreign material predominates over the keratine, whose interstices are filled up by a fibro-reticulation like that of the dermis, in which also the interstices again are tympanized by thin sarcode pierced with holes for inhalent and exhalent purposes respectively (only seen in the dried fragment), the whole forming the parenchyma of the interior, whose sarcode, together with that of the fibrous dermis, is so inspissated that, on drying, it melts down into an almost corneous consistence of a dark colour, which is very characteristic of the species. Size of spirit-preserved specimen 12 in. high by about 4×1 in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 20 fath.

Obs. Compactness of structure, prevalence of sandy fibre, soft, fleshy, fibro-reticulated dermis, and dark colour chiefly characterize this species. There are two other, but dry specimens, one of which is irregular in form and the other consists of two tongue-shaped erect pieces of nearly equal size, each of which is like that above described, but united together laterally for the greater part of their length. Both are intensely hard from the corneous character of the dermal tissue when dried; in both, too, the dermis is nearly black, while the interior is compact and of a ochreous yellow colour. Each individual of the double specimen is about 9 in. high by $2\frac{1}{4} \times \frac{1}{2}$ in. horizontally in its greatest dimensions; when fresh, they were probably nearly double this size. Under the microscope the *interstices* of the dark dermal fibro-reticulation, when dry, present a white appearance from their being tympanized by their dermal sarcode in which the pores are situated. The dry specimens are much lighter and harder than the wet one; but the characters of "consistence" generally in this state are so relative that they are not of much value in a specific point of view.

Hircinia intertexta, n. sp.

Specimen wet. Oblong, erect, like a piece of board an inch thick, slightly thinning towards the sides and upper border, whose margins are rounded and irregularly undulated, sessile, spreading below. Consistence firm and resilient, very light when dry. Colour, when fresh, "grey," now brownish grey. Surface on both sides uniformly covered with monticular, single-pointed conuli averaging 1-24th inch apart and about the same in height above the sunken intervening dermis, which unites them together more or less linearly; dermis consisting of a beautifully reticulated, soft, grey fibre without foreign objects, which dries light brown, and whose interstices are tympanized by a thin transparent sarcode in which the pores are situated, supported by another subjacent reticulation of amber-coloured keratose fibre, which, resting on the ends of the arenaceous vertical filaments, thus together form the conuli and support the dermis. Vents large, chiefly on the upper margin. Internal structure consisting of a mass of reticulated fibre of three kinds, *like the dermis*, viz.:—1, large, scanty, cored with foreign objects, vertical; 2, middle-sized, exclusively amber-coloured keratine, lateral; 3, microscopic, soft when fresh, hard and transparent when dry, intertextural, whose interstices, tympanized by thin poriferous sarcode, occupy the rest of the space and, traversed by the branches of the excretory canal-system, complete the parenchyma. Size of specimen 12 in. high by $3\frac{1}{2} \times 1\frac{1}{2}$ in. horizontally in its greatest dimensions. As a slice has been cut off from one side perpendicularly, the probability is that this specimen was much wider, perhaps double the present width, when entire.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 18 fath.

Obs. The most striking feature in this specimen is the presence of the microscopic, intertextural fibre filling up the interstices of the skeleton, which can only be well seen in a dried fragment; in which the predominance also of the keratine over the mineral element shows that it is in the opposite state, in this respect, to that of *Hircinia solida*, whose weight is rendered much greater simply by the predominance of the mineral element, while that of *H. intertexta* is comparatively light, as above stated.

This is the second species which I have briefly described in my observations on the "Circulation in the Spongida" (p.120) as affording an example of the opening of pores through the subdermal cavities *directly* into a large branch of the excretory canal-system, whereby the nutrient particles must be subsequently deflected through smaller or collateral branches to the ampullaceous sacs, and brought back by a similar set, as the large vessel goes on uninterruptedly increasing in size to its termination in the vent.

Hircinia flabellopalmata, n. sp.

Specimens dry. Compressed, expanded, thin, stipitate, flabelliform, palmate, irregularly and deeply denticulated above, even at the sides, passing downwards into an elongated round stem, which is terminated by a root-like expansion; denticulations thin, wide and compressed like the body, variable in shape and dimensions. Consistence hard now, being dry. Colour whitish grey, from the abundance of foreign spicules incrusting the dermis. Surface consisting of little, pointed, short conuli closely approximated, sometimes united laterally so as to form lines or a reticulation, supporting the dermis, which is densely charged with foreign bodies, chiefly fragmentary sponge-spicules of many kinds; furrowed at the margins on both body and denticulations, with smooth grooves branching inwards, indicating the presence of corresponding canals in the wet state. Pores in the interstices between the conuli. Vents scattered over the surface generally, sometimes arranged linearly on one side of the margin of the denticulation in connexion with the "grooves." Internal structure composed of a reticulate mass of coarse sand-cored or axiated and simple keratose fibre, ending towards the surface in points which form the axes of the conuli respectively; tympanized in the interstices by thin, transparent, flimsy sarcode. Size: there are two specimens of this species which are very much alike, but one much smaller than the other. The largest is 14 in. high (3 in. of which are stem), and 8 by $\frac{1}{3}$ in. in its largest horizontal dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth not given.

Obs. These specimens belong to Mr. Wilson's dry collection, which, although carefully prepared, are, from having undergone much contraction during desiccation, very different from what they would have been in the spirit-preserved state, of which there is none for comparison.

Hircinia communis, n. sp.

Specimen massive, lobed, sessile. Consistence soft. Colour, when fresh, "whitish buff," now light grey. Surface cactiform, uniformly covered with single-pointed conuli, which are comparatively prominent, averaging 3-16ths in. apart and about the same in height, held together by a soft, glutinous dermis which is permeated by an equally soft, fibrous, branching reticulation, *without foreign objects*. Pores in the sarcode tympanizing the interstices of the dermal reticulation. Vents scattered irregularly over the surface. Fibre sand-cored and simply keratose; the former, which is vertical and axiates the conuli, large and coarse, the latter, which is lateral, scanty, tympanized in its massive reticulated structure by the sarcode of the parenchyma, which, together with that of the dermis, shrinks up when dried to the consistence of hard glue. Size of specimen 4 in. high by 4 × 2 in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 20 fath.

Obs. The scantiness of the fibre, soft, thick, glutinous nature of the sarcode, which is chiefly permeated throughout by the equally soft fibro-reticulation that characterizes the dermis, and large cancellation of the parenchyma, cause this species, on drying, to shrink up into a brown corneous mass, which not only obscures the structure generally, but brings the vertical sand-cored filaments into such close proximity as to give them an unnatural predominance; thus altogether rendering the dried fragment so different from the spirit-preserved specimen in its wet state, that one never could be understood by the other if studied separately. It is this kind of *Hircinia* which appears to me to be subject beyond all others to that transformation which is produced by the presence of *Spongiophaga communis*.

Hircinia pulchra, n. sp.

Specimen wet. Consisting of several erect, subcylindrical, unbranched processes of different sizes, more or less united together laterally; compressed in the centre, becoming cylindrical towards the free end, which is obtusely pointed; all rising from a single contracted stem. Consistence firm, resilient. Colour, when fresh, "grey with purple tint," now all grey. Surface uniformly covered with small monticular conuli about 5-8ths in. apart and about the same in height, held together by a strong development of branched, reticulated, simple, keratose fibre supporting the dermal membrane, in which there is *no* foreign material. Pores in the interstices of the dermal reticulation. Vents numerous and small, scattered over the surface in the intervals between the conuli. Fibre sand-cored and simply keratose, almost colourless; the mineral contents of the sand-cored fibre, which is scanty, predominating over the keratose envelope; structure compact; excretory canals numerous and small. Parenchyma more or less charged with ova in different stages of development below the more advanced segmental state. Size of specimen 7 in. high, 2 × 2 in. horizontally in its greatest dimensions; largest process about 1 in. in its greatest diameter; compressed.

Hab. Marine.

Loc Port Phillip Heads, South Australia. Depth 19 fath.

Obs. There is nothing strikingly specific in this specimen beyond the uniformity of its conulated surface, in which the conuli are comparatively small, mostly separate, well formed and striated laterally in the dried fragment by folds of the dermal membrane descending from their apices, the great number of vents and the scantiness of the sand-cored fibre, in which, as above stated, the mineral element far exceeds the envelope of keratine. The great number of vents indicates a great number of excretory canal-systems, and therefore correspondingly small canals, thus leading to the compact character of the parenchyma.

Spongiophaga communis.

Here is the place for me to say a few words on the "filament," which often replaces the whole of the sarcode or soft parts in both the largest and smallest specimens of the *cactiform Hirciniæ* with such fidelity that the pores and excretory canal-systems are left intact as much as they would be in their natural state; indeed, such is the exactness with which the sponge continues to be represented under this transformation, that even some of the best spongiologists have regarded it as a distinct species. For this filament I long since proposed the name of *Spongiophaga communis*, subsequently describing and figuring it among "The Parasites of the Spongida" ('Annals,' 1878, vol. ii. p. 168).

It is almost impossible, in the smallest collection of Psammonematous sponges, not to find some specimens in which the soft parts have been replaced by filaments of this enigmatical organism; so in Mr. Wilson's there are *nine*, of which six are *Hirciniæ*, one a specimen of my group Euspongiosa and the other two in the fibreless Arenosa. That this transformation should take place in different kinds of Psammonemata, although chiefly in the *cactiform Hirciniæ*, is sufficient to show, as before stated, that it has *no specific value*, and that all that can be said of it in connexion with the specimens so transformed is to note its presence in one or the other, as the case may be.

One fact, however, to which I have casually alluded is more particularly worth noting here, viz. that in a specimen of *Hircinia*, whose naturally projecting points have been rounded or covered over by the abundance of the filament, there are several ova dispersed through the structure, in which otherwise there is not the smallest portion of the original sarcode or soft parts left. These ova, about 1-48th in. in diameter, are spherical in form, of a yellow colour, and consist of a mass of small nucleated granuliferous cells surrounded by a very delicate membrane, supported by a tough capsule in which they are respectively contained; so that it would appear as if this capsule had protected them from the transforming power of the filament. I had thought that their contents might have thrown some light upon the development of the "filament" by the granuliferous cells having presented it in an embryonic form; but not the slightest trace of any such connexion could be detected, so this organism remains, as before, an enigma for future observers to solve.

Fam. **Bibulida.**

We now come to the first family of my order Psammonemata, viz. the Bibulida (see "tabular view," *antea*, p. 215), which in my original classification (*op. et loc. cit.* p. 132) is stated to be characterized by "solid fibre, chiefly *without* core of foreign objects," to which is added a footnote, stating that I had never failed to find here and there a fibre cored with foreign objects.

Possibly this may be the case, but practically it is of no use in a specific point of view; for if this can only be demonstrated by much searching with the microscope, it can hardly be considered more than accidental, as the species which I am about to describe will show, in which I have not been able to find foreign material in any part of the fibre, even "here and there."

Euspongia anfractuosa, n. sp.

Specimen dry, massive, convex, sessile, lobate, spreading irregularly. Consistence firm, light. Colour black on the surface, dark purple within. Surface most irregular, consisting of crevices, anfractuosities, circular holes, and irregular depressions ending in the openings of sinuous cavernous cavities internally, which are often bridged over on the surface fenestrally by an extension of the dermal membrane; the latter, which is black, supported on the subjacent fibrous reticulations, whose knots here and there throw up a short point which becomes the axis respectively of microscopic conuli about 1-80th in. apart; this point, when projecting through the dermal membrane, may be seen under the microscope to consist of a simple pointed (?budding) end of the fibre, generally cored with the usual flocculent material, but *without* any foreign bodies. Pores in the dermal membrane over the interstices of the subjacent fibrous reticulation. Vents circular, generally large, but variable in size, scattered numerously over the surface among the anfractuosities. Fibre remarkable for the uniformity of its character in point of fineness and short branching, thus rendering the internal structure soft but very compact; the larger filaments cored with the usual flocculent substance, but *no* foreign bodies, and the whole supporting the sarcode of the parenchyma, in its interstices, traversed plentifully by the canals of the excretory systems, which present a black colour on their surface, from being lined with an extension inwards of the black dermis (?-ectodermic epithelial cells), and end in the vents mentioned, among the "openings" of the "sinuosities," which, also traversing the whole of the sponge, impart to it its anfractuous character both externally and internally. Size of specimen 1½ in. high by 6 × 4 in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. I have described this species from the dried specimen in Mr. Wilson's collection; but there is another spirit-preserved one about the same size, which, in colour, is grey now, but when taken is stated to have been "bright orange."

Also in my cabinet there is a dry specimen of the same species (apparently beach-worn) from the Mauritius, again about the same size, in which, from half an inch into the interior, the colouring-matter has been washed out, leaving the fibre yellowish or sponge-colour, while within this again it is all dark purple, like that of the dried specimen in Mr. Wilson's collection.

Moreover, there are two other dry specimens in Mr. Wilson's collection of a much larger size with the same characters as regards form, above given, but whitish, the sponge itself apparently having grown in the midst of fine sand, as there is as much sand as fibre in it; while in one of these specimens there is the addition of *Spongiophaga communis*, to which I have before alluded, whose filaments can be distinguished from the fibres of the sponge by being *smaller*, together with the terminal bulbs which characterize the filament, but so abundant as to mask over, by a rounded form in the midst of the sand, the characteristic anfractuosities of the purer form, and thus give it a smooth papillated surface in which the papilliform elevations frequently run into linear ridges.

Euspongia anfractuosa resembles the representation of "*Spongia cavernosa*" (Duch. et Mich. Caribbean Sea Sponges, pl. iii. fig. 4), also Hyatt's photograph of his "*Spongia meandriniformis*" (*op. et loc. cit.* pl. xvi. fig. 2).

Coscinoderma lanuginosum.

Coscinoderma lanuginosum, Ann. 1883, vol. xii. p. 309.

There are two spirit-preserved specimens of this species, both of which are very much alike throughout, being stipitate, expanding from a round stem, terminated by a root-like extremity, into a subtriangular body, compressed, thinning to the margin, and bearing on its upper border, which forms one side of the triangle, a series of short, conical, truncated processes of different sizes. Consistence resilient. Colour, when fresh, "grey;" the same now, but faint yellow internally. Surface even, consisting of an arenaceous incrustation which is uniformly perforated by circular holes about 1-48th in. in diameter, and a little more than this apart. Pores in the dermal sarcode tympanizing the bottom of the circular holes. Vents on the conical processes which project from the upper border. Fibre very fine and uniform in calibre, scantily cored here and there with foreign objects, for the most part solid and clear, also scantily branched, but often united transversely by a short portion of the same calibre, which is perpendicular to the two filaments thus united; very abundant and compact, so as to give the parenchyma a felt-like appearance and consistence, traversed by the canals of the excretory system. Size of largest specimen $4\frac{1}{2}$ in. high including the stem, and $2\frac{1}{2} \times 1$ in. horizontally in the greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia. Depth 19 fath.

Obs. The specimens, although much smaller, are precisely the same as that described under the above name in the 'Annals' (*loc. cit.*).

Paraspongia laxa, n. sp.

Specimens dry. Massive, much lobed, somewhat compressed now, sessile, contracted towards the base; lobes mamilliform, erect, and proliferous. Consistence now firm, but *very* light. Colour on the surface for the most part black, becoming lighter on the less exposed parts, light sponge-colour internally. Surface uniformly covered with low conuli about 1-24th in. apart, consisting of a few grains of sand crowning a conical projection of the subjacent fibro-reticulation which supports the black dermal membrane. Pores in the dermal membrane opposite the interstices of the subjacent fibro-reticulation. Vents large and numerous at the ends respectively of the mamilliform lobes and on the margin of the more crested parts. Fibre internally small, solid, very uniform in size, without core, reticulated; traversed vertically by little tracks of sand, held together by a minimum of keratine, which is continuous with the rest of the fibre, and terminating in the conuli mentioned; interstices of the mass of reticulated fibre tympanized by thin transparent sarcode, which thus gives the parenchyma an unusually wide, cancellated, flimsy structure, which being traversed also by the branches of the excretory canal-systems, produces the very light structure which characterizes the species. Size of the largest specimen, for there are two, 11 in. high by 6×2 in. horizontally in its greatest dimensions.

Hab. Marine.

Loc. Port Phillip Heads, South Australia.

Obs. The scantiness of the fibre and its wide reticulation, accompanied by the flimsy transparent sarcode in its present dried state, which tympanizes the interstices, produces an extremely light and loose cancellous texture when dry, which, together with the black colour of the dermis which is equally thin, renders the species almost unmistakable.

Fam. **Pseudohircinida.**

Finally, we have to return to the last family in my orignal classification of the Psammonemata, viz. the Pseudohircinida (see Tabular View, *anteà* p. 215), whose consideration, for reasons already given, was postponed for a more convenient opportunity, which has now arrived.

This family was intended for Psammonematous sponges whose sand-grains were accompanied by spicules of species belonging to one or other of the three following orders:—viz. the Rhaphidonemata, Echinonemata, and Holorhaphidota; hence the three groups of which the family was composed were named Chalinohircinina, Armatohircinina, and Pseudoarenosa respectively.

But it now seems to me that the location of these groups should be determined by the state in which their spicules are, that is, whether they are *entire* or *fragmentary*, since, if the former, the groups may be relegated to the orders to which they respectively belong; and if the latter, viz. *fragmentary*, they *must* form part of the foreign microscopic objects of a genuine Psammonematous sponge, for which the existence of a family Pseudohircinida is therefore no longer necessary.

This I have seen for some time past, and my attention was first called to it by finding two species of caulescent *Chalinida*, in which the fibre not only contained the spicules of the species *entire*, but also, in addition, sand-grains and other microscopic foreign objects; hence it may be remembered that, in the 'Annals' of 1882 (vol. ix. p. 280), I described these two species under the names respectively of "*Chalina digitata*, var. *arenosa*," and "*Cavochalina digitata*, var. *arenosa*," in a new family named "Pseudochalinida," which I proposed to add to the order RHAPHIDONEMATA.

And now it seems to me desirable that a similar transfer should be made to the order ECHINONEMATA.

At first I thought, from the abundance of foreign material and great thickness of the keratose envelope in the fibre of the skeletal specimens of this kind in the British Museum, that the echinating spicules had been appropriated by the Psammonematous sponge, and so made a group to receive them under the name of "Armatohircinina" (*loc. cit.*); but having had to examine a spirit-preserved specimen as well as a dried one, taken respectively from their natural habitat by Mr. Wilson, it seems to me much more reasonable to infer, from the following facts, that the Echinonematous rather than the Psammonematous fibre took in the foreign objects.

Thus in the species *Echinonema anchoratum* ('Annals,' 1881, vol. vii. p. 379) the spiculation consists of an acuate skeletal, a spined clavate echinating, and an equianchorate flesh spicule, each of which has its fixed position in the sponge; that is, the acuate spicule forms the core of the fibre; the echinating spicule is attached to the *outside* or surface of the fibre, and the equianchorate is restricted to the surrounding sarcode, which is precisely the case in the "Armatohircinina."

Now on examining the species in Mr. Wilson's collection to which I have alluded—which, from its large size, handsome flabellate growth, firm consistence, transparent, colourless, glass-like keratose fibre, and greyish-white colour generally, together with the presence of several dry specimens of the same sponge in the British Museum (under the no. 128), which came from the southern coast of Australia, indicating that it is not only a striking object but prevailing form there, I shall name "*Wilsonella australiensis*"—it is evident that a similar spiculation, in which the spicules are *entire*, with the same arrangement, exists in this species as in *Echinonema anchorata*; hence, in accordance with what I have above stated, *Wilsonella australiensis* will be more particularly described at the end of the order ECHINONEMATA, under a new family, viz. "Pseudoechinonemata."

So the remaining group in the family Pseudohircinida, viz. the Pseudoarenosa, in which the spiculation of a *Halichondrina* or an *Esperia* may be often seen in a perfect or *entire* state, may, under the same circumstances, be added to the order HOLORHAPHIDOTA under the family name of "Pseudoholorhaphidota," to correspond in nomenclature and signification with those already proposed for the RHAPHIDONEMATA and ECHINONEMATA respectively.

[To be continued.]

XXVI.—*Remarks on the Variations of* Elapomorphus lemniscatus. By G. A. BOULENGER.

[Plate X.]

SIMULTANEOUSLY with the publication, in the last number of these 'Annals,' of my "List of Reptiles and Batrachians from the Province Rio Grande do Sul, sent to the Natural-History Museum by Dr. H. von Ihering," I received, through the kindness of Dr. A. Strauch, a separate copy of his contribution, "Bemerkungen über die Schlangengattung *Elapomorphus* aus der Familie der Calamariden"*. One species is described as new, viz. *E. Iheringi*, from Rio Grande do Sul, which is the form mentioned in my "List" as a hitherto unrecorded variety of *E. lemniscatus*, distinguished by the absence of the black vertebral band.

The fact that Dr. Strauch had only one specimen before him, and none of the allied forms for comparison, explains the error into which he has fallen. But I trust the illustrations appended to this note will convince the eminent herpetologist that the differences relied upon by him are not sufficiently constant to warrant a specific, or even subspecific, distinction.

We have at present in the Natural-History Museum eight specimens determined as *E. lemniscatus*, to which, for convenience, I will refer by letters:—

a. Adult.	(Ventrals 204, Caudals 22.)	Paraguay (Prof. Grant).
b. Adult.	(V. 208, C. 22.)	Uruguay.
c. Half-grown.	(V. 185, C. 25.)	Uruguay.
d. Young.	(V. 192, C. 26.)	Uruguay.
e. Adult.	(V. 208, C. 25.)	Rio Grande do Sul (Dr. von Ihering).
f. Adult.	(V. 209, C. 26.)	Rio Grande do Sul (Dr. von Ihering).
g. Young.	(V. 186, C. 28.)	Rio Grande do Sul (Dr. von Ihering).
h. Adult.	(V. 212, C. 24.)	High Pampas of San Luis, Mendoza (Mr. E. W. White).

* Mél. Biol. Ac. St. Pétersb. xii. pp. 141-211 (1885).

No two specimens are perfectly alike.

The characters insisted upon by Dr. Strauch as distinguishing *E. Iheringii* from *E. lemniscatus* are the following:— In the latter the snout is narrower and three black bands run along the back, the outer ones being separated from the black colour of the ventral shields. In the former the snout is remarkably broad and rounded, and the head is much depressed and even longitudinally grooved on its upper surface; the median black dorsal band is absent, and the black of the ventrals extends to the flanks. Now we may take specimens *b* and *f* (so lettered also on the Plate) as the extreme forms, representing *E. lemniscatus* and *E. Iheringii* respectively; however, in the latter the head is neither so strongly depressed as observed by Dr. Strauch, nor longitudinally grooved. The differences between these two specimens are considerable, but are bridged over by the others— specimen *a* with the typical coloration and the broad rounded snout; *e* with the black vertebral band, but without the light band separating the ventrals from the latero-dorsal ones; *g* lacking the former, and with distinct indication of the latter. To another variety, not noticed before, belongs specimen *h*; the scales between the black dorsal bands are not yellowish (or red), but greyish brown, each with a small crescentic black marking, and the light collar is absent.

In concluding I must also remark that there is no more ground for separating *E. reticulatus* of Peters from *E. lemniscatus*. The type specimen of the latter species, described by Duméril, must be anomalous if really possessing a simple anal, for all the eight specimens in the British Museum, as well as those examined by Jan, have that shield divided.

XXVII.—*Report on the Testaceous Mollusca obtained during a Dredging-excursion in the Gulf of Suez in the Months of February and March* 1869. By Robert MacAndrew.—*Republished, with Additions and Corrections, by* Alfred Hands Cooke, M.A., Curator in Zoology, Museum of Zoology and Comparative Anatomy, Cambridge.—Part I.

The following Catalogue is a revision of the above "Report," which appeared in the Ann. & Mag. Nat. Hist. for December 1870. In 1873 Mr. MacAndrew died, bequeathing all his collections to the University of Cambridge, and it has fallen to my lot to work through and arrange them. I have been induced to pay particular attention to these Suez shells, which have always been kept in drawers quite by themselves, because an opportunity so seldom occurs of investigating a collection made by a skilled collector, which undoubtedly is derived from the locality specified, and from that locality only. The problem of the geographical distribution of the Mollusca will never even approach solution until we have a number of such collections as this to supply us with adequate data to work upon.

Two reasons have induced me to propose to reissue this "Report" in an entirely new form—firstly, because in Mr. MacAndrew's copy of his pamphlet, now in this museum, numerous corrections and additions occur in his own handwriting; secondly, because a careful examination showed that a certain proportion of his identifications were wrong, and therefore the catalogue as it stood was misleading. Whoever helped him to determine his specimens had evidently gone upon the principle of making as many species out of them as possible (see, *e. g.*, the list of *Ancillaria* below), and the correction of this tendency alone has meant a good deal of work. I may further add that in the "Report" such an entry as "——. Eleven species, undetermined," was not uncommon. Many of these have now been identified, while a few turn out to be new species.

The geographical affinities of the Suez shells have already been remarked upon by Mr. MacAndrew in his article. Taking two genera only I find that

Of 19 species of *Cypræa* found at Suez,

9 are common to the Sandwich Islands;
6 " " Japan;
8 " " Australia;
5 " " Natal.

Of 7 species of *Triton* found at Suez,

2 are common to the Sandwich Islands;
2 " " Japan;
1 is " " Australia.

But I hope to deal more fully with the distribution of the species at the end of this article.

The localities that I have added are in every case drawn from authentic sources, either from the 'Proceedings of the Zoological Society,' the 'Annals and Magazine of Natural History,' various other scientific publications, or from private sources of information on which I can rely.

Words placed within square brackets are additions to or corrections of the original article.

Shell.	Station.	Distribution.	Remarks.
STROMBIDÆ.			
Strombus tricornis, *Mart.* . . .	Low water; frequent at Suez.	Philippines, W. Indies? [The habitat W. Indies doubtless arises from a confusion with *bituberculatus*, Lam.]	"Eaten by the Arab and Greek workmen" (*Issel*).
—— deformis, *Gray* [columba, *Lam.*].	Three specimens, dead: Jubal Is.	Australia, Zanzibar, Persian Gulf. [Mauritius, Ceylon, Philippines, E. Indies generally.]	Unquestionably a somewhat large form of *columba*, Lam., a very variable species, whose metropolis is in the East-Indian Ocean. Specimens before me from Zanzibar are absolutely identical with those here named *deformis*, except in point of size. Issel gives *columba* as an inhabitant of the Red Sea, but makes no mention of *deformis*. Add to synonymy *Swainsoni*, Reeve.
—— elegans, *Sowb.* [dentatus, *L.*].	Six specimens; 3–10 fath., Jubal Is.	Philippines. [Mauritius, Seychelles, Ceylon, New Caledonia, Viti Is., N. Australia.]	Identical with *dentatus*, L., and *rugosus*, Sowb., another variable species, the variations lying mainly in the more or less turreted spire and the prolongation of the longitudinal ribs over the body-whorl.
—— fasciatus, *Born*	One specimen, living, Jubal Is.; dead on shore at Suez, &c.	Red Sea.	The operculum is remarkably large and toothed. The opercula of the larger *Strombi* at Panama (*galea*, *peruvianus*) are the favourite home of a species of *Crepidula*.
—— gibberulus, *L.*	Very abundant on reefs at Ras Mahommed.	Philippine and Society Is. [Mauritius, Cargados, Ceylon, Rodriguez, Natal.]	
—— fusiformis, *Sowb.*	Three specimens, Jubal Is.	N. Australia.	Reeve doubts the localities Red Sea and Indian Ocean, given by Deshayes. Issel confirms MacAndrew, giving it from the Gulf of Akaba.
—— Rüppellii, *Reeve* [dentatus, *L.*, var.].	Two specimens, Jubal Is.	Red Sea.	Probably nothing more than a small variety of *dentatus*, L., in which the longitudinal

			ribs have almost disappeared from the underside of the last whorl, and are slightly more gathered into nodules on the upper side. The mouth, spire, and bandings are exactly identical.
—— terebellatus, *Sowb.* . .	Two specimens, Jubal Is.	Philippines. [New Caledonia.]	Does not occur in Issel's list.
—— floridus, *Lam.*	Frequent, Jubal Is.	Philippines. [Mauritius, Seychelles, Cargados, Natal, Paumotus, Viti Is., Samoa, Rarotonga, Society Is.]	
Harpago Sebæ, *Val.* [= Pteroceras bryonia, *Gmel.*].	Not rare at 4 fath., Tur and Jubal Is.	Society Is. [Seychelles, Amirantes, Java, Nagasaki, Australia.]	Issel seems to regard the two species as distinct, but without sufficient grounds.
Gladius magnus [curvirostris, *Lam.*].	Not rare; dead on shore.	Red Sea, Persian Gulf.	
Terebellum subulatum, *Lam.*	Four specimens, 12 fath., sand, Straits of Jubal.	China and Sooloo Archipelago. [Indian Ocean, Moluccas, and S. Pacific, N.E. Australia, Japan.]	
MURICIDÆ.			
Murex crassispina, *Lam.* [=tribulus, *L.*].	Frequent in sand at moderate depth.	Eastern seas.	A fine series, showing the gradual development of the spines both in number and sharpness.
—— anguliferus, *Lam.*	Frequent at low water.	Ceylon, Persian Gulf. [Bourbon.]	
—— corrugatus, *Sowb.*	Shore to 10 fath.; only young specimens living.	N. Australia. [Philippines.]	Two specimens of a white variety are included.
—— ramosus, *Lam.*	Not rare; shore and shallow water.	Eastern seas.	
—— pleurotomoides, *Reeve*	. . . .	. . . .	Not in the printed list, but no doubt one of the "six species, undetermined; one specimen of each." The present is certainly not *pleurotomoides*, Reeve; its bad condition prevents my determining it.
—— [Urosalpinx] funiculatus, *Reeve* [contractus, *Reeve.*].	Not rare; shallow water, Ras Mahommed.	[New Caledonia, Philippines, Viti Is., Bombay, Japan.]	Given as a *Cantharus*; in the Brit. Mus. it is placed under *Urosalpinx*; Tryon groups it with *Ocinebra*. The identification with Reeve's *Murex contractus* is undoubted.

Shell.	Station.	Distribution.	Remarks.
Fusus marmoratus, *Ph.* ..	Suez: common at low water.	Australia (*Jukes*).	A fine series of eighteen, varying in length from ·25 to 4 inches.
—— polygonoides, *Lam.* ..	Tur and Jubal Is., abundant at low water.	Eastern seas.	
—— strigatus, *Ph.* [marmoratus, *Ph.*].	Low water, two specimens.	....	A misidentification; they are only whitish specimens of *marmoratus*.
Fasciolaria Audouini [*Jonas*] [trapezium, *L.*].	Dead on shore, Ras Mahommed.	Red Sea. [Natal, East Indies generally, Japan, Bourbon, Tasmania.]	One specimen only, manifestly a var. of the common and variable *trapezium*, L.
Latirus turritus, *Gmel.*	Six specimens, Ras Mahommed.	Philippines. [Bourbon.]	Five specimens only are *turritus*; the sixth is quite distinct, and is possibly a worn specimen of *pulcher*, Reeve.
—— [pulcher, *Reeve*].	[One specimen, with the above.]	[Philippines.]	
—— polygonus, *Gmel.*	Dead; rare, Ras Mahommed.	Philippines.	
Vasum cornigerum, *L.*	Abundant on reefs.	Moluccas, &c.	
Cassidulus [Melongena] paradisiacus, *Reeve.*	Abundant at low water.	Indian Ocean, Ceylon. [Natal.]	
Cantharus rubiginosus, *Reeve.*	Two specimens, Ras Mahommed.	Red Sea. [Indian Ocean, Japan, Polynesia, Natal.]	
Phos roseatus, *Hinds*, var. [virgatum, *Hinds*].	Two specimens; 5 fath., sand, Jubal Is.	Philippines, Moluccas.	A misidentification; *virgatum* varies considerably in the number and breadth of the ribs. Should not *Phos* be *neuter*?
Nassa coronula, *A. Ad.* ..	Frequent; shore to 5 fath., Straits of Jubal, &c.	Philippines.	Tryon is perhaps correct in regarding *coronula* as a synonym of *tiarula*, Kien.
—— pullus, *L.*	Not rare; shore to 5 fath., Straits of Jubal, &c.	Philippines. [Bourbon.]	Written on the cards (also in Issel, Tryon, Reeve, &c.) *pulla*, wrongly. Linnæus, in the 'Systema Naturæ,' described the shell as *Buccinum pullus*, *pullus* being a substantive, and meaning the young of an animal. If he had meant to use the adjective *pullus*, brown, he would have called it *Buccinum pullum*. But this *Nassa* is not brown any more than our common English *Phasianella* is.

—— Rumphii, *Desh.*	Two specimens; Straits of Jubal, &c.	Philippines.	Specifically identical with *Bronni*, Ph.=*coronata*, Brug.
—— gemmulata, *Lam.*....	Rare, dead; 5 fath., Straits of Jubal, &c.	Philippines. [Formosa, Japan.]	Two good specimens. Another card (not labelled) contains what are probably two very young forms of the same.
—— nodicostata, *A. Ad.*..	One, dead; shore, Straits of Jubal.	Persian Gulf, Philippines.	
—— Kieneri, *Desh.*	Frequent; shore to 5 fath., Straits of Jubal.	Réunion. [Singapore, Polynesia.]	
—— densigranata, *A. Ad.*..	One specimen; 5 fath., Straits of Jubal.	Philippines.	
—— pulchella, *A. Ad.*	Rare; 5 fath., Straits of Jubal.	Philippines. [Cape of Good Hope, Bourbon.]	
—— *unifasciata, *Pease* [pulchella, *A. Ad.*].	[Nine specimens.]	....	A misidentification; the shells are only a young form of the preceding species. Carpenter (P. Z. S. 1865, p. 516) has united *unifasciata*, Pease, with *paupera*, Gould=*plebecula*, Gould.
—— *sinusigera, *A. Ad.*, var.	[Thirteen specimens.]	[Philippines, Mauritius.]	
COLUMBELLIDÆ.			
Columbella flavida, *Sowb.* [*Lam.*].	Not rare; Tur and Jubal Is.	[Ceylon, Bourbon, Mauritius, Philippines, Japan.]	Thirty-four specimens in all, of various sizes.
—— pœcila, *Sowb.*	Frequent, Tur; sand, shallow water.	Philippines.	
—— spectrum, *Reeve* [pœcila, *Sowb.*].	Moderate, Tur; sand.	Philippines.	The specimens given as belonging to these two species cannot be thus divided; they all belong to the same species, those given to *pœcila* being banded with rows of dots, while those given to *spectrum* are destitute of markings. The shape and texture of the shell is in each case identical. The identity of the two species is a different

* Species thus labelled are added to the original list in MacAndrew's own handwriting.

Shell.	Station.	Distribution.	Remarks.
			matter. Tryon (Manual Conch. iv. p. 110) regards them both as synonyms of *varians*, Sowb.
Columbella tringa, *Lam.* [flavida, *Lam.*].	Rare, Jubal Is., 5 fath.	Philippines.	The two specimens do not differ from *flavida*, Lam.
—— turturina, *Lam.*	Rare, Jubal Is., 5 fath.	Philippines. [Natal, Bourbon.]	
—— minima, *Gask.*	Abundant in 30–40 fath., Straits of Jubal.		
—— albina, *Kien.*	Rare, 5–10 fath., Straits of Jubal.	Philippines.	
—— conspersa, *Gask.*	Frequent, 5-10 fath., Jubal Is.	Philippines.	
—— baculus, *Reeve* [conspersa, *Gask.*].	Rare, 5–10 fath., Jubal Is.	China.	The five specimens appear to be only dead and rather worn specimens of the foregoing.
—— *ornata, *Pease*	Two specimens.		
Engina mendicaria, *Lam.*..	Abundant at low water, Jubal Is.	Philippines. [Ceylon, Mauritius, Polynesia, Natal.]	
Terebridæ.			
Acus crenulata, *Lam.*	Not rare.	Moluccas and Pacific.	
—— consobrina, *Desh* [subulata, *L.*].	Not rare.	Red Sea. [Seychelles, Moluccas, Society Is., Japan.]	The specimens are merely old and rather worn forms, in which the yellowish ground-colour of *subulata* has given place to dead white, and the purple-brown spots have changed to light orange. Indeed I doubt if the species, as a whole, will bear investigation. It appears to me to be simply a worn form of *subulata*, for the pricked striæ which Reeve describes as distinguishing it are equally found in that species.

—— duplicata, *Lam.*	Frequent.	China, Indian Ocean, E. Africa.	In all the specimens the ribs are so much sharper and less numerous than in the ordinary type of *duplicata*, as almost to make one think that this is a distinct species. They are all young and undeveloped specimens, however.
—— maculata, *Lam.*	On shore, in bad condition.	Philippine and Society Is., Australia, Moluccas, Persian Gulf, &c. [Bourbon.]	
—— nimbosa, *Hinds*	Two specimens.	Red Sea.	
—— fictilis, *Hinds*	Two specimens.	Australia.	
Terebra babylonia, *Lam.* ..	Four specimens.	China, Sandwich Is.	
—— cingulifera, *Lam.*	One specimen.	Philippines, Marquesas.	
—— lima, *Desh.*	Four specimens.	China seas.	
—— ligata, *Hinds*	Two specimens.	Marquesas.	This identification is exceedingly doubtful. The specimens are in the worst possible condition, the only distinguishable resemblance to *ligata* being that in one of them a few square spots of colour can be detected on the body and next few whorls.
—— affinis, *Gray*	Frequent, Jubal Is.	Philippines, Seychelle Is., &c.	
—— columellaris, *Hinds* ..	One specimen, Jubal Is.	Tahiti.	
—— variegata, *Gray*? [castigata, *Cooke*].	Not rare, Jubal Is.	West Africa, California.	The species has no connexion whatever with *variegata*, and appears to me to be new. *T. castigata*, n. sp.—Shell acuminate, sometimes slightly distorted, strongly corded at the sutures, marked with numerous distant longitudinal ribs, the intervals between which are smooth; ribs broad and rounded, becoming sharply evanescent at the centre of the body-whorl, and nodulous on the sutural cordings; colour fulvous-brown, streaked and spotted, especially on the cordings, with darker dashes of colour; aperture wide; columella thickened. Length ·6875 in., breadth ·1875 in.

Shell.	Station.	Distribution.	Remarks.
PURPURIDÆ.			
Purpura echinata, *Blainv.* [Sistrum spectrum, *Reeve*].	Rare, shallow water, Straits of Jubal.	Singapore.	A misidentification. The shells (four good specimens) are *Sistrum spectrum*, Reeve. That author (Conch. Icon. vol. iii. *Ricinula*, sp. 19) says the shell "appears to be naturally colourless." These specimens are corded with four or five thin bands of red-brown between each row of tubercles.
—— Savignyi, *Desh.* [bituberculāris, *Lam.*, var. Savignyi, *Desh.*].	....	Red Sea. [Aden, Persian Gulf.]	Given as a *Sistrum*; but the determination as now made is unquestionable. I have series before me which trace the varietal development from the type of *bituberculāris*, whose metropolis is the Malay peninsula, while the variety, which is always largely and strongly tubercled, is from the East-Indian Ocean, Persian Gulf, and Red Sea.
Pentadactylus albolabris, *Blainv.* [Ricinula ricinus, *L.*].	Two specimens, shallow water, Ras Mahommed.	Philippines, &c. [Benguela, Natal, Ceylon, Moluccas, Japan, Polynesia, New Zealand.]	Even Reeve suggested that *albolabris* must be a form of *ricinus*; but why does he prefer *arachnoides* (Lamarck's name) to *ricinus* (that of Linné)?
—— arachnoides, *Lam.* [= ricinus, *L.*].	Several; shore, dead, Ras Mahommed.		
—— digitata, *Lam.*	Two specimens; dead, Ras Mahommed.	Seychelles.	
—— horrida, *Lam.*	One specimen, from dealer at Suez.	Philippines. [Ceylon, Mauritius, E. Indies generally, Polynesia.]	The species is mentioned in Issel's list (p. 122) as inhabiting the Red Sea.
Sistrum anaxares, *D'Orb.*..	One specimen; dead, Ras Mahommed.	Lord Hood's Is., Natal. [Polynesia.]	
—— dealbatum, *Reeve* [spectrum, *Reeve*].	Several, Ras Mahommed.	....	Unquestionably identical, both as regards these specimens and the species as a whole, with *spectrum*, Reeve. The type was evidently described from a very worn specimen.

—— chrysostoma, *Desh.* [*Reeve*].	Three specimens.	Philippines. [Ceylon, Seychelles, Mauritius, Polynesia.]	
—— ochrostoma, *Reeve* [*Blainv.*]	Three specimens.	Philippines. [Polynesia.]	This species again must be merged in *spectrum*, Reeve, of which it is a less-developed form, differing only in the orange colour of the aperture, which, however, is distinctly recognizable in several of the shells above labelled *Purpura echinata.* As there seems to be some doubt about the certainty of the identification with Blainville's *ochrostoma*, it would be better that Reeve's name should supplant his, and not *vice versâ.*
—— spectrum, *Reeve.*	One specimen.		
—— fiscellum, *Chemn.* ..	Not rare; on reefs, Suez to Ras Mahommed.	Philippines. [Polynesia, Natal.]	
—— ——, var.	....	....	White; interior red, instead of purple.
—— tuberculatum, *Blainv.*	Common on reefs, Tur to Ras Mahommed.	Pacific Islands. [Aden, Ceylon, Andamans, Polynesia, Japan, Port Jackson, Natal.]	
—— asperum, *Lam.*	Not rare; shallow water, Straits of Jubal.	Philippines. [Natal.]	
—— *heptagonale, *Reeve.*	[Seven living specimens.]	[Natal.]	I cannot agree with Tryon in making this a mere var. of *ochrostoma* (=*spectrum*). The general turreted appearance, deep suture, abundant colouring, &c. are distinguishing features. Reeve (Conch. Icon.) reports the type as having been collected at Panama by Cuming; but this seems extremely unlikely. I have collected at Panama myself without finding it.
Iopas sertum, *Brug.*	One specimen, young; Ras Mahommed.	[Red Sea, Ceylon, Singapore, Mauritius, Philippines, Paumotus.]	
—— situla, *Reeve* [=sertum, *Brug.*].	Not unfrequent; dead on shore, Ras Mahommed.	Anaa, Pacific.	The identity of this species with *sertum* is now well established.

Shell.	Station.	Distribution.	Remarks.
Rapana bulbosa, *Sol.*	Not rare; shore, dead.	Eastern seas. [China, Japan.]	
Coralliophila costularis, *Blainv.*	Shore, dead; rare.	Philippines. [Polynesia, Australia.]	Two very worn specimens.
—— galea, *Chemn.* [costularis, *Blainv.*].	Shore, dead; rare.	Philippines.	One bad specimen only, certainly not *galea*, but identical with the preceding.
—— exarata, *Pease*	Rare; shore, Straits of Jubal.	....	Five specimens on the card, of which only three are *exarata*; the remaining two are very worn; one may be *Sistrum spectrum*, the other is uncommonly like a very young *Strombus tricornis*!
—— madreporianus, *A. Ad.* [madreporarum, *Sowb.*].	Frequent, on coral.	Eastern seas. [Tasmania, Japan.]	A fine series of twenty-five.
Magilus antiquus, *Montf.* [*Lam.*].	Common in old madrepore on the islands.	[Mauritius.]	No specimens occur in the collection.
Leptoconchus Lamarckii. *Desh.*	In madrepore, Ras Mahommed.	Mauritius.	
RANELLIDÆ.			
Ranella bufonia, *Bolt.*	Shore, dead; not rare at Ras Mahommed.	Philippines. [Bourbon.]	
—— hians, *Schum.*	Reefs, rare.	Philippines. [Eastern seas generally. New Caledonia, Japan.]	
—— affinis, *Brod.*	Shore, dead; frequent at Ras Mahommed.	Pacific Ocean, &c. [Natal, Bourbon. Ceylon, N. Australia, New South Wales, New Hebrides.]	
—— concinna, *Ph.*	One specimen living, one dead; Ras Mahommed.	Red Sea.	
—— pusilla, *Brod.*	One specimen, dead; Ras Mahommed.	Mauritius, [Pacific Is., Philippines. [Natal.]	
TRITONIDÆ.			
Triton tritonis, *L.*........	Saw a specimen in hands of fishermen.	Eastern seas. [Samoa Is., Paumotus, Japan, St. Helena.]	It apparently remained in the hands of the fishermen, for it is not in the collection. The occurrence of the species requires confirmation; it is not in Issel's list.

—— ægrotus, *Reeve* [trilineatus, *Reeve*].	One specimen, shore, Ras Mahommed.	China.	Whether *ægrotus* is or is not distinct from *trilineatus*, there is no doubt that this, a young specimen, is identical with the two shells, named *trilineatus*, that follow.
—— rubecula, *L.*	Two specimens, Jubal Is.	Philippines, &c. [Eastern seas generally, to Sandwich Is.]	
—— pilearis, *Lam.*	One specimen, young; Tur.	Philippines. [Natal, Eastern seas generally, Japan, N. Australia, W. Indies, Florida, west coast C. America.]	
—— aquatilis, *Reeve* [pilearis, *Lam.*, var.].	Two specimens, dead; Ras Mahommed,	Philippines, &c.	Unquestionably specifically identical with *pilearis*, but generally of a lighter colour.
—— gallinago, *Reeve*	Three specimens, dead; Ras Mahommed.	Philippines, &c.	
—— trilineatus, *Reeve*	Two specimens, dead; Ras Mahommed.	Philippines, Persian Gulf.	
—— cingulatus, *Reeve*	One specimen, young; Jubal Is.	Philippines.	
—— *variegatus, *Lam.* [tritonis, *L.*].	[One young specimen.]	....	This is nothing but a young and much-broken specimen of *tritonis*, the break having been such as to make the canal appear very long.
—— [clavator, *Lam.*]	....	....	I thus identify one of the young and undetermined shells.
Epidromus bracteatus, *Hinds.*	Four specimens, Ras Mahommed.	[Philippines, Marquesas, Sandwich Is.]	
—— lativaricosus, *Reeve* ..	Three specimens, Ras Mahommed.		
—— Sowerbii, *Reeve*	One specimen, young; Jubal Is.	Pacific.	
Distortio anus, *L.*	Shore, dead; frequent at Ras Mahommed and Jubal Is.	Ceylon, Philippines, &c.	
Doliidæ.			
Cadium [Malea] pomum, *L.*	Rare, Ras Mahommed.	Society and Philippine Is. &c. [Bourbon.]	

Shell.	Station.	Distribution.	Remarks.
CASSIDÆ.			
Semicassis [Cassis] torquata, *Reeve* [vibex, *L.*]	Shore, dead; Ras Mahommed.	New Holland. [Bourbon, Eastern seas generally, Japan.]	The species cannot possibly stand, even as a variety.
—— vibex, *L.*	One specimen; shore, dead, Ras Mahommed.	Philippines.	
HARPIDÆ.			
Harpa crassa, *Ph.* [minor, *Lam.*].	Not unfrequent on shore at Ras Mahommed and Jubal Is.	Red Sea. [Natal, Bourbon.]	
OLIVIDÆ.			
Dactylus [Oliva] inflata, *Lam.*	On shore at Ras Mahommed.	Persian Gulf, &c.	The four specimens appear to me much more like *elegans*, Lam.
Ancilla crassa, *Sow.* [Ancillaria cinnamomea, *Lam.*].	Sand at low water; frequent.	Red Sea.	
—— lineolata, *A. Ad.*	Sand at low water; rare.	Red Sea.	
—— ovalis, *Reeve* [cinnamomea, *Lam.*].	Sand at low water; rare.	Red Sea.	Only a white form of the shell denoted *crassa*.
—— striolata, *Sowb.* [cinnamomea, *Lam.*].	Sand at low water; frequent.	Red Sea, Persian Gulf.	Quite undistinguishable from the shells labelled *crassa*.
MITRIDÆ.			
Mitra Bovei, *Kien.*	Frequent, dead on shore at Suez; one living, 5 fath., sand, Jubal Is.	Red Sea.	
—— pretiosa, *Reeve*	Six specimens; sand at 5 fath., Jubal Is.	[Japan.]	Regarded by Tryon (Manual Conch. vol. iv. p. 135) as the young of *crenifera*, Lam.; but query?
—— pura, *A. Ad.* [filosa, *Born*].	Five specimens; sand at 5 fath., Jubal Is.	Sandwich Is. [Mauritius, Philippines, Polynesia.]	There is only one specimen in the collection; *pura*, Ads., is merely a white or

			whitened form of the common *filosa*, Born, not worthy even of the name of a variety. Add to synonymy *carnicolor*, Reeve.
—— amœna, *A. Ad.* [annulata, *Reeve*].	One specimen; sand at 5 fath., Jubal Is.	[Ceylon, Philippines, New Caledonia, Polynesia.]	Equals *annulata*, Reeve (Tryon, Manual, vol. iv. p. 141).
—— Antonelli, *Dohrn* [obeliscus, *Reeve*].	One specimen.	[Andaman Is., Philippines, Viti Is., Japan.]	A misidentification; the shell is *obeliscus*, Reeve. Tryon wrongly regards *Antonelli* as a variety of *militaris*, Reeve. Seven other specimens of *obeliscus* occur, not hitherto labelled.
—— cucumerina, *Lam.*	One specimen.	Philippines. [Ceylon, Polynesia.]	Printed as *fragra* (*sic*), Quoy, but corrected in MacAndrew's own handwriting.
—— planilirata, *Reeve* [=Solandri, *Reeve*].	One specimen.	Red Sea.	Tryon clearly shows the identity of *planilirata* and *Solandri*, the type of the latter being an old and worn shell.
—— Wisemanni ?, *Dohrn* .	One specimen.	Sandwich Is.	Identical with the specimen labelled *Pharaonis*, Issel. The two species are quite distinct, and this *Wisemanni* therefore is wrong. It should be pointed out. as against Tryon (Manual, vol. iv. p. 181), that (1) *M. Pharaonis*, Issel, is not a synonym of *cadaverosa*, Reeve, to which it has not the slightest resemblance; (2) the *M. Pharaonis* he refers to as of Issel should be of Géné, and is so given by Issel himself (Malac. del Mar. Rosso, p. 119); (3) the species is not a fossil one, as he says (hastily taking the name from Issel's list of Red-Sea shells found subfossil), but occurs in a recent state in the Gulf of Akaba (Issel, *ut suprà*).
—— Pharaonis, *Issel* [*Géné*]	One specimen.		
[Volutomitra ? sp.]	One specimen.	....	The shell appears to be a *Thala*, but is too worn for identification.
Turricula osiridis, *Issel* ..	Four specimens, Jubal Is. Has a broad brown or black band.	....	These specimens are no longer in the collection. One, however, is in the British Museum, and =*umbonata*, Sowb.

Shell.	Station.	Distribution.	Remarks.
Turricula echinata, *A. Ad.* [=mucronata, *Swains.*].	Three specimens.	....	Tryon, I think rightly, considers this a synonym of the variable *mucronata*, Swains., which, as the next name shows, occurs in the Red Sea.
—— mucronata, *Swains.* ..	One specimen.	Sandwich Is. [Polynesia.]	
—— pulchella, *Reeve*? [aureolata, *Swains.*].	One specimen.	Barbadoes. [Philippines, Polynesia.]	A misidentification. The shell is rather worn, but easily recognizable as the variable *aureolata* (=*crocata*, Lam., +*concinna*, Reeve+*venustula*, Reeve).
—— nodolyrata, *A. Ad.* [nodilirata].	Two specimens.	....	Very close to *mucronata*, Swains. Tryon, probably rightly, regards it as a synonym.
—— *turricula, *A. Ad.* ?..	[One specimen.]	....	Adams has written on the back of the card, "Much worn; can't be certain." Tryon regards *turricula* as var. of *militaris*, Reeve. To me the shell looks more like a worn specimen of *lubens*, Reeve, and this, again, Tryon regards as var. of *militaris*.
—— *lucida, *Reeve*	[One specimen.]	....	Though labelled at the back by Adams, the shell does not in the least agree with Reeve's description of *lucida*; it is not so produced at the base, not "transversely most elegantly ribbed," while the columella is not five- but four-plaited.
—— *Pharaonis, *H. Ad.*..	....	....	The type specimen, given by MacAndrew, is in the British Museum; no specimen is found in this collection. The name being preoccupied (see above) I would suggest its being changed to *Macandreæ*.
—— fidicula, *Gld.* [alauda, *Sowb.*].	One specimen.	[Indian Ocean, Mauritius, New Caledonia, Polynesia.]	There are two specimens thus named, one in Adams's hand, and their history appears to be this: they were doubtless named from two specimens in the British Museum, labelled *fidicula*, which, however, on close examination, turn out to be a variety of *alauda*, Sowb., in which the usual bands of red dots have become confluent.

—— hebræa, *Lam.* [=litterata, *Lam.*].	One specimen.	[Java, Philippines, Polynesia, Mauritius, S. Africa.]	
—— pardalis, *Küster*	Two specimens.	....	Tryon states (Manual, vol. iv. p. 184) that Reeve's figure of *pardalis* is a *Columbella*. I may as well mention, to show the value of such rash assertions, that it corresponds with these two specimens (unquestionably rightly named) in every particular.
—— *leopardina, *Küster*	[One specimen.]	....	The single specimen does not differ from *pardalis*.
——[=pardalis, *Küster*]. tusa, *Reeve*	One specimen.	Philippines.	
—— glandiformis, *Reeve* ..	Five specimens.	....	A complete misidentification; but to name the shells correctly is not so easy. They are very near to *fuscoapicata*, E. A. Smith (Japan), but the ribs in the Suez shells are fewer and angulated, not round.
—— *Rüppellii, *Reeve* [Solandri, *Reeve*].	Two specimens.	....	Undoubtedly young specimens of *Solandri*, Reeve.
—— casta, *H. Ad.* [hastata, *Sowb.*].	Two specimens.	....	The name cannot stand, as there is a *casta* of Lamarck. Sowerby (Thes. Conch. figs. 620, 632) changed it to *hastata*.
—— [puerilis, *Cooke*] ...	Seven specimens.	....	These shells are marked in Adams's hand "*casta*, var." They have not, however, the least resemblance to *casta*, and appear to me to be new. I will therefore describe them under the name of *Mitra puerilis*:— Shell small, somewhat elongated; spire turreted, but not sharply; suture deepish; strongly angled beneath the suture, longitudinally strongly ribbed; ribs on the body-whorl ten, rounded, crossed by well-marked rather distant transverse lines which are coloured on the tops of the ribs; colour light flesh-tint with (in fresh specimens) a deeper broad band on the lower half of the body-whorl; columella four-plaited. Length ·35 in., breadth ·09 in.

Shell.	Station.	Distribution.	Remarks.
Turricula [Antoniæ, *H. Ad.*]	. . . .	. . . .	Described in P. Z. S., 1870, p. 788. The type is in the British Museum, and no specimens occur in this collection.
MARGINELLIDÆ.			
Marginella pygmæa, *Issel* . .	Sand, shore to 5 fath.		
—— Savignyi, *Issel*	Sand, shore to 5 fath.	*Persian Gulf.	
—— suezensis, *Issel*	Sand, shore to 5 fath.	*Persian Gulf.	
Erato nana, *Duc.* [corrugata, *Hinds*].	One specimen.	. . . .	A misidentification; there is no sign of longitudinal wrinkles. I place the specimen (a bad one) with *corrugata*, Hinds, doubtfully.
Ringicula acuta, *Ph.*	Not rare; 5–10 fath., sand.	*Persian Gulf.	
CYPRÆIDÆ.			
Cypræa fimbriata, *Gmel.* . .	Abundant on shore, dead; Zeite Point.	Japan. [Natal, N. and W. Australia.]	*C. neglecta*, Sowb., appears to be identical.
—— carneola, *Lam.*	Not rare; reefs, Tur &c.	Pacific Ocean. [Sandwich Is. included.]	
—— talpa, *L.*	Not rare, dead.	Eastern seas. [All Polynesia; not Australia.]	No specimens in the collection.
—— erythræensis, *Beck* . .	One specimen, dead; Zeite Point.	Red Sea.	A very worn shell, without any indications of colouring, but I think correctly identified.
—— Isabella, *L.*	One specimen, in good condition; Zeite Point.	Mauritius. [E. Indies generally, Queensland, all Polynesia.]	
—— Macandræi, *Sowb.* . .	One specimen, in good condition; Zeite Point.	. . . .	Three other worn specimens are in the collection. The species is near to, but sufficiently distinct from, *punctata*, L.

—— reticulata, *Mart.* [arabica, *L.*].	Frequent, from fishermen.	Eastern seas. [Natal, N. and W. Australia, Japan, Queensland, Caroline to Paumotu Is.]	
—— annulus, *L.*	Shore.	Eastern seas. [Natal, Queensland, Viti to Caroline Is., Tasmania, N. Zealand.]	
—— moneta, *L.*	Shore, dead.	Pacific Ocean. [Japan, W. Africa, St. Helena.]	
—— caurica, *L.*	Not rare; from fishermen, Tur.	Eastern seas. [Queensland, Caroline to Cook's Is., Japan.]	
—— erosa, *L.*	Not rare; from fishermen, Tur.	Eastern seas. [Natal, Queensland, Polynesia to Sandwich Is., Japan.]	
—— lentiginosa, *Gray*	One specimen, dead; 4 fath., Jubal Is.	Ceylon.	A small, rather worn specimen, but correctly identified.
—— lynx, *L.*	Frequent, from fishermen.	Pacific Islands, Ceylon, Mauritius. [Natal, Japan to N. and W. Australia, Queensland, Polynesia to Sandwich Is.]	
—— pantherina, *Sol.*	Frequent, from fishermen.	Red Sea.	
—— turdus, *L.*	Frequent, from fishermen.	[St. Helena, Eastern seas.]	
Trivia oryza, *Lam.*	Shore, rare; Straits of Jubal.	Philippines. [Bourbon, N. Australia, Polynesia to Sandwich Is.]	
—— tremeza, *Ducl.*	Shore, two specimens, Ras Mahommed.	West Indies, Sandwich Is. [Bourbon.]	A doubtful identification. The species appears new.
—— nucleus, *L.*	Two specimens, Jubal Is.	[Bourbon to Philippines, all Polynesia included, Sandwich Is.]	
—— cicercula, *Gmel.*	On shore, in bad condition.	Pacific [as far north as the Sandwich Is.].	
Amphiperas [ovoideus, *H. Ad.*].	Rare, 8 fath., on coral.		

[To be continued.]

XXVIII.—*Description of a new Genus of* Chalcosiidæ *allied to* Himantopterus. By Arthur G. Butler, F.L.S., F.Z.S., &c.

The genus *Himantopterus*, represented by a very remarkable moth from Java, was described by M. Wesmael in 1836, in the ' Bulletins de l'Académie Royale des Sciences de Bruxelles' (1st ser. vol. iii. pp. 162, 163, pl. vi. fig. 1). The chief peculiarity of this moth consists in its linear and much-elongated secondaries, which are in fact mere balancers, similar to the tails which terminate the wings of some genera of Lycænidæ.

In describing his new genus M. Wesmael gave no account of the neuration of the wings; but this omission was subsequently remedied by Prof. Westwood, who, in 1876, examined the type in the Brussels Museum, and made a careful drawing of the venation, which he published in the 'Transactions of the Entomological Society' for 1877, pl. x. From his description, as well as from that of M. Wesmael, the secondaries appear to have no neuration.

In the first volume of the 'Zoologist,' pp. 197, 198, Mr. Edward Doubleday described and figured, under the name of *Thymara*, a new genus allied to *Himantopterus*, the posterior wings of which, however, though ornamented with a long tail, are fully developed; at the same time he reproduced Wesmael's figure in outline.

Although *Himantopterus* and *Thymara* are allied genera, they differ so considerably in the development of their secondaries that it was to be expected that intermediate genera would eventually be discovered tending to show the modification of a true wing into a mere rudimentary appendage, and now, after the lapse of upwards of forty years, one of these links has at last come to light.

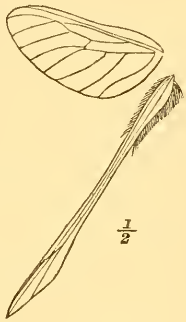
In the 'Verhandlungen der zoologisch-botanischen Gesellschaft' of Vienna (vol. xxviii. p. 42), there is a record of "a second species of the genus *Himantopterus*" from Zanzibar, brought home by Mr. E. Marno, and identified by Mr. Rogenhofer. One would naturally have expected so important a novelty to be figured in the Lepidopterous portion of the 'Reise der Novara,' yet, up to the present time, it appears to remain in obscurity.

In a collection recently received by Mr. Francis Swanzy from the west coast of Africa was a small moth of such remarkable form that he brought it to me and asked me if I knew anything like it. I at once pronounced it to be a

Himantopterus, and proceeded to compare it with the figures of that genus, when it became evident that, although nearer to that type than to any other, the African moth was clearly the representative of a new and distinct genus, which I now have the pleasure of describing.

PEDOPTILA, gen. nov. (*πηδὸν, πτίλον*).

General aspect of *Himantopterus*, but differing in the neuration of the primaries and structure of the secondaries as follows:—Primaries broader and less elongated; the two branches of the subcostal vein emitted from a short footstalk; upper radial vein straight; lower radial and third median branch emitted together from the inferior angle of the cell, but not from a footstalk; all three median branches incurved and distinctly longer; submedian vein more sinuous: secondaries almost twice the length of the primaries, very slender, spatulate, narrowest in the middle, broadly fringed at the base,



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but with the rest of the fringe short, traversed for about four fifths of their length by two parallel veins, the subcostal and the median; but at this point (where the wing begins to expand) a very oblique discocellular veinlet unites them, and immediately beyond this, the subcostal forks into the usual two branches; the apex of the wing is very acute, the outer margin (which runs back to a point nearly opposite to the forking of the subcostal vein) is very oblique. In the structure of the body this genus appears to agree closely with *Himantopterus*; the antennæ are rather short and pectinated and the mouth-organs appear to be aborted.

Pedoptila nemopteridia, sp. n.

Form of the European Neuropteron *Nemoptera coa*, but smaller than the type of *Himantopterus*; wings semitransparent; basal two fifths of primaries and basal third of secondaries bright russet reddish, remainder of the wings grey; the veins darker than the ground-colour; body sienna-reddish; antennæ dark brown. Expanse of wings 23 millim.

Cape Coast, West Africa (*coll. F. Swanzy*).

The anterior wing measures $10\frac{1}{2}$ millim. and the posterior $18\frac{1}{2}$; the body in length 7 millim.

It is probable that the Zanzibar species mentioned by Rogenhofer belongs to this genus rather than to *Himantopterus*.

XXIX.—*Description of a new Species of the Coleopterous Genus* Mecynodera (Sagridæ). By CHARLES O. WATERHOUSE.

Mecynodera Wickhami, n. sp.

Nigra, nitidissima; thorace femoribusque sanguineis; elytris rufoflavis, fascia basali, gutta discoidali et apice nigris. Long. 13 lin.

Very close to *M. Balyi*, Clk., but larger and broader. The thorax is entirely red, smooth, with a slight impression on the disk behind the middle. The elytra have the basal third black, except the shoulders and a red spot in the middle of the base. The curved impressed line which exists in *M. Balyi* is in this species divided into two. There is a black punctured punctiform impression a little behind the middle of each elytron. The whole of the apex is black. The femora are red, except a little black at the base and apex. On the middle area of the elytra some lines of very fine delicate punctures may be traced.

Hab. Queensland.

Together with the above-described species a specimen of *Eurytrachelus arfakianus*, Lansb. (C. R. Soc. Ent. Belg. xxiii. 1880, p. cxviii) was received. This is the first time any species of this group of Lucanidæ has come under my notice from Australia. The species is easily recognized by the incision behind the eyes &c.

XXX.—*Notices of British Fungi.* By the Rev. M. J. BERKELEY, F.R.S., and C. E. BROOME, F.L.S.

[Continued from ser. 5, vol. xii. p. 374.]

**Agaricus* (Tricholoma) *bufonius*, Fr. Hym. Eur. p. 63. Penzance, J. Ralfs.

Just the plant of Bulliard; but it is doubtful whether it is really distinct from *A. sulphureus*. What was formerly regarded as this species is a dark form of *A. saponaceus.* The scent is quite as strong as in the normal *A. sulphureus.*

**A.* (Tricholoma) *putidus*, Fr. Hym. Eur. p. 78.

The synonym of *A. rancidus*, Kalchb., really belongs to this species. Specimens occurred at Coed Coch in 1883 which exactly agreed with Kalchbrenner's figure, and not at all with that in Fr. Icon.

**A.* (Clitocybe) *fumosus*, Pers. Syn. p. 348.

Specimens of this variable species were sent by the Rev. D. Paul from Roxburgh of such a dark brown that at first sight they seemed quite different from the ordinary plant and approaching very near to it, as figured by Letellier, the only difference being that the stem was of a brownish tint and deeply striate. Compare what is said by Fries in the Hym. Eur. p. 91.

2028. *A.* (Collybia) *laxipes*, Fr. Hym. Eur. p. 115; Batt. p. 46, tab. ix. fig. 1 (not fig. 5).

On a willow board in a heap of firewood, Sibbertoft, Dec. 29, 1883.

This is scarcely more than a slender form of *A. velutipes.* The specimens were scattered and for the most part solitary and very pale, from growing in perfect darkness. One group only was slightly cæspitose.

2029. *A.* (Nolanea) *piceus*, Kalchb. tab. 12. fig. 3.

Coed Coch, 1883. The small form figured by Kalchbrenner, which looks very different from the large form figured by Cooke. Dr. Badham sent from East Bergholt a fish-scented Agaric; but it was a *Lepiota* too imperfect to describe.

2030. *A.* (Pholiota) *subluteus*, Fl. Dan. tab. 1192.

Faldonside, Rev. D. Paul and W. B. Boyd.

Stem nearly 6 inches high, $\frac{3}{8}$ thick, somewhat tuberculose at the base. Spores dull yellow, elliptic, ·0004 to ·0005 inch long.

An interesting addition to the list of British Agarics, as it was known to Fries only by the 'Fl. Danica' figure. Ring rather ragged; stem silky; gills at first decurrent, pale yellow.

2031. *A.* (Pholiota) *inauratus*, Smith, Cooke, tab. 477.

On a fallen willow, Batheaston, &c.

Formerly passed by as a form of *Ag. squarrosus.*

2032. *A.* (Flammula) *gymnopodius*, Fr. Hym. Eur. p. 244; Cooke, tab. 431.

On pine sawdust, Munstead, T. Howse.

A grand addition to British Fungi.

2033. *A.* (Flammula) *fusus*, Fr. Hym. Eur. p. 247; Cooke, tab. 434.

Sibbertoft, Miss Ruth Berkeley.

A large form on the ground.

2034. *A.* (Naucoria) *pusiolus*, Fr. Hym. Eur. p. 258; Cooke, tab. 457.

Sibbertoft.

2035. *A.* (Galera) *vittæformis*, Fr. Hym. Eur. p. 269; Cooke, tab. 464.

Sibbertoft, amongst grass in a garden, July 31, 1884.

2036. *A.* (Tubaria) *embolus*, Fr. Hym. Eur. p. 274.

Penzance, J. Ralfs. So like *A. umbelliferus* that it might be passed without notice if the bright-coloured spores were not observed.

2037. *A.* (Galera) *minutus*, Quélet, tab. i. f. 5; Cooke, tab. 466.

On twigs, Wrotham, Kent, Rev. M. J. Berkeley.

2038. *A.* (Psalliota) *subgibbosus*, Fr. Hym. Eur. p. 281. Pileo gibboso, subfulvo, carnoso, subscabro-hispidulo; annulo appendiculato sericeo-fibrilloso; lamellis ascendentibus liberis fulvis.

By the side of a road, Penzance, J. Ralfs.

The name occurs under *A. comtulus*, Fr. It seems quite distinct from any *Psalliota* with which we are acquainted; the pileus is rough with scabrous silky points. Stem of the same colour as the pileus, fibrillose; gills dark brown; umbo of pileus fibrillose.

2039. *A.* (Psathyra) *helobius*, Kalchb. tab. 17. fig. 4.

On a heap of rubbish, Coed Coch, Sept. 1884.

Remarkable for the radiating wrinkles, even in young specimens. Exactly Kalchbrenner's species.

2040. *A.* (Panæolus) *remotus*, Schæff. t. 210.

Penzance, J. Ralfs.

2041. *A.* (Psathyra) *fatuus*, Fr. Hym. Eur. p. 308.

Coed Coch, July 1882.

Pileus campanulate, margin striate, umber; gills adnexed, pale umber, ascending, first dirty white; stem elongated, thicker below, white, fistulose, at length umber.

2042. *Coprinus platypus*, Berk. Pileo campanulato albo leviter striato, atro-squamoso; margine subcrenato; stipite sursum æquali, basi dilatato albo pulverulento; lamellis fusco-atris, margine rubeolis, prope marginem pilei albis, sterilibus, remotis.

Sibbertoft. On cocoa-nut bracts in a hothouse.

A very pretty minute species, possibly of Indian origin, not very deliquescent.

2043. *Cortinarius* (Hydrocybe) *dilutus*, Fr. Hym. Eur. p. 389.

Coed Coch.

**Hygrophorus Wynnei*, B. &. Br. under no. 1962.

An important clerical error, substituting *Marasmius* for *Hygrophorus*, has already been recorded. The present object is to point out that the species is probably what Bulliard called *Agaricus mollis*, tab. 38, which has not of late years been noticed by him. In Bulliard and Ventenat it is said to be a form of *Lentinus tigrinus*.

2044. *Marasmius varicosus*, Fr. Hym. Eur. p. 469.

Tarland, Aberdeenshire. Amongst moss, Rev. M. J. Berkeley.

2045. *Boletus aurantiporus*, Howse.

A fine drawing and specimen of this beautiful species have been received from the author.

**Polyporus Rostkovii*, Fr. Hym. Eur. p. 524.

Penzance, J. Ralfs. A new locality for a very rare species.

2046. *P.* (Merisma) *alligatus*, Fr. Hym. Eur. p. 543.

This curious species, which appears to be the same with *Boletus rugosus*, Sow. tab. 422, was sent by a member of the Northampton Natural History Society, who found it in the course of one of their excursions. The base penetrates into the ground. The colour was a little different from Sowerby's figure, but it seems to be essentially the same. The description in Fries's 'Elenchus' accords very well with the specimens.

**P.* (Anodermei) *epileucus*, Fr. Hym. Eur. p. 545.

Penzance, J. Ralfs.

2047. *P.* (Inodermei) *ravidus*, Fr. Hym. Eur. p. 566. *Boletus heteroclitus*, Sow. tab. 367; Bolt. tab. 164.

Penzance, J. Ralfs. The plant of Sowerby and that of Bolton are clearly the same; but Fries seems to make them distinct. The pores are rather large and yellow when young.

2048. *Dædalea polyzona*, Pers. Myc. Eur. iii. p. 8.

Penzance, J. Ralfs. Exactly Persoon's species, and, like that, reaching many inches in length.

2049. *Urocystis Primulæcola*, Mag. Hedwigia, 1879; Gard. Chron. Aug. 30, 1884.

Sent by Mr. Wolley Dod, from his garden.

On *Primula farinosa*. Mr. Broome found it in Teesdale in 1867, and abundant specimens were sent to him from the Cumberland lakes.

2050. *Sphærella Taxi*, Smith, in Gard. Chron. June 28, 1884, p. 827.

Abundant at Sibbertoft in 1884.

BIBLIOGRAPHICAL NOTICES.

Report upon the Crinoidea collected during the Voyage of H.M.S. 'Challenger' during the Years 1873–76.—*The Stalked Crinoids.* By P. Herbert Carpenter, D.Sc., Assistant Master at Eton College. Pp. i–xii, 1–442; 69 plates. [*Report on the Scientific Results of the Voyage of H.M.S. 'Challenger.'*—Zoology, part xxxii.] Published by Order of Her Majesty's Government, 1884.

Few among the varied forms of invertebrate organisms have exercised such a fascination over naturalists as the Crinoids. Ever since the first living *Pentacrinus* was brought to notice by Guettard in 1755 a feeling not far removed from romance has been almost inseparably associated with the recent members of this group of animals, a sentiment at first perhaps mainly due to their beauty and rarity; but later, when their relations became known, to the fact that these treasures from the deep bore positive testimony to the existence in our seas of the survivors of a race which had been thought to have long since passed away, and were to be known only in a fossil state.

It was whilst Dr. W. B. Carpenter and the late Sir Wyville Thomson were studying the structure and development of Crinoids together in Ireland in 1868 that the scheme was matured of applying to the Admiralty for assistance in undertaking a series of deep-sea investigations. The 'Lightning' and 'Porcupine' expeditions were the result; and to the success attending these first systematic dredgings in great depths the despatch of the 'Challenger' expedition itself was directly due. The Crinoids have thus been associated in a special manner with the 'Challenger' expedition.

Sir Wyville Thomson, who for some years had devoted much attention to the stalked Crinoids, had proposed himself to undertake the preparation of the Report upon the collection of this group made during the expedition; and he had also arranged with Prof. Alex. Agassiz to include a description of the Crinoids dredged by the U.S. Steamer 'Blake' in the Caribbean Sea, in order that a monograph of all the species at present known might be produced. On the lamented death of Sir Wyville Thomson the respective collections were entrusted to Dr. P. Herbert Carpenter; and the excellent report just published fully warrants the opinion that the work could not have been placed in more able hands. It is worthy of our great national expedition; it is worthy of Dr. Herbert Carpenter's acknowledged reputation, which it will enhance and crown; and it is a worthy tribute of a son to a father whose name is honoured among the biologists of all nations, and whose investigations in the same group of animals are a monument of patient research and logical reasoning.

Twenty-one years ago, that is to say up to 1864, only three species of living stalked Crinoids were known to science; we are now acquainted with thirty-two, which belong to six genera, and are the representatives of four families. More than half this number, including two new genera, were discovered by the 'Challenger;' and twenty-one of the species (*i. e.* more than 65 per cent. of the known forms) are due to British exploration conducted on H.M.SS. 'Porcupine' and 'Challenger.' The present Report forms a complete and masterly monograph of the whole group.

Chapters I.–VI. are devoted to Morphology. Each factor in the structure of a Crinoid is separately described, the modifications presented in the different living forms are reviewed, and their relations to allied fossil forms discussed. The habits and parasites of living Crinoids, as far as known, are likewise fully dealt with. This portion of the work is of the greatest importance, for it renders possible a more exact knowledge of extinct forms, and throws light upon numberless points in their structure, and consequently upon the classificatory position of many doubtful forms as to which palæontologists were hitherto only able to conjecture. To attempt to summarize the chief points of this section is beyond the scope of a general notice, and we must therefore content ourselves with referring those interested in the subject to the Report, assuring them that palæontologist and anatomist alike will find a mine of information and of careful investigation.

Dr. Herbert Carpenter follows Dr. Leuckart in separating the stalked Echinoderms from the remainder of the group, under the name Pelmatozoa; and he ranks the Crinoidea, Blastoidea, and Cystidea as independent classes of this division, in preference to the course taken by some writers of regarding the two latter groups as subclasses or orders of the Crinoidea. The term Crinoidea is thus limited to the strictly brachiate forms for which it was proposed by Miller. This step appears to us the right one; and the reasons adduced by the author are alike cogent and logical. The old divisions of the Crinoidea into Articulata, Tessellata, and Costata, adopted by Joh. Müller, have been shown by several writers to be altogether untenable, and with the advance of knowledge to have become practically meaningless. Dr. Herbert Carpenter, in a former volume of this journal (ser. 5, vol. vii. p. 296, 1881), proposed the name of Neocrinoidea for the Mesozoic, Tertiary, and Recent types, whilst that of Palæocrinoidea, introduced by Mr. Wachsmuth, comprised the Palæozoic types. The chief characters which distinguish these two well-marked divisions were enumerated in the paper referred to, and need not be recapitulated here. The relations of the Neocrinoidea to the Palæocrinoidea have a chapter devoted to their discussion in the Report; and light, chiefly of an anatomical character, is thrown on the classificatory position of a number of doubtful fossil genera by the knowledge acquired from recent forms, which, if insufficient at present in some cases to solve the difficulty, at least paves the way for its solution when more perfect fossil material is available.

The affinities of recent Neocrinoidea to the Palæocrinoidea are obviously relative rather than direct. On the other hand, between the recent and fossil Neocrinoidea comparisons of the greatest interest and importance may be drawn. The living stalked Neocrinoids at present known belong to the following genera and families:—Fam. Holopidæ: *Holopus*, d'Orb. (1 sp.). Fam. Hyocrinidæ: *Hyocrinus*, Wyv. Thoms. (1 sp.). Fam. Bourgueticrinidæ: *Bathycrinus*, Wyv. Thoms. (4 sp.), *Rhizocrinus*, Sars (2 sp.). Fam. Pentacrinidæ: *Pentacrinus*, Miller (9 sp.), *Metacrinus*, Carpenter (15 sp.).

The fossil Holopidæ are represented by "*Micropocrinus* of the Italian Miocene, *Cyathidium* in the Chalk of Faxoe, the singular *Gymnocrinus* in the Oxfordien of France and Switzerland, and, lastly, in the Middle Lias *Cotylecrinus* and *Eudesicrinus*; while *Edriocrinus*, from the Upper Silurian and Devonian, a type much resembling *Holopus* in character, is a proof of the great antiquity of these sessile Crinoids." The Hyocrinidæ, a family established by the author for the reception of the single genus *Hyocrinus*, have no fossil representatives. This genus had been placed by De Loriol and Zittel in the family Plicatocrinidæ, in association with the genus *Plicatocrinus*; but its present separation on structural grounds appears to be fully warranted. Of the Bourgueticrinidæ "we have no certain evidence of the occurrence of the typical genus *Bourgueticrinus* in other than Cretaceous rocks; though stem-joints which have been referred to this genus occur both in Jurassic and in Eocene deposits. It is not unlikely, however, that they belong to *Thiollierícrinus* or to *Rhizocrinus* respectively." "And some of the stem-joints hitherto referred to *Rhizocrinus* or to *Bourgueticrinus* may possibly belong to *Bathycrinus*, no calyx of which has yet been found in the fossil state." "The Pentacrinidæ are remarkable for their long geological history. The type genus *Pentacrinus* first appears in the Trias, together with the short-lived *Encrinus*. It persisted through the whole of the Secondary and Tertiary periods, and is represented by nine species at the present time." On the other hand, *Extracrinus* is confined to the Lias and Lower Oolites, unless, as the author is disposed to think, the *P. asteriscus*, which is found associated with Trias fossils in the Western Territories of the United States, is also to be referred to this genus. *Balanocrinus* ranges from the Middle Lias to the Lower Neocomian. "The remaining genus *Metacrinus* is confined to Oceania and the shallower parts of the Pacific, and is at present unknown in the fossil state. The general character of the fossil Pentacrinidæ is essentially the same as that of their recent representatives, except that they often had much longer stems, which sometimes reached as much as 50 or even 70 feet."

It is obviously outside the limits of this notice to remark on the different species enumerated in the Report, further than to state that each form is described in the fullest detail possible from the material available—varieties, affinities, and in some cases even youthful characters, being carefully noted. It is interesting, however, to observe in passing that there appears to be ample evidence that a Pentacrinite may become detached from its root-plate and lead a more or less free life, loosely rooted in the mud, or attached temporarily by its cirri. Indications of this semi-free detached condition have been observed in several species belonging to the genera *Pentacrinus* and *Metacrinus*. This character was originally mentioned by Sir Wyville Thomson some years ago in his account of the 'Porcupine' dredgings, and we are led to refer to the now complete confirmation of his conclusions, since one of the members of the 'Talisman' expedition sought to prove in a popular article that Sir Wyville Thomson was wrong, and insinuated, on the strength of an inaccurate quotation of his words, that his conclusions were drawn from the examination of a single example only; whereas it was clearly stated to occur in two species, and in all the specimens then known of one of them (about twenty in number).

In this Report is included the description of that most remarkable Comatulid, *Thaumatocrinus renovatus*, whose archaic characters and striking affinities with several of the extinct forms of stalked Crinoids have been already published by Dr. Herbert Carpenter in the Phil. Trans. for 1883.

The accompanying Table, extracted from a more extended one in the Report in which the Comatulid genera are also included, will indicate briefly the geographical and bathymetrical range of the genera of recent stalked Crinoids so far as at present known.

Genus.	Depth.	Temp.	Latitude.	Oceans.
	fathoms.	° C.		
Pentacrinus ..	42–1350	1·8–20	46° N.–30° S.	A. C. P. E.*
Metacrinus ..	68– 630	4–21·7	35° N.–30° S.	P. E.
Rhizocrinus ..	73–1900	0–21·5	68° 15′ N.–35° 39′ S.	A. C.
Bathycrinus ..	1050–2435	0·8–2·5	65° 55′ N.–46° 46′ S.	A. S.
Hyocrinus....	1600–2325	0·8–1·8	5° 31′ N.–46° 16′ S.	A. S. E ?P.
Holopus	About 100	......	10°–20° N.	C.

In summarizing the bathymetrical distribution of the recent Crinoids, the author remarks on the custom which has prevailed of late years of regarding the stalked Crinoids as pre-eminently abyssal types, and considers that too much stress has been laid upon Sir Wyville Thomson's conjecture, that they probably formed a "rather important element in the abyssal fauna." From the statistics now given it would appear that subsequent researches have not altogether confirmed these views. Thus, taking 500 fathoms as the limit of the continental line, it is found that twenty-four of the thirty-two recent species of stalked Crinoids, or 75 per cent., occur within this limit; while nine of these living at depths less than 100 fathoms may be called littoral. On the other hand, "thirteen species have been found in the abyssal zone, two of which are also littoral, while

* A. Atlantic. C. Caribbean Sea. S. Southern Ocean. P. Pacific. E. The more or less enclosed seas of the East-Indian Archipelago, between Cape York and Singapore.

three are continental. The two former both belong to the genus *Rhizocrinus*, of which no exclusively abyssal species are known, though it has been met with at sixteen out of the thirty-four stations in the abyssal zone." Of *Pentacrinus* four species have been found in the abyssal zone, whilst two of these are also continental. *Bathycrinus*, on the other hand, has never been found at a less depth than 1600 fathoms, and embraces four out of the eight species peculiar to the abyssal zone. "No fossil *Bathycrinus* is known, however, and the genus has no special affinities except with *Rhizocrinus*, of which it may almost be said to be the 'benthal' representative. Of the four remaining abyssal species one is the sole representative of the remarkable genus *Hyocrinus*, and has only been met with at 1600 fathoms and still greater depths. Like the Comatulid genus *Thaumatocrinus*, which occurs at 1800 fathoms in the Southern Ocean, it has certain strong points of resemblance to the Palæocrinoids." The other exclusively abyssal forms are two species of *Pentacrinus* and one of *Metacrinus*. One species of *Metacrinus* occurs both in the abyssal and continental zones. "*Pentacrinus* ranges back to the Trias and *Rhizocrinus* to the Eocene or Upper Cretaceous. But they are both abundant at depths of less than 100 fathoms, *Pentacrinus* occurring in the Pacific and in the East-Indian Archipelago, as well as in the Atlantic and among the Caribbean Islands; whilst *Rhizocrinus*, though limited to the eastern hemisphere, ranges through over 100° of latitude." In conclusion, after reviewing the distribution of the recent Neocrinoids both in time and space, the author remarks:—"In spite therefore of the existence of a few characteristic abyssal types, it is somewhat of an exaggeration to speak of the Stalked Crinoids as a group 'on the verge of extinction,' of which a few survivors may occasionally be discovered in the deeper parts of the great ocean basins."

In an Appendix are discussed a number of topics raised by several works which have appeared during the passage of the Report through the press. Among the more important of these may be noticed the following. The first "Note" deals with the question of the apical system in Echinoderms generally. Prof. Lovén's views on the homologies of certain plates of the Crinoidal calyx in other Echinoderms have been previously discussed by the author and others. As, however, the opposing arguments have not been refuted in the recent work of the veteran Swedish naturalist on *Pourtalesia*, and as these opinions have been followed by other writers without any additional arguments in their favour, the question is again passed in review, and most cogent reasons are again adduced and strengthened, at least in our opinion, beyond refutation, by recent discoveries in the embryology of Asterids and Ophiurids, for rejecting the homologies which Prof. Lovén seeks to establish between the dorsocentral of an Echinoid or Asterid and the under-basals of a dicyclic Crinoid. In connexion with this subject reference is made to certain conjectures of Prof. Perrier's, which an echinodermatist may well describe as eminently sensational! That writer considers (1) that the embryonic "basals" of an Asterid, which primitively surround the dorsocentral plate, ultimately leave that position, pass on to the actinal surface, and become the so-called "odontophores;" (2) that the Crinoid calyx finds its homologies in the Echinoids in the "lantern of Aristotle" and not in the plates of the apical system; and consequently that the mouth of an Urchin occupies the position of the point of attachment between the stem and the body of a Crinoid; and, further, that the abactinal surface of a Starfish corresponds to the actinal or buccal region of an Urchin and not to its abactinal or apical region. Dr. Herbert Carpenter points out that the former of these views had been refuted previously, on grounds which he considers to be cogent and logical, and to which M. Perrier makes no reply in his recent work, wherein the same views are again advanced. The homologies which M. Perrier seeks to establish in the case of the Echinoids and Asterids are shown, both on morphological and rational grounds, to be altogether untenable. We also notice that the author does not accept M. Perrier's assumption that the "dorsal appendage" of *Caulaster* is homologous with the stem of a Crinoid; or the similar views of Drs. Danielssen and Koren in the case of their genus *Ilyaster*. It is pointed out that the former of these Asterids has been considered to be only the young of *Porcellanaster*, and that M. Perrier's comparison of the plates round the dorsal appendage of *Caulaster* with those forming the periproct of an Urchin cannot be followed out in detail.

In three succeeding "Notes" certain statements of M. Perrier on the anatomical structure of *Comatula* are criticized. (1) His assertions that the water-tubes depending from the oral ring are in direct continuity with the inner ends of the water-pores of the disk, that some of the water-pores open into the glandular tubules of the labial plexus, and that the canals forming the inner ends of the water-pores on the lower part of the disk open into the cavities of the chambered organ, are regarded by the author as highly improbable, not only on structural grounds, but because it is hardly possible to imagine that these connexions could have remained unobserved by the numerous competent investigators who have recently studied this form with the greatest care. (2) The canals regarded by Prof. Ludwig and Dr. Herbert Carpenter as intervisceral blood-vessels are believed by M. Perrier to be merely parts of a vast aquiferous system. The improbability of this assumption is shown from the fact, that the body-cavity through which they ramify already contains water, admitted through the water-pores; that their lumen is frequently filled up with coagulum; and that it would be hard to understand the object of a special set of aquiferous tubes distributed over the coils of the digestive canal and not communicating with the ambulacral system, but with the axial organ and the labial plexus. M. Perrier's theory of the fundamental unity of the water- and blood-vascular systems of Echinoderms is regarded as untenable, and unworthy of recognition until a basis of definite proof is established by figures and facts, instead of the mere assertion upon which the assumption at present rests.

The concluding "Note" in the Appendix is devoted to the nervous system of Crinoidea. The opinions of several recent writers on the subject are discussed, and reference is made to the remarkable and entire confirmation of the views of Dr. W. B. Carpenter and the author as to the nervous character of the axial cord, afforded by the independent and almost simultaneous observations of Prof. Marshall and Dr. Jickeli. Further important morphological deductions, especially bearing on the phylogeny of the axial cords, are added by the author as sequel to the investigations just mentioned.

This notice would be incomplete if mention were omitted of the splendid plates, sixty-nine in number, illustrating the Report, which, in artistic execution and clearness, leave nothing to be desired. A valuable bibliographical list is added, and the indices are most complete, in fact models of what an index ought to be.

The author is to be congratulated on the completion of a noble monograph, which is destined to rank as a classic in the future; and naturalists are likewise to be congratulated on the acquisition of an important contribution to knowledge. The Report on the *Comatulæ*, which is in the same able hands, and is, we understand, well advanced, will be awaited with keen interest.

Guide to the Collection of Fossil Fishes in the Department of Geology and Palæontology, British Museum (Natural History). Printed by Order of the Trustees. 8vo. London: 1885.

Guide to the Galleries of Mammalia (Mammalian, Osteological, Cetacean) in the Department of Zoology of the British Museum (Natural History). Printed by Order of the Trustees. 8vo. London: 1885.

In former days, when the collections of the British Museum were all contained in one great establishment in Bloomsbury, the only guide-book the visitor could procure was one to the general contents of the building, in which all the departments were noticed in more or less detail. With the transfer of the natural-history departments to their new home in South Kensington this mode of treatment, of course, became impossible, and we are glad to see that the keepers of the departments are taking advantage of the change of conditions to offer to visitors to the museum a series of "Guides" which promises to occupy a much more important position than could ever have been attained under the old system. The new plan consists in the issue of popular handbooks to the different departments of the collection and to important subdivisions of these departments, and it was to a certain extent commenced, if we are not mistaken, even previously to the removal of the natural-history collections, by the production of the 'Guide to the Gould Collection of Humming Birds.'

The earliest of the departmental guide-books was that to the mineral gallery, "with an introduction to the study of minerals," a most useful little handbook apart from its applicability to the collections of the British Museum. Dr. Woodward has also published a general guide to the collections under his charge, well adapted to give sound general notions upon geological and palæontological matters to those who would otherwise merely gape and wonder at the queer objects exposed for their inspection in the galleries.

The commencement of the series of special guide-books to this department has been made by the production of the 'Guide to the Collection of Fossil Fishes,' embracing a sketch of the classification of fishes adopted in the arrangement of the Museum, with notices of the more remarkable forms of fossil fishes and of the habits of some of their living allies. This little book is profusely illustrated with woodcut figures.

The Keepers of the Zoological and Botanical Departments have issued as yet no general guides to the treasures under their charge; but the former has commenced the publication of the special series in the form of an excellent guide to the collection of Mammalia. It is divided into three parts, corresponding to the galleries in which the objects are exhibited. The first section deals with the stuffed specimens, and treats of the creatures represented from the natural-history and systematic point of view, indicating very briefly their general characteristics, habits, relations (in the past as well as at the present day), and especially their geographical distribution. The second part is descriptive of the Mammalian portion of the osteological collection; while the third is devoted to the true Cetacea, which are placed apart on account of the gigantic size of many of their representatives, and deals with both their natural history and their osteological structure. This last section is the work of the Director of the Museum, Prof. Flower; the other two have been drawn up by the Keeper, Dr. Günther, with the assistance of Mr. Oldfield Thomas. The Mammalian guide contains a considerable number of good illustrations scattered through the text, and is also provided with plans showing the mode of arrangement of the galleries.

If we compare these two guide-books in no invidious spirit it is impossible not to award the palm to the second of them. Its authors have been allowed for some reason to have much better print, much better paper, and much more of it on which to disport themselves than has fallen to Dr. Woodward's lot; and if we add to this that with more space their subject is smaller, and that it lends itself much more readily to popular treatment than any class of fossils whatever, it will be no matter of wonder if the Guide to the Mammalia prove to be the more successful work of the two. Each of them, however, is excellent in its own way, and a series of such guides will place our great national collection on a footing of usefulness such as can be claimed for no other museum in the world.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 25, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On a Dredged Skull of *Ovibos moschatus*." By Prof. W. Boyd Dawkins, M.A., F.R.S., F.G.S.

As some doubts have been expressed as to whether a skull of

Ovibos moschatus, described by the author in a previous communication to the Society, had been derived from the Forest bed, he first quoted the opinion of Mr. Clement Reid, that that specimen really came from the bed in question, and then proceeded to describe a second imperfect skull of the same animal in the University Museum of Zoology and Comparative Anatomy at Cambridge. The trace of red sandy matrix still remaining and the impregnation with iron peroxide showed that this also had been derived from the Forest bed, whilst the presence of marine Polyzoa on the surface and in cracks was considered to prove that the fragments in question had lain at the bottom of the sea, and the sharpness of the angles forbade the supposition that it had been rolled on a beach. The writer inferred that the skull had been dredged, and that it had been originally derived from cliffs near the Dogger Bank before the coast-line had been cut back to its present position. The fragments consisted of the coronal and frontal portions of the skull with the horn-cores and right orbit. It seems of unusual thickness, and the author briefly described its leading peculiarities and measurements.

2. "Fossil Chilostomatous Bryozoa from Aldinga and the River-Murray Cliffs, South Australia." By Arthur Wm. Waters, Esq., F.G.S.

The 73 fossils described in the present paper were collected by Professor Ralph Tate, and, with few exceptions, are from Aldinga and the River-Murray Cliffs, Australia.

This collection again furnishes interesting cases of species growing in both the *Eschara* and the *Lepralia* form; but the chief interest is in a number of specimens which grow in a "cupulata" manner, thus in the mode of growth resembling *Lunulites*. Attention was again called to the fact that though the shape and nature of the zoœcial avicularia (onychocellaria) are characters of the greatest value, yet their presence or absence cannot be made a specific distinction, as there are a large number of cases where specimens are found with none or only a few such avicularia, whereas on other specimens of the same species, collected under similar circumstances, they may occur abundantly over the whole colony, or in parts of the colony, in large numbers.

In the 'Challenger' Report, Mr. Busk refers to a slender process rising from the middle of the base of the avicularian mandible, and names it "columella." This he considers only occurs in one division of the *Celleporæ*, and in this division only in those belonging to the southern hemisphere. This was shown to be by no means the case, as it is found in the mandibles of *Cellepora sardonica* from the Mediterranean, in two other common Mediterranean *Celleporæ* &c. In many species there is a denticle in this position rising from the calcareous bar which divides the avicularium. This denticle occurs in various genera and species, and may often be found a useful specific character when examining fossils.

Out of the 220 species now described in this series of papers, just about one half are now known living.

The species noticed in this paper were 73 in number, referred by the author to the genera *Cellaria*, *Membranipora*, *Micropora*, *Monoporella*, *Steganoporella*, *Cribrilina*, *Mucronella*, *Microporella*, *Lunulites*, *Porina*, *Lepralia*, *Smittia*, *Schizoporella*, *Mastigopora*, *Retepora*, *Rhynchopora*, *Cellepora*, *Lekythopora*, and *Selenaria*. Six species were described as new, namely *Microporella pocilliformis*, *Lepralia confinita*, *Cellepora divisa*, *C. biradiata*, *Schizoporella protensa*, and *Membranipora temporaria*.

MISCELLANEOUS.

On the Discovery of an Impression of an Insect in the Silurian Sandstone of Jurques (Calvados). By M. C. Brongniart.

The author refers to the discovery by Prof. Lindström of a scorpion in Swedish Silurian rocks * as proving the existence of terrestrial air-breathing animals at that early period. Insect-remains had been found in Carboniferous and Devonian rocks, but hitherto in no older deposits. He has received from Prof. Douvillé a fragment of Middle-Silurian Sandstone from Jurques belonging to De Verneuil's collection, which shows the impression of an insect's wing, which, though imperfectly preserved, shows most of the nervures. M. Brongniart describes it as follows :—

"This wing, which measures 35 millim. in length, belonged to a Blattide ; the humeral area is broad, and we see in it the superior humeral vein and the inferior humeral vein, which is bifurcate at its extremity ; the vitreous or median vein also divided into two branches ; the superior and inferior discoidal veins and their very oblique divisions which unite at their extremity, as is the case in certain Blattæ of the present epoch ; we can trace the anal vein, which is nearly straight and extends almost to the end of the wing, and also the axillary veins, which are parallel."

The length of the anal vein and the narrowness of the axillary area distinguish this from all other wings of cockroaches, whether living or fossil, the nearest approach to the fossil among Carboniferous species being made by *Progonoblattina Fritschii*, Heer, and *Gerablattina fascigera*, Scudder. For the species the author proposes the name of *Palæoblattina Douvillei*. As the sandstone of Jurques belongs to the Middle Silurian, this cockroach is of older date than the Scotch and Swedish scorpions.—*Comptes Rendus*, December 29, 1884, p. 1164.

The Royal Society of New South Wales.

The Royal Society of New South Wales has put forward a list of subjects for memoirs, offering its medal and a money-prize of £25 for the best communication in each case, "provided it be of sufficient merit." The memoirs must contain the results of original research, and the successful ones will be published in the Society's annual

* See 'Annals' for January 1885, p. 76.

volume. The competition is open to all without any restriction, and each memoir must be furnished with a motto for the purpose of identification, the writer's name and address being placed in a sealed envelope, having the motto on its outside. Competitors are requested to write upon foolscap paper and upon one side only.

The natural-history subjects suggested are as follows:—

To be sent in not later than May 1, 1885:

1. Anatomy and Life-history of *Echidna* and *Platypus*.
2. Anatomy and Life-history of Mollusca peculiar to Australia.

To be sent in not later than May 1, 1886:

List of the Marine Fauna of Port Jackson, with descriptive Notes as to Habits, Distribution, &c.

To be sent in not later than May 1, 1887:

On the Infusoria peculiar to Australia.

A new Insect injurious to Wheat. By C. V. Riley.

The following description was presented to the Washington Entomological Society at its monthly meeting, Nov. 6. The description is comparative with *Isosoma tritici*, Riley, with which it is most nearly allied.

Isosoma grandis, n. sp.

Female. Length of body 4·2 millim., expanse 7·6 millim. Antennæ rather more slender and less clavate than in *tritici* and but half the length of thorax. Thorax with the mesonotum slightly more rugulose; wings larger and less hyaline than in the winged specimens of *tritici*, the veins extending to outer third, the submarginal nearly four times as long as marginal; legs with the femora less swollen. Abdomen not so long as thorax, stouter than in *tritici*, ovate-acuminate, approaching typical *Eurytoma*. Less hairy than *tritici*, especially about legs, the hairs of abdomen being less numerous, less regular, and shorter. Coloration similar to that of *tritici*, but brighter and more highly contrasting, the pronotal spot larger and brighter yellow, the pedicel of antennæ yellow, and the femora with a definitely limited, suboval, yellowish spot below, near the tip, extending two fifths the length of femur on front pair, smaller on middle pair, and still shorter and less definite on posterior pair.

Larva.—Greenish yellow in colour. Average length 6 millim.; otherwise of same proportions and structure as in *tritici*.

Pupa.—Average length 5 millim. Except in larger size and ample wing-pads undistinguishable from that of *tritici*.

Described from twenty-four females, reared from wheat-stems in June, and taken by Mr. F. M. Webster at Lafayette, Indiana. The species is treated of in my forthcoming report as U.-S. Entomologist, and works in wheat much as *tritici* does. Its larger size, stouter build, aside from the other characters mentioned, readily distinguish it, however; while from *hordei*, Harris, *vitis*, Saunders, and *elymi*, French, it is still more readily distinguished.—*Bull. Brooklyn Entom. Soc.* vol. vii. p. 111.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 89. MAY 1885.

XXXI.—*On some new or little-known Fossil Lycopods from the Carboniferous Formation.* By Robert Kidston, F.G.S.*

[Plate XI.]

The following notes are offered as a small contribution to our knowledge of the Carboniferous flora of Britain. Several of the specimens now about to be described have been known to me for a considerable length of time, but various causes have contributed to delay their publication.

1. *Sigillaria McMurtriei*, Kidston, n. sp.
2. *Sigillaria coriacea*, Kidston, n. sp.
3. *Sigillaria Walchii*, Sauveur.
4. *Lepidodendron Peachii*, Kidston, n. sp.

1. *Sigillaria McMurtriei*, Kidston, n. sp. (Pl. XI. figs. 3–5.)

Description.—Leaf-cushion rhomboidal, with the upper and lower angles truncated, giving it a hexagonal appear-

* Read before the Royal Physical Society, Edinburgh, March 18, 1885.

ance, elevated; from the leaf-scar downwards runs a flattened area, which bears a slightly raised medial line; surface of the cushion ornamented with fine granulations placed in irregular lines and more prominent on the lower part of the cushion. Leaf-scar situated on the upward-directed elevated summit of the cushion, elongated, rhomboidal; lateral angles prominent and produced, the lower angle rounded, the upper rounded, with a slight sinus. Vascular cicatricules three, the two lateral oval and directed outwards, the central transversely linear and placed below the centre of the lateral cicatricules.

Remarks. This species of *Sigillaria* in some of its characters has a superficial resemblance to both *Lepidodendron* and *Lepidophloios.*

Figures 3 and 5 have very much the appearance as if the leaf-scar were surrounded by a "*field,*" as in *Lepidodendron*; but the apparent "*field*" is merely a cortical extension, similar to the leaf-cushions in the Clathrarian *Sigillariæ*, and only differing from the other members of this group of *Sigillaria* in its more highly developed condition.

On the lower part of the cushion occurs a flattened area, which runs from the lower rounded angle of the leaf-scar to the base of the cushion. In the centre of this band is a very gently raised line, from each side of which, at an almost imperceptible angle, slope the two sides of this flattened area. The surface of the cushion is ornamented with irregular granulations, which appear to be roughly arranged in lines springing from its base.

The extent to which the cushions are elevated is shown in the vertical sections, figs. 3 *a*, 4 *a*, and 5 *a*, which respectively represent sections of cushions and leaf-scars from specimens drawn at figs. 3, 4, and 5. From the examination of this part of the fossil it is evident that we are dealing with a cortical extension similar to the leaf-cushions of the Clathrarian *Sigillariæ*, and not with the "field" of a Lepidodendroid leaf-scar.

The much-elevated cushions in *Sigillaria McMurtriei* have a considerable resemblance to those of *Lepidophloios*; but the character which at once proves this plant to be a true *Sigillaria*, and not a *Lepidophloios*, is the form of the vascular cicatricules. Of these the two lateral are linear-oval, the central transversely elongated and placed below the centre of the lateral cicatricules. In some cases the central cicatricule appears to be composed of two points placed closely together (fig. 3 *b*). A form and arrangement of the vascular bundle cicatricules such as that just described occurs only in the genus *Sigillaria*.

From the epidermal ornamentation of the cushions it is also clear that the leaf was not attached to any part of its surface, but to the vascular scar alone.

This last character is of itself sufficient to exclude the plant from *Lepidodendron* and restrict its relationship to *Lepidophloios* or *Sigillaria*; but, as already indicated, the vascular cicatricules are Sigillarian, and not those of *Lepidophloios*, and, in fact, there is here only a Clathrarian *Sigillaria* with highly developed leaf-cushions.

Of the three figures which I give of this plant figs. 3 and 5 must be regarded as representing the typical form.

On all the specimens the leaf-scar is of the same shape, but the slight sinus in its upper margin is sometimes very feebly developed.

In fig. 3 the ornamentation is more strongly marked on the portion of the leaf-cushion below the leaf-scar than on the part above it; in fig. 5 the ornamentation covers more equally the whole surface of the cushion.

In fig. 4, on the other hand, the ornamentation is very slightly represented; so little is it shown that it can scarcely be said to be present. Although on this specimen the leaf-scars are larger and their cushions more elevated than in figs. 3 and 5 (see fig. 4 *a*), it probably represents a younger state of the plant, which, when older, would have the cushions more drawn out, as in fig. 5.

As figs. 3, 4, and 5 are drawn of the natural size, it is scarcely necessary to give the measurements of the leaf-scars and their cushions; these also vary considerably with the age of the specimen. In all cases the leaf-scar is broader than high.

In the decorticated condition the surface of the stem is roughened by an irregular small mesh-like granulation, which is more or less arranged in vertical lines (fig. 5, part marked *a*).

The only species to which *Sigillaria McMurtriei* has any resemblance is *Sigillaria tumida*, Bunbury, sp. (*Lepidodendron? tumidum*, Quart. Journ. Geol. Soc. vol. iii. p. 432, pl. xxiv. fig. 1). From this species it differs in the form of its leaf-cushions. The surface-ornamentation in *Sigillaria tumida* also differs in being "rather irregular, wavy, longitudinal striæ."

Bunbury described his plant as *Lepidodendron? tumidum*, and Schimper places it in *Lepidophloios* *; but I believe that this plant is also a *Sigillaria*.

In his description Bunbury does not mention the form of

* Schimper, Traité d. paléont. végét. vol. ii. p. 52.

the lateral cicatricules, nor does his drawing show it very clearly; but he says the central cicatricule consists of "two vascular points placed close together and often confluent."

In some of the leaf-scars of *Sigillaria McMurtriei* there is the same appearance in the central vascular cicatricule (see fig. 3 *b*). A similar structure occurs in the vascular impression of *Sigillaria Lorwayana*, Dawson *.

In *Sigillaria Moureti*, Zeiller †, a somewhat similar structure of the vascular cicatricule also occurs.

I have entered very fully into the description of *Sigillaria McMurtriei* to show that it is a true member of the genus *Sigillaria*; and from the great similarity of *Lepidodendron? tumidum*, Bunbury, to *Sigillaria McMurtriei* in all general points, I think there cannot remain any doubt as to its also being a Clathrarian *Sigillaria*. Bunbury himself expresses his difficulty in regard to the position of his plant, and says that it would be referred by some to *Lepidodendron* and by others to *Sigillaria*.

I first observed this species in the collection of Mr. J. McMurtrie, Radstock, after whom I have great pleasure in naming it. Mr. McMurtrie has not only carefully collected the fossil plants of the Radstock Coal-field, but has done much to elucidate the geology of his neighbourhood. I also take this opportunity of expressing my thanks to him for much valuable assistance received while examining the fossil flora of the Radstock Coal-field.

Horizon. Radstock series of the Upper Coal-measures.

Locality. Tyning Pit, Radstock, Somersetshire.

2. *Sigillaria coriacea*, Kidston, n. sp. (Pl. XI. fig. 2.)

Description. Ribs alternately widening and contracting; leaf-scars placed on the dilations, wider than high, with a slight sinus on their upper margin; lateral angles prominent, situated about the centre of the scar, with downward-running ridges; vascular cicatricules placed above the middle of the leaf-scar, the two lateral lunate, the central punctiform. Outer surface of the bark ornamented with a fine granulation.

Remarks. The only specimens of this fine *Sigillaria* with which I am acquainted are those in the British Museum,

* Dawson, 'Fossil Plants of Lower Carboniferous and Millstone-grit Formations of Canada,' p. 43 (woodcut), 1873.

† Zeiller, Bull. Soc. Géol. de France, 3e sér. vol. viii. p. 210, pl. v. fig. 3.

which became known to me while preparing the 'Catalogue of the Palæozoic Plants' in that collection. All the specimens represent a similar age of the plant, and perhaps are different pieces of one individual.

The ribs measure across the dilated portions 22 millim. and at the constrictions 19 millim. The leaf-scars are 16 millim. broad and 12 millim. high, and 16 millim. apart.

The whole surface of the bark is ornamented with a fine granulation. On the central portion of the ribs it is more strongly marked and the granulation slightly larger than on the other portions of their surface; but its presence is distinctly seen over the whole area of the ribs.

The two lunate vascular impressions are 3 millim. long, and the central punctiform cicatricule is about 1 millim. in diameter. The sinus on the upper margin of the leaf-scar, though slight, is distinct.

The ornamentation of the bark is of a somewhat similar nature to that which occurs on *Sigillaria duacensis*, Boulay*, but much finer. From this species it differs entirely in the form of the leaf-scar and the position of the vascular cicatricules, which are central in *S. duacensis*, while those of *Sigillaria coriacea* are placed above the centre.

The specimens unfortunately do not bear any note of the locality from which they were collected; but from indirect evidence there is every reason to believe that they came from the Newcastle-on-Tyne Coal-field.

The figure (Pl. XI. fig. 2) is taken from a plaster cast of an impression of the plant in the British Museum. My thanks are due to Dr. H. Woodward, F.R.S., for permission to describe this species.

Horizon. Coal-measures.

Locality. (?) Newcastle-on-Tyne, Northumberland.

3. *Sigillaria Walchii*, Sauveur. (Pl. XI. fig. 1.)

Sigillaria Walchii, Sauveur, Végét. foss. d. terr. houil. de la Belgique, pl. lvii. fig. 3 †; Boulay, Terr. houil. du nord de France et ses végét. foss. p. 43.

Description. Ribs wide, smooth; leaf-scars separated by a short interval, subtriangular, as broad as high, the upper angle obtusely rounded, the lateral angles placed below the

* Boulay, 'Le terr. houil. du nord de la France et ses végétaux fossiles,' p. 43, pl. ii. fig. 3. Thèse de géologie présentée à la Faculté des Sciences de Caen: Lille, 1876.

† Académie royale des sciences, des lettres et des beaux-arts de Belgique, 1848.

centre, rounded, but distinct, the lower margin indented by a slight sinus; vascular cicatricules situated above the centre, the two lateral lunate, the central punctiform. On the ribs immediately above the leaf-scar is a slightly bent transverse furrow. The decorticated stem is finely striated longitudinally.

Remarks. In the specimen figured on Pl. XI. fig. 1, the ribs are 20 millim. broad; the leaf-scars, of pyriform outline, are 10 millim. in height and the same in breadth; they stand about 4 millim. apart. The slightly lunate transverse furrow which surmounts them is about 10 millim. long. The outer surface of the bark is quite smooth.

The elevation of the ribs is shown at fig. 1 *b*. They are flat, but, from the perfection with which the leaf-scars are preserved, I am inclined to think that the fossil has suffered little from pressure.

This example agrees in all respects with the figure given by Sauveur (without description) and that described by Boulay, except that neither of these authors notes the occurrence of the transverse furrow above the leaf-scar; but the specimens described by these writers do not appear to have been very well preserved.

Boulay mentions, in his description, that in his fossil the cicatricules were badly preserved; and from the slight haziness which pervades Sauveur's figure, one is also led to conclude that neither was it in a very good state of preservation.

The ribs on the Scotch specimen are broader in proportion to the size of the leaf-scars than in the foreign examples; but this character is evidently dependent on the age of the plant.

I have observed in specimens of *Sigillaria lævigata*, Brongniart, that though the ribs with age increase much in width, the leaf-scars undergo little or no enlargement; hence the relative size of the leaf-scar to the width of the rib appears to be of very little specific value. The distance of the leaf-scars apart is also subject to much variation, even on the same specimen.

Sigillaria Walchii appears to be rare in Britain. The only example I have as yet seen was communicated to me for examination by Mr. J. Smith, Kilwinning, to whose courtesy I am indebted for the addition of this species to our Carboniferous fossil flora.

Horizon. Coal-measures; roof of turf-coal.

Locality. Kilwinning, Ayrshire.

4. *Lepidodendron Peachii*, Kidston, n. sp. (Pl. XI. fig. 6.)

Description. Leaf-scars rhomboidal, the boundary lines of the upper part of the leaf-scar convex, those of the lower part concave, lateral angles prominent. Vascular impression slightly above the middle, rhomboidal, transversely elongated; from its lateral angles extends a raised line to the centre of the lateral angles of the leaf-scar, dividing the "field" into an upper and a lower portion. The upper part of the leaf-scar is slightly more elevated than the lower portion, which causes it to rise above the vascular impression in a hood-like manner. Vascular-bundle cicatricules three, punctiform.

Remarks. The figure shows on each side of the main stem the remains of a small branch; these are so much narrower than the stem which bears them that they give the fossil an appearance as if it possessed a lateral ramification, but these small branches are evidently the result of an unequally developed dichotomy. On a specimen of this plant from Newsham the same characteristic is exhibited.

On none of the few examples of *Lepidodendron Peachii* which I have seen, are the two little oval depressions shown, which in well-preserved Lepidodendroid leaf-scars are usually exhibited, one on each side of the median line immediately below the vascular impression; but their absence may be due to imperfect preservation.

Lepidodendron Peachii has a slight resemblance to *Lepidodendron Rhodeanum*, Sternberg; but in *Lepidodendron Peachii* the lateral angles are more prominent and the upper extremity of the scar much more rounded. The vascular impression is also more central and its angles more prominent.

The point, however, which at once separates this species from *Lepidodendron Rhodeanum* is the elevation of the upper portion of the leaf-scar. This is seen in profile at fig. 6 *b*. This peculiar inflation imparts to the leaf-scar a characteristic appearance, which at once distinguishes *Lepidodendron Peachii* from any other species of *Lepidodendron* with which I am acquainted.

Lepidodendron Peachii is also related to *Lepidodendron minutum*, Sauveur*, and *Lepidodendron Andrewsii*, Lesquereux†.

The figure given by Sauveur of his *Lepidodendron minutum* shows a fragment of a stem rather less than 2 inches long

* Sauveur, 'Végétaux fossiles d. terr. houil. de la Belgique,' pl. lxi. fig. 3 (1848).

† Lesquereux, 'Coal Flora of Pennsyl.' p. 389, pl. lxiv. fig. 6 (1880).

and about three quarters of an inch wide. The leaf-scars are about 4 millim. long and of about the same width; in outline some of them are hexagonal, especially towards the lower part of the figure. Notwithstanding, however, the general similarity of *Lepidodendron minutum* to *Lepidodendron Peachii*, without further evidence than that afforded by Sauveur's figure, which is unaccompanied by a description, it is quite impossible to identify the Scotch specimen as his plant.

Another example of *Lepidodendron Peachii* from Newsham, Northumberland, showing a younger branch on which the leaf-scars are smaller than on the Falkirk specimen, has also a like similarity with *Lepidodendron minutum*, but the objections mentioned in regard to the identification of the Falkirk fossil with Sauveur's species also apply to this.

The type of *Lepidodendron Andrewsii* is also fragmentary, and scarcely affords sufficient characters for a satisfactory comparison. Lesquereux says of his species, that "it is of the type of *Lepidodendron Volkmannianum*," to which group *Lepidodendron Peachii* can scarcely be said to belong.

The specimen which forms the type of this species was collected in 1870 by Mr. C. W. Peach, who some time ago submitted it to me for examination; but owing to the difficulty in identifying specimens of *Lepidodendron* with many of the described species without the opportunity of examining the types, it has been allowed to remain over till the present time. I have great pleasure in naming this plant after its discoverer, to whom I owe so deep a debt of gratitude for willing assistance given me in my study of the British Palæozoic fossil flora.

Horizon and Localities. Scotland: Coal-measures; Brickworks, Falkirk, Stirlingshire. England: Middle Coal-measures (low-main seam); Newsham, Newcastle-on-Tyne, Northumberland.

EXPLANATION OF PLATE XI.

Fig. 1. *Sigillaria Walchii*, Sauveur. From the roof of the turf-coal, Kilwinning (nat. size). 1 *a*. Leaf-scar, enlarged $1\frac{1}{2}$ diameters. 1 *b*. Section of specimen, showing elevation of ribs. Original in the possession of Mr. J. Smith, Kilwinning.

Fig. 2. *Sigillaria coriacea*, Kidston, n. sp. From (?) Newcastle-on-Tyne. Figure taken from plaster cast of specimen in the collection of the British Museum. (Nat. size.)

Figs. 3–5. *Sigillaria McMurtriei*, Kidston, n. sp. From Tyning Pit, Radstock, Somersetshire (nat. size). 3. Figure taken from plaster cast of impression in the author's collection, communicated by Mr. J. McMurtrie, Radstock. 3 *a*. Vertical section of one of the cushions (*a* indicates position of leaf-scar, *b* its supporting cushion). 3 *b*. Leaf-scar, enlarged $1\frac{1}{2}$ diameters, to show the vascular cicatricules, the central of which is composed of two confluent dots. 4. Figure from plaster cast of an impression in the collection of Mr. McMurtrie. 4 *a*. Vertical section of one of the cushions. 5. Four cushions with their associated leaf-scars, from a specimen in the author's collection. Communicated by Mr. J. McMurtrie. The part marked *a* shows the decorticated condition. 5 *a*. Vertical section of one of the cushions.

Fig. 6. *Lepidodendron Peachii*, Kidston, n. sp. From the Brickworks, Falkirk, Stirlingshire (nat. size). Original in the collection of of Mr. C. W. Peach. 6 *a*. Leaf-scar, enlarged 2 diameters. 6 *b*. Leaf-scar, shown in profile, enlarged 2 diameters.

XXXII.—*On the Relationship of the Sponges to the Choanoflagellata.* By Franz Eilhard Schulze *.

After Dujardin, Carter, and Lieberkühn had demonstrated the agreement of certain cells of the sponge-body with *Amœbæ*, the Sponges were for a long time referred to the Protozoa. More recent investigations, however, have led to the conviction that they do not consist of colonies of homogeneous individual creatures, but of different tissues, that they reproduce sexually, and are built up out of at least two germinal layers, and consequently belong to the Metazoa.

As, however, some naturalists still continue zealously to maintain the Protozoal nature of the Sponges, it becomes necessary to test the arguments brought forward by them.

Within the last few years the opinion first put forward in the year 1866 by James Clark † has been defended with peculiar emphasis by Carter and Saville Kent—namely that the so-called *collared cells* of the sponges provided with a hyaline membranous annular frill are to be regarded, not as epithelial cells, but as *flagellate* Infusoria, and consequently the entire sponges as *colonies of Flagellata*. Somewhat as the whole of the individual animals in a colony of *Ophrydium* are placed side by side, imbedded superficially in a common gelatinous mass, so also in the Sponges the *spongozoa*, as Carter calls the collared cells, in accordance with the above-mentioned conception, are seated as independent creatures upon a common foundation after the fashion of a colony.

It is not to be denied that there exists a great similarity

* Translated from a separate impression of the paper in the 'Sitzungsberichte der Königlich-preussischen Akademie der Wissenschaften zu Berlin,' 1885, pp. 179–191.

† Proc. Bost. Soc. Nat. Hist. 1866, and Mem. Bost. Soc. Nat. Hist. 1868, vol. i.; see also Ann. & Mag. Nat. Hist. 1868, ser. 4, vol. i.

between the collared cells of the Sponges and those flagellate Infusoria, occurring sometimes singly and sometimes in colonies, which are denominated Choanoflagellata by Saville Kent and by Bütschli Calicomastiges. This resemblance is the more striking because we do not meet with similar structures elsewhere in the whole animal kingdom. In both cases we have to do with a cylindrical or rounded plasma-body with contained granules and a well-developed nucleus. From the middle of the somewhat prominent free end-surface originates a flagellum, and from the outer circular margin freely projects the so-called collar, an extremely delicate hyaline annular membrane, which generally exhibits the form of a cylindrical mantle, but is also susceptible of certain changes of form. Thus we may observe sometimes an abbreviation, sometimes a funnel-like enlargement or a contraction of the tube outwardly, sometimes a bellied inflation. Those small limpid vacuoles which regularly occur in the Choanoflagellata in the basal part, and perform rhythmical pulsations, are also asserted by some naturalists, such as James Clark, Carter, and Saville Kent, to be constant and characteristic structures of the collared cells of Sponges; but I have by no means found them regularly in the latter. Granular pigment-masses, such as occur, often abundantly, in the collared cells of *Spongelia*, *Oscarella*, and other Sponges, have hitherto not been observed in the Choanoflagellata.

Although these and other differences may appear insignificant in comparison with the remarkable agreement which is expressed in the peculiar collar, it is nevertheless clear that even so close a resemblance between certain unicellular Protozoa and individual cells of the Sponges (which consist of *three* different tissue-layers) can by no means alone lead to the conclusion that the Sponges belong to the Protozoa. The untenability of such a conclusion becomes still plainer (as, indeed, Lendenfeld * has lately pointed out) if we apply it to other groups of animals, and refer the Cnidaria, for example, to the Protozoa, because their gastro-vascular system is lined with flagellate cells, which resemble certain Flagellata.

Saville Kent † himself seems to have felt the insufficiency of such a proceeding, as he has endeavoured to bring forward, in addition to the arguments adduced by James Clark, other and indeed more cogent reasons in favour of the correctness of his conception. For this purpose he has, in the first place,

* Proc. Linn. Soc. New South Wales, vol. ix. 2, p. 329.

† "Notes on the Embryology of Sponges," in Ann. & Mag. Nat. Hist. 1878, ser. 5, vol. ii. p. 139; and 'A Manual of the Infusoria,' 1880–81.

studied the larvæ of certain Sponges, such as *Oscarella* (*Halisarca*) *lobularis*, *Grantia compressa*, *Leucosolenia botryoides*, and *Halichondria* sp., both in the developed state and during their development, and arrived at the astonishing result that these structures by no means correspond to the first developmental stages of Metazoa, but are colonies of Choanoflagellata. He infers this both from their anatomical structure and from the mode of their formation. A mature "swarm-gemmule" (as he calls the free-swimming sponge-larvæ) of *Grantia compressa*, according to Saville Kent, represents an elongate vesicle, the wall of which consists of a single layer of radially placed cylindrical cells. Each of these cells is said to bear at its outer end a marginal collar and a central flagellum, and therefore exactly to resemble the ordinary collared cells which, in a single layer, line the radial tubes of that calcareous sponge. In oviform swarm-gemmules of the same sponge which are not yet perfectly mature the long cylindrical cells are said already to possess the flagellum, but not the collar, and to meet in the middle with their diminished inner extremities. In a Calcisponge nearly approaching *Ascandra pinus,* Häck., however, Saville Kent once found an oviform larva, the broader posterior half of which consisted of collared cells projecting further from the centre. He interprets the latter as fully developed individual animals, and the flagellate cells without collars of the anterior part as not perfectly developed, and thinks that in this way he has found the clue to the comprehension of the frequently described oviform *Sycandra*-larvæ, the anterior part of which consists of simple cylindrical flagellate cells without any collar, while the hinder part is composed of broad, somewhat convex, darkly granular cells without any appendage whatever. Here the darkly granular cells of the posterior extremity are supposed to have outrun the anterior flagellate cells in their development so far that they had already retracted a previously existing collar as well as the flagellum, and were on the point of conversion into amœboid cells of the future sponge-syncytium.

It is worthy of note that, with the exception of Kent, none of all the naturalists who have paid attention to the developmental history of the Sponges, and especially of the Calcispongiæ, and have specially and thoroughly investigated the structure of the swarm-larvæ, such as O. Schmidt, Carter, Metschnikoff, Barrois, Keller, and others, has detected the collar on the cylindrical flagellate cells of the larvæ, although, according to Kent's figures, it is hardly to be overlooked; for that hyaline and more strongly refractive marginal part which Barrois has represented upon isolated flagellate cells in fig. 29 of pl. xv. of his memoir, and which I have also detected in many swarm-larvæ, is nothing but the perfectly solid non-granular terminal part of the cells in question, from the slightly convex free surface of which the delicate flagellum originates.

In my investigations of the swarm-larvæ of *Sycandra raphanus*, which can hardly differ essentially in the structure of its larvæ from *Sycandra compressa*, and of many other sponge-larvæ, I have endeavoured, always in vain, to discover anything like the collar at the free extremity of the cylindrical flagellate cells. But when I compare the figures that Saville Kent gives of his "swarm-gemmules" with the images that one obtains by tearing up living *Sycandræ* under the microscope, I cannot avoid the supposition that what Saville Kent has described as a perfectly mature "swarm-gemmule," and finally figured in his 'Manual of the Infusoria' (pl. ix. fig. 25), is nothing more than a separated portion of the layer of collared cells, which has rolled itself up, so that the basal extremities [of the cells] are turned inwards and the collars outwards. Such deceptive images often come under observation when living *Sycandræ* are torn up in sea-water. Not unfrequently a separated sheet of cells becomes so completely rolled up, that it even appears like a closed vesicle when rotating, although, as a rule, it only forms more irregular structures, such as are figured by Saville Kent in pl. vi. fig. 17 of his memoir "On the Embryology of Sponges," in the 'Annals and Magazine of Natural History,' ser. 5, vol. ii.

Moreover, a hemispherically rolled layer of cells may occasionally attach itself to the posterior extremity of one of the oviform larvæ, which are usually present in numbers, in such a manner as to produce the form figured by Saville Kent (*loc. cit.* pl. vi. fig. 16, and 'Manual,' pl. ix. fig. 26), the posterior extremity of which appears covered with collared cells.

While, on the one hand, from my own observations, I cannot accept the composition of the bodies designated "swarm-gemmules" by Saville Kent out of collared cells equivalent to Choanoflagellata, on the other hand I must assert that, even if their structure were of the kind stated by Saville Kent, their nature, as colonies of Flagellata, would be by no means proved. They would then as now have to be regarded and described as true sponge-larvæ, because they have been produced by segmentation from a fertilized sponge-ovum, and become afterwards transformed in the same way as the well-known larvæ of other animals, such as the Hydroida, into mature Metazoa. Saville Kent will admit neither of these arguments as conclusive. He rather endeavours to refute both of them, and to prove that the whole process which has hitherto been generally regarded as egg-segmentation, larva-formation, and metamorphosis, is nothing but an organic process of multiplication, exactly agreeing with those processes which have been recognized in various Flagellata. With this view he endeavours, in the first place, to demonstrate the agreement of the process of segmentation of the egg, observed in many Sponges, with that division of a simple Flagellate animal which leads to the formation of a considerable number of equivalent individuals, that is to say, to the formation of a colony, appealing to the descriptions given by Ehrenberg, Perty, and Schneider of the propagation of *Polytoma uvella*, by Dollinger and Drysdale of the division of a Monadine, *Heteromita uncinata*, and by Häckel of the reproductive cycle of his *Magosphæra planula*, and further adducing the results of his own observations upon the propagation of a Choanoflagellate, *Salpingœca fusiformis*, newly discovered by him. In this last organism he was able to ascertain that a typically constructed individual animal became transformed within its vase-like case, after the retraction of the collar and flagellum, in the first place into an amœba-like body. After this had passed through a resting-stage in the spherical form it underwent a regular division, the final products of which quitted the capsule as flagelliferous swarmers. From each swarmer a *Salpingœca fusiformis* was again produced.

Placing this process side by side with the egg-formation, segmentation, larval development, and metamorphosis of the Sponges, Saville Kent formed the following conception of the latter. From a simple collared cell proceeds a cell capable of amœboid movements. This, by continual binary division, undergoes a segmentation like that of *Salpingœca fusiformis*, and the final product in this, as in that case, is a considerable number of cells, which in the first place have only a flagellum, but subsequently acquire a collar, and so become collared cells, whether they constitute together a free swarm-larva (swarm-gemmule) or the collared-cell-layer of a flagellate chamber.

As an essential distinction Saville Kent then indicated only the circumstance that in the Sponges the individual animals produced by division remain united (either as a swarm-gemmule or as the lining of a chamber) and produce (in the case of the swarm-gemmule after attachment) a gelatinous basis, upon which they are then seated in a continuous layer or in groups; while the Choanoflagellata do not possess any such common gelatinous supporting substance.

But even this difference Saville Kent thought he got rid of when he succeeded in discovering and studying the development of a Choanoflagellate form which, in the fully developed state, constitutes an adherent colony, and secretes a hyaline gelatinous substance in which all the individual animals are imbedded, partly in their typical development, and partly in various stages of development and metamorphosis.

The transformation of the individuals furnished with a flagellum and collar into irregular amœboid cells, from each of which a mass of spores is then developed by continued division, is easier to observe in this than in any other Choanoflagellate. But, according to Saville Kent's view, the spores pass through a stage furnished only with a flagellum in their transformation into the characteristic collared cells, which again, by division and the secretion of gelatinous basal substance, give origin to new colonies. Saville Kent names this newly-discovered Choanoflagellate *Protospongia Hæckelii*, and repeatedly refers to its great resemblance to the Sponges. To produce a sponge, although a very simple one, all that is necessary, he thinks, is a trifling modification in the position of the zooids, which would merely have to retreat, in the fashion of nests, into invaginations of the gelatinous "zoocytium." He further indicates that, even histologically, there is no essential difference between his *Protospongia* and a skeletonless sponge, seeing that not only do the individual animals of the Choanoflagellata resemble the collared cells of the Sponges, but even the gelatinous substance which serves as the common imbedding mass of the *Protospongia*-colony agrees with that mass of tissue which acts as the basis and supporting framework for the epithelial layer of the sponge-body.

Now it is well known that this fundamental tissue of the Sponges, in which alone the skeletal parts are developed, has been interpreted in very different ways. Described by Oscar Schmidt as *sarcode* and by Häckel as *syncytium*, it is understood by both as if its hyaline basal substance, which contains granules here and there, were produced by the fusion of the protoplasmic bodies of neighbouring cells, and itself contractile. Of these cells only the nuclei are preserved.

In opposition to this view I have demonstrated, in a series of monographs upon certain families, genera, and species of Sponges which I have been able to investigate in the living state, that we have to do here *not* with such a syncytium, but with a true *connective substance*. I have shown that in the tissue in question well-individualized, more or less distinctly limited cells with nucleus and plasma-body are to be recognized, and that these lie in a basal substance, which is sometimes gelatinous, sometimes firm, and sometimes even of cartilaginous hardness (*corticium*). Of these cells some are freely movable, others fixed. The former can change their place by amœboid movements as "creeping cells;" while the fixed ones are sometimes irregularly stellate in form, sometimes fusiform or even filamentous, and in many cases are capable of well-marked contractions, and may sometimes even resemble smooth muscular fibres in structure and function. *The basal substance as such, however, possesses no contractility.* It is not a sarcode or amalgamated cell-protoplasm, but an intermediate substance distinct from the cell-bodies, sometimes like that of the gelatinous connective tissue. This notion of mine has lately been adopted by most spongiologists.

Saville Kent further states, with regard to the gelatinous foundation of his *Protospongia Hæckelii*, that, being at first quite structureless, it becomes converted, by the immigration of amœboid individual animals from the surface, into a tissue which exactly resembles that of the Sponges.

In opposition to this I must, however, remark, that in this case the immigration of amœboid cells does not produce a tissue such as we generally meet with in Sponges. *No fixed connective cells at all are formed.* The immigrant elements seem rather, from Kent's own showing, destined to an increase by division or for spore-formation; whilst in the Sponges, besides the amœboid wandering cells, which probably serve for the formation of the sexual products, there occur numerous other cells, which have attained special development for different purposes, partly as *connective corpuscles*, partly as *contractile fibre-cells*, partly as *gland-cells*, and partly even as *sense-* and *ganglion-cells* (as lately stated by Von Lendenfeld in the 'Zoologischer Anzeiger,' no. 186).

As a histological difference of importance we have further to note the circumstance that, as I first demonstrated, the whole surface of the connective substance of the sponge-body, which is bathed with water, so far as it is not occupied by collared cells, is covered with a single layer of flat epithelial cells, which either possess a smooth outer surface or bear each a flagellum. Such a covering of flat cells is entirely deficient in *Protospongia*.

Finally, I will also call attention to the fact that in *Protospongia* all the collared cells are immersed up to the collar in the gelatinous uniting mass, while the corresponding cells of the Sponges are only seated by their basal surfaces upon the connective foundation, but otherwise stand freely side by side.

In turning now to the criticism of the agreement of the reproductive cycle of the Sponges and Choanoflagellata, asserted by Saville Kent, I must, in the first place, remark, that since Lieberkühn's discovery of the spermatozoa of *Spongilla*, structures have been detected in numerous sponges agreeing in their form, development, and kind of movement so completely with the spermatozoa of the higher animals, that no doubt can exist as to their true nature. Thus, even if we should not place full confidence in the statements as to the direct observation of the act of fertilization, there is the less reason to doubt of the sexual reproduction of the Sponges, as ova of typical structure, the development of which into free larvæ could in many cases be followed, have certainly been detected almost everywhere.

Saville Kent, it is true, disputes the occurrence of spermatozoa in Sponges, as, indeed, he does not admit any true sponge-ova; nevertheless it appears from his own descriptions and figures* that he has himself seen sperm-balls and their developmental stages. Only he has regarded them, together with structures of quite a different kind (such as granules of colouring-matter and cells containing reserve-nutriment), as spore-aggregates and their formative stages.

If, therefore, the Sponges possess a sexual reproduction, of which the Choanoflagellata (as probably all the Protozoa) are destitute, we find in this important difference a further confirmation of the conviction arrived at from the anatomy and histology of the two groups of animals, that the Sponges are not colonies of Flagellata, nor, indeed, Protozoa at all, but true Metazoa.

Finally, the same result is furnished by the developmental history. For different as may be the course of development in the Sponges hitherto investigated, and greatly as the accounts of individual observers may differ from each other, all the statements nevertheless agree, that *at the close of larval life two different cell-layers, an external and an internal one, may be distinguished.* In this there would be nothing to alter, even if Götte's statement (Zool. Anzeiger, nos. 183, 184) should prove to be correct, namely, that the ectoderm of the larvæ of *Spongilla fluviatilis*, which consists of flagellate cells, is entirely destroyed by exfoliation or atrophy.

If, therefore, there is nô doubt as to the Metazoan nature of the Sponges, and consequently all justification of placing them among the Choanoflagellata is entirely excluded, there still remains the possibility that an affinity of the nature of *a relation of descendance* may exist between these two groups of animals whose degree of development is so different.

* 'Manual of the Infusoria,' pl. x.

In point of fact, this idea has recently found a very decided supporter in Bütschli. "As I am of opinion," says Bütschli in his remarks upon the Gastræa-theory*, "that the group of the Sponges is completely shut off from the rest of the Metazoa, *and one which originated quite independently from the section of the Choanoflagellata* (*Saville Kent*), it appears to me a mistake to take this group into consideration in the elucidation of the phylogenesis of the other Metazoa."

No doubt this opinion of Bütschli's is founded upon the same fact which has induced James-Clark, Carter, and Saville Kent to refer the Sponges to the Choanoflagellata, namely, the striking similarity of the latter to the collared cells of the Sponges. It seems natural to refer the exclusive occurrence of so peculiar a structure as the collar in two groups of animals, not to a possible double independent formation of it, but simply to inheritance; and as we have no reason to suppose that the existing Choanoflagellata are retrograde descendants of sponge-like Metazoa, but are *à priori* inclined to assume that our lowest Metazoa originated from Protozoan colonies, we are certainly easily driven to the notion that the Sponges have been developed *from colonies of Choanoflagellata*, of the possibility of the existence of which their unaltered descendants, still existing as Protozoa, furnish the clearest proof.

With such a notion, however, the assumption of a near relationship between Sponges and Cnidaria is irreconcilable. We should then have likewise to derive the latter from Choanoflagellata, for which there is not the least reason.

As is well known, it was Leuckart who first, in the year 1854 †, on the ground of the then known facts, indicated the relationship of the Sponges to the "Polypes," and in consequence referred them to his type Cœlenterata. Although this view at first met with little acceptance, Leuckart repeated it in the year 1866 ‡, and instituted a comparison between a *Grantia* (*Ascone*) and a Hydroid polype. He indicated that the simple vibratile cavity occurs in both, but that the terminal apertures of the tubes of *Grantia* represent the buccal apertures of the individual polypes; while the absence of tentacles, which are also occasionally deficient in Siphonophora and Ctenophora, can no more stand in the way of the comparison than the occurrence of the lateral incurrent orifices, which likewise occur in many Cœlenterata as so-called water-apertures; and he concluded his comparison

* Morphologisches Jahrbuch, Bd. ix. p. 424.
† Arch. für Naturg. Jahrg. 20, Bd. ii. p. 471.
‡ Arch. für Naturg. Jahrg. 32, Bd. ii.

with the remark that the histological difference between *Hydra* and *Actinia* is hardly less considerable than that between *Hydra* and *Spongia*.

These ideas of Leuckart's, which were accepted as essentially correct by Micklucho-Maclay, Häckel, and most spongiologists, have quite recently been carried further by Marshall *, who has at the same time sought to controvert the arguments which had in the meantime been brought forward by Balfour in favour of the independent origin of the Sponges from the Protozoa.

While Balfour, in his 'Comparative Embryology' (vol. ii. p. 285), had cited the peculiar character of the digestive canal-system of the Sponges, in contradistinction to the gastro-vascular apparatus of the Cœlenterata, Marshall, like Leuckart, finds precisely in the agreement of this system in the two groups a principal reason for uniting them in the same type. After appealing to his own observation of a radial arrangement of the first flagellate chambers as diverticula of the central gastral space, and to the not unfrequent occurrence of radial symmetry in mature sponges of different sections, he says in conclusion :—"The two groups are Metazoa with gastral spaces, mesenterial sacs (which in Sponges may become flagellate chambers), and canals originating from the gastral space and running centrifugally, which open outwards by means of pores, and (occasionally even in the higher Cœlenterata) serve for the reception of nourishment. These canals, like the gastral spaces (in *Reniera*), are lined with endoderm, which in both differentiates flagellate cells."

Balfour had remarked that the early development of the mesoderm in the Sponges stands in striking opposition to the deficiency of this layer in the embryos of most Cœlenterata, and called attention to the remarkable peculiarity of the sponge-larvæ.

Marshall, however, ascribes no phylogenetic significance to the early development of the mesoderm in the Sponges, referring it to "abridged inheritance," and in general recognizes no important difference between the larvæ of Sponges and Cœlenterata.

The entire absence of urticating capsules in the Sponges is explained by Marshall by their correlative connexion with the tentacles, which the Sponges have either never possessed or lost very early, while they occurred in the true Cœlen-

* Zeitschr. für wiss. Zool. Bd. xxxvii. (1882), p. 221; and Abhandl. der Berl. Akad. der Wiss. (1884).

terata from very early times, and led to the development of urticating capsules.

In general Marshall is inclined to conceive of the Sponges as retrograded Cœlenterata, the cœlenteric apparatus of which originally resembled that of the higher Cœlenterata, and like that possessed aquiferous pores, but at first did not employ these for the reception of nourishment. It was only later, according to Marshall's view, that a change of function took place in the Sponges, the water, and with it the food, being inhaled through the external pores. During this change any tentacles that may have existed disappeared, together with the urticating capsules, and the afferent canal-system underwent a special development.

Undoubtedly the decision in favour of one or the other of the two opposite views can only be arrived at with any degree of certainty when a thorough knowledge of the *ontogeny* of numerous Sponges and Cnidaria justifies definite conclusions as to the phylogenetic development of the two groups.

What we at present know of the ontogeny of the Sponges is *not*, to my mind, in favour of the correctness of Bütschli's hypothesis. For if the Sponges had really originated from colonies of Choanoflagellata, and been indebted to this circumstance for their collared cells, we should expect that in the ontogenetic development of the Sponges the collared cells would make their appearance in that phase which corresponds to the phylogenetic stage of a Protozoan colony, namely in the *blastula*. This would indeed really be the case if Saville Kent's representation were correct, according to which the blastula or "swarm-gemmule" (at least of *Sycandra compressa*) consists of a layer of collared cells.

But as the sponge-larvæ with which we are acquainted do not possess these collared cells, but, like the larvæ of the Cnidaria, simple *flagellate cells*, and, also like the Cnidarian larvæ, have already attained the Metazoan stage by the differentiation of two distinct cell masses before the metamorphosis into the typical sponge, and consequently the formation of the collared cells, commences, it follows that the constitution of the sponge-larvæ favours, not the independent origin of the Sponges from Choanoflagellata, but rather a close relationship of the Sponges to other Metazoa, such as the Cnidaria. It is true that in this way the agreement between the collared cells of the Sponges and the Choanoflagellata becomes more difficult to understand. But still the possibility of a spontaneous production of the collar in the

Sponges quite independently of that of the Choanoflagellata seems to me to be *à priori* by no means excluded.

The circumstance that in quite distinct groups of Protozoa we meet with delicate membranous elevations of the plasma-body, which, although not the same as, are yet similar to, the collar, may perhaps indicate that the faculty of forming such processes may be inherent in protoplasm in general, and therefore that such processes might be produced independently of each other even in different divisions of animals and at different times. I have myself observed * in *Placopus ruber*, a freshwater Rhizopod, pseudopodium-like processes, which originate on the free upper surface of the animal, and by the fusion of their contiguous lateral margins may unite to form delicate membranous funnels. The so-called undulating membranes of many ciliated Infusoria also resemble the collar in many respects; but one does not on this account assume a close relationship between those Infusoria and the Choanoflagellata.

In estimating the relationship of the Sponges to the Cnidaria the consideration of the larvæ will also be of great consequence, and certainly not less important than the comparison of the fully-developed animals, which has hitherto been principally employed. Notwithstanding the small extent of our knowledge of the two kinds of larvæ and the mode of their metamorphosis, we can even now assert that the difference between the free-swimming ciliated larvæ of the Sponges on the one hand, and of the Cnidaria on the other, is on the whole not more considerable than between the different sponge-larvæ themselves. No one can say, with regard to any ciliated larva met with accidentally in sea-water and not already known to him, whether it is a Sponge- or a Cnidarian larva. It is only after metamorphosis that those primary differences of organization by which we can easily and sharply separate the two groups from each other make their appearance.

Thus, in my judgment, we are justified in the belief that the divergence of the two lines did *not* commence before that phylogenetic developmental stage which corresponds to the ciliated larva ready for metamorphosis. But what degree of organization was attained before the separation actually took place it will be more difficult to decide.

I can find in the developmental history no satisfactory ground for Marshall's above-mentioned hypothesis, that the common ancestors of the Sponges and Cnidaria possessed

* Arch. für mikr. Anat. Bd. xi. p. 348.

radially arranged mesenterial sacs, tentacles with urticating capsules, and indifferent aquiferous pores. Although in certain Sponges at an early period radial diverticula surround a central cavity, there are also Sponges, such as the Ascones, which never develop such diverticula, and others (the Sycones) in which they only originate as sacculations of the wall. But that the Ascones are not retrograde forms may be inferred from the circumstance that the Sycones, long before they form radial tubes, present the pure Ascon type. It is therefore very probable that the oldest Sponges possessed no radial diverticula of their central cavity, but, like *Olynthus* among the Calcispongiæ, had a simple sac-like form.

XXXIII.—*New Coleoptera recently added to the British Museum.* By Charles O. Waterhouse.

Scarabæidæ.

Scarabæus Thomsoni, Bates, *in litt.*

Supra cupreus, subtus olivaceus nitidus; tibiis nigris.
Long. 16 lin.

Somewhat bright uniform copper-colour above, very dark olive-green below. Thorax very convex, obliquely nar rowed in front and posteriorly; densely asperate at the sides; the disk strongly punctured, the punctures moderately large, each with a minute puncture in the middle; the punctures on the posterior part of the disk are irregularly placed, but are generally separated from each other by about the diameter of a single puncture; the surface between the punctures shining, with a few minute punctures here and there. There is an irregular smooth median line. The sides are very regularly crenulate, somewhat angular at the middle, very gently sinuate behind the middle. Elytra distinctly narrower than the thorax, moderately convex, considerably sloping down behind the middle; the suture shining, with a few small punctures; the rest of the surface dull, especially towards the sides, densely and finely rugulose; the rugæ having a tendency to run longitudinally produces an appearance of the surface being scratched; the first interstice has a few shallow punctures; the second, third, fourth, and fifth interstices have more numerous, moderately large, very shallow, dull punctures, which have a tendency to form two lines on each interstice. The space between the sixth stria and the margin is somewhat flat, without large punctures; behind the middle there are several short oblique impressed lines, visible only in certain lights. Sternum smooth and shining in the middle, closely punctured at the sides. Abdomen dull but smooth; the first segment with some large punctures at the sides, the second and third segments densely and very finely punctured at the sides, the fourth and fifth segments very strongly punctured. The epipleural fold of the elytra has numerous distinct transverse folds, giving the appearance of a ladder.

Hab. Taveta, Masai country, at the south-east foot of Kilimanjaro (*J. Thomson*).

This fine species is closely related to *S. cupreus*, Casteln., but may be distinguished by the rather coarser sculpture, by the oblique striation on the margin of the elytra, which, although apparently a slight character, is very constant; and by the granules on the sides of the thorax being confluent instead of isolated.

Trichiidæ.

Agenius suturalis, n. sp.

♂. Black, the elytra testaceous, with the suture and margin black. Head, thorax, and the body beneath clothed with rather long pale pubescence. Clypeus as in *A. limbatus*, but more finely punctured. Thorax scarcely broader in the middle than at the base, more gradually narrowed in front than in *A. limbatus*, and beginning to narrow from rather behind the middle; shining, very closely and rather strongly punctured; the base sinuate on each side. Scutellum dull, a little longer than in *A. limbatus*. Elytra a little more narrowed at the apex than in *A. limbatus*, not so dull as in that species, the punctuation similar, except that there is a series of very closely-placed punctures along each side of the suture, not quite reaching the scutellum; the apex rugose. Metasternum moderately thickly punctured in the middle, very closely and more finely punctured towards the sides. Abdomen not very closely punctured in the middle (but the punctures three times as numerous as in *A. limbatus*), closely punctured at the sides. Pygidium closely rugulose.

Length 13 millim.

♀. Entirely black, shining, the elytra dull. Much broader than *A. limbatus*; the thorax rather more convex, less narrowed at the base, less angular at the sides; rather more strongly but a little less closely punctured. The elytra are rather strongly but obscurely punctured; much less suddenly deflexed at the sides, with no distinct sublateral ridge except at the shoulder.

Length 17 millim., width 8 millim.

Hab. Cape of Good Hope (*R. Trimen*).

Myoderma rufa, n. sp.

Near to *M. alutacea*, but rather more robust and more convex. Red, clothed with red pubescence, the sterna and legs black. The front margin of the clypeus is a little less prominent in the middle. Thorax more convex, very closely and rather more strongly punctured; the sides more rounded, not sinuate before the hind angles, which are consequently more obtuse. The costæ of the elytra are broader and more strongly punctured; the pubescence is finer. The anterior tibiæ are rather broad, with three strong acute teeth. All the underside of the insect is closely and rather strongly punctured.

Length 13–14 millim.

Hab. Zulu.

Buprestidæ.

Chrysodema occulta, n. sp.

Æneo-viridis, aureo-viridi-punctata, nitida; thorace linea mediana distincta, lateribus impressione magna cuprascenti; elytris multicostatis, costis basi obsoletis, interstitiis fortiter punctatis.

Long. 14–15 lin.

The thorax has the large golden-coppery impressions bounded on the outside by a straight ridge, somewhat as in *C. radians*, but sharper. Each elytron has eight costæ, of which the alternate ones are somewhat indistinct, and none of the costæ are distinct at the base. Behind the middle, between the fourth and sixth costæ, there is a rather indistinct golden impression. The usual apical golden impressions are very narrow.

This species is very near to *C. Jansoni*, Deyr., and is difficult to distinguish by the upper side. The thoracic impressions are rather more clearly defined. The elytra have no impression before the middle, and the apical longitudinal impressions are much narrower.

The apical segment of the abdomen in the female in *C. Jansoni* has a small but rather deep incision at the apex, the sides of the incision being parallel. In *C. occulta* there is a smaller incision in the form of an acute triangle.

I have not seen the male of either of these species.

Hab. Santa Anna, Solomon Is. (*Dr. Guppy*).

Chrysodema Brownii, n. sp.

C. smaragdulæ approximans, æneo-viridis, nitida; thorace disco utrinque fovea sat magna crebre punctulata impresso, lateribus fortiter punctatis; elytris costis interruptis cyaneis parum elevatis, interstitiis fortiter punctatis viridi-auratis, plagisque nonnullis igneo-cupreis ornatis.

Long. 14 lin.

Very near to *C. smaragdula*, but (even uniting all the varieties usually placed together under this name) distinct by its more robust form, strong punctuation of the elytra, which are less narrowed at the apex, &c. The thorax has the punctuation on each side of the median line very fine, at the sides it is very coarse. The discoidal impressions are round and coppery. Each elytron has three small impressions at the base; there is a coppery impression on the disk before the middle, between the first and second costæ, and interrupting the second costa; there are two small impressions between the first and second costa just before they unite posteriorly *not* diverting the costæ, as is usually the case in *C. smaragdula*. On the side there are three large impressions, the first and second elongate, the third round and dividing the third costa near its apex. The surface between this last impression, and the apex of the elytra is more or less golden. The apical segment of the abdomen has a small but wide triangular emargination at the apex.

This species differs from *C. proxima*, Saund., in having the space on each side of the median line much less punctured; the impressions on the elytra are more coppery, and the posterior lateral impression is not united to the posterior impression, which is between the first and second costa.

Hab. Duke-of-York Island (*Rev. G. Brown*).

Note.—The males of the species of this genus appear to be rare. Of *C. aurofoveata* there are in the British Museum three males and thirteen females; of *C. radians* one male and eleven females; of *C. occulta*, ten females, no male, &c. The males are easily distinguished by the broad triangular emargination of the fifth abdominal segment, which leaves the sixth pubescent segment exposed below. The thorax is generally rather narrower, and the impressions are less marked.

Chrysodema ventralis, n. sp.

Læte aureo-viridis, nitida; thorace crebre punctato, lateribus impressione sat magna aurea ornatis, angulis posticis acutis paulo divergentibus: elytris multicostatis, costis lævibus, interstitiis crebre punctatis; apice ipso cupreo; corpore subtus pedibusque cupreis.
Long. 10 lin.

A very distinct species by its elongate elliptical form. The thorax is obliquely narrowed in front, broadest at the posterior angles, which are more diverging than in any species known to me. The surface is closely and not very finely punctured, with a slight smooth line in the middle; on each side there is a rather large, shallow, golden, punctured impression, which touches the margin. Each elytron has eight nearly equal rather strong costæ; the third costa is obliterated at the base by some very coarse punctures; the fifth does not reach the shoulder or the apex; the interstices are narrow and somewhat irregular. The whole of the under side of the body (except the sides of the sterna) is coppery.

Hab. Guam, Ladrone Is.

Cyphogastra terminata, n. sp.

Viridis, nitida; thorace aureo-impresso; elytris sat fortiter punctatis, ante apicem cupreis, apice ipso nigro-violaceo; tarsis flavis.
Long. 15 lin.

Allied to *C. punctipennis*, Deyr., but broader and more robust. The thorax has the median line and two small round impressions in front golden; the rather large lateral impressions are deep, golden, densely and finely punctured, and filled with dark yellow tomentum. The elytra are nearly parallel for more than half their length and then are gradually narrowed to the apex, and not compressed, as is so frequently the case in this genus; the punctuation is strong, rather more uniform than in *C. punctipennis.* The tarsi are yellow, except the last joint, which is green.

This species is also near *C. satrapa*, Sch. (*suturalis*, F.), but the two impressions in the front of the thorax are more distinct; the lateral impressions are larger; the punctuation of the elytra is more uniformly strong, the copper colour is less extended at the apex, and the apex is more acute.

Hab. Santa Anna, Solomon Is. (*Dr. Guppy*).

Cyphogastra abdominalis, n. sp.

Olivaceo-viridis, parum nitida; elytris sat fortiter punctatis, apice obscure cupreo tincto; abdomine cupreo-nitido.
Long. 15–17 lin.

Resembles *C. Mniszechii*, Deyr., in colour, but the form is different; the elytra are more convex posteriorly, less compressed before the apex, and the apex is more acute. The thorax has the sides very coarsely punctured. The punctuation of the elytra is strong, much stronger than in *C. Mniszechii*, and is distinct even to the apex. The process on the basal segment of the abdomen is very finely punctured, and more closely than in *C. Mniszechii*.

Hab. Duke-of-York Island (*Rev. G. Brown*).

Cyphogastra Macfarlani, n. sp.

Nigra, nitida, subtus olivaceo tincta; elytris cæruleo-viridibus, postice aureo tinctis, apice nigris, singulo elytro postice sulcis duabus leviter impresso.

Long. 14 lin.

Very close to *C. venerea*, Th., but, I think, must be considered distinct. The punctuation of the elytra is rather less strong, and the surface is almost smooth posteriorly; the longitudinal impression near the suture is less strong and much less punctured, and there is a well-marked lateral golden impression which is finely punctured. There is also an indication of a small impression below the shoulder.

Hab. Torres Straits, Murray Is. (*Rev. S. J. McFarlane*).

Cyphogastra sodalis, n. sp.

This species differs from *C. venerea* in the absence of the sutural impression of the elytra, and in the presence of an oblique shallow lateral impression, which is golden green and very slightly punctured.

Hab. Torres Straits, Cornwallis Is. (*Rev. S. J. McFarlane*).

Brachyceridæ.

Rhinoscapha uniformis, n. sp.

Nigra, pallide viridi-aureo-squamosa; thorace linea elevata mediana, guttisque parvis nigris; elytris striatis, interstitiis convexis, guttis minutissimis numerosis nigris.

Long. 9 lin., lat. $3\frac{1}{2}$ lin.

Of a uniform very pale green, with a slight golden tint in some lights, but there is no opalescence. The rostrum is longitudinally grooved, but the groove is broad and shallow. Antennæ long and slender. Thorax very convex, not impressed on the back, with some small irregular raised black marks on each side of the raised middle line. Striæ of the elytra rather deeply impressed, the punctures hidden by the scales; the interstices convex, especially the third and fifth; with numerous minute black dots, those near the base a little more conspicuous.

Hab. Aneiteum (*J. Brenchley*).

In the British Museum there is a specimen found in Santa Anna, in the Solomon Islands, by Dr. Guppy, which appears to be referable to this species, but which differs in having a slight bluish tint on the suture of the elytra, and on the base of the elytra there are numerous small, transverse, shining, raised spots. Probably these differences are due to the specimen being slightly rubbed and in less good condition than the type.

Prionidæ.

Xixuthrus costatus, n. sp.

Fusco-piceus, sordide flavo-pubescens; thorace transverso, lateribus crenulatis parallelis, angulis anticis late rotundatis, disco tuberculis nonnullis ornato; singulo elytro costis quatuor instructo, costa tertia brevi, interstitio quarto tertio multo angustiori; pedibus rugosis vix spinosis. ♂.

Long. 35 lin.

Antennæ reaching to the apex of the elytra, nearly black at the base, pitchy red beyond the third joint. The first joint 12 millim. long, subparallel, closely and very rugosely punctured; the third and following joints beset with very short acute tubercles; the eleventh joint longitudinally grooved. Thorax closely and finely rugose and finely punctured, with some shallow larger punctures intermixed. On the disk there are some slightly raised smooth lines, which together form the letter M, and on each there is an oblique interrupted raised line. The irregular teeth on the sides are very short and rather blunt. The first and second costæ of the elytra are very strong, thicker in the middle than at the apex; the third is very short and much finer, and is much closer to the fourth than to the second. The reflexed margin is rather broad when compared with that in allied species. The legs are long; the anterior femora and tibiæ are very rough, closely beset with short tubercles, those on the underside of the tibiæ acute. The intermediate and posterior femora are comparatively smooth, with a series of scarcely noticeable acute spines beneath; the tibiæ are longitudinally rugose, with some acute tubercles on the inner side, but not spinose; third joint of the tarsi very broad, the fulvous fringe on the margins of the anterior tarsi long.

Hab. Santa Anna, Solomon Is. (*Dr. Guppy*).

XXXIV.—*Notices of Fungi collected in Zanzibar, in* 1884, *by Miss R. E. Berkeley.* By the Rev. M. J. Berkeley, F.R.S.

1. *Agaricus* (Lepiota) *missionis*, B. Pileo campanulato fortiter papillato-umbonato, demum expanso, sericeo, squamuloso, cito glabrescente; margine striato; stipite æquali, basi incrassato subglabro; annulo amplo remoto; lamellis ventricosis postice rotundatis, liberis; carne secta rubra (no. 10).

Nov. 7. Eaten by the natives ("Uoga"); good to eat.

Pileus when campanulate about 2 inches across, when expanded 4 inches, white with a slight yellowish tinge; stem 3 inches high, $\frac{1}{4}$ thick, stained with red here and there, as well as when divided; gills $\frac{1}{4}$ inch wide. Approaching some allied exotic *Lepiotæ*, but distinct from any of the Ceylon species. Spores white, rather large; some specimens in drying become dark brown.

2. *A.* (Lepiota) *rhodocephalus*, B. Pileo rosello sericeo, minute tessulato, centro depresso lætiore, margine striato; stipite candido basi incrassato, anguste farcto; lamellis albis antice latis, postice attenuatis subremotis; annulo remoto (no. 7).

In tilled land, growing singly, but in great abundance. Eaten by the natives. Nov. 6.

Pileus depressed, of a beautiful rosy-cream colour, which is much deeper in the centre; the cuticle minutely tessulated, 3 inches across; margin striate; stem 2 inches high, about $\frac{1}{4}$ inch thick, incrassated at the base, ring deciduous, firm, with a narrow cavity; gills $\frac{3}{8}$ inch broad in front, attenuated behind, and subremote. A very pretty species, with much the appearance of the rose-coloured form of *A. lividus* as figured by Cooke, tab. 469.

3. *A.* (Clitocybe) *vagus*, B. Candidus; pileo expanso undulato lobato flexuoso, centro furfuraceo-squamuloso, glabescente; margine tenui; stipite basi ramoso brevi solido; lamellis longe decurrentibus angustis (no. 13).

Nov. 17. On sandy soil.

Pileus 5 inches across, much undulated, with a flexuous margin, flesh thin; stem $1\frac{1}{2}$ inch high, $\frac{3}{4}$ thick, solid, sparingly branched towards the base; gills linear, very decurrent, scarcely more than a line in breadth, but broader on one side of the pileus than the other.

A species evidently belonging to Fries's section *Difformes.* It does not accord with any of his species.

4. *Hiatula Benzoini*, Fr. Hym. Eur. p. 136; Ic. tab. 79. fig. 2 (no. 16).

Dec. 4.

5. *Agaricus* (Omphalia) *Arethusa*, B. Pusilla, glabra, tota alba; margine crenato; stipite pellucido gracili (no. 5).

By the roadside, on grass, solitary.

Pileus not exceeding $\frac{1}{4}$ inch across, umbilicate, pure white; stem $\frac{1}{2}$ inch high, about $\frac{1}{3}$ line thick; very delicate.

6. *A.* (Omphalia) *offuciatus*, Fr. Hym. Eur. p. 156; Ic. tab. 72. fig. 3 (no. 19).

I have no specimen of this, only a drawing, which accords with *A. offuciatus.*

7. *A.* (Pleurotus) *obfuscescens*, B. Pileo flabelliformi, sericeo-scabriusculo, margine subinvoluto; stipite confluente cum pileo; lamellis angustis decurrentibus, postice fuscescentibus, interstitiis rugosis (no. 11).

In cultivated ground, Nov. 6.

Pileus about 1–2 inches broad, $1\frac{1}{2}$ or more long; stem about $\frac{1}{4}$ inch long, dilated upwards, gradually passing into the pileus; when dry turning partially brown.

8. *A.* (Volvaria) *medius*, Fr. Hym. Eur. p. 184 (no. 12).

Volva deeply lobed, silky. Of a beautiful pale pink. Pileus when young campanulate.

9. *A.* (Naucoria) *scolecinus*, Fr. Hym. Eur. p. 258 (no. 8).

On roadsides, Nov. 6. The dark brown lower portion of the stem is very characteristic.

10. *A.* (Naucoria) *glandiformis*, Cooke, tab. 490.

I have only a drawing of this, which represents many specimens, springing from the same base. Possibly it may belong rather to *A. nuceus*, which it closely resembles.

11. *A.* (Naucoria) *pediades*, Fr. Hym. Eur. p. 260 (no. 1).

In a garden-pot, July 5.

The drawing represents a short-stemmed form much like *A. vervacti*, Fr., but the dried specimens accord with Cooke, tab. 492. *A. arvalis*, Cooke, tab. 479, agrees with specimens so named by M. Libert in her 'Exsiccati.' The spores are the same in all.

12. *A.* (Naucoria) *nicotianus*, B. Pileo hemisphærico, fusco, pulverulento; margine striato-lacerato; stipite flexuoso, tenui farcto concolore; lamellis latis postice truncatis sinuatis, breviter adnexis.

Pileus about $\frac{1}{2}$ inch across; stem $\frac{1}{2}$ inch high, about $\frac{1}{2}$ line thick. The gills are very peculiar, being strongly truncate behind, and then sinuate and adnexed. The species is otherwise much like *A. tabacinus.*

13. *A.* (Psalliota) *campestris*, L. (no. 18).

Dec. 4. Only a drawing.

14. *A.* (Psalliota) *Lalage*, B. Medius; pileo roseo, furfu-

raceo-squamuloso centro lætiore; annulo amplo; stipite deorsum peronato; lamellis fusco-purpureis (no. 9).

In grass after rain in large quantities. Nov. 6.

Pileus 1 inch across, pink, with darker chaffy scales in the centre; margin striate; stem about 1 inch high; ring about halfway down, below which there is a thick stocking-like coat; the stem is solid, about $\frac{1}{8}$ inch thick, slightly bulbous at the base.

A very pretty species about the size of *A. comtulus.*

15. *A.* (Psalliota) *trisulphuratus*, B. Pileo hemisphærico, lætissime aurantiaco; dense furfuraceo; carne alba; stipite concolore e furfuraceo-squamuloso, subglabro; deorsum radicante; annulo amplo; lamellis ex albo fusco-purpureis (no. 6).

On sandy ground, Nov. 6.

Pileus $\frac{1}{2}$–1 inch across; stem about 1 inch high, stuffed, strongly rooted at the base, bright orange like the pileus.

A very beautiful species. It has very much the appearance of *A. aspratus*, B.

16. *A.* (Psalliota) *nothus*, B. Pileo plano fulvo, squamis erectis aspero; stipite æquali farcto, deorsum fulvo-furfuraceo; lamellis fusco-purpureis (no. 15).

In sandy ground, Dec. 4. Allied to the last, but closely resembling *A. dasypeplus*, B., of which it might pass for a small form; but it is a true *Psalliota.* Gills purple-brown; flesh thin, white. The erect scales and duller tint distinguish it from *A. trisulphuratus*, and the stem is not rooting like that. With this is a single specimen of *A.* (Naucoria) *semiorbicularis*, Bull.

17. *A.* (Psilocybe) *albo-quadratus*, B. Cæspitosus; pileo late campanulato gibbo, albo-tessulato; stipite candido fistuloso; lamellis pallidis utrinque acutis subliberis (no. 20).

I have only a drawing of this species, which comes near to *A. sarcocephalus*, Fr.

Pileus 1 inch across, about the same high; stem ringless, $1\frac{1}{2}$ inch high, broadly fistulose, nearly equal, white; margin of pileus striate, sometimes splitting when expanded.

18. *A.* (Panæolus) *fimiputris*, Bull.

A single dried specimen, with the veil well developed.

19 *Coprinus diaphanus*, Quélet, Bull. Soc. Bot. 1877, p. 322 (no. 2).

20. *Hygrophorus chlorophanus*, Fr. Hym. Eur. p. 420.

Several dried specimens.

21. *Stereum nitidulum*, B., in Hook. Lond. Journ. 1843 (no. 14).

In sandy ground, Dec. 4.

The specimens are pure white, but cannot be distinguished from the Ceylon species; when dry they are zoned as in that species.

22. *Hirneola hispidula*, B. Ann. Nat. Hist. iii. p. 396 (no. 3).

A stipitate form which comes very near to *H. Wrightii*, B. & C., but the hymenium is strongly veined.

Erratum.

Vol. xv. p. 345, line 9, *for* "him" *read* "Fries."

XXXV.—*Report on a Collection of Marine Sponges from Japan, made by Dr. J. Anderson, F.R.S., Superintendent Indian Museum, Calcutta.* By H. J. Carter, F.R.S. &c.

[Plates XII.–XIV.]

This collection of Japanese Sponges, purchased by Dr. J. Anderson, F.R.S., at Tsushima, and said to have come from "off Misaki, at the entrance to the Bay of Tokio (Yedo)," although small, is extremely interesting, on account of the little-known and new species which it contains. These consist of:—

Four species which belong to the order Hexactinellida in my classification, viz.: *Hyalonema Sieboldii*, Gray; *Farrea occa*, Bowerbank; *Periphragella Elisæ*, Marshall; and *Hexactinella ventilabrum*, n. sp., Carter.

One species of the group Lithistina, viz. *Racodiscula* (Zittel) *asteroides*, Carter.

Two of the order Psammonemata, three of Raphidonemata, one of Echinonemata, and one of Holorhaphidota, the latter a large fragment of a new species of *Pachastrella*.

Hyalonema Sieboldii, Gray.

As this species is so well known, all that need be said of it here is that there are twenty-nine stems, of which ten only have heads, and these of different sizes. Of the two largest, one is cylindrical with a flat top, 8 in. high and 6 in. in horizontal diameter; and the other, which is similar in form but a little smaller, scattered over with defined circular holes, respectively circumscribed by a white rim of condensed tissue, of various sizes under 1-12th in. in diameter, in each of which is imbedded a parasitic isolated polyp—that is, without any stoloniferous connexion with its neighbours, and therefore unlike the *Palythoa* of the stem, which has a common sclerodermic union.

Farrea occa, Bk. (Pls. XII. and XIII. figs. 1–11.)

General form globular, stipitate, thick, shrubby, subsessile; structure originating in a short, round, hollow stem, about half an inch in diameter, which is extended below into an irregular, massive, root-like expansion, and divided above into two diverging branches, which, afterwards becoming subdivided repeatedly, form the head. Branches thick, short, cylindrical, hollow or tubular throughout, widely diverging at each division, about 5-12ths in. long by the same in diameter between the joints, dichotomously dividing repeatedly, as just stated, and more or less interuniting on the way; formed of an extremely thin and delicate reticulated wall or skeletal lamina which, in the upper part, is not thicker than the fibre of which it is composed, but rendered denser lower down, that is towards the base, by additional matter of a similar kind, that thus strengthens the support of the superstructure and causes this part to assume a whitish colour. Extremities of the branches open and dilated (Pl. XII.). During growth the termination of the branch, which is circular at first, becomes expanded upwards, then elliptical, and, finally, constricted or approximated in the centre, preparatory to division, when the same thing may be repeated and the divisions again divided singly; or one or both branches may unite with their neighbours respectively, when the result is a single tube that again divides dichotomously; and so on, till the whole head becomes formed of a series of short-jointed, hollow, dividing and interuniting branches, which thus gives rise to a clathrous structure of a globular form, as above stated. (The "branch" will hereafter be called "tubo-branch.") Consistence firm, elastic. Colour translucent white. Pores in the dermal reticulation (Pl. XIII. fig. 11). Vents cloacal or general, *i. e.* consisting of the open ends of the tubo-branches, into which the smaller ones of the wall or sponge-tissue empty themselves. Surface of the tubo-branch outside uniformly even, covered by the pore-structure. Wall or skeletal lamina consisting of a cylindrical layer of reticulated, strong, glass-like fibre, in which the interstices are more or less quadrangular and oblong, the longest diameter being in the direction of the tubo-branch (Pl. XIII. fig. 1, *a a a a*), and the points of intersection marked on each side by a long, curved, spiniferous process or spur, which is directed upwards (fig. 1, *b b*), thus supporting the sarcode or soft parts and its spicular contents, both externally and internally, that is on each side of the skeletal wall. Spiniferous process or spur about 15 to 25·1800ths in. long by 1 to 2-1800ths in. thick at the base; spines small, short, and broad, absent towards the fixed end. Interstices or meshwork generally presenting a tolerably regular aspect, but often just the opposite. Loose spicules of five forms, viz.:—(1) Sexradiate (dermal), with outer ray aborted or reduced to a mere globular tubercle, often surmounted by a single spine in the advanced form; shaft or internal ray straight and the four arms spread out horizontally, each somewhat curved towards the shaft, and all more or less inflated and abruptly pointed at the extremity; some plentifully and generally *micro*spined (fig. 4, *a*), and others sparsely *macro*spined (fig. 4, *b*), the latter chiefly on the outer aspect; arms about 15-1800ths in. long, shaft about the same length, but all the rays varying a little in this respect, even in the same specimen, as well as the total size of the spicule itself. (The *macro*spined seems to be merely a sequence or advanced state of the *micro*spined form.) (2) Acerate, straight, unsymmetrically fusiform, that is the outer or projecting part being thicker than the inner two thirds of the spicule, which is thus rendered long and whip-like; sharp-pointed at each end, spined at short intervals throughout, the spines long, smooth, and slender, respectively supported on bracket-like processes, which, being spirally arranged around the shaft, give it an irregular zigzag appearance, all sloping in the same direction, that is backwards or towards the sponge, at a very slight angle upon the shaft, whose outer or thickened end is extremely sharp, about 171-1800ths in. by 2-1800ths in. in its greatest dimensions, but very variable in this respect; longest spines, which are situated on the thickest part of the shaft, about 2-1800ths in. As this spicule necessitates a long description, and is common to almost all the Hexactinellida, I shall hereafter allude to it under the name of "barbula" (fig. 3 and fig. 8). (3) Nail-shaped, consisting of a long straight shaft, which is slightly inflated and pointed at the free end and expanded horizontally at the other into a circular head more or less spined at the circumference; shaft microspined, especially about the free end, which is slightly inflated and pointed, averaging in total length about 20 1800ths in.; head about 1½-1800ths in. horizontally (figs. 5, 5, and 7, *f*). This spicule is so very abundant and presents itself under so many different forms, that it might be as well to enumerate them serially thus:—(fig. 7, *a*) that in which the head consists of a simple, smooth, elongated, ovular, narrow, club-like inflation of the shaft; (fig. 7, *b*) the inflation becomes enlarged towards the upper part, a tubercle is developed at the summit, and an indistinct row of small spines around the widest portion; (fig. 7, *c*) the tubercle passes into the form of an umbo, the row of spines into a projecting coronal structure, cut off by hour-glass contraction from the lower part of the inflation, over which are developed several other small spines which assume a more or less subsidiary coronal arrangement at the upper part; (fig. 7, *d*) the umbo disappears, and the summit becomes simply convex or dome-shaped, while the spines of the coronal structure still more project, are increased in size and reduced in number, the spines of the constriction below have also disappeared, and the upper part of the once simply inflated head is now found to be capped by the new development or corona; (fig. 7, *e*) finally the coronal spines may be greatly increased in size and reduced even to *four* only, the original ovular inflation still more constricted in the centre and its upper part devoted to the support of the four spines. Of course there is every intermediate form to be seen, from the simple, elongated, ovular inflation to the head with four simple spines, but "*c*" and "*d*" appear to be the most common. For this spicule, which also requires a lengthy description and is probably common to the Farreas, I would propose the name of "clavula." As with the dermal sexradiate, so with the clavula here, and indeed the barbula also, the development of the *macro*spined appears to be but a sequence of the *micro*spined or simply smooth form. (But this is only what occurs generally throughout the development of a sponge-spicule, as I have long since stated, viz. "first the simple form and then the ornamentation.") (4) The rosette; sexradiate, consisting of four straight arms without central inflation, terminated respectively by four divergent rays around a central one; rays smooth and simply pointed, or more or less capitate and microspined, varying in number in each instance; average diameter of entire spicule, *i. e.* the rosette itself, about 15-6000ths in. (fig. 6 and fig. 9, *a b*). (5) A smaller sexradiate with all four arms equally developed; arms straight, pointed and spiniferous, issuing from the centre, which at first is not inflated, at equal angles to each other; variable in size, under 8-1800ths in. in diameter, and a variety of the foregoing (fig. 2, *a b*, and fig. 10). The dermal sexradiate no. 1 is chiefly confined to the surface, where, through the overlapping of its horizontal arms, it forms a quadrilateral latticework whose interstices are tympanized by the dermal sarcode in which the pores are situated (fig. 11). No. 2, the barbula (fig. 3), frequently projects more or less through the latticework, when its large sharp end, with the long spines sloping backwards, presents a formidable appearance. No. 3, the clavula (figs. 5, 5), is chiefly gathered together in bundles of six, more or less, around the shaft of the dermal sexradiate, with their heads *en groupe* projecting a little above the knob which represents the aborted ray; or they may be scattered singly along the overlapping arms of these spicules (fig. 11,*a*). No. 4, the rosette (figs. 6 and 9), is plentifully distributed throughout the sarcode, about the skeletal fibre, and among the spicules generally, but with what arrangement in particular, if any, I have not been able to discover, saving that grouped together in the "mounting" they often appear to present a polyhedral structure. No. 5 (figs. 2 and 10) appears to be entirely confined to the thickening or additional structure at the lower part and base of the specimen, where its incorporation seems to lead to the short-jointed, radiato-reticulated, smooth fibre of which this is composed. Here it may be seen in its separate and thus perfect state, in the interstices, often attached by the end of *one* arm to the main fibre, and often end to end with one of its own like, by cementing siliceous material derived from the same source as the fibre, which is thus on its way to incorporate the whole, and therefore more or less obscures the original spiniferous character of the arm; while the skeletal fibre itself, which is *smooth*, at the same time that it is moulded upon the rest of the spicules (chiefly the dermal sexradiates), which thus become axially incorporated with it, presents in its entirety the quadrilateral from above described. Size of specimen 5 in. high by $6\frac{1}{2} \times 3\frac{1}{2}$ in. horizontally in its greatest dimensions. Tubo-branch 5 to 6-12ths in. in diameter; throughout about 5 to 6-12ths in. long between the divisions or joints, dichotomously dividing, until the whole specimen reaches the dimensions above given, which, on account of the extreme ends or growing parts having been broken off, must, as the fragments with the specimen prove, have, when entire, exceeded its present measurements by 2 or 3 inches.

Hab. Marine.

Loc. Japan; off Misaki, at the entrance to the Bay of Tokio (Yedo).

Obs. Ever since I saw and examined the skeletal fragments of *Farrea occa* in the detrital root-mass of *Euplectella cucumer*, then in the possession of the late Dr. Farre, now in the British Museum, I have been desirous of seeing an entire specimen of *Farrea occa* with the sarcode on, so that I might not only know exactly what the general form was, but the forms also of its loose spicules.

The latter I thought I had obtained when I got the deep-sea specimen dredged by H.M.S. 'Porcupine,' at the entrance of the English Channel, which is described and illustrated in the 'Annals' of 1873 (vol. xii. p. 17, pl. i. figs. 1 and 7); but being entirely overgrown by the fleshy sponge, *Corticium abyssi*, it was found, when extricated from this mass, to be entirely devoid of its originally *loose* spicules, saving some which had become incorporated with the skeletal, glassy fibre itself, among which was the scopuline spicule "Besengabel," represented by Schmidt as partly characteristic of his *Farrea facunda* (ib. pl. xvi. fig. 6, and Atlantisch. Spongienfauna, 1870, Taf. i. fig. 18).

Since then, or until the present time, when I received the above-described specimen from Dr. Anderson, which, although dry, has in many parts the dermal sarcode still on, I have not had my attention called to the subject, and hence the absence in this specimen of the "Besengabel" and every other form of scopuline spicule, together with the presence of the clavula, points out to me that it is a *Farrea*, although not *F. facunda*—therefore, in all probability, that species from which the skeletal fragments in the detrital root-mass of *Euplectella cucumer*, called by Dr. Bowerbank "*Farrea occa*," had been derived. It is remarkable, too, if not significant, that the *clavula* is present without the scopula in Saville Kent's "*Aulodictyon Woodwardii*" (Monthly Microscop. Journal, Nov. 1870, pl. lxiv. p. 249).

As I possess, from the root-mass of *Euplectella cucumer*, specimens of all the representations given by Dr. Bowerbank as illustrative of *Farrea occa*, in his "Monograph of the Siliceous Sponges" (Proc. Zool. Soc. 1869, pl. xxiv. figs. 1–7), and not only that, but am now acquainted with the sponges to which they respectively belong, I can confidently state, that his "fig. 1" is a fragment of *Dendrospongia Steerii*, Murie (Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 219, tab. 36); "figs. 2–6," spicules of the genus *Samus*, Gray (Proc. Zool. Soc. 1867, p. 526), or, at all events, "4–6;" and "fig. 7," *only*, belongs to *Farrea occa*, whose skeletal fibre is smooth and spurred on both sides at the points of intersection of the quadrilateral structure, which, with the spurs a little worn down, I therefore assume to be *Farrea occa*, as I have before shown that Dr. Anderson's specimen cannot be *Farrea facunda* on account of the absence of the "Besengabel." Whether the fragments in the root-mass of *Euplectella cucumer* did or did not belong to *Farrea facunda*, there is no evidence to say, and thus I am free to apply the name of "*Farrea occa*" to Dr. Anderson's specimen.

The grouping of the heads of the *clavulæ* around the knob which represents the aborted outer ray of the dermal sexradiate, together with the lattice-work itself formed by these spicules (fig. 11), recalls to mind Dr. J. Millar's discovery of this kind of arrangement in the dermal structure of *Euplectella cucumer*, faithfully represented from one of Dr. Millar's own preparations which he gave to Dr. Bowerbank (Proc. Zool. Soc. 1875, p. 503, pl. lvi.); only that here it is the rosette which is brought to the surface and projected upon the point of the outer ray of the dermal sexradiate, which, instead of being aborted, as in *Farrea occa*, is fully developed. See also Prof. Schulze's representations of this ('Challenger' Reports, Sponges, Hexactinellidæ, *Euplectella aspergillum*, pl. A. figs. 3, 4, and 5). Lastly, there appears to have been something like this in the fossil species *Callodictyon angustatum*, Hinde, and *Porochonia simplex*, T. Smith, if not also in the two foregoing species (Hinde's Catalogue Foss. Sponges in the Brit. Museum, 1883, pl. xxx. figs. 4 *b* and 5 *b*).

As regards the general structure of *Farrea occa* there can be no doubt that it belongs to the family of Euritidæ, whose tubo-branched structure is faithfully represented in my illustration of *Eurete farreopsis* ('Annals,' 1877, vol. xix. pl. ix. fig. 1), which is taken from a photograph of the *natural size* of the specimen, but in such a position as to show the openings and structure of the tubo-branches, through which the basal structure or stem is *necessarily* concealed from view. Etymologically, the term "Eurete," *par excellence*, applies to the wall of *Farrea occa*; but its consisting only of a single skeletal layer together with the absence of a scopuline spicule (Besengabel) and the presence of the *clavula*, causes it to differ.

Again, the measurements of the spicules in the *vitreous* Hexactinellida are so variable that it is almost impossible to arrive at any that are satisfactory, on account of the addition of the siliceous slime to their exterior which is continually going on preparatory to their becoming incorporated with the skeletal fibre, after the manner of the spicules in the Keratose sponges; but whereas in the latter the contrast immediately renders them recognizable, the vitreous fibre, being of the same composition as the spicule, defies all attempt at separation in the *recent* specimen.

Lastly, the siliceous slime leads to the formation of skeletal fibre, which has its *own* specific character, as in the present species, viz. *Farrea occa*, in which it is *smooth*, while in the following species, viz. *Periphragella Elisæ* and *Hexactinella ventilabrum*, it is spiniferous.

Delicate as these spun-glass-like Hexactinellida appear to be, their resistance to destruction is very remarkable, owing to the toughness which is imparted to the silica by the presence of the albuminous element and the intricate union of their reticulated fibre, so that, while the thinner superstructure even of *Farrea occa*, when reduced to a single layer, is much tougher than it looks, the base, thickened with the additional matter, becomes almost unyielding. Hence, probably, these parts of *Farrea occa* alone are left in much-worn specimens at the bottom of the sea, and thus constitute the fragments which are often brought up in "swab" dredging without the superstructure.

Such resistance to destruction and the reparation of the most delicate parts which are essential to the life of the organism often indicate the presence of a preservative power which is far greater than we think, but how it should be so under the circumstances is utterly beyond our comprehension. Perhaps some might say that this pertinacity of vital force has been acquired by long progress in a certain direction, upon the principle of "vires acquirit eundo;" but then, how did the *first* impetus come about?

I should also add that this specimen of *Farrea occa* had been infested by a minute parasitic Hydroid, whose delicate stolonic cœnosarc, together with its small sessile polypites, had thickly spread in and over the outer surface; but at present it is so hard and shrunken from desiccation that, beyond the presence of thread-cells and the general form, there is no possibility of arriving at more specific characters. Lest the dark round points in the illustration (Pl. XII.) should be mistaken for holes or vents, it should be mentioned that they represent the polypites of the Hydroid.

Periphragella Elisæ, Marshall.

Club-shaped, stipitate, hollow, cup-like, with extended base of attachment; slightly bent upon itself; wall thick, composed of tubo-branched, anastomosing, often dividing, labyrinthic, clathrous structure, whose interstices within form fenestral openings in the sides of the excavation, and whose outer part, especially in the lower portion, passes into a much smaller tubo-reticulated structure of the same kind, which, becoming diminished in size towards the surface, terminates there in still smaller branches, whose ends are free and open; stem round, short, descending upon an expanded, wide, arched, irregular, flat foot below, and above into the structure mentioned; the open state of the terminal branches of the smaller tubo-branched structure is apparently *natural*, from similar defined circular apertures about 1-12th in. in diameter existing on the surface of the stem, close to the commencement of the structure below, where, by thickening of the tissue, all but the extreme ends of the branches have become imbedded, which thus look like vents; excavation deep, narrow, and conical towards the bottom, where it occupies the centre of the stem, fenestrated on its surface, as above described. The upper part of the specimen having been much worn away (for it had been dragged out of greenish sandy mud for preservation, where, being dead, it must have been buried for some time previously), I am unable to state how the *excavation* and its surrounding tubo-branched structure terminated *above*, but probably in the same characteristic form and with open mouths as in the smaller structure below. Consistence firm and elastic. Colour, pore-structure, and small excretory canal-system, that is of the fleshy part, when the specimen was fresh, probably the same as in the Euritidæ, together with the large excretory system, which consists of the tubo-branched canals terminating cloacally in open mouths on the outside of the excavation or surface of the specimen. Main fibre of the tubulated lamina reticular, consisting of a more or less quadrangular oblong network, in which the longest diameter of the interstices is in the direction of the tube, strengthened or thickened on each side by a less regularly reticulated growth, of which the smaller tubulated structure is almost entirely constructed, the more regular network being confined to the larger tubulation in the upper part of the head. Skeletal fibre reticulated sexradiately, not inflated at the joints, microspined throughout, formed upon small regular sexradiates, which may be seen in its interstices preparatory to becoming incorporated. Sexradiate spicule consisting of six fully-developed arms, straight, inflated, and abruptly pointed at the end, microspined throughout, especially over the end, averaging 34-6000ths in. in diameter, but very variable in size, owing to the thickening preparatory to incorporation. Three other forms of loose spicules, viz.: 1, the barbula, as already described and illustrated under *Farrea occa*; 2, scopuline spicule or "Besengabel," of which I have only met with one instance, and that only of the four capitate branches or rays of the head, the rest being incorporated with the skeletal fibre, whereby it had been thus retained, since, as usual in such buried specimens, all the *loose* spicules have disappeared; 3, the rosette (that only exists in one part of the foot which presents the freshness of life), sexradiate, without central inflation, arms straight, smooth, each supporting five rays, more or less, of which four are divergent around the central one, which is also straight; rays microspined, straight and pointed, or florally arranged and capitate, the whole rosette about 15-6000ths in. in diameter, but variable in size, the smallest being those in which the rays are most numerous, florally arranged, and capitate. As the dermal sexradiate, together with its structure *in situ*, has, of course, been destroyed, the former is only met with here and there in the body-structure, where, as usual, it is characterized by the external ray having been reduced to a mere tubercle. Size of specimen (not including the expanded base, which, after having been much reduced in size by fracture, is still $3\frac{3}{4}$ in. in its longest diameter) $4\frac{1}{2}$ in. high. Stem 1 in. long by 7-8ths in. in diameter close to the head, increasing downwards towards the foot; head about 4 in. high by $3\frac{1}{2}$ in. in diameter at its upper part, diminishing in this respect towards the stem; excavation 4 in. deep by $1\frac{1}{4}$ in. wide at the brim; fenestral openings of the clathrous structure, which surrounds it, varying a little below $\frac{1}{3}$ in. in diameter.

Hab. Marine.

Loc. Japan; Misaki, at the entrance to the Bay of Tokio (Yedo).

Obs. Having long since received, through the kindness of Dr. W. Marshall, of Leipzig, a copy of his description, photographed representation, and forms of the spicules of his *Periphragella Elisæ*, in the Imperial Museum at Leyden, originally obtained at the Moluccas (Zeitschrift f. wiss. Zool. xxxv. Bd. Suppl. p. 177, Taf. xii. B, and xiv. figs. 26–31), together with a type specimen of the spiculation itself on a slide, I have no hesitation whatever in identifying with this species the above specimen from Japan; sufficient, together with its general form, having been extricated from it for this purpose. The characteristic globular heads of the rays on the scopuline spicule, with their short angular spines, are retained in the half-incorporated fragment to which I have alluded; and the barbula, although much reduced, like the rest of the structure, by that process of disintegrating dissolution which attacks these glassy sponges after death, is easily recognized.

Periphragella Elisæ, in its general form, differs from most specimens of the Euritidæ in the presence of a cup-like excavation in the midst of the tubo-branched structure, together with diminution in size of the branches of the latter towards the outer and lower parts of the head, and in its spicular forms, chiefly by that of the scopula or "Besengabel," which up to this time is peculiar in this respect.

It is, like the rest of the Euritidæ, analogous to the Keratose sponges, in which the branches are tubulo-digitate and open at the ends, as in the tubulo-digitate Chalinæ; also, although in a minuter form, to the clathrotubular structure of the Calcareous sponges *Clathrina*, and the carneous *Halisarca lobularis.*

Hexactinella ventilabrum, n. sp. (Pl. XIV. figs. 1–10.)

Specimen, a large undulating somewhat compressed bowl, with irregularly plicated sides, approximated towards the ends and into a keel below; very thin wall and contracted substipitate point of attachment; $7\frac{1}{2}$ inches high, 13 inches long horizontally and 8 inches across the most open or central part of the brim, which is rendered very irregular by its deep subplicate undulations; sides chiefly approaching each other towards the ends, which, not being actually united, are thus rendered rimous; base keel-shaped, owing to the angular approximation of the sides at the bottom, descending subfunnel-shaped to the stem, which is excentric, about $1\frac{1}{2}$ in. in diameter, spreading out afterwards for attachment. Consistence firm, vitreous. Colour transparent white. Surface on both sides even and uniform; uniformly scattered over internally with circular apertures about $\frac{1}{12}$ in. in diameter and about the same distance apart (Pl. XIV. fig. 1), and externally with a dermal, quadrilateral, spicular reticulation, in the interstices of which the sarcode, although dry, is preserved (fig. 2, *a*). Vents on the inner side of the bowl, viz. the "apertures" just mentioned (fig. 1). Pores in the sarcode tympanizing the interstices of the dermal reticulation, about 1000th inch in diameter, more or less (figs. 2 and 9). Wall about 1-6th in. thick, composed of two layers, viz. one on each side of an irregular central plane of condensed tissue; each layer consisting of plumose fibre curving upwards and outwards florally from the central plane to the respective surfaces, strengthened by transverse fibres in their course (figs. 3 and 8); the whole, when the flat surface is placed between the observer and the light, presenting a fibrous, vertical, linear reticulation, formed by condensed tissue in the interior. Loose spicules of seven forms, that is including the skeletal fibre (fig. 4, *a–g*), viz.: 1, dermal sexradiate, with outer ray aborted and reduced to a round knob; arms and shaft gradually diminishing towards the free ends, which are abruptly pointed; knob and rays microspined throughout (fig. 4, *g*); ray about 25 by 2-1800ths in. in its greatest dimensions, but variable. 2, the barbula (see Pl. XIII. fig. 3). 3, smooth acerates, more or less flexuous from their thinness; here and there stouter, when the usual sexradiate central inflation, which is characteristic of the hexactinellid spicule, may be detected on them (fig. 4, *e*); fine form about 50 by $\frac{1}{5}$-1800ths in. in its greatest dimensions (fig. 4, *f*); stouter form about 60 by 1-1800ths in. (fig. 4, *e*). 4, scopuliform spicule or scopula consisting of a smooth shaft, attenuated and sharp-pointed at the free end, furnished at the other with 2, 3, or 4 (usually 2 in this specimen) slightly divergent rays, diminishing in size outwards, but ending abruptly, that is without terminal inflation or head, thickly microspined throughout; spines towards the free ends recurved; total length of spicule 33-1800ths in.; ray about 5-1800ths in. long, but both very variable in this respect (figs. 4, *c*, and 5). 5, rosette, sexradiate, arms smooth, straight, radiating at equal angles from the centre, without inflation of the latter, terminating in five rays more or less, which are long, divergent, and pointed for the most part, but sometimes capitate (fig. 6, *a*), or more or less numerous and always capitate, arranged florally (fig. 6, *b*), the former accompanied by short and the latter by longer arms; or in a small variety the arms may be thick and elongated into a point without rays, but with four or more comparatively long spines on each arm, outwardly directed; size about 20-1800ths in. in diameter (fig. 7). 6, internal or skeletal sexradiate, much the same as the dermal form, but with all the arms equally developed; very variable in size (fig. 4, *b*, and fig. 10). 7, skeletal fibre, microspined, irregularly sexradiate, chiefly built on the foregoing spicule (fig. 4, *a*). No. 1 is for the most part confined to the dermis, where the arms, overlapping those of the neighbours, give rise to a quadrilateral reticulation, whose areas are frequently again divided into four triangular spaces by a sexradiate of the same kind situated in the centre (fig. 9); interstices throughout tympanized by the dermal sarcode in which the pores are situated. No. 2, the barbula, is scarce. No. 3 (fig. 4, *f*) in bundles, characteristically plentiful, especially in the dermal structure in its finer form, while the stouter one is chiefly found in the interior with nos. 4 and 5 (the scopula and the rosette), intermingled with the skeletal fibre, which is chiefly built on nos. 1, 3, and 6. Size of specimen given at the commencement.

Hab. Marine.

Loc. Japan, Misaki, at the entrance of the Bay of Tokio (Yedo).

Obs. This is an instance in which not only the general form but the internal structure so closely resembles *Phakellia ventilabrum*, Bk. (Mon. Brit. Spong. vol. iii. pl. xxii.), that, but for the fibre being glossy and the spicules hexactinellid, while the fibre of *Phakellia ventilabrum* is keratose and the spicules "monactinellid," the two are almost identical, further illustrating the fact that there is a unity of plan in the Spongida as regards general form, whatever the nature of the material of construction may be.

On account of the addition of the central sexradiate to the quadrilateral areas of the dermal reticulation (fig. 9), the interstices of the latter become divided into triangular spaces very much like those of *Esperia*, which, together with the poriferous tympanizing sarcode, thus gives it a similar beauty; while the presence of the sarcode with the pores still existing in it, although dry now, shows that the specimen was taken *alive* and preserved with much care afterwards.

I have often thought with reference to the open state of the pores under such circumstances that—after having shown in my "Ultimate Structure of *Spongilla*" ('Annals,' 1857, vol. xx. p. 25, pl. i. figs. 6 and 7), that the "investing membrane" or dermal sarcode is composed of plastic nucleated cells, and that it is by their partial separation and alteration in form that the pores are alternately produced and closed—it might be asked how the pores are maintained in an open state during desiccation. In reply to which it may be stated that these plastic units, which in fact are the epithelial cells, are, like *Amœbæ*, so exceedingly slow in their movements that, under desiccation, they pass into a homogeneous dry membrane before they have time to go very far in the alteration of their form, and thus the pores remain open; thus too the cilia of the spongozoa is often preserved.

The fact of the pores in this species opening directly into large channels of the excretory canal-system whose vents are immediately opposite, *i. e.* on the other side of the wall (Pl. XIII. figs. 1, 2, and 9), recalls to mind what occurs in *Teichonella labyrinthica* ('Annals,' 1885, vol. xv. p. 119, pl. iv. fig. 7) in this respect, that is the nutritive particles which pass through the pores do not go on to the spongozoa (Geisselzellen) of the ampullaceous sacs, direct.

The presence of the smooth acerates, no. 3 (fig. 4, *e, f*), is, so far as my knowledge extends, a peculiarity in the Hexactinellida; at the same time they appear to me to be very like the smooth early form of the *barbula*, which also occurs in bundles of this form at an early period, as well as afterwards in their fully developed state. The *un*capitate rays of the scopuliform spicule furnished for the most part with only two is also new to me *in situ*; while the only other case in which I have met with this form is in my mountings of the dust from the detritus of the root-mass of *Euplectella cucumer*, which came from the Seychelles, in which it is very plentiful. It is equally unusual, too, to find a scopuline spicule in a form like that of *Hexactinella ventilabrum.*

Racodiscula (Zittel) *asteroides* (Crtr.).
(Pl. XIV. fig. 11, *a–g*.)

Form massive, thick, short, cylindrical, excavated cup-like, divided below into three or more root-lobes, which have been cut off, thus reducing the height to $3\frac{1}{2}$ in., with a maximum breadth horizontally of $2\frac{3}{4}$ in.; excavation conical downwards, about $2\frac{1}{2}$ in. deep, commencing in a closed, round, pointed end below, expanding upwards into an irregularly oval aperture above, about $1\frac{3}{4}$ by 1 in. in its greatest dimensions; wall about $\frac{3}{8}$ in. thick at the brim, increasing downwards as the wall of the excavation recedes from the surface. Consistence compact, heavy. Colour sponge-yellow-grey. Surface even. Pores not seen. Vents numerous, chiefly opening into the bottom of the excavation, also scanty and very large here and there on the surface, unless the latter be worm-holes. Spicules of four forms, viz.: 1, minute, elliptical, elongate, subdiscoid, microspined, about 3 by 1-6000ths in. in its greatest dimensions (fig. 11, *d*, *g*); 2, minute acerate, curved, fusiform, gradually sharp-pointed, thickly microspined all over, about 11 by $\frac{2}{3}$-6000ths in. (fig. 11, *c*, *f*); 3, large acerate, comparatively long, smooth, curved, fusiform, also gradually sharp-pointed, 83 by $\frac{3}{4}$-1800ths in. in its greatest dimensions (fig. 11, *e*); 4, tetractinellid spicules of the skeleton, which commence in a nail-like discoid form on the surface, consisting of a short pointed shaft and horizontal circular head of extreme thinness, in the centre of which may be seen the trifid central canal, indicating the number of branches into which it subsequently becomes transformed (the smallest seen measuring about 1-200th in. in diameter, fig. 11, *a*, *b*), then becoming (as it grows larger) irregular in form, curvilinear in outline, and finally trilobate; after this elk-horn-like and branched; finally filigreed at the ends of the branches, when that of the shaft or fourth arm also grows out into this form, and the whole interlocking on all sides with their neighbours, thus become inextricably mixed together, but *never* connected by *direct union* (*for there is no glossy fibre here*). Interlocking portions when fully developed rather diffuse than circumscribed or globular, as they are in some species. At this time this spicule may be at least 1-50th in. in diameter each way (or 35-1800ths of an inch), with all four arms smooth, but of course very variable. Nos. 1 and 2 are chiefly confined to the dermal sarcode, where, in great abundance, they cover the nail-like disks, inside which, among the branched forms of the staple spicule, the acerates no. 3 appear in bundles, finally becoming lost inwards or only sparsely present as the staple spicule becomes developed into its ultimate or interlocking form. For analogous transitionary forms of development into which the simple disk (fig. 11, *a*, *b*) passes on its way to produce the entire spicule I must refer the reader to my delineations of *Discodermia papillata* &c. ('Annals,' 1880, vol. vi. pl. viii. fig. 48, &c.), as there is no room in my plate for a repetition of this here.

Hab. Marine.

Loc. Japan, Misaki, at the entrance of the Bay of Tokio (Yedo).

Obs. This is the species to which Zittel has given the name of "*Racodiscula*," illustrated by the "trilobate" form of the staple spicule, together with some of the long acerates, broken off at the ends, as they generally present themselves in a fragment mounted in balsam in its natural state, together with some of the minute ellipsoids (Abh. d. k. bayr. Akad. ii. Cl. Bd. xiii. 2, 1878, p. 151, Taf. i. fig. 8, and 'Annals,' 1878, vol. ii. p. 480), which came from a vasiform thick-stemmed specimen about $4\frac{1}{2}$ in. high, $4\frac{1}{2}$ in. across the brim, and 3 in. deep in the excavation, also obtained from Japan. The presence of the minute ellipsoid makes it differ from all the species from the Gulf of Manaar whose respective spiculations I have illustrated ('Annals,' 1880, vol. vi. pl. viii.); but the transformation of the surface-disk into the branched and filigreed, staple, tetractinellid spicule is the same, whereby it can be seen that the trilobate form given by Zittel as illustrative of his genus "*Racodiscula*" is of no specific value, nor is the long acerate spicule no. 3 (fig. 11, *e*), which is found in many species and which Prof. Sollas discovered and first pointed out in the fossil genus *Siphonia* (Quart. Journ. Geol. Soc. Nov. 1877, p. 808, pl. xxvi. figs. 5 and 5 *a*); but in no instance, I believe, have the minute spicules nos. 1 and 2, together with the earliest discoid forms of the tetractinellid (which led to Bocage's designation "*Discodermia*" in the *recent* species), been discovered *in situ* in the fossilized specimens, being too delicate probably to survive this transitionary ordeal. The general form and structure of Dr. Hinde's *Trachysycon nodosum* ('Catalogue of Fossil Sponges in the British Museum,' 1883, pl. xii. figs. 3 and 3 *b*) very much resembles the species above described.

Of the remaining specimens which belong to my order Psammonemata and the spiculiferous Keratosa respectively it might be observed *imprimis* that all appear from their sarcodeless state to have been gathered off a beach, and they consist of:—

1. Psammonemata.

A single specimen, which is thick, flat, and massive, composed of stiff amber-coloured keratose fibre, presenting small penicilliform sandy tufts or tags on the surface in the midst of a quantity of clear reticulated lateral tissue of the same kind.

Also an insignificant specimen of *Polytherces*, D. et M. (*Hircinia* transformed by *Spongiophaga communis*), which has overgrown some mussel-shells.

2. Rhaphidonemata.

One specimen of a solid, digitate, branched form of *Chalina* like *C. polychotoma*, but in which the spicule, instead of being acerate, fusiform, and sharp-pointed, as is usually the case, is acerate, curved, cylindrical, and round at the ends, sausage-like, about 1-300th in. long (Pl. XIV. fig. 12).

This is of much interest, because I have lately received from Mr. B. W. Priest a fragment of a similar species in which the spicule is of the same form but four times larger, and said to have come from the Mauritius (fig. 13), since it closely approaches both in general form and in that of the spicules the freshwater sponge "*Uruguaya*" from South America, in which no statoblast has yet been found ('Annals,' 1881, vol. vii. p. 100, pl. vi. fig. 17), thus favouring the opinion of some that such sponges at least have had a marine origin. For this variety I would propose the name of *Chalina polychotoma*, var. *mauritiana*. Like *Uruguaya corallioides*, too, the Mauritius specimen presents its spicule in several stages of development, but *none* are *microspined* like those of that species, and it has a minute acerate flesh-spicule.

Four specimens of *Tuba lineata*, var. *flabelliformis*, D. et M., vasiform, with appressed sides, wherein the spicules of the fibre, which are of the usual form, viz. acerate, fusiform, smooth, curved, and sharp-pointed, are scanty, while the keratose element of course predominates. Hence their tough consistence and brown colour.

Two other specimens of a similar kind, but more open, in which the same form of spicule *predominates* instead of the keratose element, which is thus scanty; hence they are softer, not near so tough, and of a light grey colour, which causes them to resemble the open vase-like form called by Dr. Bowerbank "*Isodictya infundibuliformis*" (Mon. Brit. Spong. vol. iii. pl. liv.); but not being the same, it might, for distinction's sake, be termed "*Tuba poculum*."

3. Echinonemata.

One branched specimen, compressed throughout, with the ends flat and expanded, and the spicule of one form only, viz. stout, acuate, arranged in tufts on the surface over a dense interior. Colour brown. Species undescribed.

4. Holorhaphidota.

A portion only of a *Pachastrella*, $2\frac{1}{4}$ in. in its longest diameter, but which, being new, is sufficiently interesting for the following brief record of its spiculation, which consists of a very large acerate body-spicule, whose natural length amounts to 1-6th in. (Pl. XIV. fig. 14, *a* and *g*), a large quadriradiate zone-spicule (fig. 14, *b*) and a crust of minute microspined acerates, mixed with a few still more minute sceptrellæ and spinispirulæ, one form passing into the other (fig. 14, *c*, *d*, and *e*, *f*). The body-spicule radiates in bundles from a common centre; and the quadriradiate, whose shortest arm is directed inwards, has the other three rays spread over the surface among the small microspined acerates &c. Thus the spiculation very much resembles that of *Pachastrella amygdaloides* ('Annals,' 1876, vol. xviii. pl. xiv. fig. 22, &c.), only that the radiate spicule in the present instance has four instead of three arms; while the absence of the minute stelliform spicule, although the spiculation otherwise resembles that of a *Stelletta*, that is the large acerates are confined to the body and the quadriradiates to the surface &c., induces me to propose for it the name of "*Pachastrella stellettodes*." For measurements of the spicules I must refer the reader to the illustrations in which fig. 14, *a*–*d* are drawn to the scale of 1-48th to 1-1800th inch, *e* and *f* being enlarged views of *c* and *d* respectively, and *g* the natural length of the body-spicule.

EXPLANATION OF THE PLATES.

Plate XII.

Farrea occa, skeleton of. From a photograph, about the natural size, of the specimen.

N.B.—The round black points represent the polypites of a parasitic Hydroid.

Plate XIII.

N.B.—Figs 1–6 are drawn to the scale of 1-24th to 1-1800th inch, to show their relative proportions. The rest are, for the most part, more magnified views of the same, to show their detail.

Fig. 1. *Farrea occa*, fragment of skeletal fibre from the upper part of the specimen. *a a a a*, main fibre; *b b*, spurs, whose punctate surface is intended to indicate that they are for the most part covered with short spines; *c c*, ends of spurs supposed to have been broken off close to the base.

Fig. 2. The same. Fragment of skeletal fibre from the base of the specimen, showing—*a*, fibre; *b b*, small sexradiates.

Fig. 3. The same. The *barbula*, on whose surface the spines of the upper third *only* are represented.

Fig. 4. The same. The dermal sexradiate. *a*, *micro*spined form; *b*, *macro*spined form.

Fig. 5. The same. The *clavulæ, in situ*.

Fig. 6. The same. The rosette.

Fig. 7. The same. A series of more magnified views of the head and shaft of the *clavula*, to show its transitionary conditions from *a*, the simple, smooth, club-shaped, ovular form, to *b*, enlargement of the upper part of the inflation, incipient tubercle on the summit, and incipient row of spines across the body; *c*, development of tubercle into an umbo and the row of spines into a coronal form projecting beyond the surface of the body; inflation becomes constricted just below the crown, and the lower part roughened by spines, which often present a subsidiary coronal arrangement above; *d*, the umbo disappears, leaving a smooth, convex, dome-shaped summit, the coronal spines decreased in number but increased in size, the constriction between the two parts of the inflation increased and the spines on the lower portion gone; *e*, the coronal row of spines reduced in number to four, which are much increased in size and situated at the cardinal points of the upper part of the inflation, which, in this view, is seen to be devoted to their support or to the head, while the constriction which separates it from the lower part of the inflation that passes into the shaft is still more pronounced; *f*, the lower two thirds of the shaft, magnified upon the same scale, to show its terminal but pointed inflation and spinous surface. (All these representations are magnified to the scale of 1-12th to 1-6000th inch, to show their relative proportions.)

Fig. 8. The same. Fragment of the *barbula*, much magnified, to show the form and arrangement of its spines.

Fig. 9. The same. More magnified view of the *rosette*, showing the two forms of rays in the same figure, viz. *a*, the pointed, and *b*, the capitate rays. For the sake of perspicuity only two or three of the rays are delineated.

Fig. 10. The same. More magnified view of the sexradiate of the basal structure.

Fig. 11. The same. Portion of the dermal structure, magnified upon the scale of 1-48th to 1-1800th inch, showing the sexradiate dermal spicules, the heads of the *clavulæ* around the aborted external ray and the pores, all *in situ*. *a*, single *clavulæ*, occasionally seen along the line of reticulation.

Plate XIV.

Fig. 1. *Hexactinella ventilabrum*, n. sp. Fragment of the inner surface, to show the vents. Natural size.

Fig. 2. The same. Fragment of outer surface, showing the dermal reticulation and subjacent apertures in the body-substance leading to the vents. *a*, portion covered by the dermal structure; *b*, portion from which it has been removed. Nat. size.

Fig. 3. The same. Vertical section of the wall, to show its plumose structure. Nat. size. All diagrams after nature.

Fig. 4. The same. Group illustrative of all the spicular elements, drawn to the scale of 1-24th to 1-1800th inch, to show their relative sizes. *a*, main fibre; *b*, sexradiate of the interior; *c*, scopula; *d*, rosette; *e*, hexactinellid acerate of the interior (stout form); *f*, the same of the dermis (finer form); *g*, sexradiate of the exterior or dermis. Diagrammatic after nature.

Fig. 5. The same. Scopula with three rays, much magnified.

Fig. 6. The same. Rosette, much magnified, showing—*a*, form with long simple pointed rays, sometimes capitate; *b*, with short rays, always capitate. Only two or three rays to each arm delineated, for the sake of perspicuity.

Fig. 7. The same. Another form of the rosette often met with. (Figs. 5, 6, and 7 drawn to the same scale.)

Fig. 8. The same. Vertical section of wall, magnified about four diameters, to show character and direction of the plumose fibre.

Fig. 9. The same. Fragment of dermal structure, to show reticular arrangement of the sexradiates and situation of the pores.

Fig. 10. The same. Sexradiate of the interior, more magnified, to show that its arms are spiniferous.

Fig. 11. *Racodiscula asteroides*. Spiculation of surface, magnified to the scale of 1-24th to 1-1800th inch. *a*, upper view of disk, showing the three arms of the central canal, which indicate the forthcoming upper three branches of the tetractinellid or staple spicule of the structure; *b*, lateral view of the disk, showing the spine on its under surface, indicating the position of the fourth branch; *c*, small microspined acerate; *d*, minute elliptical body or spicule; *e*, large smooth acerate; *f*, more magnified view of "*c*"; *g*, more magnified upper and lateral views of "*d*" respectively.

Fig. 12. *Chalina polychotoma*, var. *mauritiana*. Spicule of Japanese specimen.

Fig. 13. The same from the Mauritius specimen, together with a more curved form. (Figs. 12 and 13 magnified to the same scale, viz. 1-48th to 1-6000th inch, to show their sizes relatively.)

Fig. 14. *Pachastrella stellettodes*, n. sp. *a*, large smooth body-acerate; *b*, quadriradiate spicule of surface; *c*, small microspined acerate of the crust or surface; *d*, minute sceptrella (all magnified to the scale of 1-48th to 1-1800th inch); *e*, small microspined acerate, and *f*, sceptrella, respectively more magnified, to show their detail; *g*, large smooth body-acerate of the natural length.

XXXVI.—*On three new Species of* Gonepteryx *from India, Japan, and Syria.* By Arthur G. Butler, F.L.S. &c.

In a collection from the North-west Provinces recently presented to the Museum by J. F. Duthie, Esq., I find an interesting new species of the genus *Gonepteryx*.

To those lepidopterists who regard the whole genus as consisting of one extremely variable and widely distributed species this unexpected novelty will doubtless be nothing more than another example of what they inaccurately call local varieties; to me it is a local form, and therefore a true species of the only kind existing in the Lepidoptera. I propose to call it *G. carnipennis*.

G. carnipennis belongs to the *rhamni* group; and before pointing out how it differs from its two nearest allies, *G. rhamni* of Europe and *G. nepalensis*, I may mention that I have before me specimens of the following species:—

G. rhamni, *G. nepalensis*, *G. cleopatra*, *G. maderensis*, *G. cleobule*, *G. farinosa*, *G. aspasia*, and *G. zaneka*, besides two other species which are at present unnamed in our collection and hitherto undescribed.

Gonepteryx nepalensis was originally separated from *G. rhamni* by Mr. G. R. Gray as a mere variety of the latter; but subsequently, in the 'Genera of Diurnal Lepidoptera,' p. 71, it was named by Edward Doubleday. Neither of these gentlemen, however, mentioned any character by which it could be distinguished from *G. rhamni*. The following synopsis will readily separate the three species:—

a. Wings above in male yellow, in female greenish white.

1. Wings of both sexes with ill-defined marginal brown points; upper surface of male of a deep sulphur-yellow colour; secondaries of female decidedly greenish; wings below with *costal area of primaries and whole of secondaries decidedly greenish*. *G. rhamni*. Europe.

2. Wings of both sexes with well-defined, partly confluent, marginal brown points; upper surface of male gamboge-yellow, of female creamy white, hardly greenish even on the secondaries; wings below with *costal area of primaries and whole of secondaries whitish* . . . . *G. nepalensis.* India.

3. Wings of male with marginal brown points well defined and partly confluent; upper surface deep gamboge-yellow; orange spot on secondaries very large (twice as large as in allies); wings below with *costal area of primaries and whole of secondaries flesh-pink* . . . . *G. carnipennis.* N.W. India.

Gonepteryx carnipennis, sp. n.

Wings above apparently broader than in *G. nepalensis*, owing to the apex being less produced; decidedly deeper in colour, and with a very large orange spot at the extremity of the discoidal cell of secondaries: primaries below sulphur-yellow, with the costal third flesh-pink; marginal black dots at extremities of veins; fringe at apex rose-red; a brown spot at end of cell as usual: secondaries flesh-pink; the subcostal vein broadly pale sulphur-yellow, as also the termination of the median vein; a large rounded purplish-grey spot at end of cell; fringe rosy at extremities of veins. Expanse of wings 67 millim.

Káli valley, 9000–10,000 feet (*J. F. Duthie*).

The following species from Japan and China is intermediate between the two groups in the genus, the *G. rhamni* and *G. zaneka* groups; though nearest to *G. rhamni*, with which it has been confounded by H. Pryer and others, it has features distinctly linking it to the *G. zaneka* group.

Gonepteryx maxima, sp. n.

The largest species yet described; the primaries well produced at apex as in *G. aspasia*; the primaries of male not quite so deeply coloured as in that species, though much more so than in *G. nepalensis*; the primaries a little deeper coloured than the secondaries and with confluent red-brown marginal spots (as in *G. nepalensis*), a character not found in *G. aspasia*; orange spot of secondaries nearly as large as in *G. carnipennis*; costal area of primaries and whole of secondaries below greenish white; female greenish white, uniformly coloured. Expanse of wings 78 millim.

♂, Nikko; ♀, N. China.

From *G. nepalensis**, to which this species is most nearly allied, it differs in its decidedly darker primaries, its more falcate, more elongated, and altogether larger wings, and the (consequently) larger orange spots on the wings, also in the less sinuous outer margin of the secondaries: from *G. aspasia*, to which most of these very characters prove its affinity, it differs in its slightly paler primaries and darker secondaries; the brown edging to the wings and the distinct separation of the under surface into two colours, as in the *G. rhamni* group.

The following species was captured on Mount Tabor by B. Lowne, Esq.:—

Gonepteryx antonia, sp. n.

Nearest to *G. cleopatra*, of the same brilliant yellow above, but with the large diffuse orange patch on the primaries replaced by a much paler diffused saffron-yellow nebula, and not extending so near to the margins. Under surface almost as uniformly coloured as in *G. rhamni*, whereas in *G. cleopatra* the costal area of primaries and the secondaries are of a chalky greyish-green tint. Expanse of wings 62 millim.

Mount Tabor, Syria. B. M.

This species must be placed between *G. rhamni* and *G. cleopatra*.

XXXVII.—*New Genera and Species of Fossil Cockroaches from the Older American Rocks.* By SAMUEL H. SCUDDER†.

SINCE the publication of my essay on Palæozoic cochroaches ‡, a considerable number of new types of Palæoblattariæ have come to hand, largely through the endeavours of Mr. R. D. Lacoe, to whose favour I owe the opportunity of studying them, and partly from my exploration of an interesting locality in South Park, Colorado. Some of the former have since been published in a revision of the species of *Mylacris* §, and the more interesting of such as remain are described in this paper.

The two new genera of Mylacridæ are closely allied to, but differ considerably from, the known genera. Of the Blattinariæ, the species of *Oryctoblattina* is the first secured from

* I originally recorded the male under this name, not having placed it side by side with the Indian species; it is doubtless a similar omission which has led Mr. Pryer to regard it as *G. rhamni*.

† From the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' March 10, 1885, pp. 34–39.

‡ Mem. Bost. Soc. Nat. Hist. iii. pp. 23 *et seq.*

§ *Ibid.* iii. pp. 299 *et seq.*

America; and the Triassic genera and species are interesting, not only from the deposit in which they occur, but also from their relation to Carboniferous and Liassic types*. They will all be figured on another occasion.

Promylacris (πρό, μυλακρίς), nov. gen.

The mediastinal vein, though large and abundantly supplied with veins, terminates not far beyond the middle of the wing; most of the branches fork more than once; the scapular vein runs in nearly a straight course, and terminates a short distance beyond the mediastinal, playing a very insignificant part; the externo-median vein is far more important, crowding back the scapular vein on the one side and the externo-median on the other; the anal furrow is very deeply impressed and the anal area stongly convex, its veins regular, frequent, and strongly curved.

Promylacris ovalis, nov. sp.

Represented by a single specimen and its reverse in a nodule preserving well the anterior half of the body. The pronotum is regularly arched, about one fourth as high as broad, and twice as broad as long. The front wings have a strongly developed humeral lobe and a costal margin of considerable convexity. The mediastinal branches are clustered into three groups; the scapular vein is composed of only two branches, each of which forks with slight divarication; the externo-median vein has three principal branches, all of which originate far toward the base of the wing; the interno-median area is unusually small, apparently not reaching so far out as the scapular area. The fragment is 20 millim. long, and the wing 12 millim. broad, but it was probably about 29 millim. long.

Carboniferous deposits of Mazon Creek, Ill. Received from Mr. Wm. Gurley.

Paromylacris (πάρος, μυλακρίς), nov. gen.

The mediastinal vein consists of at least seven or eight principal branches, several of them forking close to the base, the outermost extending far toward the tip of the wing, making this area unusually important; the scapular is also important, the main vein running through the middle of the wing in a straight course to the tip; the externo-median branches do not

* Amer. Journ. Sc. (3) xxviii. pp. 199 *et seq.*

separate widely, and occupy on the margin of the wing only the lower half of the broad apex; the anal furrow is deeply impressed, and strikes the middle of the inner margin.

Paromylacris rotunda, nov. sp.

The single specimen shows the larger portion of the upper surface, and all the more important parts, visible from above. The whole body is strongly arched, and the central portion of the pronotal shield, which is twice as broad as long, is elevated about 4·5 millim. above the margins. The front wings are obovate, scarcely narrower at tip than at base, barely twice as long as broad; the humeral angle very prominent. The scapular vein has four or five straight superior branches; the externo-median vein runs parallel to the scapular, and has two dichotomizing branches. The length of the wing is 29·5 millim., and its width 15 millim.

Carboniferous deposits of Mazon Creek, Ill. (Mr. R. D. Lacoe, No. 2026).

Spiloblattina (σπῖλος, *Blattina*), nov. sp.

This genus is allied to *Etoblattina*, but differs from it and from all other genera of Blattinariæ in the divergence of the scapular and externo-median veins beyond the middle of the wing, and then their rapid convergence beyond a more or less conspicuous elongated spot (whence the generic name) which fills the space so produced; a similar arrangement is seen even more conspicuously between the externo-median and interno-median veins, where the spot is much larger and round. All the species are Triassic.

Spiloblattina Gardineri, nov. sp.

A number of specimens of this were found, some of them nearly perfect. The wing is long and slender, more than three times as long as broad, the tip roundly produced. The mediastinal vein terminates some way beyond the middle, approaching the margin very gradually; the scapular runs parallel to the costal margin, slightly more removed from it in the apical than in the proximal half, and terminates a little before the tip of the wing; it has many branches, usually compound; the externo-median vein begins to branch usually in the middle of the wing, about opposite the stigma, in the interspace between it and the scapular vein, and its branches fill the apex of the wing. To form the enlarged cell for the median stigma, the curve of the main externo-median vein is graceful and very gradual. The anal terminates far before the middle of the wing. Length of wing about 17·5 millim., width 5·5 millim. Named after my son, who obtained the first and best specimen seen in our exploration of the beds.

Triassic beds near Fairplay, Colorado.

Spiloblattina triassica, nov. sp.

In this species the wing appears to be more slender than in the others, although the exact proportions cannot be given from the imperfection of the specimens; all the branches have a more longitudinal and less arcuate course, the externo-median and scapular veins scarcely part from each other to give place to the stigma, and the divergence of the former and the interno-median veins is also less conspicuous. The wing was probably about 18 millim. long and 5 millim. broad.

Triassic beds near Fairplay, Colorado.

Spiloblattina guttata, nov. sp.

This species differs from the others in the stoutness of the wing, which is proportionally much shorter than any of the others; in keeping with this peculiarity is the greater width of both the mediastinal and scapular areas, and the more rapid descent to the margin of the termination of at least the former. In other respects the species completely resembles *S. Gardineri*. Two fragments only were obtained, which indicate a wing about 15 millim. long and 7 millim. broad.

Triassic beds near Fairplay, Colorado.

Spiloblattina marginata, nov. sp.

This species, of which only a single specimen was found, is remarkable for the paucity of its neuration, and for the fact that all the veins and branches are margined with a slender dark edging. The scapular vein recedes more than usually from the costal margin opposite the very slight median stigma, and the externo-median vein is consequently more than usually curved to make place for it. The probable length of the wing was 18 millim. The inner margin being lost, the width can hardly be more than conjectured; but it was perhaps 7 millim.

Triassic beds near Fairplay, Colorado.

Oryctoblattina occidua, nov. sp.

The veins appear to originate from the middle of the upper half of the base of the wing, and have scarcely the least basal arcuation. The mediastinal vein runs at but slight distance from, and nearly parallel to, the costal border, in the outer half constantly but gradually approaching it, emitting numerous oblique, generally simple branches; the vein terminates in the middle of the outer half of the wing, and shows no such peculiarities at its tip as characterize *O. reticulata* of Europe. The scapular vein is also not so peculiar as there; it runs in near proximity and parallel to the mediastinal vein, but there is the same slight bend in its course at the base of the principal branch; the mass of the branches, which are fewer than in *O. reticulata*, do not arise as there from a vein emitted abruptly from near the base of the second branch, to which they are inferior, but from the principal branch itself, to which they are superior. The interno-median vein terminates at about the end of the middle third of the wing, and has only a few branches. The externo-median branches all terminate on the inner margin. The length of the wing is 19 millim., its breadth 7 millim.

Carboniferous beds of Mazon Creek, Illinois (R. D. Lacoe, No. 2039).

Petrablattina æqua, nov. sp.

Mediastinal vein terminating scarcely beyond the middle of the costal margin, with numerous, closely crowded, simple branches; scapular vein terminating above the tip of the wing, and beyond the basal curve nearly straight, with four or five singly forking branches; branches of externo-median vein straight, superior, mostly simple, parallel to the main scapular vein; the interno-median area extending to some distance beyond the middle of the wing. It is a tolerably large species, the wing measuring 24 millim. in length and 10 millim. in breadth.

Triassic beds near Fairplay, Colorado.

Petrablattina Meieri, nov. sp.

Mediastinal vein terminating a long way beyond the middle of the costal border, with comparatively distant, usually simple branches. Scapular vein terminating just below the tip of the wing and beyond the basal curve, gently arcuate throughout, with branches similar to those of *P. æqua*, but occupying a larger area. In consequence the externo-median area is of less importance than in *P. æqua*, and it has but few branches, which appear to be generally simple and slightly declivent, though superior. Unfortunately this portion of the wing in the single specimen known is very obscure. The interno-median vein is not preserved in its outer portion, but it evidently reached the border nearer the base than the mediastinal vein, and the anal furrow is strongly curved. The wing is broken at the base, but its probable length was 19 millim. and its breadth 7 millim. It is named after Mr. Robert A. Meier, of Garo, Col., in whose shaft all these specimens were obtained, and who afforded our party all possible assistance in working them.

Triassic beds near Fairplay, Colorado.

Poroblattina (πόρος, *Blattina*), nov. gen.

Allied to *Petrablattina*, and especially the species of that genus found in the same Triassic rocks, differing from them principally in the insignificant part played by the mediastinal area and the corresponding importance of the scapular area. The mediastinal vein extends no further out than the anal, terminating far before the middle of the wing, and has consequently but a few offshoots; while the mediastinal, sweeping downward away from the costal margin at the termination of the mediastinal, occupies nearly half of the wing before curving upward again to terminate above the apex. The externo-median vein is arcuate and terminates on the lower margin not far from the tip, and has only three or four superior long'tudinal branches. The anal furrow is strongly arcuate. The anal veins are nearly parallel to the inner margin, but impinge upon it near the anal furrow.

Poroblattina arcuata, nov. sp.

The costal border is considerably convex. The scapular vein is unusually arcuate, and has a large number of mostly simple oblique branches. The externo-median and interno-median veins, on the contrary, have few and distant branches, and the former is also strongly arcuate. The whole surface of the wing is broken by closely crowded cross-veins, which are more transverse to the whole wing than to the interspaces. A single rather imperfect specimen is known, indicating a species with a wing about 10 millim. long; the width is 4 millim., and apparently the wing was well rounded and much shorter in proportion to its breadth than in the next species.

Triassic beds near Fairplay, Colorado.

Poroblattina Lakesii, nov. sp.

The costal border is nearly straight and the wing elongate. The scapular vein is much less arcuate than in the preceding species, and has a comparatively small number of distant singly or doubly forked oblique branches. The much less oblique branches of the interno-median vein are more frequent, but appear less crowded from their simplicity, while those of the externo-median are more distant than the latter, and equally simple. There is no sign of any cross-venation. This species, like the preceding, is small, the wing measuring about 12 millim. long and 4·5 millim. broad. Named after Prof. Arthur Lakes, of the School of Mines at Golden, Colorado, the first discoverer of these fossils.

Triassic beds near Fairplay, Colorado.

XXXVIII.—*Remarks upon Lepidoptera collected in the Ellice and Gilbert Islands.* By Mr. C. M. Woodford *.

Throughout Mr. Butler's article in the March number of the 'Annals' the word "Tamana" should be substituted for "Tarawa" wherever it occurs (three times). It is an error caused by the similarity in the names of the two islands. Tamana I visited, Tarawa I did not.

1. *Junonia villida.*

This insect was extremely common upon all the islands that I visited, and I also noticed the larva, but cannot identify the food-plant.

2. *Hypolimnas rarick.*

This was common at Tapetewea and at other islands in the Gilbert group, and I found the larva feeding upon a species of *Abutilon* (a specimen of the plant was left by me at the Natural-History Museum). At Nukufetau, in the Ellice group, I saw only a solitary specimen of *Hypolimnas* (a male), but could not capture it.

3. *Chærocampa erotoides.*

The single example brought was the only one I saw, and I took it from the head of a child, who had tied it by a thread attached to the insect's tongue, and fastened the other end to his hair. This accounts for the damaged state of the speci-

* Communicated by Arthur G. Butler, F.L.S., F.Z.S., &c.

men. I have seen the Fijian children treat *C. celerio* and *P. convolvuli* in the same way.

4. *Cephonodes hylas.*

This handsome insect was common in the Gilbert group, flying about the flowers of *Guettarda speciosa.* I was fortunate enough to find the larva feeding upon the same plant, and I append description :—General colour pale apple-green ; head lighter. Segment over top of head powdered with minute yellow dots. Spiracles red. A faint yellow line over the spiracles, and a colourless dorsal line ; caudal horn-green, minutely dusted with black. This larva changed to a pupa upon the day after capture, but came to nothing, being probably killed by the rolling of the ship. The dead pupa was in the box of insects.

5. *Deiopeia pulchella.*

Common both in the Ellice and Gilbert groups upon *Tournefortia argentea*, upon which shrub I also noticed the larva, which I find described in my diary as " a dirty greyish white, spotted with black and red, and with pale-coloured hairs." I once saw the perfect insect in Fiji, singularly enough upon the same shrub.

6. *Prodenia retina.*

Also observed in Fiji.

7. *Amyna octo.*

Common on all the islands, flying about the *Abutilon* mentioned above.

8. *Heliothis armigera.*

Common on all the islands of the Gilbert group visited by me except Tamana, where I failed to notice it. It flies about the plants of *Abutilon*, and is shy and wary.

14. *Margaronia Woodfordii*, n. sp.

Common throughout the Gilbert group upon *Guettarda speciosa*, from which shrub I obtained it by shaking the leaves. I also found the larva rolled up in the leaves of the same shrub.

15. *Rinecera mirabilis.*

Taken in the Ellice group upon *Abutilon.*

16. *Harpagoneura complexa*, n. sp.

This insect I found at rest upon the trunk of a cocoanut-tree; it was the only specimen I saw.

All the above insects were taken during the daytime, and I do not think many more species are wanting to complete the list of Lepidoptera of the Gilbert group. The islands are nothing but coral-reefs, in no part rising more than 12 feet above the sea; and the list of trees and plants collected by me, which I believe to be complete, only extends to twenty-two species. I should like to have spent a night or two on shore after moths; but I thought it prudent to return to the ship each evening. One day while at Apamama, after returning on board, I found on my coat a small Geometer larva; but there is no perfect insect belonging to this group in my collection.

Gravesend,
April 10, 1885.

BIBLIOGRAPHICAL NOTICES.

A Monograph of the British Phytophagous Hymenoptera (Tenthredo, Sirex, *and* Cynips, *Linné*). By Peter Cameron. Vol. II. 8vo. London: Ray Society. 1885.

The volume issued by the Ray Society to their subscribers for the year 1884, which has lately been produced, is the second volume of Mr. Cameron's 'Monograph of British Phytophagous Hymenoptera,' the appearance of the first instalment of which we noticed in December 1882. In this volume the author continues the description of the species of Sawflies, and we learn from his preface that the subject is to occupy two more, the third to "contain the remainder of the Tenthredinidæ, the Siricidæ, and the introductory part of the Cynipidæ, including a discussion on the phenomena relating to the structure and growth of galls in general," while the fourth will be occupied by the systematic description of the Cynipidæ.

In this second volume Mr. Cameron deals only with the species of a single tribe or subfamily of Sawflies, namely the Nematina, including the great genus *Nematus* and its allies. This group, although not so extensive as that of the Tenthredina, which were treated of in the first volume, is the one which presents the greatest difficulties for the descriptive entomologist, as it includes the great genus *Nematus*, of which Mr. Cameron here records 107 British species, many of which are closely allied—in fact so closely that, as in the case of the Lepidoptera, it seems to be necessary in some cases to rear the species, the larvæ presenting decided differences when those between the perfect insects are obscure. The whole number of British species of the group is only 132.

In an Appendix Mr. Cameron indicates certain species to be added to genera treated of in his first volume, and also offers some important remarks upon the subject of parthenogenesis as occurring among the Sawflies, as to which he says, " there seems to be no doubt that the phenomenon is quite common."

In the matter of illustrations we are even more liberally dealt with now than in the preceding volume ; we have here no fewer than twenty-seven plates. and of these thirteen furnish us with coloured representations of the insects and their larvæ, the remainder, with one exception, being occupied by outline figures of the saws of different species. The adoption of colour in the representations of the perfect Sawflies will be an immense advantage to students, and the figures, drawn by Mr. Purkiss and Mr. Edgar Smith, are worthy of all praise. The only difficulty is to know where the plates are to come from to illustrate two more volumes : the figures in those now published carry us quite to the end of the Securiferous Hymenoptera, so that the available material for the illustration of the remainder of the work consists almost wholly of the figures relating to the Cynipidæ. It is to be regretted that the plates could not have been kept throughout to the same volumes which contain the text they illustrate. This, however, is but a minor detail, and one which detracts but little from the value of Mr. Cameron's contributions to the natural history of the Tenthredinidæ, a work the completion of which will be most welcome. British entomologists, using the term in the widest sense, are deeply indebted to the Ray Society for providing them with such books as Mr. Buckton's on the Aphides, Mr. Michael's on the Oribatidæ, and the present work.

Transactions of the Cumberland and Westmoreland Association for the Advancement of Literature and Science. No. IX. 1883–84. Edited by J. G. Goodchild. 8vo. Carlisle : G. and T. Coward. 1885.

The ninth volume of this valuable local publication, which has just reached us, contains perhaps rather fewer papers relating to natural-history subjects than its predecessor, which we noticed a twelvemonth ago ; but its contents will be of much interest to residents in Westmoreland and Cumberland. Both in bulk and in the number of articles it agrees pretty closely with the preceding volume.

The first of the thirteen articles, the Address of the President, Mr. R. S. Ferguson, has a title which might lead one to expect an anatomical dissertation. It is on "The Formation of the English Palate." But it is not to the structure of that important part of our organization that Mr. Ferguson has directed his attention, but to the gustative functions performed by it; his paper is an amusing digest of information on the art of cookery from the earliest period of which we have any records, with the object of showing in what manner our palates have been trained to their present system of likings and dislikings. Mr. W. Wilson's paper "Thirlmere and its Associations" and Mr. J. B. Bailey's article entitled "Who was the founder of Roman Maryport?" deal with interesting bits of local topographical and antiquarian information, with a good deal of interspersed literature; and the Rev. T. Ellwood's "Poets and Poetry of Cumberland, including the Cumbrian Border," is devoted exclusively to local literature, and will be read with interest outside of the circle to which it is specially addressed.

Coming now to the articles on subjects of natural history we may notice in the first place the conclusion of Mr. Goodchild's "Contributions towards a List of the Minerals occurring in Cumberland and Westmoreland," which treats chiefly of minerals which take part in the formation of crystalline rocks, and has appended to it a general alphabetical index to all the minerals noticed by the author in this and previous parts of his work. Mr. Goodchild also contributes a paper on "The Penrith Sandstone," a semipopular monographic study of the rock, with especial reference to the history of its formation.

Whether it be that the editor, after the fashion of some editors, has unduly put himself forward, or whether there may be some more legitimate mode of accounting for the circumstance, certain it is that we must plead guilty to having violated those *bienséances* embodied in the three words *place aux dames*. And this is the more blamable as Miss Donald's "Notes on some Carboniferous Gasteropoda from Penton and elsewhere" is undoubtedly the most seriously scientific article in the volume. Miss Donald refers *Turritella Urei*, Flem., to *Loxonema*, *T. elongata*, Flem., to *Aclisina*, and *Murchisonia quinquecarinata*, Kon., to *Orthonema*, and describes a new species of *Aclisina* under the name of *A. costatula*, from the study of specimens chiefly obtained from a shale in the Calciferous-Sandstone series. She has also figured the above species and another *Aclisina* in an octavo plate drawn and lithographed by herself.

There are two more geological papers in the volume, namely, some "Notes on the best Locality for Coal beneath the Permian Rocks of West Cumberland," by Mr. T. V. Holmes, in which the author points out the principles which ought to guide those who propose searching for coal in the district in question, and discusses, not always quite harmoniously, the statements made by Mr. J. D. Kendall, in a paper communicated by him in 1883 to the North of England Institute of Mining Engineers; and an article by Dr. J. Leitch, descriptive of "The Geological Formation and Fossils of the new Silloth Dock," recording the beds excavated and the occurrence in different parts of remains of *Cervus elaphus*, *Bos primigenius*, and a species of *Balænoptera*. Some of the bones of *Bos primigenius* are figured on a plate accompanying this paper.

The papers on subjects of recent Natural History are only four in number. Mr. J. C. Smith furnishes "Contributions towards a List of Plants found in the Penrith Neighbourhood," consisting of a list of about 130 species of plants with localities; and Mr. W. Duckworth, the first part of a paper on "Wild Flowers around Carlisle," a pleasant gossiping article on common plants, with many notes upon popular names, and other local particulars worth perusing. Under the head of Zoology we have also two articles: one on "Shrikes," by the Rev. H. A. Macpherson, giving a popular account of the species of *Lanius* found in Britain, and illustrated with a lithographed figure of Pallas's Shrike; the other, the fourth part of Mr. George Dawson's Notes on "Local Entomology," which deals with the moths of the group Cuspidatæ, and embodies some useful notes on the collecting and breeding of those insects. The "Local Scientific Notes and Memoranda" are also of interest, especially those by Mr. T. V. Holmes and Miss Donald's Additions to the local List of land and freshwater Mollusca.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 25, 1885.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Relationship of *Ulodendron*, Lindley and Hutton, to *Lepidodendron*, Sternberg, *Bothrodendron*, Lindley and Hutton, *Sigillaria*, Brongniart, and *Rhytidodendron*, Boulay." By Robert Kidston, Esq., F.G.S.

The Author commenced by expressing an opinion that the so-called genus *Ulodendron* of Lindley and Hutton comprised specimens belonging to several species and even to different genera. Unless the outer surface of the bark is well preserved, stems of Clathrarian *Sigillariæ* and *Lepidodendra* are undistinguishable; but species of *Ulodendron* have been in several cases founded on decorticated examples, and distinguished by such characters as the size of the Ulodendroid scar. The three species which have furnished most of the specimens described as *Ulodendron*, and to the description of which the present paper is chiefly devoted, are *Lepidodendron Vel-*

theimianum, Sternb., *Sigillaria discophora*, König, sp., and *S. Taylori*, Carruthers, sp.

The subject of the paper was divided into four heads. In the first an epitome of the views of previous writers on *Ulodendron* was given. The writers noticed were Steinhauer, Rhode, Allan, König, Sternberg, Brongniart, Lindley and Hutton, Buckland, Hooker, Sauveur, Unger, Göppert, Tate, Geinitz, Goldenberg, Miller, Eichwald, Macalister, Dawson, Carruthers, Röhl, Schimper, Weiss, Williamson, Feistmantel, Stur, Thomson, Zeiller, Lesquereux, and Renault. In the second part the Author described the specimens belonging to the species named that he had been able to examine, several of which he proposed to figure.

The third part contained the general conclusions as to the nature of *Ulodendron* at which he had arrived. He commenced by defining the four genera *Lepidodendron*, *Lepidophloios*, *Sigillaria*, and *Rhytidodendron*, as distinguished by the characters of their leaf-scars, and showed that *Lepidodendron*, *Sigillaria*, and *Rhytidodendron* occasionally exhibit large scars, arranged in two opposite vertical rows. These are the Ulodendroid scars. They marked, in the Author's opinion, the point of attachment of a caducous appendicular organ, which had in a very few cases been found in position. These appendicular organs were probably sessile cones. Details were given, showing the progressive development of the scars, the obliteration of the normal leaf-scars by the appendicular organs, and the branching of Ulodendroid stems.

The concluding portion of the paper contained the synonymy at length and full descriptions of the three fossil plants, *Lepidodendron Veltheimianum*, *Sigillaria discophora*, and *S. Taylori*, together with the horizons and localities in which they have been found in Britain. *Bothrodendron* was shown to be a decorticated form of Ulodendroid stem, and *Knorria* a cast of the case of *Lepidodendron*.

2. "On an almost perfect Skeleton of *Rhytina gigas* = *Rhytina Stelleri* ('Steller's sea-cow') obtained by Mr. Robert Damon, F.G.S., from the Pleistocene Peat-deposits on Behring's Island." By Henry Woodward, LL.D., F.R.S., F.G.S.

The Author spoke of the interest which palæontologists must always attach to such animals as are either just exterminated, or are now in course of rapid extirpation by man or other agents. He referred to the now rapid destruction of all the larger Mammalia, and expressed his opinion that the African elephant, the giraffe, the bison, and many others, will soon be extirpated unless protected from being hunted to death. The same applies to the whale- and seal-fisheries.

He drew attention to a very remarkable order of aquatic animals, the *Sirenia*, formerly classed with the Cetacea by some, with the walruses and seals by others, and by De Blainville with the elephants. He particularly drew attention to the largest of the group, the *Rhytina*, which was seen alive and described by Steller in

1741. It was then confined to two islands (Behring's Island and Copper Island). In forty years (1780) it was believed to have been entirely extirpated. It was a toothless herbivore, living along the shore in shallow water, and was easily taken, being without fear of man. Its flesh was good, and it weighed often 3 or 4 tons.

The Author then described some of the leading points in the anatomy of *Rhytina*, and indicated some of the characters by which the order is distinguished. He referred to the present wide distribution of the Sirenia:—*Manatus* with three species, namely, *M. latirostris*, occupying the shores of Florida and the West Indies; *M. americanus*, the coasts of Brazil and the great rivers Amazon and Orinoco; *M. senegalensis*, the west coast of Africa and the rivers Senegal, Congo, &c.

Halicore with three species, namely, *H. tabernaculi*, the Red Sea and east coast of Africa; *H. dugong*, Bay of Bengal and East Indies; *H. australis*, North and East Australia.

The fossil forms number thirteen genera and twenty-nine species, all limited to England, Holland, Belgium, France, Germany, Austria, Italy, Malta, and Egypt, and to the United States and Jamaica.

The Author gave some details as to the dentition of fossil species, of which *Halitherium* and *Prorastomus* are the two most remarkable types.

Lastly, with regard to the geographical area occupied at the present day by the Sirenia, the Author pointed out that two lines drawn 30° N. and 30° South of the equator, will embrace all the species now found living. Another line drawn at 60° N. will show between 30° and 60° N. the area once occupied by the twenty-nine fossil species.

He looked upon *Rhytina* as a *last surviving* species of the old Tertiary group of Sirenians, and its position as marking an "*outlier*" of the group, now swept away.

The greater northern extension of the group seems good evidence of the once warmer climate enjoyed by Europe, Asia, and America in the Tertiary epoch.

MISCELLANEOUS.

Preliminary Notes on the Echinoderms of Beaufort. By Henry F. Nachtrieb.

Recent work on the morphology and embryology of invertebrates and the speculations on the phylogeny and relationships of the various classes of animals now claiming the morphologist's consideration make a coherent history of the evolution of the Echinoderms very desirable, especially as no satisfactory explanation (so far as I know) of this interesting class of Invertebrates has ever been given. From what has been done it is evident that before we can safely speculate on the relationships of Echinoderms to Nemerteans &c., we must get a clear understanding of the evolution of the class itself. Towards this understanding no two investigators have contributed more than Johannes Müller in his memoirs, and Ludwig in his classical 'Beiträge.' But much remains yet to be done, and it was with a view to add something to our knowledge of this group that I began my work, at the suggestion of Dr. Brooks, at Beaufort, early last June. These Notes are rather an earnest of what is to be than a synopsis of what has been done.

The Echinoderms of Beaufort represent all the orders except the Crinoids, and with one or two exceptions are abundant, easily obtained, and in their variety offer excellent material for comparative work and for the solution of puzzling and important questions.

The starfish are represented by *Asterias Forbesii*, *Luidia clathrata*, *Astropecten articulatus*, and an undetermined species, of which I found only one specimen. This specimen was closely related to *Luidia* and *Astropecten*, and may prove to be a cross between the two—which surmise suggests some experiments in a field which certainly is promising. Of the Ophiurids great numbers of *Ophiothrix angulata* are found in the cavities of the sponges so abundant in certain parts of the harbour; some *Ophiophragma Wurdemanii*, Lyman, are found in the sand on Shark Shoals. Great numbers of *Ophiura olivacea* are found among the eel-grass in various parts of the harbour, and one undetermined species was dredged in deep water. The Echinoids are represented by thousands of the Clypeastroid, *Mellita petapora*, Lütk., commonly known as the sand-dollar, great numbers of Sea-Urchins, *Arbacia* and *Strongylocentrotus*, and by one Spatangoid, *Moira atropos*, which is common in the sand on Shark Shoals. The Holothurians are represented by *Synapta* and several undetermined species.

When I arrived at Beaufort last June, the sand-dollar was spawning, and I accordingly began my work on it. The eggs, when laid, are surrounded by a gelatinous membrane, in which are lodged numbers of large purplish-red pigment-granules, which vary in size and shape, and are always more or less angular. Fertilization takes place through this membrane. In no case could I see anything like a polar globule. The first two planes of segmentation (meridional) and the third, which is equatorial, divide the egg into eight blastomeres of equal size—occasionally the four at one pole are a trifle larger than the four at the opposite pole. After eight blastomeres are formed irregularities in segmentation begin, but as I did not pay special attention to segmentation I shall not attempt a description of the process.

After the blastosphere is formed each cell acquires a cilium; the larva then begins to rotate within the membrane, and at length wears through one portion of it and then escapes into the water. It is generally stated that the blastosphere and gastrula of Echinoderms are uniformly ciliated. This, I am prepared to say, is not altogether true—at least it is not true for all the forms studied at Beaufort.

At the pole opposite to where the blastopore is formed is a small circular area in which the cilia are longer, stronger, and less active than those at any other point of the larva. When the gastrula is swimming these long cilia are directed forwards, now and then sway to and fro slightly, but never aid in propelling or turning the larva, apparently being inactive except that occasionally they seem to act as sensory cilia. In some few cases this area with the long cilia was somewhat thicker than the neighbouring ectoderm. This thickening of the ectoderm and greater length of cilia over this thickened area was very marked in many *Strongylocentrotus*-gastrulæ, and it was always easily recognizable in *Ophiothrix*, and was well marked in *Moira*. Nothing of the kind was observed in the few starfish-gastrulæ I was able to get. That we have here to do with a differentiation peculiar to this part of the larva only, and that it is to some extent comparable to the region of the præoral tuft of cilia of other larvæ, is shown by the fact that it is marked some time before the larva escapes from the membrane, and that it exists long before there is the slightest indication of the posterior and the unmistakable anterior ridge of the ciliated band of the future *Pluteus*. And that it is not an optical delusion due to a difference in the rapidity and manner of vibration of the cilia in different parts of the larva is proven by specimens killed on the slide with osmic acid or other hardening fluid. How much importance can be attached to this fact will be discussed in a later paper. In passing I would, however, here point out that it is possible to explain the præoral band of cilia of *Bipinnaria* as a modified form of this group of long cilia, and that in those forms where we have but one band of cilia, these long cilia of the gastrula have merged into the anterior ridge of cilia, which then united with the postoral ring. The body-cavity and water-vascular system of *Mellita* is derived from a two-horned diverticulum of the enteron, just as in *Strongylocentrotus*. In *Moira* the process of segmentation, which is regular only up to eight blastomeres, leads to a blastosphere, this to a bilaterally symmetrical gastrula, which gradually develops into a nine-armed Pluteus, the posterior unpaired arm arising soon after the two ventral ones. No polar globules were seen. The body-cavity and water-vascular system arise as they do in *Mellita*. A phenomenon observed one day while fertilizing some immature eggs of *Moira* deserves mention here. The immature eggs have a clear distinctly visible nucleus and a number of clear spaces of varying sizes. Some of these eggs were mixed with active spermatozoa, and in a few moments after the spermatozoa had been added quite a number of pseudopodia were thrust through the egg-membrane, which, after having felt about a short time, again slowly withdrew themselves. The eggs did not undergo segmentation, and some hours later disintegrated. Want of time did not permit me to experiment in this direction.

The small opaque eggs of *Ophiothrix* always threw off two polar globules after being mixed with the male fluid. The first two planes of segmentation are meridional, the third is equatorial. The eight blastomeres are equal in size. As in the cases mentioned above, so here segmentation begins to be irregular. In the cases that came under my observation the segmentation of *Ophiophragma* was regular till four blastomeres had been formed. These eggs were obtained but a few days before my departure, and owing to circumstances I could not follow the segmentation any further at the time, and then southerly winds and high water cut off my work, so that I was able to get only the latter half of the development of the eggs I had obtained one afternoon from some of the Ophiurids I had in an aquarium. The eggs were laid in the afternoon about four o'clock, and early next morning the larva already had passed the important stages. One interesting thing was noticed in the segmentation so far as observed. The first two blastomeres, before completely separating, were connected at their middle points by a spindle-shaped body, which was finally constricted off, the two blastomeres having widely separated from each other, then gradually came towards the surface, became spherical, and looked very like a polar globule. The blastomeres rounded out, and again approached each other. Each next divided into two, a body similar to the one mentioned above being given off between each pair of blastomeres, which again widely separated from each other, rounded up, and then approached each other again. At this stage I was obliged to leave. Whether what I saw was the result of a pathological condition or not I cannot say. The larvæ I found in my aquaria the next morning were pyramidal bodies, somewhat flattened, drawn-out gastrula-shaped bodies, of which the anterior bluntly-pointed half was transparent, consisting of a single layer of ciliated ectoderm-cells around a cavity in which were branched mesoderm-cells, and of which the posterior broad end with the blastopore was dark, quite opaque, and already had established in it the enteron with its diverticula. The Ophiurid developed entirely in this posterior half of the larva. The anterior transparent half was gradually resorbed, and, so far as observed, no special invagination for the mouth obtained. On the starfish observed I have nothing new to add at present.

A few words on the phylogeny of the Echinoderms. If we compare the origin of the body-cavity and water-vascular system in the different classes we see that in the Holothurians we have one median pouch given off from the enteron, and that it, by division, gives rise to the body-cavity and water-system. In the Echinoids there is a two-horned pouch given off. In the starfish there are two separate lateral pouches given off, of which the left gives rise anteriorly to the water-system, and the right and the posterior part of the left become the body-cavity. In Ophiurids, so far as known, there are two separate pouches, both of which divide, the anterior part of the left becoming the water-system, the anterior of the right atrophying, and the posterior parts of the right and left becoming the body-cavity. In the Crinoids there are first given off two separate pouches, which become the body-cavity, and then a single one, that becomes the water-system. Assuming that the story of the Ophiurids and Crinoids is correct, we have here a rising scale, in which the Holothurians occupy the lowest, the starfish the middle, and the Crinoids the highest position. In favour of this there are some anatomical facts. The objections of palæontology are not very difficult to answer. In assuming the Holothurians as the primitive forms it is not necessarily implied that the line of development is a straight one, as it is represented above. It is quite probable that the line began to break with the appearance of the starfish.—*Johns Hopkins University Circulars*, March 1885, p. 67.

A new Freshwater Sponge from Nova Scotia.

Mr. E. Potts described a form recently identified by him as follows :—

Heteromeyenia pictouensis, n. sp.

Sponge light green, even when dry, massive, incrusting; texture very compact; spicules non-fasciculated, persistent; surface mostly smooth.

Gemmules very scarce, spherical, crust thick.

Skeleton-spicules cylindrical, short, robust, rounded or abruptly terminated; entirely spined, spines conical at the centre of the spicule, elsewhere generally curving *forward*, or towards each extremity. Rounded terminations of spicules covered with short spines, though frequently a single large spine or acute termination is seen at one or both extremities.

Dermal spicules absent or undiscovered.

Birotulates of the longer class surrounding the gemmules, rather numerous, one half longer than the others; shafts conspicuously fusiform or largest at the centre, where are frequently found one or more long spines. Their rotules consist of from three to six irregularly placed rays, recurved at the extremities.

Birotulates of the shorter class abundant and compactly placed around the gemmule; shafts mostly smooth, though sometimes bearing a single spine, irregularly cylindrical, but rapidly widening to support the rotules, which are large, umbonate, nearly flat, and finely lacinulate at their margins; occasionally bearing spines.

Measurements. Skeleton-spicules 0·0075 inch long by 0·00075 inch thick; length of long birotulates 0·0021 inch, of short birotulates 0·0012 inch; diameter of disk of latter 0·0009 inch.

Habitat. On submerged wood &c.

Locality. Collected only by or for Mr. A. H. McKay, B.A., B.S., of Pictou, Nova Scotia, from several lakes upon the watershed of that region.

This beautiful and interesting sponge was first discovered by Mr. McKay during the summer of 1884. At that time its novelty, as indicated by its unusually robust entirely spined skeleton-spicules, was easily recognized; but the absence of gemmules at that season precluded the determination of its generic relations, and it has continued unnamed. During the last week of December, however, a further search was rewarded by the finding of other "specimens upon sticks pulled up through a break made in the ice," and amongst these a few, and but a few, gemmulæ have now been discovered.

These suffice to place it clearly within the genus *Heteromeyenia*, near *H. Ryderii*, while the peculiarities of its birotulates distinguish it from that or any other species.

Mr. Potts called attention to its green and apparently living and growing condition, during midwinter, in that northern latitude, as indicating that like *Spongilla aspinosa*, of the New Jersey swamps, this species also is an "evergreen," continuing its life in the normal state throughout the year, and for this reason not needing to form "protected gemmules" in such abundance as do other species.

At the suggestion of Mr. McKay, to whose enthusiastic search we owe its discovery, the local specific name *pictouensis* has gladly been given to this species.—*Proc. Acad. Nat. Sci. Philad.*, Feb. 24, 1885, p. 28.

An Example of Samia Cecropia *having a fifth Aborted Wing.* By Hermann Strecker.

I have lately received from Mr. Ph. Laurent, of Philadelphia, an example of *Samia Cecropia*, bred by him from a cocoon, having an aborted, or rather the portion of a third primary. It is a male of the ordinary size, expanding about $5\frac{1}{2}$ inches, and is one of those smoky varieties in which the red portion of the transverse bands on the wings is very much narrowed. The right primary and both secondaries are normal in shape and marking. The left primary is in length from base to apex exactly the same as is the right; but in width from inner angle across to the costa it is $\frac{3}{16}$ inch less; the markings are the same, allowing for a little condensing owing to the difference in the width. The venation is normal in all the wings; the left primary is also somewhat narrower at the base where it joins the body: the inner margin is in exact line with that of its fellow, thus causing the wing at costa, where it joins the thorax, to be further in from the collar and head than its opposite.

The third primary, or rather portion of a primary, emerges from the side of the collar, and consists mainly of the costal and subcostal nervures, a small part of the median nervure, and a strip of wing about a quarter of an inch wide; but the latter was much curled and twisted in drying, and does not show this width fully. Its length is about two thirds that of the normal wing, with which it runs parallel, but it is in no way visibly connected therewith.

This form of monstrosity is apparently of exceedingly great rarity. I have heard of only three other instances—those recorded by Prof. Westwood in the Trans. Ent. Soc. Lond. 1879, pp. 220, 221, in which three diurnals are described, each possessing a third aborted right-hand secondary. In one of them, an example of *Gonepteryx Rhamni*, the normal right wing is much less than the left, the same with the second example, a *Vanessa Urticæ*, leading to the conclusion in those cases, as with the *Cecropia*, that the abnormal wing was produced at the expense of the normal.

In the two cases just cited, the extra wing is joined at the base of the costa to the proper wing; in the third case mentioned by Prof. Westwood, it is apparently a streak or strip, as it were, on the inferior surface of right secondary, distinguished from the rest of the wing, or the part thereof, by the difference in colour and marking alone.

It will be noticed in the case of the three diurnals, that the extra wing is always a right secondary, whilst in the *Cecropia* it is a left primary.—*Proc. Acad. Nat. Sci. Philad.* 1885, p. 26.

New Rhizopoda of the deep-water Fauna of the Lake of Geneva.
By Dr. Henri Blanc.

In 1879 Prof. Du Plessis noted* three species of Rhizopods obtained by him and M. Kursteiner in mud from a depth of 45 metres off the Mole of Ouchy, namely, *Amœba princeps*, Duj., *A. terricola*, Greef, and *Difflugia proteiformis*, Ehr. The author has made his investigations in the same locality, but at a greater depth, namely from 70 to 120 metres, partly by dredging and partly by sinking glass-plates and leaving them for some weeks to get covered with the mud. He obtained eight species not taken by Prof. Du Plessis. Prof. Forel and the author also procured another species off Morges, and this brings the number of known deep-water Rhizopods of the Lake of Geneva to twelve, of which the author gives the following list :—

1. *Amœba proteus*, Leidy, = *A. princeps*, Duj. Very common.
2. —— *verrucosa*, Ehr., = *A. terricola*, Duj. Frequent.
3. —— *radiosa*, Ehr. Rare.
4. *Difflugia pyriformis,* Perty. Frequent.
5. —— *urceolata*, Carter. Rare.
6. —— *globulosa*, Duj., = *D. proteiformis*, Ehr.
7. *Hyalosphenia cuneata*, Stein. Very rare.
8. *Arcella vulgaris*, Ehr. Pretty common.
9. *Centropyxis aculeata*, Stein. Pretty common.
10. *Pamphagus hyalinus*, Leidy. Very rare.
11. *Actinophrys sol*, Ehr. Very frequent.
12. A large *Difflugia* found off Morges by Prof. Forel and the author, probably a new species.

The author remarks that the whole of the above Rhizopods have been observed by Leidy in the surface-waters of the United States, which gives them a very wide geographical distribution; and, further, that the species indicated as rare by Leidy are so also in the deep waters of the lake.—*Bull. Soc. Vaud. Sci. Nat.* sér. 2, vol. xx. p. 287.

On the Nervous System of the Bothriocephalidæ.
By M. J. Niemiec.

The author has investigated several scolices of *Bothriocephalus latus* and also of a species parasitic in the dog. He has employed the method of sections.

Following the series of transverse sections the sixth from the free extremity of the scolex presents, near the middle, some irregular clear spots, and following the descending series these spots are

* "Matériaux pour servir à l'étude de la faune profonde du lac Leman," in Bull. Soc. Vaud. Sci. Nat. vol. xvi. p. 166.

seen to group themselves and finally to unite into two lateral granular masses traversed by delicate fibres. These masses reciprocally emit fine filaments, which creep over the bottom of the sucking-disks. Three sections lower, the two lateral masses are entirely separated; but from each there issue four nervous filaments, which run divergently to the outer epithelial layer, in which they seem to terminate suddenly. In the succeeding sections, however, besides the commissure uniting the two nervous masses which now makes its appearance, the sections of eight nerves show themselves, four on each side, surrounding in semicircles the sections of the lateral ganglia. This arrangement continues in the succeeding sections as far as the middle of the scolex. By the reconstruction of all these images the author represents the whole as follows:—

The lateral nervous cords ascend from the cervical region into the scolex, where they continue to travel in the same direction. There are no ganglia and no commissures either in the posterior part of the scolex, where their existence is assumed by M. Böttcher and M. Moniez, or in the middle of the length of the scolex, where M. Blanchard supposed them to be. It is only after attaining the anterior extremity of the scolex that the lateral cords incline to meet, and, after a slight inflation, unite by a powerful commissure. The latter is thickened in the middle and contains ganglion-cells. As in the *Tæniæ*, the median thickening may be called the *central ganglion*, although it is not so definite in the *Bothriocephali*, and even seems to be partly amalgamated with the lateral ganglia.

In front the lateral cords are continued beyond the ganglia. Immediately below the commissure they give origin on each side to four nerves, which at first take a radial direction, but soon bend backward and accompany the principal cords. At first one is struck with the analogy in the arrangements of these threads and the collateral descending filaments in the *Tæniæ*; but while the latter can be traced into the cervical region, those of the *Bothriocephali* cannot be followed through more than half the length of the scolex.

The principal nervous cords terminate in front at the level where they give origin to the collateral filaments; they emit a series of short delicate nervous filaments to the epithelial coat of the scolex. Other filaments seem to unite in the plane of one of the sections, to form a sort of anterior nervous ring.

These arrangements in *Bothriocephalus* are morphologically important as giving the key to the complications observed in *Tænia*. The nervous ring, the polygonal commissure, and the branches of the suckers in the latter are in relation to the great development and complexity of their muscular system. Abstracting this accessory system there remains only a central nervous system, much resembling that of the *Bothriocephali*, namely:—(1) a central ganglion: (2) the lateral ganglia the development of which is in relation to the bilateral symmetry of the worm; (3) ten descending nervous filaments, two of which are larger than the rest; and (4) the branches which run to the anterior extremity of the scolex. Thus the nervous system in *Bothriocephalus* is related to that of *Tænia* as a simpler and more primitive state of evolution.—*Comptes Rendus*, April 13, 1885, p. 1013.

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XXXIX.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).* By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

[Plate XVI.]

II. *On the Spawning of certain Marine Fishes.*

Clupea harengus.

On the morning of February 5th a boat reached St. Andrews harbour from the fishing-ground, having on the deck a quantity of the eggs of the herring, which probably had been shaken from the nets and had been for several hours in the open air. Some of the ova were collected by the hand and brought to the marine laboratory, where they were placed in a vessel under a tiny trickle of sea-water. Their development was not specially studied, though Mr. Alex. Thomson *, one of the students of natural history, made a few notes and several drawings at various stages. The main feature of interest in connexion with the experiment was the vitality of the eggs. The first embryos emerged from the eggs on the 6th March at noon, and thus a month elapsed from the date

* First Prizeman in the Natural-History Class of this Session.

of deposition, the lengthened period being probably connected with the low temperatures of the season. Thus it would not appear that the statements made as to the injury or disturbance of these ova by the sole or ground-rope of a trawl require qualification. As a rule the eggs of fishes deposited on the bottom, such as those of the herring, cottus, lump-sucker, and Montagu's sucker, are by no means delicate. Indeed, if nothing more befalls them than conveyance on deck by the trawl and subsequent tossing overboard into the sea, they will be little worse for the accident. It is by such means that many of the young fishes have been procured for observation. It would be well, however, for trawls to avoid ground covered with herring-spawn, especially at the hatching of the embryos, as these would be more liable to succumb to pressure of any kind than the ova, though they are more capable of getting out of its way. The young herring, on its escape from the egg, is much less active and vigorous than the young of other fishes with fixed eggs, such as Montagu's sucker, for the former were unable to make much progress above the bottom for some days, while the latter at once disported themselves throughout the water, shooting here and there like ephemeræ in the air.

Zoarces viviparus, L. Viviparous Blenny.

Many of the viviparous blennies collected in November and December were characterized by the great distention of the abdomen, as, indeed, previous observations had shown. The opinion of Willughby, therefore, that the species brings forth young in the depth of winter, seems to be most in accord with the condition on the Scottish shores, for the well-developed young are found in the ovary in November, December, and January.

In the fully developed female the embryos at this season lie over each other in compact masses in the ovarian cavity amidst a quantity of fluid. Moreover, so far as observed, the size of the adult does not appear to be connected with that of the young on extrusion, though the number may be. Dr. Shaw, however, found in a very large female (15 in.) that the young on extrusion measured nearly 5 inches. In a large female in which the young were accidentally discharged through a wound in the abdominal wall in November their length was 41 millim., while those normally produced in January from smaller specimens were 51 millim. in length. The lateral regions in these young forms are mottled with dark brownish touches on pale olive, the markings beneath the dorsal fin somewhat resembling Arabic characters. A darker band runs along the lower lateral region, and in this are a series of silvery spots. The dorsal fin is marked as in the adult. The coloration thus indicated is present before the extrusion of the young fish. The yolk-sac is almost absorbed, only a slight enlargement occurring in this situation. They seek the shelter afforded by crabs, stones, submerged wood, and similar structures, since they are readily devoured by the young cod, haddock, whiting, and other fishes (including their parents). When unmolested, however, as in a separate vessel, they stretch themselves at various heights on the horizontal branches of *Eudendrium* and other zoophytes, and feed on the hydroids and minute crustaceans that lurk amongst the twigs.

In the ovary the embryos lie over each other in a compact mass; yet in life the fluid in the chamber not only moistens the branchial apparatus, but enables them to glide over each other with ease. The ovarian cavity is single, and its wall is comparatively thin. Moreover, stretching inward from the latter are numerous long villous processes, which in shape are often clavate, narrow at the base and wide at the tip. In some the tips are expanded so as to form somewhat flattened sucker-like surfaces. The wall of the ovary presents in transverse section a thick epithelial layer externally (Pl. XVI. fig. 1, *a*), while the stroma beneath consists of mixed fibres and cells (*b*), the former including a considerable proportion of muscular fibres and the latter many nucleated cells. To this coat are attached the membranous vascular lamellæ just mentioned, and which, when viewed as transparent objects (Pl. XVI. fig. 2), show a complete meshwork of anastomosing blood-vessels, which do not seem to be reduced to the size of capillaries, since in the smallest twigs several blood-corpuscles pass in column. A large volume of blood is thus carried swiftly into the organ. In transverse section, moreover, it is found that these vessels are arranged along the external margins of all the folds (Pl. XVI. fig. 1, *c*, *c*), so that they are in close contact with the fluid in the ovarian chamber. A thin epithelial coat with connective or basement-tissue beneath alone intervenes between them and the cavity. The walls of these blood-vessels are somewhat thick. In specimens examined immediately after the discharge of the young fishes the vessels are remarkably large and conspicuous as well as gorged with blood. While preserving in the main a longitudinal direction, each trunk has connexions with the adjacent vessels at short intervals. The villous processes carrying these vessels fill the ovarian chamber at this time (after extrusion of the young), while small intermediate ova on short pedicles are studded on the surface of the thin wall.

The chief feature of the male is the muscularity of the sperm-ducts, the terminations of which are stated to be capable of eversion, so as to facilitate the introduction of the male elements into the ovarian chamber. This also would readily be accomplished if, as in certain other marine forms, the sea-water containing them gained admission to the cavity of the ovary.

Ovaries of the Catfish (Anarrhichas lupus, *L.*).

The somewhat close approach made by the catfish to the foregoing species made the examination of its ovaries noteworthy in this connexion*. In shape these considerably differ, since they are separate anteriorly and connate posteriorly, as usual in many fishes. Their walls are also much more massive. There is considerable similarity, however, in the arrangement and connexion of the eggs with the ovarian wall, to which they are fixed like large flattened bunches of grapes. In a female procured during the trawling experiments at the end of August (29th) the majority of the ova are about 4 millim. in diameter, each being attached by fine thread-like bands of tissue. The membranous parts of the folds to which the ova are attached show, in addition, numerous microscopic ova. The vascularity of this tissue is slight, and in striking contrast with the villous processes in the ovary of the viviparous blenny. The ovaries of a specimen obtained in February were unusually coarse internally from the presence of numerous large ova (5 millim. in diameter) amongst the smaller. Some of the large ova were quite free and apparently ready for extrusion, while others were fixed to the membranous pedicles and folds, which presented many branching blood-vessels, as well as more minute ova. The latter seem to be developed everywhere in the stroma of the ovary and its villous processes. From the variable size of the ova in this instance the spawning-period probably extended over a considerable time. The ova are, further, evidently deposited on the bottom.

Towards the posterior part of the organ, viz. about an inch and a half behind the fork, in the latter specimen are several bullæ, which have whitish albuminous contents. They are visible on both sides of the wall.

* In connexion with the development of the Teleostean reproductive organs an interesting paper by Jules MacLeod will be found in the 'Archives de Biologie' (of Van Beneden and Bambeke), vol. ii. p. 497, pls. xxix., xxx.

Ova of the Short-spined Cottus (Cottus bubalis, *Bloch*).

So little definite information has hitherto been available with regard to the spawning of this species, that in the recent and excellent work by Mr. Francis Day the following account is given :—" Breeding: In Greenland it has been observed to deposit its eggs on the seaweed in December and January. Its eggs are very small, and in this country are extruded during the spring in the sand or pools in the rocks. The male is said to make a nest of seaweed and pebbles for the reception of the spawn, while he is believed to watch over and protect the young when hatched." On the other hand, Prof. Alex. Agassiz observes that the ova of certain American *Cotti* are pelagic. It was not till the 1st of March that a female deposited its ova (Pl. XVI. fig. 4) in the laboratory. This specimen had been isolated and its movements somewhat limited, and it is probable therefore that the deposition may have been hastened. A large quantity of faint pinkish ova were extruded in a few seconds, and they adhered firmly together, forming a mass like that of the lump-sucker (Pl. XVI. fig. 3), though they were individually smaller, viz. 1·5 millim. in diameter. An examination of its ovaries shortly afterwards showed that a few ova were still present. Subsequently others deposited eggs of a beautiful roseate hue, of a deep red or of a pale straw-colour. All adhered very firmly together, yet leaving a series of cavities, so that the whole mass, as in *Cyclopterus*, imbibes and retains water, a provision of importance in the case of eggs deposited near low-water mark. The egg-capsule is thick, tough, and resistant, and shows the facets or processes by which it adheres to neighbouring ova. This coat is seen to be minutely punctured under a high power. None of the ova deposited in the tanks seem to have been fertilized. Many reddish examples (in mass) were procured from the rocks towards the latter third of March, and in these the embryos were well advanced.

This species is one in which the ova attain a nearly uniform size in the ovaries, and are extruded simultaneously. At the full period, indeed, the ovaries are heart-shaped, only a slight sinus occurring in the middle line anteriorly, while the posterior end is bluntly conical.

Armed Bullhead (Agonus cataphractus, *L.*).

The ova of this species were nearly ripe in a specimen trawled on March 12, in St. Andrews Bay, where they abound amongst the sand. They had a pale salmon-colour and a diameter of 1·3 millim. They are somewhat less resistant than those of the short-spined cottus, and have a thinner capsule, which is minutely and somewhat regularly punctured. They are probably deposited on stones, seaweeds, and other structures. A male showed fully developed spermatozoa at the end of January.

Bimaculated Sucker (Lepadogaster bimaculatus, *Donov.*).

The ova are somewhat irregularly arranged over an area of a square inch or two inside the valves of dead specimens of bivalves, such as *Solen siliqua*, in July. The eggs do not touch, but are firmly attached at somewhat regular distances to the smooth surface. In one instance the eggs occurred (with the adult) inside the hollow bulb of *Laminaria bulbosa*; and as the embryos were far advanced, it is probable, as Mr. Hyndman observes, that the adult remained in charge of them, even when subjected to the rough treatment of the dredge. In the latter case, the eggs were less regularly arranged than on the smooth inner surface of the *Solen*. The egg-capsules have very evident punctures.

Montagu's Sucker (Liparis Montagui, *Donov.*).

Almost the only kind of ova procured by the local trawlers (liners in their fishing-boats), in February, March, and April, is that apparently of this species, attached to various zoophytes, such as *Hydrallmania falcata* and *Sertularia abietina* (Pl. XVI. fig. 5) and on various algæ. They are considerably smaller than either of the species figured, measuring only $\frac{1}{20}$ inch in diameter, and are remarkable for the almost areolated appearance caused by the conspicuous punctures. They are of a light straw-colour and form firm masses on the zoophytes or algæ, while they are easily developed in the tanks, even after considerable exposure in the open air on the deck of a boat. Moreover, the embryos are well developed, especially in regard to the organs of circulation, pigment on the anterior region, pectoral fins and powers of locomotion, since on escape they at once swim through the water.

Pelagic Ova.

During the experiments on behalf of H.M. Trawling Commission many pelagic (or floating) eggs were examined. Those familiar with such ova will hardly accept the view that they float in virtue of the oil-globules they contain, since in the common forms, *e. g.* cod, haddock, whiting, flounder, dab, and turbot, no oil-globule is present. Masses of oil-globules, indeed, are more characteristic of ova that lie on the bottom, or that are fixed to submerged stones and rocks. Amongst others, however, the pelagic ova of the grey gurnard*, and, as shown by Mr. G. Brook †, the rockling ‡ and the lesser weever § present oil-globules. It is well to remember also that the abundance of oil does not in any degree cause the ova of the cottus, fifteen-spined stickleback, or those of the salmon or trout to float. A feature noticeable in most pelagic eggs is the delicacy of the investing capsule (*zona radiata*) and the crystalline translucency of the yolk-mass. Another is the fact that the embryos produced by such eggs are generally in a rudimentary condition, some, such as the young of the common flounder (*Pleuronectes flesus*), cod, haddock, whiting, and others, being devoid of mouth and anus as well as of blood-vessels. The minuteness and delicacy of the young Gadoids and Pleuronectidæ, and the difficulty of rearing them in confinement after the absorption of the yolk-sac, are considerable obstacles to the successful extension of such forms by artificial means in exhausted water.

In connexion with these pelagic ova the changes which ensue when ova captured and kept in the water of the open sea are placed in littoral water, especially that near a harbour or estuary, have not yet been fully investigated. They are not more remarkable, however, than those which occur in certain adult invertebrates when similarly treated.

The Young of the Ling (Molva vulgaris, *Flem.*).

In the Trawling Report allusion was made ‖ to the immature examples of the ling that had come under observation, and which for the most part had been procured by the hooks of the liners. Mr. Day states¶ with regard to the young, that "the back and sides are yellowish olive, broken up and divided into patterns by pale lilac lines." The striped condition of the young ling affords such a contrast to the boldly spotted state of the young cod that it is desirable to record it in greater detail. About the middle of December a specimen $3\frac{1}{8}$ inches long was found in a pool at the commencement of the East Rocks. In this an olive-brown band passes from the tip of the snout in a line with the middle of the eye straight backward to the base of the caudal fin-rays. The pale ventral surface bounds it inferiorly, while dorsally a stripe having a beautiful opaline lustre runs from the tip of the snout over the upper part of each eye to the base of the caudal

* Report of the Royal Commission on Trawling, 1885, p. 633.
† Journ. Linn. Soc. xviii. pp. 273 and 299.
‡ *Ibid.* p. 298. § *Ibid.* p. 275.
‖ *Op. cit.* p. 360. ¶ *Op. cit.* p. 306.

rays. The latter band is opaque-white on the tail, and it gives the fish a characteristic appearance. The dorsal fins are well marked, the first presenting a distinct black speck posteriorly, and another black pigment patch occurs at the end of the second. The dorsal line from the brain backward is distinguished by a narrow wedge of dull orange or a mixture of olive and yellow, and this brings out in relief the colours formerly mentioned. The young ling is thus a striped form, and contrasts boldly with the spotted or tesselated condition observed in the young cod.

Young Eel.

While digging for sand-eels near low water a young eel which presents certain features of interest was found deeply imbedded in the moist sand. The fish measures $3\frac{1}{4}$ inches in length, and is extremely translucent. Anteriorly, however, a symmetrical pale greenish coloration commences at each eye and passes backward and slightly outward, keeping external to the translucent cranium. Behind the latter a similar greenish band, broad at first, but subsequently narrowing, extends along the anterior vertebral region. The eyes are blackish. At the base of the brain is a little blackish pigment, and a line of the same colour indicates the spinal cord. The dorsal fin begins a considerable distance behind the pectorals, and thus differs from that of the adult conger, in which it commences at the last quarter or the end of the pectorals. The anal begins about the length of the head behind the dorsal, and apparently a little in front of the middle of the total length. The projection of the mandible beyond the premaxillaries is also pronounced. In both of the latter characters, therefore, it leans to the condition in the common eel. The tail is broadly lanceolate from the extension of the marginal fin on both edges, but especially superiorly; a small blackish patch occurs in its middle. The opercular region presents a striated or faintly radiate appearance from the peculiar ossification; the blood is faintly pinkish. This habit of a young eel, which at first sight was supposed to be a conger frequenting moist sand, is interesting.

On the multiple Tumours of Plaice and Common Flounders.

In Day's 'History of British Fishes'*, it is mentioned that Lowe describes the common flounder of the Ouse as "affected with a peculiar skin-disease resembling epithelioma —large fungous growths cropping out over the whole body, the granulations large and roe-like—under the microscope

* Part v. p. 36.

consisting of large nucleated cells." A similar affection is found in this species at St. Andrews and in the Thames, and the same tumours occur on the plaice.

In a male example of the latter, for instance, the coloured surface is crowded with small rounded tumours which resemble shot. They are also attached to the various fins (Pl. XVI. fig. 6) as well as invading the white surface. They are firmly fixed to the skin, give pain when interfered with, and are vascular. The isolated tumours range from 1·7 millim. to 1 millim. or less; the larger masses (Pl. XVI. fig. 6, *a*), when bisected, show a series of smaller areas, the whole being composed of multiple tumours, mostly of the same size (Pl. XVI. fig. 7). In the fresh state section is followed by the exudation of a minute granular whitish creamy substance, and the occurrence of fine fibrillæ under examination indicates that the fluid is probably coagulable. Each chamber is cystic, presenting a firm hyaline wall of considerable thickness, bounding the granular contents. The stroma exterior to the former is chiefly fibro-granular. Smaller cysts in course of development are observed amongst the stroma, the thick translucent hyaline wall being conspicuous. These tumours therefore would appear to differ from the kind with nucleated cells described by Lowe.

EXPLANATION OF PLATE XVI.*

Fig. 1. Transverse section of the ovary of *Zoarces viviparus*, shortly after the escape of the embryos. *a*, epithelial coat; *b*, muscular layer; *c*, section of the blood-vessels at the margins of the villi. ×about 40 diam.

Fig. 2. A fragment of the membrane of a villus, showing the large anastomosing vessels. Magnified.

Fig. 3. Ova of *Cyclopterus lumpus*. About the natural size.

Fig. 4. Ova of *Cottus scorpius*. About the natural size.

Fig. 5. Ova of *Liparis Montagui*. About the natural size.

Fig. 6. Portion of the anal fin of a small *Pleuronectes platessa*, with a multiple tumour and a few detached masses. About natural size.

Fig. 7. Transverse section of the foregoing multiple tumour. Enlarged.

XL.—*Some new Infusoria from American Fresh Waters.* By Dr. Alfred C. Stokes.

[Plate XV.]

The following hitherto undescribed Infusoria were originally met with in shallow ponds in central New Jersey, or were

* I have to thank Mr. Ed. Prince, Assistant-Zoologist at the Marine Laboratory, for the careful drawings in this Plate.

developed in a more or less concentrated infusion of fallen leaves with water from the Delaware river. They are individuals from an interesting class of animal life particularly abundant in this country, but one whose study has here been almost entirely neglected.

Heteromita mutabilis, sp. nov. (Pl. XV. fig. 16.)

Body ovate or subpyriform, about twice as long as broad, very soft, flexible, and changeable in shape, the alterations confined chiefly to the posterior extremity, and consisting of varied pseudopodial extensions of this part, which is normally widest and rounded; endoplasm granular; anterior vibratile flagellum thick, slightly exceeding the body in length, the posterior or trailing one slender, twice to two and a half times that length; nucleus obscure, apparently subspherical, near the centre of the left-hand border; contractile vesicle near the right-hand margin of the posterior extremity. Length of body $\frac{1}{3000}$ inch.

Hab. Standing pond-water, with aquatic plants. Movements evenly and steadily forward.

Although this infusorian can assume various shapes apparently at will, it is remarkable for the presence and variety of the posterior protrusions of the body-sarcode. These are usually almost constantly formed during the creature's progression, one scarcely disappearing before its place is taken by another of different shape and length. The tips of these pseudopodial prolongations seem to be adhesive, since they appear to cling to the surface of the glass slide and to require a slight effort for their release. The production of these characteristic prolongations, which, so far as I am aware, have not hitherto been observed in any other species of the genus except *H. lens* (Müll.), S. K., when in a dying condition, together with the posterior location of the contractile vesicle, which, with this exception, is placed so close to the rear in *H. lens* only, are of diagnostic value, and will readily lead to the recognition of the infusorian. From *H. lens*, for which it is hardly possible to mistake it, *H. mutabilis* can be distinguished by its normally ovate or subpyriform contour, but chiefly, apart from the posterior changes of shape, by the diverse length and thickness of the flagella. In *H. lens* the latter are both equal in size and about equal in length, being twice as long as the body.

Petalomonas carinata, sp. nov. (Pl. XV. fig. 14.)

Body broadly ovate, somewhat longer than wide, both extremities rounded, the anterior the narrower; ventral surface concave, the dorsal elevated into a single, median, longitudinal, keel-like projection, traversing the entire body; flagellum not exceeding the body in length, arising from the ventral surface somewhat back of the frontal border; oral fossa capacious; nucleus near the centre of the right-hand margin, the contractile vesicle somewhat in advance, on the opposite side; parenchyma transparent. Length of body $\frac{1}{1125}$ inch.

Hab. Standing pond-water, with aquatic plants.

This form seems to combine the characters of *P. abscissa* (Duj.), Stein, and of *P. mediocanellata*, Stein, the former bearing one or two dorsal keel-like elevations, and the latter having a groove traversing its ventral surface, while *P. carinata* possesses both in a marked degree. The dorsal aspect of the latter is conspicuously angular, the keel-like ridge forming the apex and the right-hand and left-hand sides respectively sloping evenly in opposite directions to the lateral borders, as shown in diagrammatic transverse optic section by fig. 14. The infusorian is much the smallest member of the genus hitherto observed. Its movements are usually directly forward and not rapid, the flagellum conspicuously vibrating only at its distal extremity, the creature frequently coming to rest on a fragment of aquatic plant, and extending the flagellum in all directions, as if in search of food, or, where food seems specially abundant, remaining for a long time with the anterior border or the large oral aperture in contact with the heap of débris, the posterior extremity being lifted upwards, the flagellum then also being directed to various points in the vicinity.

Zygoselmis acus, sp. nov. (Pl. XV. fig. 15.)

Body elongate, needle-shaped or subfusiform, changeable in shape, about six times as long as broad, both extremities pointed; surface smooth; endoplasm granular; flagella very diverse in length, the shorter scarcely as long as the body, the longer once and a half to twice that length; nucleus apparently subcentral. Length of body $\frac{1}{1500}$ inch.

Hab. Standing pond-water, with aquatic plants. Movements active.

There seems to be but little dissimilarity between the *Zygoselmis* of Dujardin and Ehrenberg's *Distigma*, the possession by the latter of two eye-like pigment-spots being the chief point of difference, and even these often being absent. In *Zygoselmis* they have not been observed at any stage of the infusorian's life-history. The form here referred to as *Z. acus* undoubtedly belongs to the genus in which it is now placed. Its ability to change its shape is not often exercised; but when the need arises the alteration is rapid and conspicuous. Its favourite haunt seems to be dead and partially empty algal cells, where several of the species can usually be found in the small pool affected by them.

Anisonema emarginatum, sp. nov. (Pl. XV. fig. 11.)

Body suborbicular, depressed, the frontal border somewhat narrowed, rounded, and centrally emarginate, the dorsal surface convex, the ventral slightly concave; flagella subequal in size, the anterior or vibratile about twice as long as the body, the trailing one slightly longer, both inserted near together somewhat toward the right-hand side of the frontal emargination; contractile vesicle single, in the anterior body-half near the right-hand margin; nucleus not observed; endoplasm granular, enclosing numerous dark-bordered linear corpuscles. Length of body $\frac{1}{1800}$ inch.

Hab. Standing water, with *Myriophyllum* and other aquatic plants.

Entosiphon ovatus, sp. nov. (Pl. XV. fig. 12.)

Body ovate, somewhat depressed, a little less than twice as long as wide, rounded posteriorly, narrowed anteriorly, and slightly curved toward the ventral aspect, the frontal border somewhat emarginate on the left-hand side, the cuticular surface traversed by ten or twelve longitudinal sulci; the two flagella inserted near together on the left-hand side of the pharyngeal aperture, the posterior or trailing one about twice as long as the body, the anterior or vibratile not exceeding the body in length; pharyngeal tube protrusible, extending backwards for fully four fifths of the entire length of the body; contractile vesicle single, near the left-hand border of the frontal margin; nucleus spherical, near the centre of the left-hand border. Reproduction by longitudinal fission. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch.

Hab. An infusion of dead leaves.

Entosiphon sulcatus (Duj.), Stein, has the trailing flagellum from two to three times as long as the body, the cuticular sulci are but four or five, and the animalcule is very much smaller than the form here described. The contractile vesicle has been observed to become rosette-shaped in *E. ovatus*, as it has in the form from European waters. Reproduction by longitudinal fission, beginning at the anterior border, has been noticed in both.

Tillina flavicans, sp. nov. (Pl. XV. fig. 8.)

Body subreniform or bean-shaqed, soft and flexible, but persistent in form, holotrichous, minutely roughened and obliquely striate, the anterior and posterior extremities subequal in width, the anterior body-half compressed; oral aperture ovate, obliquely placed near the centre of the right-hand border of the ventral surface; pharyngeal passage long, recurved, entirely ciliate; contractile vesicle single, spherical, on the left-hand margin near the posterior extremity; nucleus spherical, subcentrally located; anal aperture postero-terminal. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch.

Hab. An infusion of dead leaves.

The animalcule's movements are rapidly forward in straight lines or in irregular spirals, commonly with one side or the other downward. The food-particles are usually collected in conspicuous spherical masses, which are carried around the body in a quite constant endoplasmic current. The colour, usually a shade of brown, varies considerably, probably being affected by the colour of the infusion in which the animalcule thrives.

In the 'American Naturalist' for February 1884 the writer referred to a species of this genus under the name of *Tillina inflata*, which was not there described. As it and the preceding somewhat closely resemble each other, *T. inflata* is here diagnosed and a figure given for comparison, although the likeness is confined chiefly to internal structure.

Tillina inflata, Stokes. (Pl. XV. fig. 9.)

Body irregularly subreniform, obliquely striate, entirely ciliated, the posterior body-half rounded, inflated, conspicuously widened, and somewhat oblique; the anterior half compressed, its ventral surface flattened; oral aperture ovate, ventral, obliquely placed, and followed by a short, recurved, entirely ciliated pharyngeal passage; nucleus ovate or spheroidal, subcentrally located; contractile vesicle single, spherical, postero-terminal; anal aperture postero-terminal, in close proximity to the pulsating vacuole. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch.

Hab. Water in which the bulbs of the Chinese *Narcissus* were growing.

This interesting creature is found only in the habitat mentioned, but always there. Its movements are very similar to those of *T. flavicans*. The food-masses also receive the spherical form; but the rotation of the endoplasm so noticeable in *T. flavicans* is here seldom visible. In colour the infusorian is a deep amber, the tint varying with that of the infusion and, to a certain extent, with age, the young animalcules being paler than the mature. Reproduction takes place by encystment, with subsequent binary or quadruple fission, the young resembling the undivided forms in all except colour. Conjugation has not been observed.

Lacrymaria truncata, sp. nov. (Pl. XV. fig. 10.)

Body flask-shaped or clavate, flattened, very soft and flexible, four and one half to five times as long as broad, narrowed into a neck-like region anteriorly, the frontal border of which is somewhat dilated and obliquely truncate, the apical groove conspicuous; the posterior extremity rounded; entire surface strongly and longitudinally striate; cuticular cilia long and fine; oral aperture terminal, followed by a long conical membranous pharynx, visible only after death; apical groove bearing a single row of cilia; contractile vesicle single, spherical, postero-terminal; nucleus long, band-shaped, variously curved and twisted, having several laterally-attached nuclei; anal aperture postero-terminal. Length of body $\frac{1}{200}$ inch.

Hab. Standing water, with dead leaves.

This is the only freshwater member of the genus thus far observed. It is remarkable for the very long and band-like nucleus, and especially for the capacious conical pharyngeal passage, which has hitherto not been recorded as appearing in any of the several marine species. It is here visible only after the animalcule's death, which in this instance was accomplished by the glycerole of tannin, when it becomes conspicuous, and is seen to occupy almost the entire width of the frontal border, thence tapering to an acute termination and extending through about one third of the entire body.

In most of the species the apical extremity is conical; here, however, it is conspicuously flattened, oblique, and truncate. As the infusorian now referred to is undoubtedly a member of the genus *Lacrymaria*, a slight change in the generic diagnosis would seem necessary; and such change would be preferable to the erection of a new generic title for the creature, as might seem desirable on account of the cushion-like apical extremity and the extensively developed pharyngeal passage. The latter probably brings the genus closer to the *Lagynus* of Quennerstedt, in which the pharynx is plicate and the apical groove wanting. The movements of the infusorian are rapid and usually by rotation on the long axis.

Colpidium truncatum, sp. nov. (Pl. XV. fig. 13.)

Body somewhat reniform, from two to three times as long as wide, striate longitudinally, compressed anteriorly, the extremities subequal in width, the posterior one evenly rounded, the anterior somewhat curved toward the ventral aspect, the frontal border obliquely truncate; oral aperture ovate, the pharynx long; vibratile membrane large, conspicuous; contractile vesicle single, located on the right-hand border of the posterior extremity near the dorsal surface; nucleus ovate or subspherical, single, subcentral; anal aperture postero-terminal. Length of body $\frac{1}{500}$ to $\frac{1}{600}$ inch.

Hab. Standing water, with *Myriophyllum* and other aquatic plants.

This form was for a time very abundant in a small vessel of water from an aquarium containing *Myriophyllum* in various stages of growth and decay. It differs from the hitherto single-known member of the genus in the oblique truncation of the frontal border, the single nucleus, and the position of the contractile vesicle. In numerous instances conjugation was observed, union taking place between the anterior third of the ventral surface of each animalcule. Transverse fission was also repeatedly noticed, the newly-separated animalcules being subspherical in form, soon, however, assuming the normal contour of the adult infusorian.

Vorticella octava, sp. nov. (Pl. XV. fig. 17.)

Body conical-campanulate, somewhat changeable in form, once and one half to twice as long as broad, tapering posteriorly, slightly constricted beneath the peristome, which is revolute and exceeds the body-centre in width; obovate or pyriform when contracted; cuticular surface finely striate transversely; ciliary disk somewhat and obliquely elevated; pedicle seven to nine times as long as the body, the hyaline sheath apparently thickened on one margin and twisted about the stout muscular thread; contractile vesicle single. Length of body $\frac{1}{900}$ to $\frac{1}{1000}$ inch.

Hab. Standing water; attached to *Proserpinaca*. Solitary or few together.

This is not uncommon in the pond where it was originally found, and the peculiar appearance of the sheath about the pedicle seems to be characteristic of the species; in none of the previously described *Vorticellæ* has such an apparent twisting of this covering been noted. One border only of the sheath seems to be conspicuously thickened, the spiral line visibly crossing the pedicle and forming a curve on the opposite side, thus producing the twisted aspect. The other margin of the sheath is not distinguishable from the thread when the pedicle is extended, and is apparently then in contact with it.

The body is quite changeable in shape; the usual alteration, besides shortening and widening, is the formation of a deep depression in one side anteriorly, in this habit somewhat resembling *Vorticella smaragdina*, Stokes*, in which this is usually a conspicuous feature.

As this is the eighth member of the genus found in American waters, and presumably restricted to this continent, the event has been commemorated by compelling the long-stemmed infusorian to bear the ordinal number as its specific title.

Urostyla trichogaster, sp. nov. (Pl. XV. fig. 3.)

Body elongate, elliptical, soft, and flexible, three times as long as broad, both extremities rounded, somewhat narrowed anteriorly, and slightly curved towards the left-hand side; upper lip prominent, crescentic; the entire cuticular surface roughened by minute elevations in irregularly longitudinal clusters; peristome-field obovate or subtriangular, extending obliquely backward from the left-hand side of the frontal border towards the right, to somewhat beyond the anterior third of the ventral surface, bearing on the left-hand margin a fringe of large, strong, adoral cirri and a row of fine paroral cilia, the right-hand border supporting a conspicuous undulating membrane and a row of preoral cilia, a series of long fine endoral cilia depending from the median part and continued through the long, narrow, tubular pharynx; the frontal region between the right-hand side of the peristome-field and the body-margin beset by numerous uncinate styles, gradually decreasing in size posteriorly, but suddenly passing into the fine setæ which clothe the entire ventral surface in closely approximated longitudinal lines; marginal setæ uninterrupted, longest on the posterior border; anal styles slender, subequal, ten to twelve in number, arranged in an oblique row, not projecting beyond the body-margin; contractile vesicle single, spherical, on the left-hand side of the peristome near its posterior extremity; nucleus single, subspherical, posteriorly

* 'American Naturalist,' 1885, p. 18.

located; anal aperture subterminal. Length of body $\frac{1}{75}$ to $\frac{1}{100}$ inch.

Hab. A vegetable infusion. Reproduction by transverse fission.

For some time this was the prevailing form in an infusion, gliding over the fungoid slime on the surface as visible whitish spots. By transmitted light it is brown and semi-opaque.

The structure of the peristome is complex, resembling that of the same part in *Gastrostyla Steinii*, Eng. The series of fine "paroral" cilia on the left-hand border of the region, in addition to the large adoral cirri on the same margin, is especially notable, as it has but seldom been observed in any animalcule.

A nucleus does not seem to be invariably present. Only one has been noticed in any individual, and in many instances none could be perceived even after treatment by reagents and staining-fluids.

The food consists chiefly of the smaller animalcules, the rhizopod *Trinema enchelys*, Leidy, and in several instances of small *Anguillulæ*, all of which were observed within the endoplasm, while an unsuccessful effort to swallow a large *Anguillula* was noted.

Opisthotricha emarginata, sp. nov. (Pl. XV. fig. 2.)

Body elongate, obovate, soft and flexible, depressed, about four times as long as broad, widest anteriorly, the frontal border rounded; somewhat tapering to the posterior extremity, the right-hand margin of which is conspicuously emarginate; peristome-field arcuate, narrow, without an inner or right-hand border, extending from the frontal margin for about one third the length of the body; eight frontal styles, six scattered setose ventral, and five large conspicuous anal ones; marginal setæ scarcely interrupted at the posterior extremity, more numerous on the right-hand border; caudal setæ three; several longitudinal rows of hispid setæ on the dorsal surface; nucleus double, ovate; contractile vesicle single, spherical, close to the left-hand border, near the posterior termination of the peristome. Length $\frac{1}{200}$ to $\frac{1}{175}$ inch.

Hab. Standing water, with aquatic plants. Reproduction by transverse fission.

In its movements this infusorian is rapid and erratic. Frequently after remaining comparatively quiescent, it suddenly darts backward entirely out of the field of the objective.

The contractile vesicle expels its contents through the dorsal surface, at complete systole forming there a conspicuously projecting elevation of the cuticular surface.

Stylonychia notophora, sp. nov. (Pl. XV. fig. 1.)

Body elliptical, more than twice as long as broad, the extremities subequal in breadth, the posterior one usually rounded and sometimes slightly emarginate on the right-hand side, the frontal border obtuse, the left-hand margin obliquely truncate, the right-hand corner obliquely emarginate, the upper lip prominent, crescentic; the inferior surface bearing eight frontal styles, the posterior three being smallest, and five ventral, with five anal, of the latter the three on the right-hand side projecting beyond the posterior border; marginal setæ conspicuous, interrupted at the posterior extremity, longest and most numerous on the right-hand margin; caudal setæ long, widely separated and inserted on the dorsal surface of the posterior extremity; peristome-field arcuate, extending to the centre of the ventral surface, its apical extremity terminating in a tubular ciliated pharyngeal passage sharply curved towards the right-hand side, the outer or left-hand border bearing the large adoral cilia, the right-hand margin finely ciliate and supporting a conspicuous undulating membrane; nucleus ovate, double; contractile vesicle single, spherical, on the left-hand side of the peristome, near its posterior extremity; anal aperture on the left-hand side of the dorsal surface, somewhat in advance of the position of the anal styles, the dorsum also bearing four longitudinal rows of immotile hispid setæ; all the styles as well as the marginal setæ occasionally fimbriated. Length of body $\frac{1}{200}$ inch.

Hab. Standing water with dead leaves, or with various aquatic plants.

This differs from *Stylonychia mytilus*, Ehr., which, of all the species, it most resembles, in that the extremities are subequal in width, in the rounded posterior margin, beyond which project three instead of two anal styles, in the possession of the motionless bristle-like hairs on the dorsal surface, and especially in having the opening of the anal orifice on the superior or dorsal aspect. This, so far as I am aware, is only the second infusorian hitherto observed with the cytopyge, or anal opening, debouching on the dorsum, the first to be noted being *Loxodes vorax*, Stokes*, it being an interesting coincidence that both infusorians are members of the same order.

Podophrya brachypoda, sp. nov. (Pl. XV. fig. 4.)

Body subspherical or broadly pyriform, commonly rounded posteriorly, subsessile, the pedicle being very short and incon-

* 'American Journal of Science,' July 1884, p. 38.

spicuous; tentacles distinctly capitate, often twice as long as the diameter of the body, arranged in two, three, or four fascicles; contractile vesicles two; nucleus ovate, coarsely granulate, subcentral or near the posterior extremity; endoplasm granular. Diameter of the body $\frac{1}{600}$ to $\frac{1}{750}$ inch.

Hab. Standing water with dead leaves; attached to fragments and débris.

So abundant in its habitat was this *Podophrya* that a single dip of a small glass rod brought to the microscope-stage a dozen or more attached to floating fragments in the bacterial pellicle. The foot-stalk is here so short and inconspicuous —no previously-observed *Podophrya* possessing so obscure a stem—that the infusorian may be recognized by this peculiarity. Unless seen in profile or side view, or in longitudinal optic section and attached to the supporting object, from which it is readily separated, it bears a not remote resemblance to *Sphærophrya*. In the figure (Pl. XV. fig. 4) the pedicle is shown of extreme length, being the longest observed among innumerable individuals. Ordinarily it is not more than one half the length there represented. In young or immature forms—which were as plentiful in the infusion as the larger, more distinctly pedicellate specimens—the foot-stalk is so rudimentary that the animalcules seem to be quite sessile, and the posterior point of attachment to be somewhat indented, thus giving that part the aspect of an adhesive acetabuliform disk. The latter is said to be conspicuous in *Podophrya Buckei*, S. K., so named by Kent from its discoverer, who described it, but failed to supply a specific title; and Kent intimates that, on account of this peculiar modification at the point of attachment, the creature may hereafter become the type of a new genus. In view, however, of the disk-like aspect of the adhesive extremity in the young *P. brachypoda*, I would suggest that *P. Buckei* is probably an immature form of an unobserved, more distinctly pedicellate member of the present genus.

The embryo of the present species is elongate-ovate, about three times as long as broad, and very active. It has two contractile vesicles and a conspicuous ovate nucleus. I have been unable to follow the development, as all those seen to leave the parent have, within the confined space below the cover-glass, sooner or later fallen victims to the appetite of waiting *Podophryæ*.

Solenophrya inclusa, sp. nov. (Pl. XV. fig. 5.)

Lorica subspherical, irregularly rounded or somewhat flattened posteriorly, bearing near the anterior border an irregular equatorially-disposed rim or projection, close to which the thin walls are pierced by narrow fissures for the exit of the four to six fascicles of distinctly capitate tentacles; animalcule elongate-ovate or subspherical, entirely enclosed, not attached to the lorica posteriorly; contractile vesicle single; nucleus ovate, coarsely granular. Diameter of lorica $\frac{1}{650}$ inch.

Hab. Standing water; attached to *Proserpinaca* and other aquatic plants.

The margin of the sheath in most of the loricate members of the order to which the genus *Solenophrya* belongs is usually difficult to demonstrate distinctly; but in this particular species the frontal convexity or roof is so hyaline that its existence can be satisfactorily observed only by the use of some chemical means of removing the enclosed zooid. This is readily accomplished by a drop or two of caustic potash in solution. The soft animal is thus entirely dissolved, the hyaline lorica remaining unchanged and in condition for examination. The lorica is then observed to be generally but irregularly spherical, the rounded contour being interrupted anteriorly by the conspicuous rim, the edge of which is also irregularly undulate and angular. The fascicles of tentacles seem to issue from fissures near this rim, as I have been unable to detect openings in the upper surface or dome-like roof of the lorica.

Solenophrya pera, sp. nov. (Pl. XV. fig. 6.)

Lorica irregularly cubical or satchel-shaped, compressed anteriorly, membranous, hyaline, the greatest height, length, and breadth subequal, longest and widest at the base of attachment, narrowing to the anterior border, the sides more or less concave, the sloping ends truncate, the posterior angles rounded, a narrow elongate cleft extending along the entire frontal margin; enclosed animalcule oval, about twice as long as broad, not adherent to the lorica posteriorly; tentacles numerous, capitate, arising from the entire frontal border; contractile vesicle single, posteriorly placed; nucleus conspicuous, subspherical, coarsely granular, located somewhat in advance of the pulsating vacuole. Length and height of lorica $\frac{1}{600}$ inch, width $\frac{1}{644}$; length of animal $\frac{1}{750}$ inch, width $\frac{1}{1200}$ to $\frac{1}{1000}$ inch; two individuals often occupying the same lorica.

Hab. Standing water; attached to *Myriophyllum* and other aquatic plants.

The form of this lorica is so much like that of the ordinary hand-satchel now popular among ladies, that it suggested the specific name. I have not observed the act of reproduction; but the presence of two individuals in one lorica suggests fission or budding, the usual method in the order being by the formation of a ciliated embryo. In another remarkable undescribed species of this genus reproduction takes place by encystment and the subdivision of the entire body into biflagellate organisms. As I have thus far seen this form only in its encysted condition, I prefer to observe the arrangement of the tentacles before describing it.

Acineta urceolata, sp. nov. (Pl. XV. fig. 7.)

Lorica urceolate, widest and compressed anteriorly, the walls thin, readily taking the form of the enclosed animalcule, the posterior extremity continued as an attenuate, very short, hollow pedicle one eighth to one tenth as long as the lorica, the frontal margins separated by a narrow cleft-like fissure, widened and rounded at the lateral borders; enclosed body almost filling the cavity of the lorica, and attached to it posteriorly by a prolongation continued through the pedicle; endoplasm granular; tentacles capitate, a fascicle issuing from each lateral angle of the anterior fissure; nucleus oval; contractile vesicle spherical, single. Length of lorica, including pedicle, $\frac{1}{600}$ inch.

Hab. Standing water, with various aquatic plants. Trenton, New Jersey, U. S. A.

EXPLANATION OF PLATE XV.

Fig. 1. *Stylonychia notophora*, × 480.
Fig. 2. *Opisthotricha emarginata*, × 500.
Fig. 3. *Urostyla trichogaster*, × 187.
Fig. 4. *Podophrya brachipoda*, × 480.
Fig. 5. *Solenophrya inclusa*, × 480.
Fig. 6. *Solenophrya pera*, × 420.
Fig. 7. *Acineta urceolata*, × 480.
Fig. 8. *Tillina flavicans*, × 550.
Fig. 9. *Tillina inflata*, × 550.
Fig. 10. *Lacrymaria truncata*, × 280.
Fig. 11. *Anisonema emarginata*, × 1000.
Fig. 12. *Entosiphon ovatus*, × 900.
Fig. 13. *Colpidium truncatum*, × 450.
Fig. 14. *Petalomonas carinata*. Transverse section Diagram.
Fig. 15. *Zygoselmis acus*, × 1350.
Fig. 16. *Heteromita mutabilis*, × 1200.
Fig. 17. *Vorticella octava*, × 600.

XLI.—*Notes on the Infusorial Parasites of the Tasmanian White Ant.* By W. Saville Kent, F.L.S., F.Z.S., Superintendent and Inspector of Fisheries, Tasmania*.

So long since as the year 1856 M. C. Lespés, in a memoir devoted to the organization of the European white ant (*Termes lucifugus*), recorded the fact that the contents of the intestine of this insect are represented by a brown pulp consisting chiefly of a living agglomeration of Infusoria. No specific description of these Infusoria has been published up to the present date, and it is only so recently as the year 1881 that a detailed account, with illustrations, of the analogous parasites of the American white ant (*Termes flavipes*) has been contributed by Dr. Joseph Leidy to the 'Proceedings of the Academy of Natural Sciences of Philadelphia.' Through the kind courtesy of Dr. Leidy I was enabled to include reprints of his drawings of these parasitic animalcules in my monograph of the Infusoria, then in course of publication, and subsequently received from him, while residing in London, a supply of the white ant with its accompanying parasites for personal examination.

It was with much interest that I discovered, soon after my arrival in Tasmania, that a species of white ant (specific name at present undetermined) abounds in this colony, feeding, after the manner of the North-American type, upon decaying timber, and having its intestine similarly laden with parasitic Infusoria. On making a close examination of these Infusoria I ascertained furthermore that they agreed with the American types in being referable to no less than three distinct varieties, two of which may be included in the generic groups instituted for the American species by Dr. Leidy, while the third form is entirely distinct. As species none of the series is precisely identical with any that have hitherto been described, and they have consequently to be recorded as new to science.

The largest and most abundantly developed form to which I will draw attention on this occasion is referable to Dr. Leidy's genus *Trichonympha*. It is an elongate or pyriform animalcule, having normally a smooth, somewhat inflated, posterior region, and an acuminately-pointed, highly flexible, anterior portion, which is more or less distinctly striated in a longitudinal direction. From Dr. Leidy's species *Trichonympha agilis* it differs most distinctly in the relative shortness

* From the 'Papers and Proceedings of the Royal Society of Tasmania' for 1884, pp. 270–273. Read November 17, 1884.

of the hair-like cilia which clothe the entire surface of the body. In the last-named species a portion of these cilia are as long as or longer than the body, and exhibit under certain conditions a remarkable plume-like aspect. In the Tasmanian species, which, by way of compliment to the talented discoverer of the genus, I propose to distinguish by the title of *Trichonympha Leidyi*, the length of the cilia but little exceeds that of many of the Opalinidæ and other previously known endoparasitic Infusoria. It is furthermore not so easy to recognize in the present species that the cilia, with respect to their length, form three or four more or less distinct series, as obtains in the American variety; for while those that clothe the equatorial region of the body are somewhat the longer, the entire series merge into one another by almost imperceptible gradations. In this respect the species here introduced may be said to resemble an immature stage of the American type. The great flexibility of the anterior portion of the body is a feature common to the American and Tasmanian species, both exhibiting in a like manner a tendency to roll this region upon itself in the form of a helix.

An important point that was left undetermined by Dr. Leidy respecting the structure of *Trichonympha* relates to the precise position of the oral aperture. The bodies of the animalcules are almost invariably filled with fragments of the woody débris devoured by their hosts the white ants, which shows that their sustenance is taken into their body in a solid state, and is not simply absorbed in the fluid form, as occurs with the group of the Opalinidæ. A prolonged observation of living examples of the American species remitted me by Dr. Leidy, and likewise of the Tasmanian type here introduced, has resulted in my determining that a distinct oral aperture is developed upon one side of the body at a short distance only from the apical extremity. This orifice takes the form of a transverse slit, and is followed by a narrow œsophageal track, which opens into the capacious digestive cavity that occupies one half or two thirds of the posterior region of the body. The plan recommended by Dr. Leidy for observing the vital phenomena of these animalcules is to empty out the intestine of the white ant containing them into a little white of egg. I also have found this material favourable for their observation, but have gained an additional insight into their life-history by employing in a like manner thinly diluted milk. In this medium they not only live for a considerable time, but meet with abundant nutriment, their pharynx and digestive cavity being frequently found densely packed with its component corpuscles after their immersion in this fluid for a short interval.

As with the American species, *Trichonympha Leidyi* is represented in its earlier and immature conditions by a host of polymorphic forms that differ greatly in aspect from the adults. The youngest observed are of an ovate contour, and clothed throughout with cilia of even length. These young individuals gradually increase in length until their long diameter may equal or even exceed four or five times their greatest breadth, the cilia in the more advanced phases being longest posteriorly, while the surface may be obliquely furrowed in opposite directions. It is in connexion with this transitory condition that I have observed the phenomena of propagation not hitherto recorded. This is effected by a process of transverse fission, division taking place towards the anterior region of the body along two intersecting furrows. The anterior of the two separated moieties assumes a pyriform outline, and grows speedily to the parent shape, while the posterior one retains its primitive attenuate fusiform contour, and may continue to multiply by fission.

When placed in diluted milk the animalcules of both the American and Tasmanian species of *Trichonympha* have been observed by me to assume a fixed condition that has not hitherto been described. An attachment to the surface of organic substances or other convenient fulcra is then accomplished through the medium of the long fascicle of hair-like cilia that are produced from their posterior extremity. These cilia, intersecting one another at a short distance from the body, form a sort of hollow cone, the expanded base of which grasps the selected fulcrum of support after the manner of an acetabulum. This habit of, as it were, anchoring themselves by their long caudal cilia was observed in both the adult and immature animalcules. No trace of the structure common to all higher Infusoria known as the contractile vesicle has been detected in connexion with *Trichonympha agilis*, and in the species now introduced it is, so far as I have been able to ascertain, as conspicuously absent. In this absence of a contractile vesicle *Trichonympha* assimilates itself to many Opalinidæ. While commenting upon the apparent position of *Trichonympha*, with relation to other Infusorial forms ('Manual of Infusoria,' vol. ii. p. 553), it was suggested by me that, with respect to the great length of its cilia and characteristic movements, it to some extent resembled the multiflagellate genus *Hexamita*. Though the more abundant evidence since adduced has sufficed to demonstrate that it belongs essentially to the Holotrichous

Ciliata, the great length of the cilia, the manner in which they are employed, and the habit the animalcules exhibit of anchoring themselves to foreign substances by their long posterior cilia, is suggestive of the remote derivation of these white ant parasites from a flagelliferous type allied to *Hexamita*.

Of the two remaining Infusoria found by me in the Tasmanian white ant the one is apparently referable to Dr. Leidy's genus *Pyrsonympha*, while the other belongs to Stein's multiflagellate genus *Lophomonas*, so far recorded as a parasite only of the Orthopterous insects *Blatta* and *Gryllotalpa*. Several important points in their organization not having yet been clearly ascertained, descriptive details of these two new forms are reserved for a future communication.

XLII.—*On a Variety of the Freshwater Sponge* Meyenia fluviatilis. By H. J. Carter, F.R.S. &c.

On the 17th of December, 1883, I received from Mr. B. W. Thomas, F.R.M.S., of Chicago, a mounted preparation, with specimen in the natural state, of a variety of *Meyenia fluviatilis*, which he had found in the Calumet river near the lake of this name, in the township of Calumet, South Chicago, suggesting, if it were new and undescribed, that it might be designated "*calumetica*." At this time I did not consider the differences were sufficient to constitute a variety that should be named, so, in reply, wrote to Mr. Thomas to this effect.

Subsequently, however, I had occasion to examine some preparations of *Meyenia fluviatilis* from various localities near London, which my friend Mr. J. G. Waller had kindly sent me, and amongst them noticed one labelled "Ditchley's" which not only differed from the rest, but presented the same varietal peculiarities as the Calumet specimen; hence I began to attach more importance to Mr. Thomas's suggestion than I had hitherto done. Meanwhile I received another specimen labelled "Ditchley's—England," from Mr. H. Mills, of Buffalo, N. Y., in which there were a number of immature statoblasts together with the spiculation of the Calumet variety; and having, in reply, stated that it was the same sponge as that which Mr. Thomas had proposed to designate "*calumetica*," I learned from Mr. Thomas afterwards that Mr. Mills had sent my letter on to him; that he was glad that I recognized his variety; that Mr. Mills's specimen which had come from England came from himself; and that he would be very glad, not knowing much about sponges, if I would publish a description of it.

It then struck me that the label "Ditchley's" being on both Mr. Waller's and Mr. Mills's preparations, there must be some connexion between the two, so I immediately (that is on the 28th March last) communicated the facts to Mr. Waller, who, in reply, not only pointed out the way in which the "Ditchley's" specimen got to America, but very kindly sent me a specimen of it in the natural but dried state, which, by the presence of the immature statoblasts &c., exactly corresponded with Mr. Mills's preparation. To this specimen Mr. Waller added the following statement, viz.:—that the sponge, growing around the stems of an aquatic plant, had been obtained from a large pond at "Ditchley's Manor," South Weald, near Brentwood, in the county of Essex, and had been noticed by him as a variety, in a paper entitled "Variation in *Spongilla fluviatilis*," published in the 'Proceedings of the Quekett Microscopical Club, vol. v. 1878.

As Mr. Thomas's specimen of this sponge from the Calumet river is very small in quantity, I must describe it chiefly from what Mr. Waller has kindly sent me, thus:—

Meyenia fluviatilis, var. *angustibirotulata.*

Coating the stems of aquatic plants to the extent of one sixth of an inch in thickness all round. Consistence elastic, fragile. Colour light yellow-brown. Skeletal spicule smooth, curved, fusiform, gradually sharp-pointed, varying in size under 75 by 3-6000ths in. in its greatest dimensions.

Statoblast globular, even on the surface, and white in colour when fully developed, infundibularly depressed over the hilous opening of the chitinous coat; about 85-6000ths in. in diameter; consisting of the usual germinal contents, surrounded by a layer of birotules in juxtaposition, arranged perpendicularly over the chitinous coat, and filled in between with a microcell-structure up to the umbos of the birotules, which, being naked and allowing the light to pass through them, present a dark point respectively like minute holes in the midst of the white microcell-substance; birotule consisting of a cylindrical shaft, more or less constricted in the middle, which is sometimes furnished with one or more spines; rotule fringed towards the margin rather than denticulated, so as to present a striated appearance, which does not reach the umbo or centre; total length of birotule about 6-6000ths in.

Loc. England and America.

Obs. Described in the *dry* state. The Calumet specimen is remarkable for presenting the birotulate spicules in all stages of development *loose* in the tissue of the sponge, where it may be seen that the shaft is the first part to be formed, commencing in two minute elongated portions, constricted yet connected by a delicate thread in the centre, and thus strongly foreshadowing the characteristic hourglass form of the fully-developed spicule; while, on the otherh and, the "Ditchley's" specimen presents the *whole* statoblast in all stages of development, from a minute and shrunken, shapeless dried bit of yellowish sarcode, to the fully developed form of this reproductive body. When first recognizable, in its present dried state, as a reproductive organ, it presents an ovoid or globular form of a yellow colour, about half the size of the matured object, composed of a toughish yellow transparent capsule, filled with globules or cells of a refractive matter, which can be plainly seen through this envelope; globules or cells varying in diameter under 5-6000ths in., consisting of a semifluid refractive substance, which, although evidently undergoing subdivision in the larger portions, is sufficiently consistent to retain its globularity when forced out into the water by rupture of the capsule; so arranged as to fill up the latter except at one point in the end, which presents a minute, circular, transparent area, the future hilous opening of the chitinous coat (?). After this the capsule becomes transformed into the shape of the fully-developed statoblast, but still retaining its yellow colour, and now covered by the layer of birotules *alone*, with their inner rotules resting on the capsule, now also seen to be the chitinous coat; to which is then added the white microcell-structure which fills up the space between the birotules, and thus completes the formation of this reproductive body.

The only variety of *Meyenia fluviatilis* that can be confounded with it is that of Bombay, on account of the greater length of the birotules, which bear the proportion of six in the former to seven in the latter; but here the shaft is equal in thickness throughout and the rotules denticulated to the umbo or centre, rather than fringed or striated towards the circumference only, much as represented in my original description of 1849 ('Annals,' vol. iv. pl. iii. fig. 6, *d*); not like that given by Dr. Bowerbank in 1863 (Proc. Zool. Soc. pl. xxxviii. fig. 4), which must have been taken from an *accidental* form, and therefore is misleading. On the other hand, the *skeletal* spicule in the Bombay variety may be spiniferous as well as smooth; while I have never seen any spiniferous ones in the Calumet variety.

In general the European and American specimens of *Meyenia fluviatilis* have very short birotules, and although the shaft expands into the rotule on either side, still, from want of length, it does not present the hourglass shape of the Calumet variety, which, and the *smooth* skeletal spicule, constitute the chief distinguishing features of the latter.

XLIII.—*New Species of* Histeridæ, *with Synonymical Notes.* By George Lewis, F.L.S.

The part of the 'Munich Catalogue' containing the Histeridæ was issued in 1868, and gave 1151 species; and in 1884 Herr Joh. Schmidt published a supplementary list of 334 species in the 'Berliner ent. Zeitschrift.' Synonymists have corrected our records from time to time, but not to the extent of materially reducing the total of 1485 species; and lately I have carefully examined the types of the species in the national collection, and the results I have obtained, which relate chiefly to synonymy, are given in this paper.

The family has not attracted the attention of many entomologists, although the monograph of De Marseul, to which too high praise cannot be given, is an excellent introduction to the study of the group, and the clear and well-defined exo-skeleton presented to the student in all the genera offers characters easily tabulated or retained in the memory. Some of the neglect at home doubtless rests on the collectors abroad, who rarely send to Europe even the most abundant species; and yet many of the most curious species may be easily obtained by searching under loosened bark.

In the United States the species have been studied as members of a "limited fauna," and it is difficult at once by the aid of the descriptive literature alone to arrange all the American species in their right order in a general catalogue, as the descriptions do not refer to the allied species existing elsewhere. But I hope before long to compile a systematic catalogue, to replace those in alphabetical order now in use. One of the results of limiting the study to local forms in America is manifested by curious irregularities in the estimated value of genera on the part of students and authors. Dr. Horn lowers *Phelister* and *Platysoma* to subgenera, and gives full generic value to others, as *Echinodes* and *Teretriosoma*. In

Teretriosoma the chief generic character is the double pygidium, and *virens*, *chalybœum*, *facetum*, *festivum*, are species which clearly belong to it; but *Teretrius somerseti* is an insect that comes between Horn's genus and a typical *Teretrius*, and if Horn had known *T. somerseti* he could not, on the principles he has laid down, have given higher, if as high, rank to *Teretriosoma* than he accords to *Phelister* in his synopsis of 1873.

I am willing to recognize *Teretriosoma*, but while doing so I think it consistent to accept also such genera as *Pachylopus*, considered synonymous with *Saprinus* by Horn, especially as by accepting it the genus *Saprinus* is somewhat reduced; and this last genus even now, when collections contain many novelties, comprises 330 species.

I have a collection containing over 1000 species of Histeridæ, and this enables me to give comparative notes of the differences between most of the new species and old ones, and these memoranda are to my mind, in a group like the present, the more valuable part of a description.

List of Species, arranged generically.

Hololepta pilipes.
—— flagellata, *Kirby*.
Placodes ebeninus.
Apobletes esurialis.
—— cavatus.
Platysoma novum.
—— Robestorfi.
—— planisternum.
—— restoratum, *Walker*.
—— desinens, *Walker*.
—— abyssinicum.
—— cinnamomeum, *White*.
—— elingue.
—— dufali, *Marseul*.
—— directum.
Pachycræerus nigro-cæruleus.
Baconia loricata.
—— patula.
Hister mundissimus, *Walker*.
—— luciscus.
—— somali.
—— decollatus, *Roth*.
—— glabratus, *Roth*.
—— regularis, *Leconte*.
—— metallicus.
—— castus.
Hister femoralis, *Motsch*.
—— castaneus.
—— pusio, *Erichson*.
—— præcox, *Erichson*.
Paromalus locellus.
—— oblisus.
—— commeatus.
Cœlocræra nitida.
Renia meticulosa.
Dendrophilus sulcatus, *Motsch*.
—— finitimus, *Walker*.
Saprinus æqualis, *Walker*.
—— rubripes, *Walker*.
Styphrus corpulentus, *Motsch*.
Xenonychus altus.
Pachylopus ripæ.
Tryponæus torpedo.
—— bombacis.
—— veda.
Teretrius æstivus.
—— pulex, *Fairm*.
Homalopygus commensalis.
Teratosoma longipes.
Chlamydopsis inquilina.
Onthophilus foveipennis.
—— hova.

Hololepta pilipes, n. sp.

Ovato-lata, depressa, nigra, nitida; fronte plana subconvexa; pronoto lateribus punctulato et ante basin inæqualiter impresso, stria marginali valida antice late interrupta; elytris, margine inflexo, lævi, striis 1 et 3 brevissimis, 2 integra; propygidio punctis sparsis cincto, utrinque bifoveolato; pygidio dense et fortiter punctato; tarsis subtus (anticis exceptis) rufo-pilosis. L. 9 mill., lat. 6.

Broadly ovate, depressed; forehead smooth and very slightly concave between the eyes; tubercle in front of each eye prominent, with a cluster of large punctures behind them. Mandibles simple. Thorax widest in the middle, with a large irregular impression before base on each side; lateral stria well defined, interrupted behind the head; a fine line in front of the scutellum reaches nearly to the middle; base bisinuate before the scutellum. Elytra with deep inflexed margin, first and third stria very short, second complete. Propygidium with scattered punctures at sides, with four shallow foveæ, two at the apex and two above them nearer the lateral margin; there is also a faint smooth median line. Pygidium very densely and strongly punctured. Prosternum broad, widening out to the base, and without a margin; mesosternum slightly sinuate, the sinuosity being as broad as the base of the prosternum; tibiæ bidentate at apex, with a large tooth above; tarsi very short, middle and hind pairs pilose beneath.

Hab. Borneo (*Wallace*).

There is no other known species of *Hololepta* to which this can be compared; the shape of the thorax and pilose tarsi are very remarkable.

The type of *Hololepta flagellata*, Kirby, in the Museum is an example of *Lioderma 4-dentatum*, F. The locality given by Kirby is doubtless an error.

Placodes ebeninus, n. sp.

Oblongo-ovatus, convexiusculus, niger, nitidus; fronte stria integra antice biarcuata; pronoto lævi stria interna laterali valide impressa obliqua, interstitio ante medium multo latiore; elytris striis punctiformibus, 1–3 integris, 4 basi abbreviata, 5 obsoleta; pygidio grosse punctato. L. $12\frac{1}{2}$ mill.

Hab. Zanzibar (*Raffray*).

This species is intermediate between *caffer* and *senegalensis*, and possesses some of the characters of each. The frontal stria is more distinctly biarcuate than in *caffer*, the species it most resembles in size and outline. The thorax is a little more transverse than in *senegalensis* and less so than in *caffer*, and the thoracic line behind the eye is angulated more distinctly than in either. The interstice between the margin and the lateral stria widens out before the middle, and at its widest part is double the width of that in *senegalensis*. The striæ of the elytra resemble those of *caffer* in their disposition; but they are even more punctiform than in *senegalensis*.

Apobletes esurialis, n. sp.

Oblongus parallelus, depressus, planatus, rufo-brunneus, nitidus; fronte transversa tenuissime punctulata, stria inter oculos recta, leviter impressa: pronoto lævi, marginato, stria pone oculos interrupta; elytris striis dorsalibus 1–2 integris, 3 interrupta; propygidio tenuissime punctulato; pygidio æqualiter sat dense punetato; prosterno plano, lato, basi sinuato, lateribus arcuatis; mesosterno bisinuatim inciso, basi emarginato; tibiis, mediis 4-denticulatis, posticis apice spinosis. L. $3\frac{1}{4}$ mill.

Hab. New Guinea.

The flat and parallel form, colour, and general sculpture will distinguish this species from others in the list. I had the opportunity to compare it with those in Marseul's collection in January 1884; it is rather larger than *mysolicus*; the middle tibiæ are armed with four teeth, the posterior pair are smooth at the sides.

Apobletes cavatus, n. sp.

A. foveipygo proxime affinis, sed multo latior: brunneus, nitidus; elytris striis 1–3 integris, 4 apicali, cæteris nullis. L. $2\frac{3}{4}$ mill.

Hab. Java (*Raffray*).

This species is allied to *diopsipygus* and *foveipygus*, and has similar fossettes in a smooth pygidium. It is broader than these species, and may be separated from them by its three complete and one short apical striæ. Beneath the prosternum and mesosternum are broader, and the sinuosity of the latter is wider in proportion than in *diopsipygus*, and in this respect agrees best with *foveipygus*.

Platysoma novum, n. sp.

Oblongo-ovatum, subdepressum, nigrum, nitidum; fronte concava dense ocellato-punctata et minute punctulata, stria antice subinterrupta, clypeo dense strigoso-punctato vel rugoso; pronoto lateribus grosse et late punctato, stria integra sed antice punctiformi, ante scutellum foveolato; elytris striis 1–3 integris, 4 valde abbreviata, 5 obsoleta; mesosterno stria marginali integra; pygidio grosse ocellato-punctato, basi utrinque foveolato. L. 6 mill.

Hab. Malabar.

This insect may be placed in the first division of the genus, although the sculpture of the head and clypeus and the thoracic punctures do not allow a comparison with any of the described species. The frontal punctures apparently stamp out and obliterate the frontal stria.

Platysoma Robestorfi, n. sp.

Oblongum, subparallelum, nigro-piceum, nitidum; fronte concava, stria integra; elytris striis 3 primis dorsalibus integris, 4–5 dimidiatis, suturali ultra medium abbreviata; pygidio margine elevato, æqualiter punctato. L. $3\frac{1}{2}$ mill.

Hab. Andaman Islands.

This species is closely allied to *P. striale* from Celebes; it is, however, smaller, with head less transverse, the fourth and fifth striæ run to the middle of the elytra, and the margin of the pygidium is less elevated. It is named after our late Resident at Port Blow, by whom it was taken abundantly on several occasions.

Platysoma planisternum, n. sp.

Oblongo-ovatum, complanatum, piceum, nitidum; antennis pedibusque rufis; fronte leviter concava, subtiliter punctulata; stria transversa tenuiter impressa, recta; pronoto stria antice late interrupta; elytris striis 1–2 integris, validis, 3 in medio interrupta; propygidio parce punctato; pygidio ocellato-punctato, margine æqualiter elevato. L. $5\frac{1}{2}$ mill.

Hab. Mysol (*Wallace*).

The species composing the genus *Apobletes* are, as Marseul admits, somewhat heterogeneous; and I believe the present insect may be an *Apobletes*. The prosternum is flat, slightly rounded at the base, without sculpture, widely (not deeply) sinuate between the coxæ. The mesosternum is broad and transverse at the apex, widely and slightly sinuate. Superficially it is hardly perceptible that the meso- and metasternum are not of one piece; the latter has, however, a lateral marginal stria, which terminates where the suture is beneath the surface chitin.

Platysoma Dohrnii, Mars. 1864=*quinquestriatum*, Motsch. 1863=*restoratum*, Walker, 1858. I have determined that

Dohrnii=*restoratum* by seeing the type of the latter in the British Museum; and an example of *quinquestriatum* which I possess from the collection of the late Mr. Andrew Murray, apparently received by him from Motschulsky, is a small individual referable also to *Dohrnii*.

Platysoma Motschulskyi, Mars. 1864=*ceylonicum*, Motsch. 1863=*desinens*, Walker, 1858. Synonymy determined by comparison, as in preceding species.

Platysoma abyssinicum, n. sp.

Ovatum, subdepressum, nigro-piceum; antennis pedibusque piceo-brunneis; fronte concava punctata, stria integra; pronoto transverso, lateribus grosse punctato in medio punctulato, marginato, stria pone oculos subangulata; elytris apice parce punctatis, striis 1–3 integris, 4–5 antice abbreviatis, 6 dimidiata; propygidio pygidioque grosse punctatis primo ad hoc subfoveolato; prosterno sparse punctulato; mesosterno sinuato marginatoque. L. $3\frac{1}{2}$ mill.

Hab. Abyssinia (*Raffray*).

This belongs to the same group as *sculptum* and *capense*, but its general outline, more depressed form, and the fourth and fifth elytral striæ of nearly equal length, will separate it. In its upper surface it has the general appearance of *Pachycrœrus arabicus*.

Hister cinnamomeus, White, from New Zealand is an immature *Platysoma*. Type in the Museum.

Platysoma elingue, n. sp.

Ovatum, subdepressum, piceum, nitidum; fronte subtilissime punctulata, stria valida transversa integra; pronoto impunctato, stria completa; elytris striis validis, 1–3 integris, 4 ante, 5 ultra medium abbreviatis; propygidio pygidioque grosse punctatis. L. $3\frac{1}{4}$ mill.

Hab. Hadley Estate, Dikoya, Ceylon. December 1881.

In general facies this species agrees with *carolinum*; it differs in having but five dorsal striæ, 1–3 complete, as in *carolinum*, 4 apical and occupying one third of the elytra, 5 much longer and equidistant from the fourth and suture. The forehead and clypeus are not concave, and beneath the insect is more convex than *carolinum*, the prosternum less wide, and the apex of the mesosternum less transverse. Marseul considers *semistriatum*, Motsch.=*birmanum*, and in this case Motschulsky was very wrong in comparing the first to *carolinum*.

Platysoma dufali, Mars.—I obtained a few examples of this at Galle in November 1881, and record its occurrence in Ceylon for the first time.

Platysoma directum.

Cylindricum, nigrum, nitidum, antennis pedibusque rufis, fronte parum concava, punctulata; pronoto punctato, stria laterali integra antice interrupta, pone oculos angulata, ante scutellum foveolato; elytris striis 1–4 integris, 5–6 dimidiatis; mesosterno late sinuato, stria integra; propygidio pygidioque parce et grosse punctatis. L. $4\frac{1}{4}$ mill.

Hab. Para.

The facies and sculpture of this species are close to those of *coarctatum*, but it is as large again; the forehead and clypeus more deeply excavated; the transverse line of thorax interrupted; the punctures throughout are much larger and the apical sinuosity of the mesosternum relatively wider.

Pachycrœrus nigro-cœruleus, n. sp.

Oblongus, cylindricus, nigro-cæruleus, nitidus, punctulatus; fronte stria integra, pronoto undique punctulato; elytrorum striis 1–4 dorsalibus integris, 5 dimidiata, 6 ante basin abbreviata; propygidio pygidioque dense punctulatis. L. 3 mill.

Hab. Abyssinia (*Raffray*).

In form and sculpture this species is closely allied to *Raffrayi*. The differences are in size (3 millim. instead of 6) and the colour; the 5th stria only reaches the middle of the elytron and the 6th does not attain to the base.

BACONIA, n. gen.

Corpus depressum. Caput retractile, parvum; mandibulis parvibus et æqualibus; fronte subexcavata, stria circulari. Antennæ sub frontis margine insertæ, clava ovali. Pronotum transversum latum, marginatum, elytris 3- vel 4-striatis. Prosternum parum angustatum, bistriatum, basi emarginatum, lobo antico transverso et latissimo. Mesosternum latissimum antice rectum. Tibiæ extus unidentatæ vel inermes.

The antenna has articles 3 to 8 nearly equal, the second is as long again as the third, and the club is composed of three articles equal in size.

The name of this genus, which may be placed before *Phelister*, will associate it with the name of the Elizabethan philosopher.

Baconia loricata, n. sp.

Ovata, depressa, nigra, nitida, supra cærulea; fronte punctata stria circulari; pronoto lateribus parce et tenue punctato, ante medium impresso, stria marginali integra; elytris apice punctatis, striis tenuibus, 1–4 integris, cæteris nullis; mesosterno stria antice interrupta; propygidio parce punctato, pygidio sat dense punctato utrinque subimpresso; tibiis anticis tridentatis et cæteris unispinosulis. L. 6 mill., lat. $4\frac{1}{4}$.

The surface-sculpture of this fine species in some respects agrees with *Phelister violaceus*, and both are from the same country. Amongst the flat Histeridæ it is remarkable for its great breadth.

Hab. Blumenau, Brazil.

Baconia patula, n. sp.

Ovata, depressa, nigro-picea, nitidissima; fronte tenuissime punctulata, stria antice interrupta; pronoto punctis in lateribus aliquot sparsis, angulis antice rufis; elytris apice sparso punctatis, striis 1–2 integris, 3 dimidiata; propygidio pygidioque punctatis; mesosterno stria antice integra; tibiis postice non-denticulatis. L. 3 mill., lat. 2.

This species, when compared with *loricata*, has several characters that are observed also between *Macrosternus Marseuli* and *Lafertei* when compared together. The blue colour is lost in both the smaller species and the surface-sculpture is less obvious. In *Baconia* the great dilatation of the thorax is owing to the widening out of the thoracic margin, and not to the extensive growth of the prosternum, as in *Macrosternus*; but the plate of the mesosternum is much wider in *Baconia* than in Marseul's genus. The widest part of this insect and the last is just below the humeral angle.

Hab. Blumenau, Brazil.

Hister mundissimus, Walker, 1859=*scævola*, Er. 1834. This I have determined by the examination of the type in the national collection. Walker begins his description of his species by comparing it to *scævola* and *chinensis*.

Hister luciscus, n. sp.

Ovatus, subconvexus, niger, subnitidus; fronte stria antice recta; pronoto stria interna integra; elytris striis 1–3 dorsalibus integris, 4 brevissima punctiformi, suturali arcuata abbreviata; propygidio pygidioque punctulatis. L. 9 mill.

Hab. Birmah (*ex coll. Monchicourt*).

This insect is closely allied to *Baconi*, but it differs as follows:—It is smaller, with the inner thoracic stria complete and without a fovea, the fourth elytral stria short and formed only of punctures, and the sixth faint and visible only before the apex. I compared this with the type of *Baconi* in Marseul's collection when last in Paris.

Hister somali, n. sp.

Oblongo-ovatus, depressus, niger, nitidus; antennis pedibusque brunneis; fronte subtiliter punctulata, stria integra antice recta; pronoto subtilissme punctulato, stria interna integra, pone oculos angulata, externa brevi arcuata; elytris striis 1–4 validis integris, 5–6 dimidiatis, evidenter punctatis; propygidio sparse punctulato; pygidio lævi; prosterno basi subimpresso, punctato, mesosterno antice rotundato emarginato stria integra; tibiis anticis tridentatis, posticis biseriatim multispinosis. L. $3\frac{1}{2}$ mill.

Hab. Somali Land.

The system of surface-sculpture here places the species in the *abyssinicus* group. The diminutive size, more depressed form, non-sinuate mesosternum, and smooth pygidium are its most distinctive characters.

Hister decollatus and *glabratus*, Roth, are allied to *abyssinicus* and *subsulcatus*, but cannot be identified by the descriptions published in 1851.

Hister regularis, Leconte, also is of the same section, and the name would probably prove to be a synonym could the type be examined. The locality given by Leconte is "Africa," and species of the *abyssinicus* group occur on both the east and west coasts.

Hister metallicus, n. sp.

Oblongus, convexus, æneus, nitidus; fronte subbifoveolata, stria integra, antice elevata, subtiliter punctulata; pronoto lævi, stria interna integra, externa vix abbreviata; elytris striis 1–3 integris, et cæteris obsoletis; propygidio (utrinque bifoveolato) pygidioque grosse punctatis, in medio lævibus, prosterno basi depresso, mesosterno stria integra. L. 8 mill.

Hab. India; two examples in the British Museum, and one in my own collection.

This species must be placed next to *punctulatus*, and it is a very remarkable species on account of its colour. It differs chiefly from *punctulatus* in the absence of punctures on the head, thorax, and elytra, and in the forehead being more transverse.

Hister castus, n. sp.

Ovalis, convexiusculus, niger, nitidus; antennis pedibusque rufis; fronte punctulata, stria circulari; pronoto stria laterali interna haud interrupta, externa basi vix abbreviata; elytris rubris macula communi angulata nigra, striis 1–6 integris, 5–6 arcuatim junctis; propygidio pygidioque grosse punctatis; prosterno undique strigoso, lobo parce et grosse punctato; mesosterno arcuato, marginato; tibiis anticis tridentatis, posticis biseriatim spinosis. L. 3 mill.

Hab. El Hahaz (*Millingen*).

This species comes near to *kurdistanus*, from which it is known by its size and colour, by the simple punctuation of the pygidium and non-sinuate mesosternum. In *kurdistanus*, of which Dr. Millingen also found examples, the pygidium has large ocellated punctures. The strigose sculpture of the prosternum requires a high power to reveal it.

Hister femoralis, Motsch. 1863 = *cœlestis*, Mars. 1857. In a long series I took in Ceylon some of the examples have an anterior transverse line on the thorax, in others it is nearly obliterated, and in most absent; the last of these varieties agrees with the type of *cœlestis*.

Hister castaneus, n. sp.

Ovalis, subconvexus, castaneus, nitidus; fronte plana, subtilissime punctulata, stria antice recta, ad oculos terminata; pronoto stria interna integra, externa vix abbreviata, ante scutellum subfoveolato; elytris striis 1–4 validis crenatis integris, 5 et suturali abbreviatis; propygidio parce punctulato basi subbifoveolato; pygidio punctulato utrinque subfoveolato; prosterno subtiliter punctato stria integra; mesosterno in medio sinuato, stria valida; tibiis anticis fortiter bidentatis, posticis biseriatim, longius multispinosis. L. $4\frac{1}{2}$ ad 5 mill.

Hab. Chontales (*Belt*).

This is a peculiar species as regards colour; the anterior angles of the thorax are very prominent, and the raised margin is continued round them, joining the internal stria behind the eyes, at which point the stria is slightly deflexed. The lobe of the prosternum is large and directed downwards. In one of my examples the foveæ in the pygidium are more distinct than in the other, and there is a third fovea at the apex. The fore tibiæ are somewhat dilated and have very prominent denticulations.

The species described by Erichson as *Hister præcox* and *pusio* from Peru seem to me to be placed by him in a wrong genus.

Paromalus locellus, n. sp.

Ovalis, parum convexus, niger, nitidus, sat dense punctulatus. Antennis pedibusque brunneis, fronte stria ad oculos completa; pronoto stria integra; elytris striis prope obsoletis; prosterno basi parum lato, stria marginali antice et postice interrupta; mesosterno antico emarginato, stria transversa biangulata; propygidio pygidioque subtiliter punctulatis. L. $3\frac{1}{2}$ mill.

Hab. Sarawak (*Wallace*).

The oval form distinguishes this species from the two next, but all belong to a section of the genus which has the metasternum broadly depressed in the middle of the basal half, and which has the first segment of the abdomen with an acutely raised line or linear tubercle, which divides a depression similar to that of the metasternum though wider. The mesosternum has the transverse line much like that in *oblisus*.

Paromalus oblisus, n. sp.

Subellipticus, niger, nitidus, sat dense punctulatus; antennis pedibusque brunneis; fronte marginata, pronoto stria marginali integra; elytris striis subhumeralibus obsoletis; prosterno basi parum lato, stria marginali antice et postice interrupta; mesosterno stria transversa biangulata; propygidio pygidioque subtiliter punctulatis. L. $3\frac{1}{4}$ mill.

Hab. Andaman Islands.

The elliptical form of this species distinguishes it from *locellus*, and beneath the punctuation is much finer and the prosternum is narrower and round at the base. Both species have the facies of the European *complanatus*, but are larger. The mesosternum is limited at its base by a transverse line acutely angulate on either side.

Paromalus commeatus, n. sp.

Oblongo-ovalis, parum convexus, punctulatus, pedibus antennisque brunneis, clava rufa; fronte subtilissime punctulata, stria marginali antice angulata, pone oculos interrupta; pronoto stria integra, antice ad angulum subfoveolato; elytris vix dense punctulatis; propygidio pygidioque subtilissime punctulatis; prosterno lateribus striatis, basi submarginata; mesosterno stria interrupta, dense punctato, metasterno in medio depresso. L. $3\frac{1}{2}$ mill.

Hab. Kandy and Balangoda, Ceylon.

This species is even more like *complanatus* than the two preceding, because of its outline, but it is less depressed. It has, like *oblisus* and *locellus*, the peculiar raised line in the middle of the first abdominal segment, and the mesosternum has the transverse line less acutely angulated than in the Andaman species.

Cœlocræra nitida, n. sp.

Nigra, nitida; antennis pedibusque fuscis; fronte punctulata, stria semicirculari, valida; pronoto circum late punctato, ante scutellum transversim impresso; elytris subtilissime punctulatis, striis validis 1–4 et suturali integris, 2 posterioribus basi arcuatim junctis, 5 in medio abbreviata; propygidio grosse et minute punctato; prosterno lobo grosse punctato, bistriato, basi inciso; mesosterno antice subacuminato et subbisinuato. L. $3\frac{1}{2}$ mill.

Hab. Abyssinia and Zanzibar.

This insect, although differing so much above in surface-sculpture from *C. costifera*, doubtless belongs to the same genus. Beneath the apex of the mesosternum is less acuminate than in *costifera*, on which species alone the genus has hitherto stood, and it is also slightly bisinuate; but in other respects the under surface agrees with the species named. There is no fovea on the forehead in *nitida*.

RENIA, n. gen.

Orbicularis, subconvexa, brunnea, nitida. Caput retractum; fronte et clypeo modice latis, stria carinata basi obsoleta; mandibulis robustis. Antennæ brevissimæ, sub frontis margine insertæ; clava articulo unico cylindrico et cæteris sensim incrassatis. Prosternum lobo antico lato, marginato, basi inciso; mesosternum profunde bisinuatum, marginatum. Pronotum latum, stria unica tenuissime marginali. Propygidium hexagonum parum convexum; pygidium dejectum inferius semiovale. Femora et tibiæ valde dilatata.

The lobe of the mesosternum overlaps the prosternum, which is cut out to receive it.

Renia meticulosa, n. sp.

Orbicularis, subconvexa, piceo-brunnea, fronte stria antice integra; pronoto subtilissime punctulato, cum linea utrinque basi elevata, intus curvata; elytris marginibus angustis elevatis, striis 1–4 tenuissimis elevatis, basi incurvatis, suturali tuberculiformi; prosterno lobo strigoso in medio utrinque bistriato; mesosterno antico arcuatim striato subtilissime et parce punctato; pygidio parce punctulato, apice rugoso. L. $4\frac{1}{2}$ mill.

Hab. Parana.

This genus may be placed near *Eretmotus*; the species is one of the most curious in the family.

Dendrophilus sulcatus, Motsch.

I am indebted to Mr. G. C. Champion for examples of this species, which has been found in Besika Bay in a rotten tree, in company with the rare *Hister Ariasi*. It is very closely allied to *punctatus*, but is smaller, less oblong, more coarsely and more thickly punctured, and all the dorsal striæ are more deeply impressed. The fifth and sutural striæ are always well defined, and in one example I have they are as deep as the others. Beneath, the plate of the abdominal segment joining the metasternum is more quadrate and the apex of the mesosternum is distinctly less sinuate. It is very different from *Xavieri*, of which, from description, Marseul thought it might be a variety.

Dendrodipnis grandis, Reitter, has been recorded in error by Herr Schmidt as a *Dendrophilus*.

Dendrophilus finitimus, Walker (Ann. & Mag. Nat. Hist. 1859, p. 53), is a species of *Carcinops* with large dorsal punctures.

Saprinus rubripes, Walker, 1871 (nec Erichson, 1834), and *æqualis*, Walker, cannot be made out by the descriptions. I notice them here because Herr Joh. Schmidt includes them in his carefully compiled list of 1884.

The descriptions read as follows:—

Saprinus æqualis.—Black, extremely thickly and minutely punctured. Prothorax with a smooth and shining disk. Each elytron with five oblique and abbreviated striæ; space towards the suture smooth, shining. Legs slightly fringed with gilded bristles. Length of body 3 lines.

Saprinus rubripes.—Black, shining, very thickly and minutely punctured. Antennæ and legs deep red. Each elytron with five slightly oblique striæ, which do not extend beyond half the length from the base; a small smooth space adjoining the fore part of each suture. Length of the body $1\frac{3}{4}$ line.

Motschulsky's genus *Styphrus* has been admitted into Herr Schmidt's list; but Harold did right in refusing to recognize it in the Munich Catalogue. The generic character is simply "*Styphrus corpulentus*, M., Ce genre de Histérides est remarquable par son corps convexe;" and the species is characterized as "Le *St. corpulentus* est noir et bordé d'un poil roussâtre. Il est de la taille du *Saprinus nitidulus*, auquel il ressemble, et provient de Tourcomenie."

Xenonychus altus, n. sp.

Ovatus, brevis, perconvexus, brunneus, subnitidus; fronte lævi inter oculos angulatim striata; pronoto undique transversim vermiculato-striato, lateribus marginato; elytris rugoso-punctatis, striis 1–2 dorsalibus et suturali integris, 3 abbreviata, 1 et 2 basi cum suturali junctis; propygidio pygidioque parum dense strigosis; tibiis anticis latis fortiter bidentatis, posticis dilatis et multispinosis. L. $3\frac{1}{2}$ mill.

Hab. Egypt.

I am indebted to Dr. Sharp for this Histerid, which is allied to *fossor*, but is a far more extraordinary insect; its great convexity gives it a dorsal outline suggestive of *Pulex irritans.* The convexity of the abdominal region is twice as great as that of the dorsal area, which is covered by the elytra. The peculiar sculpture of the thorax, which is clothed at the anterior angle with griseous hairs, although incipiently apparent in *fossor*, is at present unique amongst the Histeridæ.

Xenonychus was misplaced in the Munich Catalogue; the right position for it is between *Saprinus* and *Pachylopus.* I think, as I have said at the beginning of this paper, that *Pachylopus* is worthy of generic rank, and may be known at once from *Saprinus* by the "tibiæ posticæ tumidæ extus dense strigillatæ." It is a genus at present confined to the Cape of Good Hope and the sandy coasts of the Pacific; but the African species is distinct from all the others by a remarkable sexual character displayed in the prolongation of the apices of the elytra in one of the sexes; whether in the male or female is not yet recorded.

Pachylopus ripæ, n. sp.

Niger, nitidus; antennis pedibusque rufo-brunneis; fronte stria transversa recta; pronoto lævi, basi sparse punctato, stria integra; elytris impunctatis, striis validis 1–2 obliquis ante medium abbreviatis, 3 plus quam dimidiata, 4 brevissima vel obsoleta, propygidio punctulato, pygidio lævi. L. $2\frac{1}{2}$ ad $2\frac{3}{4}$ mill.

Hab. Enoshima and Hakodate, in Japan.

This species is about the size of *Saprinus lucidulus*, and is remarkable for the smoothness of its upper surface. Some examples are unicolorous, others have a red band across the middle of the elytra, wide at the outer margin, and gradually lessening towards the suture.

Tryponæus torpedo, n. sp.

T. thoracico proxime affinis. ♀. Ater, nitidus, latus, robustus; fronte leviter excavata, rostro apice obtuso bilobo, pronoto pone oculos subfoveolato; tibiis fortiter denticulatis. L. $11\frac{1}{2}$ mill.

Hab. Chontales.

This species is the largest *Tryponæus* yet discovered; it is very near *thoracicus*, but is in every way more robust. The spine or prolongation of the pygidium, viewed sideways, appears slightly raised, not depressed as in *thoracicus*; the apex of the rostrum is broader, and the tibiæ are armed with stronger and more robust teeth. All the plates of the substructure are also much broader.

I have two examples, both females, taken by Mr. Belt.

Tryponæus bombacis, n. sp.

Cylindricus, niger, nitidus; fronte excavata punctata, inter oculos tenuissime strigoso, rostro apice bituberculato; pronoto dense et grosse punctato, lateribus marginato; elytris parce punctatis; propygidio pygidioque dense punctatis, prosterno parallelo marginato. L. $2\frac{1}{2}$ mill.

Hab. Ceylon.

I took two examples of this species, one at Peradeniya on a *Ficus*, the other at Kitulgal on a *Bombax*; both are, I believe, females. This and the following, like the two Japanese species, fall into *Tryponæus* rather than *Trypeticus*. All four have certain characters in common, and probably represent a section of the genus peculiar to Eastern Asia.

Tryponæus veda, n. sp.

Cylindricus, niger, nitidus; antennis pedibusque rufo-piceis, pronoto stria laterali integra parum dense punctato; elytris sat parce punctatis; propygidio pygidioque dense punctatis. L. $3\frac{1}{4}$ mill.

♂. Fronte leviter impressa lateribus basique margine elevatis, rostro apice obtuso reflexo, pronoto antice retuso, opaco; pygidio obtuso.

♀. Fronte fortiter impressa, apice subbituberculato.

Hab. Dikoya, Ceylon.

The prosternum is quadrate in front, sinuate at the base, and punctured, with a broad, rather deep and wide sulcus on each side, reaching from the base to three fourths of its length. The mesosternum is obtuse, arcuate at the sides, and the broader part has a similar sulcus to the prosternum.

I saw plenty of this species in a stump of iron-wood, with a *Platypus*, which has the apices of the elytra bifurcate, but only succeeded in securing two, which are fortunately one of each sex.

Teretrius æstivus, n. sp.

Cylindricus, subelongatus, niger, nitidus, undique sat dense punctulatus; fronte convexa, stria laterali supra oculos, pronoto stria marginali integra, interstitio lato; prosterno basi profunde inciso, striis subparallelis; mesosterno in medio acuminato marginato, stria transversa terminato: metasterno punctato, linea in medio; pygidio tenuissime strigoso-rugoso, punctato. L. $3\frac{1}{2}$ mill.

Hab. Abyssinia (*Raffray*).

This is near *parasita*, but is more cylindrical and more elongate. The punctuation is more general, the marginal striæ of the prosternum are more parallel and only slightly divergent in front. A transverse line divides the meso- from the metasternum, and in this and in the wide interstice of the thoracic margin it agrees with *picipes*. The pygidium under the microscope is very finely strigosely rugose between the rather large punctures.

Teretrius brunneus, Lewis, 1879=*pulex*, Fairm. 1877. I am enabled to determine the synonymy of the above through the kindness of Mons. R. Oberthür, who has sent me a type of *pulex*.

Homalopygus commensalis, n. sp.

Oblongo-ovatus, subconvexus, piceus, nitidus; antennis pedibusque rufo-brunneis; fronte dense subocellato-punctata, stria utrinque sat distincta; pronoto antice subocellato-punctato, postice punctato, stria interna integra, media in angulo cessante: elytris undique punctulatis, striis 2 et 3 dorsalibus integris, 1 et 4 basalibus brevibus, suturali basi et apice interrupta; propygidio pygidioque punctulatis; prosterno lateraliter marginato; mesosterno stria integra. L. $2\frac{1}{2}$ mill.

This species is less wide and more convex than *longipes*, and the thoracic and elytral striæ, which are short or nearly obsolete in the latter, are long and well defined in *commensalis*.

Hab. Blumenau, Brazil, and has been found, Herr E. Reitter informs me, in the galleries made by Termites.

TERATOSOMA, n. gen.

Oblongum, gibbum, setulosum. Caput non-retractum, mandibulis crassibus non-prominulis. Antennæ breves, margine insertæ, scapo grosso, articulis 3–7 sensim incrassatis, clava articulo unico oblongo-ovato. Pronotum bisulcatum, lateribus elevatissimis, fossa antica pro receptione (in totum) antennarum. Scutellum triangulare. Elytra gibbosa, striis punctiformibus, humeris elevatis. Pedes longissimi, flagelliformes, tarsis anticis brevissimis, tibiis apice subcanaliculatis.

Teratosoma longipes. n. sp.

Oblongum, rufo-brunneum, fulvo-setulosum; pronoto parce punctato, in longitudine profunde sulcato, in medio bituberculato, nitido;

elytris striis confusis punctiformibus, sutura elevata, basi utrinque sulcatis; propygidio parce punctato; prosterno dense punctato, lateralibus sinuato, basi valde arcuato; mesosterno depresso antice angustato, postice lato. L. 3 mill.

Hab. Blumenau, Brazil.

This curious insect may be placed near *Onthophilus.* The anterior angle of the thorax, viewed from above, seems angulated, in the same manner as in *Hetærius hispanus, lioderus,* and others; but when viewed from the front this protuberance is seen to be the superstructure of a large cavity which occupies the greater part of the elevated thoracic ridge. In this cavity the whole of the antennæ can be lodged, having at the same time space for movement, and when the antennæ are thus stored, club first, the large basal joint fits into the orifice and effectually closes it. In *Chlamydopsis*, the basal joint of the antennæ covers the funiculus when in a state of repose, but leaves the club visible. *Teratosoma* is a Myrmecophilous species; but while being able to effectually protect the antennæ when disturbed or enjoying repose, Nature has made no provision for the protection of the long legs, which are often contractible in members of this family. The long legs are doubtless of the greatest value in securing rapid movement, and the fore tarsi are very short and can rest in the tibial grooves; but in the other legs the recesses are too shallow to afford much security. The hind femora are bowed in such a manner as to enable the insect to raise them perpendicularly.

Chlamydopsis inquilina, n. sp.

Castanea, gibba, subnitida; fronte opaca, rugoso-punctata; pronoto transverso, nitido, margine acute elevato, parce *obsoleto-punctato*; elytris subnitidis, fere ut in *C. striatella*, parce setulosis; pedibus elongatis, pube adpressa vestitis; propygidio pygidioque dense griseo-hirsutis. L. $3\frac{1}{4}$ mill.

Hab. Australia (*Duboulay*).

C. inquilina may be known from *duboulai* (sic) by its larger size and transverse thorax, which is acutely and evenly elevated both in front and at the sides. From *striatella* it differs in its longer and more robust legs, and shining thorax with large, shallow, indistinct punctures, and the elytra are less elevated in the region of the scutellum. The propygidium and the pygidium are clothed with long griseous hairs, and the legs are covered with a short dense pubescence.

The genus *Chlamydopsis* should be placed near *Onthophilus.*

Onthophilus foveipennis, n. sp.

Ovatus, supra depressiusculus, niger, subopacus; fronte inter oculos sub-bifoveolata; pronoto dense punctato, 6-costulato, margine non-elevato; elytris costis 6 alternatim elevatis, intervallis bi-crenato-carinulatis, insterstitiis punctulatis; propygidio grosse punctato, in medio subelevato; prosterno lato, basi sinuato; mesosterno bisinuato, metasterno in medio subsulcato. L. $2\frac{1}{3}$ mill.

Hab. Amurland (*Christoph*).

This species has the thoracic margin and costæ as in *exaratus*, but the punctuation of the thorax is after the manner of *sulcatus*, but more dense. The elytra also are sculptured closely to the pattern of *exaratus*, but the punctures are not strigose. Between the second and third costæ at the base of each elytron there is a large and very deep sulcus, as is often the case in *sulcatus*.

Onthophilus hova, n. sp.

Ovalis, subconvexus, niger, nitidus; antennarum clava tarsisque flavis, fronte inæqualiter impressa; pronoto ocellato-punctato, margine magis dilatato, stria interna parallela fortiter elevata; elytris sutura et 4 costis elevatis, intervallis biseriatim punctatis, cum punctulorum linea intermedia; prosterno lateraliter marginato, basi sinuato; mesosterno bisinuato; metasterno profunde bifoveolato, in medio sulcato. L. $1\frac{3}{4}$ mill.

Hab. Madagascar (*Raffray*).

This species is very roughly sculptured and relatively longer than any other known species. It is allied to *costipennis* and 9-*costatus*, from which the size, absence of thoracic carinæ, and the deep foveæ and sulcus in the metasternum, thus •|•, will distinguish it. It is slightly setose, and is probably a species which resides under bark like *hispidus* and *arboreus*.

XLIV.—*Notes on some Fossil Plants collected by Mr. R. Dunlop, Airdrie, from the Lanarkshire Coal-field.* By Robert Kidston, F.G.S.*

Through the kindness of Mr. Dunlop I have had the opportunity of examining the fossil plants collected by him from several localities in the Lanarkshire Coal-field. The annexed list of species, compiled from this collection, though of considerable interest, must not be regarded as a complete representation of the Carboniferous fossil flora of this district; but it contains one or two species which have not been previously

* Read before the Geological Society of Glasgow, April 2, 1885.

recorded from Scotland. I have only to express my hope that Mr. Dunlop will continue his investigations in a field of natural history on which he has so successfully entered. Many of the specimens he has secured are exceedingly fine; of some of the species, they are finer than any I have yet seen from the British Coal-fields.

As it is my intention to work out the distribution of the Carboniferous flora, I am much indebted to Mr. Dunlop for the facilities he has given me in examining his specimens. I shall be very glad if others, who possess specimens of Carboniferous fossil plants, would kindly allow me to examine them, and so assist in working out their distribution; on my part I shall be most happy, as far as I can, to help any who may wish for assistance in the study of this most interesting class of fossils.

It is only possible by mutual cooperation to compile a complete list of the Carboniferous fossil plants from an area so large and rich as that of the British Coal-fields.

Calamariæ.

Calamites, Suckow.

Weiss, in his two volumes on *Calamites* *, has contributed so much to our knowledge of the stems and their ramification, the fructification, foliage, and roots of *Calamites*, that this group of fossil plants can no longer be looked upon as that about which we are most ignorant. His first volume deals chiefly with the fructification of *Calamites*, his second treats of the stems, as well as of the foliage and roots, with much additional information in regard to their fructification and systematic position.

The Calamariæ have usually been classed with the Equisetaceæ; but from the examination of their fructification it is seen that there are points in which they clearly differ from the recent *Equisetum*. On the other hand, there are some characters in which *Calamites* have a considerable similarity with the Equisetaceæ, and among recent plants it is certainly with this group they have the greatest affinity.

It would appear that *some* of the fossil cones which have been referred to the Calamariæ show that their upper part bore *microspores*, whilst their lower portion bore *macrospores*,

* "Steinkohlen-Calamarien.—Part I.," Abhandl. zur geologischen Specialkarte von Preussen und den Thüringischen Staaten, Band ii. Heft i. 1876; "Steinkohlen-Calamarien.—Part II.," Abhandl. &c. Band v. Heft ii. (1884).

nor are the spores provided with *elaters*, as in *Equisetum* *. But in the order Lycopodiaceæ some members are *heterosporous* and others *isosporous*. For example, *Lycopodium* has only one kind of spore (*isosporous*), while *Selaginella* has both *microspores* and *macrospores* (*heterosporous*). It may, perhaps, be found then that, although some of the cones which are supposed to belong to *Calamites* show a *heterosporous* condition, this may not be of sufficient importance to exclude them from the Equisetaceæ, where the spores are *isosporous*. It is also most probable that the genus *Calamites*, when its fructification is more fully examined, will require to be separated into many genera; and in this light the genus *Calamites*, as Weiss points out, can only be regarded as of a most provisional nature.

The roots of *Calamites* are those fossils to which Lindley and Hutton applied the name of *Pinnularia*.

From our present standpoint of knowledge Weiss proposes to divide the genus *Calamites* into the four following groups:—

CALAMITES, Suckow (provisional genus).

Division A. *Furrows on stems alternating at the nodes or joints.*

Group I. *CALAMITINA*, Weiss.

Branch-scars occurring periodically, the nodes bearing scars being separated from each other by a certain number of joints which do not bear branches. In most cases there is a distinct increase or decrease in the length of the joints which connect the branch-bearing nodes.

Group II. *EUCALAMITES*, Weiss.

Branch-scars occurring on every joint. The joints are of the same length or of irregularly different lengths.

Group III. *STYLOCALAMITES*, Weiss.

Branch-scars occurring without definite order, subordinate; often long stretches of the stem occur on which the branch-scars are entirely absent. The joints are of equal length or irregularly different.

* See also Dr. Williamson's papers on the structure of *Calamites* published at various dates in the 'Philosophical Transactions.'

Division B. *Furrows on the stem not alternating at the nodes or joints.*

Group IV. *Archæocalamites*, Stur (*Asterocalamites*, Schimper; *Calamites*, Brongniart).

Branch-scars irregularly distributed. Joints unequal in length.

For the purpose of classifying these fossils, the groups proposed by Weiss will be found most useful; but perhaps Nos. I., II., and III. had better be regarded at present as convenient *sections* rather than *genera*. Group IV., on the other hand, is so well defined, both as concerns its stems and fruit *, that it must be regarded as a true *genus* and quite distinct from *Calamites*.

In geological distribution groups I.–III. are characteristic of the Coal-measures; group IV. of the Lower Carboniferous (=Carboniferous Limestone series and Calciferous Sandstone series).

A good deal of discussion has taken place as to whether the exterior surface of the bark of *Calamites* was smooth or furrowed. It appears, as is often the case in such differences of opinion, that both views are correct in part. It now seems clearly proved that the species with thin bark show on their outer surface the characteristic furrows, but, on the other hand, the stems with thick bark show no trace of the furrows on their outer surface. The decorticated stems, however, are always distinctly furrowed, and it is in this condition that *Calamites* most frequently occur. This vexed question, from the careful investigations of Prof. Weiss, seems to be now satisfactorily settled.

Group I. *Calamitina*, Weiss.

Calamites (*Calamitina*) *varians*, Sternberg.

Calamites varians, Sternberg, Vers. ii. p. 50, pl. xii.

Remarks. This specimen belongs to one of the forms of this species, but is not in a good state of preservation.

Locality. Drumgray Coal, Airdrie.

Calamites (*Calamitina*), sp.

Remarks. Unfortunately only a small fragment of this

* The fruit of *Archæocalamites* is the *Pothocites Grantonii* of Paterson. See Ann. & Mag. Nat. Hist. May 1883, p. 297.

plant was collected. It belongs to the group of *Calamites* with a thick smooth bark. At the nodes the leaf-scars form a chain of transversely oval contiguous scars, similar to those occurring in *Calamites* (*Calamitina*) *varians*, var. *inconstans*, Weiss ('Steinkohlen-Calamarien,' vol. ii. p. 69, pl. xxv.). From the fragmentary nature of the specimen, however, I cannot with any certainty refer it to that species. We can only hope that more perfect examples will soon be found which will enable us satisfactorily to determine the species.

Locality. Blaes between Kiltongue and Drumgray Coals; Whiterigg Colliery, near Airdrie *.

Group II. *Eucalamites*, Weiss.

Calamites (*Eucalamites*) *ramosus*, Artis.

Calamites ramosus, Artis, Antedil. Phyt. pl. ii.
Calamites (*Eucalamites*) *ramosus*, Weiss, Steinkohlen-Calamarien, part ii. p. 98, pl. v. figs. 1, 2, pl. vi., pl. vii. figs. 1, 2, pl. viii. figs. 1, 2, and 4, pl. ix. figs. 1, 2, pl. x. fig. 1, pl. xx. figs. 1, 2.
Calamites nodosus, Lindley & Hutton, Foss. Flora, vol. i. pls. xv., xvi.

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* As the plants from this bed occur in a state of great perfection, to show its exact position I append a section, which was procured for me by Mr. Dunlop from Mr. Prentice, manager of the colliery.

Section of Strata between the Kiltongue Coal and the Upper Drumgray Coal, showing the Fern-bed (Stanrigg Colliery, by Airdrie).

		ft.	in.
Coal (including 3 inches of gas-coal)	Kiltongue	1	0
Dark fireclay	Kiltongue		5
Coal	Kiltongue	1	4
Fireclay			10
Argillaceous schist		5	6
Fireclay		1	1
Coal			6
Argillaceous schist		4	10
Sandstone		5	9
Argillaceous shale		1	1
Coal			8
Argillaceous shale		3	6
Sandstone		2	5
Argillaceous schist (*Fern-bed*)		2	6
Argillaceous shale		3	3
Sandstone		3	3
Argillaceous schist		1	8
Shale (dark), studded with *Anthracosia*		1	0
Argillaceous shale			8
Sandstone (hard)		5	6
Argillaceous shale			10
Coal (Upper Drumgray)		2	0

Annularia radiata, Zeiller, Végét. foss. du terr. houill. de la France, p. 24, pl. clx. fig. 1.
Asterophyllites radiatus, Brongniart, Class. d. végét. foss. p. 35, pl. ii. fig. 7.
Asterophyllites foliosus, Lindley & Hutton, Foss. Flora, vol. i. pl. xxv. fig. 1.
Annularia ramosa, Weiss, "Beobachtungen an Calamiten und Calamarien," Neues Jahrb. vol. ii. (1881).

Remarks. This species is very fully described by Weiss. The little branches, with verticillate leaves, each of which terminates in a sharp apex and is also tapered from its centre to its point of attachment with the stem, and which have been described as *Annularia radiata,* are now known to be the foliage of this plant. The fruit is also described by Weiss. This and the following species are the two most plentiful in the Scotch Coal-measures.

Localities. Blaes between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie; Pits, Airdrie; Shettleston, near Glasgow; Bent Colliery, about 1½ mile E. of Bothwell.

Group III. *Stylocalamites,* Weiss.

Calamites (*Stylocalamites*) *Suckowii,* Brongniart.

Calamites Suckowii, Brongniart, Hist. d. végét. foss. p. 124, pl. xiv. fig. 6, pl. xv. figs. 1–6, pl. xvi. figs. 2, 3 (? fig. 1).
Calamites Suckowii, Zeiller, Végét. foss. du terr. houil. de la France, p. 12, pl. clix. fig. 1.
Calamites (*Stylocalamites*) *Suckowii,* Weiss, Steinkohlen-Calamarien, part ii. p. 129, pl. ii. fig. 1, pl. iii. figs. 2, 3, pl. iv. fig. 1, pl. xxvii. fig. 3.

Localities. Pits near Airdrie; Bent Colliery, about 1½ mile E. of Bothwell.

Calamocladus, Schimper.

Calamocladus equisetiformis, Schlotheim, sp.

Calamocladus equisetiformis, Schimper, Traité d. paléont. végét. vol. i. p. 324, pl. xxii. figs. 1–3.
Asterophyllites equisetiformis, Brongniart, Prodrome, p. 159; Germar, Vers. v. Wettin u. Löbejun, p. 21, pl. viii.
Hippurites longifolia, Lindley & Hutton, Fossil Flora, vol. iii. pls. cxc., xci.
Casuarinites equisetiformis, Schlotheim, Flora d. Vorwelt, p. 30, pl. i. figs. 1, 2, pl. ii. fig. 3.

Remarks. A very fine specimen of this species has been collected. It shows the remains of four branches, the longest of which, however, is incomplete, but measures 8 inches and bears seventeen whorls of leaves. From the position in which the branches lie to each other they have evidently been attached to a common stem. Each whorl contains about thirty leaves.

Localities. Bent Colliery, about 1½ mile E. of Bothwell; Blaes between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie.

Calamocladus grandis, Sternberg, sp.

Calamocladus grandis, Schimper, Traité d. paléont. végét. vol. i. p. 325.
Bechera grandis, Sternberg, Vers. i. fasc. iv. p. xxx, pl. xlix. fig. 1.

Remarks. Most probably this species is not distinct from *Calamocladus equisetiformis*, Schl. sp.

Locality. Bent Colliery, about 1½ mile E. of Bothwell.

Annularia, Sternberg.

Annularia patens, Sauveur, sp.

Asterophyllites patens, Sauveur, Végét. foss. du terr. houil. de la Belgique, pl. lxix. fig. 4.

Description. Stem faintly striated longitudinally; internodes varying in length (according to the age of the specimen). Leaves whorled, numerous (8–16 in a whorl), long, linear, narrow, single-nerved, and terminating in a sharp point; basal portion of leaf not contracted. The leaves vary in length from $\frac{3}{10}$ of an inch on the smaller branches to nearly an inch on the larger, and in width from $\frac{1}{20}$ to $\frac{1}{25}$ of an inch. From the leaf-whorls are given off lateral branchlets.

Remarks. Of this species the only figure with which I am acquainted is that given by Sauveur, which only shows a portion of a whorl of leaves. Unfortunately no description accompanies his sketch.

The leaves are long in proportion to their breadth and of equal width throughout, and this, in connexion with their not being contracted at their base, easily distinguishes *Annularia patens* from *Annularia radiata.* The leaves are generally rather longer than one and a half times the length of the internodes. On the smaller branches of course the leaves and internodes are smaller than on the larger branches, but they usually hold the same proportional relationship to each other in size. One small example shows a lateral branch springing from the axil of one of the leaves; but none of the other nodes of this example gives rise to branches. From this its mode of ramification appears to be irregular.

Although this species has not been previously recorded from Britain, I have seen it, in addition to the Airdrie locality, from the Coal-measures, Furnace Bank Pit, Old

Sauchie, near Alloa, and Devonside, Tillicoultry, Clackmannanshire; and Blairpoint, Dysart, Fife.

Locality. Pit, near Airdrie.

(?) Rhizocarpeæ.

Sphenophyllum, Brongniart.

Sphenophyllum cuneifolium, Sternberg, sp.

Sphenophyllum cuneifolium, Zeiller, Végét. foss. du terr. houil. de la France, p. 30, pl. clxi. figs. 1, 2.
Sphenophyllum erosum, Lindley & Hutton, Fossil Flora, vol. i. pl. xiii.
Rotularia cuneifolia, Sternberg, Vers. i. fasc. ii. p. 33, pl. xxvi. fig. 4.
Rotularia pusilla, Sternberg, Vers. i. fasc. iv. p. xxxii.

Localities. Pit, Airdrie; Bent Colliery, about 1½ mile E. of Bothwell.

Filicaceæ.

Sphenopterideæ.

Renaultia, Zeiller.

Renaultia microcarpa, Lesquereux, sp.

Sphenopteris microcarpa, Lesquereux, Coal Flora of Pennsyl. p. 280, pl. xlvii. fig. 2.
Sphenopteris microcarpa, Kidston, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 9, pl. i. figs. 7–14.
Renaultia (*Sphen.*) *microcarpa*, Zeiller, Ann. d. Sciences Nat. 6^e sér. Bot. vol. xvi. p. 185.

Remarks. The fruit of this species was first described by Lesquereux, but later and more fully by myself. It consists of small oval exannulate sporangia which are situated at the extremities of the veins.

Localities. Roof of Kiltongue Coal, Mount Vernon; Pit, near Airdrie.

Sphenopteris, Brongniart.

(?) *Sphenopteris trifoliolata*, Artis (not Brongn.).

Sphenopteris trifoliolata, Brongn. Prodrome, p. 50.
Filicites trifoliolatus, Artis, Antedil. Phyt. pl. xi.

Remarks. The specimen I refer to this species is small and not in a good state of preservation for a satisfactory determination; hence this record of the occurrence of this species requires corroboration.

I have, however, previously seen this species from Wishaw.

Locality. Bent Colliery, about 1½ mile E. of Bothwell.

Sphenopteris obtusiloba, Brongniart.

Sphenopteris obtusiloba, Brongniart, Hist. d. végét. foss. p. 204, pl. liii. fig. 2*.
Sphenopteris irregularis, Andræ, Vorwelt Pflanzen, p. 24, pl. viii. pl. ix. fig. 1.
Sphenopteris irregularis, Sternberg, Vers. ii. p. 63, pl. xvii. fig. 4, p. 152, pl. ix. fig. 7.
Sphenopteris latifolia, Lindley & Hutton, Fossil Flora, vol. ii. pl. clvi., vol. iii. pl. clxxviii.
Sphenopteris trifoliolata, Brongniart (not Artis), Hist. d. végét. foss. p. 202, pl. liii. fig. 3 (excl. refer.).

Remarks. Exceedingly fine specimens of this were collected.

Locality. Blacs between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie.

Sphenopteris furcata, Brongniart.

Sphenopteris furcata, Brongniart, Hist. d. végét. foss. p. 179, pl. xlix. figs. 4, 5.
Diplothmema furcatum, Zeiller, Végét. foss. du terr. houil. de la France, p. 45, pl. clxii. fig. 3.

Locality. Cutting, new Caledonian Railway, Airdrie.

Sphenopteris, sp.

Remarks. The specimens I place here have a great resemblance to *Sphenopteris rotundifolia*, Andræ ('Vorweltliche Pflanzen,' p. 37, pl. xii.), but, as it is necessary to use great care in recording the occurrence of a species, I will refrain at present from applying the specific name of "*rotundifolia*, Andræ," to them, and await further evidence before definitely determining this fern. But to whichever species this plant belongs, these examples are the first I have seen.

Locality. Blaes between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie.

Mariopteris, Zeiller.

Mariopteris, Zeiller, Bull. Soc. Géol. de France, 3e sér. vol. vii. p. 92; Végét. foss. du terr. houil. de la France, p. 68 (from vol. iv. de l'explication de la carte géologique de la France, 1880).

This genus was founded by Zeiller to include certain ferns which, among other characters, are distinguished by a peculiar dichotomizing of their pinnæ. The primary pinnæ are attached to the rachis by a naked stalk, which bifurcates at a very obtuse angle; each of the forks of this first dichotomy again bifurcates, forming the secondary pinnæ, on which are borne the tertiary pinnæ, which in turn support the pinnules.

Mariopteris latifolia, Brongniart, sp.

Mariopteris latifolia, Zeiller, Bull. de la Soc. Géol. de France, 3e sér. vol. vii. p. 92, pl. vi.
Sphenopteris latifolia, Brongniart, Hist. d. végét. foss. p. 205, pl. lvii. figs. 1–4.

Locality. Roof of the Kiltongue Coal, Mount Vernon.

Mariopteris muricata, Schlotheim, sp.

Mariopteris muricata, Zeiller, Bull. Soc. Géol. de France, 3e sér. vol. vii. p. 92.
Pecopteris muricata, Brongniart, Hist. d. végét. foss. p. 352, pl. xcv. figs. 3, 4, and pl. xcvii.
Filicites muricatus, Schlotheim, Flora d. Vorwelt, p. 54, pl. xii. figs. 21 and 23.

Locality. Bent Colliery, about 1½ mile E. of Bothwell.

Mariopteris nervosa, Brongniart, sp.

Mariopteris nervosa, Zeiller, Végét. foss. du terr. houil. de la France, p. 69, pl. clxvii. figs. 1–4.
Pecopteris nervosa, Brongniart, Hist. d. végét. foss. p. 297, pl. xciv. and pl. xcv. figs. 1, 2.
Pecopteris nervosa, Lindley & Hutton, Fossil Flora, vol. ii. pl. xciv.

Remarks. Some of the specimens are very fine.
Locality. Bent Colliery, about 1½ mile E. of Bothwell.

NEUROPTERIS, Brongniart.

Neuropteris heterophylla, Brongniart.

Neuropteris heterophylla, Brongniart, Hist. d. végét. foss. p. 243, pl. lxxi., and pl. lxxii. fig. 2.
Neuropteris heterophylla, Zeiller, végét. foss. du terr. houil. de la France, p. 49, pl. clxiv. figs. 1, 2.
Neuropteris Loshii, Brongniart, Hist. d. végét. foss. p. 242, pl. lxxii. fig. 1, and pl. lxxiii.
Cyclopteris trichomanoides, Brongniart, Hist. d. végét. foss. p. 49, pl. lxi. *bis*, fig. 4.

Remarks. Some exceedingly fine specimens of this fern, from blaes lying between the Kiltongue and Drumgray Coals, which were brought up while driving a road, were collected by Mr. Dunlop at Whiterigg Pit, near Airdrie. These examples are the finest British specimens I have seen.

Several specimens of *Cyclopteris trichomanoides*, Brongn., which at one time was supposed to form a distinct species of a different genus, have also been collected. These peculiar cyclopteroid pinnules were attached to the main rachis of the fern, and a figure showing their relation to the other parts of the frond has been given by Röhl (Vers. d. Steink.-Form.

Westphalens, pl. xvii.). *Neuropteris heterophylla* and *Neuropteris Loshii* are now known to represent only different portions of the same species.

Localities. Blaes between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie; cutting, new Caledonian Railway, Airdrie; roof of Kiltongue Coal, Mount Vernon (at the two last-mentioned localities pinnules of the so-called *Cyclopteris trichomanoides* also occurred); Bent Colliery, about 1½ mile E. of Bothwell.

Neuropteris gigantea, Sternberg.

Neuropteris gigantea, Sternberg, Vers. i. fasc. iv. p. xvi; Brongniart, Hist. d. végét. foss. p. 240, pl. lxix.
Osmunda gigantea, Sternberg, Vers. i. fasc. ii. pp. 33, 36, pl. xxii.

Remarks. The specimen from Coatbridge shows the fern in circinate vernation.

Localities. Bent Colliery, about 1½ mile E. of Bothwell; Coatbridge.

Neuropteris Scheuchzeri, Hoffmann.

Neuropteris Scheuchzeri, Hoffman, in Keferstein, Teutschland geogn.-geolog. dargestellt, vol. iv. p. 157 (excl. figs.).
Osmunda, Scheuchzer, Herbarium diluvianum, p. 37, pl. x. fig. 3 (ed. 1709).

Remarks. The synonymy of this species is in a very unsatisfactory state; I therefore refrain from giving any further references.

Neuropteris Scheuchzeri, which is one of the earliest figured ferns, occurs plentifully in some of the English Coal-fields; but the examples from Whiterigg are the first I have seen from a Scotch locality. Some of the specimens are very good, and showed attached to the main axis large cyclopteroid pinnules analogous to those to which reference has already been made in regard to *Neuropteris heterophylla*, Brongn.

Locality. Whiterigg Pit, near Airdrie.

Alethopteris, Sternberg.

Alethopteris lonchitica, Schlotheim, sp.

Alethopteris lonchitidis, Sternberg, Vers. i. fasc. iv. p. xxi.
Pecopteris lonchitica, Brongniart, Hist. d. végét. foss. p. 275, pl. lxxxiv.; Lindley & Hutton, Fossil Flora, vol. ii. pl. cliii.
Pecopteris heterophylla, Lindley & Hutton, Fossil Flora, vol. i. pl. xxxviii.

Remarks. This is one of the commonest ferns of the Scotch

Coal-measures and is subject to great variation. To many of these varieties specific names have been given.

Localities. Roof of Kiltongue Coal, Mount Vernon. Bent Colliery, about 1½ mile E. of Bothwell.

RHACOPHYLLUM, Schimper.

(?) *Rhacophyllum filiforme*, Gutbier, sp.

Fucoides filiformis, Gutbier, Vers. d. Zwickauer Schwarzkohlengebirges, p. 12, pl. i. fig. 9.

Remarks. Among the fossils is a small specimen of *Rhacophyllum* with filiform segments, which, though not very well preserved, is, I believe, referable to this species.

Locality. Cutting, new Caledonian Railway, Airdrie.

LYCOPODIACEÆ.

LEPIDODENDRON, Sternberg.

Lepidodendron Sternbergii, Brongniart.

Lepidodendron Sternbergii, Brongniart, Prodrome, p. 85; Lindley & Hutton, Fossil Flora, vol. i. pl. iv., vol. ii. pl. cxii., vol. iii. pl. cciii.

Lepidodendron dichotomum, Sternberg (in part), Vers. i. fasc. i. pp. 19, 23, pls. i., ii. (excl. pl. iii.); and Vers. ii. p. 177, pl. lxviii. fig. 1.

Lepidodendron elegans, Hist. d. végét. foss. vol. ii. pl. xiv.; Lindley & Hutton, Fossil Flora, vol. ii. pl. cxviii., vol. iii. pl. cxcix.

Lepidodendron gracile, Lindley & Hutton, Fossil Flora, vol. i. pl. ix.; Brongniart, Hist. d. végét. foss. vol. ii. pl. xv.

Lepidodendron lycopodioides, Sternberg, Vers. i. fasc. 2, p. 31, pl. xvi. figs. 1, 2, and 4.

Remarks. One or two very fine specimens of that form of *Lepidodendron Sternbergii* which has been named *L. lycopodioides* by Sternberg and *L. elegans* by Brongniart were collected from a cutting on the new Caledonian Railway, near Airdrie.

Lepidodendron elegans and *L. gracile* appear to be only the younger and smaller branches of *Lepidodendron Sternbergii*, and not specifically distinct from that plant.

Localities. Cutting on new Caledonian Railway, Airdrie (*L. elegans*). Pit, Airdrie (*L. Sternbergii*). Bent Colliery, about 1½ mile E. of Bothwell (*L. gracile*).

Lepidodendroid Branches.

Under this head I include two fine slabs from Whiterigg, which show on their surface a number of delicate twigs, measuring in some cases 10 or 11 inches in length, and about ¼ inch wide at their broadest part, including the leaves. The stems alone which bear the leaves are a little more than one tenth of an inch thick. The branches diminish gradually in width towards their apex. The leaves are very narrow, and about one fifth of an inch long. These two fossils are similar to those figured by Röhl as *Lycopodites selaginoides* ('Fossile Flora der Steinkohlen-Formation Westphalens,' pl. vii. fig. 3).

I prefer, however, to record these specimens merely as Lepidodendroid twigs, rather than to place them under *Lycopodites*, for this genus, as founded by Brongniart, contained a number of Coniferous branches and small twigs of *Lepidodendron*, and was subsequently given up by that author; but *Lycopodites*, as resuscitated by Goldenberg*, contains certain plants very closely related to the recent genus *Lycopodium*, and quite distinct from *Lepidodendron*, and as the specimens from Whiterigg appear to be only young twigs of *Lepidodendron* (though of which species of *Lepidodendron* I am unable to say), they cannot be referred to *Lycopodites*, as restricted by Goldenberg.

Locality. Blaes between Kiltongue and Drumgray Coals, Whiterigg, near Airdrie.

Lepidophloios, Sternberg.

Lepidophloios, sp.

Remarks. This genus is only represented by a fragment of a compressed stem, showing the Halonian condition of *Lepidophloios*, it now being known that *Halonia*, Lindley and Hutton, and *Cyclocladia ornata*, Goldenberg †, are the fruiting branches of *Lepidophloios*.

The example from Airdrie agrees in all respects with Goldenberg's figure. As the leaf-scars are not preserved on the fossil it is impossible to distinguish the species of *Lepidophloios* to which this fragment belongs.

Locality. Pit, Airdrie.

Lepidophyllum, Brongniart.

Lepidophyllum lanceolatum, Lindley & Hutton.

Lepidophyllum lanceolatum, Lindley & Hutton, Fossil Flora, vol. i. pl. vii. figs. 3, 4.

Remarks. In *Lepidophyllum* are placed isolated bracts

* Goldenberg, 'Flora Saræpontana fossilis,' Heft i. pp. 9, 10 (1855). See also Kidston, Ann. & Mag. Nat. Hist. Aug. 1884, p. 111.

† Goldenberg, 'Flora Saræpontana fossilis,' Heft i. p. 20, pl. iii. fig. 11.

and leaves, which apparently belong in part to *Lepidodendron*, *Lepidophloios*, and *Sigillaria*.

Localities. Pit, Airdrie. Bent Colliery, about 1½ mile E. of Bothwell.

Lepidostrobus, Brongniart.

Lepidostrobus variabilis, Lindley & Hutton.

Lepidostrobus variabilis, Lindley and Hutton, Fossil Flora, vol. i. pls. x., xi.

Remarks. Under this name are most probably included the cones of different species of Lycopods.

Locality. Blackband, Airdrie; Bent Colliery, about 1½ mile E. of Bothwell.

Sigillaria, Brongniart.

Sigillaria discophora, König, sp.

Lepidodendron discophorum, König, Icones fossilium sectiles, pl. xvi. fig. 194 (1825).
Ulodendron majus, Lindley & Hutton, Fossil Flora, vol. i. pl. v. (excl. ref.).
Ulodendron minus, Lindley & Hutton, Fossil Flora, vol. i. pl. vi. (excl. ref.).

Remarks. *Ulodendron minus*, L. & H., is only a smaller specimen of their *Ulodendron majus*, and both are similar to the plant described by König as *Lepidodendron discophorum*. It is now known that certain *Ulodendra*, such as *U. parmatum*, Carruthers (= *U. commutatum*, Schimper), belong to *Lepidodendron Veltheimianum*, Sternberg, and there are other *Lepidodendra* which also bear Ulodendroid scars. But in addition to *Lepidodendra*, some Clathrarian *Sigillariæ* were likewise provided with Ulodendroid scars, of which *Sigillaria discophora* is an example. Ulodendroid scars also occur in the genus *Rhytidodendron*, Boulay. The presence of these large scars cannot then be regarded as a generic character. The leaf-scars only afford the necessary comparative points for the classification of these so-called Ulodendroid Lycopods, and the leaf-scars of *Sigillaria discophora* are essentially those of a Clathrarian *Sigillaria*.

Locality. Pit, near Airdrie.

Sigillaria notata, Steinhauer, sp.

Sigillaria notata, Brongniart, Hist. d. végét. foss. p. 449, pl. cliii. fig. 1.
Phytolithus notatus, Steinhauer, Amer. Phil. Trans. vol. i. pl. vii. fig. 3.

Remarks. This collection contains only one small specimen of this species, with narrow ribs and proportionately small leaf-scars. The leaf-scars are more distant than figured by Brongniart; but in this character the plant varies much.

Locality. Bent Colliery, about $1\frac{1}{2}$ mile E. of Bothwell.

Sigillaria, sp.

Remarks. I place here a small decorticated example of a *Sigillaria*, which, in the absence of the outer surface of the stem, does not afford sufficient characters for a specific identification. It is the *Sigillaria* (*Syringodendron*) *cyclostigma*, Brongn. (Hist. d. végét. foss. pl. clxvi. fig. 3), of which, however, nothing more can be said than that it is a decorticated condition of a *Sigillaria*.

Locality. Baillieston.

Lycopod Spores.

Remarks. These are probably the spores of *Lepidodendron* or *Sigillaria.* They are about $\frac{1}{25}$ inch in diameter, and apparently belong to Reinsch's group Triletes*. These little spores almost entirely cover the surface of some small slabs, and are restricted to the "parting" of the stone.

Locality. Blaes at old pit, near Airdrie.

Stigmaria, Brongniart.

Stigmaria ficoides, Brongniart.

Stigmaria ficoides, Brongniart, Class. d. végét. foss. p. 9, pl. i. fig. 7; Lindley & Hutton, Fossil Flora, vol. i. pls. xxxi.–vi.

Stigmaria ficoides (and vars.), Göppert, Gatt. d. foss. Pflanzen, Lief. 1, 2, p. 13, pls. viii.–xvi.

Remarks. Stigmariæ, the roots of *Lepidodendron* and *Sigillaria*, are common throughout the whole of the Coal-measures. The specimen from Airdrie shows a transition from the Lepidodendroid leaf-scar to the Stigmarian root-scar. The Stigmarian vascular scar is here surrounded by a "field," similar to that which surrounds the vascular impression of the Lepidodendroid leaf-scar.

Stigmaria ficoides, var. *reticulata* (Göppert), has also been met with.

Localities. Common throughout the whole district. *Stigm. ficoides*, var. *reticulata*: above oil-shales, Airdrie.

* 'Micro-Palæo-Phytologia Formationis Carboniferæ,' vol. i. p. 1, 1884. (Vols. i. and ii. Erlangen, Bavaria, 1884. Many hundreds of these organisms are figured in this work.)

Cycadaceæ.

Cordaites, Unger.

The internal organization of the leaves, flowers, and stems of *Cordaites* have been fully described by Grand'Eury and Renault*. According to Grand'Eury, the stems of *Cordaites* attained a height of from 20 to over 30 feet, and were irregularly ramified. At the upper extremities of the branches and stems were borne the long narrow leaves. In *Cordaites* the pith was chambered and the curious fossils, variously called *Sternbergia* or *Artisia*, are casts of its pith-cavity.

The wood in structure approaches closely to that of the Coniferæ, and was previously described as *Pinites Brandlingii* by Witham. It is also most probable that many of the fossil woods referred to *Pinites*, Witham (*Araucarioxylon*, Kraus; *Araucarites*, Göppert), are portions of the stems of *Cordaites*. The wood-fibres bear one or many vertical rows of bordered pits. The leaves are more or less long in proportion to their width; and from characters derived from these organs, Grand'Eury proposes for *Cordaites* the three following divisions:—

I. *Eucordaites.*—Leaves spathulate, obovate, elliptical, or lanceolate, sessile, entire, with rounded apices and of leathery consistency. The leaves are from 20–90 centim. in length. The nerves are either equally or unequally strong.

II. *Dorycordaites.*—Leaves lanceolate with sharp points; nerves numerous, fine, and equal in strength. The leaves attain a length of from 40–50 centim.

III. *Poacordaites.*—Leaves narrow, linear, entire, blunt at the point, with nerves nearly equally strong. The leaves are as much as 40 centim. in length†.

The flowers of *Cordaites* are monœcious. The male flowers consist of a number of imbricated bracts, in the axils of which are situated the stamens, or they are placed around the depressed apex of the axis of inflorescence. The female flower contains several naked ovules, which are each short-stalked and set in the axils of the bracts. Their fertilization takes place in a somewhat similar manner to that of the Cycads

* For a full description of the structure of *Cordaites*, see Renault, 'Cours de botanique fossile,' première année (Paris, 1881); Grand'Eury, "Flore carbonifère du Département de la Loire et du centre de la France" (1877); Zittel-Schenk, 'Handbuch der Paläontologie,' ii. Band, Lief. iii. p. 241 (1884).

† Since writing the above a new type of *Cordaites* has been described by Renault and Zeiller, which they have named *Scutocordaites* ('Comptes Rendus,' March 23, 1885).

and Conifers. During the maturation of the fruit the short stalk, to which the seed is attached, in some cases becomes much elongated, as in *Cardiocarpus* (*Cordaianthus*) *Lindleyi*, Carruthers, and *Cardiocarpus anomalus*, Morris, sp. In very few cases have the flowers been found in union with their parent stems, so till we know to which species of *Cordaites* the isolated inflorescences and fruits belong, it is necessary to apply to them specific names in order that their occurrence may be recorded. The structure of the seeds has been investigated by Brongniart *.

From the results of the observations of these botanists, who have been successful in securing specimens preserved in silica, in which the most minute details of structure are exhibited, even to the pollen-grains, it appears that *Cordaites* must be looked upon rather as a *group* of plants than a *genus*. In certain structural points *Cordaites* approaches closely to the Coniferæ, in other respects to the Cycads; but taking into account all the structural peculiarities of the plants, their affinities appear to be more Cycadaceous than Coniferous.

I have given but a meagre outline of the organization of these plants, and must refer those who are interested in the subject to the original works of the authors quoted.

From the fragmentary manner in which *Cordaites* usually occur, the chief specific characters are derived from the neuration of the leaves.

Cordaites (*Eucordaites*) *principalis*, Germar, sp.

Cordaites principalis, Geinitz, Vers. d. Steinkf. in Sachsen, p. 41, pl. xxi. figs. 1–6 (excl. fig. 22).
Cordaites principalis, Weiss, Foss. Flora d. jüng. Stk. u. d. Rothl. p. 200.
Flabellaria principalis, Germar, Vers. v. Wettin. u. Löbejun, p. 55, pl. xxiii.
Pycnophyllum principale, Schimper, Traité de paléont. végét. vol. ii. p. 191.

Description. Leaves long, attaining a length of from 12 to 18 inches, and sometimes rather over 2 inches wide, narrowed towards the base and again narrowing towards the apex, the extreme point of which is rounded or obtuse; seven or eight of the stronger nerves in one tenth of an inch, between which are from three to five finer (?) nerves.

Remarks. In well-preserved specimens there are seen running parallel with and between the strong nerves from three to five fine lines. These are described by Geinitz as vertical

* Brongniart, 'Recherches sur les graines fossiles silicifiées' (Paris, 1881). Also, "Etudes sur les graines fossiles trouvées à l'état silicifié dans le terrain houiller de Saint Etienne," Annales des Sciences Nat. botan. 5^{e} sér. vol. xx. pls. xxi.–xxiii.

rows of cells, and his fig. 2, pl. xxi., shows these finer lines strongly magnified, and certainly they here appear more like rows of tabular cells than veins; but Weiss, in his description of the species, calls them nerves. Only very perfectly preserved specimens can decide whether the finer lines placed between the strong nerves are rows of cells or finer nerves.

The plant included here I have little doubt is Germar's species. It is very frequent in the Scotch Coal-fields.

Locality. Bent Colliery, about 1½ mile E. of Bellshill.

CARDIOCARPUS, Brongniart.

Cardiocarpus (*Cordaianthus*) *Lindleyi*, Carruthers.

Cardiocarpon Lindleyi, Carruthers, Notes on some Fossil Plants, figs. 1 & 2, Geol. Mag. vol. ix. 1872.

Cardiocarpon acutum, Lindley & Hutton, Fossil Flora, vol. i. pl. lxxvi.

Cardiocarpon apiculatum, Berger & Göppert, Fruct. et semin. p. 23, pl. ii. fig. 32.

Antholithes Pitcairniæ, Lindley & Hutton, Fossil Flora, vol. ii. pl. lxxxii.

Remarks. These little seeds have been found attached to stems, which were previously called *Antholithes Pitcairniæ*, Lindley & Hutton, by Mr. C. W. Peach, at the Cleuch, Falkirk, and have been described and figured by Mr. Carruthers in the Geol. Mag. vol. ix. 1872.

As *Cardiocarpon Lindleyi* is almost invariably found associated with *Cordaites principalis*, it is perhaps the fruit of that species.

Locality. Bent Colliery, Bellshill.

CORDAIANTHUS, Grand'Eury.

Cordaianthus, sp.

Remarks. This specimen is probably a young condition of *Antholithes Pitcairniæ*, L. & H., and is the female inflorescence of a *Cordaites*. The fossil shows an axis 3¼ inches long, and at its basal extremity it is fully $\frac{1}{10}$ inch wide. On each side of the stem is a vertical row of alternate bracts, from the axils of some of which traces of fruit-pedicels can be seen. Each row contains about twenty groups of bracts; those at the base of the inflorescence are about $\frac{1}{5}$ inch long and rather less than $\frac{1}{10}$ inch wide; but they become slightly smaller and more distant towards the upper part of the specimen, of which, however, the extreme apex is wanting. The structure and number of bracts in each group is not shown. On the same slab is a specimen of *Cardiocarpus Lindleyi.* This example of *Cordaianthus* was found associated with *Cordaites principalis*, Germar, sp.

Locality. Bent Colliery, about 1½ mile E. of Bothwell.

Of uncertain Affinity.

TRIGONOCARPUS, Brongniart.

Trigonocarpus Parkinsoni, Brongniart.

Trigonocarpum Parkinsonis, Brongniart, Prodrome, p. 137.
Trigonocarpum Noeggerathii, Lindley & Hutton (not Sternberg), Fossil Flora, vol. ii. pl. cxlii. C; vol. iii. pl. cxciii. figs. 1–4 B, pl. ccxxii. figs. 2 and 4.

Remarks. *Carpolithes alatus*, Lindley and Hutton ('Fossil Flora,' vol. ii. pl. lxxxvii., vol. iii. pl. ccx. B), appears to be only *Trigonocarpus Parkinsoni* enclosed in its pericarp. It is not yet discovered to which plant these seeds belong.

Specimens of a *Trigonocarpus* have been found in which the internal structure was preserved, and these show that it is Gymnospermous.

Locality. Roof of Kiltongue Coal, Mount Vernon.

XLV.—*Description of a Species of Wild-Mulberry Silkworm, allied to* Bombyx, *from Chehkiang, N. China.* By F. MOORE, F.Z.S., A.L.S., &c.

THE wild species of silkworm, of which the following is a description, was recently procured by Mr. F. Kleinwächter, Commissioner of the Imperial Maritime Customs, Pekin, who obtained it from Wu-lou, on the borders of the Tai-hu, province of Chehkiang, where it is found feeding on the wild mulberry. During the present month (May) specimens have also been brought home by Mons. Fauvel, one of the Commissioners of the Imperial Maritime Customs, who found them at Hankeou on the wild mulberry.

For the specimens and the opportunity of describing this new insect I have to thank Mons. Natalis Rondot of Paris, and the Chamber of Commerce of Lyons, to whose energy and special labours in sericiculture we are indebted for the knowledge of this species, as well as for several other interesting and valuable silk-producers.

RONDOTIA, nov. gen.

Fore wing shorter and more triangular in form than in typical *Bombyx* (*B. mori*); apex shorter, not subfalcate, exterior margin acutely angular at end of upper median vein: hind wing with the apex regularly convex; exterior margin oblique hindward, slightly sinuous and distinctly angular at end of lower median vein. Cells comparatively broader and shorter. Venation similar, except that in the fore wing the fourth subcostal branch is emitted nearer the apex, and in the hind wing the two subcostals are emitted at fully half beyond the cell, instead of close to the end, and the middle median from some distance before the end of the cell, instead of beyond the end. Body and base of wings squamous, whereas in *B. mori* they are lanuginous. Shaft of antennæ not so thick, the branches slender and with finer cilia; legs and tarsi slender, laxly squamous, not thick and densely lanuginous as in *B. mori*.

Rondotia Menciana.

Wings ochreous-yellow; fore wing with a transverse, slender, black-scaled, antemedial curved band, which is slightly angulated between the median and submedian veins; a similar postmedial irregularly undulated band, and a slender dentated streak at the end of the cell: hind wing with a less-defined black-scaled, transverse, discal band, which is also slightly angulated outward beyond the cell, being darkest and broadest at its posterior end; a black-speckled spot also on middle of the abdominal margin. Thorax ochreous-yellow; abdomen brownish ochreous; legs paler; eyes black; shaft of antennæ brown, pectinations blackish; tips of femora and tibiæ blackish.

Expanse, ♂ $1\frac{3}{10}$, ♀ $1\frac{4}{10}$ inch.

Hab. Province of Chehkiang, N. China.

Larva about 1 inch in length, pale olivaceous yellow or whitish; with sixteen legs; slender; head and second segment small; third and fourth segments somewhat tumid; a small black fleshy horn, $\frac{1}{10}$ inch in length, on top of twelfth segment, the horn being thick at its base and slender at the tip; all the segments (except the head) are transversely corrugated, each segment having four or five ridges, which are more or less longitudinally folded beneath below the spiracles; the spiracles are oval, brown, and with a very slender black outer ring; the anterior and posterior segments have some minute brown speckles between the corrugations, and there is a brown-speckled streak above the anterior and middle legs and the other segments except the anal; the claws and claspers are also brownish; side of the head and mandibles speckled with dark brown; a black dorsal spot on anal segment. Found feeding upon the wild mulberry.

Cocoon small, oval, from half to three quarters of an inch in length; flossy in texture, of a pale creamy-yellow colour; spun on a leaf, with some transverse threads of stouter silk fixed across the outside of the cocoon from side to side of the leaf.

Pupa dark reddish brown.

The eggs are deposited on the bark of the mulberry-tree in clusters, and are more or less covered with the short hairy scales of the anal tuft.

It is stated that there are two broods of this wild silkworm in the year.

BIBLIOGRAPHICAL NOTICE.

Die Pilzthiere oder Schleimpilze. Von Dr. W. Zopf. Breslau: E. Trewendt, 1885.

It is now more than twenty years since the publication of De Bary's 'Mycetozoen,' which first called general attention to the remarkable life-history of these organisms. The first result of that publication was to raise a storm of criticism, which, so far as it was respectful and the outcome of reflection, was natural enough. The occasion was one of a new and somewhat startling departure, and it naturally surprised some more than others. The violence of the criticism was in proportion to the unpreparedness of the critic, and a considerable body of it produced in this country was characterized by abject ignorance of the bearings of the investigation and consequent misrepresentation of its results. First of all it was pretty commonly thought that the whole thing was absurd, chiefly because it was imperfectly understood. Next came a period of indifference and relapse, to be followed by the energetic and well-directed work of recent years.

Rostafinski's beautiful monograph (1875) was the next great contribution to our knowledge; but from the fact that it is written in Polish it is accessible only in a fragmentary way. For example, Dr. M. C. Cooke has extracted and translated the parts referring to such species as have been recorded in Britain; but this gives one merely so much as to lead to a demand for more. To come to more recent publications, De Bary's treatment of the group in the 'Vergleichende Morphologie' (noticed in Ann. & Mag. Nat. Hist. Nov. 1884) has been followed by two valuable publications, viz. that at the head of this notice and Schröter's treatise, just published, which begins the third volume of the 'Kryptogamen-Flora von Schlesien.' The latter is merely a systematic arrangement, differing, it is true, from Zopf's as to the disposition of a number of genera, but not otherwise in any striking way. In all of these publications, from Rostafinski's onwards, there is manifest the fruit directly borne by the investigations recorded in the 'Mycetozoen,' which were so long regarded by many with indifference.

Dr. Zopf has succeeded in producing an extremely useful book; the matter is well arranged, the descriptions clear, and the illustrations good and plentiful. After a short introduction the book is divided into three parts, dealing with the morphology, physiology, and systematic disposition respectively. The first and second sections are remarkably well done, and the amount of detail is just what is desirable in such a handbook. In the systematic section the student will be agreeably surprised to find not an outline merely, but detailed descriptions of species, such as are certain to render great service in their identification. The 174 pages of the book are about as well filled with useful matter as could be desired.

As regards the position of this group of obscure organisms, there is naturally a great temptation to place it between true fungi and *Bacteria*, though there is much to be urged against yielding to this.

G. M.

MISCELLANEOUS.

On the Circulation of the Larvæ of Ephemeræ. By N. Creutzburg.

In the microscopic investigations which I have made in the laboratory of the Zoological Institution at Leipzig upon the circulation of the blood in the larvæ of *Ephemera diptera*, I have succeeded in arriving at some interesting results, which I wish now to bring into general knowledge as briefly as possible, reserving a more detailed treatment of the subject to some future time.

My observations, in which I availed myself of M. Verlooren's memoir on the circulation of the blood in insects * as my foundation, had for their principal object the part taken by the dorsal vessel in the movement of the blood in the caudal setæ of the Ephemera-larvæ. This is effected, as indeed is shown by Verlooren in the above-mentioned memoir, by the contractions of a pyriform vessel, which, situated in the last abdominal segment, appears to be a direct continuation of the dorsal vessel, and on a superficial examination may easily be taken for its last chamber. This view is contradicted, however, by the circumstance that this vessel is quite independent of the contractions of the dorsal vessel.

With regard to this vessel Verlooren speaks as follows in the above essay (pp. 84, 85):—

"We find in it no lateral apertures with their valvular arrangement belonging to them, but in the middle a single apparatus, the valvular membranes of which are opposite in direction to the valves of the dorsal vessel. This apparatus therefore permits a flow of the blood from before backwards, a flow opposite to that occurring in the dorsal vessel.

"If this organ is connected with the posterior extremity of the heart, it may be furnished by the action of the latter with blood, which therefore will acquire a movement from before backward. This blood will then be communicated to it by the heart-chamber situated in the fourteenth segment. If no such union be present, blood may be conveyed into it from without, from the body-cavity, by the action of the valvular apparatus."

The latter view appears to be regarded by Verlooren as in accordance with the truth, for he says (p. 84) it seemed to him that no communication existed between the heart and the vessel in question.

* Mém. couronnés de l'Acad. Roy. de Belgique, 4to, tome xix.

On the contrary, after a series of observations upon the most different objects, I have arrived at the conviction that this view is erroneous. I have succeeded in demonstrating the following facts:—

1. The vessel-like dilatation of the canals of the caudal setæ in the last abdominal segment is directly connected with the dorsal vessel. During the contractions of the heart it receives a portion of the blood which may be in the hindmost division of the vessel, and which it then by its own contractions drives into the canals of the caudal setæ.

2. A communication of this vessel with the body-cavity, so as to permit the entrance of blood into it in accordance with the above-mentioned opinion of Verlooren's, I have been unable to observe. There rather seems to me to be a firm union with the dorsal vessel.

3. The valvular apparatus situated at the anterior end of the vessel consists of two membranes parallel to the plane of symmetry of the body, which, as processes of the dorsal vessel, are directed backwards and attached in an inversion of the vessel.

4. These membranes, like the other valvular apparatus of the dorsal vessel, are set in motion by its action, only in the opposite way. They apply themselves together when the dorsal vessel expands, and open when it contracts, by which of course a flow of blood directed from before backwards is produced.

The latter fact is probably the best proof of the untenability of Verlooren's opinion. For if the vessel were to be furnished with blood from the body-cavity by the action of the valvular apparatus, the movement of the membranes must have stood in some relation to the phenomena of contraction of the vessel, which, however, is by no means the case.

On the other hand, scarcely any argument can be brought against the proposition established by me; on the contrary, we may easily convince ourselves by direct observation of the correctness of my statements.—*Zool. Anzeiger*, April 27, 1885, no. 193, p. 246.

On the Existence of a Nervous System in Peltogaster; *a Contribution to the History of the Centrogonida.* By M. Y. Delage.

Until quite recently the Centrogonida (*Rhizocephala* of Fritz Müller) were regarded as destitute of a nervous system. In a communication to the Academy *, and, more recently, in a more extended memoir †, I have shown that the nervous system exists in *Sacculina*. After this it was almost certain that it existed also in

* 'Comptes Rendus,' tome xcvii. (October 29, 1883).

† "Evolution de la Sacculine, Crustacé endoparasite de l'Ordre nouveau des Kentrogonides," Archives de Zool. expér. sér. 2, tome ii. 1884. [We do not see why Fritz Müller's name Rhizocephala was not retained for the new order; but, while accepting the new name, we shall not disfigure the pages of the 'Annals' by adopting the author's barbarous spelling.]

Peltogaster, which is closely allied to *Sacculina*. Having succeeded, not without difficulty, in obtaining some Peltogasters, I have dissected them and succeeded in discovering the nervous system.

The central organ (as in *Sacculina*) consists of a single ganglion. This ganglion is situated in the sagittal plane in the interior of the mesentery which unites the cloaca to the peduncle, almost between the cement-glands *, but, nevertheless, a little beyond towards the cloaca, exactly at the level of the testicular cæcum. Its situation is therefore very superficial, as it is separated from the outer world only by half the thickness of the mantle. It is an elongated ganglion which measures about $\frac{1}{10}$ millim.; hence it is hardly visible to the naked eye, even when it has been completely prepared by dissection under the microscope with the aid of the erecting prism. It is absolutely simple, and by no means composed of two approximated symmetrical masses. Its constitution includes small, fusiform, peripheral cells, and large central multipolar cells with a large rounded nucleus furnished with a punctiform nucleolus. It gives origin to numerous nerves, which, however, are very fine and extremely difficult to trace by dissection, since they are hardly distinguishable from the muscular and connective fibres in the midst of which they twist about. On the side of the cloaca it gives off four long filaments, two of which, superficial and forming a pair, run to that organ, and particularly to its sphincter; while the two others, also a pair, penetrate the visceral mass between the two symmetrical halves of the ovary. From its opposite extremity it gives origin to a large median trunk which insinuates itself between the two symmetrical masses of the ovary, giving off from place to place ramifications to each of them. From the origin of this trunk, or perhaps from the ganglion itself, originate two small nervous filaments, which follow the inner margin of the testes, and are distributed to those organs. Upon the sides originate three pairs of nerves—two in the cloacal half of the body, one in the opposite half. The former two run obliquely outward, and penetrate into the mantle at the point where this splits to form the lamellæ of the mesentery. The last passes between the cement-gland and the testis, then outside the latter, taking a direction towards the deferent canal. Near its origin it furnishes two branchlets for the cement-gland, one for the gland itself, the other for its lateral parts, and no doubt for its sphincter. Not far from its termination it gives off a nervous filament, which passes under the margin of the mesentery, to run, no doubt, to the wall of the visceral mass or to the mantle.

Just as these nerves are difficult to trace, so are the central ganglion and the origin of the principal trunks easy to see, *when one knows where to look for them*; but this last condition is indispensable.

* The cement-glands, which have been regarded as absent, really exist; but they are reduced to two very wide sacs with glandular walls, but without ramifications.

It is from not having had it at their disposal that the authors who have investigated *Peltogaster* (Rathke, Anderson, Lilljeborg, Kossmann, and so many others) have not succeeded in finding these parts. In fact the absence of the digestive tube and of the limbs, and the want of determination of the cephalic and caudal extremities, deprive us absolutely, in the Centrogonida, of the marks which serve to guide us in more regularly constructed animals. And how, without reference-marks, is one to find an imperceptible ganglion, lost in an innumerable mass of ova, each of which is at least twice its size? Thus I only succeeded in finding it in *Sacculina* after two years of investigations. In *Peltogaster*, on the contrary, although the absolute difficulties of the search are exactly the same as in *Sacculina*, I found it in the first individual dissected after less than an hour's work. I mention this particular only to show the value of the morphological method; for if I have found this nervous system it is by no means due to particular address in dissection; it is because, armed with the morphological data derived from the study of *Sacculina*, I sought for it precisely where it ought to be found.

The type *Peltogaster*, although notably different from the type *Sacculina*, may be regarded as derived from the latter in consequence of certain modifications. The body is depressed and elongated; the mesenteric or ventral side * has diminished in length to the advantage of the dorsal side, so as to carry the cloaca to one of the extremities of the cylinder; on the dorsal side a new mesentery has been developed; lastly, and this is the principal modification, the cement-glands have ascended and, quitting the declivous parts of the ovary, have gone to place themselves close to the peduncle and the male sexual glands.

In these displacements of the organs was the nervous ganglion to retain its original situation at the bottom of the ovary, or was it to follow the cloaca, or the mesentery, or the cement-glands? Observation has shown that it did not remain immovable; therefore its relations with the declivous pole of the ovary are not at all essential; it had followed the cloaca and the mesentery, but especially the cement-glands, in their movements; hence it is with these organs, and chiefly with the last-named, that it has fundamental relations. On the other hand, we see that the close relations of the ganglion with the testes in *Peltogaster* are quite accidental, since in *Sacculina* those organs are as far apart as possible. Henceforward in seeking for the nervous system in other Centrogonida, in which the viscera may again affect new relations, we see that we shall not have to pay any attention to the testes or to the antipeduncular pole of the ovary, and that it is between the cement-glands, in the sagittal plane, and perhaps slightly towards the cloaca and the cement-glands, that we must direct the forceps and

* For the orientation of the animal, see the memoir cited, pp. 440 and 695.

the scalpel. It is only by the study of a type in which the cement-glands may be far removed from the mesentery and the cloaca that we can see whether the nervous ganglion would entirely break off its relations with the latter two organs and follow the cement-glands in their displacement.—*Comptes Rendus*, April 13, 1885, p. 1010.

On the Pelagic Fauna of the Baltic Sea and Gulf of Finland. By MM. G. Pouchet and J. de Guerne.

The authors received from the Hereditary Prince of Monaco the materials obtained by him with the towing-net during a yacht voyage in the Baltic in 1884. His operations were carried on from 54° 59′ N. lat. and 17° 8′ E. long., as far as the bottom of the Gulf of Finland. They extended from the 14th August to the 15th September; the weather was fine and the sun generally shining, and the surface-temperatures of the sea when the collecting was carried on, *i. e.* from 9 A.M. to 4 P.M., were between 14° and 16° C. (57°·2–60°·8 F.).

The chief materials obtained in the Baltic consisted of Cladocerous and Copepod Crustaceans, with a great quantity of small algæ. The latter cover the whole extent of the basin included between Gothland, Prussia, and the entrance of the Gulf of Finland. They give the water of the Baltic its characteristic olive-green colour.

In the Gulf of Finland there were found freshwater Crustaceans distinctly characterized as *lacustrine pelagic* (Forel), such as *Cyclops quadricornis*, *Daphnella brachyura*, *Daphnia quadrangula*, and *Bosmina longirostris*. The last-named species forms three fourths of the mass of animals obtained in these waters. It is found associated with *Hyalodaphnia kahlbergiensis* and a *marine pelagic* form, *Evadne Nordmanni*, which becomes more and more abundant as the saltness of the water increases. Towards the south the *Evadne* is gradually substituted for the *Bosmina*, which, however, occurs beyond Danzig, and the marine *Bosmina* taken in the Sound by Müller and at Kiel by Möbius is probably only a variety of that of the Gulf of Finland.

Towards Gothland the marine Copepoda begin to be numerons, forming about one third of the animals captured. The remainder consists chiefly of the *Evadne*. Further south, in latitude 54° 59′ N., some embryonic Lamellibranchs make their appearance; but their scarcity contrasts with the abundance of such larvæ in the ocean and the Mediterranean. A single doubtful specimen of a Peridinian (*Dinophysis*) occurred. *Temora velox*, well known as an inhabitant of brackish water, occurs everywhere.

The authors sum up as follows the general results of their investigations:—"It seems to us," they say, "that the pelagic fauna of the Gulf of Finland resembles in general character that of the great

European lakes, as made known to us by Forel, Lilljeborg, P. E. Müller, Pavesi, G. O. Sars, Weissmann, &c. As in the Scandinavian lakes, certain species of *Cladocera* are represented by a considerable number of individuals. We also find them attacked by parasitic Cryptogamia. Lastly, the presence of numerous Infusoria and of Rotifera of the genus *Anuræa* increases the analogy of this fauna with that of the Swiss lakes recently explored, from this point of view, by Imhof.

"These resemblances are explained by the analogy of the conditions of temperature (68° F. at the surface of the Lake of Geneva, according to Forel; 57°·2–60°·8 F. in the Gulf of Finland, according to observations made at the same time as the collections). But they are particularly explained by the slight degree of saltness of the water of the gulf (0·073 per cent. at Cronstadt, 0·262 per cent. at Leskär, and 0·751 per cent. between Gothland and the Russian coast). From the point of view of the pelagic fauna we may compare the Gulf of Finland to a lake with a wide opening to the Baltic.

"As to the central basin of that sea as far as 16° E. long. and probably still further, even to the mouth of the Oder, it presents very distinct characters of transition between the pelagic fauna of fresh waters and that of strongly saline waters. Nature seems to have completely realized the conditions which M. Plateau and M. Bert reproduced experimentally in the course of their investigations upon the vitality of *Daphniæ* in waters of different salinity.

"The presence of *Evadne* and *Podon* in the Gulf of Finland shows that the Cladocera of those genera, which are regarded as essentially marine, may adapt themselves to the conditions of existence in scarcely brackish waters. *Podon intermedius*, for example, which in the Mediterranean bears a salinity or 3·7 to 3·9 per cent., also lives in the eastern part of the Gulf of Finland, where, as has been stated, the water only presents a salinity of 0·073 per cent. We are thus led by the *Podon* and *Evadne* of a nearly fresh sea to the lacustrine forms with a marine facies (*Bythotrephes*, *Polyphemus*, &c.), which have been met with in most of the lakes of Europe" *.
—*Comptes Rendus*, March 30, 1885, p. 919.

* [In their concluding remarks the authors assume that the lacustrine Cladocera derived from marine forms must have been introduced by the agency of migratory birds to their freshwater habitats, and therefore from the north to the south. But one does not see why the agency of migratory birds should be invoked at all.—W. S. D.]

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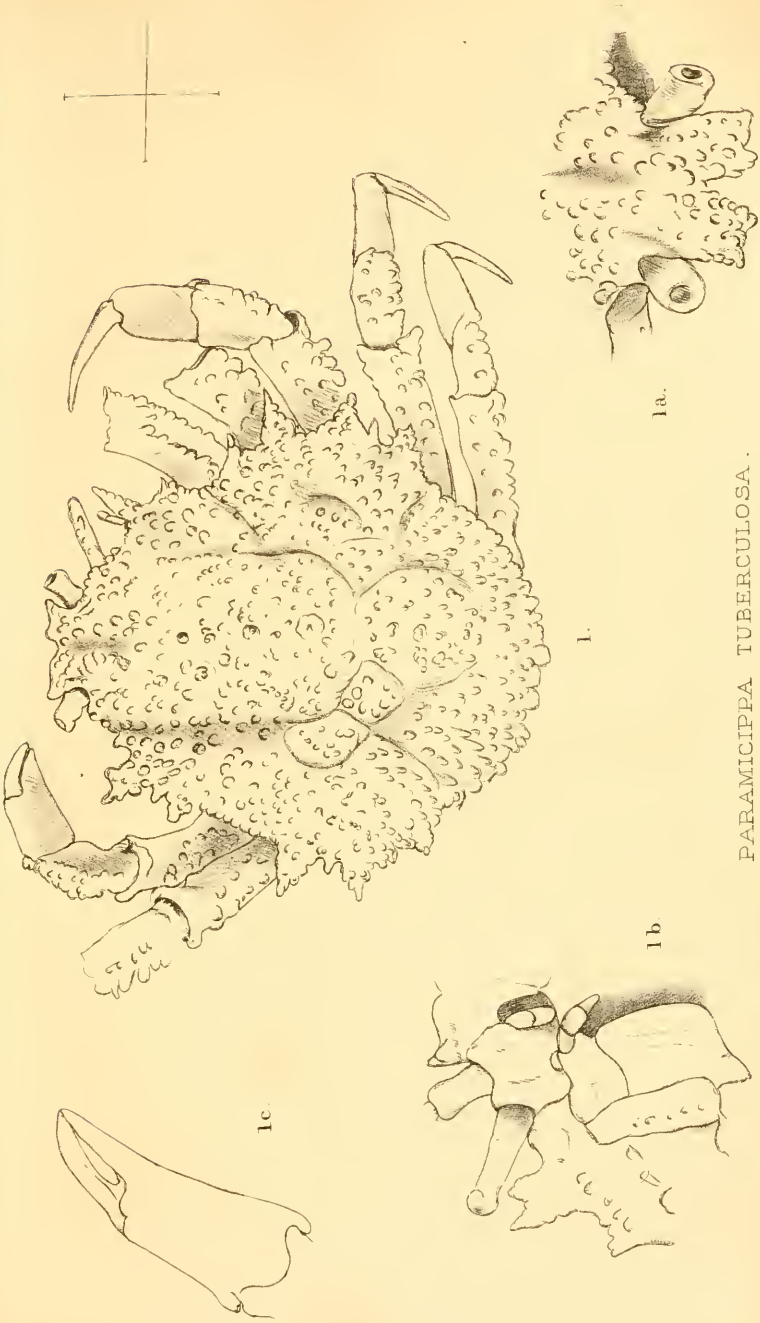

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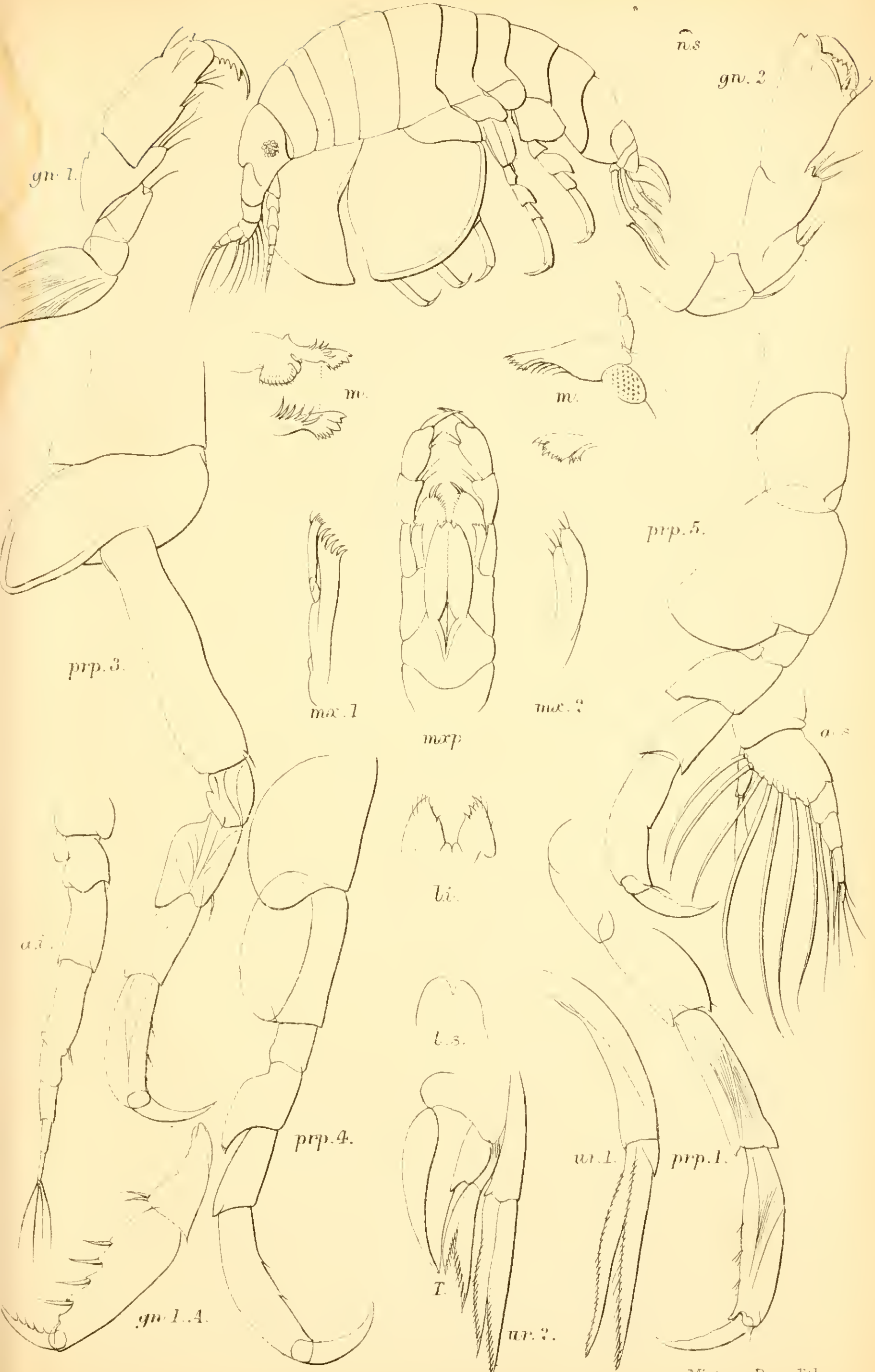

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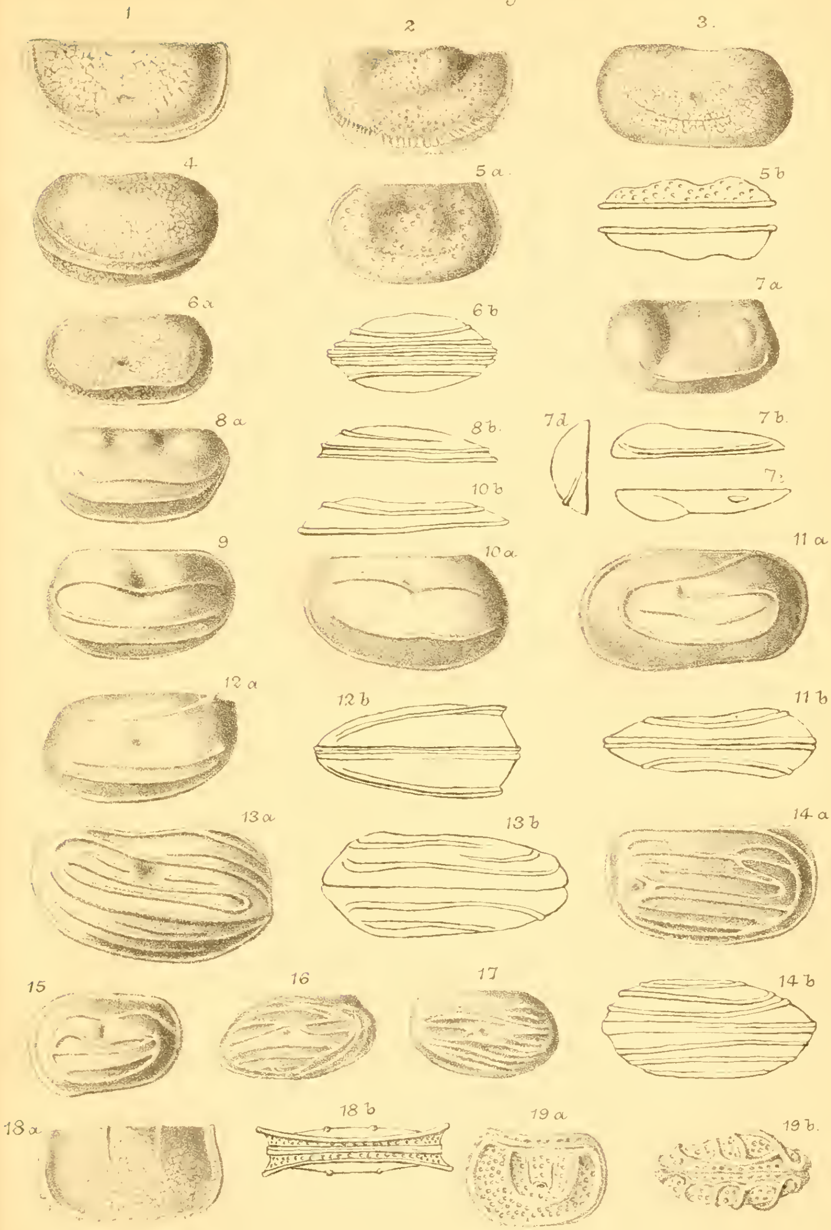

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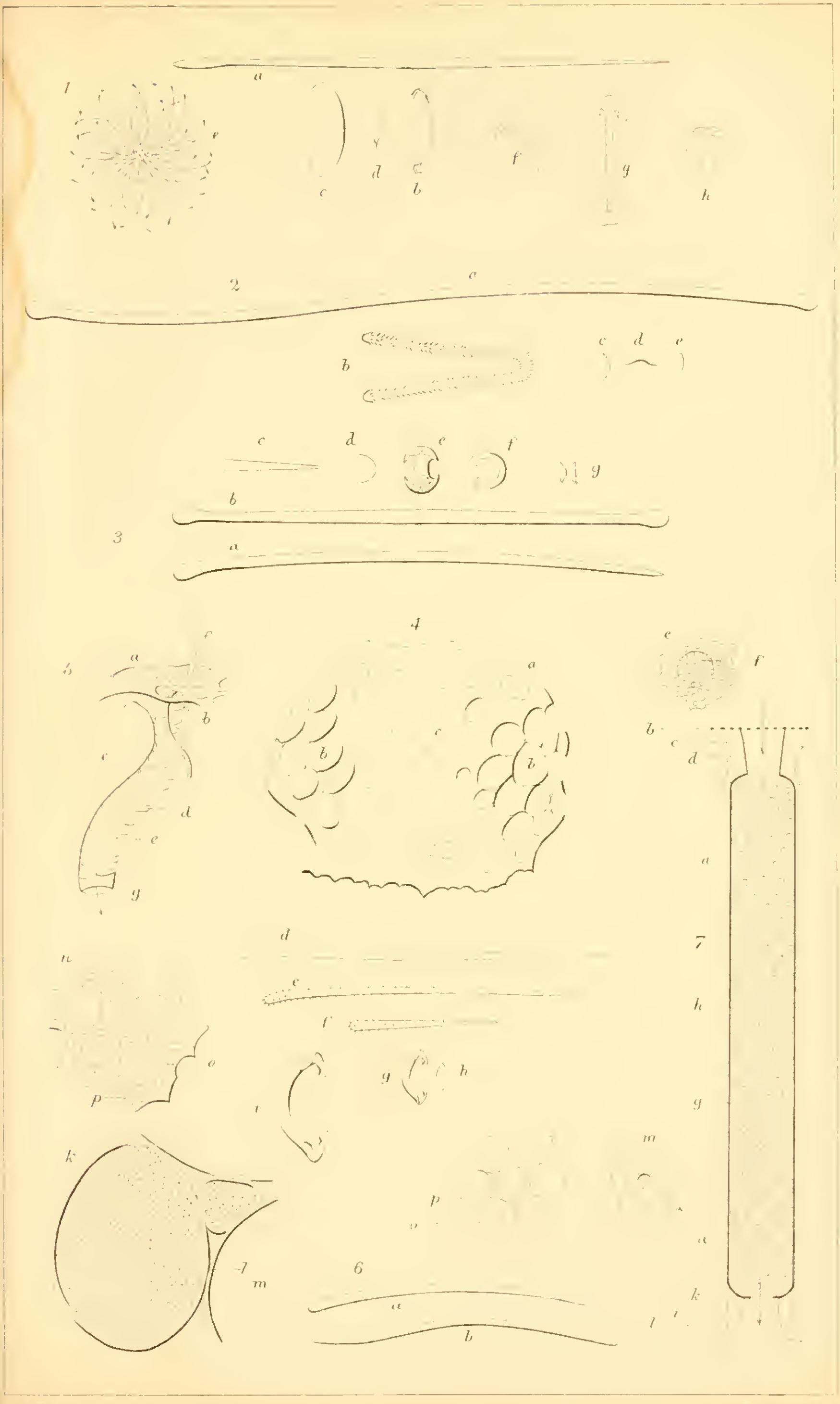

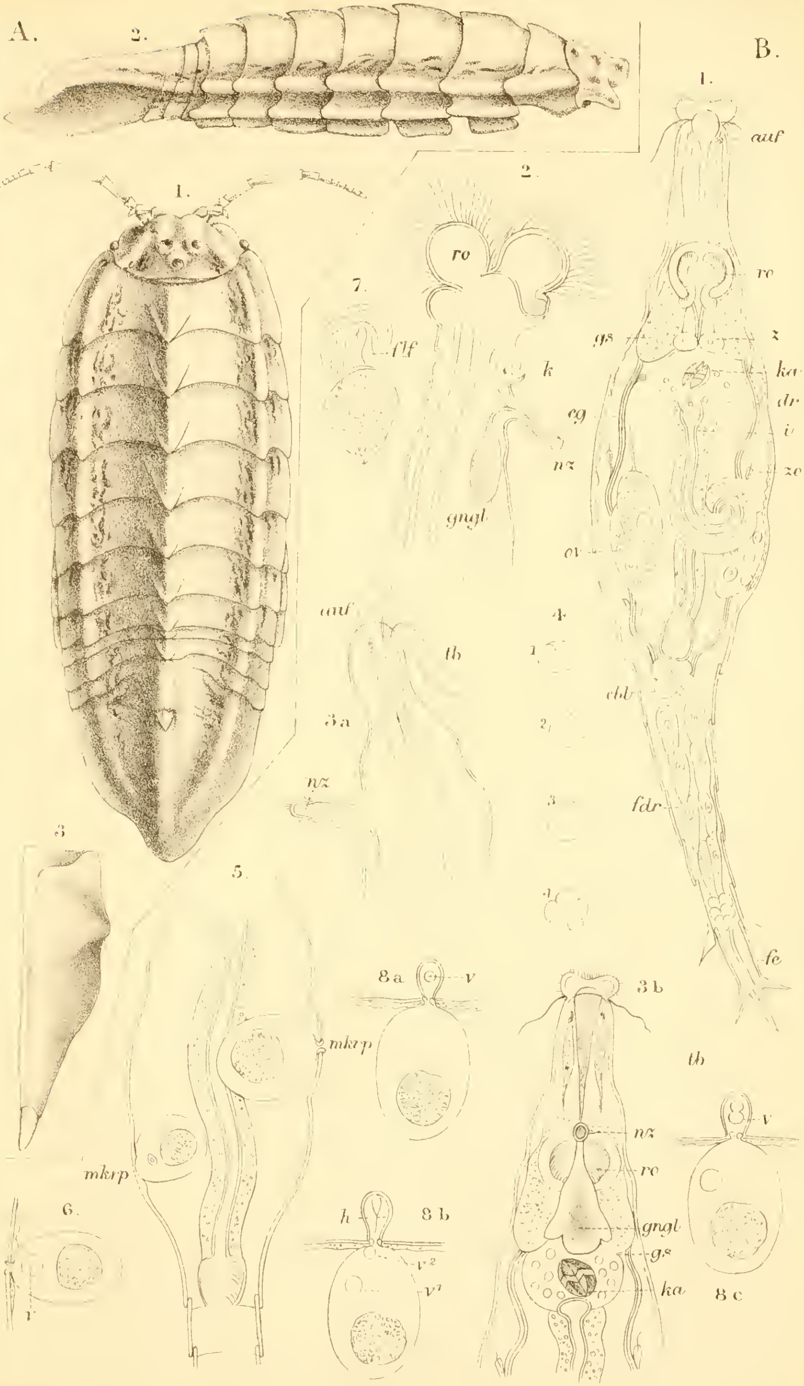

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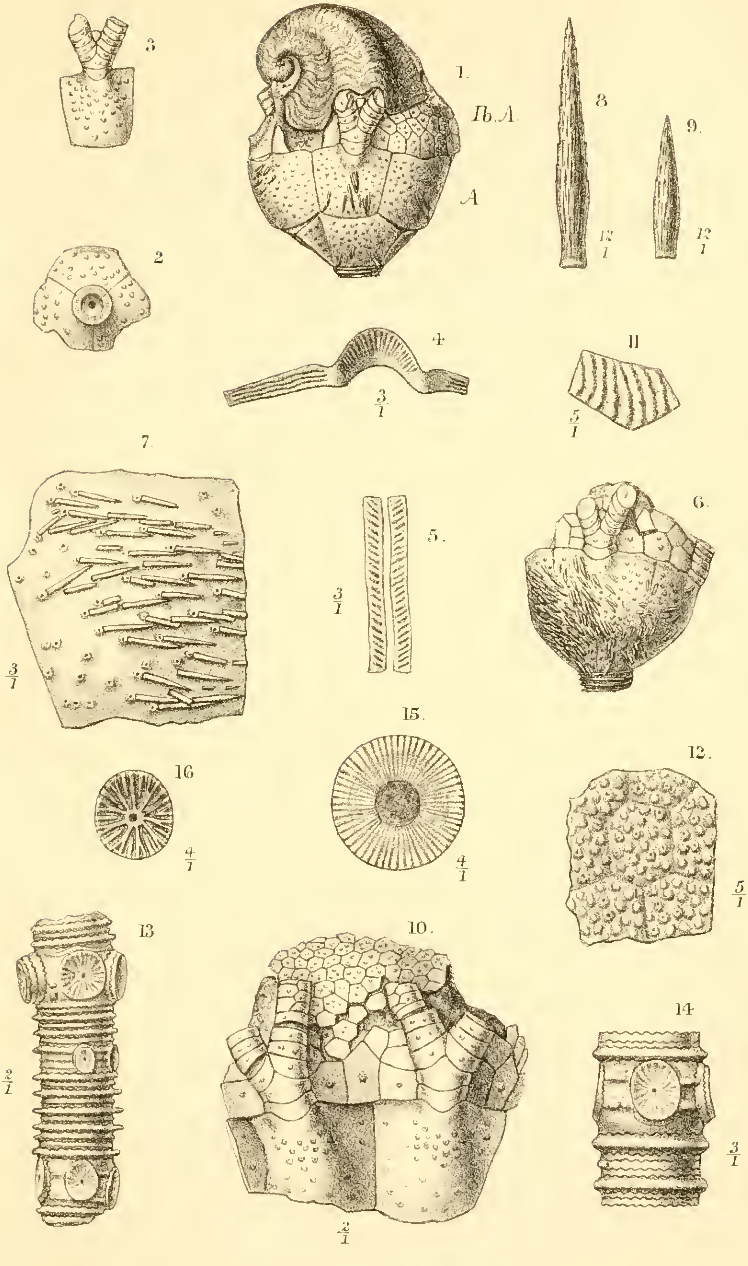

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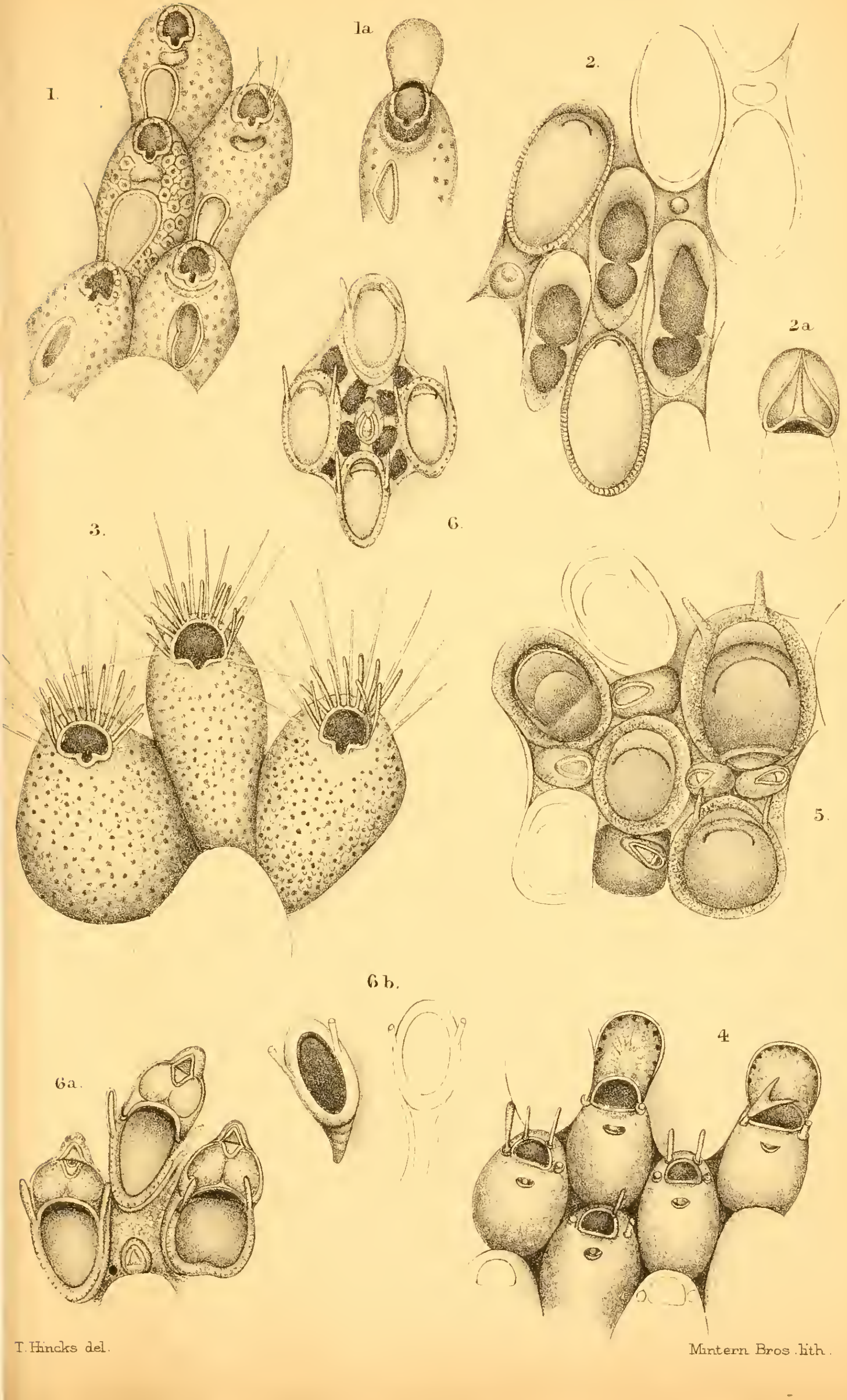

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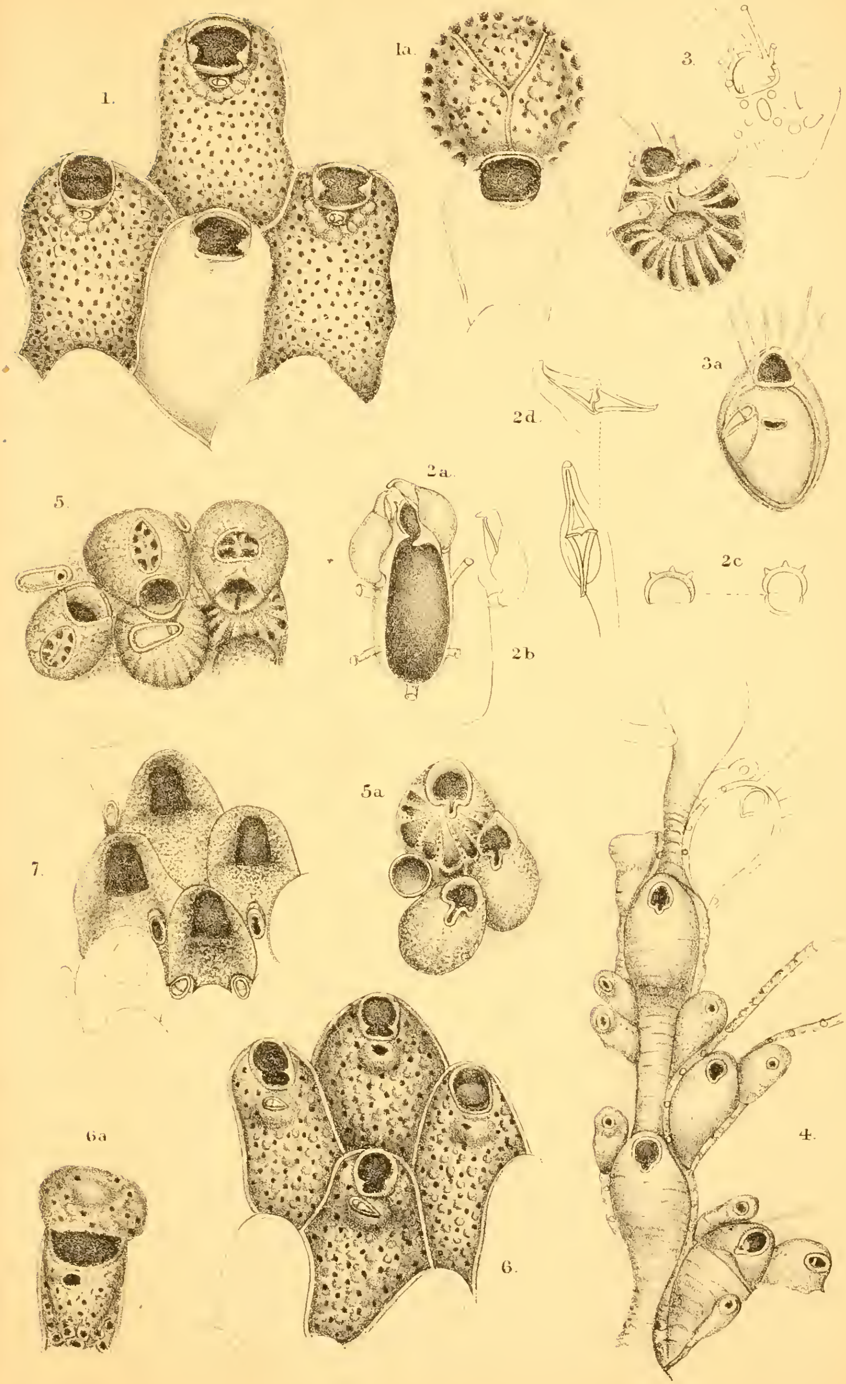

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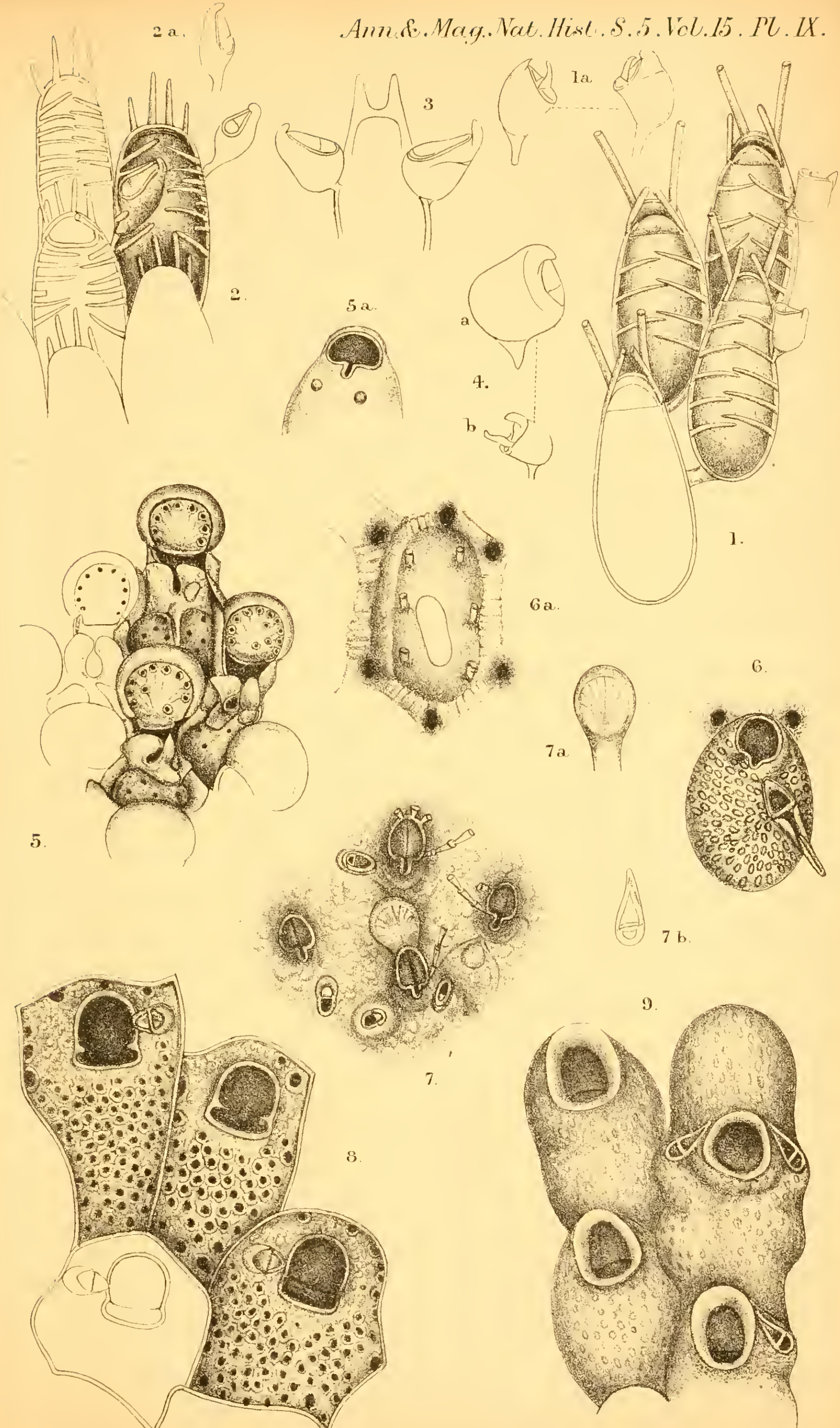

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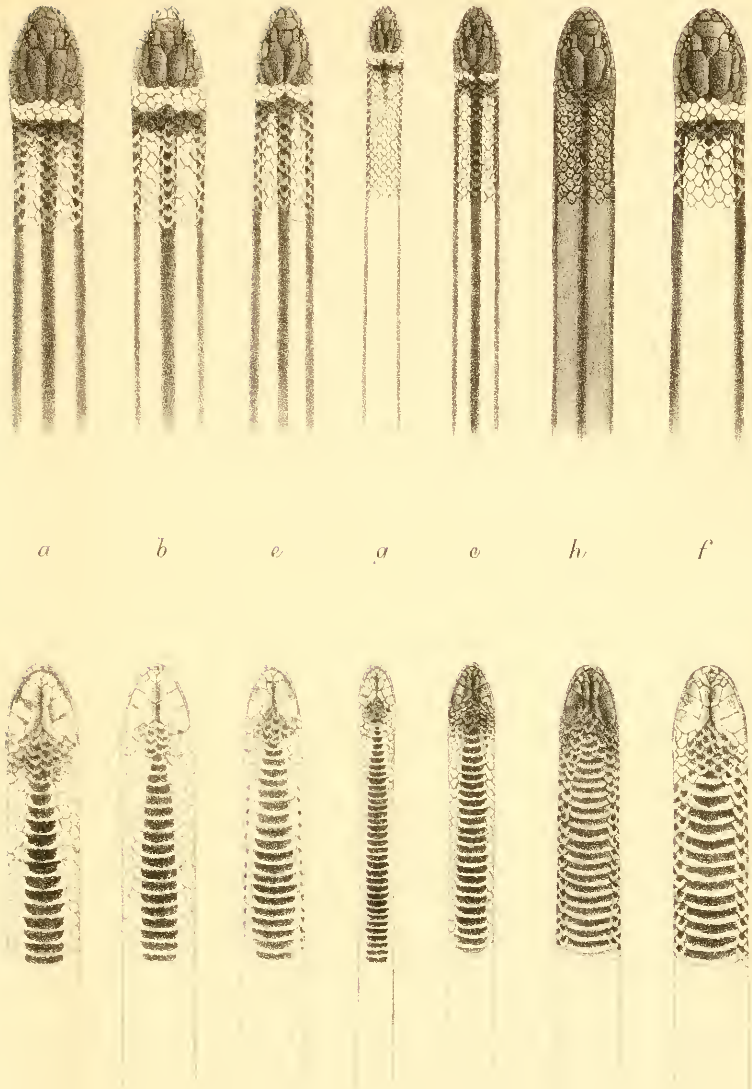

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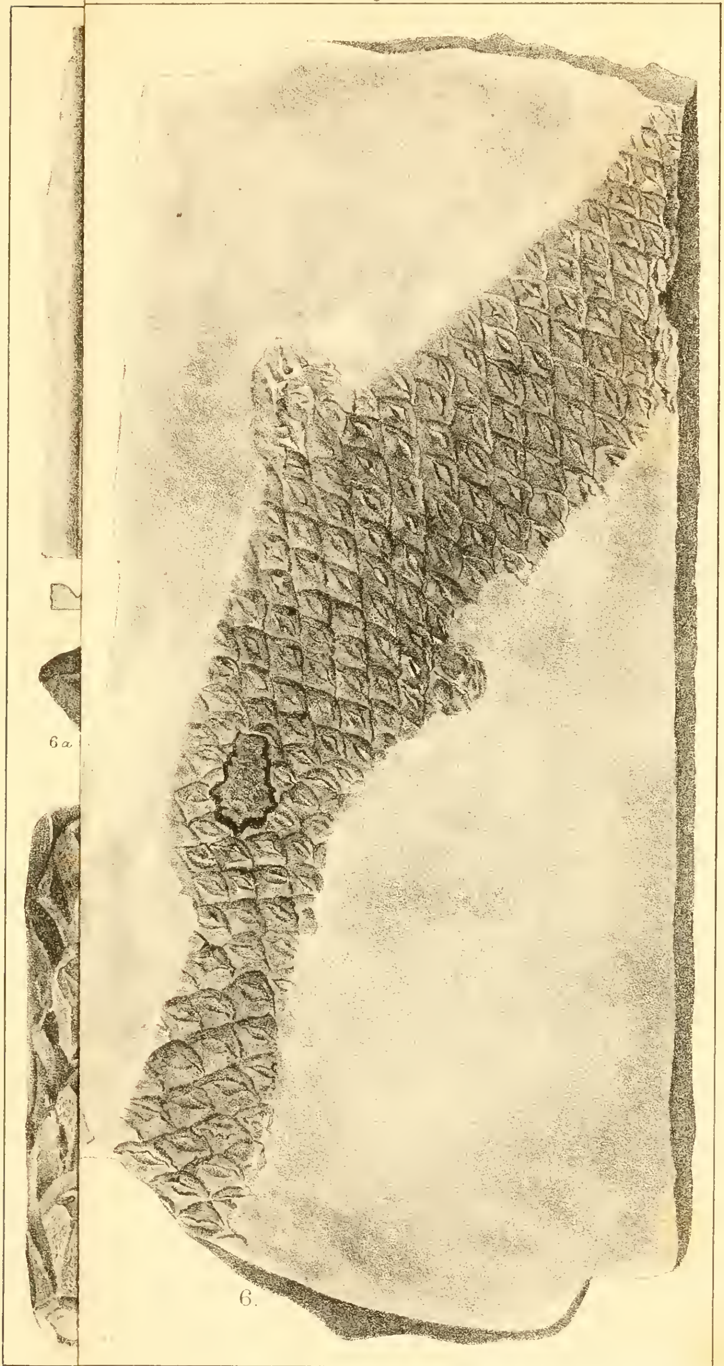

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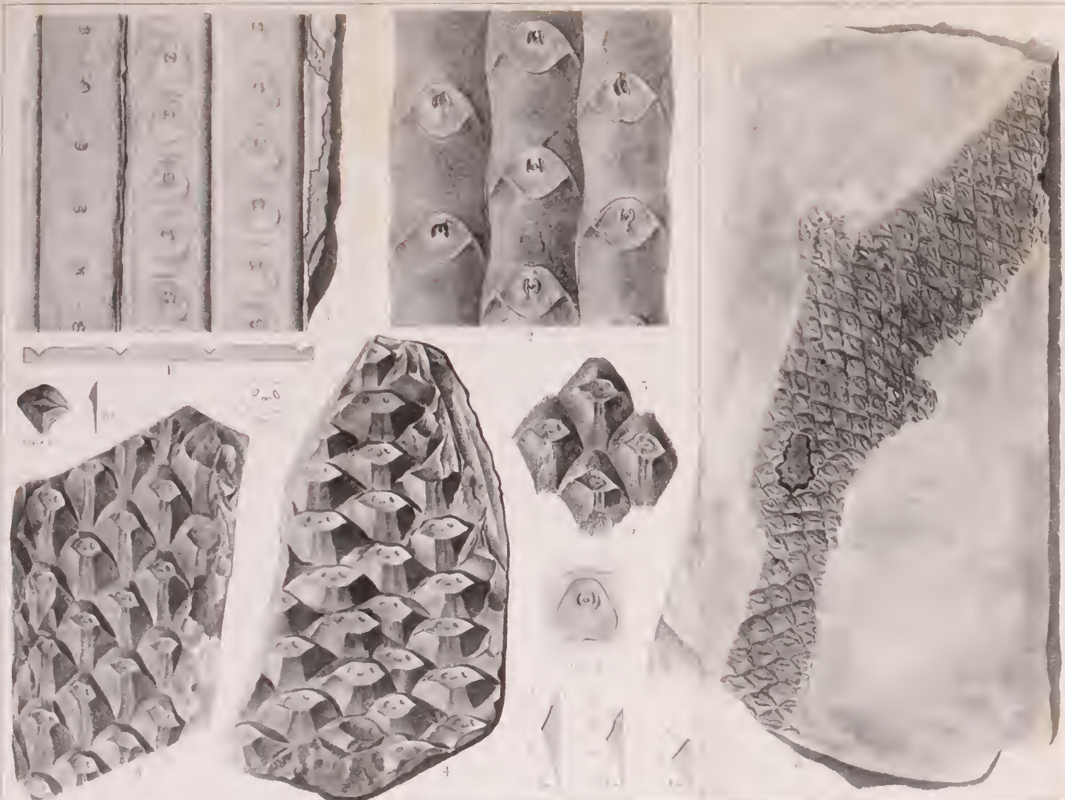

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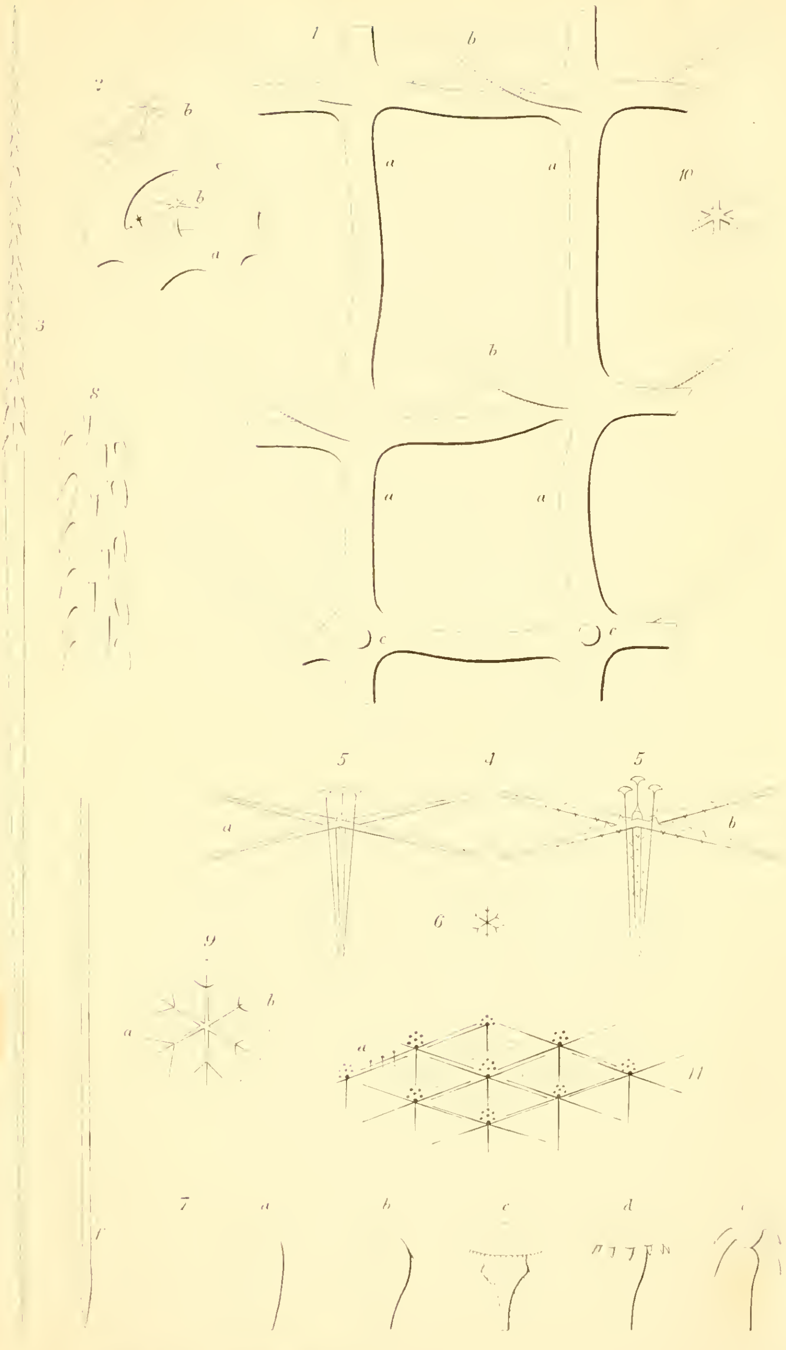

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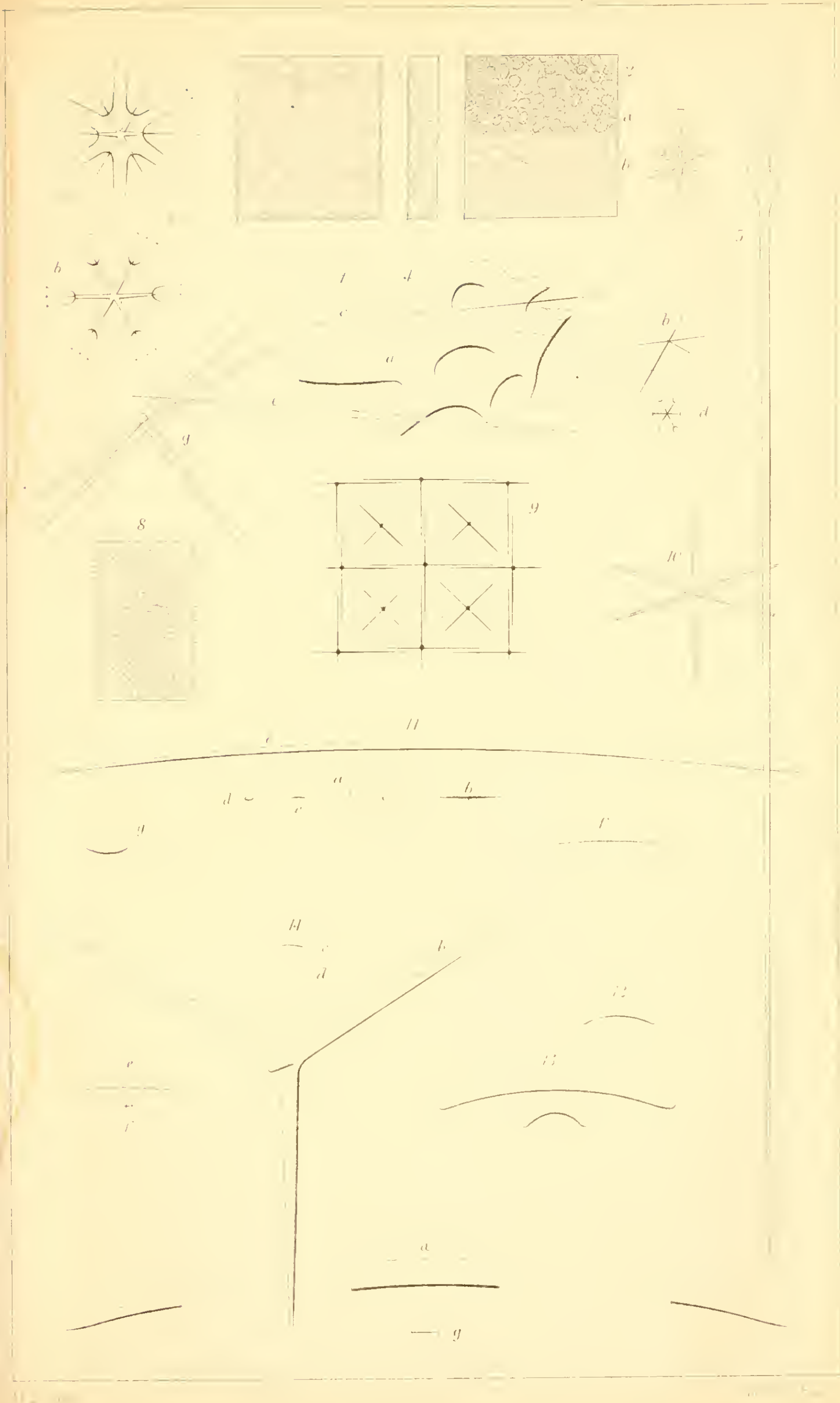

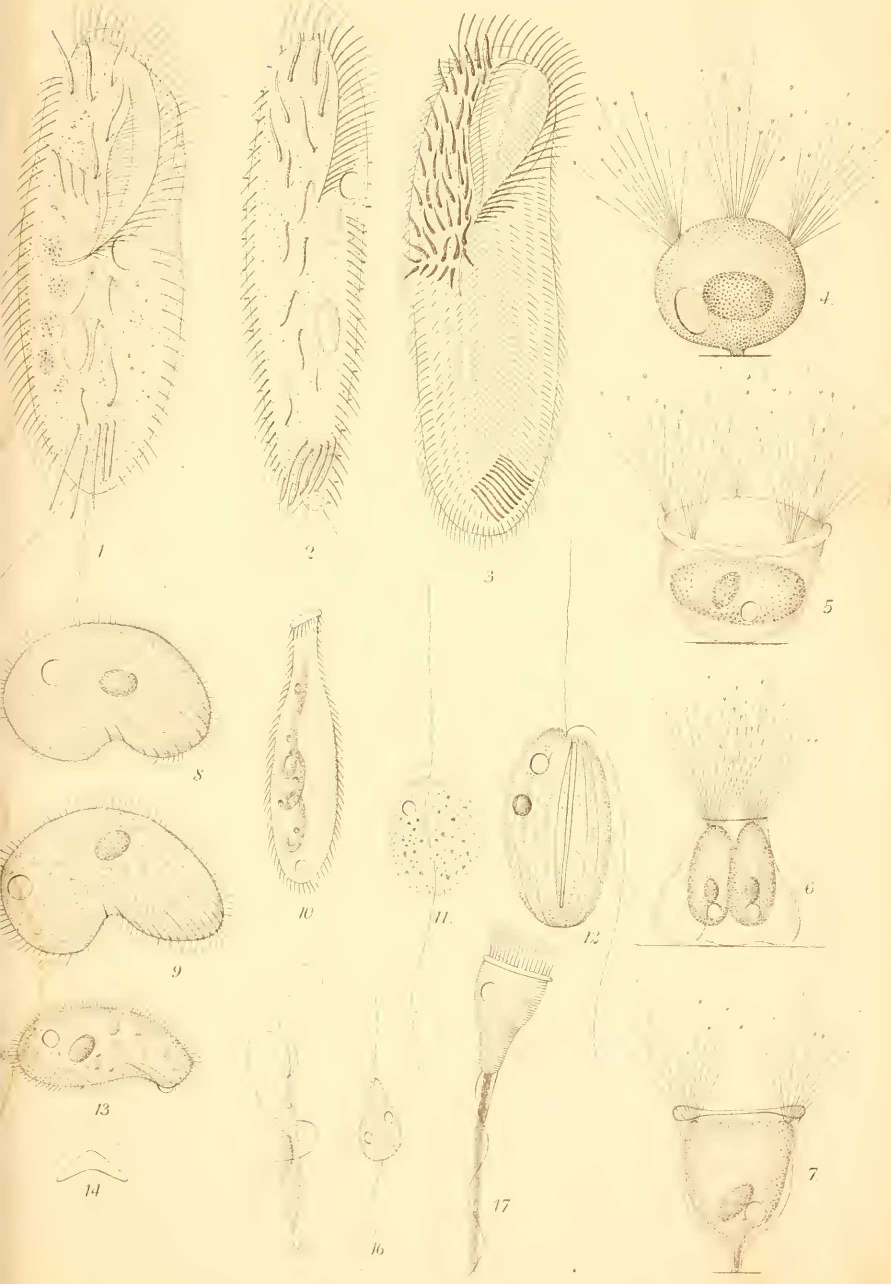
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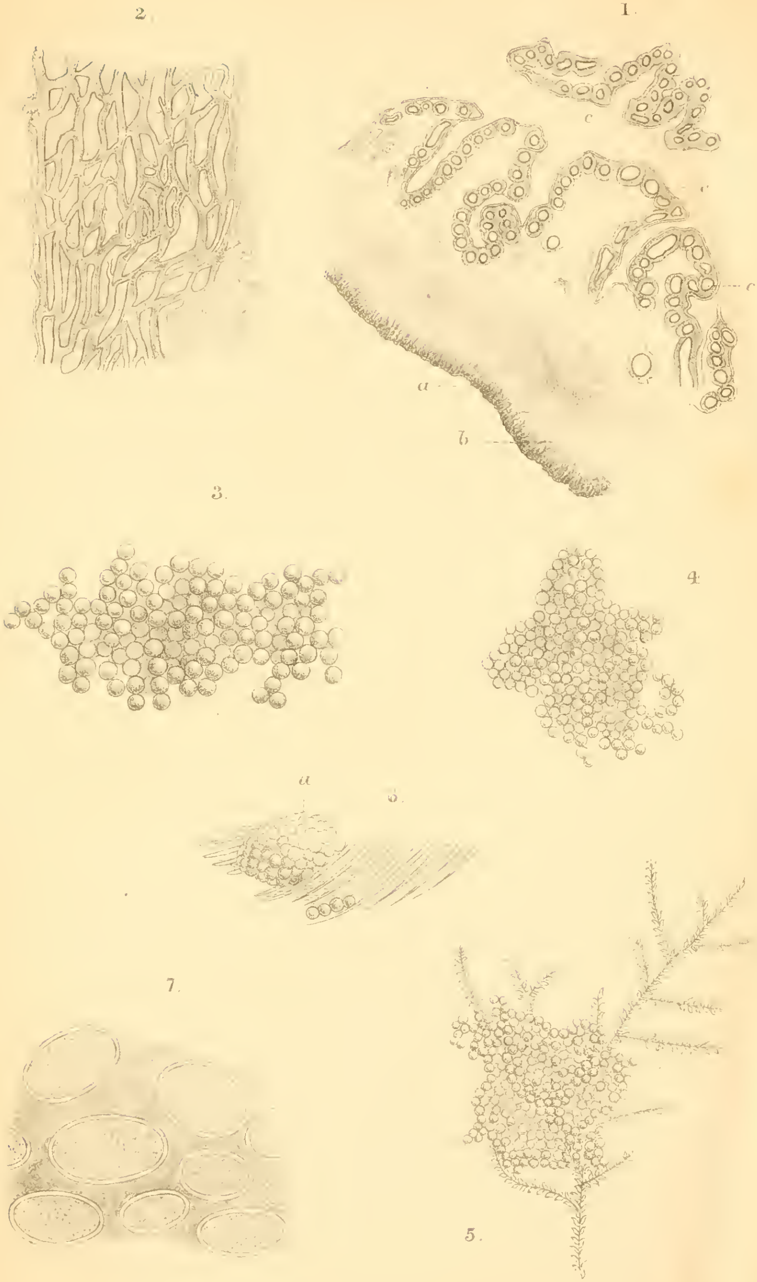

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