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# THE ANNALS

AND

# MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

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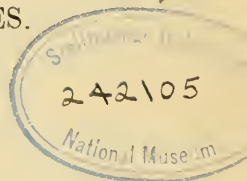
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VOL. III.—FIFTH SERIES.  
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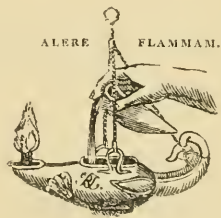
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“Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; 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.





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# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

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“..... per litora spargite museum,  
Naiades, et circum vitreos considite fontes:  
Pollice virgineo teneros hic 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.

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No. 13. JANUARY 1879.

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I.—*Supplementary Observations on the Anatomy of Spirula australis, Lamarck* \*. By Prof. R. OWEN, C.B., F.R.S., &c.

[Plates I.-III.]

‘THE Zoology of the Voyage of H.M.S. Samarang,’ 4to, 1848, includes a monograph on this subject (pp. 6-17, pl. iv.), at the conclusion of which the following particulars are noted as “still remaining to be determined:—such, for example, as the structure of the male organs and that of the female organs, particularly as to whether the oviduct be single or double, whether complicated by glandular enlargements or associated with nidamental glands; the brain and cranium, the principal nerves, the tongue, beak, and lips; the structure of the eyes and the condition of the eyelids; the relations of the shell of the *Spirula*, and especially of its last or open chamber, with the muscular system of the animal” †.

The materials on which the descriptions in the above “monograph” were founded consisted of a headless specimen with the hind end of the mantle torn off (referred to the *Spirula Peronii*, De Bl. ‡), of part of the mantle with shell attached of a *Spirula reticulata*, Ow. § (taken by Dr. Bennett,

\* ‘Encyclopédie Méthodique,’ pl. 456. fig. 5.

† *Op. cit.* p. 16.

‡ *Ibid.* pl. iv. figs. 1, 4, 5, 6.

§ *Ibid.* pl. iv. figs. 3, 9, 10.

F.L.S., off Timor), and of the then unique specimen of *Spirula australis*, Lam., in the possession of Mr. Cuming, "perfect in all its parts except the termination of one of its tentacles"\*. This specimen was found by Mr. Percy Earl on the shore at Port Nicholson, New Zealand, in a fresh state.

The anatomical characters forming the main subject of the "monograph" were derived from dissections of Admiral Sir Edward Belcher's specimen: the uniqueness of the Cumingian one justified the wish of the eminent conchologist, its possessor, to retain it uncut†.

At a later period Mr. Cuming was enabled to place in my hands the specimen (Pl. I. fig. 1) from which the subjoined additional facts have been taken.

The body of *Spirula australis* is divided into head and trunk. The head with its non-retractile arms forms about one third the length of the animal. It is a short, thick cylinder, slightly swollen on each side by the eyes, of which the tegumentary pupils (ib. *a*) open 7 millims. behind the bases of the arms.

The trunk, or mantle, is elongate, subcompressed, slightly expanding at the hinder third, in the dorso-ventral direction, to lodge the shell. The margin of the anterior aperture of the mantle is thin and free, with three emarginations:—one ventral, deep and short, above which the funnel (*i*, figs. 1 & 4; Pl. III. fig. 1, *i*) projects; and two dorso-lateral, meeting at a point (Pl. I. fig. 1, *b*) which projects forwards from the middle of the dorsal border. There are two similar but shorter ventral points at the sides of the funnel. Beyond this margin the mantle gains in thickness, and again thins off to its posterior border.

The mantle terminates behind in two broad lateral lobes (ib. figs. 1, 2, 3, *c, c*) rounded posteriorly and clasping, as it were, the sides of the shell, concealing the umbilical turns. A portion of the last whorl projects from both the ventral (*e*) and dorsal (*f*) interspaces of these lobes, but most so from the dorsal one (fig. 2), towards which the larger end of the whorl is bent, before inclining ventrad to its termination within the body.

The dorsal part of the mantle, continued from the anterior pointed lobe backward, thins off to the margin of the aperture (ib. *f*), through which appears the part of the outer whorl of the shell: from the margin of this aperture, which is entire, the

\* Lovell Reeve, 'Elements of Conchology,' 8vo, 1846, p. 18, pl. A. figs. *a-f*.

† Ibid.: "Mr. Cuming is desirous of preserving the specimen under consideration entire" (p. 18).



thin epithelium (*f*) is continued upon, and seemingly lost in, the periostracum (*g*); part of the shell is exposed at *h*, fig. 2.

The well-defined convex border of each lateral posterior or terminal lobe (*c*) of the mantle has its smooth, soft, inner layer tucked up, as it were, and bent towards the central aperture of the umbilicus.

Between the lobes is an elliptical convex substance ("bouton terminal," *De Blainville* \*; "thick gland," *Gray* †) (fig. 3, *a b*) with a central depression (ib. *a d*); this disk is flanked by a pair of oblong productions (ib. *a c*, *a c*), the homologues of the better-developed museular fin-like bodies in *Spirula reticulata* ‡.

M. de Blainville describes the lateral appendages (*a c*) as fins, "fort semblable à ce qui à lieu dans les Sépioles" §. Dr. Gray, in his account of the original Cuningian specimen affirms, "It differs from the cuttlefish in being entirely destitute of fins" ||. It is possible that the French anatomist may have had for his subject a specimen of *Spirula reticulata*, in which they are more developed ¶. The parts (*a c*) in my example of *Spirula australis* may have been contracted; but I deem them, like those in *S. reticulata*, to be homologues of such small terminal lateral fins as one sees in *Loligopsis*. The intervening terminal gland-like mass is composed of a substance resembling dense cellular tissue, in which minute tortuous filaments were the chief structural character; its thin covering was vascular. At the middle of the central depression is a pore; but this terminates blindly, and is not the duct of a gland. If the disk (*a b*) were applied to a flat surface and the central part (*a d*) were withdrawn from the level, a vacuum would be produced, which would convert the disk into a sucker. Should the *Spirula* so attach itself, as Rumphius describes, its tentacles (fig. 1, *d*) and arms (1, 2, 3, 4) would be free to exercise their prehensile power on any passing object of food. The formal analogy to the polype, indicated by Aristotle's name for the "Poulpe," would thus be carried further in *Spirula* by its occasional repetition of the *status* of a hungry Actinia.

The mantle consists of a thin epiderm, a pigmental reticular connective tissue, and an unusually dense corium, in which the circular or transverse museular fibres are crossed by thinner and more superficial longitudinal fasciuli (Pl. II. fig. 2, *h h*).

\* "Quelques observations sur l'animal de la Spirule," *Annales françaises et étrangères d'Anatomie et de Physiologie*, tome i. 1837, p. 376.

† *Annals and Magazine of Natural History*, April 1845.

‡ 'Zoology of the Voyage of H.M.S. Samarang,' *Mollusca*, p. 13, pl. iv. figs. 3, 9.

§ *Loc. cit.*

|| *Loc. cit.*

¶ See my Monograph, *loc. cit.* pl. iv. fig. 9, *a c*, *a c*.

These are faintly indicated in the magnified view of the mantle (Pl. I. fig. 2); but the reticular character is more strongly marked in *Spirula reticulata*, besides being associated with formal characters described and illustrated in the monograph of 1848.

The thin semitransparent epiderm is continued beyond the muscular stratum from the borders of the dorsal interspace of the terminal lobes for about 9 millims. upon the shell, the rest of which is covered by the extremely thin and minutely granular periostracum. The same modification of the mantle occurs at the ventral interspace of the lobes; but it is continued to a less extent, the thin corium of the mantle terminating by a well-defined margin from which the epiderm is continued. The production of this skin upon the shell regains the thick fleshy border of the terminal lobes of the mantle at the posterior end of the interspace, which is filled up by the soft disk (*a b*) and the fin-rudiments (*a c*).

The integument of the head is smooth; it was coloured by minute points of brownish pigment; it is so thin around the eye as to permit the black pigment of the choroid to appear through. The original coloration of the mantle had been lost by long immersion in spirit. About the middle of the dorsal aspect were two narrow oblong marks (Pl. I. fig. 1, *m*).

The inner surface of the mantle, a little behind each of the ventral angular processes, presents a linear longitudinal prominence of almost cartilaginous hardness, for the cavities at the base of the funnel.

This (Pl. I. figs. 1, 4, Pl. III. fig. 1, *i*) is a conical tube, with entire parietes; the apical outlet unusually small, due probably to strong contraction, but defended by a correspondingly small semicircular valve. At the sides of the expanded base of the funnel were the cartilaginous cavities (Pl. I. fig. 4, *o*; Pl. II. fig. 3, *o*) articulating with the pallial prominences.

The head of the *Spirula* is defined by a feeble linear constriction from the soft and broad valvular folds (Pl. I. fig. 4, *h*) continued therefrom and from the base of the funnel, one on each side, to meet and blend at the dorsal aspect of the neck. Here the valve, which, from its functional relation to the mantle-cavity, may be termed "pallial," is impressed by a triangular shallow pit with a slightly raised border (fig. 4, *k*), the base turned forwards and the apex prolonged backwards. The antero-posterior extent of the valve, which terminates backward in a thin free border, is 4 millims.; it is shorter posteriorly, where it is attached to the dorsal retractors of the head. Just behind or beyond this border the peritoneum is reflected upon the lining membrane of the mantle. The finely

punctate pigment is continued a little way on the inner surface of the mantle.

The eight ordinary arms (of which the four of the left side are shown in Pl. I. figs. 1, 4) are of nearly equal length, the first and fourth being the shortest, the third the longest; they are joined together by a short and thick web, or duplicature of the skin, at the outer side of their basal interspaces (Pl. I. fig. 5). Compared with the others, the bases of the two ventral arms (4, 4) are the thickest, and the division between them is deepest and widest. Each of the arms is conical and trihedral with the long angle outward, and one face turned inward. This surface is bounded by a well-defined border on each side (fig. 6, *l*), and is beset with numerous, minute, pedunculate acetabula, thick-set at the distal half and arranged in an irregular quincuncial order; five or six may be counted in the oblique rows that cross the surface. The acetabula (figs. 6, *a*, *b*, *c*) are oblate spheroids or pear-shaped, more flattened at the side upon which the small suctorial cavity (ib. *s*) opens, with slender peduncles (ib. *p*) equalling the acetabulum in length and inserted toward one side of the end next the arm. On some of the arms there were one, two, or three longer peduncles with larger acetabula than the rest, formed by the swelling out of one side of the sucker into a spheroidal tumour, containing a compact light-brown substance. The margin of each cup is strengthened and armed by a delicate iridescent horny hoop.

The stems of the tentacles (figs. 1, 5, *d*\*) equal in thickness at their base (fig. 5, *d*, *d*) those of the ordinary arms; they are cylindrical, gradually contract to their terminal expansion, the inner side of which shows a narrow longitudinal raised tract, which supports the stems of the acetabula in a double alternate series. The corresponding part of the tentacles of *Loligopsis Veranii* offers a resemblance to this structure.

The length of the oral mass (Pl. I. fig. 8, magn.) is 5 millims.: it is connected with the surrounding cephalic sheath by loose, elastic, cellular tissue, yielding readily to the protrusive and retractile movements of the mass.

Both mandibles (ib. figs. 8, 9, *p*, *q*) were of horny or chitinous tissue, of a dark brown hue, deepening to the free points, paling towards the thin inserted margins. There was no trace of calcareous superaddition.

The beak is surrounded by a double lip—the inner one (figs. 7 & 11, *n*; fig. 11<sup>a</sup>) thin, finely plicated, with a crenate border; the outer one (fig. 7, *o*) thicker, with coarse radiating folds on its inner side, the termination of which gives the border a crenate

\* "Proboscides," Arist.

character. The anterior or outer side of this lip is comparatively smooth (fig. 5); it is continued to the bases of the eight ordinary arms, and into the fold which connects together the contiguous sides of the bases of the third and fourth arms on each side, the interspace between which forms the sheath of the long tentacle (*d*). The outer muscular coat of the buccal mass (fig. 8, *r*) consists chiefly of a stratum of longitudinal fibres connected by cellular membrane to the inner coat (*s*), which consists of two subelliptical bundles of oblique fibres, commencing from the same mid line of the dorsal aspect of the buccal mass, and swelling as they proceed ventrad and outward to pass beneath the outer plate-layer of the under (ventral) mandible to be inserted therein, as the temporal muscles into the coronoid processes of the vertebrate mandible, in the course most favourable for approximating the ventral (lower) to the shorter dorsal (upper) mandible.

The inner surface of the inner lip, or labial beak-sheath, is produced into many deep, sharply defined radiating folds, each of which is indented at the base, wavy at the free margin (figs. 11, *n*, 11<sup>a</sup>). Thin bands of longitudinal muscular fibres pass on from the two subelliptical bundles to the inner lip, for its retraction.

A labial membrane is reflected from the inner lip upon the outer one, at about 2 millims. from the transverse oral aperture; folds of the inner lip radiate from the crenate border of that aperture (fig. 7, *n*).

*Dissection.*—I proceed to note the appearances presented in the first steps of the dissection of my *Spirula*.

On laying open the mantle along the ventral aspect the gills were first exposed; no rectum or anal tube appeared, at least no mediastinal membrane embracing a rectum in its folds, as in an *Octopus*. The gills (Pls. II. & III. fig. 1, *a*) are suspended each by a delicate frænum or "mesobranchia" (*f*), extending from the base to half the length of the gill, the other half being free. But at the ventral interspace between the bases of the branchiæ there is a slight prominence supporting, as in the first dissected specimen, the anal orifice, the oviducal orifice (Pl. III. fig. 1, *e'*), and the renal outlet (fig. 3, *k*). Just within the border of the vent (*g*) opens the duct of the ink-bag (*h*).

The ovary (Pl. III. fig. 1, *b*) lies in the left hind compartment of the visceral chamber; the chief folds of the oviduct (ib. *e*, Pl. II. fig. 3, *e*) are on the right side, partially separated therefrom by the pellucid membrane which envelops the inner whorls of the shell, which membrane is also closely attached to the sinus surrounding the rectum.

In the angle between the branchial hearts (Pl. III. fig. 3, *b*, *c*) and the intestinal fold (*f*) is the "pericardial" or

“urocardial” chamber, containing the (supposed renal) venous follicles (ib. *d*, *d*).

Viewing the viscera from the left side (Pl. II. fig. 3), one sees the large and few convolutions of the wide oviduct (*e*) crammed with ova, of a deep yellow colour, four or five on the same transverse line: the last long recurrent fold advances over the liver, between the last chambers of the shell and the converging masses (ib. *f*) of the retractors of the head and funnel; these enter, overlap the margins, and send an aponeurosis over the exterior of the last chamber of the shell (*u*). The above parts are on the dorsal aspect; on the ventral one are the gills and the succentorial or nidamental glands.

Reflecting back the oviduct we expose the right lobe of the liver, impressed by the impacted ova in the duct which overlay that lobe.

The visceral chamber is bifid posteriorly, through the forward intrusion, at the median line, of the last whorl of the shell and the mass continued from its last chamber (Pl. II. fig. 2, *z*).

The branchiæ are attached to the membrane reflected from each side of this intrusive mass\*.

The peritoneum after lining the mantle is reflected, on the dorsal side, 4 millims. below the edge of the pallial valve, upon the last chamber of the shell, and is firmly united to the periostracum on that side of that chamber; a crescentic portion is continued from the shell upon the sides of the muscular attached mass.

The inner surface of the peritoneum is smooth, of a dull silvery glistening colour, without pigment.

The tissue of the urocardial walls includes a stratum of very numerous, fine, smooth fibrils, together with capillary vessels, ramifying with some regularity.

The retractores infundibuli (Pl. I. fig. 4, *t*; Pl. II. fig. 1, *f*) pass obliquely distad and dorsad to join the retractores capitis, where these enter, or are attached to, the last shell-chamber. From this part the peritoneum, extending ventrad, sends off the “mesobranchia” and envelops the gill, from which it is continued upon the free termination of the oviduct and oviducal gland (Pl. III. fig. 6, *d*); it is then continued over the pericardium and upon its valvular outlet, and upon the end of the rectum, before being reflected to gain the inner surface of the mantle.

On the ventral side of the visceral chamber the nidamental glands (Pl. III. fig. 1, *c*, *c*) occupy nearly the same relative position as in the *Nautilus*, but, as in Decapods, are not adherent to the mantle.

\* See “Monogr. on *Spirula*,” *op. cit.* pl. iv. fig. 11.

The liver occupies a special peritoneal sac reflected from the dorsal aspect of the lobes upon the ventral curvature of the last chambers of the shell.

On dissecting aside from the median line the thick layer (Pl. III. fig. 2, *k*) of the longitudinal muscular bands (*retractores capitis*) which pass backward from the ventral side of the skull, above and behind the base of the funnel (ib. *i*), a cavity was laid open from which escaped much fine granular and oily globular matter: I had tapped, in fact, the hepatic follicles (*l'*).

The muscular parietes of the funnel (Pl. III. figs. 1, 2, *i*) are 1 millim. thick at its base, becoming gradually thinner to the apex. The aperture at this part is half a millim. in diameter, and is defended by a flat semicircular valve (*j*), attached by its base to the inner surface of the dorsal aspect of the infundibular wall.

The "*retractores infundibuli*" (Pl. I. fig. 4, *t*; Pl. II. fig. 2, *t*, fig. 1, *f*), arising from the aponeurotic sheath (ib. *y*) of the last shell-chamber (ib. *u*), advance, inclining, at first, ventrad to the sides of the base of the funnel, pass under the pallial valve (fig. 3, *h*) and blend peripherally with its inner surface; they next, by a free margin, blend centrally with the mass of the "*retractores capitis*" (Pl. II. fig. 2, *f*), closing the communication between the cavity of the mantle and the cavity of the funnel at that part.

The *retractores infundibuli* originate partly from the inner surface of the peripheral wall of the last shell-chamber, partly from an aponeurosis (ib. *y*) which spreads over the wall of that and preceding chambers, beneath the part of the peritoneum which is reflected therefrom to line the mantle.

One thin fascicule (Pl. II. fig. 2, *f'*) attached to the pallial ganglion (*d*) passes distad and ventrad to the mantle: a broader aponeurotic sheath is continued from the muscles over the involute whorls of the shell (Pl. II. fig. 2, *w*, *y*).

The valvular pallial fold (Pl. I. fig. 4, *h*; Pl. III. fig. 1, *h*) is muscular, and is continued partly from the base of the funnel, mainly from the muscular walls of the head.

The "*retractores capitis*" (Pl. II. figs. 2, 3, *f*), attached to the cranial cartilage, converge as they pass backward, become connected with the "*retractores infundibuli*," and finally spread upon the walls of the last chamber of the shell (ib. *u*), which serves as a fixed point for the origins of those muscles. A delicate but firm membrane (Pl. II. fig. 4, *u'*) is reflected from such muscular sheath of the shell-mouth upon and over the margin of the outer shell-chamber into its cavity, and upon the hemispheric mass (ib. *z*) occupying that chamber, and attached to the hind ends of the lobes of the liver (ib. *l*, *l'*).

The muscular fibres of the shrunken fin-like appendages

(Pl. I. fig. 3, *a c*) are disposed in regular fasciculi; they are not transversely striate.

The tongue has a single retractor (Pl. I. fig. 8, *t*: the muscles of the mandibles, *r*, *s*, are shown in this figure).

The brain is immediately covered by delicate meninges; and the part of the cartilaginous cranium protecting its periphery is thin. It presented a small anterior "cerebral" or olfactory lobe (Pl. II. fig. 2, *a*) set upon the large optic lobes (*b*), like the crystalline lens upon the vitreous humour.

The pallial nerve-trunks (*c*) perforate the "retractores infundibuli," and swell into the "ganglia pallialia" (*d*).

The visceral nerves (*e*) descend together, dorsad of the oesophagus, between the inferior salivary glands, and, with the oesophagus, enter the interspace between the hepatic lobes. They send filaments to the salivary glands as they pass between those glands; and continuing backward and ventrad between the hepatic lobes to the gastric ganglion, they send filaments to the "hemispheric mass" (*z*) in the last shell-chamber (*u*).

Dorsad of the infundibulum project the two large subspherical ear-capsules (Pl. II. fig. 6, *a*), the soft subtransparent walls of which permit the contained opaque white otocones (*b*) to be discerned. The cartilage of the auditive capsule presented a bluish hyaline colour; that of the orbits was of a grey colour and more opaque.

Immediately in advance of the acoustic capsules the cartilaginous orbital cup of the cranium extends forward, expanding. A thin sheath or layer of muscular fibres arises from the ventral side of the skull to pass upon the liver: in advance of this a fibrous layer is directly continued from the margin of the cartilaginous orbit upon the sclerotic. The pupillary aperture (Pl. I. fig. 4, *a*) is subcircular and opens into the extensive conjunctival or aqueous chamber (Pl. II. fig. 2, *l*), which extends on one side of the eyeball to near the large optic ganglion (*i*).

The conjunctive membrane is reflected from the postorbital cavity upon the side of the gullet and base of the circular eyelid; it is connected with the sclerotic (*l*) by loose laminated cellular tissue, together with granular adipose tissue and the great optic ganglion.

The precranial part of the gullet (Pl. II. fig. 2, *k*; Pl. I. figs. 8, 9, *k*) is 5 millims. in length; the tube then enters the canal or groove in the cartilaginous skull; and the brain-membrane is reflected upon the oesophagus as this tube (Pl. I. fig. 11, *a*) with the salivary ducts (*b*) passes through the cerebral ring.

Three filaments accompany the cephalic part of the oesophagus: the middle and broadest (*b*) is continued from the ventral

and fore part of the salivary gland (*g*), and includes the two ducts. The two lateral filaments (*i*) I could not satisfactorily trace; they seemed to issue from or enter the hind part of the skull, and were either nerves or vessels.

Dorsad of the ear-sacs (Pl. II. fig. 6, *a*, *b*) goes the gullet (*h*), which, beyond the skull, is crossed ventrad by the lower salivary glands (Pl. I. fig. 11, *g*), and then passes, of slender dimensions, without trace of ingluvial expansion, into the interspace of the hepatic lobes (*l*, *l*).

From each side of the gullet the pallial nerves (fig. 11, *c*) diverge to their ganglion (*d*).

The œsophagus, which lies at the lowest (ventral) part of the hepatic interspace (Pl. III. fig. 2, *a*), after a course of 5 millims., expands into the stomach (*b*), which is small. The duodenum, leaving the stomach, communicates near the pylorus with the second or pancreatic stomach (*c*), which was larger than the first. A large mass of pancreatic follicles (*d*) communicate with the second stomach.

The intestine (*e*) bends about 2 millims. obliquely backward, then turns abruptly forward and becomes "rectum" (*f*), which is 4 millims. long. The rectum is enveloped in a loose mesorectum. There are no anal appendages. In the angle of the last intestinal fold lies the ink-bag (*h*), the duct of which goes forward to pierce and terminate within the infundibular anus. This glandular bag is pyriform, scarcely 2 millims. in length; it lies close to and is connected with the urocardial capsule.

The superior salivary glands (Pl. I. fig. 10, *o*) are oblong flat bodies, applied one on each side of the basal or faucial folds of the tongue (*s*).

The posterior salivary gland (Pl. I. fig. 11, *g*; Pl. II. fig. 4, *g*, & fig. 10) appears to be single; it is deeply grooved along the middle of its dorsal aspect, and deeply notched on each side by the lateral pallial nerve-trunks. Viewed from behind, the posterior salivary glands are seen to be a pair, subtriangular in shape. The white, flat, filamentary ducts of these glands run forward on each side of, and close to, the gullet, enveloped and supported by the same cellular œsophageal envelope.

The liver is not single as in *Octopus*, but consists, as in the Decapods, of two symmetrical lobes (Pl. I. fig. 11, *l*, *l*; Pl. II. fig. 4, *l*; Pl. III. fig. 2, *l*, *l*). These are of an elongated subtriangular shape, with the base turned forward, as viewed from the ventral aspect. Each is invested by a glistening capsule. The fine muscular web connecting or passing between the "retractores" or "crura infundibuli" is spread over the two oblong lobes or divisions of the liver. When this sheet is removed the lobes are seen to be invested by a proper musculo-membranous sheath. The fibres of the semi-



ing muscular part are "smooth" and disposed in longitudinal bands.

The lower ends of the liver-lobes, or continuations of their capsules, enter the last chamber of the shell, and contribute to form the hemispheric mass (Pl. II. fig. 4, *z*), from the capsule of which the membranous siphon (ib. *v'*) is continued. The outer cellular membrane, or covering of the liver, is condensed where it connects the lobes with the "hemispheric mass," and forms a well-defined border of the part occupying the last shell-chamber.

The liver consists of well-defined pyriform sacculi; the obtuse round blind ends, being next the capsule, give the reticulate appearance (Pl. II. fig. 4, *l*).

The last chamber of the shell is filled by a solid, soft, hemispheric body, covered by delicate smooth membrane, from which the small siphuncle (ib. *v'*) is continued. The dissection made with the view of determining the nature and connexions of this membrane is represented in figure 4, Pl. II., the shell being removed.

The shell-membrane, continued from the fibrous sheath formed by the origins of the retractores capitis et infundibuli, divides into two layers, one of which (*u'*) is continued over the exterior of the shell and is lost in the periostracum; the other lines the last chamber, coating its contents (*z*), and is continued therefrom to form the membranous siphon (*v'*); from this a third thin layer extends from near the basal circumference of the hemispheric body (*z*) upon the "capsula propria" of the liver. This being removed, the structure of the hepatic gland is indicated by an irregular subhexagonal pattern of the surface. A circular indent of the shell-membrane marks the terminal margin of the calcified part of the last chamber. In the siphon fine muscular fibres could be traced the whole length.

The calcareous siphon (Pl. II. fig. 2, *v*) slightly diminishes as it passes backward, and is surrounded by a raised border where it enters the aperture in the next septum.

The anterior aorta passes to the interspace of the "retractores capitis," and goes forward alongside the œsophagus. Dorsad of this aorta the vena cava (Pl. III. fig. 3, *e*) enters the same fissure and receives the hepatic vein, which emerges between the cystic follicles and the duodenum. It then penetrates the urocardial chamber, divides, and develops the renal follicles (*d*, *d*).

Each branchial heart (Pl. III. fig. 3, *b*, *b*) is semicircular, subcompressed, with a small spherical appendage (*c*); it receives the large vein with which the renal (?) spongy appendages are connected. These follicles contained small coagulated masses, consisting of filamentary groups of cells, bent

upon themselves at acute angles, and of minute granules. A slight pressure destroys the form of most of these filamentary groups\*.

The right branchial vein (*i*) crosses, dorsad of the branchial heart (reflected upward in fig. 3), in the form of a cylindrical canal, and enters the smaller end of a transversely extended systemic ventricle (*a*); the left branchial vein (*i'*) enters the opposite end. Each branchial vein is continued from the ventral side of the gill-base.

The systemic heart-substance, or "bulbus arteriosus" (*k*), bends forward at right angles to the main ventricle (*a*), and near the entry of the right branchial vein (*i*). A smaller posterior aorta (*l*) is given off from near the middle of the back part of the transverse ventricle. This aorta supplies the nidamental glands and succenturiates, the hemispheric mass of the last shell-chamber, also the capsule applied to the umbilical parts of the shell-whorls.

From the inner surface of the ventral part of the mantle, distad of the border of the pallial valve, a vein emerges; on the inner surface of the dorsal part of the mantle are glistening bands of transverse fibres intercepting orifices or transverse slits of the sinus continued from the veins from the "retractores capitis" and salivary glands.

The gills (Pl. II. fig. 1, *a, a'*; Pl. III. fig. 3, *g, g'*) are two in number, of the same structure as in other Dibranchiates; they are rather larger, relatively, than in *Loligopsis*, but have the same number of laminae (twenty-four pairs). From the basal half or rather more of the fleshy stem is continued the frænal fold above mentioned (Pl. III. fig. 1, *f*), the layers of which are continuous with the general serous membrane of the visceral chamber. The gill (*a'* in fig. 1, Pl. II.) is reflected to show the opposite surface.

The specimen confided to me for dissection was a female. The generative organs consist, as in *Sepia*, *Sepiolo*, and *Rossia*, of an ovary (Pl. III. fig. 1, *b*), an oviduct (Pl. II. fig. 3, *e*), with an oviducal gland (ib. fig. 3, *d*; Pl. III. fig. 6, *d*), and a pair of nidamental glands (Pl. III. fig. 1, *c, c*; Pl. II. fig. 3, *c*).

The ovarium, filled with ovisacs, the largest of which are  $1\frac{1}{2}$  millim. in diameter, occupies the left side of the fundus of the visceral chamber. The oviduct is continued from its anterior part, and is soon dilated by ova, of large relative size, as in *Sepiolo* and *Rossia*.

\* In the sac lodging the homologous follicles of the Pearly Nautilus, Van der Hoeven found "a calcareous reddish-white and friable concrement: I believed it to contain uric acid; but the chemical inquiry of Prof. Van der Boonchesch has not confirmed my supposition" ("Contributions to the Knowledge of the Animal of *Nautilus pompilius*," Transactions of the Zoological Society, vol. iv. p. 24).

The ova are close-packed ; two or three may be seen on the same transverse line along the terminal recurrent fold of the oviduct. Near its termination the glandular part is developed (Pl. III. fig. 6, *d*).

The membranous part of the oviduct terminates round the thick border of the infundibular beginning of the glandular part, the fine folds of which radiate therefrom. The oviducal gland is pyriform ; its plicated substance makes a spiral turn before reaching the apex.

The outlet of the oviduct (ib. fig. 1, *e'*) is an elliptical slit, situated posteriorly and laterad of the valvular orifice of the urocardium and of the anus.

Much loose cellular tissue connects the peritoneum with the long folds of the oviduct on the left side of the visceral mass.

*Spirula* is almost as devoid of external organs of natation as *Nautilus*. In both the direction in which such forces act is retrograde.

*Nautilus* exercises them mainly by virtue of the muscular funnel, through which it forcibly ejects into the surrounding water the respiratory currents\*. *Spirula* superadds to this the ejection of that volume of water upon which the cephalic arms and their basal webs contract, after the fashion in which other Dibranchiates, especially the Octopods, propel themselves backwards. The dynamic of the recoil in both instances is exemplified by that of the cannon, when the gas of the ignited powder is driven into the surrounding atmosphere. *Spirula* is superior to *Nautilus* in the cephalic mechanism, although the thick cylindrical muscular sheath enclosing the buccal mass may exercise a similar though feebler power in the backward propulsion of the body ; but inferiority in the cephalic motor, in *Nautilus*, is in some degree compensated by superiority of the infundibular one. In both instances of multilocular Cephalopods the natatory power is inferior to that of existing Dibranchiates.

Rumphius testifies of the "great post-horn" (*Nautilus*), "it keeps itself chiefly at the bottom, creeping sometimes into the nets of the fishermen ; but after a storm they may be seen in troops floating on the water ; whence one may infer that they congregate in troops at the bottom. This sailing, however, is not of long continuance ; for having taken in all their tentacles, they upset their boat, and so return to the bottom."

I have already referred to the testimony of the same observant naturalist that "the little post-horn" (*Spirula*) "hangs to the rocks by a thin and small door," or disk—"that it sets itself fast to the rocks." The marginal indication of the

\* Anat. & Phys. of Invertebrates, 8vo, 1855, p. 583.

paragraph on the *Spirula* is "En zit aan de klippen"\* . Admitting this function of the terminal suetorial disk, which is peculiar to *Spirula* among Cephalopods, yet it nevertheless occasionally floats, and probably passes more of its time as a swimmer than does the *Nautilus*. Rumphius observed both multiloculars on the shores or coast of Amboyna. The subject of the present supplementary monograph, and that of J. E. Gray and Lovell Reeve, was captured, recent if not living, on the shore of New Zealand. A *Spirula*, borne away from its shores by storms or currents, would find subsistence in the open ocean as long as nutriment could be taken by its prehensile organs. In regard to its relations to *Nautilus* I would submit the following remarks.

The more or less fixed attachment of a musele being regarded in anatomy as its "origin," the chief masses of the muscular system in both *Nautilus* and *Spirula* have a similar origin, viz. the terminal open chamber of the multilocular shell. In *Nautilus* the retractores infundibuli and retractores capitis arise on each side of the inner surface of that chamber by a single origin †, the insertional tissue or "tendon" of which, however, is continued round the circumference of the chamber at the level or line of the main parial attachments. In *Spirula* the corresponding muscular masses arise equally from the entire circumference of the terminal part of the inner surface of the last chamber, but also extend their attachments over the margin and a little way beyond it on the exterior of the shell; they are, in fact, "shell-muscles" in the same sense as those so-called in *Nautilus*. In both genera, therefore, the shell, besides other offices, serves as the *point d'appui* of the retractors of the funnel and of the head with its locomotive and prehensile organs. Moreover the last chamber of the shell in *Spirula* also receives part of the visceral mass, viz. the hind termination of the liver, which, covered by its capsule, and this again by the peritoncum or a delicate aponeurosis continued from the attached shell-muscles, constitutes the hemispheric mass that fills the chamber and forms or sends off the beginning of the membranous siphon. This siphoniferous and visceral mass ("calotte" of De Blainville ‡) is answerable in *Spirula* to the siphoniferous and visceral mass which, in *Nautilus*, occupies the

\* 'D'Amboinsche Rariteitkamer,' fol. 1741, p. 61.

† 'Memoir on the Pearly Nautilus,' 4to, 1832, p. 17, pl. i. g.

‡ This anatomist regarded the "calotte" as wholly muscular, and its siphonal production as the tendon of such. Describing the retractores as "la gaine musculaire que traverse l'oesophage," he proceeds, "Son extrémité antérieure qui va à la tête et aux appendices était tronquée à l'endroit de l'arrachement; mais la postérieure était bien conservée; on voyait qu'allant en se rétrécissant elle s'attachait à une lame charnue qui tapissait le fond de la première loge de la coquille, en formant une

fundus of the last chamber \*, only with reversed proportions ; such visceral mass occupies a smaller proportion of the last chamber in *Nautilus*, yet consists of a larger proportion of the viscera than in *Spirula*. Although by the forward extension of the last chamber beyond the muscular attachments, in *Nautilus*, a still greater proportion of the animal is contained, or may be retracted, within that chamber—nevertheless, in the degree in which the mantle may be reflected over the exterior of the shell, such proportion of the shell may be regarded as internal. Lateral prolongations of the mantle can extend over the umbilicus, and are the efficient of the deposition there of coloured calcareous matter, in *Nautilus pompilius* ; and such pallial prolongations are homologous with the lateral terminal lobes of the mantle of *Spirula* (Pl. I. figs. 1, 2, 3, *c*, *e*), which similarly cover the umbilical parts of its shell.

The distinction, therefore, between *Nautilus* and *Spirula*, in regard to the shell, in its protective relation, is relative, not absolute : in the one a small proportion of the shell is occasionally “ internal ; ” in the other a small proportion is always “ external : ” in both the multilocular shell corresponds with the phragmocone of the Belemnite †.

The tetrabranchiate *Orthoceras* may be called a representative analogue of the dibranchiate Belemnite, as the tetrabranchiate Ammonite is of the dibranchiate *Spirula*. The siphon is “ ventral ” and “ marginal ” in both kinds of coiled shells, but it runs along opposite sides of the coil. In *Spirula* its position is “ internal ” or “ entomarginal ; ” in *Ammonites* it is “ external ” or “ ectomarginal.”

## EXPLANATION OF THE PLATES.

### PLATE I.

*Fig. 1.* Right-side view of *Spirula australis*, in outline, showing the four arms (1, 2, 3, 4) and the tentacle (*d*) of that side. *a*, eye-aperture ; *b*, dorsal pointed lobe of fore border of mantle ; *c*, umbilical fold of mantle ; *e*, exposed part of outer wall of shell on the ventral side ; *f*, the same on the dorsal side ; *g*, longitudinal marks

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sorte de calotte se continuant par sa circonférence avec l'enveloppe de celle-ci, et donnant, au fond et vers le bord inférieur, naissance à un prolongement tubiforme pénétrant et s'attachant dans le siphon de la première cloison, puis se continuant sans autre adhérence, à ce que je suppose, jusqu'à son origine vers le sommet de la coquille, dont j'ai pu, en effet, le retirer sans briser, dans une longueur considérable ; en sorte que l'on peut dire que celle-ci est dans un prolongement du muscle columellaire ou rétracteur de la tête et de ses appendices, et que le siphon membraneux n'est lui-même qu'une partie de ce muscle.”—*Op. cit.* p. 379.

\* *Op. cit.* pl. i. a.

† See the restoration of this extinct form in my ‘Lectures on the Comparative Anatomy and Physiology of the Invertebrate Animals,’ 8vo, 1843, p. 333, fig. 133, b.

on dorsal part of mantle; *i*, funnel projecting between the pair of pointed lobes on the ventral side of the fore border of the mantle. Nat. size.

- Fig. 2.* Dorsal view of hind part of mantle, showing the interspace between the two terminal umbilical lobes (*c, c*). A portion of the outer whorl of the shell is exposed, at *h*, by removal of the periostracum (*g*), with which the epithelial layer of the mantle (*f*) is continuous. Magnified 3 diameters.
- Fig. 3.* Terminal disk (*ab*) and appendages (*ac*), with ends of terminal lobes (*c, c*), of the mantle, and exposed parts of outer whorl of shell (*h, h*). Magn. 2 diam.
- Fig. 4.* Muscular mass of *Spirula*, including the head and its appendages (1, 2, 3, 4, and *d*), the funnel (*i*), the pallial valve (*h*), the retractors of the head (*f*) and funnel (*t*), which blend together to be attached to the last chamber of the shell (*u*); the digestive organs and ink-bag are also given. Nat. size.
- Fig. 5.* Anterior view of the head and appendages, with the mouth and bases of the peduncles. Nat. size.
- Fig. 6.* One of the eight arms, showing the acetabuliferous surface. Magn. 3 diam. Three detached acetabula (*b, d, c*) and their pedicles, more highly magnified.
- Fig. 7.* Mouth and bases of the cephalic arms and peduncles, with the outer lip laid open, exposing the inner lip and mouth. Magn. 3 diam.
- Fig. 8.* The buccal mass. Magn. 4 diam.
- Fig. 9.* The upper and lower mandibles. Magn. 6 diam.
- Fig. 10.* Muscles of the buccal mass, upper salivary gland, and tongue. Magn. 6 diam.
- Fig. 11.* Parts of *Spirula*, extending from the mouth (*n*) to the shell (*s, v*), magn. 3 diam.: the letters are explained in the text. 11<sup>a</sup>, inner surface of inner lip.

#### PLATE II.

- Fig. 1.* Dissection showing the funnel and its retractors, gills, a nidamental gland, ovary, and part of the shell. Magn. 3 diam.
- Fig. 2.* Dissection of parts of *Spirula*, from the mouth (*m*) to part of the shell (*v*); the letters are explained in the text. Magn. 3 diam.
- Fig. 3.* Head of *Spirula*, with pallial valve and muscles, and female organs of generation. Nat. size.
- Fig. 4.* Parts of *Spirula*, including the lower salivary glands, liver, and contents of last shell-chamber. Magn. 3 diam.
- Fig. 5.* Muscular mass of retractors of head and funnel of *Spirula*, and their attachment to the last shell-chamber. Nat. size.
- Fig. 6.* Acoustic organs and contiguous parts. Magn. 4 diam.
- Fig. 7.* Digestive organs. Magn. 4 diam.
- Fig. 8.* Shell of *Spirula*, with hemispheric mass filling terminal shell-chamber, raised; also part of mantle and terminal disk.
- Fig. 9.* Terminal chambers of shell, laid open to show origin of siphon and contents of last chamber. Magn. 2 diam.

#### PLATE III.

- Fig. 1.* Female organs and funnel. Magn. 3 diam.
- Fig. 2.* Alimentary canal, hepatic lobes, interior of funnel, and last shell-chamber. Magnified.
- Fig. 3.* Circulating and respiratory organs. Magn.
- Fig. 4.* Digestive organs; mass of retractor muscles. Magn.
- Fig. 5.* Portion of oviduct, with left gill and branchial heart. Magn.
- Fig. 6.* Termination of oviduct with oviducal gland. Magn.

II.—On *Plectronella papillosa*, a new Genus and Species of Echinonematous Sponge. By W. J. SOLLAS, M.A., F.G.S., &c.

[Plates IV.—VII.]

*Plectronella*\* *papillosa* (nov.).

(Examined in the dried state.)

*Sponge* (Pl. IV. figs. 1, 2) attached; stem short, thick, irregular, dividing into a number of once- or twice-bifurcated branches; branches cylindro-conical, curving irregularly, uniting where grown in contact, consisting of a central axis and a number of conical papillæ proceeding from it; papillæ  $\frac{1}{5}$  inch long,  $\frac{1}{25}$  inch in diameter, with simple, or bifid or trifid ends, arranged along the axis of the branch more or less spirally and at right angles to it, very numerous, producing the general outline of the sponge. Oscules and pores?

*Colour* drab or soft fawn-colour.

*Skeleton* composed of three kinds of spicules:—(1) those of the interior; (2) those of the surface; (3) those of the sarcode.

1. Spicules of the interior fusiform acerates, curved or straight,  $\cdot 00125$  inch in diameter and  $0\cdot 0225$  inch long (Pl. V. fig. 1), arranged in a confusedly fibrous manner, forming the chief skeleton of the sponge. Spicular fibres of the stem numerous, longitudinal, undulating, bifurcating and anastomosing, composed of acerate spicules lying longitudinally, frequently crossed by transverse ones, curving at intervals towards the exterior to supply a single fibre for the axial skeleton of each papilla (fig. 1, p. 18). Surface of the stem and papillæ echinated by the forward projection of some of the acerate spicules.

2. Spicules of the surface (Pl. V. figs. 2, 21) triradiate; two rays smooth, abruptly pointed, equal in length, diverging at equal angles from the third, which is longer, spined, especially towards the end, and terminated either by a sharp point or a rounded surface. Spines conical, usually bent backwards, talon-like. Length of the smooth rays, measured from the centre of the triradiate canal,  $0\cdot 0028$  inch, of spined ray  $0\cdot 0055$ . Spicules arranged echinately, the pair of smooth rays seated on or immediately below the surface of the spicular fibre; the spined ray projecting obliquely forwards.

3. Flesh-spicules extremely fine filaments,  $0\cdot 005$  inch long, straight, or curved once, twice, or three times (Pl. V. figs. 3, 4);

\* *πληκτρον*, a spur.

very numerous, frequently collected into longitudinal bundles (fig. 5).

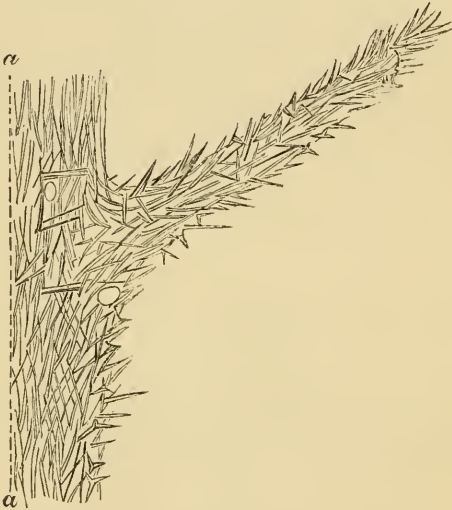
*Hab.* Marine.

*Loc.* (?). Collection, Bristol Museum.

*Obs.* Two of the most important characters of this sponge are, first, the triradiate form of its echinating spicules, and, next, the extreme tendency to variation which these display.

That the normal echinating spicule is truly triradiate, just as, say, a characteristic Hexactinellid spicule is sexradiate, is proved by the triradiate form of its axial canal. In spicules

Fig. 1.



Diagrammatic section taken longitudinally through a papilla and one half of the stem of the sponge: *a, a*, axial line of the stem.

which have not been subjected to any chemical treatment the canal is only just discoverable; but by boiling them for three or four minutes in caustic alkali it becomes enlarged and is then very obvious. The cavity from which the three arms of the canal originate is frequently globular in shape, and exceeds the canals in diameter; it represents the position of the young spicule-cell before it had budded to produce the adult form; and it may very conveniently be used as a fixed point within the spicule from which to measure the length of its diverging rays.

To produce the normal form of echinating spicule, two buds must have sprouted from the inner or proximal face of the spicule-cell, and by growing obliquely into the sponge have



given rise to the smooth paired rays, while a third bud must have started from its outer or distal face, and by growing outwards have produced the third unpaired ray. From the sides of the third ray additional offshoots have been developed forming the spines, into each of which a branch from the axial canal of the ray on which they occur is continued.

As it is very probable that the spines of spinose spicules in many other kinds of sponges are solid, and not provided with lateral diverticula from the axial canal, it may become necessary to distinguish between two kinds of spines, those with and those without a central canal, just as one distinguishes between those spines of plants which are mere epidermic outgrowths and those which are true aborted branches. Indeed, since writing the preceding sentence I have been able to verify the existence of solid non-canalculated spicular spines in several instances, one of which will be described in a forthcoming paper on a new species of *Plocamia*.

The variations from the average form of echinating spicule are exhibited by some 4 or 5 per cent. of these spicules, and extend over a very wide range. In figs. 17 and 18, Pl. V., we have a form possessing two rays only, one of the proximal rays having disappeared and the remaining one grown backwards in the same line as the distal ray. Fig. 20 is another case of a similar kind, but with the single proximal ray inclined at an angle of  $125^{\circ}$  with the distal one.

Thus figs. 17 and 18 are biradiate but uniaxial forms, and in this respect resemble ordinary straight acerate spicules; while fig. 20 is biradiate and biaxial as well, and thus resembles a curved acerate, which is both biradiate and biaxial and therefore cannot, either in a strict or even in a wide sense, be said to be monactinellid: the only truly monactinellid spicules are the pin-headed ones and some other (but not all) forms of acuates. The variations shown in figs. 22, 24, 27, and 31 exhibit changes in the relative length of the three rays, and in the angle which the paired rays make with each other and with the third ray. Thus in fig. 27 the three rays are inclined at nearly equal angles of  $120^{\circ}$  with each other, and are all of nearly the same length; in fig. 22 one smooth ray continues the direction of the single ray, and the other projects at right angles from it, producing a form which recalls that of some commonly occurring hexactinellid spicules. In fig. 31 both paired rays diverge nearly at right angles from the third; in fig. 24 one smooth ray points forwards and the other keeps its normal backward direction; in some instances, not figured, both smooth rays point forwards.

Figs. 23 & 25 illustrate variations in the terminations of the

rays. Normally the paired rays are pointed, though somewhat abruptly, so as to resemble in optical section the point of a lancet, while the third ray may be either rounded off at the end or prolonged into a conical point, terminating one way just as often as the other. In the exceptional form, fig. 23, one of the smooth rays is rounded off at the end hemispherically, the other retaining its pointed termination; in fig. 25 both paired rays are terminated hemispherically. These last two variations are of some importance, as showing the possibility of acerate spicules passing into acuate ones: in a sponge containing only uniaxial acerate spicules, for instance, an acuate variety, if it occurred, might be taken for an intruder from some other sponge; but with such a spicule as fig. 25 such an explanation is obviously impossible.

In figs. 28, 29, & 32 we have varieties with four rays, a third smooth one having put in an appearance. These are true quadriradiate spicules, and thus seem to lead on to the Tetractinellid type. It must be observed, however, that they differ in one important particular from the quadriradiate pronged spicules of such sponges as *Geodia*, since in the latter the single bud produced from the spicule-cell grows inwards towards the centre of the sponge, while the three buds which form the prongs grow outwards away from the centre—just the very reverse of what occurs in *Plectronella*, where the three rays grow inwards towards the axis of the stem or papilla (on whichever the spicule is seated), and the fourth grows outwards away from the axis. An intermediate case is seen in *Dercitus Bucklandi*, where the four rays of its quadriradiate spicules are equal as regards length, and indifferent as regards direction of growth.

The quadriradiate spicules of *Plectronella* remind one also of the quinquerradiate spinicruces which echinate the spicular fibre of *Meyerina*, *Hyalonema*, and some other Hexactinellids.

As regards the acerate spicules of our sponge, they likewise are very apt to sport into new varieties; bifurcation of the spicule with an accompanying bifurcation of its canal is not uncommon; and spines occasionally sprout from the sides.

Of the flesh-spicules one need not say much here; they appear to result from the fibrillation of the contents of a spicule-cell, and to be set free from it in some manner unknown; they are of such tenuity that under a magnification of 1000 diameters they appear no thicker than pencil-lines; and one need not add that they exhibit no axial canal.

On passing in review the numerous departures from the normal spicule-forms figured in Pls. V. and VI. one becomes able to formulate the following propositions:—

- (1) The group of spicules comprising the bifid form and all

its varieties result from the tendency to continued variation displayed by an organ or organism in which a variation has once been initiated.

(2) The overwhelming preponderance of the bifid spicule of figs. 2 & 21 is an instance of the survival of the fittest; this form has been selected from the great diversity of related forms because it best satisfied the requirements of the sponge.

(3) The biaxial and uniaxial biradiate varieties, whether regarded as "reversions" or survivals of an ancestral form which a not very rigorous or not long-enough-continued selection has overlooked, serve in any case to establish a passage from an originally uniaxial spicule to the normal triradiate one.

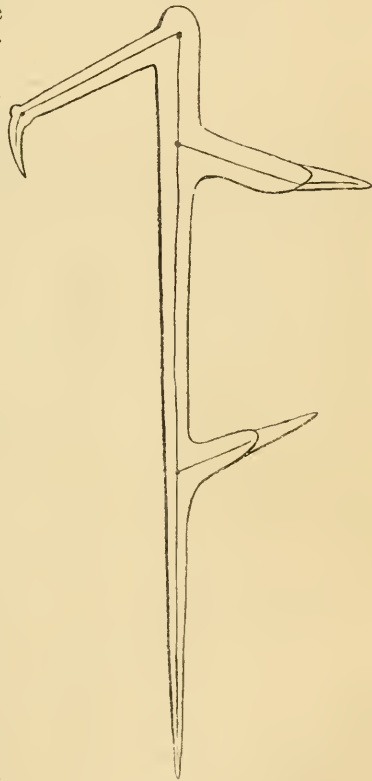
(4) The quadriradiate forms, which illustrate the tendency to progressive variation, shadow forth the spicules which, under different conditions, have established themselves as the fittest survivors amongst the *Pachastrellidæ* and *Pachytragidæ*.

(5) The bifurcation of the acerate spicules of *Plectonella* appears to indicate a tendency to give rise to a triradiate form.

The difference between a bifurcated acerate and a true triradiate spicule lies in the fact that in the former a biradiate growth of the spicule-cell has already taken place before the third ray is produced, and that this then takes its origin, not from the original spicule-cell, but from one of the rays which have issued from it; so that the third ray arises as a secondary instead of a primary bud. That this difference

may be bridged over appears, however, from a consideration of such abnormal spicules as that of *Dercitus Bucklandi* represented in fig. 36, Pl. VII., and of a *Stelletta* of which a sketch is given here (fig. 2).

Fig. 2.



From these we see that spicules which are usually produced by the immediate radiation of four arms from a mother cell may pass into varieties in which the origin of some of the rays is postponed till the spicule-cell has assumed a linear growth and so made it impossible for fresh rays to appear except as secondary instead of primary radiations—a change analogous to that which sometimes occurs in the vegetable kingdom, where a whorl of leaves may exceptionally become elongated into a branch. Conversely a spicule in which bifurcation took place after the spicule-cell had produced an acerate form might easily pass into one in which the bifurcation took place at the commencement of growth, and thus rise to a truly triradiate form.

If the acerate and triradiate spicules of *Plectronella*, widely different as they now are, did originally branch off from a common ancestral form, one is led to inquire whether the same may not be the case with the still more diversified spicular groups belonging to other kinds of sponges. We cannot attempt to enter into this question now; but it may be interesting to examine a few other sponges with a view to determining whether they present us with analogous variations to those exhibited by *Plectronella*. A few hours' examination of two specimens of *Dercitus Bucklandi* has furnished us with the variations of its quadriradiate spicules figured on Plate VII. The commonest variety is that of fig. 43, where one of the four rays is bent, near its termination, about  $30^\circ$  from its normal course. Sometimes two or even three of the rays may be similarly modified, giving us, in the last case, a figure very like that of the Manx arms. This flexure is almost invariably the forerunner of a bifurcation of the ray, owing to the appearance of a second termination to the ray, as if to maintain its symmetry (fig. 40). The secondary rays so produced may themselves become flexed and eventually bifurcated (fig. 39). When three out of the four rays of a spicule are thus bifurcated, we are carried a long distance on towards the branched spicules of the more complicated Tetractinellidæ.

On the other hand, the fourth ray is sometimes completely suppressed; and the triradiate form (fig. 33) is then produced. Again, the third ray may not arise immediately from the young spicule-cell, but from one of the arms of a biradiate spicule (fig. 36); or the third ray may wholly disappear, when we have a biradiate form, bringing us back to a curved acerate spicule. Unfortunately the only instance I have observed of this was lost before I could sketch it; but there is no doubt that a more extended examination would reveal other examples.

In fig. 38 we have a true quinquerradiate spicule, very similar to the quinquerradiate spicules of *Euplectella* and other Hexactinellids. This may be regarded as related to fig. 40 as fig. 33 to fig. 36. It seems to show a tendency for bifurcation to work its way back towards the initial cell, till it results in biradiation. The remaining figures are merely intended to illustrate the great tendency to vary in all directions which the quadriradiate spicules of *Dercitus Bucklandi* display, except in the case of fig. 46, which is a genuine case of ankylosis, two quadriradiates having fused together by two of their arms (*a* and *b*).

A cursory examination of *D. Bucklandi* thus reveals just the same class of facts as we met with in *Plectronella*. We have:—first, a great general tendency in the spicules to vary in numerous directions; next, the selection of one variety (the equal-armed 4-radiate) as the average form; thirdly, a number of varieties leading back to the acerate type; and, lastly, others leading on to the higher Tetractinellidæ in one direction and to the Hexactinellidæ in another.

The Hexactinellidæ, again, present us with variations of a similar kind. One has only to refer to the series of figures 153–157 (pl. vi.) and 175–183 (pl. vii.) in Dr. Bowerbank's 'Monograph of the British Spongiadæ' (vol. i.) to discover a complete passage from the ordinary cylindro-cruciform spicule of *Hyalonema mirabile* to a spined uniaxial cylindrical spicule, and from the attenuated rectangulated sexradiate of *Euplectella* to a triradiate something like the abnormal form, fig. 22, of our *Plectronella*. On the other hand, the fossil Hexactinellid *Hyalostelia Smithii*, from the Carboniferous Limestone, furnishes us with spicules in which the number of rays has multiplied beyond the normal six, and amounts to eight\* or even more. It is also noticeable in this sponge that the rectangularity which is so marked a feature of ordinary sexradiate spicules is very frequently and widely departed from.

In conclusion, regarding the various kinds of sponge-spicules as resulting from a variously modified cell-growth, we may attempt to embody in the following diagram (fig. 3, p. 24) the relations subsisting between the chief of them.

1. An elongate growth of the original cell in two opposite directions at equal rates gives us the ordinary acerate spicule (fig. 3, 1), which is biradiate (diactinellid) but uniaxial.

2. A retardation of growth in one radius gives the acuate spicule of fig. 3, 2.

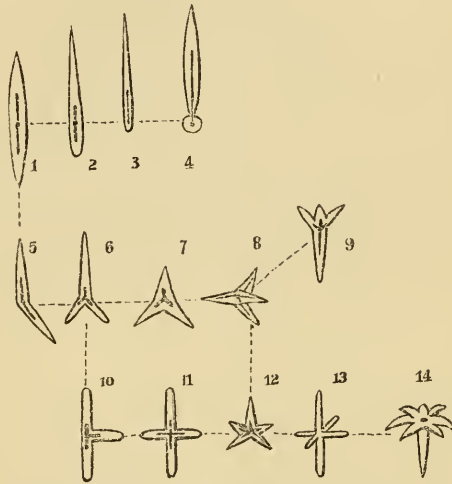
3. A linear growth in one direction only gives the acuate

\* Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. i. pl. ix. figs. 7, 10, 11, pp. 132, 133.

(fig. 3, 3); if accompanied by increased concentric growth of the initial cell, then the pin-headed acuate (fig. 3, 4) is produced.

4. An elongation of the cell in two directions inclined to each other at a less angle than  $180^\circ$ , gives us the curved acerate (fig. 3, 5), which is both biradial and biaxial.

Fig. 3.



5. The inclination of the two rays in fig. 3, 5, is followed by the appearance of a third in fig. 3, 6, where we have the triradial spicule of *Plectonella*. In this spicule two of the radii arise from the proximal face of the cell and grow inwards towards the axis of the fibre on which it is situated, and the third ray arises distally and grows outwards away from the axis.

6. A growth of the cell in three directions making equal angles with each other, and having no determinate relations to any symmetrical line within the sponge, gives us the equiangular triradial spicule (fig. 3, 7), which occurs abnormally in *Dercitus Bucklandi*. (Triradial spicules also occur as varieties in *Eccionema*, Bwk., and *Normania*, Bwk. ('Monograph of British Spongiadae,' vol. iii. pl. ix. figs. 4, 5, and pl. lxxx. figs. 6, 8), and as a normal form in *Sphinctrella horrida* (Schmidt, 'Spongien d. atlant. Gebietes,' pl. vi. fig. 7) and in *Pachastrella connectens*.)

7. A quadriradial growth of the cell in directions having no determinate relations to the form of the sponge gives us the normal spicule of *Dercitus Bucklandi* (fig. 3, 8).

8. The cell gives off three buds from its distal face, which grow outwards away from the sponge, and a fourth from its proximal face, which grows inwards, and we have the forked forms of *Geodia* and the like (fig. 3, 9).

9. The cell grows in five directions along three axes at right angles to each other, which are not determinately related to any lines of reference within the sponge (*Dercitus Bucklandi*), or which are so related (*Euplectella* and other Hexactinellids), and we have the quinquerradiate form (fig. 3, 12).

10. In fig. 3, 6, the growth of the three rays is along directions inclined somewhere about  $120^\circ$  with each other; if two of the rays grow in opposite directions, and the third at right angles to them, fig. 3, 10, results (a form abnormal in *Plectronella*, frequent among the Hexactinellidæ).

Fig. 3, 11, requires no comment.

Fig. 3, 13, is the result of a sexradiate growth of the cell along three axes at right angles to each other, and represents the typical Hexactinellid spicule.

Fig. 3, 14, is an octoradiate form, seven buds having grown out radiately in one plane and the eighth at right angles to them; it occurs in the fossil *Hyalostelia*.

The foregoing remarks have arisen out of our description of *Plectronella papillosa*, which was the main object of this paper; but the variability of sponge-spicules is far too important a subject to be treated thus incidentally, and might furnish material enough for a lengthy memoir. No sponge that has come under my observation has failed to exhibit numbers of spicules departing more or less widely from the average type; frequently the range of variability is extreme; and no doubt, when a large number of specimens of allied species of sponges come to be carefully compared, we shall find not only in their external form, but in the details of their internal structure as well, easy passages from one to the other, and links will be discovered uniting together types of sponge-structure that now appear widely separated from one another.

*Taxonomical position of Plectronella*.—The existence of distinct fibres echinated by characteristic spicules places this sponge in Carter's fifth order, the ECHINONEMATA.

In the general structure and arrangement of its fibres and the position of its echinating spicules it most resembles the genus *Dictyocylindrus* (Bwk.).

In the form of its echinating spicules it appears to approach the crutch-shaped spicules of the group *Baculifera* (Carter), founded on Savile Kent's *Caulospongia*. In the *Baculifera*, however, the crutch-shaped spicules form the core as well as echinate the surface of the fibre, while it is only exceptionally

that a spur-like spicule is found wholly inside the fibre of *Plectronella*.

If there were no spur-shaped spicules in *Plectronella*, the projection of its acerate spicules beyond the surface of the fibre would place it in the Axinellid family; but since they are present and characteristically seated on the fibre, its proper place is clearly enough with the Ectyonida, amongst which it will take rank, on account of the unique form of its echinating spicule, as the representative of a distinct group, the *Plectronina*.

## Order ECHINONEMATA, Carter.

### Family Ectyonida, Carter.

### Group PLECTRONINA, Sollas.

### Genus PLECTRONELLA.

### Species *Plectronella papillosa*, Sollas.

## EXPLANATION OF THE PLATES.

### PLATE IV.

#### *Plectronella papillosa*.

- Fig. 1.* The entire sponge, seen from above.  $\frac{1}{2}$  natural size.  
*Fig. 2.* Sponge seen from below.  $\frac{1}{2}$  natural size.

### PLATE V.

#### *Plectronella papillosa*.

- Fig. 1.* Acerate spicule from the interior of the fibre.  
*Fig. 2.* Spur-shaped spicule (when *in situ* echinating the fibre).  
*Fig. 3.* Flesh-spicule. (Figs. 1-3 all drawn to the same scale,  $\frac{1}{10}$ .)  
*Fig. 4.* Flesh-spicules, straight and curved.  
*Fig. 5.* A sheaf of flesh-spicules. (Figs. 4 & 5  $\times 400$ ).  
*Figs. 6-10.* Varieties of the acerate spicule ( $\times 140$ ). *Fig. 6* a form frequently assumed when the acerate spicule projects from the fibre echinately.  
*Fig. 11.* Two acerates ankylosed together; ends broken.  
*Figs. 12, 13.* Bifurcated acerate spicules.  $\times 140$ .  
*Fig. 14.* Young form of echinating or triradiate spicule.  $\times 140$ .  
*Fig. 15.* Variety of acerate.  $\times 140$ .  
*Fig. 16.* A spicule not belonging to the sponge, but met with in its examination; it presents a cylindrical shaft terminated at each end by a microspined globular head.  $\times 315$ .  
*Fig. 17.* Biradiate uniaxial variety of echinating spicule.  
*Fig. 18.* Similar variety, showing axial canal.  
*Fig. 19.* Biradiate biaxial variety; rays inclined at  $90^\circ$  to each other.  
*Fig. 20.* Similar variety but with single smooth ray taking the same direction as it would if its fellow were present.  
*Fig. 21.* Normal form of echinating spicule. (Figs. 17-21  $\times 315$ .)



## PLATE VI.

*Plectonella papillosa.*

- Fig. 22.* Triradiate variety; spined ray and one smooth one lying in the same straight line, with which the second smooth ray makes almost a right angle.
- Fig. 23.* Triradiate variety; one smooth ray terminated bluntly, the other one pointed.
- Fig. 24.* Triradiate variety; one smooth ray making an angle nearly  $90^{\circ}$  less than usual with the spined ray.
- Fig. 25.* Triradiate variety; both smooth rays stunted and with rounded ends; a large erect spine projects from one side.
- Fig. 26.* Triradiate, equiangular, very slightly spined. (This is the form figured by Bowerbank, Monograph Brit. Spong. vol. i. pl. v. fig. 88, and described by him as equiangular, triradiate, unilaterally spined; he obtained it from a small fragment of a parasitic sponge.)
- Fig. 27.* Similar form, showing the canaliculation of the spines.
- Fig. 28.* Quadriradiate variety.
- Fig. 29.* Similar but much younger variety.
- Fig. 30.* Young form of triradiate spicule.
- Fig. 31.* Triradiate variety, with both smooth rays inclined approximately at right angles to the spined one.
- Fig. 32.* Quadriradiate, with a very long spined ray, and showing the canals of the spines. (Figures on Pl. VI. all  $\times 315$ .)

## PLATE VII.

*Dercitus Bucklandi.*

- Fig. 33.* Equiangular triradiate variety.
- Fig. 34.* Quadriradiate, with one arm longer than the others and one subdivided into two rays of unequal length.
- Fig. 35.* Quinqueradiate variety, with one ray flexed, and another bifurcated and once spined.
- Fig. 36.* Biradiate variety, with one ray bifurcated.
- Fig. 37.* Quadriradiate, one ray giving off a branch or a spine in a backward direction.
- Fig. 38.* Quinqueradiate rectangular variety.
- Fig. 39.* Quadriradiate with two rays flexed at the end and one ray bifurcated; ends of bifurcated ray, one rounded off hemispherically, the other incompletely bifurcated a second time.
- Fig. 40.* Quadriradiate with one ray bifurcated.
- Fig. 41.* Quinqueradiate similar to fig. 38.
- Fig. 42.* Quadriradiate with two arms flexed in opposite directions and two straight.
- Fig. 43.* Quadriradiate, one ray flexed.
- Fig. 44.* Quadriradiate with one ray terminated hemispherically.
- Fig. 45.* Quadriradiate; one ray flexed first to one side and then to the other so as to regain its original direction, one ray flexed and rounded hemispherically, a third simply rounded off at the end, and the fourth unaffected.
- Fig. 46.* Two quadriradiates ankylosed by the rays *a* and *b*.

The Museum, Bristol,  
Sept. 20, 1878.

### III.—On the Bryozoa (*Polyzoa*) of the Bay of Naples.

By ARTHUR WM. WATERS, F.L.S., F.G.S.

[Plates VIII.—XI.]

THE Bryozoa from the Mediterranean have received some little attention from time to time; but very much remains to be done, and on this account I made a collection during a few weeks' stay in the Zoological Station at Naples. My attention was specially given to the calcareous species, in order to compare the recent forms with the abundant Pliocene and Miocene faunas of Italy.

Marsigli (1725), G. Olivi (1792), St. delle Chiaje (1843, in *Descr. e Notom. d. Anim.*), and Costa (Fauna del Regno di Napoli) have given descriptions of a few species; but as the early conceptions of the Bryozoa were crude, these works are of little assistance.

In 1810 the 'Description de l'Egypte' was published, and a series of folio plates of the Bryozoa were prepared under the direction of J. C. Savigny; but as soon as these were completed a serious and ultimately fatal illness prevented him writing the description, or, in fact, being consulted as to what had been done; and it became necessary for the French government to insist on the work being brought to a conclusion, and M. Audouin was intrusted with the completion of the "Polypes." He gave a name to each of the figured forms, but no description; so that his work is only a catalogue of species named after some member of the expedition, or friends and a few French savants. It will thus be seen that a difficulty in nomenclature is introduced, as the figures frequently do not admit of determination, since the characters which are now used were not understood, and artistic fancy was allowed rather free scope; however the name given should be retained for those species which are clearly distinguishable.

In 1867 Prof. Cam. Heller published his 'Bryozoen des Adriatischen Meeres' (in *Verh. der k.-k. zool.-bot. Gesellsch. Wien*, tom. xvii.), which is a part of his series on the Adriatic zoology; and this will always be a most useful and important guide to the Mediterranean Bryozoa. And although I have ventured to make one or two changes, as in the case of *Lepralia perugiana* and *L. Steindachneri*, such alterations are only to be expected, especially when it is remembered that this is only one group out of many studied by Prof. Heller; and in the two cases mentioned I have perhaps had the opportunity of consulting more material than was available for Prof. Heller.

A number of papers by Reuss on the Eocene and Miocene,

in the 'Denkschriften' of the Vienna Academy, have been constantly consulted, as also the completion of the work by Dr. A. Manzoni, who has so ably taken up the study of the Italian Pliocene Bryozoa, and has published a series of papers in the 'Sitzungsberichte' of the same Academy, together with one on a few forms of recent Bryozoa. Smitt's papers and Busk's catalogue are the text-books employed.

For convenience I commence this paper with Lepraloid forms—though, as I am quite convinced that the genus *Lepralia*, as now understood, must soon be abolished, the division may seem very strange; but classification is in the first place useful for mere arrangement and for enabling zoologists to know with certainty what is meant when any species is mentioned, and the classification of the British-Museum Catalogue has assisted in this direction; but as knowledge advances an artificial arrangement has to give way before that which is more natural.

Smitt, the most careful observer of these animals, has proposed a classification in which the greatest weight is given to the form of the zoecia, and the shape of the aperture is largely used, instead of making the colonial form of growth the most important. Our own countryman, Dr. Hincks, has quite recently proposed, in these pages, a classification in much the same direction as Prof. Smitt; and both of these are, in my opinion, much superior to that in more general use. My reason for not at present adopting either is that there seem so many points which have not yet received their due attention, and there is so much material not yet worked up, that, for my own part, I am inclined to wait a short time, lest further knowledge should show that change is again necessary. The researches of Barrois on the embryology may furnish some landmarks. I have also noticed that the form of the operculum\* is a most useful character in determination, as, besides showing difference in size and shape, the hinge of many is characteristic; and the position of the opercular muscles is another guide. In some cases the muscles are at the edge of the operculum; in others they are attached nearer the middle. A disk in the diaphragm of the Ctenostomata, and on the sides of the Cheilostomata, has been noticed by Reichert, Smitt, Nitsche, Ehlers, and Joliet, and has been called by them the "Ro-

\* "The Use of the Opercula in the Determination of the Cheilostomatous Bryozoa," Proc. Manch. Lit. & Phil. Soc. vol. xviii. 1878.

In the present paper I will refer to the figures in the communication just cited by giving the number of the figure after the word operculum—thus, operculum (1\*) means fig. 1.

For comparison the opercula should be examined by a power magnifying about 250 times.

It is scarcely necessary to say the principal value of the measurements is in giving the proportion of length to width.

settenplatte." This, I have shown, varies in nearly all species in such a manner as to be a most useful character, and, as it is connected with the mode of growth, may give important classificatory indications\*.

It is perhaps necessary to Anglicize the term into "rosette-plate" on account of forming a plural; but I do not see any reason for giving a new name for what has been recognized by so many under that appellation, though perhaps some, anxious to give their own names, may suggest a fresh one.

The mode of attachment at the base will, I believe, when worked out, also show important variations. Until these points are further investigated I hesitate to make a change, lest it should be only temporary; but should Dr. Hincks, in his forthcoming work, have additional matter to support his classification, I shall be prepared to follow him. However, for the present, I use the classification which is already in the condemned cell, and which, in my opinion, no royal authority can long retain.

The drawings are made with the camera lucida, magnified 25 times, except in a few cases where it has been advisable to give figures magnified 50 times. I much regret not having more skill with the chalk, in order to better illustrate my meaning.

#### CHEILOSTOMATA.

##### 1. *Lepralia Cecilioi*, Aud. (Pl. VIII. fig. 6.)

*Flustra Cecilioi*, Aud., Savigny, Egypte, pl. 8. fig. 3, p. 66.

*Flustra Duboisii*, Aud., Savigny, Egypte, pl. 8. fig. 4, p. 66.

*Lepralia Cecilioi*, Aud., Busk, Journ. Micr. Sci. vol. v. pl. xv. figs. 6, 7, p. 173.

*Lepralia perugiana*, Heller, Bry. Adr. Meeres, p. 102, pl. ii. fig. 10.

Cells ovate; surface regularly perforated with small pores, except an elongated area below the aperture; pores arranged in irregular linear series round this imperforate area; mouth rounded above, straight below, with a very distinct sinus; surface often slightly raised near the sinus. Ovicell smooth, elongate, contracted near the aperture.

Audouin points out that *F. Duboisii* and *Cecilioi*, Aud., are very much alike; and, in the absence of any description, I have ventured to unite them and to call the beautiful porcelainous species from the Bay of Naples *L. Cecilioi*. My specimens all show an imperforate area; but this does not seem to be the case in others.

Busk, in his figure of a specimen from Jersey, shows a di-

\* The end wall, which I merely speak of as the "distal wall," shows the most variation and is likely to be the most useful in determination.

stinet umbo; and this is evidently the same as *L. perugiana* of Heller; so that, if necessary, we may consider there is a variety with an umbo and one without.

A Red-Sea specimen in my possession has no umbo; and there is also one in the British Museum from Kino Channel, Japan, in which the form and measurement of the aperture are just the same as in that from Naples; but there is no distinct imperforate area, nor on the small fragment are there any ovicells.

*Loc.* Cornwall, Jersey, Adriatic, Red Sea, Japan.

## 2. *Lepralia vulgaris*, Moll. (Pl. X. figs. 1, 2.)

*Eschara vulgaris*, Moll, Seerinde, p. 61, pl. iii. fig. 10, A, B.

*Lepralia vulgaris*, Busk, Quart. Journ. Micr. Sci. vol. vi. 1858, p. 127, pl. xviii. fig. 3.

*Flustra Duterei*, Aud. in Sav. Egypte, pl. 9. fig. 2.

*Cellepora otophora*, Reuss, Foss. Polyp. d. Wien. Tert. p. 90, tab. 11. fig. 1.

*Lepralia otophora*, Reuss, F. Bry. Oest.-Ung. Mioc. p. 164, tab. 8. fig. 5.

?*Lepralia tumida*, Manz. Bryozoi di Castrocaro, p. 25, tab. iii. fig. 33.

*Lepralia intermedia*, Reuss, Oest.-Ung. Mioc. p. 160, tab. 8. fig. 11.

Although here cells are figured without a central umbo, I find that the majority have an umbo which is very variable in size, and there is also a projection on the ovicell.

The sinus of the oral aperture is well marked; and the tooth of the operculum, which fits into it, spreads out and terminates with a rounded edge. The width of the operculum (2\*) is 0.108 millim., height .08, length of sinual tooth .028.

*Loc.* Oligocene, Miocene, and Pliocene (see 'Bry. from Bruc.'). Living: Ireland, Cornwall, Madeira, Mediterranean.

## 3. *Lepralia pertusa*, Esper. (Pl. VIII. fig. 5.)

It seems that under this name two distinct forms are mixed up, as some have the proximal edge of the operculum rounded, and others with a distinct sinus; but until I have the opportunity of examining more material I will only separate them as vars. *rotundata* and *sinuata*.

Var. *rotundata*. This is the variety in the British-Museum collections; and from Naples I have it without any avicularia, and also with an avicularium below the aperture, as in *auriculata*. This may be called var. *armata*.

Var. *sinuata*. This is the form drawn, and is the one figured by Manzoni (Supp. a. Fauna, pl. ii. figs. 5, 6). This sometimes has no avicularia, but very frequently one or two at the sides of the aperture.

Operculum (3\*) .168 millim. wide, .160 long, including sinus.

4. *Lepralia ansata*, Johnst., var. *porosa*, Rss.

*Cellepora Dunkeri*, Reuss. Foss. Polyp. Wien. Tert. p. 90, pl. x. fig. 27.

*Lepralia spinifera*, Johnst. in Busk, B.M. Cat. p. 69, pl. lxxxi. figs. 6, 7; Manzoni, Bry. Pl. Ital. p. 7, pl. ii. fig. 11.

*Lepralia unicornis*, Johnst. in Busk, Crag Polyz. p. 45, pl. v. fig. 4.

*Lepralia tetragona*, Reuss, Foss. Bryoz. Oest.-Ung. Mioc. p. 159, pl. 7. figs. 1-3, &c.; Manzoni, Bry. foss. Ital. cont. 3, p. 8, pl. ix. fig. 19.

*Mollia vulgaris*, var. *ansata*, Smitt, Krit. Fört. ö. Sk. Hafs-Bry. 1867, vol. xxiv. p. 15, pl. xxv. figs. 79-82.

I am in doubt as to whether this group should be *ansata* or *unicornis*, but have followed Reuss in making *ansata* the type. Although the *spinifera* and *ansata* groups are mixed up in the British-Museum Catalogue under the name *spinifera*, they are easily distinguished by the form of the operculum.

*Loc.* Miocene, Austria and Hungary; Oligocene, Doburg; Pliocene, Castellarquato, Castrocaro, &c., and many localities in Sicily. Living: Arctic Ocean, Britain, Mediterranean.

5. *Lepralia auriculata*, Hass. (Pl. IX. fig. 5; Pl. XI. fig. 3.)

*Lepralia auriculata*, Hass. B.M. Cat. p. 67.

The piece drawn (Pl. IX. fig. 5) shows the various stages of growth of this species, which is very common in the Bay of Naples. *a* shows the commencement of calcification; *b*, the three oral spines are now always to be seen, and a depression at the proximal edge of the zoecia, and already the commencement of the avicularia is visible. The perforations are very distinct; but the granulation is also apparent, though not yet distinct. In the cells a little older the avicularia, projecting above the mouth, are raised and very distinct. The ovicells are soon formed in the depression already mentioned, as seen at *c* &c. and *d*. By the growth of the calcareous front of the cells the ovicells are soon immersed, as at *e*, and the granulations or warts on the surface become more prominent, though careful examination always shows the perforations as well. It is hardly necessary to say that it is only upon the younger cells that the oral spines are visible.

To give a complete idea of the colony drawn, I should have figured about five rows more of plain cells like *f*; and then we should reach the centre of the colony.

Pl. XI. fig. 3 shows a form which the avicularia sometimes take; but this is only a modification in size and position; for the avicularia may project very much in the ordinary position at right angles to the axis of the zoecia, and then the shape is seen to be the same as that figured in a horizontal position

(fig. 3). In most large colonies two or three such avicularia are usually found.

As I am not aware that this has been pointed out before, it may have struck some as strange that I should have allied a form figured\* as var. *leontiniensis* with *auriculata*; but I think the specimens fully justify the determination; and, in fact, I have since found that *auriculata* grows frequently in the *Hemeschara* stadium, and often with many layers of cells one above another; so that it is very doubtful if the Bruccoli specimen is different from recent ones from Naples.

In *Eschara foliacea*, which has an avicularium somewhat similar to that of *auriculata*, horizontal avicularia sometimes occur; and the same variations are known in *E. pertusa*, M.-Edw., and in *E. macrochila*, Rss.

Widest part of operculum (13\*) 0·1 millim., proximal edge 0·084, length 0·08.

*Loc.* Pliocene, Bruccoli. Living: Britain, Finland, Spitzbergen, Greenland.

#### 6. *Lepralia ciliata*, Pall.

*Escharina armata*, D'Orb. Voyage dans l'Amérique, vol. v. p. 15, vol. ix. pl. 4. figs. 1-4.

Width of operculum 0·121 millim., length 0·073.

*Loc.* Miocene and Pliocene (see Bry. from Brucc.). Living: Arctic seas, Britain, Mediterranean, Florida, New Zealand (*Hutton*), South Africa, var. ? (*J. Boyd's* coll.), Novaja Semlja (*Smitt*, 1878), Falkland Islands (*D'Orb.*).

#### 7. *Lepralia Malusii*, Aud.

*Cellepora Malusii*, Savigny, Egypte, pl. 8. fig. 8.

Manzoni ("Supplemento alla Fauna dei Bry. Medit.," Sitzb. Akad. Wissensch. Wien, lxiii., 1871, Taf. ii. fig. 2) gives a very good figure of this most beautiful *Lepralia*, but did not find in his specimens the stelliform pores; whereas in all I examined from Naples they are most distinct, and correspond exactly with the British specimens, as well as with one from Tierra del Fuego in the British Museum.

Heller mentions a variety (Taf. ii. fig. 3); but it appears as if some slip had been made about it, as there does not seem any thing in common.

The ovicells of *Lepralia personata*, Busk, are similar, as also the lunar pore; and we must look upon these two as re-

\* "Bryozoa from the Pliocene of Bruccoli," Trans. Manch. Geol. Soc. vol. xiv. p. 469.

lated, though the Falkland-Islands *L. personata* has a large avicularium. The characters of the ovicells of *personata* are not quite sufficiently given in the 'Catalogue of the Marine Polyzoa.'

Operculum (30\*) ·14 millim. wide, ·076 long.

*Loc.* Widely distributed; occurring in the northern seas (*Smitt*) and in South America and New Zealand. It has been found fossil in the English Crag and in the Pliocene of Castrocaro (Italy).

8. *Lepralia bimucronata*, Moll, var. *granifera*.  
(Pl. VIII. figs. 2, 3.)

*Lepralia granifera*, Johnst. (part.) in Landsborough, History of Brit. Zoophytes, p. 309.

Zoecia ovate, front punctured all over with large stelliform pores, large central round or lunatic pore on umbo; aperture rounded above, straight below, margin raised on both sides. Ovicells globose, smooth, with occasional small perforations. Operculum thicker at the two sides, corresponding to the raised margins.

This species is closely related to *L. Malusii*, but is much smaller (as will be seen from fig. 3, on the same scale as most of the species drawn), and has an umbo looking forward, so that often the semilunar or circular pore cannot be seen. It is difficult to decide if this should be considered a variety of Moll's *L. bimucronata*, as he does not figure any umbo; but sometimes cells are found without, or it might be overlooked.

It is also very closely related to *Lepralia granifera*, Busk, but does not, from an examination of the Museum specimen, appear to be exactly the same, though a variety, but is evidently the same as the umbonated variety figured by Landsborough.

One of our best authorities does not agree in thinking this the same as *bimucronata* of Moll; and if this is thought to be the case it might be called *granifera*, var. *occidua*, as the pore often cannot be seen. There are two small teeth in the lower edge of the pore.

Operculum (31\*): width 0·116 millim., width of proximal edge 0·08, length 0·084.

Common, covering seaweed from depths of a few fathoms.

9. *Lepralia violacea*, Johnst.

*Porina violacea*, Smitt, Floridan Bryozoa, Kongl. Svenska Vet. Akad. Handl. 1873, vol. ii. pt. 2, p. 30.

I have only met with this two or three times at Naples, and then from depths of about 40 fathoms. Heller gives the depth as 20–55 fath., and Smitt as 35 fath.



Loc. Crag. Middle Pliocene of Belgium (*Houzeau de Lehaie* \*). Living: Britain, Gibraltar, Roscoff (*J.*), Adriatic, Tortugas (Florida).

10. *Lepralia Brongniartii*, Aud. (Pl. IX. fig. 7.)

*Lepralia capitata*, Reuss, Foss. Bry. des Oest.-Ung. Mioc. p. 21, pl. iv. fig. 7.

*Lepralia Brongniartii*, Manzoni, Briozoi di Castrocaro, p. 20, pl. ii. fig. 27, pl. iv. fig. 54; id. Bry. fossil. Ital. contrib. 2, pl. ii. fig. 9.

The connexions between the zoecia are short tubes, as shown by Savigny's figure, but which are not given in Busk's catalogue. This is interesting as showing the first step towards more widely separated cells, like *Diachoris*; and Hutton calls a form very closely allied to this *Diachoris Buskia*.

These connecting tubes terminate with a convex end in the upper part of the zoecia, so that in the upper half of each cell are the spreading-out ends of the tubes of the zoecia above, while in the lower half are the tubes which terminate in the zoecia below them. I hope shortly to give a figure explaining this.

Loc. Miocene, Baden. Pliocene: Crag, Castrocaro (rare), Volterro. Living: Britain, Roscoff (*J.*), Adriatic (*Heller*); and there is a specimen from Japan in the British Museum. Naples, common on Algæ from moderate depths, 5-20 fath.

11. *Lepralia annulata*, Fab., var. *innominata*.

*Lepralia innominata*, B.M. Cat. p. 79.

*Lepralia innominata*, Couch, Manzoni, Suppl. Fauna dei Bryozoi Medit. cont. 1<sup>a</sup>, and Bry. Plioc. Ital. cont. 1<sup>a</sup>.

As *L. annulata*, *innominata*, and *scripta* pass gradually into one another, it will be well to distinguish the different forms as varieties of *annulata*.

Loc. See p. 7, Bry. from Brucc.

12. *Lepralia radiata*, Moll.

*Eschara radiata*, Moll, Die Seerinde, p. 70, pl. iv. fig. 17, A, B, C, D, E.

*Frustra Pouilletii*, Aud. in Sav. Egypte, p. 68, pl. 9. fig. 12.

*Lepralia megacephala*, Reuss, Polyp. d. Wiener Tertiärbeckens, p. 83, pl. x. fig. 5.

*Lepralia scripta*, Reuss, l. c. p. 82, pl. ix. fig. 28; id. Foss. Bry. Oest.-Ung. Mioc. p. 25, pl. i. fig. 7, pl. vi. fig. 1.

*Lepralia scripta*, Reuss in Manzoni, Suppl. alla F. dei Bry. Medit. cont. 1, p. 5, pl. i. fig. 6, and Bry. Foss. It. cont. 3, p. 4, pl. i. figs. 1, 2.

*Lepralia radiata*, Moll, in Busk, Quart. Journ. Micr. Sci. vol. vi. p. 263, pl. xx. fig. 4.

\* 'Esquisse Géol. et Pal. des dép. plioc. d'Anvers,' par M. E. Vanden Broeck.

*Loc.* Miocene: several localities in Austria and Hungary, Turin. Pliocene: Piacenza, Tuscany, Brucoli, &c. (Sicily). Living: Mediterranean, Red Sea (*Aud.*), Madeira (*Busk*), Florida (*Sm.*).

13. *Lepralia Gattyæ*, Landsb. (Pl. IX. fig. 6.)

*Lepralia Gattyæ*, Landsborough, Pop. Hist. of Brit. Zooph. p. 326, pl. xviii. fig. 71; B.M. Cat. p. 73, pl. lxxxiii. fig. 6.

*Lepralia Steindachneri*, Heller, Die Bryoz. des Adriat. Meeres, Verh. der k.-k. zool.-botan. Gesellsch. Wien, vol. xvii. 1867, p. 109, pl. ii. fig. 195.

?*Flustra Jaubertii*, Aud. in Sav. Egypte, p. 68, pl. 9. fig. 9.

The ovicell is large, orbicular, nearly as wide as the zoœcia, with a slightly raised keel above the aperture. The border of the ornamented area is deeply indented; and occasionally in each indentation rises a very minute spine. In the centre of the area is a tubercle which sometimes is prominently raised and bifurcate at the extremity. In fig. 6*a* this is seen surrounded with the minute spines just mentioned.

This is a semitransparent species, and, as it contains but little calcareous matter, is only to be satisfactorily seen when preserved in fluid, though the delicate radiating lines are only visible when dry.

I did not recognize from Busk's figure that it was the same as Heller's *L. Steindachneri*; but upon comparison of the British-Museum specimen found that it had a well-marked area as figured by Heller. The figure given by Landsborough is much better than that in the British-Museum Catalogue. I cannot see that this has much resemblance to *L. coronata*, Aud., which seems more to approach *L. vulgaris*.

Operculum (34\*) ·068 millim. wide, ·04 long.

*Loc.* Lesina (Adriatic), Sidmouth, Jersey.

14. *Lepralia cribrosa*, Heller. (Pl. IX. fig. 4.)

*Lepralia cribrosa*, Heller, Die Bryoz. des Adriat. Meeres, p. 109, pl. 11. fig. 6.

The name *cribrosa* has already been used by Boeck for another species; but as Boeck's *cribrosa* is considered a synonym, I have provisionally retained Heller's name.

The zoœcia of this species are much larger than those of *L. Steindachneri*; but the two are evidently closely related. The ornamented area is perforated with small pores near the centre, and much larger ones at the edge; the ovicells have similar holes and radial lines. There is frequently an avicularium near the end of the ovicells, and usually one avicularium at

the side of the oral aperture ; sometimes this is absent ; and in other cases there is one on each side.

Heller has figured two vibracular processes, but does not mention them in his text ; but I think, in spite of this difference, there is no doubt this is *L. cribrosa*.

I have figured terminal cells in order to show the structure of the connecting furrows. Before these are covered by the growth of the zoëcia they appear like ridges of pustules connected with the zoëcia on each side. The cells of most *Diachores* are connected by long distinct tubes ; but in *Diachoris patellaria*, var. (Pl. XIII. fig. 4\*), they are sometimes quite short, and in many specimens can only be seen when dissected ; also in *Lepralia Brongniartii*, Aud., the zoëcia are connected by short tubes, as is well shown in Savigny's figure, and which form the "reticulated spaces" of Busk ; and *L. cribrosa* shows another variation in this mode of connexion. There are several *Lepraliae* with similar rows of minute chambers between the zoëcia ; and I think a study of the basal connexion would throw much light on the specific variation in the growth of the Bryozoa.

*Loc.* Lesina, on Algæ (Heller) ; Naples, on seaweed at slight depth.

#### 15. *Lepralia verrucosa*, Esper.

*Cellepora Endlicheri*, Reuss, Foss. Polyp. d. Wiener Tertiärbeckens, p. 82, pl. ix. fig. 27.

*Lepralia Endlicheri*, Reuss, Die Bryozoen des Oest.-Ung. Mioc. p. 31, pl. i. fig. 9.

*Cellepora scarabeus*, Reuss, F. Polyp. p. 86, pl. x. fig. 14.

*Lepralia scarabeus*, Reuss, Br. Oest.-Ung. Mioc. p. 32, pl. i. fig. 10.

I am unable to see in the later figures of Reuss any material difference from recent *L. verrucosa*.

*Loc.* Miocene, Pliocene, Pruma (Calabria, *A. W.*). Living: Arctic Ocean (*Sm.*), Britain.

#### 16. *Lepralia linearis*, var. *biaperta*. (Pl. XI. figs. 1, 2.)

*Hippothoa biaperta*, Smitt, Floridan Bryozoa, Handl. Kongl. Svenska Vetensk. Ak. 1872, vol. ii. pt. 2, p. 46, pl. viii. figs. 173-176.

*Escharella linearis*, Hass., forma *biaperta*, Busk, in Smitt, Krit. Fört. p. 14, 1867.

This form varies very much in its different stages ; so that on the one piece I have from Naples the youngest cells most nearly correspond with *linearis typica*, having raised avicularia on each side of a ventricose cell, in a later stage the cells are the same as fig. 176 of Smitt, while in the oldest the aper-

\* This Plate will appear in a future number.

ture is situated at the bottom of a deep depression as figured. In this depression are the two oral avicularia; and it is only upon the older cells that the large acute avicularia are found. The ovicells are very characteristic, being usually slightly raised, with a flat depressed area ornamented with radiating lines. Round the depressed oral aperture there is usually a ridge.

This is undoubtedly very nearly related to *L. biapertura* of the Crag; but I am not quite sure if it should be considered a synonym.

Operculum with a rounded proximal edge, .116 millim. wide, .12 millim. long, muscular impressions .064 millim. apart.

Found by Pourtales on shells and corals, Florida. Sea of Kara (*Smitt*, Bry. e Nov. Sem. & Jen. 1878). There is also a specimen in the British Museum (in the *Eschara stadium*) from Sio-ū-wha Bay, Tartary, lat. 42° N., long. 133° E.

17. *Lepralia linearis*, Hass., var. *hastata*, Hincks.

*Lepralia linearis*, Hass., var. *hastata*, Hincks, Ann. & Mag. Nat. Hist. ser. 3, vol. vii. p. 206, pl. xii. figs. 4, 4 a, and vol. x. p. 362.

Avicularian process half the length of the cell. On seaweed.

18. *Lepralia linearis*, Hass., forma typica, Smitt.

*Lepralia linearis*, Hass., B.M. Cat. p. 71; forma typica, Smitt, Krit. Fört. Skand. Hafs-B. 1867, pp. 13, 95, pl. xxiv. figs. 68, 69.

Occurs at Naples on seaweed &c. in 10–50 fathoms, with the two avicularia on rounded mamillary eminences.

Operculum (7\*) rounded at the distal end, subtriangular at the proximal, with prominent hinge-processes; length 0.109 millim., width 0.1; muscular impression close to border, 0.6 millim. from the proximal apex.

*Loc.* Pliocene: Reggio. Living: Scandinavia (all depths), Finland, Britain, France, Adriatic.

19. *Lepralia linearis*, Hass., typa secundaria, Smitt.  
(Pl. IX. fig. 2.)

This differs from the last form in having no avicularia. The large opening to the ovicell has a bar across, in the middle of which is a minute denticle on both sides for attachment of the horny cover.

Row of eight to ten lateral rosette-plates, one third of the height from the base. The distal wall has about four near the base, and two above these close to the side.

20. *Lepralia errata*, stadium *Hemeschara*. (Pl. X. fig. 5.)

*Lepralia spinifera*, Johnst. in Busk (part.), B.M. Cat. pl. xci. figs. 1, 2.

Under *spinifera* Busk has described widely different forms. The specimen in the British Museum, from which pl. lxxvi. figs. 2 & 3 is taken, is *spinifera* of Johnston, and has a large sinus, and the operculum (as far as could be seen without a preparation) nearly corresponds with that of *L. Cecillii*; while pl. xci. figs. 1, 2, appears the same as the one under consideration, which has a circular distal and proximal edge and distinct muscular impression.

Smitt has already separated some of Busk's forms of *spinifera*, but does not seem to have found the present.

Cells rhomboid, separated by divisional lines, coarsely punctured; mouth suborbicular; the proximal arc of the operculum, being smaller, gives the appearance of a large wide sinus; often an umbo below the mouth, an acute avicularium on one side; ovicells — ? Zoarium at the base with three or four layers, one over the other; from the incrusting base little stalked cups spring up. In the British Museum there is a piece, about 2 inches high, in which these cups are prolonged into long anastomosing tubes 4 millims. in diameter.

I do not see any difference in the Naples, Cape-of-Good-Hope, and Australian specimens, but have not yet had the opportunity of detail-examination of the latter.

Unfortunately the detail of this drawing does not appear, as it was transferred to the stone after the others, and apparently sufficient pressure was not given.

21. *Lepralia arrogata*, sp. nov. (Pl. VIII. fig. 1.)

Zoecia quincuncially arranged, ovate-rhombic; surface with pores and tubercles; aperture suborbicular, with a wide sinus; large acute avicularium nearly covers the front of the cell. Ovicell raised on the proximal half of each cell, with a flat, depressed, perforate space, bounded by an annular row of large tubercles.

The ovicells are very peculiar, and approach very closely to those of *Lepralia cheilostomata*, Manz. (third contribution), from the Pliocene of Castellarquato. Although the ovicells seem separated off and to belong to the zoecia above and on which they are situated, this is not the case, and they of course belong to the proximal zoecia. From this appearance the name is chosen.

The operculum (6\*) is 0.125 millim. long, 0.125 millim. wide; the distal end is circular, the proximal triangular hinges very long (0.04 millim.) and narrow, with the muscles nearer the distal end.

22. *Lepralia coccinea*, Abild.

*Lepralia coccinea*, B.M. Cat. p. 70.

*Loc.* Upper Eocene of Northern Italy, and Miocene of Hungary. Pliocene: Castrocaro and Sicily from various places. Living: Northern seas to Mediterranean.

23. *Lepralia cucullata*, Busk. (Pl. X. fig. 4.)

*Escharina torquata*, Edw. Voyage dans l'Amérique par D'Orbigny, vol. v. p. 15, vol. ix. pl. iv. figs. 1-4.

*Lepralia cucullata*, Busk, Mar. Polyz. p. 81, pl. xcvi. figs. 4, 5.

?*Cellepora Magnevillana*, Aud. in Sav. Egypte, pl. 8. fig. 6.

?*Cellepora ovoidea*, Aud. in Sav. Egypte, pl. 8. fig. 1 (non Lamx.).

This species is very variable: sometimes there is no margin to the aperture; in other cases it projects very much, swelling out especially on the two sides, when it reminds us of the lips of *L. labiosa*. The surface is perforated with very large pores; and Mr. Busk's description, "granular," is neither correct for this nor for the British-Museum specimen of *cucullata*; but as the thick black membrane almost covers the specimen, it may have been difficult for him to see the structure; and on that account his fig. 4 is misleading; in fact, until I had made a comparison I did not think they were the same. The cells vary also in shape from widely ovate to clongate.

The operculum is very large and characteristic. At each side are two large round spaces, much thinner and lighter than the rest. The proximal end is nearly black with two light spots near the apex. In the specimen drawn (fig. 4a) the proximal end is open; but whether this is only the result of drying, or whether the animal can keep it open, I have not the opportunity of forming an opinion. Width of operculum (14\*) .2 millim., length .22. The distal wall has normally six rosette-plates—four near the base, and one near each side above the two outside plates; lateral wall eight plates, with numerous perforations.

*Loc.* Ægean Sea (*Forbes*); Naples, on seaweed from shallow water; Rio de Janeiro (*D'Orb.*).

24. *Lepralia reticulata*, Macg., var. *ophidiana*.  
(Pl. IX. fig. 1.)

I have felt some doubts as to whether this should be considered a species or variety, but upon comparison have come to the conclusion that the differences from *reticulata* are not very important.

This may be the same as *Flustra Legentilii*, Aud.; but as there is only a figure it seems somewhat doubtful, and there-

fore Smitt is not followed, though *Legentilii* is an earlier name than *reticulata*.

In some cases the peristome is very much raised, in others only slightly so, as figured; the ovicells are perforated, not very much raised and rather behind the peristome; the peculiar feature is the position of the avicularian mandible, which is much below the aperture, and often very long and projecting into the aperture of the cell below, when it is frequently bifid; and from this division, which reminds me of a serpent's tongue, it may be called var. *ophidiana* if there is any occasion to distinguish it. This is not the only case of the point of the mandible appearing divided, as it is sometimes so in *Escharella verrucosa*. Although the mandible is placed so low down, the avicularian chamber is immediately below the aperture, and the two pores just below the mouth open into this avicularian chamber.

Sometimes it is incrusting, at others partially free, so that to those who recognize the genus *Hemescharella* it would belong to it; but, following Smitt, I should call the two forms stadium *Lepralia* and stadium *Hemescharella*.

The operculum (26\*) is subsemicircular, the lower margin slightly curved inwards, 0·19 millim. wide, 0·144 long. Muscular impression close to the border, about 0·08 from the proximal edge.

Inside the oral aperture there is a wide denticle.

There are three distal and six lateral rosette-plates. The distal plates are situated close to the basal walls.

*L. reticulata* has been found from the Arctic Ocean to New Zealand.

25. *Lepralia reticulata*, Macg., forma *inequalis*, nov.  
(Pl. IX. fig. 3.)

The cells are ovate-elongate, punctured specially near the edges; internal denticle; but instead of having a single sub-oral avicularium, there is usually one on each side; sometimes one of these is very large, covering nearly the whole of the cell, with the other extremely minute. The peristome is considerably raised.

Operculum (33\*) ·16 millim. long, ·1 millim. wide.

26. *Lepralia galeata*, Busk.

*Lepralia galeata*, Busk, B.M. Cat. p. 66, pl. xciv. figs. 1, 2.

*Escharella porifera*, Smitt, forma typica, Krit. Fört. ö. Sk. Hafs-Bry. 1867, p. 9, pl. xxiv. figs. 30, 32.

This has a distinct oral denticle, and has much resemblance

to *L. reticulata*, with which I think it would be well to unite it as var. *galeata*.

*Loc.* Falkland Islands, Tierra del Fuego (*Busk*); Spitzbergen and Greenland (*Smitt*); Lesina (*Heller*).

27. *Lepralia ventricosa*, Hass., var. (Pl. VIII. fig. 4.)

This is evidently closely related to the ordinary *ventricosa*, but differs in having the secondary aperture much raised, especially at the two sides. I have not succeeded in showing the cells as much raised and distinct in front, as is the case. On one cell only have I seen a small avicularium. The central cells are smaller than the younger ones, though this is slightly exaggerated from the position in which it was drawn.

28. *Lepralia Pallasiana*, Moll.

This is common at Naples.

At each side of the operculum there is a characteristic ridge, 0·11 millim. long, ending in two swellings.

The length of an operculum drawn (19\*) is 0·18 millim., width 0·17, being about the size of the aperture as given by Smitt.

*Loc.* Pliocene: Bruccoli, Sicily, Crag. Living: Scandinavia, British coasts, Roscoff (*J.*), Adriatic (*Heller*).

29. *Lepralia Pallasiana*, Moll, var. *armata*, Busk.

This variety has an avicularium turned over the aperture as the ordinary avicularia of *L. auriculata*.

30. *Lepralia Pallasiana*, Moll, var. *projecta*.  
(Pl. X. figs. 3, 3 a.)

This is studded with spinous tubercles about the length of the aperture; and in between are the pores. Below the aperture is a short spatulate avicularium.

I think it extremely probable that this is *Eschara Otto-Mulleriana* of Moll (*Seerinde*, fig. 15 A, B, C), but cannot be sure that the half-round pore on a prominence, which he mentions, is the avicularium.

Operculum (17\*) 0·248 millim. long, 0·16 wide.

A rosette-plate at each basal corner of the distal wall; four lateral rosette-plates.

31. *Lepralia lata*, Busk. (Pl. XV. figs. 12, 13: next part.)

*Lepralia lata*, Busk, Quart. Journ. Micr. Sc. vol. iv. p. 309, pl. x. figs. 1, 2; Manzoni, Bry. Plioc. Ital. cont. 1, p. 4, pl. 1. fig. 6.



*Lepralia Kirchenpaueri*, Heller, Bry. Adriat. Meeres, p. 105, pl. ii. fig. 11; Manzoni, Supp. Fauna dei Bry. Medit. cont. 1, p. 8, pl. iii. fig. 3.

*Lepralia cupulata*, Manz. Bry. foss. Ital. cont. 3, p. 13, tab. iv. fig. 21; Waters, Bry. from Pl. of Bruccoli, Manch. Geol. Soc. vol. xiv. pt. 21, p. 473, fig. 6.

All my specimens are upon a small *Trochus*, and show considerable variation, so that on one piece some cells have the two large bosses, while others are without; and from these variations I think we are justified in reducing the synonymy.

Operculum (20\*) suboblong, .104 millim. in length, .06 millim. wide, except at the base, where it is .08 millim.

*Loc.* Miocene, Pliocene, living. Add Pliocene, Castellarquato and Bruccoli.

### 32. *Lepralia fissa*, Busk. (Pl. XI. fig. 6.)

*Lepralia fissa*, Busk, Quart. Journ. Micr. Sc. vol. iv. p. 308, pl. ix. figs. 8, 9, 10.

The peristome is much raised, with long spines, but does not show the dentation mentioned by Busk; the walls are thin, granular, somewhat hyaline; and large avicularia occupy the space of a zoecium.

The small fragment from Naples very much resembles *L. Lyallii*, as figured by Busk, although none of the cells have a vibraculum. As the British-Museum specimen is, unfortunately, not in its place, I have been unable to make a comparison.

### 33. *Eschara foliacea*, stadium *Hemeschara*. (Pl. XI. figs. 4, 5.)

This is another case of finding cells similar in the *Eschara* and *Hemeschara* or *Lepralia* forms.

Figs. 4 and 5 are taken from different specimens.

The avicularia are very small, and are situated in the primary mouth. The globular ovicells have two openings just above the aperture; sometimes a raised peristome joins the ovicells; but as there are but few ovicells on the pieces in my possession, it is impossible to say how general this may be.

The ovicells of *Eschara foliacea* do not seem to have been described as yet.

Operculum (24\*) somewhat sellate; width 0.18 millim.; muscular attachment central on the border of the operculum.

(The scale and most of the figures are magnified 25 times.)

[To be continued.]

IV.—*Hemiptera* from the North-eastern Frontier of India.

By W. L. DISTANT.

THE insects enumerated and described in this paper were collected by Mr. A. W. Chennell, of the Indian Topographical Survey, and are the result of some five or six years' entomologizing in the following localities:—

	Altitude.
Naga hills . . . . .	2000 to 6000 ft.
Khasia hills, high ranges . . .	4500 to 6000 „
North Khasia hills, lower ranges	1500 to 3000 „
Eastern Garo hills . . . . .	1500 to 2500 „
Noa-Dehing valley, south of	
Brahmaputra . . . . .	800 „
Sadia, north of Brahmaputra . . . .	350 „
Dibru, south „ . . . .	250 „
Sibsàgar, south „ . . . .	200 „
Ràmrup, south „ . . . .	150 „

I have here only dealt with the tribe Scutata, which is somewhat largely represented in the collection, and propose treating of the remaining Heteroptera in a subsequent paper. As regards the geographical affinities of the species, it will probably be better, in our present knowledge of Indian Hemiptera, to merely point out some of the widest-ranging insects in this part of the collection.

*Picromerus spinidens*, Fab., is not only recorded from Java, Sumatra, and Borneo, but is also found in Mexico. *Ædnus ventralis*, Dall., *Erthesina fullo*, Thunb., and *Dalsira glandulosa*, Wolff, are well-known Chinese species. *Aziagastus rosmarus*, Dall., has hitherto only been received from the Philippine Isles, Celebes, New Guinea, and Siam, while *Eurydema festiva*, Linn., is a common European form. The following is a list of the species; and it will be seen that some families are totally unrepresented:—

Fam. PACHYCORIDÆ.  
*Solenostethium rubro-punctatum*, Guér.  
*Cantao ocellatus*, Thunb.  
*Pœcilocoris* Hardwickii, Hope.  
    — *Druræi*, Linn.  
*Scutellera nobilis*, Fab.  
*Brachyaulax oblonga*, Hope.  
*Chrysocoris grandis*, Thunb.  
    — *patricius*, Fab.  
    — *purpureus*, Hope.  
*Lamprocoris Roylii*, Hope.  
    — *spiniger*, Dall.

*Hotea curculionides*, H.-S.

Fam. PODOPIDÆ.

*Scotinophora lurida*, Burm.  
    — *obscura*, Dall.  
    — *tarsalis*, Voll.  
*Aspidestrophus morii*, Stål.

Fam. PLATASPIDÆ.

*Coptosoma duodecimpunctata*, Germ.  
*Brachyplatys VahlII*, Fab.  
    — *Burmeisteri*, n. sp.

Fam. ASOPIDÆ.

- Cazira verrucosa, *West.*  
 Cecyrina platyrhinoides, *Walk.*  
 Canthecona tibialis, n. sp.  
 — binotata, n. sp.  
 Picromerus obtusus, *Walk.*  
 — spinidens, *Fab.*  
 — robustus, n. sp.

Fam. CYDNIDÆ.

- Adrissa, sp. ?

Fam. SCIOCORIDÆ.

- Laprius varicornis, *Dall.*  
 Ædnus ventralis, *Dall.*

Fam. HALYDIDÆ.

- Agonoscelis nubila, *Fab.*  
 Erthesina fullo, *Thunb.*  
 Dalpada oculata, *Fab.*  
 — clavata, *Fab.*  
 — varia, *Dall.*  
 Halys dentata, *Fab.*  
 Cestopis, nov. gen.  
 — terra, n. sp.

Fam. PENTATOMIDÆ.

- Belopis, nov. gen.  
 — unicolor, n. sp.  
 Cratonotus, nov. gen.  
 — coloratus, n. sp.  
 Hoplistodera, sp. ?  
 Axiagastus rosmarus, *Dall.*  
 Stollia guttigera, *Thunb.*  
 Tolumnia latipes, *Dall.*  
 Halyomorpha picus, *Fab.*  
 — scutellata, n. sp.  
 Cappæa taprobanensis, *Dall.*  
 Plautia fimbriata, *Fab.*  
 Antestia anchora, *Thunb.*  
 Eurydema festiva, *Linn.*

- Strachia crucigera, *Hahn.*  
 Catacanthus incarnatus, *Drury.*  
 Nezara viridula, *Linn.*  
 Prionochilus octopunctatus, *Dall.*  
 Menida flavo-varia, *Dall.*  
 — varipennis, *Hope.*  
 Prionaca lata, *Dall.*  
 — ? exempta, *Walk.*  
 Diplostira valida, *Dall.*  
 Rhynchocoris humeralis, *Thunb.*  
 Sastragala uniguttata, *Don.*

Fam. UROSTYLIDÆ.

- Urostylis punctigera, *Hope.*  
 — gracilis, *Dall.*  
 Urolabida, sp. ?

Fam. EDESSIDÆ.

- Tessarotoma malaya, *Stål.*  
 Eusthenes cupreus, *Hope.*  
 — robustus, *St. Farg. et Serv.*  
 — scutellaris, *H.-S.*  
 Eurostus grossipes, *Dall.*  
 Pycanum rubens, *Fab.*  
 Cyclopelta tartarea, *Stål.*  
 Aspongopus brunneus, *Thunb.*  
 — janus, *Fab.*  
 — ochreus, *Hope.*  
 — nigriventris, *Hope.*  
 — nepalensis, *Hope.*

Fam. PHYLLOCEPHALIDÆ.

- Placosternum taurus, *Fab.*  
 Dalsira glandulosa, *Wolff.*  
 Tetroda histeroides, *Fab.*  
 Macrina coccinea, *Walk.*  
 — dilatata, n. sp.  
 Megarhynchus limatus, *H.-S.*

Fam. MEGYMENIDÆ.

- Megymenum inerme, *H. S.*

NOTES AND DESCRIPTIONS.

*Brachyaulax oblonga*, Hope.

*Tectocoris oblonga*, Hope, Cat. i. p. 14 (1837).

The type as described was from Java. The North-Indian specimens differ in having the large central spots on the scutellum confluent, forming two transverse waved bands.

*Chrysocoris purpureus*, Hope.

*Callidea purpurea*, Hope, Cat. i. p. 15 (1837).

All the specimens of this species collected by Mr. Chennell vary in coloration from purplish to sanguineous above.

*Scotinophora tarsalis*, Voll.

*Podops tarsalis*, Voll. Faun. Ind.-Néerl. i. p. 42, pl. 3. fig. 8 (1863).

According to Vollenhoven, "les cuisses et les quatre premières jambes sont noires, les postérieures ont la moitié de la jambe d'un brun clair." These specimens, however, agree with the form of the species from Perak in having the legs luteous, punctured with black.

*Brachyplatys Burmeisteri*, n. sp.

*Thyreocoris silphoides*, Burm. Handb. ii. p. 384. 3 (1835).

This species was considered by Burmeister as being the *Cimex silphoides*, Fab. Stål's description of that species (H. Fab. i. p. 5. 2) will, however, prevent any confusion. *B. Burmeisteri* can be at once distinguished from *B. Vahlü* and *B. silphoides* by its uniform coloration above, and absence of luteous markings on head and pronotum, as described by Burmeister, "Æneo-niger, margine omni, pedibus abdominisque maculis marginalibus luteis." The luteous abdominal radial streaks are as in *B. radians*, figured by Voll. Faun. Ind.-Néerl. i. pl. iv. f. 7.

Long. 6 to 8 millims.

Noa-Dehing valley, 800 feet; Sadia, 350 feet.

*Canthecona tibialis*, n. sp.

Head brassy black, very thickly punctured; central lobe reaching apex of head, with its base obscurely luteous; eyes brown. Antennæ pilose; third and fourth joints longest, subequal; apical joint rather shorter than second, which is brown, the third and fourth blackish with their bases narrowly brown, fifth dark fuscous with basal third luteous. Rostrum luteous, tip blackish. Pronotum brassy black, very coarsely punctate, and lightly and irregularly rugulose, with a slightly raised central longitudinal line and irregular luteous markings, which indicate faintly four longitudinal striæ, two on each side of the central line; the crenulated portion of the margin and a small spine behind the eyes luteous; lateral angles produced into short, black, obtuse spines, strongly emarginate at apex. Scutellum with the basal half brassy black, very thickly punctured; apical half paler and more sparingly punctured, with a small central basal spot, a large rounded spot in each basal angle, two small irregular and indistinct markings beneath these, and the apex broadly luteous. Corium luteous, somewhat thickly marked and punctured with black; on the *underside* at apex is a large reddish spot; membrane fuscous,

with two large whitish spots, one on the outer and the other on the inner border. Abdomen above shining green, very thickly punctured, with a marginal row of three luteous spots, which appear on margins of alternate segments above and below. Body beneath luteous, breast thickly punctured with brassy black. Abdomen with a central, narrow, longitudinal, impunctate area, from which it is sparingly punctate halfway to outer border, which is very thickly punctured with brassy black; a large black subapical spot. Legs luteous, with the apices of the femora, and bases and apices of intermediate and posterior tibiae brassy black; fore tibiae very widely dilated and strongly punctured, black; fore tarsi black, intermediate and posterior tarsi luteous with apex black; tibiae strongly sulcated.

Long. 17 millims., exp. lat. ang. pronot. 9 millims.

*Var. A.* Smaller, with the ground-colour brownish instead of brassy black.

Allied to *C. furcellata*, Wolff, from which it differs principally in the shorter and obtuse lateral angles of the pronotum.

North Khasia hills, 1500 to 3000 feet.

*Canthecona binotata*, n. sp.

Luteous, thickly punctured with brown. Central lobe reaching apex of head, lateral lobes thickly covered with brassy black punctures. Eyes prominent, fuscous, luteous at base. Antennae with second and third joints subequal, fourth rather longest; first and second joints luteous, third and fourth dark fuscous, luteous at base; rostrum luteous, with the tip reddish. Pronotum considerably deflexed from base towards head, with a central raised longitudinal line, which is prolonged through the whole length of the scutellum; lateral edges with an indistinct, obscure, violet submarginal border, and some other indistinct striae of the same colour on disk; lateral angles produced into short, obtuse, black spines, emarginate and luteous at tip. Scutellum somewhat gibbous at base, where it is thickly and darkly punctured, the central longitudinal line becoming broad and impunctate towards apex. Corium with a somewhat triangular subcostal blackish spot situated a little beyond medium. Membrane produced considerably beyond abdomen, black, with the apical half whitish. Abdomen above blackish, with a segmental marginal row of alternate subquadrate green and luteous spots. Body below luteous; breast with three violet streaks on each side; abdomen with the marginal row of subquadrate green spots as above, a submarginal row of narrow, transverse, waved, dark lines,

situate one on each segment, and a large subapical blackish spot. Legs luteous, pilose; tibiæ strongly sulcated; fore tibiæ dilated, their apical halves and bases and apices of intermediate and posterior tibiæ blackish.

Long. 15 millims., exp. lat. ang. pronot.  $7\frac{1}{2}$  millims.

Allied to the former species, from which, however, it is very distinct.

Naga hills, 2000 to 6000 feet.

*Picromerus robustus*, n. sp.

Has somewhat the elongated form of *P. spinidens*, but with the thorax robust, much deflexed anteriorly, and body narrowed posteriorly. Luteous, covered regularly and thickly with coarse brown punctures. Central and lateral lobes of the head equal in length; eyes large, prominent, obscure fuscous; rostrum luteous, with the tip pitchy; antennæ with the second and third joints subequal, pale luteous, third joint pitchy at apex (remainder mutilated). Pronotum much narrowed in front and widened posteriorly, with an indistinct, central, longitudinal line; a transverse row of four small luteous spots situated a little behind a somewhat obscure transverse ridge; lateral angles produced into long black-pointed spines, toothed behind, which gives them the appearance of being emarginate at apex. Scutellum with a small luteous spot in each basal angle. Corium with purplish reflections towards apex. Membrane fuscous, with a large whitish spot on outer and inner border (size of these spots variable). Body beneath luteous, punctured and mottled with brown; intermediate thighs testaceous, and tibiæ brownish, with apex and tarsi dark fuscous.

♂, long. 11 millims., exp. lat. ang. pronot.  $6\frac{1}{2}$  millims.;

♀, long. 14 millims., exp. lat. ang. pronot. 9 millims.

The ♀ varies in having the luteous spots above much more obscure and the legs luteous.

Sadia, 350 feet.

*Dalpada varia*, Dall.

*Dalpada varia*, Dall. List, i. p. 185. 8 (1851).

In these specimens a certain amount of green pubescence which is seen in the type is rubbed or worn off. Thus exposed, the apex of the scutellum is broadly luteous.

ÆSTOPIS, nov. gen.

Ovate, depressed; head triangular, lateral lobes much longer than central, meeting beyond it, but divided at the apex.

Antennæ four-jointed; first joint robust, not quite reaching apex of the head; second joint a little shorter than the third; third and fourth subequal, the last somewhat thickened. Rostrum reaching posterior coxæ; apical joint longest. Pronotum a little longer than head, about twice as broad as long, the lateral margins denticulated, the lateral angles prominent; it is slightly prominent and rounded at base, deflexed towards head. Scutellum a little longer than broad, extending slightly beyond base of membrane, gradually narrowed for two thirds its length from base, when it extends almost straight to apex, which is narrowed and rounded. Membrane with longitudinal nervures. Abdomen dilated, projecting a little on each side, convex below. Abdomen, legs, and sternum unarmed.

The four-jointed antennæ, length of the lateral lobes of the head, and general shape of body ally this genus to *Atelocera* and *Memmia*.

*Estopis terra*, n. sp.

Brownish luteous; corium with a reddish hue, thickly and somewhat regularly covered with darker punctures. Head very thickly punctured and somewhat darker in hue. Antennæ luteous; apical joint black, luteous at base. Pronotum with the punctures thicker and darker along lateral and near anterior margins. Scutellum somewhat rugulose and darker at base. Membrane pale fuscous. Abdomen above pitchy; abdominal margin broad and distinct. Sternum concolorous with upperside of body; underside of abdomen rather darker, with a faint central longitudinal black line. Legs luteous, thighs thickly speckled with black.

Long. 17 millims., lat. pronot. ang. 8 millims.

Khasia hills, 4500 to 6000 feet.

BELOPIS, nov. gen.

Broad-ovate; head triangular, lateral lobes longer than the central, and meeting beyond it, but divided at apex. Antennæ five-jointed. Rostrum with the last joint mutilated. Pronotum rather more than twice as broad as long; the lateral angles prominent, subacute, the lateral margins denticulated; deflexed towards head. Scutellum with the length equal to the breadth at base, gradually narrowed for two thirds the length, and then extending nearly straight to apex, which is narrowed and rounded. Membrane with longitudinal nervures. Abdomen dilated above, projecting a little on each side; convex below. Sternum and abdomen unarmed; tibiæ moderately sulcated.

*Belopis unicolor*, n. sp.

Ochraceous, thickly and finely punctured; punctures somewhat darker on frontal half of pronotum and head. Antennæ reddish; second joint longer than first, shorter than fourth, third and fifth longest, subequal. Scutellum with the central portion punctured, rather darker, lateral edges concolorous with other parts of upper surface; membrane ochraceous. Underside of body and legs concolorous, the former thickly and finely punctured.

Long. 14 millims., lat. pronot. ang. 10 millims.

Khasia hills, 4500 to 6000 feet.

## CRATONOTUS, nov. gen.

Head broad and elongated; ocular part broadest, with the lateral edges somewhat sinuated about the middle; central lobe shorter than the lateral lobes. Eyes prominent; ocelli situated rather nearer the eyes than to each other. Antennæ longer than the head and thorax, five-jointed; second joint slightly shorter than the third, fourth longest. Rostrum robust, just passing posterior coxæ; second joint longer than third; apical joint shortest. Pronotum twice as wide as long, raised and rounded at base, deflexed in front, angles obtusely prominent; lateral margins deeply sinuated, with their anterior portion crenulated. Scutellum reaching a little beyond base of membrane, gradually narrowed for two thirds its length from base, when it is straightened to apex, which is moderately broad and rounded; width at base about equal to length. Membrane with longitudinal nervures. Abdomen widened above, projecting a little on each side, convex beneath; abdomen and sternum unarmed. Legs moderately long, tibiæ sulcated.

This genus should be placed near *Durmia*, Stål.

*Cratonotus coloratus*, n. sp.

Brown, somewhat shining, thickly punctured with black; head black, thickly punctured; eyes black, with their bases luteous; antennæ luteous; rostrum brownish; pronotum with the basal half rugulose and very coarsely punctured, lateral margins narrowly luteous, pronotal angles pitchy. Scutellum transversely rugulose, with a large irregular patch at base and apex broadly luteous; membrane pitchy, shining. Margins of abdomen above and body beneath luteous, the last with a broad green stripe on each side, extending narrowly along underside of head, widened at anterior coxæ, and extending



to about the base of the fifth abdominal segment; two obscure marks on disk and a subapical spot pitchy. Legs luteous; apices of femora and tibiæ black, anterior tibiæ punctured with black; tarsi black. Other structural characters as in generic diagnosis above.

Long. 19 millims., lat. pronot. ang. 11.

North Khasia hills, 1500 to 3000 feet.

*Halyomorpha scutellata*, n. sp.

Brunneous, thickly and strongly punctured. Head with frontal and lateral margins black; eyes pitchy; ocelli brown, shining. Rostrum black, reaching posterior coxæ. Antennæ black; second joint much shorter than third, fourth joint rather longer than fifth, both of which are pilose. Pronotum with the lateral margins narrowly reflexed, bordered with black, with the extreme edge sanguineous for about two thirds the length from apex; base rugulose, a somewhat triangular space enclosed by pale impunctate lines situated on each side of frontal border behind eyes; lateral angles prominent. Scutellum bright luteous, with two dots at base, two small parallel lines on disk, and lateral margin, very narrowly at base and broadly towards apex, brunneous; the luteous area has a few deep brown punctures, the other brunneous portion of the scutellum punctured as on other parts of upper surface. Membrane fuscous, with strong longitudinal nervures. Abdomen above sanguineous, with a marginal row of bluish-black spots situated conjointly in pairs at base and apex of each segment both above and below. Underside of body sanguineous; prosternum with some greenish markings behind eyes, a large dull blackish patch near odoriferous apertures, a stigmatal row of rounded bluish-black spots, and a large pitchy spot near apex. Legs black; coxæ sanguineous, bases of femora dull reddish.

Long. 16 millims., lat. pronot. ang. 9 millims.

North Khasia hills, 1500 to 3000 feet.

Var. *a*. Scutellum without the two brown lines on disk, marginal and stigmatal spots on underside of abdomen coalescing. Prosternum with a large black spot behind eyes in place of greenish markings.

*Note.* Specimens from Bombay have the upper surface bluish instead of brunneous, have typical scutellar markings, but underside as in var. *a*.

The *Urolabida*, sp., is evidently an undescribed form allied to *U. Grayii*, White; but, in its mutilated condition, I have abstained from any diagnosis.

*Pycanum rubens*, Fab.*Cimex rubens*, Fab. Ent. Syst. iv. p. 107 (1794).

In this collection all the representatives of this species are of a uniform ochreous colour above.

*Aspongopus brunneus*, Thunb.*Cimex brunneus*, Thunb. Diss. Ent. Nov. Ins. Spec. ii. p. 45 (1783).

This species is closely allied to and commonly confounded with *Cimex obscurus*, Fab. The two species, however, seem to be thus easily differentiated:—

Abdomen above red.

Third joint of antennæ a little longer than second. *brunneus*, Thunb.  
Abdomen above black.

Second and third joints of antennæ equal . . . . . *obscurus*, Fab.

*Aspongopus ochreus*, Hope.*Aspongopus ochreus*, Hope, Cat. i. p. 25 (1837).

The first four joints of antennæ are black; they are described (*l. c.*) in error as "fuscis." I have examined the type with Prof. Westwood.

*Macrina dilatata*, n. sp.

Broad, ovate. Rufous. Head broad, triangular, moderately covered with deep dark punctures; lateral lobes slightly sinuated, divided at apex, meeting beyond central lobe, which is much shorter. Antennæ with the third joint shortest; fourth rather longer, fifth longest, black, with the base rufous (the first four joints vary in different specimens from rufous to luteous). Rostrum reaching anterior coxæ. Pronotum with the base slightly rugulose, somewhat crescent-shaped in front, where it is bordered with a pale luteous band between the lateral angles, which are produced into two stout spines directed forwards; spinal apices black. Anterior portion of the pronotum abruptly deflexed to head, transversely costate, moderately punctured with brown; lateral borders denticulated. Scutellum reaching beyond base of membrane, with five longitudinal, indistinct, somewhat catenulate elevated ridges, which are sprinkled with luteous, the centre ridge generally most indistinct. Membrane pale fuscous, extending beyond apex of abdomen. Underside of body and legs concolorous, thickly and finely punctured with brown. Tibiæ sulcated.

♂, long. 16 millims., lat. at base of corium 8 millims., exp. pronot. ang. 11 millims.; ♀, long. 17 millims., lat. at base of corium  $8\frac{1}{2}$  millims., exp. pronot. ang. 12 millims.

Naga hills, 2000 to 6000 feet; North Khasia hills, 1500 to 3000 feet.

This species approaches *M. coccinea*, Walk., but prominently differs from that and all other species of the genus by its much greater breadth. I have placed it provisionally in the genus *Macrina*.

Some specimens are much darker in colour than others.

V.—*Descriptions of two new Fishes from New Zealand.*

By Prof. F. W. HUTTON, of the Otago University.

*Percis Gilliesii.*

D.  $\frac{5}{21}$ . A. 18. L. lat. 70. L. trans. 8 20.

Length  $3\frac{2}{3}$  times that of the head, which is  $3\frac{1}{2}$  times the diameter of the eye, which is 3 times the interorbital space. Præoperculum entire. Operculum with one spine. Spinous portion of the dorsal lower than the soft; the fifth dorsal spine the longest. Caudal fin square.

Pale reddish, with a narrow longitudinal black band, which is below the lateral line on the anterior portion, and above it on the posterior portion. Above this band is a row of black spots, and another somewhat similar one below it. Dorsal white, the base with black spots. Total length of the specimen  $6\frac{3}{4}$  inches.

Brighton, near Dunedin (*R. Gillies, Esq.*).

*Argentina elongata.*

D. 10. A. 11. P. 15. V. 12.

The length of the head goes  $3\frac{2}{3}$  times into the total (with caudal). Height of the body goes 9 times into the same. Diameter of the eye goes  $3\frac{1}{2}$  times into the length of the head; it is less than the length of the snout. Maxillary does not extend halfway to the eye. No teeth in the jaws, nor on the palate and vomer (?). Tongue with a series of curved teeth on each side. Ventrals situated rather behind the middle of the length (caudal not included). Scales without teeth. Yellowish white; a silvery band down each side; a dusky mark above each eye. Total length of the specimen  $3\frac{1}{2}$  inches.

Cape Campbell (*Mr. C. H. Robson*).

VI.—*Crustacea Cumacea of the 'Lightning,' 'Porcupine,' and 'Valorous' Expeditions.* By the Rev. A. M. NORMAN, M.A.

Order CUMACEA.

Genus DIASTYLIS, Say, 1817.

(=*Alauna*, Goodsir, 1843.)

1. *Diastylis Rathkii* (Kröyer).

1841. *Cuma Rathkii*, Kröyer, Naturhist. Tidsskrift, vol. iii. p. 513, pl. v. figs. 17–30; id. *op. cit.* anden rækkes ii. 1846, p. 144, pl. i. figs. 4, 5; id. *Voyages en Scandinavie &c.* pl. v. fig. 1, *a–u*.

1852. *Cuma Rathkii*, Lilljeborg, Öfversigt af Vet.-Akad. Förhandl. p. 6.

1856. *Diastylis Rathkii*, Bate, Ann. & Mag. Nat. Hist. 2nd ser. xvii. p. 451, pl. xiii.

1859. *Diastylis Rathkii*, Danielssen, Beretning om en Zoologisk Reise foretag. Som. 1857, p. 7.

1864. *Diastylis Rathkii*, G. O. Sars, Om Cumacea, Chr. Vid.-Selskab. Förhandl. 1864, p. 35, and 1873, Om Cumaceen fra de store dybder i Nordishafvet, Kongl. Vet.-Akad. Handl. Bd. ii. no. 6, p. 7, pl. iii. figs. 8, 9.

'Lightning' Expedition, Station 3, lat. 60° 31' N., long. 9° 18' W., 229 fathoms. 'Valorous' Expedition, Station 4, Davis Strait, lat. 66° 59' N., long. 55° 27' W., 60 fathoms.

This polar species is widely distributed in the Arctic and Boreal North Atlantic. I have seen it from Greenland, river St. Lawrence, N.E. America (New-England coast), Norway, Sweden, and Great Britain.

Professor G. O. Sars has, I think, fallen into error\* in supposing that *Cuma angulata* of Kröyer is the male of his *C. Rathkii*. Both sexes of *D. Rathkii* are alike in the spiny armament of the carapace, consisting of two longitudinal lines of spines, one on each side of the dorsal line; these spines are largest and widest apart just behind the rostrum, where the spines are also usually in pairs on each line; the two lines gradually converge backwards, the spines rapidly decreasing in size, so as entirely to disappear at some distance from the hinder margin of the carapace. Among a collection of N.E. American Cumacea, for which I am indebted to Mr. L. I. Smith, is a *Diastylis* which I take to be the true *Cuma angulata* of Kröyer.

\* Beskrivelse af de paa Fregatten Josephines expedition fundne Cumaceer, 1871, pp. 5 and 21.

2. *Diastylis cornuta* (Boeck).

- ?1853. *Cuma bispinosa*, Stimpson, Marine Invertebrata of Grand Manan, p. 39.  
 1860. *Cuma cornuta*, A. Boeck, Vidensk. Selsk. Förhandl. p. 190.  
 1864. *Diastylis bispinosa*, G. O. Sars, Om Cumacea, p. 89.  
 1865. *Diastylis bicornis*, Bate, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 84, pl. i. fig. 2.  
 1868. *Diastylis bispinosa*, Norman, Brit. Assoc. Report, 1868 (1869), p. 270.

I am not satisfied that this is the *Cuma bispinosa* of Stimpson, though it is the species which has been known by that name among European carcinologists. I am not aware that the form for which I here adopt Boeck's name has been recorded from the American coast; and specimens of a New-England *Diastylis* are before me which seem to agree more nearly with Stimpson's brief description.

Sars says that the male of this *Diastylis* has a spineless carapace; but I have males which closely agree in the spiny armature of the carapace with the females; these are not, however, fully developed, inasmuch as the lower antennæ and uropods have not attained their plumose characters. It is hardly likely, however, that the subsequent exuviation, in which a change in *degree* of development would take place in these organs, would result also in so great a change in *kind* as from a strongly spinous to a smooth carapace. *Fully developed* males of *Diastylis* are scarce—that is, males in which the antennæ have attained their excessive length and the verticillately ciliated peduncle, and the abdominal feet have their swimming setæ on the peduncles. *Such* males I have seen of only a few species that I could assign to their females; they are more commonly taken in the tow-net than at the bottom, where, from their great activity, they probably generally succeed in escaping the dredge.

*Diastylis cornuta* was taken in the 'Porcupine' Expedition, 1869, in Lough Foyle, in 15 fathoms, and at Station 21, lat. 55° 40' N., long. 12° 46' W., in 1476 fathoms.

3. *Diastylis insignis*, G. O. Sars.

1871. *Diastylis insignis*, G. O. Sars, Œfvers. af Kongl. Vet.-Akad. Förhandl. p. 76; id. Beskrivelse af de paa Fregatten Josephines expedition fundne Cumaceer, Kongl. Svenska Vetensk.-Akad. Handl. ix. p. 34, pl. xiv. figs. 68-71.

A strongly marked and beautiful species, described by Sars from the 'Josephine' Expedition, having been taken on a muddy bottom in 550 fathoms off the coast of Portugal. A single specimen was dredged in the 1869 'Porcupine' Expe-

dition, in 250 fathoms, to the west of Shetland, lat.  $60^{\circ} 45'$  N., long.  $3^{\circ} 6'$  W.

#### 4. *Diastylis echinata*, Bate.

1865. *Diastylis echinata*, Bate, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 81, pl. i. fig. 1.

The type specimen was dredged off Shetland; and Sars has taken it in 100–300 fathoms on the coast of Norway (Hardanger and Christiania Fiords and Lofoten Islands).

In 1868 it was dredged by the 'Lightning' Expedition, Station 8, lat.  $60^{\circ} 10'$  N., long.  $5^{\circ} 59'$  W., in 550 fathoms.

#### 5. *Diastylis Josephinæ*, G. O. Sars.

1871. *Diastylis Josephinæ*, (Efvers. af Kongl. Vet.-Akad. Förhandl. p. 77; id. 'Josephines' Cumaceer, Kongl. Svenska Vetensk.-Akad. Handl. ix. p. 36, pl. xv. figs. 72–74.

The types of this *Diastylis* were dredged in 750 fathoms off the Portuguese coast (lat.  $38^{\circ} 10'$  N., long.  $9^{\circ} 25'$  W.), in the 'Josephine' Expedition. It seems to be the commonest Cumacean inhabiting the deep waters between Farøe and Shetland.

	Station.	Lat.	Long.	fms.
'Lightning,' 1868 . . .	6	$67^{\circ} 7'$ N.	$5^{\circ} 21'$ W.	500
'Porcupine,' 1869 . . .	36	48 50	11 9	725
" " . . .	47a	59 34	7 18	542
" " . . .	75	60 45	3 6	344
" " . . .	90	59 41	7 34	458

#### 6. *Diastylis polaris*, G. O. Sars.

1873. *Diastylis polaris*, G. O. Sars, Om Cumaceer fra de store dybder i Nordishavet, Kongl. Svenska Vetensk.-Akad. Handlingar, xi. no. 6, p. 4, pl. i. figs. 1–3.

*Cephalothorax*, viewed laterally, elongated ovate, greatest depth subcentral. *Carapace* longer than free cephalothoracic segments, having two indistinct obliquely transverse rugæ on the hinder portion, rough all over with microscopic spines of subequal size, and pitted all over, the pittings being more conspicuous on the portion posterior to the rugæ, where also the microscopic spines are fewer in number; lateral margin denticulately serrated on the anterior half; posterior margin elevated into a well-pronounced fillet. Second, third, and last cephalothoracic segments denticulate on their anterior margin; last segment with the epimera not produced. *Telson* not quite equal in length to two preceding segments, subequal to peduncle of uropod, with 9–11 small spines on each side. *Uropods* slender; peduncle subequal to telson, with 12–

14 spines on inner margin; inner ramus with first joint furnished with five, second with two, third with three lateral and a terminal spine; outer ramus longer than inner, with 4-5 setæ on external margin. Length 8-10 millims.

At first sight near to *D. lævis*; but the carapace, instead of being conspicuously setose as in that species, is rough with microscopic spines, the small and uniform size of which suffices to distinguish it from the spine-ornamented species with which we are acquainted, except *D. stygia*, G. O. Sars, which has not the rugæ of *D. polaris*. Sars speaks of the rugæ as one or three in number; in the above description, which was drawn up before the species was described in Norway, it will be seen I mention two.

*Habitat*. 'Lightning,' 1868, Station 3, lat. 60° 31' N., long. 9° 18' W., 229 fathoms. The type specimens were dredged by the Swedish Expedition in the Arctic Seas, lat. 80°, long. 4° 33' E., in 950 fathoms.

#### 7. *Diastylis biplicata*, G. O. Sars.

1864. *Diastylis biplicata*, G. O. Sars, Om Cumacea, p. 46.

This species has a great range in depth. The types were taken by Sars in 20-30 fathoms, off the Lofoten Islands; and I have specimens dredged off the Durham coast in a few fathoms; but in the 'Porcupine' Expedition of 1869 it occurred down to 1630 fathoms. The localities in that expedition are:—

	Lat.	Long.	fms.
Station 2 . . .	51° 22' N.	12° 25' W.	808
„ 11 . . .	53 24	15 24	1630
„ 17 . . .	54 28	11 44	1230
„ 18 . . .	54 15	11 9	183

#### 8. *Diastylis spinosa*, Norman.

1868. *Diastylis spinosa*, Norman, Brit. Assoc. Report, p. 271.

1878. *D. bimarginatus*, Bate, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 409.

1878. *D. bimarginatus*, Sim, Ann. & Mag. Nat. Hist. ser. 5, vol. ii. p. 453, pl. xviii. figs. 3-5.

A single specimen was taken, 'Porcupine' 1869, in each of the following localities:—

	Lat.	Long.	fms.
Station 6 . . .	52° 25' N.	11° 40' W.	90
„ 18 . . .	54 15	11 9	183

The type was from Shetland; and I have also procured the

species in deep water off Valentia, Ireland, while Mr. Bate has recorded it from Aberdeen.

Only the male is known to me. It would be more satisfactory if we could pair it; but the two sexes of such species as might be supposed to be most nearly allied to *D. spinosa* are known; and we conclude, therefore, that the female, up to the present time, has hidden herself.

### 9. *Diastylis longipes*, G. O. Sars.

1871. *Diastylis longipes*, G. O. Sars, Beskr. af de paa Fregatte Josephines Exped. fundne Cumaceer, p. 32, pl. xiii. figs. 65-67.

At once known by three very remarkable characters:—

1. The extraordinary length of the first pair of feet, which had led me to apply the very same name in my MS. to the species as that which Sars has given it.

2. The crest of spines on the underside of the first abdominal segment.

3. The peculiar and unique appearance of the large telson, which is devoid of the usual lateral spines throughout almost its entire length, and has only a few minute spines close to the origin of the terminal fork.

Sars records it from lat.  $38^{\circ} 7' N.$ , long.  $9^{\circ} 18' W.$ , 'Josephine' Expedition, 550 fathoms; and it occurred in almost the same depth in the British dredgings, viz.:—

	Station.	Lat.	Long.	fms.
'Lightning,' 1868	. 6	$60^{\circ} 45' N.$	$4^{\circ} 49' W.$	510
'Porcupine,' 1869	. 90	$59 41$	$7 34$	458

### 10. *Diastylis stygia*, G. O. Sars.

1871. *Diastylis stygia*, G. O. Sars, (Efvers. af Kongl. Vet.-Akad. Förhandl. p. 798.

1873. *Diastylis stygia*, G. O. Sars, Om Cumaceer fra de store dybder i Nordishafvet, Kongl. Vetensk.-Akad. Handl. xi. p. 6, pl. ii. figs. 4-7.

A female measuring 6 millims. comes so near to *D. stygia* that I here assign it to that species; the carapace is longer in proportion to the free cephalothoracic segments, being nearly twice their length; the anterior dorsal margin of the free segments is not crenulated; the pleon is quite smooth; the telson and uropods very like those of *D. stygia*; the peduncle of the latter has ten slender marginal spines, and the inner ramus has seven spines on 1st, three on 2nd, and two on 3rd joint; there is a spine on the abdomen, between the last pereopods.

An immature male has the carapace as in female, except that the denticulations of the infero-anteal margin are larger and stronger, the first five abdominal segments are smooth



(the last two segments being mutilated in the specimen), and the first two are furnished with swimming-feet.

The slight differences in the above characters from those of the type might, for the most part, be easily accounted for by difference in age and size, as Sars's specimen measured 10 millims.; the only points of distinction of any consequence are:—1st, that although the 'Porcupine' specimen is smaller, it has more spines on the uropods than Sars's; and 2nd, the presence of a spine between the *last* legs\*. It must be left to the future to determine whether there is any value in these distinctions.

'Porcupine' Expedition, 1869, Station 36, lat. 48° 50' N., long. 11° 9' W., 725 fathoms.

Sars says of his type of *D. stygia*, "Habitat in mari arctico, latit. 78°, longit. occident. 2° 28', in profunditate portu-tosa 2600 orgyrum."

### 11. *Diastylis Bradyi*, n. sp.

*Female*. *Cephalothorax* having the dorsal margin unusually straight, the depth not being very unequal throughout; subequal in length to the pleon, exclusive of the telson. *Carapace* as long as the free segments; lateral margin very minutely serrated throughout almost its entire length; surface with scattered spines of small and subequal size, and ornamented with lines of small spines, the points of which are directed forwards. These lines of spines map the carapace out into areas as follows:—The central lacinia is surrounded by what is a plica in front, but a row of spines at its hinder portion, and it is crossed by two transverse spine-rows; the anterior of these passing into the lateral lacinia terminates at its junction with an arched spine-row, which, taking its origin from the lateral margin, sweeps upwards and forwards to the rostrum; the second transverse spine-row passes right down to the lateral margin; further back is a third transverse spine-row, which, crossing the dorsum, curves at the sides forwards and either dies out or joins the second transverse spine-row. The anterior *free segments* have their front dorsal margin very minutely crenulated; the last is widely separated from the preceding segment, and remarkable in its form and character; behind, the epimera (in both sexes) are greatly produced into large spine-like processes, while the anterior dorsal margin is cut into large teeth, alternating with conspicuous plumose setæ,

\* I cannot say whether my specimen has the spines between the first three pairs of legs, which characterize *D. stygia*, as I was unwilling to mutilate the only specimen, which would have been necessary to get a good view of this part.

which have a backward direction. The *pleon* has small spines (in both sexes) on the ventral surface of the fourth, fifth, and sixth segments, but chiefly on the fifth. *Upper antennæ* reaching beyond the rostrum by the last very long joint of the peduncle; flagellum 3-jointed, as long as the last joint of the peduncle; shorter flagellum small, not longer than the first joint of the longer flagellum. The *first feet* have the three terminal joints subequal; first joint of all the legs, and even the basal joint of their palps, spinose; last three legs very robust. *Telson* with about fourteen spines on each side. *Uropods* with twenty-five lateral spines on the peduncle; inner branch with 1st joint bearing eleven spines on the inner margin, 2nd three, 3rd three and terminal spine; outer branch having about fifteen cilia on the exterior margin. Length 11 millims.

*Immature male*. Length 9 millims. Like ♀ in character of carapace, pereion, pleon, legs, &c.; *telson* with ten lateral spines; *uropods* having their peduncle equal in length to the telson and bearing eighteen spines on the inner margin; inner branch having 1st joint furnished with eight spines, 2nd with four, 3rd with three and terminal spine.

Dredged during the 'Poreupine' Expedition of 1869, in Lough Swilly, co. Donegal, in 15 fathoms.

I have named this species after my friend Professor G. S. Brady, who has added so much to our knowledge of the Entomostraea of our seas.

## 12. *Diastylis lævis*, Norman.

1869. *Diastylis lævis*, Norman, Last Report Shetland Dredging, Brit. Assoc. Report, 1868 (1869), p. 270.

Professor Sars has given the above as a synonym of *D. tumida*, Lilljeborg. It certainly comes very near it, but is, I think, distinct. At the time I drew up the description of *D. lævis* I had by my side (a) specimens of *D. tumida* received from Professor Lovén, (b) Sars's description of that species. In describing my species, in order to draw attention to the strong points of resemblance, I adopted almost the very words of Sars's description wherever they were applicable. I have now also by me specimens received from the Professor as *Diastylis tumida*. The points of distinction seem to be as follows:—1st, the carapace of *lævis* is much more elongated and much less deep; 2nd, the telson is of a different form; in *D. lævis* the part posterior to the anal aperture is always markedly longer than the basal portion, whereas in *D. tumida* it is usually much shorter, never apparently longer; 3rd, in the much more numerous spines of telson and uropods in *D. lævis*.

A *female* taken in the 'Porcupine' has seventeen spines on each side of the telson, and the uropods have twenty-four spines on the peduncle; inner ramus, 1st joint seven, 2nd four, 3rd three spines; the outer ramus is longer than the inner, its inner margin is smooth, but the outer margin and face carry fifteen setæ besides three terminal smooth setæ. An *immature male*, measuring 10 millims., has eleven pairs of spines on the telson; uropods with twenty-three spines on the peduncle; inner ramus, 1st joint eight, 2nd four, 3rd three spines; outer ramus has only seven very small setæ on the external margin. The last segment of the pereion has strongly produced epimera, and the anterior dorsal margin is both strongly serrated and adorned with plumose setæ. When the pleon is viewed from above, rows of spines are seen on each side of the segments; the hinder spine of each segment is larger than those before it; and, as seems to be general with the males in this genus, the spines of the fifth segment are the most developed\*.

'Porcupine' Expedition, 1869.

Station		Lat.	Long.	fms.
6	. . .	52° 25' N.	11° 40' W.	90
"	11 . . .	53 24	15 24	1630
"	18 . . .	54 15	11 9	183

### 13. *Diastylis Edwardsii* (Kröyer).

1841. *Cuma Edwardsii*, Kröyer, Naturhist. Tidssk. iii. pp. 504, 531, pl. v. figs. 1-16; id. op. cit. anden rækkes ii. (1846), pp. 128, 207, pl. i. figs. 1, 3, 5, 9-14; id. Voyages en Scandinavie &c. pl. iv.  
 1846. *Cuma brevirostris*, Kröyer, Naturhist. Tidssk. anden rækkes ii. pp. 174, 208; id. Voyages en Scandinavie &c. pl. v. A. fig. 1 *a-t* (mas adultus).

*Carapace* tumid, not remarkably deep or broad, occupying about three fifths of the length of entire cephalothorax, with five denticulately edged plicæ on each side, the first curving directly forwards and running right out to the end of the rostrum; the second branching laterally from the first and proceeding towards the lateral margin, which, however, it does not reach; the third running right down from above to the lateral margin; the fourth and fifth curving forwards and looping with the third plica, which they join; rostrum short, hispid. *Free segments* of cephalothorax having their anterior margin elegantly denticulated. *First pereiopods*, when extended forwards, reaching beyond the rostrum by the last two

\* My description of the first feet in the Brit. Assoc. Report is incorrect. These organs do not differ materially in the proportional length of the joints from *D. tumida*.

joints and half of the antepenultimate; first joint strongly spined on the outer margin. *Pleon* having the fifth segment spinose on the posterior margin. *Telson* with nine pairs of lateral spines. *Uropods* having peduncle edged with fourteen spines; inner branch, 1st joint with six, 2nd with two, 3rd with two marginal spines. Length 11 millims.

*Young male* (sexual characters not fully developed) has the telson with seven pairs of lateral spines, and uropods with eleven spines on peduncle, four on 1st, two on 2nd, and two on 3rd joint of inner branch, and four small spine-like setæ on outer margin of external branch.

'Valorous' Expedition, off Holsteinborg, Station 5, lat. 66° 59' N., long. 55° 27' W., 57 fathoms.

This species approaches, but is quite distinct from, the N.E.-American *Diastylis sculpta* of Sars.

#### 14. *Diastylis strigata*, n. sp.

*Male. Carapace* with antero-lateral corner produced forwards in the form of a well-rounded and strongly serrated lobe; rostrum short, spinose on the sides; surface of carapace not spined, having two transverse and vertical plicæ on the anterior portion, and a third longitudinal plica running nearly parallel with, and a little within, the lateral margin, and joining the posterior of the vertical plicæ at nearly a right angle; these plicæ are all quite smooth (neither serrated nor spine-crowned). *Inferior antennæ* reaching beyond the extremity of the uropods. *Cephalothorax* having the anterior dorsal margin of the last segment serrated, and the epimera produced backwards into well-developed pointed lobes. *Last pereopods* have the basal joint excessively flattened throughout the greater part of its length, but rounded at the distal extremity. *Pleon* with a crest of three spines on the underside of the first segment (similar in position and character to those of *D. longipes*, but fewer in number and of smaller size); viewed from above, the 1st and 2nd segments are seen each to have a pair of minute spines transversely placed; 3rd, 4th, and 5th segments have a central dorsal line of minute spines; these lines of spines are confined to the posterior portion of each segment, and the hindermost spine in each row is the largest; these three segments have also a crest of spines on the external angles of the ventral surface; the spines composing these ventral crests are of much larger size than those of the dorsal surface; and the crests of the 5th segment are more developed than those of the preceding segments (as is usual in males of the genus). *First joint of posterior maxillipeds and of first pereopods* unarmed, except that there is a single

distal spine; penultimate joint of first legs longer than, and commonly folded back upon, the antepenultimate; last joint about half the length of preceding. *Upper antennæ* with filaments longer than usual, the longer equalling the last two joints of peduncle, the shorter as long as the last joint. *Pleopods* well developed on first and second segments of pleon.

*Telson* with six to seven pairs of lateral spines. *Uropods* very slender; peduncle furnished with about twenty-five complex spines on the inner margin; inner ramus with the three joints subequal in length, 1st with sixteen to eighteen, 2nd with seven to eight, 3rd with four to six spines; outer ramus longer than the inner, with two to three short setæ on internal, and five to six on external margin. Length 7 millims.

One specimen dredged in Lough Swilly, co. Donegal, in 15 fathoms, 'Porcupine,' 1869. In the following year I took the species in the tow-net off Valentia.

### 15. *Diastylis Calveri*, n. sp.

*Male. Cephalothorax* much wider than deep. *Carapace* not deep, dorsal line only slightly arched; surface not spined, with two curved plicæ on the central portion, and extending from the dorsal line to the margin; numerous little pits stud the surface; and the stomachal region is furnished with numerous lucid spots (as in *D. sculpta* and other species); lateral margin unusually straight, strongly serrated in front; rostrum very short, blunt, and broad, hollowed above at the base. *Third free segment* with a pair of dorsal spines; first, second, and last denticulately serrated on the front dorsal margin; epimera of last segment only slightly produced backwards, and bearing two or three plumose setæ. *Pleon* with a pair of thorn-like spines on the under surface of first segment, a spine at the dorsal posterior angle of each segment, and a spine at the posterior ventral angle of the first two segments. *First pereopods* extending beyond the rostrum by their last two joints, the first of which is longer than the antepenultimate and three times as long as the last joint. *Telson* and uropods very slender; the telson has the anal aperture very far back, almost at its commencement, and at some distance from the end of the thicker anterior portion; this anterior portion is channelled above, the edges of the channel being serrulated; distal and more slender portion of telson with five pairs of very slender lateral spines; terminal spines largely developed and long. *Uropods* with eight to eleven spines on inner margin of peduncle; inner ramus having 1st joint with nineteen to twenty-two, 2nd with four, 3rd with three and terminal spines, the whole of the inner margin is also minutely pectinate, with ex-

cessively minute spinules between the spines just enumerated; outer ramus reaching only to the end of the second joint of inner, very narrow and slender in structure, with about eight small slender setæ on each margin. Length 8–9 millims.

Two specimens, 'Porcupine' Expedition, 1869. Station 11, lat.  $53^{\circ} 24'$  N., long.  $15^{\circ} 24'$  W., 1630 fathoms.

I have named this species in honour of Captain Calver, the able commander of H.M.S. 'Porcupine,' to whose nautical skill, untiring zeal, and keen appreciation of the value of scientific research, exhibited in his able and successful conduct of the 'Porcupine' Expeditions, natural history owes so much.

16. *Diastylis armata*, n. sp.

1876. *Diastylis armata*, Norman, MS., 'Valorous' Report, Proc. Royal Soc. xxv. p. 212.

*Female.* *Cephalothorax* short; free segments remarkably short, scarcely half as long as the carapace, the three posterior segments developed as usual, but the two before these only indicated by a narrow fillet. *Carapace* broad, deep, and tumid; length only half as much again as depth; dorsal margin boldly arched in the centre, declining posteriorly, and still more anteriorly in the sweep to the rostrum; posterior margin abruptly truncate; lateral margin strongly arched in the centre, where the carapace attains its greatest depth; anteriorly the margin is serrulate; serrulations about twenty, increasing in size in front; no infero-anteal angle, the lateral margin gradually sloping upwards to the rostrum; rostrum short, reaching the middle of the second joint of the peduncle of the upper antennæ, its sides rapidly converging to the acute point in which it terminates; surface of carapace for the most part glabrous and devoid of spines, sculptured with scattered little shallow pittings; the rostrum bears a pair of conspicuous, acute, erect spines; behind these each lateral lacinia bears a longitudinal curved row of four spines, the anterior of which is similar to those on the rostrum, but the hinder ones very small; beneath this row, between it and the lateral margin, is an isolated triangular spine of small size. The *free cephalothoracic segments* and those of pleon are all quite smooth, save that the epimera of the last cephalothoracic segment are armed with a spine (but not produced backwards). *Upper antennæ* have the three joints of peduncle subequal, the first armed with a spine at the extremity on the lower side. *First legs* with the basal joint strongly armed with spines all along the margin. *Pleon* exceeding the length of the cephalothorax by its last two segments. *Telson* longer than the peduncle of the uropods,

having the basal portion longer than usual (exceeding the length of the sixth segment); only three pairs of small lateral spines, but the terminal fork long and slender. *Uropods* weakly formed; peduncle narrow, but slightly widening distally, with only three small spines on the inner margin; inner branch rather shorter than the outer; external margin quite smooth, inner with two spines on 1st, two on 2nd, one and a terminal spine on 3rd joint; outer branch narrow and delicately formed, quite smooth on both sides, devoid both of spines and setæ, terminating in a long and very slender spine. Length 10 millims.

One specimen taken by the 'Valorous' at the entrance of Davis Strait, Station 9, lat. 59° 10' N., long. 50° 25' W., 1750 fathoms.

### Genus LEPTOSTYLIS, G. O. Sars (1869).

#### *Leptostylis producta*, n. sp.

*Cephalothorax* remarkably short and tumid, not half as long as the abdomen (exclusive of the uropods). *Carapace* very short, broad, and gibbous, abruptly truncate behind, length not greater than breadth; rostrum short, rounded, slightly bent upwards; surface smooth, or nearly so; lateral margins strongly denticulately serrated, infero-anteal corner not produced. *Telson* short, scarcely more than one third as long as basal joint of uropods; not longer than sixth, and not more than half the length of the fifth segment; no lateral spines; terminal spines two, large in proportion to size of telson. *Uropods* having the base nearly three times as long as the telson, slender, with four long, widely distant spines on the inner margin; inner ramus long, styliform, nearly as long as the basal joint, 1st joint with two, 2nd with one long spine on inner margin, 3rd joint much produced, gradually attenuated to a fine point, no spines on the inner margin; outer ramus only equalling in length the first joint of the inner ramus, slender, and scarcely exceeding in size the terminal joint of the inner ramus.

A single specimen procured in the 'Porcupine' Expedition, 1869, off the Butt of Lewis, Station 90, lat. 59° 41' N., long. 7° 34' W., 458 fathoms.

### Genus CHALAROSTYLIS, n. g.

(χαλαρός, laxus; στῦλος, stilus.)

*Male*. General characters the same as in *Diastylis*, but furnished with three pairs of feet on the pleon, each consisting of a

long peduncle and two branches furnished with plumose setæ. Telson short, terminating in three spines (instead of the usual fork). Uropods remarkably long and slender. *Female* unknown.

*Chalarostylis elegans*, n. sp.

*Male* (adult). *Cephalothorax* equal in length to five abdominal segments. *Carapace* shallow, but wide, length three-fifths of entire cephalothorax; dorsal margin well-arched on hinder portion, but depressed on the anterior two thirds of its length; surface microscopically spinulose; lateral margin not serrated, gradually sloping upwards, without any sinus, to the extremity of the rostrum; anterior margin (*i. e.* slope from lateral margin) edged with about fifteen spines; anterior portion of dorsal margin with a crest of about ten small spines. *Anterior margin* of free cephalothoracic segments smooth; epimera of last segment not posteriorly produced. *Pleon* quite smooth and glabrous. *Upper antennæ* with the basal joint covered with numerous spines, especially on the underside. *Lower antennæ* as long as cephalothorax, with last joint of peduncle and also the flagellum furnished with very numerous semiverticils of crowded cilia. *First feet* having first joint more slender than usual, not spined, with three to four verticillately plumose short setæ on the hinder margin; 2nd joint very short, armed with one long spine; 3rd joint longer, having one long spine; 4th very long, almost as long as three upper joints, and much longer than two following combined, armed with ten spines, of which two are much longer than the rest, and of the same size as the large single spine on the preceding joints; penultimate joint very short, about one fifth the length of 4th; last joint three times as long as penultimate, terminating in spine-like setæ. *Three pairs* of abdominal feet, each consisting of a long peduncle (as long as the depth of the pleon), minutely spinous on the hinder margin, and two branches furnished with plumose setæ. *Telson* short, equalling length of sixth segment, but not much more than half the length of fifth, with two pairs of lateral spines, and terminating in three spines (instead of the usual fork). *Uropods* remarkable for their great length and slenderness; peduncle three times the length of telson, with twenty-four spines on the inner margin; inner branch with first joint as long as telson, with eight marginal spines, 2nd with two, 3rd without any marginal spines; outer branch reaching to the middle of the last joint of the inner branch, 1st joint with three spine-like setæ on inner margin,



and 2nd with four such setæ on inner margin and three terminal setæ; outer margin without setæ. Length rather more than 8 millims.

One taken, 'Porcupine,' 1869, off Rockall, in 109 fathoms.

Genus SPENCEBATEA, n. g.

(Named after Mr. C. Spence Bate.)

*Characters of Male*.—General aspect that of *Diastylis*. Five segments of cephalothorax exposed behind the carapace. All feet, except the last, palpigerous. No feet on pleon. Telson rudimentary (as in *Eudorella*). Uropods with both branches two-jointed. *Female* unknown.

*Spencebatea abyssicola*, n. sp.

*Male*. *Cephalothorax*, viewed laterally, long ovate, the upper margin a bold gradual curve from the rostrum to the last segment. *Carapace* three fifths of the length of entire cephalothorax, shallow and of nearly equal depth throughout; dorsal margin evenly arched; lateral margin inarched and exposing all the feet to their very bases, entire throughout (*i. e.* not denticulated); rostrum very short, suddenly and broadly truncated, its inner sheath projecting considerably beyond the outer; entire surface of carapace showing a structure composed of hexagonal cells, not at all spinous; but a few hairs are scattered on carapace, free segments, and pleon. *Last cephalothoracic segment* having a pair of spines on the ventral surface between the slender legs; a pair of minute spine-like points are also present on the back of this segment. *Telson* rudimentary. *Uropods* greatly developed, equal in length to the last four abdominal segments; peduncle much longer than the rami, with eight cilium-tipped spines on the inner margin; inner branch consisting of a long first joint having eight long spines on the inner margin, and a terminal greatly developed spine, which might be considered a second joint, and has been so called in the generic description; outer branch much smaller, shorter and more slender, 1st joint short, 2nd with one minute spine on inner and one small seta on outer margin, terminating in two slender spines, one of which is of great length and very slender.

A very small species, only measuring 4 millims.

A single specimen, 'Porcupine,' 1869, Station 19, west of Donegal Bay, lat.  $54^{\circ} 53'$  N., long.  $10^{\circ} 56'$  W., 1360 fathoms.

## Genus LAMPROPS, G. O. Sars (1864).

1. *Lamprops rosea* (Norman).

1863. *Vaunthompsonia rosea*, Norman, Trans. Tyneside Nat. Field Club, v. p. 271, pl. xiii. figs. 1-3 (femina adulta).

1863. *Cyrianassa elegans*, Norman, Trans. Tyneside Nat. Field Club, v. p. 275, pl. xiv. figs. 1-6 (mas adultus).

1864. *Lamprops rosea*, G. O. Sars, Om Cumacea, Vid. Selsk. Forhandl. p. 64.

'Porcupine' Expedition, 1869, Lough Foyle, 15 fathoms.

2. *Lamprops cristata*, G. O. Sars.

1869. *Lamprops cristata*, G. O. Sars, Nye Dybvandskrustaceer fra Lofoten, Vidensk. Selsk. Forhandl. p. 157.

'Porcupine,' 1869, south of Rockall, Station 23, lat.  $56^{\circ} 7'$  N., long.  $14^{\circ} 19'$  W., in 630 fathoms.

## Genus IPIHINOË, Bate (1856).

(= *Halia*, Bate, 1856, in use for genera of Mollusca and Lepidoptera.)

Animal greatly elongated. *Cephalothorax* low, narrow, compressed, greatly produced, generally having the dorsal line of carapace spined in female; rostrum produced; five free segments of pereion, the last two subequal, scarcely wider or higher than the pleon. *Second maxilliped* having the basal joint longer than the remainder taken together, first and second joints distally furnished with a long plumose seta, last joint in the form of a strong nail. *Third maxilliped* having the first and third joints produced into very large setiferous lobes on the inner distal extremity; the lobe of the first joint reaches at least to the middle or end of the third joint, that of the third joint extends to the middle of the fourth joint. *Pereiopods*, only the first, even in the male, furnished with palpi; second pair much smaller than usual and more like the following pairs. *Telson* rudimentary, but bilobed. *Uropods* strongly developed, both branches two-jointed; outer joint flattened, truncate at the apex. The male has the first five segments of pleon furnished with swimming-feet, and the spines on the dorsal line of the carapace usually (? always in adult) absent.

This genus was established by Bate (Ann. & Mag. Nat. Hist. 1856, 2nd ser. vol. xvii. p. 458) under the name *Halia*, with the *Cuma trispinosa*, Goodsir, as the type. Subsequently finding that *Halia* was already in use for a genus of Lepidoptera, he changed the name to *Iphinoë* (Ann. & Mag. Nat. Hist. 1856, 2nd ser. vol. xviii. p. 187).

The members of this genus bear a striking general resem-

blance to *Leucon*; but in that genus three pairs of pereopods are furnished with a palp, and the male has only two pairs of swimming-feet on the pleon.

*Iphinoë serrata*, Norman.

1866. *Iphithoë serrata*, Norman, Report of Committee for exploring Coasts of the Hebrides, Brit. Assoc. Report, 1866 (1867), p. 201.

1868. *Iphinoë serrata*, Norman, Brit. Assoc. Report, 1868 (1869), p. 272.

'Poreupine,' 1869, Station 20, lat. 55° 11' N., long. 12° 46' W., 1443 fathoms.

Genus LEUCON, Kröyer (1846).

1. *Leucon longirostris*, G. O. Sars.

1871. *Leucon longirostris*, G. O. Sars, Beskr. af Fregatten Josephines Exped. Cumaceer, Kongl. Vet.-Akad. Handl. vol. ix. p. 42, pl. xv. fig. 75.

The type of this species was procured in 550 fathoms off the coast of Portugal during the 'Josephine' expedition. It was only a fragment, part of the pleon being broken off.

A single specimen dredged in the 'Valorous' expedition, at the entrance of Davis Strait, lat. 59° 10' N., long. 50° 25' W., in 1750 fathoms, agrees very closely with Sars's beautiful figure.

I add a few notes, chiefly on that portion of the animal which was absent in the type specimen. The specimen examined by me is a female; that observed by Sars was a male.

Number of dorsal spines of carapace seven, of the underside of the rostrum four, of the antero-lateral margin nine; and there are two small spines close together on the front margin between the antero-lateral corner and the base of the rostrum.

The first legs are very long and remarkably free from setæ; the thigh is armed with two spines.

On the belly between the last pair of legs is a thorn-formed spine with the point curving forward.

Pleon having the first five segments gradually increasing in length, but the fifth twice as long as the sixth; telson very short.

Uropods broad and flattened; peduncle with two spines on the inner margin; inner branch with eleven spines on the inner margin (nine on 1st joint, two on 2nd), and terminating in a long spine; the second joint not one third the length of the first; outer branch as long as the first joint of the inner

branch, its first joint very short and unarmed, second having one simple and two plumose spines on the inner margin and terminating in two very long spines. The spines of the inner margin of the inner branch are all tipped with a little cilium; and the two long spines of the outer branch, which I have called "plumose," are of very peculiar structure: their basal portion under the microscope appears as if furnished with stiff hairs; but the apical portion would perhaps be more correctly described as pectinate.

The peculiar production of the rostrum in this species is a very remarkable feature.

From the wide distance apart at which the only two known examples were found, it is probable that *Leucon longirostris* will prove to be widely diffused over the bed of the Atlantic Ocean.

### 2. *Leucon nasicus*, Kröyer.

1841. *Cuma nasica*, Kröyer, Naturhist. Tidsskrift, vol. iii. p. 524, pl. vi. figs. 31-33.

1846. *Leucon nasica*, Kröyer, Naturhist. Tidsskrift, and. rækkes vol. ii. pp. 189, 209, pl. ii. fig. 5, a, b; id. Voyages en Scandinavie &c. pl. iii. fig. 2, a-o.

1855. *Leucon nasica*, Lilljeborg, Œfvers. af Vetensk.-Akad. Förh. p. 121.

1864. *Leucon nasicus*, G. O. Sars, Om Cumacea, Vid. Selskab. Forhandl. p. 53.

A single specimen taken by the 'Porcupine' expedition in 1869 in the Minch. Not before known as belonging to the British fauna.

### 3. *Leucon serratus*, n. sp.

1876. *Leucon serratus*, Norman, MS., 'Valorous' Report, Proc. Royal Soc. vol. xxv. p. 212.

*Female.* Carapace much longer than the free segments of cephalothorax and very deep, the depth being subequal to the length, exclusive of the rostrum; dorsal margin boldly arched, having a continuous unbroken serrated line throughout its length; serrations triangular, small posteriorly, and gradually increasing in size forwards; rostrum, viewed laterally, short, deep, triangular, directed horizontally in front of the point where the dorsal line sweeps down to meet it, its edge with a few elongate serrations; antero-lateral corner produced forwards and outwards in wing-like form; lateral margin with about ten elongated triangular serrations, of which the three or four front (on the wing-like expansion) are much larger than the rest. Total length of *pleon* (without uropods) not exceeding that of the cephalothorax. *Upper antennæ* very small, just reaching to the end of the rostrum. *First feet* having

seven spines on the hinder margin of the first joint; the last three joints gradually decrease in length; and the limb does not reach beyond the extremity of the rostrum. *Telson* rudimentary. *Uropod* with a peduncle not exceeding in length the 5th segment of the pleon, bearing three spinules on the inner margin; inner branch much shorter than the outer, 1st joint with five spines, of which the distal is much the largest, on the inner margin; second joint with five spines, which gradually increase in length distally, on the inner margin, one distal spine on the outer margin, and a terminal spine, which is two thirds as long as the joint from which it springs; outer branch having the first joint short and unarmed, the second very long, with two or three minute setæ on the outer margin, and long setæ on the distal portion of the inner margin and at the apex. Length 6 millius.

One specimen taken in the 'Valorous' expedition at the entrance of Davis Strait, Station 9, lat. 59° 10' N., long. 50° 25' W., in 1750 fathoms.

#### 4. *Leucon brevirostris*, n. sp.

*Female*. *Cephalothorax* equal in length to five segments of pleon. *Carapace* longer than the free segments, ovate, deep, gently arched above, compressed; infero-anteal angle greatly produced and terminating in a sharp point, with five serrations; rostrum unusually short, broad, rounded, minutely serrated on the edge; dorsal line toothed more or less throughout, but the teeth separated by intervals posteriorly, where they are small, increasing in size and closeness to each other in front, about twenty in all; the teeth are not regularly arranged, as usual, in single file, but in an irregular double alternating line; surface everywhere ornamented with very pretty and regular hexagonal celled structure; carapace, seen from above, widest behind the middle, gradually and evenly narrowed thence to the extremity of the rostrum. *Third maxilliped* with the first joint strongly spined, the four or five more distal spines of great size and thorn-like form, the lobe of this joint greatly developed, reaching forward to the end of the third joint, and its long setæ extending to the end of the penultimate joint; second joint armed with one spine, similar in character to those of first joint. *Telson* very short, semiovate, smooth. *Uropods* with peduncle slightly longer than the fifth segment of the pleon, having five long spines on the inner margin; inner branch with first joint longer than the second, having ten spines of unequal length on the inner margin; second joint with five spines on the inner margin and two longer at the extremity; outer branch

longer than the inner, and longer than the peduncle; first joint short; second with four hair-like spines on the inner margin and two long setæ at the extremity. Length 10 millims.

'Porcupine,' 1869, dredged in 109 fathoms, to the south of Rockall, lat.  $56^{\circ} 26' N.$ , long.  $14^{\circ} 28' W.$

The short rostrum distinguishes this at once from *L. nasicus* and *pallidus*; the absence of the three spines on each side of the central line of the middle lacinia from *L. nasicoides*; and the more numerous teeth of the crest from *L. fulvus* and *L. acutirostris*.

Genus EUDORELLA, Norman (1867).

(= *Eudora*, Bate, 1856; name preoccupied.)

1. *Eudorella truncatula*, Bate.

1856. *Eudora truncatula*, Bate, Ann. & Mag. Nat. Hist. ser. 2, xvii. p. 457, pl. xiv. fig. 3.

1864. *Eudora truncatula*, G. O. Sars, Om Cumacea, Vid. Selskab. Forhandl. p. 61.

1867. *Eudorella truncatula*, Norman, Brit. Assoc. Report, 1866 (1867), p. 197, note.

1871. *Eudorella truncatula*, G. O. Sars, Kongl. Vetensk.-Akad. Handl. ix. p. 44, pl. xviii. fig. 99.

'Porcupine,' 1869, Station 20, lat.  $55^{\circ} 11' N.$ , long.  $11^{\circ} 31' W.$ , 1443 fathoms.

2. *Eudorella hirsuta*, G. O. Sars.

1869. *Eudora hirsuta*, G. O. Sars, Undersøgelser over Christianiafjordens Dybvandsfauna, p. 43.

1871. *Eudorella hirsuta*, G. O. Sars, Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceen, Kongl. Vetensk.-Akad. Handl. ix. p. 44, pl. xviii. fig. 100.

A 'Porcupine' *Eudorella* is so near *E. hirsuta* that I prefer provisionally considering it a variety of that species to giving it a distinctive name. I give, however, the characters.

*Cephalothorax* deepest at the anterior part of the carapace, and thence gradually becoming shallower to the last segment, which is not deeper than the abdomen. *Carapace* subequal in length to the free segments; front margin truncate, but not retuse, the lower two thirds of this margin and also the lateral margin denticulate throughout; denticulations of nearly equal size; infero-anteal angle well rounded off; a narrow sulcus at about one-fourth-way up the anterior margin, but the denticulations are not interrupted even by this sulcus, but pass down into it; there are about six denticulations from the bottom of the sulcus to the infero-anteal corner, and about ten

above, counting from the bottom of the sulcus; surface not strongly hispid (as in *hirsuta*), only a few scattered hairs, sculptured with roundish or hexagonal cells. *Uropods*: peduncle not broad, the length much less than that of fifth segment of pleon, and about four times its own breadth; the anterior half of the inner margin bearing four little hairs, while the more distant portion has two spines; inner ramus longer than the peduncle or the outer branch, the first joint has eight spines on inner and three little spine-like setae on outer margins, the 2nd joint has three spines on the inner and two distal spines on outer margin besides the terminal spine; outer branch has the first joint glabrous, the second with thirteen spine-like setae. Length 5 millims.

'Porcupine,' 1869, midway between Ireland and Rockall, in 1380 fathoms (Station 30, lat.  $56^{\circ} 24' N.$ , long.  $11^{\circ} 49' W.$ ).

Genus *CAMPYLASPIS*, G. O. Sars (1864).

*Campylaspis rubicunda* (Lilljeborg).

1855. *Cuma rubicunda*, Lilljeborg, Öfvers. af Vet.-Akad. Förhandl. p. 121.

1864. *Campylaspis rubicunda*, G. O. Sars, Om Cumacea, p. 77.

1873. *Campylaspis rubicunda*, G. O. Sars, Om Cumaceer fra de store dybder i Nordshafvet, Kongl. Svenska Vetensk.-Akad. Handl. xi. p. 10, pl. iv. figs. 14-16.

Off Holsteinborg, Greenland, 'Valorous,' Station 5, lat.  $66^{\circ} 59' N.$ , long.  $55^{\circ} 27' W.$ , 57 fathoms; one specimen.

Genus *CYCLAPIS*, G. O. Sars (1864).

*Cyclapis longicaudata*, G. O. Sars.

1864. *Cyclapis longicaudata*, G. O. Sars, Om Cumacea, p. 82.

Off the Spanish coast, 'Porcupine,' 1870, Station 9, lat.  $48^{\circ} 6' N.$ , long.  $9^{\circ} 18' W.$ , 539 fathoms; and North Atlantic, 'Valorous,' 1875, Station 12, lat.  $56^{\circ} 11' N.$ , long.  $37^{\circ} 41' W.$ , 1450 fathoms.

VII.—*Descriptions of new Genera and Species of Gallerucinae.* By JOSEPH S. BALY, F.L.S.

[Continued from vol. ii. p. 422.]

Genus *DIABROTICA*, Chev.

*Diabrotica eximia.*

*D. subelongata*, postice paullo ampliata, nigra, nitida, pedibus

antennisque fulvis; thorace trifoveolato; elytris rugosis, læte viridi-metallicis, limbo exteriore anguste rufo-fulvo.

*Mas* elytris fovea magna communi elevato-marginata ante apicem posita instructis.

Long. 3 lin.

*Hab.* Bolivia.

Head rather longer than broad, elongate-trigonal; front impressed above the encarpæ with a deep fovea; encarpæ not distinctly separated from the front; carina raised, linear; antennæ filiform, the second joint short, the third nearly twice its length, more than half as long as the fourth. Thorax one fourth broader than long; sides straight and parallel, slightly sinuate from the base to the middle, thence slightly converging to the apex, the hinder angle armed with a small tubercle; surface sparingly impressed with very fine punctures; disk trifoveolate, the middle fovea shallow, placed just in front of the basal margin; the two others, situated one on either side the middle disk, arc large and more deeply excavated. Elytra ovate, dilated posteriorly, convex, rugose-punctate.

*Diabrotica rufolimbata.*

*D.* subelongata, prasina, nitida, capite fulvo; antennis, basi excepta, piceo tinctis, articulis octavo nonoque piceis; thorace transverso-quadrato, obsolete triimpresso, tenuiter punctato; scutello piceo; elytris subcrebre punctatis, extrorsum rufo limbatis; tarsis fulvo tinctis.

Long. 4 lin.

*Hab.* Rio de la Plata.

Third joint of antennæ twice the length of the second, scarcely more than half the length of the fourth; eyes black. Thorax broader than long; sides reflexed, parallel from the base to beyond the middle, slightly sinuate, thence obliquely rounded and converging to the apex; disk finely and not closely punctured, faintly impressed with three shallow ill-defined foveæ. Scutellum trigonal, piceous. Elytra narrow, oblong, more closely and more strongly punctured than the thorax, broadly margined with rufo-fulvous. Body beneath clothed with griseous hairs.

*Diabrotica viridilimbata.*

*D.* elongata, pallide rufo-fulva, nitida, antennis extrorsum nigris; thorace bifoveolato, olivaceo; elytris crebre punctatis, rufo-fulvis, limbo exteriore viridi.

Long. 4 lin.

*Hab.* —?

Front impressed with a deep fovea; carina linear, well defined; antennæ filiform, the second joint short, the third



distinctly longer than the second, one half the length of the fourth, four outer joints black; eyes black. Thorax subquadrate; sides parallel, sinuate behind the middle, slightly converging at the apex; disk smooth, impressed on either side with a deep fovea. Elytra narrowly oblong-ovate, closely and rather strongly punctured, subopaque, the green outer limb nitidous.

*Diabrotica nigriceps.*

*D. subelongata*, flavo-fulva, nitida, capite nigro; antennis sordide fulvis, articulis primo, sexto, septimo et octavo nigro-piceis, nono, decimo et undecimo albidis; thorace late transversim excavato; elytris oblongis, tenuiter punctatis, prope medium transversim depressis, ad latus infra medium excavatis, pallide castaneis, limbo apicali flavo.

Long.  $3\frac{1}{2}$  lin.

*Hab.* Guatemala.

Head longer than broad, wedge-shaped, vertex smooth; front impressed with a deep fovea; encarpæ ill-defined; carina short, linear; antennæ filiform, the second joint short, the third nearly three times its length, three fourths the length of the fourth. Thorax transverse; sides parallel and distinctly sinuate behind the middle, slightly dilated in front of the latter, the anterior angles obtuse, the hinder ones subacute; disk shining, impressed at base and apex with a few shallow punctures, broadly and deeply excavated transversely on the disk. Scutellum trigonate, nigro-piceous. Elytra narrowly oblong, finely punctured, transversely depressed near the middle, obliquely excavated on the outer disk just below the latter, the basilar space distinctly elevated, the humeral callus thickened.

*Diabrotica interrupto-fasciata.*

*D. anguste ovata*, nitida, subtus nigra, pube grisea sat dense vestita, pedibus prothoraceque flavis; supra flava, antennis, basi excepta, nigris; thorace transverso, lateribus latis, parallelis, disco bifoveolato, utrinque ante medium puncto nigro-piceo notato; scutello nigro; elytris oblongis, rugoso-punctatis, utrinque infra callum humerale elevato-costatis, flavo-fulvis, vitta suturali, basi et apice sæpe abbreviata, fasciisque tribus, una infra basin, secunda prope medium tertique inter medium et apicem, his fasciis plus minusve interruptis, nigris.

Long. 3 lin.

*Hab.* Oaxaca. Collected by M. Sallé.

Head longer than broad; front impressed above the encarpæ with a deep fovea; encarpæ thickened, contiguous; carina raised, narrowly wedge-shaped. Antennæ equal to the body

in length, the second joint short, ovate, half the length of the third, the latter three fourths the length of the fourth; the three lower joints flavous, the rest black. Thorax transverse; the sides straight and parallel, rather broadly margined, the anterior angles scarcely produced, obtuse, the hinder ones acute; the basal margin with its middle portion sinuate; surface very minutely punctured, the punctures only visible under a deep lens; hinder disk flattened, impressed on either side with a deep fovea; in the middle, just in front of the basal margin, is a third, smaller and less defined. Scutellum shining black, its apex obtuse. Elytra oblong, very coarsely punctured, the interspaces very irregularly wrinkled and rugulose.

*Diabrotica octosignata.*

*D. late ovata*, nigra, nitida; thorace minus erebre distincte punctato, utrinque profunde foveolato, lateribus reflexis piccis; elytris sat erebre punctatis, late marginatis, fulvis, utrinque punctis quatuor, duobus infra basin, duobus vix pone medium, transversim dispositis, nigris.

Long.  $3\frac{1}{2}$  lin.

*Hab.* Mexico, Oaxaca.

Head scarcely longer than broad, trigonate; front impressed above the enearnæ with a deep fovea; enearnæ thickened; earina raised, sublinear. Antennæ entirely black, the second joint half the length of the third, the latter two thirds the length of the fourth. Thorax transverse; sides straight and parallel, rounded and converging at the apex, the anterior angles slightly produced, thickened, obtuse; disk distinctly punctured, the puncturing finer and more scattered on the anterior disk; on either side, scarcely behind the middle, is a large round fovea. Scutellum shining black, smooth, impunctate. Elytra much broader than the thorax, broadly margined; each with four small black spots, placed transversely and somewhat obliquely in pairs, two some distance below the base and two just behind the middle.

*Diabrotica Jacobyi.*

*D. anguste ovata*, postice ampliata, modice convexa, flava, nitida, tibiis, tarsis, postpectore capiteque nigris; antennis articulis basalibus tribus piceo tinctis, quarto, octavo ultimoque nigropiceis; thorace bifoveolato pallide rufo-piceo; elytris modice convexis, dorso paullo deplanatis, erebre tenuiter punctatis, infra callum humerale elevato-vittatis, et intra vittam longitudinaliter sulcatis, obscure cyaneis, limbo laterali, apice lato, fascia lata subarcuata communi, vix infra medium sita, vix intra limbum

laterale abbreviata et utrinque pustula magna ovali a vix infra basin fere ad medium extensa flavis.

Long.  $2\frac{2}{3}$  lin.

*Hab.* Ecuador.

Head scarcely longer than broad; front impressed above the encarpæ with a deep fovea; encarpæ thickened, contiguous; carina strongly raised; antennæ filiform, the second and third joints short, the latter slightly longer than the second, less than half the length of the fourth, the three lower joints obscure fulvous, stained with piceous, the ninth and tenth yellowish white, the rest nigro-piceous. Thorax scarcely broader than long; sides slightly dilated and rounded just beyond the middle, converging at the apex; surface shining, impunctate, impressed on either side the middle disk with a deep fovea. Elytra oblong, slightly dilated posteriorly, finely but rather closely punctured; outer disk below the humeral callus thickened and forming an ill-defined broad longitudinal costa, the space within which is deeply sulcate.

*Diabrotica generosa.*

*D.* obovata, modice convexa, nigra, nitida, femoribus flavis, abdomine piceo; antennarum articulis basalibus quatuor fulvis, duobus penultimis flavo-albidis, ultimo piceo; thorace rufo-piceo, disco bifoveolato; elytris tenuissime punctatis, utrinque macula elongata basali inter suturam et callum humerale posita, altera minore oblonga infra callum humerale, fascia vix pone medium, utrinque abbreviata, maculaque subapicali subrotundata magna albedo-flavis.

Long. 3 lin.

*Hab.* Ecuador.

Head much longer than broad; front impressed with a deep fovea; encarpæ thickened, not distinctly separated from the front; carina rather strongly raised, linear; labrum large; antennæ filiform, the second joint very short, the third one half longer than the second, the fourth longer than the two preceding united. Thorax more than a fourth broader than long; sides parallel, sinuate, converging in front, the anterior angles thickened, the hinder ones slightly produced, acute; surface shining, impressed on either side with a deep fovea. Elytra increasing in width from the base towards the apex, faintly depressed below the basilar space, finely punctured.

*Diabrotica fulvo-signata.*

*D.* anguste ovata, nigra, nitida, femoribus sordide fulvis; antennis articulis duobus basalibus, duobus penultimis ultimoque basi pallide flavis; thorace transverso, subremote punctato, trifoveo-

lato ; elytris sat crebre punctatis, utrinque fascia arcuata ad basin, altera vix pone medium transversa, utrinque abbreviata, maculaque ante apicem subrotundata fulvis.

Long. 3 lin.

*Hab.* Guatemala.

Head scarcely longer than broad; front impressed above the encarpæ with a deep fovea; encarpæ shining, thickened, subquadrate; carina not defined; antennæ filiform, the second joint short, the third nearly one half longer than the second, the fourth more than equal in length to these two united. Thorax nearly a third broader than long; sides parallel, sinuate behind the middle, the anterior angles thickened, obtuse; disk subremotely punctured, impressed on either side just behind the middle with a round fovea; behind these, in front of the basal margin, is a third, smaller and less defined. Elytra distinctly punctured, slightly depressed on the inner disk, below the basilar space; each elytron with three large fulvous markings: the first, broad, commences immediately below the basal margin between the suture and the humeral callus, curves round the latter, and terminates some distance within the lateral margin; the second, placed scarcely below the middle, forms a transverse band, abbreviated on the suture and on the lateral border, its hinder margin sinuate; the third, subrotundate, is placed near the apex. Lateral margin of abdominal segments narrowly edged with flavous.

*Diabrotica Pascoei.*

*D.* anguste ovata, postice ampliata, modice convexa, flavo-fulva, nitida, capite (antennis basi et apice exceptis) nigro; tibiis tarsisque nigro-piceis; thorace lævi; elytris nigris tenuissime punctatis, utrinque limbo exteriori apice dilatato, fascia prope medium obsolete elevata, utrinque abbreviata, punctoque inter basin et medium fulvis.

Long.  $3\frac{1}{4}$  lin.

*Hab.* Cayenne.

Head broader than long, trigonate; front impressed above the encarpæ; the latter transverse, thickened, distinctly separated from the front, confluent with each other on the median line; carina raised, linear; antennæ filiform, the second joint short, the third twice its length, nearly three fourths the length of the fourth; the four lower joints obscure fulvous, the three upper ones yellowish white, the extreme apex of the terminal one black. Thorax rather more than one fourth longer than broad; sides parallel and obsoletely sinuate from the base to beyond the middle, thence converging to the apex; disk moderately convex, shining, impunctate. Elytra

broader than the thorax, dilated posteriorly, broadly rounded at the apex, moderately convex, faintly excavated below the basilar space, very minutely punctured; the fulvous fascia on the middle of each elytron slightly but distinctly thickened.

*Diabrotica speciosissima.*

*D. subelongata*, postice ampliata, modice convexa, nigra, nitida, abdomine flavo; antennis piceis, articulis ultimis tribus (ultimo apice excepto) albido-flavis; thorace rufo-testaceo, dorso excavato, obsolete trifoveolato; elytris obscure cyaneis, limbo laterali, apice fasciaque communi vix pone medium sita flavis.

Long. 4 lin.

*Hab.* Ecuador.

Head scarcely longer than broad, trigonate; front impressed above the encarpæ with a deep fovea; encarpæ thickened, trigonate; carina (its extreme apex excepted) not defined; antennæ filiform, the second joint short, the third nearly twice its length, more than half the length of the fourth. Thorax scarcely one fourth broader than long; sides broadly margined, slightly sinuate and slightly diverging to the middle, thence rounded and converging to the apex; upper surface very minutely and sparingly punctured; middle disk with a large shallow subtrigonate depression, which extends backwards nearly to the basal margin, its surface impressed on either side and at the base with a small fovea. Elytra slightly flattened along the suture, distinctly punctured, interspaces granulose, faintly wrinkled on the hinder disk; the yellow fascia, which is narrowly dilated on the extreme sutural margin, is slightly curved, its concavity looking backwards.

*Diabrotica fraterna.*

*D. elongata*, fere parallela, nigra, nitida, abdomine thoraceque flavis; hoc lævi, non foveolato; antennis filiformibus, articulis penultimis duobus albidis; elytris crebre punctatis, granulosi, obsolete rugulosis, cæruleo-nigris, utrinque maculis duabus inter basin et medium, una magna subrotundata in disco interiore sita, altera infra humerum (his oblique transversim positis), fascia lata, utrinque abbreviata, vix pone medium, maculaque subrotundata ante apicem, flavis ornatis.

Long. 3 lin.

*Hab.* Guatemala.

Head not longer than broad, trigonate; front impressed above the encarpæ with a deep fovea; encarpæ thickened, trigonate; carina raised, linear; antennæ filiform, the second and third joints very short, equal, the fourth equal in length

to the three preceding united; the three lower joints picceous, the ninth and tenth yellowish white. Thorax about one third broader than long; sides parallel from the base to beyond the middle, thence converging to the apex; disk smooth, impunctate. Elytra broader than the thorax, scarcely dilated posteriorly, rather closely and distinctly punctured; interspaces granulose, faintly wrinkled.

*Diabrotica elegans.*

*D. subelongata*, fulva, nitida, abdomine flavo; postpectore, tibiis, tarsi capiteque nigris; antennis nigro-picceis, articulis ultimis tribus (ultimi apice nigro excepto) sordide albis; thorace transverso-quadrato, lævi, obsolete trifoveolato; scutello trigonato, nigro-picco; elytris sat crebre punctatis, viridi-cyaneis, limbo exteriore angusto, fascia lata prope medium apicem flavis.

Long.  $3\frac{3}{4}$  lin.

*Hab.* Ecuador (*Buckley*).

Clypeus sparingly clothed with griseous hairs; carina obsolete; encarpæ contiguous, not well defined; front impressed just above the encarpæ with a deep fovea. Antennæ filiform, the second joint short, two thirds the length of the third, the latter less than three fourths the length of the fourth. Thorax transverse-quadrate; sides parallel and slightly sinuate from the base to beyond the middle, thence obliquely converging to the apex, the anterior angles obtuse, oblique, the hinder ones acute; disk remotely and very minutely punctured, the interspaces finely strigose (these markings are only visible under a very strong lens); hinder disk faintly impressed on either side and at the base with a shallow, ill-defined fovea. Elytra rather strongly punctured, the interspaces granulose-punctate.

*Diabrotica Buckleyi.*

*D. subelongata*, viridi-flava, nitida; postpectore, tibiis, tarsi, scutello capiteque nigris; antennarum articulis basalibus tribus picceis, nono et decimo albidis; thorace flavo-viridi, subquadrato, lævi, utrinque obsolete excavato; elytris anguste oblongis, sat crebre tenuissime punctatis, disco exteriore obsolete longitudinaliter sulcatis, læte viridibus, fascia basali lata, extrorsum vix intra marginem abbreviata, alteraque longe pone medium, fere ad marginem extensa, nigris.

Long.  $2\frac{3}{4}$ –3 lin.

*Hab.* Ecuador.

Head not longer than broad; front impressed with a deep fovea; encarpæ thickened, subrotundate, contiguous; carina raised, linear; antennæ filiform; the second joint short, the

third slightly longer than the second, the fourth equal in length to the two preceding united. Thorax scarcely broader than long; sides parallel, very slightly sinuate, converging at the apex, the anterior angles obliquely truncate; surface smooth and shining, minutely punctured, the puncturing only visible under a lens; disk impressed on either side with a very shallow, ill-defined fovea. Scutellum trigonate, shining, impunctate. Elytra narrowly oblong, distinctly and rather closely punctured, the interspaces granulose-punctate, faintly wrinkled on the inner disk; on the anterior portion of the outer disk are four or five faint longitudinal sulcations, the one below the humeral callus being more distinct and more deeply impressed than the others.

*Diabrotica sexmaculata.*

*D. elongato-ovata*, postice vix ampliata, subtus picco-fulva, nitida, femoribus (basi excepta) prothoracque prasinis, abdomine flavo; supra prasina, antennis (articulo basali excepto) piccis; thorace transverso-quadrato, lævi, utrinque sat profunde foveolato; elytris crebre punctatis, infra callum humerale longitudinaliter sulcato, utrinque maculis magnis tribus, una oblonga, a basi fere ad medium extensa, secunda vix pone medium, transversa, leviter curvata, tertiaque ante apicem subtrigonata fulvis.

Long.  $3\frac{1}{2}$  lin.

*Hab.* Guatemala.

Head not longer than broad; front impressed above the encarpæ with a deep fovea; carina raised, linear. Antennæ filiform, nearly equal to the body in length; second and third joints very short, equal; the fourth longer than the two preceding united: labrum fulvous. Thorax scarcely broader than long; sides parallel, slightly sinuate, slightly converging at the apex; disk smooth, impunctate, impressed on either side the middle with a deep fovea. Elytra closely but finely punctured, impressed below the humeral callus with a short longitudinal groove.

*Diabrotica dilaticornis.*

*D. ovata*, modice convexa, nitida, subtus nigra, pube grisea sat dense vestita, prothoracc glabro, fulvo, abdomine cyaneo; supra fulva, antennis nigris; thorace lævi transverso, disco subarcuatim excavato; scutello nigro; elytris crebre punctatis, leviter rugosis, viridi-cyaneis, limbo exteriore (apice excepto) fulvo.

*Mas* antennarum articulis ultimis quatuor compressis et dilatatis.

*Fcem.* antennis filiformibus.

Long.  $2\frac{1}{2}$  lin.

*Hab.* Amazons. Collected by Mr. Bates.

*Ann. & Mag. N. Hist.* Ser. 5. Vol. iii.

Head longer than broad; carina slightly raised, linear; encarpæ thickened, contiguous; labrum and eyes black. Antennæ nearly three fourths the length of the body in the ♂, rather shorter in the ♀; the second joint nearly half the length of the basal one, two thirds the length of the third, this last as long as the fourth and fifth united: in the ♀ the antennæ are nearly filiform, and all the joints are cylindrical; in the ♂ the fifth joint is trigonate, not more dilated than the fourth or sixth, the four upper joints are compressed and laterally dilated, the eighth and ninth trigonate. Eyes and labrum black. Thorax transverse; sides straight and parallel, rounded and converging at the apex; disk impunctate, impressed behind the middle with a shallow transverse curved fovea, which is rather more deeply depressed on either side. Scutellum trigonate, black. Elytra broader than the thorax, oblong-ovate, rather broadly margined, strongly and closely punctate, the interspaces granulose, subrugulose; bright metallic greenish blue, the outer limb (its extreme apex excepted) fulvous.

*Diabrotica erythrodera.*

*D. ovata*, valde convexa, prasina, nitida, tibiis tarsisque piceis, abdomine nigro, epipleuris aureo tomentosus; capite nigro, vertice oculorumque orbitis rufis; antennis pallide prasinis, apice pallide piceis; thorace subquadrato, rufo, dorso paullo deplanato, utrinque obsolete foveolato; elytris oblongis, valde convexis, crebro tenuissime punctatis, infra basin transversim depressis, infra callum humerale longitudinaliter sulcatis.

Long. 4 lin.

*Hab.* Peru.

Head scarcely longer than broad, trigonate; front impressed above the encarpæ with a deep fovea; carina raised, linear. Antennæ filiform, nearly equal to the body in length, pale grassy green; the four outer joints pale piceous, the second and third short, the third about one half longer than the second, the fourth equal in length to the two preceding united. Thorax subquadrate; sides straight and parallel, converging at the apex; disk smooth and shining, flattened behind the middle, and very faintly impressed with a shallow ill-defined fovea. Elytra oblong-ovate, very convex, transversely depressed below the basilar space, longitudinally sulcate below the humeral callus, very minutely and rather closely punctured.

*Diabrotica opacipennis.*

*D. late ovata*, postice ampliata, convexa, nigra, subtus nitida, pubo grisea sat dense vestita; supra minus nitida, thorace transverso,



trifoveolato ; elytris opacis evidenter sat crebre punctatis, aurantiacis ; antennis apice sordide fulvo-albidis.

Long.  $3\frac{1}{2}$  lin.

*Hab.* Ecuador.

Head rather longer than broad, subtrigonal ; encarpæ trigonal, separated by a longitudinal groove which runs upwards to the vertex ; carina raised, linear ; clypeus finely rugose-punctate, clothed with adpressed griseous hairs ; palpi ovate. Antennæ filiform ; the second joint short, ovate, the third nearly twice the length of the second, three fourths the length of the fourth, the four outer joints obscure yellowish white. Thorax more than half as broad again as long ; sides rather broadly margined, diverging from the base to beyond the middle, converging at the apex, the anterior angle mucronate ; upper surface subopaque, finely but distinctly punctured ; hinder disk impressed with three rather large foveæ, one on the basal margin, the others one on either side, just behind the middle of the thorax, the three conjointly forming a semicircular depression. Elytra much broader than the thorax, dilated posteriorly, convex, subventricose, opaque, finely but distinctly punctured.

#### *Diabrotica divisa.*

*D.* late ovata, postice ampliata, ventricosa, picco-fulva, nitida, antennis (articulo basali excepto), tibiis, tarsis, femoribus posticis, abdomine elytrorumque dimidio postico nigris ; thorace transverso, levi, disco obsolete subarcuatim excavato ; elytris tenuissime punctatis, punctis apicem versus obsoletis.

*Mas* elytris utrinque callo oblongo prope suturam ante apicemposito, instructis.

Long. 4 lin.

*Hab.* Ecuador.

Head much longer than broad, wedge-shaped ; front impressed just above the encarpæ with a deep fovea ; encarpæ thickened ; carina raised, linear. Antennæ filiform, tapering towards the apex ; the second joint short, the third one half longer than the second, two thirds the length of the fourth, the basal joint (its extreme apex excepted) picco-fulvous. Thorax about one half broader than long ; sides parallel from the base to beyond the middle, thence converging to the apex ; surface smooth, impunctate, faintly impressed on the middle disk with a transverse, slightly curved sulcation. Elytra much broader than the thorax, dilated posteriorly, ventricose, very minutely punctured, the puncturing entirely obsolete on the hinder disk.

This species may be known from all its allies by the longer head and by the extremely fine punctuation of the elytra.

*Diabrotica rugata.*

*D. subelongata*, postice vix ampliata, subtus fulva, nitida, pectore nigro-piceo; supra nigra, antennis (apice excepto) fulvis; thorace transverso, rufo-fulvo, rude rugoso-punctato, disco transversim excavato, lateribus fere rectis; elytris minus nitidis, rude rugosis, elevato-vittatis, limbo laterali fulvo.

Long.  $4\frac{1}{2}$  lin.

*Hab.* Ecuador. Collected by Mr. Buckley.

Head much longer than broad, wedge-shaped; lower portion of front longitudinally depressed; encarpæ nearly obsolete; carina linear; labrum nigro-piceous. Antennæ filiform, equal to the body in length; the second joint short, the third nearly three times its length, three fourths the length of the fourth; the seventh and eighth joints stained above with piceous, the three outer ones black. Thorax more than twice as broad as long; sides parallel, slightly sinuate behind the middle; the anterior angles thickened, obtuse, the hinder ones subacute; disk coarsely rugose-punctate, transversely excavated across the middle, the excavation broad, nearly straight, more deeply impressed at either end. Scutellum trigonate, its apex subacute, its surface shining, impunctate. Elytra oblong, scarcely dilated posteriorly, very coarsely rugose; each elytron with four more or less distinct raised vittæ; the general surface black, the outer limb, dilated at the apex, fulvous.

[To be continued.]

VIII.—*Notice of a Collection of Reptiles from Islands of Torres Straits.* By Dr. A. GÜNTHER, F.R.S.

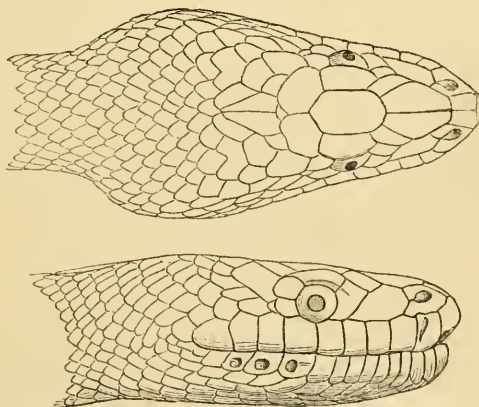
THE Rev. S. MacFarlane has continued to pay attention to the reptiles of the islands situated between New Guinea and Australia. In my notice of the first collection (Ann. & Mag. Nat. Hist. 1877, vol. xix. p. 413) information was missing as regards the particular islands in which the specimens had been collected. This information can be supplied as regards the present collection, which was formed partly in Murray, partly in Cornwallis Island. The following is the list of the species collected:—

Lizards.	Cornwallis Island.	Murray Island.
1. <i>Odatria timorensis</i> , Gray . . . . .	...	*
2. — <i>prasina</i> , Müll. . . . .	*	...
3. <i>Monitor chlorostigma</i> , Cuv. . . . .	*	*
4. <i>Lialis punctulata</i> , Gray . . . . .	*	...
5. <i>Cryptoblepharus pæcilopleurus</i> , Wiegmann . . . . .	...	*

Lizards.	Cornwallis Island.	Murray Island.
6. <i>Heteropus fuscus</i> , D. & B. . . . .	...	*
7. <i>Lygosoma scutirostrum</i> , Ptrs. . . . .	*	*
8. <i>Hinulia striatula</i> , Steindach. . . . .	...	*
9. <i>Mabouia Cartereti</i> , D. & B. . . . .	...	*
10. — <i>macrura</i> , Gthr. . . . .	...	*
11. <i>Carlia Macfarlani</i> , Gthr. . . . .	...	*
12. <i>Tropidolepisma majus</i> , Gray † . . . . .	...	*
13. <i>Hemidactylus frenatus</i> , D. & B. . . . .	...	*
14. <i>Peripia torresiana</i> , Gthr. . . . .	...	*
15. <i>Gymnodactylus Arnouxii</i> , Dum. . . . .	...	*
Snakes.		
1. <i>Lielaphis modestus</i> , Schleg. † . . . .	*	*
2. — <i>australis</i> , Gthr. . . . .	...	*
3. <i>Dendrophis calligaster</i> , Gthr. § . . . .	...	*
4. <i>Dipsas irregularis</i> , Merr. . . . .	*	*
5. <i>Liasis amethystinus</i> , Schneid. . . . .	*	*
6. — <i>cornwallisius</i> , sp. n. . . . .	*	...
7. <i>Brachysoma triste</i> , Gthr. . . . .	*	*

*Liasis cornwallisius*, sp. n.

Fig. 1.



*Liasis cornwallisius*: top and side views.

Allied to *Liasis Childrenii*. Rostral without pit; the first

† = *Tropidolepisma striolatum*, Ptrs.

‡ See Günther, Proc. Zool. Soc. 1877, p. 129.

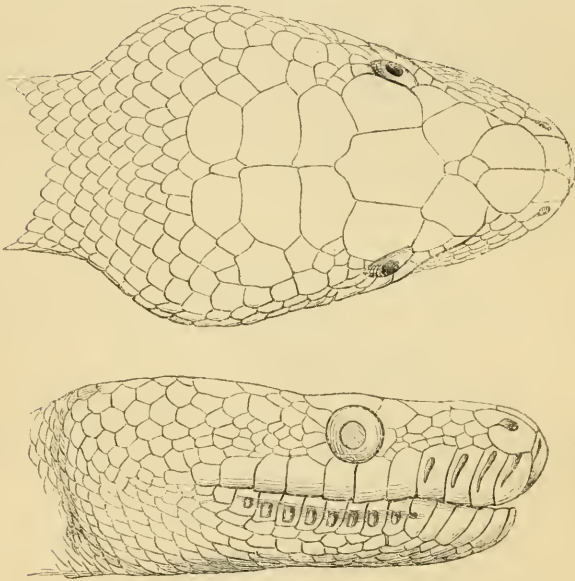
§ The loreal shield is normally present in this species, which has never the uniform coloration or the short head of *Dendrophis punctulata*. The latter is an eastern species.

upper labial and three lower labials are pitted, but not very deeply. Loreal single, very large. The middle pair of frontal shields elongate, as long as the vertical, with which they are broadly in contact. Vertical seven-sided, not broader anteriorly than behind. One anterior and two posterior oculars. The scales in 41 series. Uniform brown above and yellowish below.

A single specimen,  $4\frac{1}{2}$  feet long, from Cornwallis Island.

*Liasis duceboracensis*, sp. n.

Fig. 2.



*Liasis duceboracensis*: top and side views.

On reexamination the form from Duke-of-York Island proves to be a species distinct from *Liasis amethystinus*, to which, however, it is closely allied. Like the latter species it has the loreal region occupied by many small scutes disposed in two or three longitudinal series; the rostral also has two pits, and four of the upper labial and seven of the lower are pitted. But the Duke-of-York-Island species differs by the middle pair of frontal shields being in contact with the vertical only very slightly or not at all; in the latter case a small azygous shield is intercalated between the frontals and the vertical.

The scales also are larger and fewer in number, the number of longitudinal series being thirty-five or thirty-six.

Two anterior and four posterior ocellars. Light brownish grey, with irregular, narrow, darker cross bands.

This species, which I propose to name *Liasis duceboracensis*, appears to attain to the same size as *Liasis amethystinus*.

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IX.—*New Species of Ceratorrhina allied to C. guttata, Ol.*  
(Coleoptera, Cetoniidæ). By CHARLES O. WATERHOUSE.

THE British-Museum collection of Cetoniidæ has recently been enriched by some West-African specimens of the genus *Ceratorrhina* allied to *C. guttata, Ol.* They represent three species which appear all to be undescribed. As this group will now consist of five species, which closely resemble each other in general colour and spotting, it will only be necessary to point out the differences.

*Ceratorrhina (Stephanorrhina) guttata, Ol.*

Læte viridis, micans; thoracis limbo, scutello elytrorumque sutura plus minusve rufo-cupreis; clytris guttis plurimis (c. 22) albis notatis.

Long. 12–13 lin.

♂. Head with three short horns—one frontal in the form of a T, two anterior, somewhat straight, nearly parallel; anterior tibiæ simple; abdomen impressed in the middle.

♀. Head simple; anterior tibiæ with three sharp teeth; abdomen not impressed; pygidium very acutely produced.

*Ceratorrhina (Aphelorrhina) Julia, n. sp.*

This species closely resembles *C. guttata* in form and size, but the colour is decidedly paler green (some examples are yellowish green), the copper-colour on the suture is more diffused, and the coppery spot on the subapical callosity is much more distinct; the punctuation of the thorax and elytra is much less distinct; elytra spotted as in *C. guttata*.

♂. Head without horns, with anterior angles of the clypeus somewhat reflexed.

♀. Clypeus less strongly and less closely punctured than in *C. guttata*; anterior tibiæ less strongly toothed; pygidium less acutely conical.

Long. 12 lin.

Hab. Mongo-ma-Lobah.

*Ceratorrhina (Aphelorrhina) simillima*, Westw.

*C. (Aphelorrhina) simillima*, Westw. Arcan. Ent. i. p. 72, t. 19. f. 4, and p. 181.

♂. Dark green as in *C. guttata*, spotted in the same way, but the spots are very small; it is of a narrower form, the clypeus is unarmed, the thorax is more narrowed in front, the sides not angular before the middle, the punctuation is stronger, the copper-colour is almost wanting, except traces at the sides and base of the thorax. From the male of *C. Julia* it differs in having the clypeus much longer and narrower, densely longitudinally strigose-punctate, whilst in *C. Julia* the fore part of the clypeus is rather sparingly and finely punctured, the anterior angles are not reflexed; the intermediate tibiæ are slightly curved at the base; the pygidium is more densely transversely strigose; posterior tibiæ with no external tooth.

Long.  $9\frac{1}{2}$  lin.

*Hab.* Sierra Leone. Type in Brit. Mus.

*Ceratorrhina (Aphelorrhina) bella*, n. sp.

♂. Coloration exactly as in *C. guttata*, but with the form of *C. simillima*, having the thorax regularly narrowed anteriorly. From *C. guttata* it differs in the absence of the horns on the head, &c. From *C. Julia* it differs in colour and in the form of the thorax; the intermediate tibiæ are somewhat curved at the base; the clypeus as in *C. simillima*. From *C. simillima* it differs in the presence of the copper-colour on the suture of the elytra, in having a distinct tooth on the outside of the posterior tibiæ, and in having the white spots on the elytra larger. From all the foregoing it differs in having the third spot of the mesial line of spots on the same level with the first spot of the sutural line of spots, so that there are four spots in a straight line across the middle of the two elytra.

Long.  $9\frac{1}{2}$  lin.

*Hab.* Mongo-ma-Lobah.

*C. simillima* and *C. bella* differ from the other species in having the sternal process much narrower and more acuminate.

*Ceratorrhina (Aphelorrhina) tibialis*, n. sp.

♂. Coloration of *C. guttata*, but rather paler, of a more elongate form, the thorax regularly narrowed in front (not angular at the sides); elytra much more narrowed towards the apex; the spots are very much reduced, those near the suture being transverse, and the apical spots are wanting. The clypeus is simple, nearly as in *C. simillima*, but not

quite so densely strigose; the intermediate tibiæ are more distinctly curved at the base, and the posterior tibiæ are not toothed externally, but are swollen in a most remarkable manner just below the base and then gradually narrowed to the apex.

Long. 11 lin.

*Hab.* Angola.

#### BIBLIOGRAPHICAL NOTICE.

*The Geological Record for 1876.* Svo. Pp. xxii and 415.  
London: Taylor and Francis, 1878.

THE study of Geology has been likened to geographical exploration, which bears small results unless the proved outcome of each traveller's work is duly recorded and compared with previous additions to our knowledge. It is not enough to have at hand the journals of travel, however carefully prepared. Comparative tables and indices for ready reference are necessary; so that observations, past and present, far and near, may be studied together,—so that slips and patches of mapped lands may be combined, scattered descriptions of parts of nations be brought together under one head, and the isolated accounts of various local products be made to supply a compendium of the natural history of one region. Besides a mere cataloguing of the names of places, peoples, and things, the geographer requires also condensed statements of matters of fact and inference, to aid in the construction of his compendious books, whether he has to prepare these abstracts or finds them made ready to his hand.

Thus also in Geology we have many useful catalogues of names of authors and books, and of fossils, rocks, and minerals. Some are in the form of dictionaries, some are regular bibliographical portions of periodical journals, some constitute appendices in books and memoirs, and some are published in an independent form. Some have succinct notices, descriptive or suggestive, attached to the subjects mentioned, and some carry much information in collateral columns, but many indicate nothing more than what the mere names and titles can suggest. Of those more completely useful works which assist the geologist in finding what has already been done and thought of in this or that department of his science, the 'Geological Record,' edited by Mr. Whitaker, F.G.S., with the assistance of many other good and energetic geologists and mineralogists, stands high in worth and favour. It has no rival except the excellent 'Revue de Géologie,' by MM. Delesse and Lapparent, which has reached its fourteenth annual volume, and worthily fulfils its useful mission among our fellow-labourers in France.

In our 'Record' the distribution of matter is made thus:—  
1. Stratigraphical and Descriptive Geology, under eight geogra-

phical headings; 2. Physical Geology, as Phenomena of underground origin, Surface phenomena, and Rock-formation; 3. Applied and Economic Geology; 4. Petrology; 5. Mineralogy; 6. Palaeontology, taking in order the Vertebrates, Invertebrates, and Plants; 7. Maps and Sections; 8. Miscellaneous and General; together with Supplements for 1874-6, a very valuable Index of new Species (rocks, minerals, and fossils), and, lastly, an excellent General Index. The long list of periodicals supplying memoirs and notices, treated of in abstract, occupies 14 pages. Numerous books, of course, are noticed in their respective places according to their subjects. Altogether the year 1876 has evidently produced a fair harvest of geological work; and the 'Record' may be likened to the reaper, binder, stacker, thresher, and winnower of the golden grain of knowledge, enabling some to compile now and valuable accumulations, others to use and digest excellent aliment for their intellectual progress, and others to sow chosen and most promising seed, in well prepared furrows, for the benefit of future students.

## PROCEEDINGS OF LEARNED SOCIETIES.

### GEOLOGICAL SOCIETY.

November 6, 1878.—Henry Clifton Sorby, Esq., F.R.S.,  
President, in the Chair.

The following communications were read:—

1. "On the Range of the Mammoth in Space and Time." By Prof. W. Boyd Dawkins, M.A., F.R.S., F.G.S.

The author expressed his opinion that the result of the evidence collected since the death of Dr. Falconer has been to establish the view of that palæontologist as to the Mammoth having appeared in Britain before the Glacial epoch. The evidence as to the occurrence of the Mammoth in the south of England was first examined. The remains found beneath the bed of erratics near Pagham belonged, not to *Elephas primigenius*, but to *E. antiquus*. But in 1858 remains belonging to the former were found by Prof. Prestwich under Boulder-clay in Hertfordshire. In Scotland remains of *E. primigenius* have been found under Boulder-clay; but whether under the oldest Boulder-clay is uncertain. In 1878 a portion of a molar was brought up from a depth of 65 feet near Northwich; it was in a sand beneath Boulder-clay, which the author considered to be undoubtedly the older Boulder-clay. The author now assents to Dr. Falconer's opinion (which he formerly doubted) that *E. primigenius* was a member of the Cromer Forest-bed fauna. It is also clear that it was living in the southern and central parts of England in Postglacial times. It has not been found north of Yorkshire on the east, and Holyhead on the west, probably because Scotland and North-west England were long occupied by glaciers. Its remains have



been found on the continent as far south as Naples and as far north as Hamburg, but not in Scandinavia. Its remains, as is well known, abound in Siberia, and it ranged over North America from Eschscholtz Bay to the Isthmus of Darien, *E. columbi*, *E. americanus*, and *E. Jacksoni* being only varieties. The author then discussed the relations of *E. primigenius* to *E. columbi*, *E. armeniacus*, and *E. indicus*, and came to the conclusion that it was the ancestor of the last.

2. "The Mammoth in Siberia." By H. H. Howorth, Esq., F.S.A. Communicated by J. Evans, Esq., LL.D., F.R.S., V.P.G.S.

The author gave reasons for considering that the "griffon's claw" sent by Harun-al-Rashed to Charlemagne was the horn of a fossil Rhinoceros, so that the extinct mammals coeval with the Mammoth were known in Europe at an early date. They were probably known even in the days of Herodotus. Other evidence, such as the Christy Collection, shows that the Siberian deposits were known at a very early time. There is evidence, too, to show that fossil ivory was known to the Chinese, who asserted that the animals were still living underground. The author described several cases of the discovery of well-preserved bodies of Mammoths in historic times. They have occurred in widely separated places, from the eastern watershed of the Obi to the peninsula of the Tschuksi. Bones also have been found over the whole length of Siberia, the Brai Islands, and the islands of New Siberia.

The author further discussed the theories which account for their presence:—1. That the animals lived much further south, and were carried down by rivers to where they now lie; 2. That they lived on the spot. As there are physical difficulties in the way of the transport theory, as the Mammoth was covered with dense hair and fed on plants growing on the spot, and as the remains are not confined to the vicinity of rivers, it is probable that the second view is the correct one.

There are, however, some points connected with it requiring further consideration. It being proved that the Mammoth only required a temperate climate, it must not be hastily assumed that it could endure that of Siberia. Where the Mammoths are now found the ground at 2 or 3 feet below the surface is permanently frozen all the year round, vegetation does not appear till June and is very poor and stunted, the summer is very short, the winter proportionately long, the temperature in January is as low as  $-65^{\circ}$  F., and no tree will now grow in the greater part of North Siberia. How then could *Elephas primigenius* and *Rhinoceros tichorhinus* obtain food on such ground? The only alternative seems to be, either to suppose a great migration N. and S., or a change of climate. The author is of opinion that in Siberia such a migration is not possible. It seems therefore more probable that the climate of Siberia has become more severe. The plants found in the fissures of the Rhinoceros-teeth are those now living in South Siberia. The plant-remains associated with the Mammoth (not floated from a distance, but of

the locality) show the same thing, larch, birch, and other trees of good size being found. Freshwater and land shells are also found, not now living. Hence it seems reasonable to conclude that the climate has become more severe, and that of the north in the days of the Mammoth resembled that of the south at the present time. The author then considered the cause of the Mammoth's extinction. This he held to have been sudden. The remains must have been preserved soon after death. He therefore maintains that they were destroyed by a flood due to some sudden convulsion which also changed the climate.

3. "On the Association of Dwarf Crocodiles (*Nannosuchus* and *Theriosuchus pusillus*, e. g.) with the diminutive Mammals of the Purbeck Series. By Prof. R. Owen, C.B., F.R.S., F.G.S.

The author noticed an objection which had been raised to his view of the origin of the differences between the Mesozoic and Neozoic Crocodiles by the adaptation of the latter to the destruction by drowning of large mammalia (Q. J. G. S. xxxiv. p. 422), namely that mammals were coexistent with the Mesozoic forms, and remarked that from their small size they would hardly constitute a suitable prey for the Crocodiles to which he then specially referred, but would be more likely to perform the same part as the Ichneumons of the present day, which check the increase of Crocodiles by destroying their eggs and newly-hatched young. He stated, however, that in waste slabs of "feather-bed" marl which accompanied the Becklesian Purbeck Collection to the British Museum, the remains of small Crocodiles were detected in considerable abundance; and he gave a description of these, and especially of one which he named *Theriosuchus pusillus*. This reptile, which is estimated to have been about 18 inches long, had scutes presenting the "peg and groove" character of those of *Goniopholis*, with which genus it further agreed by having the antorbital part of the skull of the broad-faced Alligator type. In the dentition it resembled the Triassic Theriodonts more than any other Crocodiles. The vertebræ are amphiplatyan. In conclusion, the author indicated the conditions which have to be fulfilled in the case of recent Crocodiles to enable them to drown a large mammal without inconvenience to themselves, and showed that these conditions were realized also in the Neozoic forms, whilst there was no reason to suppose that any Mesozoic Crocodiles possessed the adaptations in question.

November 20, 1878.—R. Etheridge, Esq., F.R.S.,  
Vice-President, in the Chair.

The following communications were read:—

1. "On the Upper-Greensand Coral Fauna of Haldon, Devonshire." By Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S., &c.

The author in this paper stated that since the publication of his

supplement to the British Fossil Corals, published by the Palæontographical Society, several new corals have been obtained at Haldon by Mr. Viary, of Exeter. Twelve additional species were noticed, of which ten were new. This brings the total number of species in the Haldon Greensand up to twenty-one. The new species are thus distributed :—*Aporosa*: *Oculinidæ* (1), *Astræidæ* (3), *Fungidæ* (5); *Perforata*, *Turbinariæ* (2); *Tabulata* (1). The paper concluded with remarks on the genera and species represented, from which it appeared that the Coral fauna of Haldon is the northern expression of that of the French and Central European deposits, which are the equivalents of the British Upper Greensand. The Haldon deposit was formed in shallow water, and the corals grew upon the rolled débris of the age.

2. "Notes on *Pleurodon affinis*, sp. ined., Agassiz, and Description of three Spines of Cestracionts from the Lower Coal-measures." By J. W. Davis, Esq., F.G.S.

The author described some fossil remains of fish obtained from the bone-bed immediately above the "Better-bed Coal" referred to by him in a former paper (see Q. J. G. S. vol. xxxii. p. 332). The fossils described included *Ielthyodorulites* belonging to 4 species, namely :—*Pleurodon affinis*, a species named, but not described or figured by Agassiz; *Hoplanchus elegans*, gen. et sp. nov.; *Ctenacanthus æquistriatus*, sp. nov.; and *Phricacanthus biserialis*, gen. et sp. nov. Teeth believed to be those of *Pleurodon affinis* were also described.

## MISCELLANEOUS.

### *Diastylis bimarginatus*.

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

GENTLEMEN,—When Mr. Sim sent me the specimen of *Diastylis bimarginatus* it was accompanied with his own drawing, which is similar to that which you have published in the last number of the 'Annals.' It was because I had the opportunity of comparing it with the animal that I preferred making the sketch I sent to you. Had I received the animal in an unmutilated condition I could have entered into more minute detail.

Yours faithfully,

Plymouth, Dec. 22, 1878.

C. SPENCE BATE.

*Germination of the Spores of Volvox dioicus.* By M. HENNEGUY.

Two years ago I communicated to the Academy of Sciences a note on the subject of the reproduction of *Volvox dioicus*, Cohn, in which I indicated the gradual appearance of sexuality in these organisms,

the male sex appearing before the female, in proportion as the species degenerates by sexual reproduction.

The spores proceeding from the fecundation of the oospheres by the antherozoids fall to the bottom of the water, and remain in a stationary condition for a considerable time. Cohn, who has lately published an important memoir\* on the monœcious *Volvox globator*, thinks that these spores need to be dried before germinating, but he was unable to observe this germination. Cienkowski has seen the contents of the spore divide, and he thinks that each sphere of segmentation ultimately becomes a cœnobium.

I was fortunate enough at the beginning of June to trace the development of the spores of the species of *Volvox* which I had previously studied. I have ascertained that, contrary to Cohn's opinion, the spores of *Volvox* pass the winter in the water. In fact those which I observed were collected in the mud of a tolerably deep basin in the Jardin des Plantes which was constantly filled with water.

These spores, of an orange-yellow colour, possess two enveloping membranes—an exospore with double outline and a delicate endospore. At the moment of germination the exospore is ruptured, and the swelled endospore is seen to project through the torn place. At the same time the contents of the spore, separated from the endospore by a clear space, divide into two equal parts, which, by successive bipartitions, give origin to four, eight, sixteen, &c. small cells. The cells, which are at first orange-yellow, acquire a brown tint, becoming more and more greenish in proportion as the work of division advances. When the segmentation of the spore is completed, the cells form a spherical layer analogous to the blastoderm of a holoblastic ovum. Each element afterwards acquires two vibratile cilia. The endospore disappears, and the young *Volvox*, thus constituted, moves freely in the water. The cells, which are at first very close together, separate from each other by the intervention of a gelatinous substance.

An interesting fact is the presence, among the vegetative cells of the *Volvox* while still contained in the endospore, of elements larger than the others, which will subsequently give origin to the daughter colonies by a mode of division analogous to that observed in the spore.

The spores of *Volvox* therefore germinate in water, and each of them produces a single colony by an operation of segmentation identical with that which gives origin to a daughter colony at the expense of a cell of the mother colony.—*Bull. Soc. Philomath. Paris*, July 27, 1878.

*On the Anatomy of the Larva of Eristalis tenax.* By Dr. BATELLI.

Dr. Batelli has communicated to the Tuscan Society of Natural Sciences a memoir on the structure of the well-known "rat-tailed" larva of *Eristalis tenax*. He regards the external tube of the tail

\* Beiträge zur Biologie der Pflanzen, 1875.

as a modified segment of the body, its nature being indicated by the existence on each side of it of a mamilla and two very long hairs, characters which are repeated upon every segment. He describes the structure of the tail, indicating how the outer tube bends more or less according as the internal tube is more or less retracted. The retraction of the internal tube is due to two muscles inserted at its superior extremity; and at this extremity there are, moreover, some gigantic cells with large nuclei having in the interior as a product of elaboration a long twisted filament. Connected with the two tracheal ramifications there are in the body two sacs, almost equal to it in length, formed of an external structureless membrane and containing small free globules. These globules on analysis prove to consist principally of earthy carbonates (carbonates of lime and magnesia).

The digestive apparatus has in its vestibule two chitinous plates. In the pharyngeal bulb there are, besides the two jaws, eight very peculiar beards (*fanoni*) consisting of two series of divaricated barbules. The salivary glands, which open beneath the inferior anastomosis of the jaws, have in their excretory tube a chitinous *interna* with a spiral thread, just as in the interior of the tracheæ and of a portion of the silk-glands of the Lepidoptera. The "valvular apparatus" of Plateau, or (better) the *gizzard*, leaves a closed peripheral space where there is an endothelium; the middle intestine or chylic stomach, which is very long, is preceded by four ventricular glands, accompanied by four Malpighian tubes. These, which discharge by four distinct orifices, unite in pairs to form an upper and a lower loop. The anal glands, which contain a great quantity of urates, are composed each of a straight part and another which is folded back; they present a muscular ligament which straightens them when they are drawn outwards.

Besides the supra- and subœsophageal ganglia the nervous system includes two intermediate ones, which, by means of a peduncle inserted into the lateral commissure, fit in between the two, especially in the antero-superior zone. A sympathetic system starts from the lower surface of the anterior extremity of the nervous chain. The thoracic and abdominal ganglia are united into a band, which immediately follows the central system above described. Small cells exist in the intermediate, and large ones in the supra-œsophageal and subœsophageal ganglia; these are few in the former, but very numerous in the latter.

The tracheal tubes have in their anterior stigma, besides a solid terminal sheath, an involucrum lined internally with an endothelium, and containing very large cells, in the same way as above described for the tail, interposed between the involucrum in question and the tube of the trachea.—*Soc. Tosc. di Scienze Nat., Proc. Verb.*, Nov. 10, 1878.

#### *On the Dentition of Smilodon.* By M. P. GERVAIS.

The *Smilodontes* are great Felidæ found fossil in the caves and in the deposits of the Pampas of South America (Brazil and the

Argentine Republic), which have in the upper jaw a pair of canines in the form of long poniards. The late M. Lund, to whom we are indebted for so many curious discoveries relating to the extinct Mammalia of the former of the above regions, first of all gave the name of *Hyæna neogæa* and afterwards that of *Smilodon populator* to these redoubtable carnivores; and De Blainville has figured an almost entire skull of one in his 'Osteography of *Felis*,' calling it *Felis smilodon*. This cranium belongs to the collection of the Paris Museum; and it offers this peculiarity, that it is provided with three pairs of inferior molars, as is also the case in all the other species of Felidæ, whether the ordinary Felidæ or the *Machairodontes* or Felidæ with cultriform superior canines, of which we are completely acquainted with the dentition.

Among the latter figure *Machairodus megantereon* from the Pliocene of the Auvergne, *M. leoninus* from the Upper Miocene of Greece, *M. palmidens* from the Miocene of Sansan (Gers), *M. bidentatus* or *Eusmilus perarmatus* from the phosphorites of Quercy, and *M. (Drepanodon) primævus* from Dakota.

On the other hand the *Smilodontes*, in the normal state, appear to have possessed only two inferior molars on each side; and Prof. Reinhardt was so convinced of this fact that he believed that the third pair of teeth (first pair of premolars) of the Parisian cranium had been added in order to give more value to the specimen\*. From the small size of the teeth in question and their inequality, I should prefer to consider them accidental; moreover they are implanted in true alveoli.

At any rate I find only two pairs of molars in the same jaw in all the other *Smilodontes* that I have been able to examine; and as these are tolerably numerous, it seems to me difficult to believe that there is more than one species in this genus, and that its dental formula should be expressed otherwise than as follows:—i.  $\frac{2}{3}$ , c.  $\frac{1}{1}$ , m.  $\frac{2}{2}$ .

*Machairodus necator*, which I have indicated from the skeleton brought by M. Larroque, follows the ordinary rule; and De Blainville's *Felis smilodon* must, in all probability, be regarded only as presenting a case of anomaly, worthy, no doubt, to be mentioned, but which cannot be considered to indicate a distinct species.

A cranium of a young *Machairodus smilodon* with two inferior molars, discovered in the Argentine Republic, forms part of the Museum at Stockholm; there are also two adult crania, of the same origin, at the Museum of Copenhagen, in which the dentition is the same; a maxillary belonging to the College of Surgeons in London, and another, preserved in the Museum at Paris, do not differ in this respect; and lastly, as I learn from M. Ameghino, there are several exactly similar crania in the museums of Buenos Ayres.

In conclusion it may be remarked that the lower jaw represented in M. Lund's memoirs, and which is, so to speak, the type of the species under consideration, also possesses the same character.—*Comptes Rendus*, October 22, 1878, p. 582.

\* Tidsskrift for populær Fremstillinger af Naturvidenskaben, p. 344.

# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 14. FEBRUARY 1879.

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X.—*On some new and rare Hydroid Zoophytes (Sertulariidæ and Thuiariidæ) from Australia and New Zealand.*  
By D'ARCY W. THOMPSON, Edinburgh.

[Plates XVI.-XIX.]

THE Hydroid Fauna of Australia and New Zealand has been, perhaps, more fully investigated than that of any region of the earth's surface, with the exception of the European seas and the eastern coasts of North America. Its history, however, is contained as yet only in many detached and scattered papers; and no attempt has been made to gather together and to correlate the information contained in them.

The largest and most important collection ever brought home from the Australian seas was that described by Mr. Busk in the appendix to Macgillivray's 'Voyage of the Rattlesnake.' Besides numerous and most interesting Plumulariidæ, it contained fifteen species of *Sertularia*, twelve of which are new and undescribed. Of these, many, unfortunately, were small or imperfect specimens, and fully half were destitute of gonangia. Six out of the fifteen species were collected off Cumberland Island or in the Louisiade archipelago, the remainder principally in the neighbourhood of Bass's Straits. No form, I believe, was found common to the two localities. It is much to be regretted that this most valuable collection was not described at greater length, and still

more that no figures of the specimens have ever been published. I have been able to identify two species only with forms contained in the present collection, viz. *S. elongata*, Lamx., and *S. operculata*, Linn.

In 1864, Senator Dr. Kirchenpauer published a valuable paper, in the 'Nova Acta,' on the genus *Dynamena* of Lamouroux, and also described two new species from the Australian seas. One of these, however, *D. fasciculata*, is synonymous with *S. operculata*. A few scattered entries regarding Australian forms are to be found in the works of Prof. Allman, Mr. Hincks, and others; but, so far as I am aware, no other important contribution to the history of the Australian Hydroids has yet been published.

The first special list of the New-Zealand species was given by Mr. Gray, in the appendix to Dieffenbach's 'New Zealand:' it contained four species only of Sertulariidae and Thuiariidae, besides a single *Aglaophenia*. This scanty list of four was considerably extended by Captain Hutton in 1872 (Trans. N.Z. Inst. vol. v. p. 256), who mentions eleven species, two of which are probably, however, merely varieties.

In 1874 Dr. Millen Coughtrey communicated a paper to the Otago Institute, in which he added in many particulars to Captain Hutton's results and described three new species. He also contributed a paper on the same subject to the Ann. & Mag. of Nat. Hist. (Jan. 1876), which is in substance the same as one published in the Trans. N.Z. Inst. vol. viii.

In 1875 Prof. Allman read a paper before the Linnean Society, in which he described a large number of new and interesting Hydroids from many widely scattered localities. Among these were five *Sertularellæ* from New Zealand, of which three were new; and three species of Thuiariidae, one only of which was undescribed.

Among the older authorities on the Hydroida much valuable and interesting information is to be found. The works of Lamouroux and Lamarck especially contain accounts of very numerous species from southern localities. The descriptions for the most part err, according to our notions, on the side of excessive shortness, and have for that reason been entirely set aside or overlooked by many recent authors. But though a few species are thus rendered unrecognizable, a great many can be identified without any great difficulty or uncertainty.

I regret extremely being unable to obtain in Edinburgh Krauss's 'Beiträge zur Kenntniss der Zoophyten der Südsee,' published at Stuttgart in 1832.

A more minute and extended investigation will, in all pro-



bability, lead to most interesting results in regard to our knowledge of the distribution of the Hydroida. Many of them are singularly widespread, one or two (e. g. *S. operculata* and *Sertularella Gayi*) almost cosmopolitan. On the other hand, even when studying the Hydroid fauna of a comparatively restricted area, such as the Australasian seas, we become aware, somewhat dimly as yet, of the existence of several more or less distinct and circumscribed provinces. The Hydroids of Torres Straits and the Louisiade archipelago are, as has been already remarked, singularly different from those of the southern and south-eastern regions, e. g. Adelaide and Bass's Straits; and the forms inhabiting New Zealand are similarly distinct from the Australian species. *S. operculata* and *S. elongata* are, I believe, the only Sertularians which have hitherto been recorded on good authority from both localities. To these I can now add *Sertularella Johnstoni* (a common New-Zealand form, of which I possess specimens from Tasmania) and *Sertularia minima*, D'A. W. T.

For a most able and masterly sketch of the distribution of the Sertulariidae see the introduction to Prof. Allman's magnificent work on the gymnoblastic Hydroids.

The species described in the following pages have been accumulated from various sources. Many of the specimens were selected from the refuse of Harvey's great collection of Australasian seaweeds, a store which, once upon a time, yielded many new Polyzoa to Prof. Sir Wyville Thomson. Another portion were sent home by Dr. Ferd. Müller, chiefly from Adelaide and the Gulf of St. Vincent; while the remainder were principally collected in New Zealand by Dr. Jolliffe. The collection contained, in all, twenty forms belonging to the Sertulariidae and Thuiariidae, of which six are referable to the genus *Sertularella*, nine to *Sertularia*, four to *Thuiaria*, and one to *Pericladium*. Of these, ten are, I believe, new and undescribed; eight are known to us by the accounts of other authors; and the two which remain are, unfortunately, represented by such imperfect specimens that I am uncertain how to identify them with old species, and equally unwilling to designate them as new.

I have also obtained in the same collection six or seven species of *Aglaophenia*, about half of which I believe to be undescribed, and two or three Campanularians, which last, however, are in a sadly imperfect state of preservation. I hope shortly to be able to render an account of all these species.

I must here express my warmest thanks to Prof. Sir Wy-

ville Thomson for his kindness in permitting me to describe the present collection, and to Prof. Allman and Mr. Busk for much kindly given and highly valued assistance.

*Sertularella neglecta*, sp. nov. (Pl. XVI. fig. 1.)

*Trophosome*. Hydrocaulus attaining a height of about  $\frac{3}{4}$  of an inch. Pinnæ alternate, rather irregular. Hydrothecæ long, tubular, gracefully curved, a very small portion only immersed; all directed somewhat towards one side of the stem; one, rather shorter than the rest, in the axil of each pinna; orifice triangular, with three long pointed teeth. Colour reddish brown.

*Gonosome*. Gonangia obovate, with close, strongly-marked transverse wrinkles, and a distinct and longish neck-orifice with two rounded teeth.

*Locality*. Australia (probably Bass's Straits) (*Dr. Harvey*).

My specimens of this species are all much shrivelled, so much so as to make the exact form of hydrothecæ and gonangia not easily ascertained. My figure, however, is, as far as I can judge, fairly accurate.

*Sertularella fruticosa*. (Pl. XVI. figs. 2, 2 a.)

*Sertularia fruticosa*, Esper, Hist. des Zoophytes, suppl.

*Sertularia laxa*, Lamarck, Hist. des Anim. sans Vertèbres, vol. ii. p. 116.

*Trophosome*. Hydrorhiza dense, fibrous, and matted. Hydrocaulus attaining a height of about 12 inches, strong, coarse, and woody. Pinnæ long, alternate, arranged at wide intervals. Hydrothecæ large, cup-shaped, distant, often almost subpedicellate; orifice wide, unstricted, margin entire.

*Gonosome*. Gonangia arising from the pinnæ, just below the base of a hydrotheca; small, not much larger than the hydrothecæ; obovate, smooth, margin entire, operculate (?).

*Locality*. New Zealand (*Dr. Jolliffe*).

This species is a most striking and conspicuous one, from the great size both of the hydrothecæ and of the whole zoophyte; and it is a matter, therefore, of some wonderment to me to find no mention of it in recent authors.

In general appearance it closely resembles *Campanularia juncea*, a form from Ceylon figured by Prof. Allman in the Journ. of the Linnean Society, vol. xii.; indeed the generic relations of both species are somewhat uncertain.

The capsules are singularly small for so large and robust a species. In one or two I think I can detect traces of an operculum; but they are too much shrivelled for such a structure to have been fully preserved.

*Sertularella Johnstoni*, Gray.

*Sertularia Johnstoni*, Hutton, Trans. N.Z. Inst. vol. v.; Coughtrey, Trans. N.Z. Inst. vol. vii.

*Sertularella gracilis*, Allman, MS.

*Sertularella Johnstoni*, Allman, Journ. Linn. Soc. vol. xii.

This species is well represented in the collections to which I have had access, and, indeed, seems to be of common and widespread occurrence. I have little or nothing to add to the full and accurate descriptions already published, save to corroborate Dr. Coughtrey's account of the gonangia. These, according to Dr. Allman, possess a "tubular orifice, which is situated excentrically on the truncated summit." My specimens, like Dr. Coughtrey's, show three distinct variations in the form of the gonangium. In the first the neck is tubular and elongated; in the second it is everted and infundibuliform; and in the third it is absent or inconspicuous.

I think it extremely probable that the excentric position of the neck, as shown in Prof. Allman's specimen, was only an accidental or abnormal variation from the more common type.

The specimens hitherto described seem all to have been obtained in New Zealand; but I also possess some sent home by Dr. Ferd. Müller from Van Diemen's Land.

*Sertularella exigua*. (Pl. XVI. fig. 3.)

*Trophosome*. Hydrorhiza rather stout, creeping. Hydrocaulus attaining a height of about .2 inch, unbranched, much twisted at the base. Hydrothecæ rather large, barrel-shaped, tumid, smooth or indistinctly wrinkled towards the mouth, diverging for about half their length; margin thickened, flexuous; aperture four-sided. Colour whitish.

*Gonosome*. A single gonangium to each hydrocaulus, attached close to the proximal end. Globular or obovate, strongly corrugated with transverse folds.

*Locality*. New Zealand (*Dr. Harvey*).

This is another very minute species, but one which I have had better opportunities of examining than the last.

The hydrothecæ are of a very definite and characteristic form, and differ entirely from all the varieties of *S. simplex* (?) figured by Dr. Coughtrey. The zoophyte occurs creeping upon small seaweeds.

*Sertularella*, sp. (Pl. XVI. fig. 4.)

*Trophosome*. Hydrocaulus minute, simple, divided by oblique joints into short internodes, each bearing a single hydro-

theca. Hydrothecæ barrel-shaped, strongly wrinkled, with a distinct neck, divergent for about half their length; orifice with four teeth.

*Gonosome.* Unknown.

*Locality.* Brown's River (*Dr. Harvey*).

I have only a tiny scrap (.2 inch in height) of the present species; and owing to this circumstance, and considering also the confusion which still exists among the smaller Australian and New-Zealand species, I do not as yet assign it a name.

The hydrothecæ are singularly like those of *S. tenella*, Hincks, but are more immersed and much closer together. I cannot detect any traces of an operculum. The species is not unlike the form figured as a variety of *S. simplex* by Dr. Coughtrey in pl. xx. fig. 10, *l. c.* The hydrothecæ, however, are closer together and exhibit less numerous wrinkles in my specimen.

*Sertularella ramosa*, sp. nov. (Pl. XVI. figs. 5, 5 a.)

*Trophosome.* Hydorrhiza consisting of short matted fibres. Hydrocaulus attaining a height of about 3 inches, strong and shrubby. Main stem flexuous, giving off alternate pinnæ often themselves pinnate. Internodes short; joints oblique and conspicuous. Hydrothecæ large, urceolate, somewhat tumid, smooth; upper third divergent, one to each internode; orifice four-sided, with short rounded teeth at the angles. Colour brown.

*Gonosome.* Gonangia long, ovate, smooth, with a distinct four-sided neck; orifice quadrangular, with four teeth.

*Locality.* New Zealand (*Dr. Jolliffe*).

This species, as regards the shape of the hydrothecæ, has affinities with *S. polyzonias*, Linn., or still more with *S. turgida*, Trask (Proc. Calif. Acad., March 1857). I found a tiny scrap of the present form among zoophytes from Bass's Straits (*Dr. Harvey*); it may, however, have got mixed up with them accidentally.

#### SERTULARIA, Linnæus (in part).

The very numerous species of *Sertularia* seem to me to resolve themselves naturally into three groups, two only of which are represented among the following species.

*a.* The first section is that whose type species may be taken as *S. pumila*—a very natural group characterized by the oppositely-paired arrangement and tubular form of the hydrothecæ, and by the possession of ovato-globular, usually smooth, go-

angia. As a general rule, the margins of the hydrothecæ are smooth or furnished with two teeth; the aperture of the gonangium is surrounded by a rim or collar, and is frequently provided with an operculum. *S. conferta*, Kirchenpauer, is an example of a species whose gonangia are strongly marked with transverse wrinkles.

It will be seen that this section, together with the genus *Diphasia*, Ag., comprehends nearly all the species formerly grouped under Lamouroux's genus *Dynamena*.

β. The second group may be typically represented by *S. abietina*, and includes forms with flexuous stems and flask-shaped alternate or subalternate hydrothecæ. The gonothecæ vary: in the type species and in *S. filicula* they are ovate and smooth; in *S. pulchella*, D'A. W. T., and in *S. elongata*, Lamouroux, they are elongated, with long spines at the top.

In *S. filicula* the hydrothecæ are sometimes, though not in typical specimens, almost opposite.

γ. The third section is well exemplified by *S. cupressina*, and contains comparatively few species. It may be defined as comprehending forms rather sparingly jointed, with alternate, tubular, deeply immersed hydrothecæ.

The forms belonging to this group approximate very closely to the genus *Thuiaria*. Indeed Prof. Allman, in a note to his paper in the twelfth volume of the Journ. of the Linn. Soc., declares that both *S. argentea* and *S. cupressina* are true Thuiarians. It seems to me, however, that *S. fusca* has more claims than any of them to be admitted among the Thuiariidæ, both the hydrothecæ and gonangia being strikingly and characteristically of a Thuiarian type. The gonangia of the two preceding species show affinities to the second form described above, as exhibited by the last-named group.

a. Type form *S. pumila*, Linn.

*Sertularia flexilis*, sp. nov. (Pl. XVII. figs. 1, 1 a.)

*Trophosome*. Hydrocaulus slender, attaining a height of about 8 inches. Pinnae alternate, given off at rather distant intervals. Hydrothecæ opposite, in pairs, subalternate on the main stem, one in the axil of each pinna, generally two pairs to each internode, tubular, distant, strongly divergent, those on the main stem less so than those on the pinnae. Aperture small, looking upwards, with one broad tooth on each side.

*Gonosome*. Gonangia attached just beneath the base of a hydrotheca, on the main stem only, and confined to the upper

part, globular, smooth; margin slightly everted; orifice with a round operculum.

*Locality.* Sealer's Cove (*Dr. Ferd. Müller*).

In the wide space which separates the pairs of hydrothecæ this species approaches *Dynamena distans* of Lamouroux. The two forms, however, have no other character in common.

A little cluster of specimens without gonangia, and from 1 to 3 inches high, which I have no doubt represent a young form of this species, are contained in Dr. Harvey's collection from Circular Head, Tasmania. They show the hydrorhiza to be fibrous, creeping, and inconspicuous. They have the stem rather stronger and the hydrotheca a little larger than is the case in the type specimens.

*Sertularia flosculus*, sp. nov. (Pl. XVII. figs. 2, 2 a.)

*Trophosome.* Hydrorhiza consisting of a slender creeping filament. Hydrocaulus attaining a height of about  $\frac{3}{4}$  of an inch, very delicate. Pinnæ alternate, nearly perpendicular to the main stem. Hydrothecæ, on the pinnæ, opposite, in pairs, closely adnate, one pair to each internode; on the stem subalternate, one in the axil of each pinna. Hydrothecæ shortly tubular, divergent for about half their length; orifice small, looking upwards, with two short teeth. Colour yellowish white.

*Gonosome.* Unknown.

*Locality.* Profusely clothing a *Fucus* from Australia (Adelaide?) (*Dr. Ferd. Müller*).

This is a singularly delicate and beautiful species, which, however, becomes greatly shrivelled in the process of drying. It has some affinities, and may possibly prove identical, with *Dynamena divergens* of Lamouroux.

*Sertularia minima.* (Pl. XVII. figs. 3, 3 a, 3 b.)

*Syntheceium gracile*, Coughtrey, Trans. N.Z. Inst. vol. vii. p. 286.

*Sertularia pumila*, Coughtrey, Ann. & Mag. Nat. Hist., Jan. 1876.

*Trophosome.* Hydrocaulus simple, attaining a height of .1 to .25 inch, springing from a delicate creeping hydrorhiza which forms a filamentous network overrunning seaweeds; branches erect; internodes marked off by a deep constriction. Hydrothecæ small, tubiform, adnate nearly their whole length, closely approximated; orifice cleft, forming two teeth.

*Gonosome.* Gonangia, one to each hydrocaulus, arising from a point just below the lowest pair of hydrothecæ; globular or somewhat pear-shaped; margin slightly everted, entire.

This little species, formerly described by Dr. Coughtrey as a second species of Allman's singular genus *Syntheticium*, was afterwards stated by him to be inseparable from *Sertularia pumila*. While it is plain that it can by no means be referred to the former genus, there also seem to be ample grounds for constituting it a distinct species of the latter one. It is undoubtedly very closely allied to *S. pumila*, L., and to *S. gracilis*, Hincks; but it differs markedly from both in the small size both of the trophosome and of the individual hydrothecæ. The teeth also on the margins of the hydrothecæ seem larger and more distinct than in the British species.

My specimens are of a whitish colour, and occur densely investing a species of *Fucus* (?)

*Locality.* Gulf of St. Vincent, Adelaide (*Dr. Ferd. Müller*); Australia (*Dr. Harvey*). Dr. Coughtrey's specimens were from the Middle Island, New Zealand.

*Sertularia australis*, Kirehenpauer.

(Pl. XVII. figs. 4, 4 a.)

*Sertularia rufa*, D. W. T., MS.

*Trophosome.* Hydrorhiza filiform, creeping. Hydrocaulus attaining a height of about an inch, much twisted at the base. Pinnæ alternate. Hydrothecæ on the pinnæ opposite, in pairs, closely adnate, one or two pairs to each internode; on the stem subalternate, one in the axil of each pinna. Hydrothecæ tubular, a small part only divergent; smooth; orifice small, directed outwards, provided with two teeth. Colour reddish.

*Gonosome.* Gonangia attached to the main stem only; globular or ovate, smooth; margin everted; aperture operculate.

*Localities.* Sealer's Cove, Port Philip, Cape Lefébre (*Dr. Ferd. Müller*); George Town (*Dr. Harvey*).

This little species occurs, investing seaweeds, in some abundance, and with very numerous gonangia, from the above localities. I have now no doubt that my specimens correspond with Kirchenpauer's species (*S. australis*), founded on an example from Port Philip, though I at first separated them on account of one or two slight points of difference. In my specimens, for instance, the hydrothecæ are longer and more tubular, the gonothecæ seem a shade smaller and more globular, and the zoophyte is coarser and less graceful feathery. These variations are not, however, sufficient for the foundation of a new species.

The dried specimens are harsh and brittle to the touch; and the colour is a distinctive and characteristic reddish brown.

*Sertularia*, sp. (Pl. XVIII. figs. 1, 1 a, 1 b.)

*Trophosome*. Hydrocaulus attaining a height of about four inches. Pinnæ alternate. Hydrothecæ opposite, in pairs, on the pinnæ; closely approximated, tubular, rather long, diverging for about a third of their length; alternate, on the stem, one in the axil of each pinna; orifice small, with two teeth. Colour reddish brown.

*Gonosome*. Unknown.

*Locality*. Gulf of St. Vincent (*Dr. Ferd. Müller*).

I only possess a single small example of this species, unfortunately without gonangia; and I therefore hesitate, in the absence of fuller information, as to giving it a new specific name. It may possibly be referable to the genus *Diphasia*.

*Sertularia operculata* (?).

*Dynamena bispinosa*, Gray.

*Dynamena fasciculata*, Kirchenpauer, Nova Acta Acad. Leop. vol. xxxi. (1863).

*Sertularia bispinosa*, Hutton, Coughtrey, &c.

After a long and careful examination of a very large series of specimens, both of the Australasian variety and of the common British species, I am forced to the conclusion that, as yet, we have really no evidence to justify the separation of the two forms.

The present form, whether specifically distinct or not, has long been known from southern localities. Dr. Johnston examined specimens from the Cape of Good Hope which "differed in no respect from those of our shores." Prof. Busk, in describing the zoophytes of the 'Rattlesnake' expedition (Macgillivray's *Voy. of the 'Rattlesnake,'* vol. i. app.), says, "This species occurs in all parts of the world. It is to be carefully distinguished from *D. bispinosa*, Gray, also an Australian and New-Zealand species." But in a report on some specimens from South Africa (Brit. Assoc. Report, 1850, p. 118), he says "The *Sert. operculata* of S. Africa is undoubtedly the same species as the British, although from a rather general deviation from the more usual tothing of the margin of the cell, which obtains in specimens from the southern hemisphere, this variety has been denominated *S. bispinosa* by Mr. Gray." Mr. Hincks, also, seems to acquiesce in the above opinion.

On the other hand, Mr. Gray, as we have seen, unhesitatingly described his specimens as a new species under the name of *Dyn. bispinosa*, and is supported in his opinion by Captain Hutton and Dr. Coughtrey. Again, Dr. Kirchenpauer, overlooking Gray's paper, described the form, of which



he gives an admirable figure, under the new name of *Dyn. fasciculata*. He says (*loc. cit.*), "Die Zellen sind ungefähr so geformt, wie bei der bekannten *D. operculata*, nur sind die beiden Spitzen des Randes länger, schmaler, weiter von einander entfernt." This is, indeed, a very accurate statement of the differences between the hydrothecæ of the two varieties. As for the gonangia, they in general differ in no particular from those of the British form. Two slight protuberances or papillæ are occasionally visible on opposite sides of the orifice; but I have never seen them any thing like so large as they are represented in Dr. Coughtrey's figure (*Trans. N.Z. Inst. pl. xx. fig. 16*). I have no specimens exactly corresponding to *S. trispinosa*, Coughtrey; but I have little doubt that it is in reality a mere variety of the present species.

If this form be correctly assigned to *Sertularia operculata*, the range of that species will be indeed almost universal. Besides its occurrence in Natal and at the Cape of Good Hope, as already mentioned, Mr. Hineks records it from Patagonia, the Falkland Islands, the Auckland Islands, and Kerguelen's Land. It did not, however, occur in the collections brought home from the last-named locality by the Transit-of-Venus expedition (*Allman, Ann. & Mag. Nat. Hist., Feb. 1876*). I possess a specimen from the Strait of Magellan, collected by Dr. C. Forbes.

*Sertularia furcata*, a small species common on the Pacific coast of North America, is undistinguishable from the present one so far as the form of hydrothecæ and gonangia is concerned (*Trask, Proc. Calif. Acad. March 1857; Clark, Trans. Conn. Acad. vol. iii. p. 258*).

*Sertularia operculata* (?) is of very common occurrence in New Zealand and Australia. There are two very distinct varieties, as, indeed, is, I think, the case with our British specimens. The first is brown in colour, and forms dense short tufts, 2 or 3 inches in height. The second variety is of a yellowish hue, and occurs in long, trailing, dichotomously branching shoots, often 2 (according to Kirehenpauer 3 or 4) feet in height. This is not merely a difference of age.

β. Type form *S. abietina*, Linn.

*Sertularia elongata*, Lamouroux. (*Pl. XVIII. figs. 2-2 c.*)

*Sertularia millefolium* (?), Lamarck, *Hist. des Anim. sans Vert. vol. ii. p. 116*.

*Dynamene abietinoides*, Gray, *Dieff. N. Zealand, vol. ii. p. 294*.

*Sertularia abietinoides*, Hutton, *Trans. N.Z. Inst. vol. v. p. 256; Coughtrey, Trans. N.Z. Inst. vol. vii.*

*Trophosome*. Hydrorhiza forming a close, strong, fibrous

network. Hydrocaulus attaining a height of 4 or 5 inches, and giving off at close intervals alternate pinnae, which, towards the upper part of the hydrocaulus, are themselves pinnate. Joints, on stem, just below the points of origin of the pinnae; on pinnae, between each pair of hydrothecæ. Hydrothecæ in pairs, subalternate, tubular, smooth, diverging for about half their length; orifice furnished with six long pointed teeth.

*Gonosome.* Gonangia springing from a point just below the base of a hydrotheca, large, elongate, inversely conical, truncate, smooth, with two long teeth or spines on opposite sides of the orifice; aperture slightly marginate, minutely dentate.

*Localities.* George Town, Bass's Straits, &c. (*Dr. Harvey*); Cape Wilson, Port Philip, &c. (*Dr. Ferd. Müller*). [New Zealand (*Gray, Hutton, and Coughtry*).]

The figure of this species, though somewhat rough, and the description, though, as usual, short, which are given by Lamouroux in his 'Polypiers flexibles,' are amply sufficient to determine his specimens as coinciding with the *Sertularia abietinoides* of later authors.

One of the specimens sent home by Dr. Ferd. Müller is marked, in his handwriting, "*Sertularia pennigera*, Lamarck." I am unable to find any reference to such a species; but *S. millefolium*, Lamarck, appears to coincide very closely with the present form.

The species appears to be a very abundant one, and, at the same time, shows a very considerable tendency to variation.

In colour my specimens range from a dark brown or black to an indescribable greenish hue, which Lamouroux seems to have tried to render by "vert-rougeâtre foncé." The latter variety seems altogether more lax and delicate; the hydrothecæ are longer and more divergent, the pinnae longer, the whole hydrocaulus more graceful and feathery. The gonangia also, which in the ordinary form are restricted to the main stem, in this one occur also on the pinnae, though apparently never more than a single one to each.

This zoophyte forms dense and luxuriant masses, overgrowing shells, the stems of *Fuci*, &c. &c. The teeth upon the margins of the hydrothecæ are often so long and sharp that Lamouroux described them as cilia ("marginibus ciliatis"). As a general rule the two teeth on the side nearest the stem or pinna are separated by a wider interval than occurs between the rest.

*Sertularia pulchella*, sp. nov. (Pl. XVIII. figs. 3, 3 a.)

*Sertularia bicuspidata* (?), Lamarck, Hist. Nat. des Anim. sans Vert. vol. ii. p. 121.

*Trophosome.* Hydrorhiza consisting of a long slender fila-

ment, not anastomosing, creeping over seaweeds. Hydrocaulus attaining a height of about  $\frac{1}{2}$  inch, flexuous, giving off alternate pinnae at short intervals. Hydrothecae in pairs, opposite or subalternate, one pair to each internode on the pinnae. Joints on the main stem immediately below the points of origin of the pinnae. A hydrotheca in the axil of each pinna. Hydrothecae small, flask-shaped, divergent; aperture small, looking directly upwards, with two sharp teeth. Colour reddish brown.

*Gonosome.* Gonangia large, about five times as long as the hydrothecae, one to each hydrocaulus, arising from a point just below the base of a hydrotheca, very near the bottom of the main stem; smooth, obovate, truncate at the top, with two long spines on opposite sides of the orifice; margin everted; orifice destitute of teeth.

*Locality.* George Town (*Dr. Harvey*).

*Sertularia bicuspidata*, a species described by Lamarck (*loc. cit.*) from an unknown locality, seems to differ little from the present form, so far as can be judged from the short description given of it. Lamarck defines it as "*S. minima, ramosa, nodulifera; denticulis oppositis, acutis,*" and adds, "Les petits nœuds bien séparés, sont formés de deux cellules opposées, à pointes divergentes en dehors: longueur, douze millimètres." In the absence, however, of more complete information, I prefer to describe my species under a new name. The hydrothecae show a considerable resemblance to those of *S. filicula*; and I have therefore, for want of a better word, made use of the expression "flask-shaped," as employed in describing that species both by Dr. Johnston and Mr. Hineks. In my species the form of the hydrothecae reminds me a good deal of an ancient Roman or Etruscan lamp.

Though *S. pulchella* has no other special characters in common with *S. elongata*, the gonangia so closely resemble those of that species, that a single figure will serve for both. They are, however, a little smaller, and the eirelet of minute denticles is not present around the mouth.

*Sertularia insignis*, sp. nov. (Pl. XIX. figs. 1, 1 a.)

*Trophosome.* Hydrorhiza consisting of a few short fibres, neither branching nor anastomosing. Hydrocaulus attaining a height of 6 or 7 inches; pinnae opposite. Hydrothecae tubular, uncontracted, rather long; the orifice with about six small rounded teeth, those on the main stem divergent at right angles, *opposite*; those on the pinnae diverging slightly upwards, *alternate or subalternate*. Colour yellow.

*Gonosome.* Gonangia springing from the base of the pinnae,

close to the main stem ; oblong, much elongated, about eight times the length of the hydrothecæ, having two long divergent spines at the top ; orifice small, inconspicuous.

*Locality.* George Town (*Dr. Harvey*).

This singular and beautiful species is at once distinguished by the abnormal arrangement of the hydrothecæ, which marks it out as widely separated from every other species of Sertularian with which I am acquainted. The *Dynamene sertularioides* of Lamouroux (a species of which I can find no further mention in more recent authors) is defined by him as "*D. cellulis sæpe subalternis*;" but though somewhat approaching my species in this character, it differs from it entirely in many other points, *e. g.* in height, in colour, and in the absence of teeth on the margins of the hydrothecæ ("bord entier ; grandeur 2 à 3 centimètres ; couleur brune").

The long upright stems and short pinnæ, almost perpendicular to the main stem, give this species a handsome and conspicuous appearance.

#### THUIARIA, Allman.

##### *Thuiaria subarticulata*, Coughtrey.

*Thuiaria articulata*, Hutton, Trans. N.Z. Inst. vol. v. p. 258.

*Thuiaria bidens*, Allman, Journ. Linn. Soc. vol. xii. p. 269.

A few specimens of this species are contained in the collection. They agree admirably with Prof. Allman's excellent figure, and with the descriptions given both by him and Dr. Coughtrey. These descriptions differ in one single important point only : according to Dr. Coughtrey the pinnæ are subalternate ; according to Dr. Allman and Captain Hutton they are alternate. The latter is distinctly the case in my specimens. Dr. Coughtrey has precedence of Prof. Allman by only a few months in regard to the naming of this species.

##### *Thuiaria dolichocarpa*, Allman.

The present collection contains a single specimen only of this rare and handsome species, obtained by Dr. Jolliffe at Hokianga, New Zealand.

It differs in no particular, except in the slightly less conspicuous marginal teeth, from the only other known specimen, figured by Prof. Allman in the 'Journal' of the Linnean Society, vol. xii. p. 270.

My specimen was found in October 1851, probably in about 15 fathoms water.

*Thuiaria monilifera.*

*Sertularia monilifera*, Hutton, Trans. N.Z. Inst. vol. v. p. 256; Coughtrey, *ibid.* vol. vii. p. 282, &c.

*Thuiaria cerastium*, Allman, Journ. Linn. Soc. xii. p. 271.

The very excellent figures and description given by Prof. Allman leave no doubt whatever as to the identity of his species with *S. monilifera* of Captain Hutton and Dr. Coughtrey. The latter gentleman, in a paper communicated to the Ann. & Mag. Nat. Hist. (Jan. 1876), expressed considerable doubt as to the generic relations of this curious species, and appears to have become convinced that, to whatever genus it should be relegated, it could not be retained in *Sertularia*. According to Prof. Allman's definition of the genus, however, the present form is quite admissible as a species of *Thuiaria*.

My collection contains a single example from Hokianga, New Zealand, collected by Dr. Jolliffe, and differing from Allman's figure only with regard to the gonangia, which are considerably narrower and less tumid in my specimens. In this respect they approach very closely to Dr. Coughtrey's figure (*l. c.*). According to Captain Hutton's original description, the apertures of the hydrothecæ are entire or furnished with two obtuse teeth; these latter, which are only indistinctly visible in my specimen, have been overlooked by Dr. Allman.

*Thuiaria ambigua*, sp. nov. (Pl. XIX. figs. 2, 2 a.)

*Sertularia* — ?, Coughtrey, Ann. & Mag. Nat. Hist. Jan. 1876, p. 29, note.

*Trophosome*. Hydrotheca small, consisting of short twisted fibres. Hydrocaulus attaining a height of about 6 inches, dark brown in colour. Main stem very much stouter than the pinnæ. Pinnæ alternate or subalternate, short. A number of large branches arise in a cluster near the upper part of the stem. Hydrothecæ—on the pinnæ, opposite, in pairs, closely adnate, a joint between every three or four pairs; on the stem, in two rows, one going up each side, with very short interspaces; tubular, deeply immersed, smooth; orifice with two broad lateral teeth.

*Gonosome*. Gonangia attached to the main stem and principal branches, close to the origin of the pinnæ; large, obovate, smooth, margin slightly everted, operculate.

*Locality*. Sealer's Cove (Dr. Ferd. Müller).

I am not quite confident about the generic relations of this species; but I think that it will most naturally come under *Thuiaria* as newly defined by Prof. Allman (Journ. Linn. Soc. vol. xii. Zool.; see also 'Hydroids of the Gulf-Stream').

I have little doubt that it coincides with the form noticed (and partly figured) by Dr. Coughtrey from Bluff Harbour, New Zealand, though the pinnæ, according to his description, are jointed between each pair of hydrothecæ. My specimens show the singular and conspicuous joint, to which he also refers, by which the pinnæ arise from the main stem.

PERICLADIUM, Allman (modified).

*Trophosome.* Hydrothecæ more or less immersed, and closely set on all sides of stem and pinnæ.

*Gonosome.* Gonangia scattered, springing from between the hydrothecæ.

The above definition differs from that originally given by Prof. Allman in one point only, viz. in the omission of the clause relating to the general habit of the zoophyte. It stood as follows:—"Hydrothecæ more or less immersed, and closely set round *bifurcating ramuli*, which spring from the sides of a common stem." Although this was a marked and prominent feature of the species (a Japanese one) for which the genus was originally created, yet the arrangement of the hydrothecæ is a still more important point, and the species about to be described agrees so closely in this respect with the type form that it is impossible to place the two in different genera. Prof. Allman, to whom I referred the point, agrees entirely with me on this matter, and says that "in young specimens and portions situated near the base of old ones, the ramification may be simple and pinnate, assuming only in adult specimens the normal character."

*Pericladium novæ-zelandiæ*, sp. nov. (Pl. XIX. figs. 3, 3 a.)

*Trophosome.* Hydrocaulus attaining a height of about 8 inches. Main stem undivided, stout, cylindrical, and tapering from the base upwards. Pinnæ for the most part alternate and subalternate, absent for about 2 inches at the base. Hydrothecæ very closely set, shortly tubular, adherent almost their whole length; aperture wide, with about four small rounded teeth.

*Gonosome.* Unknown.

*Locality.* Pandora Bank, off Cape Maria Van Dieman, New Zealand, 15 fathoms (*Dr. Jolliffe*).

I am much pleased to be able to make known this new and singular species. The two specimens I possess are, unfortunately, far from perfect: the hydrorhiza is wanting; they are destitute of gonangia; and the hydrothecæ are a good deal shrivelled. They are covered in every part with diatoms,

showing obviously that they were dead specimens when first obtained.

The pinnæ are in no case bifurcate or branched in any way, but show traces of an approach to the whorled or spiral arrangement so characteristic of the other species.

The stem is seen upon section to be a simple hollow tube; and the pinnæ are united to it by distinct joints. With this exception the zoophyte is jointless.

#### EXPLANATION OF THE PLATES.

##### PLATE XVI.

- Fig. 1. *Sertularella neglecta*, sp. nov.  
 Fig. 2. *Sertularella* (?) *fruticosa*, Esper; 2 a, upper part of hydrocaulus of *S. fruticosa*, natural size.  
 Fig. 3. *Sertularella exigua*, sp. nov.  
 Fig. 4. *Sertularella*, sp.  
 Fig. 5. *Sertularella ramosa*; 5 a, the same, natural size.

##### PLATE XVII.

- Fig. 1. *Sertularia flexilis*, sp. nov.; 1 a, the same, natural size.  
 Fig. 2. *Sertularia flosculus*, sp. nov.; 2 a, the same, natural size.  
 Fig. 3. *Sertularia minima*, sp. nov., magnified one third more than the other species; 3 a, *S. pumila*, Linné, outline magnified to the same scale as the figure of *S. minima*; 3 b, *S. minima*, a colony, natural size, attached to a piece of seaweed.  
 Fig. 4. *Sertularia australis*, Kirchenpauer; 4 a, the same, natural size.

##### PLATE XVIII.

- Fig. 1. *Sertularia*, sp.; 1 a, the same, side view of the hydrothecæ; 1 b, the same, natural size.  
 Fig. 2. *Sertularia elongata*, Lamouroux; 2 a, the gonangium, magnified to half the scale of fig. 2; 2 b, the same, natural size; 2 c, *S. elongata*, var., natural size.  
 Fig. 3. *Sertularia pulchella*, sp. nov.; 3 a, the same, natural size.

##### PLATE XIX.

- Fig. 1. *Sertularia insignis*, sp. nov.; 1 a, the gonangium.  
 Fig. 2. *Thuiaria ambigua*, sp. nov.; 2 a, the same, natural size.  
 Fig. 3. *Pericladium novæ-zelandiæ*, sp. nov.; 3 a, the same, natural size.

#### NOTE.

The above was written and had left my hands prior to the publication of M. Mereschkowsky's paper in the 'Annals' for December 1878. According to the method followed in that paper, and originally suggested by the Rev. A. M. Norman, my *Pericladium novæ-zelandiæ* should be referred to the genus *Selaginopsis*, of which it would then constitute the only example yet recorded from the southern hemisphere.

The hydrothecæ on the axial stem occur in nine or ten longitu-  
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dinal series: upon the pinnæ they are absent for a very short distance at the base; then a single one appears first upon the lower aspect of the branch; and the series thence ascends in a close spiral. Afterwards the spiral arrangement becomes lost or obscured, and we see simply the longitudinal rows, which on the pinnæ seem not to exceed the number of five or six. But, as M. Mereschowsky has observed in the case of *S. decemserialis*, this limit is not to be considered absolutely constant; for since the fundamental arrangement is a close spire, the apparent number of rows of hydrothecæ will always depend upon the thickness of the pinna they surround.

The present species seems to be most nearly related to *S. mirabilis*, Verrill, from which, however, it differs markedly in the numerous rows of hydrothecæ on the main stem, these being reduced to two in the allied species.

However similar all the species which have been ascribed to *Selaginopsis* are as regards the form and general arrangement of the hydrothecæ, I am yet doubtful whether a generic separation might not still be made with advantage between those forms which are simply pinnate and those whose branches lie in all planes or are disposed in a more or less irregular manner.

XI.—On the Bryozoa (*Polyzoa*) of the Bay of Naples.

By ARTHUR WM. WATERS, F.G.S.

[Plates XII.—XV.]

[Continued from p. 43.]

THE same plan will be followed in this as in the previous part, of only giving the synonyms where there is any special reason for doing so; but for the long list of synonyms which most species possess the reader is referred to the works of Smitt and Busk.

CHEILOSTOMATA (*continued*).

34. *Aetea anguina*, L., forma *recta*.  
(Pl. XV. fig. 7.)

*Aetea recta*, Hincks, Cat. of Zooph., Ann. & Mag. Nat. Hist. 3rd ser. vol. ix. p. 25, pl. vii. fig. 3.

*Aetea anguina*, forma *recta*, Smitt, Krit. Fört. 1867, p. 281, pl. xvi. figs. 5, 6.

? *Aetea ligulata*, Busk, Cat. Mar. Polyz. p. 31, pl. xlii.

The difficulty is very great as to the position of *Aetea*, as it has relationships with the Cheilostomata and also with the Ctenostomata (in having a collar as seen in the Naples specimens, and which Smitt pointed out in 1867); and whether it will have to be placed in a new suborder (*Stolonata*, Claus,



or Stolonifera, Ehlers\*) is yet problematic, and its usual position is retained.

Mr. Busk † says (p. 125), "the polype, as far as I have observed, is always lodged in the upright portion of the cell." This certainly is not the case in this species; for the polypide is sometimes entirely in the lower part, though more often projecting slightly into the raised tube, as seen in the right-hand cell of the figure. This necessitates a change in the generic characters; and the erect tubular portion must be regarded as a prolongation of the horizontal zoëcium.

The zoëcia bud from the end and from the sides, starting from a round disk or rosette-plate; and from similar plates on the side grow tubes bearing round or elongate cells which do not develop into zoëcia; but as their mode of growth is so similar, perhaps they are abortive zoëcia. Hincks mentions spur-like processes which start from the back of the cell of *A. truncata*; but from his description these are radicles. May the spinous processes of his *Farrella dilatata* be at all the same as the present?

The length of the erect prolongation of the zoëcia (formerly the cell) is very variable, but, as a rule, is considerable; and the creeping tubes connecting the zoëcia are also very variable—sometimes appearing like a thread for four or five times the length of the ventricose expansion, while in other cases the zoëcium expands close to the rosette-plate of the parent zoëcium.

When dry the tubes contract in the middle as in *A. ligulata* (which in the British-Museum Catalogue is evidently drawn from a dried specimen), and have just the same appearance, with the exception of the lower part being ringed; but this is not always easily made out in dry specimens from Naples, as it is not so marked as in the ordinary *anguina*. I noticed in the British-Museum collection that the Aeteidæ dissolved the shells on which they grew, and thus a permanent record is left. It is known that several Bryozoa have this power; and the idea suggests itself that some of the phenomena mentioned by Fischer ‡ are of this kind, and it may not be useless to point out that in many cases it is impossible to distinguish fossil *Aetea* from *Hippothoa*.

The *Stomatopora gallica*, D'Orb., is *Aetea*; but the other species of the genus probably belong to *Alecto* and *Hippothoa*.

\* "*Hypophorella expansa*. Ein Beitr. zur Kenntn. der minirenden Bryozoen, von E. Ehlers," Kön. Gesellsch. d. Wissensch. Göttingen, 1867.

† "Observations on the *Anguinaria spathulata*," Trans. Micr. Soc. p. 123, vol. ii. (1849).

‡ "Études sur les Bry. perforants de la fam. des Térébriporides," Nouv. Arch. du Mus. d'Hist. Nat. Paris, t. ii. 1866; and Quart. Journ. Micr. Sc. vol. viii. p. 279.

35. *Eucratea Lafontii*, Aud.

*Eucratea Lafontii*, Aud. in Savigny, Egypte, pl. xiii. fig. 2.

*Alysidium Lafontii*, Busk, Mar. Polyz. p. 14, pl. xiv. figs. 1-4.

As *Eucratea chelata* and *E. Cordieri* have so close a resemblance, I cannot bring my mind to place them in two genera merely because the latter has a horny connexion. The *Alysidium parasiticum*, Busk, being also closely allied to *E. Cordieri*, Aud., the genus *Alysidium* seems a superfluity, and the definition of *Eucratea* should be changed to admit *Alysidium*.

*Hab.* Spain, Adriatic, 25-55 fathoms; Naples on seaweed from but slight depths.

36. *Eucratea Cordieri*, Aud. (Pl. XV. figs. 9, 10, 11.)

*Eucratea Cordieri*, Aud. in Savigny, Egypte, p. 74, pl. 13. fig. 3.

Several branches of cells curving inwards, growing on a jointed stalk, rising from creeping anastomosing stolons; zoecia nearly straight in front, curved behind, narrowing to the proximal end; zoecia growing from the end of the cell, connected by short corneous tubes. Zoecium in front coffin-shaped with an opening below the oral aperture.

This is clearly the form figured by Savigny, and differs from *Eucratea chelata* in having no raised border, which is very apparent in the British species, as far as my opportunities of examination extend. This, however, seems to be somewhat variable, as Prof. Smitt says this border seems to be more common in his southern stations, and in his northern ones is not so distinct as in the English figures. It also differs from *E. chelata* in not having rigid junctions; and according to Mr. Busk's definition of *Scruparia*, should not be considered of this genus; but with the mode of growth and the shape of the cells so similar, it would hardly be justifiable to make two genera out of them at present. This, however, would unite *Alysidium parasiticum*, Busk, under the same genus; and in many points it has much in common with the present form.

From one piece of seaweed there are about fifteen colonies, all connected together by one creeping and anastomosing root. The stem rises up from this radicle, from a round disk which corresponds with the rosette-plates. This stalk consists of 6-10 joints (figs. 9, 10) with, usually, long calcareous tubes and short horny tubes, though occasionally the corneous tube is about as long as the calcareous one. At the top of the stem the joint bifurcates; and from these and other bifurcations branches are given off with about 6-8 zoecia, curling over and mostly opening in the same direction. The figure 9 only

shows a small specimen, and in larger ones there are about three times as many branches as are shown.

The zoecium when seen from the front is coffin-shaped, with the aperture at the top and a nearly circular opening below it (as in *Lepralia violacea*). The operculum is semicircular, with a straight proximal end and large muscular projections on each side. The tube from each cell emerges from a small chamber (see fig. 11) at the top of the cell; and in the lower wall of this chamber is apparently one rosette-plate.

*Hab.* Red Sea and Mediterranean (*Aud.*).

I did not find *Eucratea chelata* at Naples; but it is reported to have been found in the Mediterranean. *Eucratea* has been described fossil as *Unicrisia (tenerrima &c., in the Eocene)*; but a small-jointed species like the present would probably be overlooked even if it occurs.

### 37. *Cellularia reptans*, L.

*Canda reptans*, Busk, Mar. Polyz. p. 26, pl. xxi. figs. 3, 4.

Seas of Europe from Norway to Mediterranean.

### 38. *Cellularia scruposa*, L.

*Scrupocellaria scruposa*, Busk, Mar. Polyz. p. 25, pl. xxii. figs. 3, 4.

*Hab.* Brit., Medit., France (*J.*), Scandinavia (*Sm.*), Adriatic, Iceland, St.-Lawrence Bay (*Kirchenpauer*); common at Naples from all depths.

### 39. *Cellularia scrupea*.

*Scrupocellaria scrupea*, Busk, Mar. Polyz. p. 24, pl. xxi. figs. 1, 2.

### 40. *Beania mirabilis*, Johnst.

*Hab.* Britain, France (zone litt. et prof., *J.*), Ireland (*H.*), Adriatic (*H.*), Scandinavia (*Sm.*); Naples 8-12 fathoms and 30 fathoms, rare.

### 41. *Bugula avicularia*, Pall., forma *flabellata*, Thomps.

The ovicell has not so wide an opening as in the specimen figured by Busk.

*Hab.* Scandinavia (*Sm.*), seas of Europe; Naples, not rare in moderate depths.

### 42. *Bugula avicularia*, L.

*Bugula avicularia*, forma *avicularia*, Smitt, Kr. Fört. Sk. II.-Bry. 1867, p. 289, pl. xviii. figs. 9-18.

At the back, just above the light cuneiform area, is a beading of about ten circles on each side; each shows a light

spot in the centre. May these perform the same functions as the pore-tubes or the rosette-plates?

*Hab.* Scandinavia, Finland, and Spitzbergen, and all seas of Europe.

43. *Bugula fastigiata*, L.

*Bugula plumosa*, Pall., B.M. Cat. p. 45, pl. liv.

*Bugula avicularia*, forma *fastigiata*, Smitt, Krit. Fört. Skand. H.-Bry. 1867, p. 291, pl. xviii. figs. 16-18.

44. *Cellaria fistulosa*, L.

*Salicornaria farcinoides*, Ell. & Sol., Busk, Mar. Polyz. p. 16, pl. lxiv. figs. 1, 2, 3, pl. lxv. bis. fig. 5.

*Cellaria fistulosa*, L., Smitt, Krit. Fört. ö. Sk. Hafs-Bry. 1867, p. 362, pl. xx. figs. 18-20.

For synonyms see Smitt and Reuss.

Found in the Scandinavian seas and generally in Europe; also Algoa Bay; and in Europe has been found in the Eocene, Miocene, and Pliocene. In Naples at all depths greater than 10 fathoms.

45. *Tubucellaria cereoides*, Ell. & Sol.

*Cellaria Michelinii*, Reuss, Foss. Pol. d. W. Tert. p. 61, pl. viii. figs. 1, 2.

*Onchophora tubulosa*, Busk, Quart. Journ. Micr. Sci. 1855, vol. iii. p. 320, pl. iv. fig. 1.

For a list of synonyms see Reuss, Foss. Bryoz. des Oest.-Ung. Miocäns, p. 6; and see pl. xi. figs. 11-15, pl. xii. figs. 1, 2.

The genus under its different synonyms has been sometimes described as having only one corneous tube to each new branch, which is not the case; for sometimes several tubes grow out of the aperture of neighbouring cells, and from these are produced the basal cells of a new branch.

The operculum (36\* & 37\*) in this species is very characteristic. It is suboval with a slightly flattened proximal end; near the sides are the museular processes; the centre is lighter on account of there being a double chitinous layer over all but the centre; width 0.13 millim., length 0.06. The operculum is situated at the bottom of the tubular peristome.

In the apex of the subtriangular distal wall there is one rosette-plate near the centre of the zoarium. In the lateral walls there are four, two near the middle of the zoarium and two above, further removed. It is not without interest to find that in a closely allied species, *T. hirsuta* (*Onchophora hirsuta*, Busk, = *Margaretta barbata*, Hutton), there is a slight difference in both operculum and rosette-plates, by which they may be distinguished.

*Loc.* Eocene: Grignon, Parnes (*Mich.*). Oligocene: Latdorf and Val di Lonte. Miocene: many localities in Austria and Hungary. Pliocene: Asti, Pisa, Castellarquato, Rhodes. Living: Adriatic (*H.*), Ægean (*B.*), Indian Ocean (*Reuss*). There is a specimen in the British Museum from Dr. Bowerbank's collection from Australia, in which I do not see any difference from the Naples specimen; but I should not like to speak positively unless I have the opportunity of detail-examination. Naples, 40-50 fathoms.

#### 46. *Flustra truncata*, Linn.

*Eschara securifrons*, Pall. Elench. Zooph. p. 56.

*Flustra securifrons*, Smitt, Krit. Fört. ö. Sk. Hafs-Bry. 1867, pt. iii. p. 358, pl. xx. figs. 6-8.

*Flustra truncata*, Busk, Cat. Mar. Polyz. p. 48, pl. lviii. figs. 1, 2, and pl. lvi. figs. 1, 2.

Although no spines are apparent when a colony is examined, thin transverse sections show two microscopical spines near the oral aperture.

This, like *Flustra papyrea*, is found occasionally on the back of *Pisa armata*, and also in dredging from 40 fathoms in the Secca. Occasionally the avicularia are placed diagonally.

Rosette-plates, four distal and eight lateral.

*Hab.* Spitzbergen, Scandinavia (all depths), Britain, Atlantic, Adriatic (*Heller*), Australia (*Busk*).

#### 47. *Flustra papyrea*, Pall.

*Carbasa papyrea*, Busk, Cat. Mar. Polyz. p. 50, pl. xlix. figs. 1-3 (?).

*Flustra papyrea*, Smitt, Kr. Fört. ö. Sk. Hafs-Bry. pt. iii. 1867, p. 359, pl. xx. figs. 9-11.

Plates 49 and 50 of Mr. Busk's catalogue have evidently been changed, requiring renumbering of the plates or alteration of the text.

This is very common upon a crab (*Pisa armata*), which usually carries a small colony of this *Flustra* on its back. I do not remember seeing any at Naples except from this crab.

There is one distal and usually two lateral rosette-plates\*.

*Hab.* Arctic seas at various depths (*Sm.*), Britain, Adriatic (*Heller*).

Although specially on the look-out for *Flustra foliacea*, I was surprised not to find any.

\* In *Flustra armata*, pl. 50. fig. 4, of Brit. Mus. Cat., the rosette-plates are shown but are not mentioned.

48. *Diachoris patellaria*, Moll. (Pl. X. figs. 6, 7, 8, 9.)

*Eschara patellaria*, Moll, Die Seerinde, p. 75, pl. iv. fig. 20.

*Diachoris simplex*, Heller, Bry. Adr. Meeres, p. 94, pl. i. fig. 4.

*Mollia patellaria*, Smitt, Floridan Bry. p. 12, pl. ii. fig. 72.

The ovicells are situated on the distal end of the zoœcia, and are sometimes seen to coalesce with the cell above. The smaller openings (fig. 6), I presume, show an incompleated stage of growth; but if this is the explanation it would seem as if the growth of the ovicells influenced the growth of neighbouring cells, as in my specimen some of the cells near the ovicells have only this small subcentral opening, while all the neighbouring cells have the usual aperture.

The lower two thirds of the front is covered with a granulated calcareous wall, the rest is covered with a thin membrane; the small lid of the oral aperture is near the distal end; border much raised and granulated.

The attachment of this species is very strange, as from the base (figs. 8, 9) there are thrown out a number of radiular fibres, by which the colony is fastened to stones, sponges, &c.

49. *Diachoris patellaria*, Moll, var. *multijuncta*.

(Pl. XIII. fig. 4.)

?*Eschara depressa*, Moll, Die Seerinde, p. 76, fig. 21.

This differs from *D. patellaria* in having from eight to twelve or more tubular processes, and in the cells being longer and somewhat irregular in shape. The length of the tubular processes is also very variable; and the cells, in consequence of shorter tubes, are often close together. In such cases I am unable to see wherein it differs from *Membranipora circumcincta* of Heller (Bry. des Adriat. Meeres, p. 96, pl. vi. fig. 5). Professor Heller, to whom I sent this drawing, does not, however, think it is the same; so I suppose there must be some difference.

The definition of *Diachoris* would require altering to admit this form; but the variations indicate that the tubular processes are not safe generic guides; and this we see in *Lepralia Brongniartii* with short tubes, *L. discreta* with longer ones, and a form much like *discreta*, if not the same, which Hutton has called *Diachoris Buskiana*. The genus *Diachoris* can only be looked upon as a provisional one, without any scientific basis as at present constituted.

50. *Diachoris magellanica*, Busk. (Pl. XII. fig. 1.)

*Diachoris magellanica*, Busk, Mar. Poly. p. 54, pl. lxvii. figs. 1, 2, 3.

*Diachoris Buskei*, Heller, Die Bry. des Adriat. p. 93.

The figure given by Busk is evidently from a dried speci-

men, and does not give all the characters quite correctly. The mouth is not circular, and has no thickened and raised margin, though when the zoecial case dries and contracts in the centre it gives this appearance to the aperture. The distal edge is rounded, the proximal nearly straight. Just above the aperture are from two to four small projections on the zoecium; the tubular processes have a septum in the middle. From the back of each cell grows a long radicular tube (*h*); and in my specimens, which were attached to sponge, there was a "grappling-hook" (*p*) at the end. The position of these roots is shown in Busk's figure 2 by the circles, which he does not mention.

In the small piece drawn there are two avicularia to each of the centre cells, while the others have one on the right and left respectively. In larger pieces there are several lines of double avicularia; but this is subject to some variation.

The piece drawn shows the life-history of the Bryozoa in a very complete manner; and as the walls are transparent, it is a very good species for examination. First at *k* are the processes, which gradually increase and coalesce as at *m* and *l*; this grows until an enclosed zoecium as at *a* is the result, when the polypide begins to bud inside *a*. This grows through *b*, *c*, *d* stages, until at *e* the polypide is perfect; at *c* and *d* the oral opening of the zoecium is formed. At *f* there is a polypide budding in an older zoecium; but at *g* in the same cell is seen a "dark body," which is really the remains of a previous polypide; for after a time each polypide loses vitality and gradually becomes reduced to this "dark body," when another polypide buds from the side.

*Loc.* Living: Straits of Magellan, New Zealand (*Busk*), Adriatic (*Heller*); Naples, 30-50 fathoms.

#### 51. *Membranipora pilosa*, Pall.

European seas generally, common. From Australia I have this, if *M. verticillata*, Lamx., is to be considered synonymous.

#### 52. *Membranipora membranacea*, L.

European seas.

#### 53. *Membranipora Rosselii*, Aud.

The calcareous perforated expansion is somewhat smaller than figured by Busk; and if Manzoni's specimen (Bry. Foss. Ital. 4<sup>a</sup> contr. pl. iii. fig. 15) is really *Rosselii*, it would seem to be very variable, as the open space there is but little larger

than the oral aperture. The zoarium is attached to stones &c. by two to four radicular projections.

One rosette-plate in the middle of the distal wall.

Pliocene: Castrocaro, Castellarquato, Pisa. Pleistocene: Leghorn. Living: Britain, Orkney, Gibraltar, Adriatic (20-55 fathoms); and there is a specimen in the British Museum from Tsos-Sima. At Naples I received it from apparently about 40-50 fathoms.

54. *Membranipora Flemingii*, Busk. (Pl. XIII. fig. 2.)

In the Naples specimens the rather large avicularia are by the side of the globular ovicells. The borders of the cells are usually rather closer together than shown in the figure.

Lateral rosette-plates three, elongate, about equal distance from the base and the front wall.

Loc. Pliocene: Castrocaro (*M.*). Living: European seas, Australia? (*Busk*), Adriatic (*Heller*). At Naples, from just below low-water mark to 40 fathoms; Roscoff (*J.*).

55. *Membranipora Flemingii*, Busk, var. *gregaria*.  
(Pl. XIII. fig. 5.)

*Membranipora gregaria*, Heller, Die Bry. des Adriat. Meeres, p. 98, pl. i. fig. 8.

*Membranipora aperta*, Manzoni, Bri. del Pl. di Castrocaro, p. 9, pl. i. fig. 4.

The walls are much thinner and placed nearer together than is shown in my drawing.

*Membranipora Flemingii* is a most variable species; and there does not, to my mind, seem sufficient reason for separating this form, though, as the position of the large avicularium in front of each cell is characteristic, it may be considered a variety. *Membranipora aperta*, in 'Crag Polyzoa,' may be this variety, as well as the one figured by Manzoni.

This only differs from *Membranipora arctica*, D'Orb. in Smitt, in the shape of the avicularian mandible.

56. *Membranipora angulosa*, Rss. (Pl. XIII. fig. 3.)

For synonyms see Reuss, Die Foss. Bry. des Oest.-Ung. Mioc. p. 45, pl. x. figs. 13, 14.

?*Membranipora antiqua*, Busk, Quart. Journ. Micr. Sci. vol. vi. p. 262, pl. xx. fig. 1.

?*Mollia antiqua*, Smitt, Floridan Bryozoa, pt. ii. p. 12, pl. ii. fig. 73.

*Membranipora angulosa*, Manzoni, Bri. di Castrocaro, p. 8, pl. i. fig. 11, and other papers.

*Eschara excavata*, Reuss, Foss. Pol. W. B. p. 72, pl. viii. fig. 36.

The surface of the cell is very minutely granulated. The shape of the area varies from oval to triangular. The raised



borders of the cell do not always meet, in which case the cells are irregularly oval. The shape of the cells is just the same as in some Eocene specimens in my possession; but, it will be seen, the shape is somewhat variable. The large opening is not the oral aperture, but is covered with a membrane on which is the oral lid, as seen in the right-hand bottom cells. This operculum or lid has a tooth or projection on each side, to which is probably attached the muscle. This is shown in the two right-hand cells. As neither Busk nor Smitt have given particulars of the oral aperture of *M. antiqua*, it makes it somewhat difficult to be sure if Manzoni is correct in giving this as a synonym. The trifoliate shape of the opening of the calcareous area would be produced by a widening of the basal portion.

Abundant in the Eocene, Miocene, and Pliocene from many localities in Austria, Hungary, and Italy, Rhodes (*Manz.*).

Living: Florida, 29–44 fathoms; Madeira; Naples about 30–40 fathoms.

*Hemeschara trapezoidea*, Reuss, Bry. v. Crosaro, pl. xxix. fig. 14, is the *Hemeschara* stadium of this; and the shape of the open area more nearly corresponds with that of the Floridan and Madeira specimens. Reuss has omitted the description of this; but from the Miocene of San Martino he speaks of an "ästige *Biflustra*-ähnliche Form."

#### 57. *Micropora impressa*, Moll.

*Eschara impressa*, Moll, Die Seerinde, p. 57, pl. ii. fig. 9, A–I.

? *Cellepora gracilis*, v. Münster in Goldf. Petr. Germ. p. 102, pl. xxxvi. fig. 13.

*Cellepora gracilis*, Reuss, Foss. Polyp. W. B. p. 93, pl. xi. fig. 12.

? *Cellepora minuta*, Reuss, *loc. cit.* p. 93, pl. xi. fig. 13.

*Eschara andegavensis*, Mich. Icon. Zooph. p. 329, pl. lxxviii. fig. 11.

? *Eschara nobilis*, id. *loc. cit.* p. 329, pl. lxxix. fig. 1.

*Membranipora andegavensis*, Busk, Crag Polyz. p. 35, pl. ii. fig. 5.

*Membranipora calpensis*, Busk, Mar. Polyz. p. 60, pl. civ. figs. 5, 6.

*Membranipora bifoliata*, Heller, Die Bry. Adr. Meeres, p. 95, pl. 2. fig. 1.

*Membranipora andegavensis*, Manz. Bry. Foss. Ital. cont. 2, p. 2, pl. i. fig. 2.

*Membranipora calpensis*, Manz. Supp. alla Fauna Medit. p. 3, figs. 2, 3.

*Membranipora gracilis*, Reuss, Foss. Bry. Oest.-Ung. Mioc. p. 44, pl. x. figs. 5–7.

The special character of *Membranipora* appears to be a lid opening out of the membrane covering the aperture; but this is not the case in the present species, in which the oral aperture is surrounded by a calcareous margin, and the operculum is separable and distinct: it therefore ought to be separated from *Membranipora*.

There would seem no doubt that this is the species described by Moll. Manzoni's figure, in his *Suppl. Fauna Medit.*, shows the Naples form the best, though in my specimen the border is wider and appears formed of double granulations. There is no explanation of fig. 6 in Busk's *Cat.*, and it is therefore difficult to know what it represents; and the comparison with *Flustra Latreillii*, in the same work, must surely be a mistake. *Eschara elegans*, M.-Edw. ('*Eschares fossiles*,' p. 337, pl. xii. fig. 13), looks like the *Eschara stadium* of this species.

Two rosette-plates in the distal wall near the centre. Both these and the lateral plates have an elongated form.

Operculum: little more than half a circle, proximal edge nearly straight, width 0.12 millim., length 0.92.

*Loc.* Upper Oligocene: Astrupp, Miocenc: several places in Austria and Hungary, Doué, Thorigné. Pliocene: Castellarquato, Palermo, Rhodes. Living: Gibraltar (?), Adriatic, 20-55 fathoms (*Heller*); Naples, several layers, incrusting, 20-50 fathoms.

#### 58. *Eschara cervicornis*, Pall.

*Eschara undulata*, Rss. Foss. Polyp. der W. Tert. p. 68, pl. viii. fig. 24.

This is the species of Milne-Edwards and Busk, and is very abundant at Naples from about 30 fathoms downwards.

The operculum is saddle-shaped, widening out very much at the proximal end; long muscular boss close to the edge; proximal end 0.18 millim. wide, 0.13 long, bosses about 0.08 long.

Three distal rosette-plates divided by two raised ridges.

Pliocene: Sicily, Calabria, Belgium (*H. de Lehaie*), Rhodes (*Manz.*). Living: Britain (?), Adriatic (*H.*), France.

#### 59. *Eschara foliacea*, Ellis. (Pl. XV. fig. 8.)

*Eschara fascialis*, Pall. Elench. p. 42.

*Eschara fascialis*, Moll, Die Seerinde, p. 36, pl. i. figs. 1, 2.

*Eschara foliacea*, Milne-Edwards, Sur les Eschares, p. 39, pl. iii. fig. 1, Ann. des Sc. Nat. sér. 2, vol. vi. 1836.

*Eschara bidentata*, M.-Edw. *loc. cit.* p. 42, pl. iii. figs. 2, 2 a.

*Eschara fascialis*, M.-Edw. *loc. cit.* p. 43, pl. iv. fig. 1.

*Eschura foliacea*, Heller, Bry. Adr. Meeres, p. 114.

*Eschara fascialis*, id. *loc. cit.* p. 114.

*Eschara foliacea*, Manzoni, Bry. Foss. Ital. cont. 4, p. 18, pl. i. fig. 4, pl. iv. fig. 24; and Brioz. di Castrocaro, p. 36.

This occurs elsewhere in both broad and narrow foliations; and these have been separated by some authors into *E. foliacea* and *fascialis*, and by Moll were called variety *latifolia* and var. *angustifolia*; and in case of the shape requiring to be indicated

this latter distinction might be used. The shape of the cells and the aperture, however, seems in both to be the same.

There also does not appear to be sufficient reason for separating *bidentata*, as the raised projection at the side of the mouth is very variable and depends to a great extent upon the age. In the younger cells it is much more apparent, while in the older cells, where the aperture is more surrounded by a subsequent growth, it is scarcely seen. The specimen figured would be *bidentata* of M.-Edw., stadium *angustifolia*, Moll; but as this is only a variable difference in the peristome, and not in the oral aperture, there does not seem valid reason for making it even a variety.

I have before (p. 33) called attention to the long spatulate avicularia which are often seen in this species; and the different stages, from the very small avicularium with the small mandible placed at right angles to the axis of the zoecium, to the large spatulate horizontal avicularium, can be seen in the same piece.

The operculum is somewhat saddle-shaped, about 0.12 millim. wide and about 0.16 millim. long, with large muscular bosses at the side.

Four lateral rosette-plates and two distal, divided by a large ridge running up between them; they are situated at the base of the lateral wall.

*Loc.* Pliocene: Castrocaro, Leghorn, Sicily, Rhodes. Living: Britain, France (zone prof.), Adriatic; Naples, 30-40 fathoms.

I have two specimens in which, at the end, the two layers separate and end in a funnel-shaped expansion. This is interesting as showing a connexion between the *Hemeschara* and *Eschara* stadia.

60. *Eschara verrucosa*, Peach. (Pl. XII. figs. 2, 3, 4.)

*Eschara verrucosa*, Peach, On a new British *Eschara*, Royal Inst. of Cornwall, vol. iii. 1868, p. 116, and vol. iv. pl. with p. 88.

*Eschara lunaris*, Waters, Bry. from the Plioc. of Bruccoli, Tr. Manch. Geol. Soc. vol. xiv. 1878, p. 475, fig. 9.

Stem cylindrical, dividing dichotomously, six cells in a row; cells at the growing extremity ovate, near the base hexagonal; mouth orbicular, young cells projecting, old cells deeply immersed, four oral spines on the upper margin of the aperture; proximal edge of operculum straight, distal edge horseshoe-shaped; border of the oral aperture sometimes raised in young cells; semilunar pore below the mouth; avicularium on one side of the cell, with extremely long mandible, surface coarsely

punctured; ovicells (see fig. 9, *loc. cit.*) globose, finely punctured.

I am indebted to Dr. Hincks for pointing out that the specimens collected by me are the same as a fragment which Mr. Peach collected and described from Fowey (Cornwall); and although he does not mention any semilunar pore, and describes and figures a vibraculum, I think there cannot be much doubt that they are the same.

The zoecium of this is very much the same as that of *Lepralia ciliata*; and Smitt mentions (p. 62, Krit. Fört. 1867, Bih.) "en *Eschara*-växt" of his *Porellina ciliata*, which is evidently this species, as the peculiar shape of the aperture is mentioned.

The growing extremities (fig. 4) are different from any of the other *Escharæ* examined by the author. The ends of the last-formed row of zoecia have a double slope, like the roof of a house, with a raised, rounded, slightly overlapping ridge at the top. On each side of this are usually five tubular holes, and one or two lower down on the side. At the bottom of these tubes is a membrane which has one, two, or even more minute perforations. Fig. *a* is the ridge of the roof and rosette-pores, magnified eighty-five times.

These are the equivalents of the rosette-plates in Lepralioid forms; and as the growth of the next series takes place from these, their position should be considered in assigning a systematic place to this species. Peach doubts if it should be ranked as an *Eschara*; but of its systematic position I should not attempt to form an opinion until I had examined in detail the numerous cylindrical *Eschara*-like fossils.

In transparent sections the cells are often found not to quite join in the centre. In the old cells the semilunar pore often appears circular; but upon examination this is found to arise from it being now, in consequence of the growth of the surrounding walls, a long tubular opening; at the bottom of this tube, however, is seen the original semilunar opening. The avicularia are sometimes bifid at the end; but perhaps this may be a stage of growth.

Operculum (28\*) horseshoe-shaped; proximal edge straight, 0·08 millim., widest part 0·17, length 0·1.

*Loc.* Pliocene: Rametta, Brucoli (Sicily), Parere (Calabria). *Eschara columnaris*, Manz., from Castrocaro, looks much like a fragment from near the base. Living: Naples, 40 fathoms, from the Secca. There is a worn fragment in the British Museum, collected from the coast of Norway by R. M'Andrew, which looks like it; but without sections determination is impossible.

[To be continued.]

XII.—*Hemiptera from the North-eastern Frontier of India.* By W. L. DISTANT.

[Continued from p. 53.]

THE following paper continues and concludes the enumeration and description of the Hemiptera collected by Mr. A. W. Chennell. As regards the geographical distribution of the species contained in this portion of the collection, some few are Philippine forms, but many more are also common to China. This may serve as an introduction to the Heteropterous fauna of the region, but cannot in any sense be considered exhaustive. The Capsidæ are totally unrepresented; and many species in other families, from Assam, have been described and received which were not taken by Mr. Chennell.

## Fam. MICTIDÆ.

- Dalader acuticosta, *A. & S.*  
 — planiventris, *Hope.*  
 Derepteryx Hardwickii, *White.*  
 Helcomeria spinosa, *Sign.*  
 Prionolomia gigas, n. sp.  
 — fulvicornis, *Fab.*  
 — biplagiata, *Walk.*  
 Mictis tenebrosa, *Fab.*  
 — nigrorufa, *Walk.*  
 — pictor, *Fab.*  
 Anoplocnemis phasianus, *Fab.*  
 — compressa, *Dall.*  
 Petillia grossa, *Dall.*  
 Physomerus calcar, *Fab.*  
 Notobitus excellens, n. sp.  
 — meleagris, *Fab.*  
 — marginalis, *Hope.*  
 — serripes, *Dall.*  
 Cloresmus nepalensis, *Hope.*  
 — brevicornis, *H.-S.*

## Fam. HOMŒOCERIDÆ.

- Homœocerus biguttatus, *Hope.*  
 — unipunctatus, *Thunb.*  
 — sp.  
 — fascifer, *Stål*, var. *Walk.*

## Fam. ANISOSCELIDÆ.

- Leptoglossus membranaceus, *Fab.*  
 Lybas obscurus, *Dall.*

## Fam. ALYDIDÆ.

- Riptortus pedestris, *Fab.*

## Fam. STENOCEPHALIDÆ.

- Leptocoris varicornis, *Fab.*

## Fam. COREIDÆ.

- Cletus calumniator, *Fab.*  
 — punctulatus, *Hope.*  
 Cletomorpha denticulata, *Stål*,  
 var.  
 Acanthocoris scabrator, *Fab.*  
 Petalocnemis obscura, *Dall.*

## Fam. LYGÆIDÆ.

- Lygæus familiaris, *Fab.*  
 — nigriceps, *Dall.*  
 Graptostethus servus, *Fab.*  
 — trisignatus, n. sp.  
 — quadrisignatus, n. sp.  
 Pachymerus sordidus, *Fab.*  
 — anticus, *Walk.*  
 Dieuches uniguttatus, *Thunb.*  
 Bochrus foveatus, n. sp.

## Fam. PYRRHOCORIDÆ.

- Lohita grandis, *Gray.*  
 — longissima, *Stål*, qu. grandis,  
 var.?  
 Iphita limbata, *Stål.*  
 Physopelta gutta, *Burm.*  
 — Schlanbuschii, *Fab.*  
 Antilochus russus, *Stål.*  
 — Coquebertii, *Fab.*  
 Ectatops limbatus, *A. & S.*  
 Melamphaus faber, *Fab.*  
 Dindymus rubiginosus, *Fab.*  
 — lanius, *Stål.*  
 Pyrrhocoris vittiventris, *Walk.*  
 Dysdercus cingulatus, *Fab.*

## Fam. PHYMATIDÆ.

- Amblythyreus angustus, *West.*

## Fam. BRACHYRHYNCHIDÆ.

Brachyrhynchus membranaceus,  
*Fab.*

## Fam. REDUVIIDÆ.

Isyndus heros, *Fab.*

Endochus famulus, *Stål.*

Euagoras plagiatus, *Burm.*

Sycanus collaris, *Fab.*

Velinus annulatus, n. sp.

Cosmolestes annulipes, n. sp.

Reduvius marginellus, *Fab.*

— mendicus, *Stål.*

— costalis, *Stål.*

— ? pulchriventris, *Stål.*

— nigricollis, *Dall.* (var.)

## Fam. ECTRICHODIDÆ.

Vilius melanopterus, *Stål.*

Physorhynchus tuberculatus,  
*Stål.*

Ectrychotes pilicornis, *Fab.*

Scadra, sp. (allied to *fuscicrus*,  
*Stål.*, var.?).

## Fam. PIRATIDÆ.

Pirates atro-maculatus, *Stål.*

Lestomerus affinis, *Serv.*

Androclus granulatus, *Stål.*

## Fam. ACANTHASPIDIDÆ.

Sminthus fuscipennis.

Acanthaspis quinquespinosa, *Fab.*

— helluo, *Stål.*

— cincticus, *Stål.*

Centrocnemis, sp. ? (mutilated).

## Fam. STENOPODIDÆ.

Oncocephalus annulipes, *Stål.*

## Fam. BELOSTOMIDÆ.

Belostoma indica, *St.-Farg.* &  
*Serv.*

## Fam. NEPIDÆ.

Laccotrephes robustus, *Stål.*

— ruber, *Lin.*

— japonensis, *Scott.*

## NOTES AND DESCRIPTIONS.

*Prionolomia gigas*, n. sp.

Brown, somewhat shining, more or less clothed with short whitish hairs. Antennæ brown; first joint almost equal in length to second and third together, third joint much shorter than second (remainder mutilated). Rostrum reaching beyond anterior coxæ; third and fourth joints luteous, tip black. Pronotum rugose, granulate, the lateral angles very prominent, produced somewhat upwards and forwards, gradually narrowed to the apex, and very strongly serrated on both sides, the serration continued, but gradually diminishing in strength along the lateral margins to head; a transverse impression a little before anterior border, and another with a small acute tubercle at each end near posterior border, and three longitudinal linear impressions, of which the central one is the most distinct. Scutellum transversely and coarsely strigose, with the extreme tip luteous. Corium obscurely granulate; membrane brassy brown. Abdomen above red with the marginal borders black. Underside of body slightly darker in colour than upper surface. Sternum with an oblique whitish band on each side. Anterior and intermediate legs brown, with the tarsi dull reddish and the tibiæ subdilated; posterior legs darker in colour, the hind femora very much thickened, somewhat narrowed at base and apex, armed with strong black tubercles along the whole inner half of the upper surface, a moderately strong

black tooth on inner margin near apex, and a longitudinal row of black tubercles beneath; hind tibiæ moderately dilated on both sides, strongly angulated a little beyond the middle of inner side, after which they are narrowed and finely serrated to apex; tarsi with apical joints reddish.

Long. 43 millims., exp. pronot. ang. 19 millims., lat. at base of corium  $11\frac{1}{2}$  millims.

North Khasia hills, 1500 to 3000 feet.

Its large size will readily distinguish this species from any other of the genus at present described. *P. malaya*, Stål, is the most nearly allied form; but the shape of the pronotum is different.

*Notobitus excellens*, n. sp.

♂. Head and pronotum brassy black. Antennæ with the first three joints subequal, brassy black; apical joint longest, luteous, with its apical half fuscous. Rostrum extending nearly to intermediate coxæ; last two joints obscure luteous. Eyes luteous. Pronotum very finely granulate, lateral angles very slightly prominent and rounded; near the posterior basal side of each of these is a small hollowed impression, on inner side of which is a very obscure, small, tuberculous irregularity. Scutellum very finely granulate, brassy black, becoming brownish towards apex. Corium brown, very obscurely and faintly pilose. Membrane brassy brown. Abdomen above black with *inconstant* luteous markings. Underside of body and legs brassy black, anterior and intermediate tibiæ with their apical halves brunneous, tarsi dull luteous. Posterior femora much thickened, sparingly covered with small raised points and with a row of acute tubercles on upper surface; a strong and curved spine a little beyond middle beneath; between this and the base are two smaller ones, gradually decreasing in size, and another between it and the apex, where there are two spines. Posterior tibiæ moderately curved, inner margin denticulated, some teeth much larger than others.

Long. 30 millims., exp. pronot. ang. 9 millims.

♀. Differs from ♂ in being uniformly pale brown above; and it is also lighter in colour beneath than the other sex. Legs brown; fore and intermediate tibiæ with apical halves paler; tarsi dull luteous, as in ♂.

Long. 31 millims., exp. pronot. ang. 10 millims.

North Khasia hills, 1500 to 3000 feet; Naga hills, 2000 to 6000 feet; Sadia, north of Brahmaputra, 350 feet.

*Ann. & Mag. N. Hist.* Ser. 5. Vol. iii. 9

*Cloesmus brevicornis*, H.-S.*Nematopus brevicornis*, H.-S. W. ix. 261, f. 995 (1851).

Previous writers, probably having never seen this species, have considered it synonymous with *C. nepalensis*, Hope. It is, however, very distinct from that species, agreeing both in colour, size, and markings with Herrieh-Schäffer's description and figure (the last does not show the apical joint of antenna luteous, as it should do). The armature of the posterior femora, however, is the most distinctive character. The collection contained both sexes.

*Cletomorpha denticulata*, Stål.*Cletomorpha denticulata*, Stål, Ö. V. A. F. 1870, p. 652.

*Var.* Agrees with the description of the Philippine form, with the exception of having a narrow fascia across the corium, near apex, and not "maculaque parva rotundata ad marginem apicalem prope angulum interiore pallidis."

*Graptostethus trisignatus*, n. sp.

Red. Rostrum, antennæ, eyes, a narrow transverse patch (divided into two in a second specimen) at base of head between eyes, two large subglobular spots at base of pronotum, situated nearer to each other than to lateral borders (more irregular in shape in the second specimen), scutellum, membrane (excluding apical border), apical segment of abdomen, legs, and three spots on each lateral border of sternum (situated one on prosternum, one on mesosternum, and one on metasternum) black. Apical border of membrane whitish. The basal joint of the rostrum extends some little distance over the apex of the prosternum; the second joint of the antennæ is much longer than the third (fourth wanting); and the legs are clothed with whitish pile.

Long.  $7\frac{1}{2}$  to 10 millims.

Naga hills, 2000 to 6000 feet; North Khasia hills, 1500 to 3000 feet.

*Graptostethus quadrisignatus*, n. sp.

Red. Rostrum, antennæ, eyes, apex of central lobe of the head, apical border of pronotum (broadest on disk, and not quite reaching lateral borders), a  $\surd$ -shaped fascia on each posterior pronotal angle, scutellum, membrane (excluding apical borders), disk of apical segment of abdomen, legs, and four spots on each lateral border of sternum (situated two on prosternum, one on mesosternum, and one on metasternum) black. Apical border of membrane whitish. The basal joint



of the rostrum only just passes the apex of the pronotum. Antennæ slightly pilose; second joint longest, fourth a little longer than third. Legs clothed with whitish pile.

Long. 10 to 11 millims.

*Var. a.* Disk of corium and disk of underside of abdomen blackish.

North Khasia hills, 1500 to 3000 feet.

Allied to *C. trisignatus*, but very distinct.

*Bochrus foveatus*, n. sp.

Black; apical half of clavus with a luteous discal streak; corium with a somewhat broad fascia, slightly widened and rounded at apex, extending from base along the whole length of inner margin, luteous, and the costal margin of corium narrowly and obscurely of the same colour. Membrane luteous, with an angulated basal patch and the nervures black; a large semicircular spot occupying greater part of disk fuscous. Rostrum, coxæ, and tarsi castaneous. Antennæ pilose; second, third, and fourth joints subequal, slightly and gradually diminishing in length; basal joint and apex of central lobe of the head somewhat castaneous. Pronotum somewhat coarsely punctate, with two large foveæ, situated transversely and close together on disk, immediately in front of which are three small rounded and punctured impressions, and a large marginal fovea on each lateral border.

The head, pronotum, disk of scutellum, a narrow central longitudinal discal streak on corium, legs, and underside of body, excepting borders of odoriferous apertures, are shining black; remainder of coloration much more opaque.

Long. 10 millims., greatest lat. 4 millims.

Eastern Garo hills, 1500 to 2500 feet.

*Velinus annulatus*, n. sp.

Head above black, with the sides of the apex, a central longitudinal line (interrupted in the middle, and not reaching base nor extending beyond base of antennæ), two large lateral spots immediately above eyes, and two smaller streaks, one on each inner margin of eyes, luteous; underside of head luteous, with a small oblique streak behind eyes black. Antennæ black; basal joint with three luteous bands, the first near base and the third at apex; apical joint fuscous. Scutellum black, apex luteous. Corium reddish brown; membrane pale transparent fuscous (when the wings are folded the membrane appears blackish from the colour of the upper surface of the abdomen, which is laterally bordered with alternate luteous

and black spots). Underside of body luteous; sternum with two marginal black spots, one on mesosternum and the other on metasternum. Femora luteous, with the apices and four distinct somewhat knotted bands black; tibiæ with the basal third black, annulated with two luteous bands, remainder of tibiæ and tarsi dark fuscous.

The anterior and posterior lobes of the pronotum are profoundly sulcated through half their length, much more deeply so the anterior, which is thus bilobed. The frontal pronotal tubercles are acute and prominent. The abdomen has the lateral borders of the fourth and fifth segments more dilated in the ♀ than in the ♂. The rostrum has the second joint much longer than the first, and the tip pitehy. The membrane projects considerably beyond the apex of abdomen.

Long. 15 millims.

Eastern Garo hills, 1500 to 2500 feet; North Khasia hills, 1500 to 3000 feet.

*Note.*—I have seen another specimen of the species from West Yunnan.

*Cosmolestes annulipes*, n. sp.

Head black, shining; a Y-shaped mark situated on the centre of frontal part, a little behind base of antennæ, a transverse angular streak on each side of the inner margin of eyes, and a central longitudinal line extending along disk of hinder part of head behind eyes above, a lateral row of three spots on each side (one at base of antennæ, one behind eyes, and the other, smallest, near base of head), and the whole central portion of underside luteous. Rostrum luteous, with tip and apex of first joint blackish. Antennæ castaneous, base black; first joint plainly and narrowly annulated with dull ochreous near base, centre, and apex. Frontal lobe of pronotum black, with an anterior marginal border; frontal lateral tubercles, and two linear streaks on each side luteous; posterior pronotal lobe testaceous. Scutellum black, with a narrow central line and the apex broadly luteous. Corium obscure testaceous, with a raised, transverse, incrassated, slightly waved fascia at apical margin, shining luteous. Wings obscure fuscous. Abdominal margin luteous, with a segmental row of black spots.

Underside of abdomen luteous, transverse margins of abdominal segments on disk black; lateral borders black, in which are enclosed a row of large spots of the luteous ground-colour. Lateral borders of sternum black, in which are enclosed a large luteous spot and a very obscure smaller one. Legs luteous; femora annulated with five black rings (sometimes the rings are composed of two eneiiring lines), one at base and apex and

three intermediate; tibiæ with two black rings at base, and the hinder portion obscure fuscous.

The frontal lobe of pronotum is profoundly bilobed, the frontal tubercles of which are well developed, prominently acute, and slightly directed forwards. The angles of the hinder lobe are rounded, where there is also an obscure tubercle and a longitudinal impression on each side. The abdomen is slightly dilated on each side.

Long. 10 millims.; lat. at pronot. ang.  $2\frac{1}{2}$  millims.

Eastern Garo hills, 1500 to 2500 feet.

The most nearly allied form is *C. picticeps*, Stål.

*Reduvius nigricollis*, Dall.

*Arius nigricollis*, Dall. Tr. E. S. Lond. (2), i. p. 8, pl. ii. f. 5 (1850).

*Var.* Posterior lobe of pronotum castaneous. Underside of abdomen with three or four transverse, lateral, shining black striæ.

Long. ♂,  $12\frac{1}{2}$  millims.; ♀, 15 millims. (as described by Dallas from type).

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The Homopterous portion of the collection calls for little remark. It contained two new species, which I have already described, viz. *Tosena splendida*, Dist. Ent. Mo. Mag. vol. xv. p. 76 (1878), and *Phymatostetha binotata*, Dist. Trans. Ent. Soc. Lond. 1878, p. 322.

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XIII.—On *Loxosoma* and *Triticella*, Genera of Semiparasitic Polyzoa in the British Seas. By the Rev. A. M. NORMAN, M.A.

Genus LOXOSOMA, Kefferstein, 1862.

*Loxosoma phascolosomatum*, C. Vogt.

1861. "*Strephenterus claviger*, tentacular appendages of," Norman, Ann. & Mag. Nat. Hist. ser. 3, vol. vii. pl. ix. figs. 1-3.

1877. *Loxosoma phascolosomatum*, Carl Vogt, Archives de Zoologie Expérimentale, vol. v. 1877, p. 305; translated by Hincks, Quart. Journ. Micr. Sci. n. s. vol. xvii. 1877, p. 353, pl. xxii. figs. 1-12; Barrois, Mémoire sur l'embryologie des Bryozoaires, p. 8, 9.

In 1861, on examining a bottle of animals which had been dredged by me at Bantry Bay in 1858, I found a Gephyrean which was new to me. It was described in the 'Annals' under the name *Strephenterus claviger*.

Attached to the caudal extremity of this Gephyrean were

certain clavate bodies, which were a sore puzzle. At one time I thought they must be parasitical animals; but then they seemed to be inseparable from the body of the Gephyrean; and after much doubt and consultation with my friend Mr. Alder, they were regarded as part and parcel of the animal to which they were attached, and presumed to be analogous to the tail of *Priapulidus*. They were figured as carefully as possible from the spirit-preserved specimens, in order that any doubt there might be about them might hereafter be cleared up, and were thus described:—"The extremity is furnished with from twenty to thirty club-shaped tentacular appendages. These tentacular appendages are of peculiar construction. The longest and most fully expanded present the appearance of fig. 2. The club is somewhat spatulate; and about the centre of the upper half is seen a small round aperture, apparently opening into the interior. Below this there are two projecting processes, one of which is larger than the other; and between the bases of these two processes is seen the rudiment of a third. Another state of the tentacles is shown in fig. 3, which is taken from one of the shorter tentacles—shorter because less expanded, or, more probably, less developed. Here there is no sign of the central opening; but the head seems to contain several pear-shaped bodies, one of which has a blackish central spot. On subjecting this tentacle to the compressorium, these pear-shaped bodies escaped, and appeared to be composed entirely of granular matter enclosed in thin sacs."

At this time *Loxosoma* was unknown; but in 1862 Kefenstein described that remarkable parasitic genus of Polyzoa, having found the type species on *Capitella*, Blainville (a genus of Annelida), on the Normandy coast. Since that time much attention has been directed to the genus. Last year Carl Vogt described (*l. c.*) a new form; and his paper was translated by Mr. Hincks, and published in the Quart. Journ. Micr. Sci. The moment I saw the plate which illustrates this paper it was obvious that Vogt's *Loxosoma phascolosomatium* was the final solution of my puzzling tentaculiform appendages of 1858; and I at once wrote to Mr. Hincks and told him that he might add this species of *Loxosoma* to the British fauna in his forthcoming work on the Polyzoa. M. Barrois has arrived at the same conclusion. In his admirable and deeply interesting 'Mémoire sur l'embryologie des Bryozoaires' he notices a *Loxosoma* which he had found abundantly at Roskoff, and adds, "c'est peut-être la même que celle qui a été décrite par Norman, comme organe appendiculaire d'un siponcle qu'il nomme *Strephenterus claviger*; on doit certaine-

ment en faire une espèce distincte." Then, in a note, he adds, "Depuis que ces lignes ont été écrites, j'ai reçu sur cette espèce un nouveau travail, que M. Vogt a eu l'obligeance de m'envoyer; il la décrit sous le nom de *L. phascosomatum*; j'ai supprimé le nom qui je lui avais déjà donné pour adopter ce dernier"\*.

My object in writing this is to fully and finally rectify the mistake into which I had fallen. In 1861 *Loxosoma* had never been heard of, nor was any genus known at all like it; for the structure of *Pedicellina* is in many important points widely different. The peculiar position which these clavate bodies occupied, confined as they were to the caudal extremity of the Gephyrean, and the fact that they were so firmly attached to the host as to seem part of it, mainly conducted to the error. On this last point I may quote from Hincks's abbreviated translation of Vogt:—"As the *Loxosomas* are very firmly attached to the epidermis of the worm, it is almost impossible to remove them un mutilated. To observe them *in situ*, the extremity of the tail bearing the tuft of Polyzoa must be cut off with a pair of scissors and placed entire under the compressor." Vogt's drawings were made under the most favourable circumstances. "The author has made his observations almost exclusively on living animals by means of transmitted light. Patience and abundance of material have been the conditions that have secured his results. All his figures have been taken with the camera from living animals, and finished as far as possible with the animal before him." With these advantageous circumstances contrast the fact that I had only before me specimens which had been three years in a preservative medium, and consequently not only contracted and devoid of that motion absolutely essential to recognize parts in a hitherto unknown microscopic animal, but also that chemical changes had taken place in some of the organs. Let it also be borne in mind that a group of the animals is so small that Vogt says of it, "it forms a tuft hardly visible to the naked eye," and, further, let it be noticed that Vogt's drawings are more than double the scale of mine, and then let my figures 2 and 3 be compared with his, and the correspondence is certainly striking. His figure 2 and my figure 2 might have been drawn from the same specimen; not only the

\* It is only since Vogt described *Loxosoma phascosomatum* that it has been possible to identify the species which I met with; but Leuckart (Archiv für Naturgesch. xx. 1863, ii. Bd.), immediately after Keferstein had described the genus, pointed out that it seemed to have been previously met with by myself; and Nitsche (Beiträge zur Kenntniss der Bryozoen, iii. Heft, 1876, p. 140) also calls attention to my figures as the first representations of this semiparasitic Polyzoon.

animal itself, but the exact proportionate size of the two unequally developed buds show the closest correspondence.

There is nothing to alter in, though much, of course, might be added to, the description I gave of these animals, and which I have quoted above, except to substitute the word *Loxosoma* for "tentacular appendages." In the description of the plate the following corrections will make the figures intelligible:—

Fig. 1. *Phascolosoma Harveii*, Forbes\*, slightly enlarged, with a tuft of *Loxosoma phascolosomatum*, Vogt, *in situ* at the posterior extremity.

Fig. 2. A fully developed *Loxosoma*. *a*, the "opening into the interior." Around this in the figure will be seen converging lines, which, under the condition in which the animal was when examined by me, appeared to be only rugæ of contraction; but these lines, it is now evident, represent the retracted lophophore. *b* and *c* "supplemental processes," as I called them, are two buds in different degrees of development. In the state in which they were examined by me no trace of internal structure could be satisfactorily made out, so as to lead to the slightest suspicion as to their real nature. Vogt says, "there are never more than two buds †, and they are always unequally developed."

Fig. 3. This figure, I now take it, was drawn from a male (as figure 2 was from a female) specimen. Compared with figures 3 and 4 of Vogt, it seems tolerably clear that *f* represents the anal aperture, that *d* and *e* are what Vogt calls the testicles, while below these is seen the reniform space which Vogt considers to be occupied by the stomach and hepatic cells.

Now that the attention of our marine zoologists is called to the subject, it is probable that before long this *Loxosoma* will be rediscovered; and, no doubt, several other species of these semiparasitic Polyzoa will be found in our seas. They should be especially looked for on the Annelida, also on Hydrozoa, Sponges, &c.

It may perhaps be useful if I add here a list of species already discovered as far as known to me.

\* *Syrinx Harveii*, Forbes, = *Sipunculus obscurus*, Quat., = *Phascolosoma margaritaceum*, Keferstein (nec M. Sars), = *Phascolosoma luteum*, Theel, = *Phascolosoma Harveii*, K. & D. This is the synonymy of the species as given by Koren and Daniellssen in their 'Fauna Littoralis Norvegiæ,' 3<sup>die</sup> Hefte, 1877, pp. 136 and 164; and, having examined the several authors' works, I believe it to be correct, except that I should put ? before the *Sipunculus obscurus* of Quatrefages.

† Other known species have many buds developing at the same time.

1. *Loxosoma singulare*, Keferstein.

*Loxosoma singulare*, Keferstein, Zeitschrift f. wiss. Zool. xii. 1862, p. 13; Claparède, Beob. über Anat. und Entw. wirbelloser Thiere an der Küste von Normandie, 1863, p. 135, pl. ii. figs. 6-10; Barrois, Mém. sur l'Embryologie des Bryozoaires, 1877, p. 10, pl. xvi. figs. 7-14.

2. *Loxosoma neapolitanum*, Kowalewsky.

*Loxosoma neapolitanum*, Kowalewsky, Mém. de l'Académie Imp. des Sci. de St. Pétersbourg, sér. 7, vol. x. 1866, (separate copy) p. 3, plate.

3. *Loxosoma Kefersteinii*, Claparède.

*Loxosoma Kefersteinii*, Claparède, Annal. d. Scien. Natur. sér. 5, vol. vii. 1867, p. 28, pl. vi., translated Ann. & Mag. Nat. Hist. 1868, vol. i. p. 311; Claparède, Zeitschr. f. wiss. Zool. xxi. 1870, p. 34, pl. x. fig. 4; Nitsche, Zeitschr. f. wiss. Zool. xxv. 1875, p. 451; Nitsche, Beitr. zur Kenntniss der Bryozoen, iii. Heft, 1876, p. 139, pl. xxv. figs. 4-20, pl. xxvi. figs. 7-13.

4. *Loxosoma cochlear*, Schmidt.

*Loxosoma cochlear*, Schmidt, Archiv f. mikr. Anat. xii. 1875, fasc. 1; and Bemerkungen zu den Arbeiten über *Loxosoma*, 1878, (separate copy) p. 68.

5. *Loxosoma alata*, Barrois.

*Loxosoma singulare*, Schmidt, Archiv f. mikr. Anat. xii. 1875, fasc. 1 (nec Keferstein), = *Loxosoma alata*, Barrois, Mém. sur l'embryologie des Bryozoaires, 1877, p. 7, = *Loxosoma pes*, Schmidt, Bemerkungen zu den Arbeiten über *Loxosoma*, 1878, Zeitschr. f. wiss. Zool. xxxi. p. 69.

6. *Loxosoma raia*, Schmidt.

*Loxosoma raia*, Schmidt, Archiv f. mikr. Anat. xii. 1875, fasc. 1, and Bemerk. z. d. Arbeiten über *Loxosoma*, 1878, l. c. p. 71. Barrois considers this synonymous with *L. neapolitanum*.

7. *Loxosoma tethyæ*, Salensky.

*Loxosoma tethyæ*, Salensky, Annales des Sci. Nat. vol. v. 1877, p. 36; Schmidt, Bemerk. z. d. Arbeiten über *Loxosoma*, 1878, l. c. p. 71.

8. *Loxosoma crassicauda*, Salensky.

*Loxosoma crassicauda*, Salensky, Annal. des Sci. Nat. sér. 6, vol. v. p. 71.

9. *Loxosoma phascolosomatum*, Vogt.

*Loxosoma phascolosomatum*, Vogt, as above.

What is perhaps another genus of the same family has been described by Van Beneden and Hesse ('Recherches sur les Bdellodes ou Hirudinées et les Trématodes marins,' 1863, p. 82, pl. viii. figs. 12-20), under the name *Cyclatella anne-*

*lidicola*. It is a parasite on the tail of an Annelid belonging to the genus *Clymene*.

It may be expected that some of the above nine forms will ultimately be found to be states of other species. Thus Vogt would unite 1, 4, and 6; whereas Barrois considers 2 and 4 to be the same species.

### Genus TRITICELLA, Dalyell, 1848.

#### *Triticella flava*, Dalyell.

1848. *Triticella flava*, Dalyell, Rare and Remarkable Animals of Scotland, ii. p. 66, pl. xix. fig. 1, and pl. xxxvi. fig. 1.

1873. *Triticella flava*, G. O. Sars, Christ. Vidensk.-Selsk. Förhand. 1873, p. 398.

1873. *Triticella Korenii*, G. O. Sars, l. c. p. 397, pl. ix. figs. 1-9.

Thirty years ago Dalyell described the above genus, of which he gave rough figures and a brief description. It has since remained entirely unnoticed in Great Britain, not being so much as inserted in lists of our fauna. In 1873, however, Prof. G. O. Sars described two species which he had discovered in the Norwegian fiords, one of which, *Triticella Bæckii*, G. O. Sars, was living on the carapace and legs of the crab *Geryon tridens*, while the other, *Triticella Korenii*, G. O. Sars, had made the carapace of *Calocaris Macandrewi* its home.

In the summer of 1877 I had the pleasure of rediscovering *Triticella flava* in Scotland. When shore-hunting in Kerrera Sound, a little to the south of Oban, I procured a specimen of the now well-known Cirriped parasite *Sacculina carcini*, attached, as usual, to the tail (pleon) of the common shore-crab (*Carcinus menas*); the posterior part of the *Sacculina* was subsequently found to be occupied by a colony of the long-lost *Triticella flava*—a parasite of a parasite. But Dalyell supposed that he had found his species parasitic on an Ascidian. We turn to his work; and, behold, what he had taken to be an Ascidian, and figured plate xxxvi. fig. 1, is manifestly no Ascidian at all, but a veritable *Sacculina carcini*! At the time when Dalyell wrote, *Sacculina* had only just been described by Vaughan Thompson; and it is probable that our author was unacquainted with Thompson's paper. Now that the secret is out, and when a search is made in the right place, *Triticella* will probably be often met with.

Those who want to know what this genus is must consult Sars's capital paper, where will be found a detailed description illustrated by his usual admirable drawings. I extract here his Latin abbreviated characters:—



## "Ordo CHILOSTOMATA.

## Subordo CELLULARINA.

## Familia Triticellidæ.

## Gen. TRITICELLA, Dalyell.

"Zoëcia simplicia, pedicellata, de crustâ continuâ vel stolone repente surgentia, eute tenui et pellucidâ cornâ (non calcareâ) tecta, lateraliter compressa, facie alterâ (ventrali) latâ in totâ fere longitudine planâ, vel leviter excavatâ, limbo elevato tenui et acuto circumcinctâ, aream aperturæ lateralem distinctam elongato-ellipticam præbente, alterâ (dorsali) fastigiâtâ vel medio subcarinatâ fasciâ tenui valde chitinosâ (frenaculo) in semicirculum oblique antice curvatâ firmatâ. Pedicellum subrigidum, rectum, tenuissimum, zoëcio articulatione mobili conjunctum. Apertura zoëcii terminalis sine operculo; vagina tentacularis annulo setarum instructa."

1. *Triticella Bœckii*, G. O. Sars.

- "Zoëcia pallide cornea in fasciculos densos aggregata de crustâ continuâ surgentia, pedicellis longissimis zoëciis triplo—quadriplo longioribus instructa, a latere visio blique ovalia extremitate posteriore sat incurvatâ, margine dorsali subsigmoideo ante medium subito valde arcuato, frenaculo chitinoso distinctissimo ab extremitate posteriore sat remoto. Animalcula tentaculis 20 instructa. Longitudo zoëciorum pedicello excepto, 0.75 m. m., latitudo 0.25 m. m.
- "Habitat in sinu Christianiensi, prof. 10–20 orgyiarum, carapaci et pedibus *Geryonis tridentis* affixa."

2. *Triticella Korenii*, G. O. Sars.

- "Zoëcia subhyalina sparsa de stolone distincto tenui repente surgentia, pedicellis brevioribus zoëciis vix longioribus instructa, a latere visa elongato-ovata extremitate posteriore parum incurvatâ, margine dorsali in totâ fere longitudine æqualiter arcuato, frenaculo chitinoso tenuissimo extremitati posteriori approximato. Animalcula tentaculis 18 instructa. Longitudo zoëciorum, pedicello excepto, 0.90 m. m., latitudo 0.25 m. m.
- "Habitat ad oras Norvegiæ occidentalis circa Bergen, prof. 100–300 orgyiarum, nec non ad Bahusiam, carapaci *Calocaris Macandrewi* affixa."

3. *Triticella flava*, Dalyell.

- "Zoëcia flava a latere visa breviter ovata, margine dorsali valde arcuato, pedicello brevissimo zoëcio ipso multo brevior. Animalcula tentaculis 20 instructa.
- "Habitat ad oras Scotiæ testæ Ascidiarum affixa."

The diagnosis given above of *T. flava*, however, as drawn up by Sars from Dalyell's figure and description, by no means correctly represents the species found by me at Oban, and which, I cannot doubt, is that indicated by Dalyell, more especially as both were found affecting *Sacculina carcini*. It appears to me that Sars has laid too much stress on the comparative length of the pedicel as constituting a specific character. It will be seen that whereas in *T. Bæckii* the pedicel is three or four times as long as the body of the animal, in *T. Korenii* it is said to be about equal in length, while in *T. flava* it is "much shorter than" the zoecium. Now I find very wide difference in the length of the pedicel in the animals constituting the group which I found at Oban: in some full-grown specimens the pedicel is shorter than the zoecium; in others it is slightly longer; in others, again, it is two or three times as long. Specific characters, therefore, derived from the length of the pedicel seem in a very great measure to break down. The zoecia closely correspond with those figured by Sars of *T. Korenii*: the general form is the same; the position of the frenaeculum agrees; and there is the same angle at the lower extremity of the ventral concave and more membranous area. Having only found my specimens after they had been preserved in spirits, and the lophophores being in every instance strongly retracted, I am unable to speak with accuracy as to the number of the tentacles, which Sars states are eighteen in *Korenii* and twenty in *flava* and *Bæckii*. The budding young agree with Sars's figures 6, 7, 8, representing this state in *Korenii*; and the animals are connected by a creeping stolon.

Bearing in mind, then, that reliance cannot be placed on minute details in the drawings of Dalyell, I am constrained to come to the conclusion that no valid grounds exist (as far, at any rate, as we as yet know) by which to distinguish the Scotch species, which affects *Sacculina carcini* and is the type of Dalyell's *Triticella flava* from the Norwegian form found by Sars on *Calocaris Macandrewi*, and that the latter must be regarded as a synonym—further, that great latitude must be allowed with respect to the length of the pedicels, which in *T. flava* show great variation, and are often not only as long as described in *Korenii*, but show a great approach to the very long supports of *T. Bæckii*. The higher position of the frenaeculum in *T. Bæckii* appears to be its chief character.

XIV.—On *Holasterella*, a Fossil Sponge of the Carboniferous Era, and on *Hemiasterella*, a new Genus of Recent Sponges.  
By H. J. CARTER, F.R.S. &c.

[Plate XXI.]

IN my description of Mr. James Thomson's fossil sponges from the Carboniferous Limestone of the South-west of Scotland ('Annals,' 1878, vol. i. p. 133), I have stated that Dr. Millar had brought to my notice a stelliform spicule, "like a double star back to back," which is described and illustrated (pl. ix. fig. 11 &c.). It is also stated (p. 134 ib.) that the three different spicules mentioned and figured "appear" to have belonged to "three different sarcohexactinellids respectively," of which the first (viz. fig. 8 &c.) had only been identified with the Hexactinellida or sexradiate-spicule sponges. If, however, a six-rayed form *only* is to be considered indicative of a hexactinellid sponge, then the two other stelliform spicules, which have respectively many more rays, must be considered indications of the existence of sponges which did not belong to the hexactinellid order. And this is now evidently the case; for the fossil sponge about to be described will be found to have been *exclusively* composed of the many-rayed spicule (fig. 11, *op. et loc. cit.*).

This interesting species, which has lately been discovered, and was forwarded to me in four pieces by Mr. James Thomson of Glasgow, on the 2nd November last, I will now describe, so far as the lapidification permits, under the name of

*Holasterella conferta*, n. gen. et sp. (Pl. XXI. figs. 1-8.)

Fossil solid, massive, club-shaped, rising from a subcylindrical base which, increasing gradually and subcylindrically upwards, terminates rather suddenly in an expanded, globular, lobate head (Pl. XXI. fig. 1, *a, b, c, d*). Colour white. Composition, opaque, translucent and transparent heavy spar (sulphate of barytes), according to the position, with glistening aspect over the face of fracture and dull exterior. Surface even, irregularly undulating throughout; presenting here and there more or less ovoid, sharp-margined depressions or pits of different sizes, which appear to have been the abodes of old and young crustaceans respectively (fig. 1, *f*, and fig. 2, *a, a*). Internal structure solid throughout, having been composed *exclusively* of stelliform spicules irregularly thrown together; apparently faced by a layer of much smaller ones, arranged in some parts (which appear to be perfect, fig. 1, *h*, and fig. 2)

so as to present a minutely convoluted appearance, in the interstices of which minute round holes exist, indicative of the position of the pores (fig. 2, *b*). Vents not observed, but the canals of the excretory system evident internally. Stellate spicule *normally* composed of twelve rays or arms, viz. six above (that is, with five round an axial one), and the same below, but less regularly disposed, projecting from a central inflation, which is most evident in the smaller or younger forms; the six upper rays during growth remaining almost stationary, while those below undergo the chief increase in size, so as to produce a stellate like the one to which I have alluded, in which some of the smaller arms or rays of the head occasionally appear to be microspined (figs. 4, 5). But since this is the *normal* form, and only seen in the young stellate, the regularity becomes for the most part widely departed from as the stellate increases in size, when the rays, sometimes rendered more numerous by bifurcation (fig. 5, *a*), and sometimes less by abortive development, often terminate in a most irregular form, composed of four to fourteen rays or more, variable in length and variously disposed; while the central inflation, which does not keep pace with the enlargement of the arms, remains hardly appreciable (compare figs 4 and 8). Diameter of largest stellates about 1-6th inch (fig. 3), size of smallest stellate seen (from the surface) about 1-545th inch in diameter. The larger spicules are confined to the interior; and the small spicules occupy the surface both of the sponge itself and of the excretory canals, mixed with the pointed ends of the rays of the larger spicules in the latter, which project freely into them (fig. 8), while the larger spicules again, where still provided with the head surmounted by the six smaller ones (figs. 4, 5), are so arranged in some parts of the surface of the sponge as to present a number of rosettes like stars more or less approximated. Size of entire specimen  $5\frac{3}{4}$  inches high, greatest diameter of head 2 inches, diameter of base or stem  $\frac{3}{4}$  inch.

*Hab.* Marine.

*Loc.* Highest bed of Upper Limestone of the Carboniferous rocks of the south-west of Scotland, near Glasgow.

*Obs.* This specimen, which was originally entire, but on extrication became broken into four pieces, and reached me in this state, was easily put together for the purposes of illustration and description, as fig. 1, *a, b, c, d*, shows. The accumulation of the mineral (sulphate of baryta) of which it is composed, having more or less thickened the body (that is, the central inflation) and rays of the stellates respectively, has thus caused them also to become more or less amalgamated

with and attached to each other, so as in many specimens not only to obscure the form of the stellate, but to convert the whole into a solid mass. Hence it is only here and there that a comparatively complete form can be detached; while the union of the rays of the different stellates, where in contact with each other, being without inflation or additional material at these points, leaves one in doubt as to how much, if not all, of this attachment may be due to the effect of fossilization, and that, in their original state, they were thus all separate. The cleavage, too, of the mineral being perpendicular to the long diameter of the ray and easily effected, causes, from their lamellar structure and extreme brittleness, the rays, where adherent to one another, even in the slightest degree, to yield to the force necessary to separate them without fracture, and thus defies all attempt to obtain a *perfect* spicule. Nor is it very clear what amount of central inflation originally existed in the spicules generally; for the accumulation of the fossilizing material having spread from these points especially, and, as already stated, the inflation which is chiefly evident in the smaller spicules (fig. 8) not keeping pace with the development of the lower arms, whereby the latter appear to be almost bodiless (that is, without central inflation, fig. 4), this also is not easily determined.

Judging, however, from the entire want of fossilized fibre, like that which exists in the vitreous Hexactinellida, and, therefore, the Holorhaphidotic character of the aggregated stellates, it seems probable that they were not only originally *united*, but that the sponge did belong to the Holorhaphidota, in which order it might form a new group among the Suberitida, coming in provisionally after that of "Laxa" under the name of "Holasterellina."

Again, the presence of the ovoid depressions (fig. 2, *aa*) sunk into the surface, which, leading to no outlets internally, could not be connected with the excretory canal-system, are almost identical in form with those to which I have alluded in my paper on the Parasites of Sponges under the head of "Crustacea" ('Annals,' 1878, vol. ii. p. 157), having been observed in the Holorhaphidota *only* (that is, not in any vitreous sponge), and especially in the Suberitida, where the head of the amphipod occupies the largest end of the ovoid pit. It is just possible for this reason also that these spicules were originally connected together by flaky sarcodite, like that of the Suberitida of the present day, and thus Holorhaphidotic. Had I never noticed such depressions in the existing sponges with the crustaceans respectively in them, I should have been inclined to regard this as a peculiar character on the

surface of the fossil sponge. Thus it is interesting to find that at that remote period a crustacean parasite nestled in the surface of the Holorhaphidotic sponges as at the present day.

But up to this time no recent sponge has been made known which possesses, for the most part, a comparatively bodiless stelliform spicule of this kind only—that is, a stellate without central inflation. The globostellate or spiniglobate spicule of *Chondrilla nucula*, Sdt., is thus totally different in form, and the sponge itself inclined to a horizontal rather than an erect growth.

There are, however, recent sponges which are partly composed of stellate spicules of a similar form, and thus so far resemble *Holasterella*, and which also appear to belong to the Suberitida. Thus *Xenospongia patelliformis*, Gray (Proc. Zool. Soc. 1858, p. 230), is half composed of bodiless stellates of different sizes, together with a long, setaceous, linear, acuate spicule, and a new genus, which I am about to describe presently under the name of "*Hemiasterella*."

Besides the more perfect portions of *Holasterella*, Mr. Thomson has kindly sent me many other fragments of this sponge, more or less consolidated by the fossilization, all of which come from a compact earthy rock or stratum of an ochraceous or ferruginous colour that does not effervesce with acids. It has already been stated that they are composed of white, opaque, translucent, and transparent "heavy spar" (sulphate of barytes), according to its position, which having in many instances assumed a subpisolitic structure, from the mineral chiefly accumulating round and extending outwards from the central inflation or body of the stellates respectively, in which, the points of one or more of the rays only being sometimes projecting, a more or less solid mass of crystalline material is produced, and the spheroidal portions average 1-12th inch in diameter. It should here be remembered that not effervescing with acids is no test that the material is *siliceous*!

Thus, then, the stellate represented in fig. 11 ('Annals,' 1878, vol. i. pl. ix.) has been identified *in situ*, and the sponge thus found to which it belongs; and thus also we may fairly anticipate that some day the same thing may happen to the stellate (fig. 10 ib.) and the sponge to which *this* belongs also be identified; if not, to other spicules of a different form which may be abundant in the same deposit, such as fig. 11, to which I shall now allude.

This spicule is cylindrical and smooth, with straight shaft and obtuse round ends bent upon the shaft in the same direction (fig. 11). It varies much in measurement, losing, like the spicules of all other sponges, in one way, viz. in length,

what it gains in the other, viz. in thickness, but averaging 1-22nd by 1-120th inch in its greatest dimensions. It is possible that these spicules also may have become thickened during fossilization; but even then they have very much the appearance of the sausage-shaped form characterizing some of the large-spiculed *Renierida* (group 4, viz. *Crassa*) of the present day, though much thicker than the latter.

I might also add here that Mr. Thomson has sent me some specimens of limestone which came from the Carboniferous system of the west coast of Ireland, found on the western side of Black Head, County Clare, at the southern entrance of Galway Bay. Here he computes the limestone to be about 3000 feet thick, and overlain inshore by the "Yoredale Shales."

These specimens are of two kinds—viz. one obtained about 700 feet from the summit, and the other from the talus of the scarp below.

No. 1 consists of a mass of very small crystals of quartz, typical of a stratum 3 feet in thickness, showing by their weathered-out rhomboidal cavities *in the mass*, and their granular structure, that they have been formed *in the limestone*, now more or less occupying their interstices, while the *geodic cavities* of the mass are lined by large and more *perfect* crystals of the same mineral. What the origin of this accumulation of quartz crystals in the limestone may have been, there is no evidence to show, although, by the apparently round and pointed form of some of those in the *mass*, together with their rhomboidal excavations, so characteristic of the fossil spicules of *Hyalonema Smithii* ('Annals,' 1878, vol. i. pl. ix. fig. 4 &c.), it is possible that they may be transformed sponge-spicules; and this seems to have been the opinion of Dr. Westropp, late of the Geological Survey of Ireland, who, Mr. Thomson states, visited the locality from which the specimens were obtained. But, until the *form* of a sponge-spicule can be undoubtedly recognized among them, they must remain conjectural. Silix, in such a position, is not likely to occur without organic origin; and sponges are almost the only organisms that could supply it.

Over one portion, the dark brown spherular apothecia of a saxicolous lichen sunken into the limestone and occupying exclusively the intervals between the quartz crystals, seems to point out at once the preference of the lichen for, as well as the presence of, the limestone.

No. 2 represents the typical structure of "sheets" of dark limestone about  $1\frac{1}{2}$  inch thick and 18 by 12 inches square, found among the talus at the foot of the scarp mentioned.

These sheets are more or less traversed perpendicularly by a columnar structure of the limestone itself, which is often white and looks very much like the *fluted* fossil cord-spicules of *Hyalonema Smithii* (fig. 13 &c. pl. ix. 'Annals,' *l. c.*)—an opinion that seems at first to be strengthened by the other minute organisms of the rock (among which there are fragments of sponge-spicules) being all composed of the same kind of *white calcite*, contrasting strongly with the black colour of the limestone in which they are imbedded. But here also no sponge-spicule can be recognized by its definite form, and the white *columnar* calcite appears in veins rather than in ends of columns on the horizontal section. Thus with much appearance here, again, of organic origin, there is nothing to substantiate it satisfactorily.

#### HEMIASTERELLA, n. gen.

Having described and illustrated the interesting fossil sponge from the Upper Carboniferous Limestone lately sent to me by Mr. James Thomson, I naturally recur to my knowledge of the recent sponges to see if there are any kinds known which might be linked with this species; but, as already stated, I can find none exactly, although there are sponges which are partly composed of stellates and partly of linear spicules *alone*, which is the next grade perhaps to that of being composed of the former *only*.

Of these sponges we know *Xenospongia patelliformis*, as before stated, to be one; and two others have been found in the late Dr. Bowerbank's collection, now in the British Museum, which, as they are new and nearly allied in spiculation to *Holasterella conferta*, will at once be described under the generic appellation of "*Hemiasterella*," *i. e.* half composed of stellates which, for the most part, as before stated, are bodiless or without inflation at the point of junction at the rays.

#### *Hemiasterella typus*, n. sp. (Pl. XXI. fig. 9, *a, b*.)

General form bowl-shaped, elliptical, with thin flexible wall and deep-toothed irregular edges, proliferous on the inner side. Colour white. Substance cork-like. Surface shallow-rugose-reticulate on each side, covered with a white incrustation of little stellates through which long setaceous acuates project. Pores and vents not conspicuous, the latter probably numerous and small, being the outlets of so many small excretory systems, as is generally the case with this kind of sponges. Internal structure tough, areolar, composed of light flaky



sarcode, charged with long acuate spicules and little stellates like those of the incrustation, presenting a light yellow colour. Spicules of two kinds, viz.:—1, skeleton-spicule, long, acuate, smooth, curved, and gradually sharp-pointed, 1-15th inch long by 1-900th inch thick in its greatest dimensions (fig. 9); 2, flesh-spicule, stelliform, rays variable in number, four to eight, straight, smooth, sharp-pointed, meeting in the centre without inflation, largest about 1-720th inch in diameter, and of all sizes below this (fig. 9, *a*, *b*). The former chiefly confined to the internal structure, and the latter to the incrustation; but both equally mixed throughout the interior. Size of specimen 11 by 4 inches across the brim, 6 inches deep, wall about 1-6th inch thick.

*Hab.* Marine.

*Loc.* — ?

*Obs.* Examined in the dry state. This specimen, which I found, without label, in the late Dr. Bowerbank's collection, seems, from its tough, flexible, and light cork-like consistence, to belong to the second family of my Holorhaphidota, viz. the Suberitida, where it might come in as a new group under the name of "*Hemiassterellina*," from its being half composed of stellates without inflation of the centre. With the exception of *Xenospongia patelliformis*, I have met with no recent sponge with such a large proportion of similar stellates in its spiculation. Certainly in *Hymenaphia spiniglobata*, a new species to be hereafter described, the proportion of stellates is equally great; but then they are totally different in form, being spiniglobate, and the sponge itself hitherto has only been seen in the state of a mere film as regards thickness. (Bk. coll. no. 715.)

*Hemiassterella affinis*, n. sp. (Pl. XXI. fig. 10, *a*, *b*, *c*.)

Long, narrow, conical, cylindrical, excavated, cup-like, apparently fringed or toothed on the margin of the orifice, which has been partly worn off, proliferous on the outer side. Colour white. Substance tough, flexible, cork-like. Surface shallow-rugose-reticulate on each side, covered with a white incrustation of little stellates, which is thickest on the outer side, through which long acerate spicules project. Pores and vents not conspicuous; the latter probably numerous and small, being the outlets of many small excretory systems, as is generally the case in these sponges. Internal structure tough, areolar, composed of light flaky sarcode charged with long acerate spicules and little stellates like those of the surface, presenting a light yellow colour. Spicules of two kinds, viz.:—1, skeleton-spicule, long, acerate, smooth, curved, and

gradually sharp-pointed, 1-25th inch long by 1-900th inch thick in its greatest dimensions (fig. 10); 2, flesh-spicule, stelliform, rays straight, smooth, sharp-pointed, variable in number, from four to ten, of which seven appears to be the average (fig. 10, *a, b*), centre or point of junction of the rays sometimes with (fig. 10, *c*) and sometimes without a slight inflation or body, largest stellate about 1-600th inch in diameter, and of all sizes below this: the former chiefly confined to the internal structure, and the latter to the incrustation, but both equally mixed throughout the interior. Size of specimen, which is imperfect both above and below, 5 inches long; orifice  $2\frac{1}{2}$  inches in diameter; lower end, which has been broken off, solid,  $1\frac{1}{2}$  inch in diameter. Cavity conical, nearly as deep as the length of the specimen in its present state.

*Hab.* Marine.

*Loc.* — ?

*Obs.* Examined in the dried state. It will be observed from the description that this sponge is very like the last, although sufficiently different in the *acerate* form of the skeleton-spicule &c. to be designated "*affinis*," but must, of course, be placed in the same genus. The remarks applied to the foregoing specimen equally apply to this. (Bk. coll. no. 679.)

In my "Observations" on Mr. Thomson's fossil sponge I have noticed that *Xenospongia patelliformis* is half composed of bodiless stellates similar to those of *Holasterella conferta*, together with a long, setaceous, acute spicule, by which, on the other hand, it becomes in spiculation more closely allied to *Hemiasterella typus*; but as *Xenospongia patelliformis*, by reason of its peculiar form and mode of growth, cannot come under the genus *Hemiasterella*, it might be made the type of a separate group among the Suberitida, together with *Halicnemis patera*, Bk. (Mon. Brit. Spong. vol. iii. pp. 31, 32, pl. xv.), although the latter has a spined *acerate* flesh-spicule instead of a stellate.

*Placospongia melobesioides*, Gray (Proc. Zool. Soc. 1867, p. 128), = *Geodia carinata*, Bk. (ib. 1874, pl. xlvi. fig. 1 &c.), is another sponge of this kind; that is, its spiculation chiefly consists of the siliceous ball, like that of *Geodia*, and a pinlike spicule; but being accompanied by a *minute* spiniglobate ball like that of *Chondrilla nucula*, together with a zigzag or spinispirulate one like that of the Suberitida, to say nothing of its peculiar form and mode of growth, it too must be made the type of a distinct group in this family. The "siliceous ball" of *Geodia* also commences in a minute, simple, star-like spicule, which in abnormal development is often

more or less retained till it equals in size the full-grown "ball" itself; and thus its ontogenetic origin is determined.

A similar transition of the flesh-spicule is, according to Schmidt, met with in his *Vioa Johnstonii*, where in one instance the spiculation consists of an acerate skeleton with stelliform flesh-spicule (Spong. Adriat. Meeres, Taf. vii. fig. 17, 1862), and in the other of a pinlike skeleton-spicule with a zigzag or spinispirulate flesh-spicule (Spongienf. atlant. Geb. Taf. vi. fig. 18, 1870). This is explained at p. 5 (ib.); but the transition of the acerate to the pinlike skeleton-spicule is not mentioned, whereby I should be inclined to give a different name to either one or the other; for if we are to follow this reasoning, then *Placospongia* in spiculation might, but for its other flesh-spicules, be accounted the same as *Xenospongia*—that is, half composed of stellates and half of skeleton-spicules, like *Hemiasterella*. Little, however, as the value of the flesh-spicule in specification appears to be under these circumstances, it is not so under full development, which is the point most useful to remember in specific distinction. At the same time, as I have before stated, the form of the flesh-spicule, taken alone, when in combination with other spicules is not of much value: thus the first form of the spiculation of *Vioa Johnstonii* appears to me to indicate a form of spiculation specifically different from the second; and while the first bears a similar spiculation to that of *Hemiasterella affinis*, the second does not do so. Colour has nothing to do with it. Lamarck's *Acyonium purpureum* and an undescribed species in the Liverpool Free Museum, both different suberitic sponges from South Australia, possess a similar spiculation to that of the "second" form of *Vioa Johnstonii* described by Schmidt, together with the remarkably beautiful carmine colour possessed by the latter.

I am aware that the terms *Holaster* and *Hemiaster* are used for species of the Echinodermata; but I can find no more expressive ones for the fossil and recent sponges above described than *Holasterella* and *Hemiasterella*, in which the terminal affix must differentiate the names from those of the Echinoderms.

#### EXPLANATION OF PLATE XXI.

- Fig. 1.* *Holasterella conferta*, n. sp. (fossil), natural size. *a*, head; *b*, upper part of body; *c*, lower part; *d*, stem; *e e*, dotted lines indicating lost portions; *f*, puncta representing abodes of crustacean parasites; *g*, ends of excretory canals in a broken part.
- Fig. 2.* The same. Portion of surface, magnified, to show *a a*, form of pits of crustacean parasites among *b*, meandriniform grooves and pores. Taken from the part marked "*h*" in fig. 1.

- Fig. 3. The same. Largest form of spicule. Natural size. Diagrammatic.
- Fig. 4. The same. Typical form of large spicule, magnified, to show spines or aborted rays of head, composing, in juxtaposition and *in situ*, the surface in some parts. Copied from fig. 11, 'Annals,' 1878, vol. i. pl. ix.
- Fig. 5. The same. Head of same, more magnified, to show microspination of central ray, and *a*, bifurcation of a lateral one. Also copied from *l. c.*
- Fig. 6. The same. Small spicule with twelve to fourteen rays. Much magnified. Diagrammatic.
- Fig. 7. The same. Large spicule with fewer rays and slightly inflated centre. *a*, end view; *b*, lateral view. Much magnified.
- Fig. 8. The same. Group of small spicules *in situ* taken from surface of large excretory canal in the outer part of the sponge. Relatively magnified. Showing:—*a a*, arms of large spicules; *b b*, small spicules with central inflation and arms more or less broken off; *c c c*, arms attached to each other. Scale 1-24th to 1-830th inch.
- Fig. 9. *Hemiaspina typus*, n. sp. (recent sponge). Skeleton-spicule, linear, acute; magnified (scale 1-24th to 1-1800th inch). *a*, flesh-spicule, stelliform; magnified (same scale). *b b*, forms with from four to eight rays, more magnified.
- Fig. 10. *Hemiaspina affinis*, n. sp. (recent sponge). Skeleton-spicule, linear, acute; magnified (scale 1-24th to 1-1800th inch). *a*, flesh-spicule, stelliform; magnified (same scale). *b b*, other forms, more magnified; *c*, one with central inflation.
- Fig. 11. Spicule, fossil (? of a Renierid sponge), magnified; abundant in the same deposit with *Holasterella conferta*. (Scale 1-48th to 1-1800th inch.)

XV.—On two new Species of Fishes from the Bermudas.

By Dr. A. GÜNTHER, F.R.S.

MR. J. MATTHEW JONES, who for several years past has paid especial attention to the fishes occurring at the Bermudas (see 'Annals,' 1874, vol. xiv. pp. 370, 455), has again succeeded in discovering two species which appear hitherto to have escaped observation. The types have been kindly presented by the discoverer to the British Museum.

*Gerres Jonesii*.

D.  $\frac{9}{10}$ . A.  $\frac{3}{7}$ . L. lat. 49. L. transv.  $\frac{5\frac{1}{2}}{10}$ .

The height of the body is two sevenths of the total length (without caudal). Præorbital and præoperculum entire, the latter with the angle slightly rounded. The groove for the processes of the intermaxillaries does not extend to the vertical from the centre of the eye, is elongate, and entirely free from scales. The snout is as long as the eye, and equals the width

of the interorbital space. The spines of the fins are slender, the second of the dorsal slightly exceeding half the length of the head, and being more than twice as long as the second of the anal fin, which is stoutish and shorter than the eye. Uniform silvery.

Six specimens, from 6 to 9 inches long, were obtained.

*Belone Jonesii.*

D. 25. A. 22.

The free portion of the tail is rather depressed, somewhat broader than deep, the lateral line terminating in a low black-coloured keel. The length of the head is less than one third of the total (without caudal); its upper surface is broad, flat, striated; frontal bones diverging behind, leaving a broad space between them which is covered by skin; this space tapers in front, and is closed between the orbits. Maxillary entirely hidden by the præorbital. Jaws and teeth strong; vomerine teeth none; tongue rough. The diameter of the eye is two thirds of the width of the interorbital space, and two fifths of the length of the postorbital portion of the head. Body stout, not much compressed; pectoral fin as long as the postorbital portion of the head. Ventral fin midway between the root of the caudal and the eye. The middle and hinder dorsal and anal rays subequal in length, short, the last terminating at a considerable distance from the root of the caudal. Caudal fin deeply lobed. Scales very small, irregular and adherent.

A single specimen, 3 feet long, was obtained.

XVI.—*Remarks on Munier-Chalmas's Classification of the Dactyloporida\**. By Dr. FR. TOULA †.

THE segments of *Cymopolia barbata*, Lamx., are so nearly identical with those of *Dactylopora*, Lamk., that the latter must be considered as founded on fragmentary portions of *Cymopolia*. This generic name ought therefore to be adopted, as it applies to complete organisms, while Lamarck's, although a prior name, denotes mere fragments. Prof. Decaisne, in 1842, proved several marine organisms (*Cymopolia* among them), which

\* "Observations sur les Algues calcaires appartenant au groupe des Siphonées verticillées (*Dasycladées*, Harvey) et confondues avec les Foraminifères:" note de M. Munier-Chalmas, &c. (Comptes Rendus de l'Acad. des Sci. vol. lxxxv. no. 18, Oct. 29, 1877, pp. 814-817).

† Imper. Geolog. Instit. Vienna, Report, August 31, 1878. Communicated by Count Marschall, F.C.G.S.

were generally ranked as Zoophytes, to be really Algæ; and he regarded it as probable that many fossil forms, ranked among Polyparia by previous authors, and among Foraminifera by some contemporaries, are in reality plants. M. Munier-Chalmas proves the genera *Dactylopora*, *Acicularia*, and *Polytrypa* to be Algæ, by his figures of transverse sections and of the annular cellules of *Polytrypa elongata*, Defr., and *Cymopolia rosarium*. The same author considers *Cymopolia* and *Polytrypa* to belong to the same genus.

M. Munier-Chalmas's division, *Siphonées verticillées*, embraces the whole of the Algæ with green spores, constituting Harvey's family Dasycladeæ, also fifty Triassic, Jurassic, Cretaceous, and Tertiary genera, closely allied to *Larvaria*, *Clypeina*, *Polytrypa*, *Acicularia*, *Dactylopora*, and *Uteria*. Only seven genera are known living in the present seas. The organic substance being destroyed, there generally remains a calcareous skeleton, consisting of channels, small cellules disposed in circles, and large fructification-cells.

Munier-Chalmas's present arrangement of the *Siphonææ Verticillatæ* stands thus:—

I. CYMOPOLIIDÆ.	<ul style="list-style-type: none"> <li>Dasycladus, <i>Agardh.</i></li> <li>Halycoreyne, <i>Harvey.</i></li> <li>Clypeina, <i>Mich.*</i></li> <li>Cymopolia, <i>Lamk.**</i></li> <li>Parkerella, <i>M.-Chalm.*</i></li> <li>Hermitella, <i>M.-Chalm.*</i></li> </ul>	<ul style="list-style-type: none"> <li>a. Decaisnella, <i>M.-Chalm.**</i></li> <li>b. Larvaria, <i>Defr.*</i></li> <li>c. Vaginopora, <i>Defr.*</i></li> <li>d. Karrera, <i>M.-Chalm.*</i></li> <li>e. Polytrypa, <i>Defr.**</i></li> </ul>
II. ACETABULARIIDÆ.	<ul style="list-style-type: none"> <li>Polyphysa, <i>Lamk.</i></li> <li>Acetabularia, <i>Lamk.</i></li> <li>Briardina, <i>M.-Chalm.*</i></li> <li>Acicularia, <i>D'Arch.*</i></li> <li>Orioporella, <i>M.-Chalm.*</i></li> </ul>	
III. THYRSOPORELLIDÆ.	<ul style="list-style-type: none"> <li>Thyrsoporella, <i>Gümb.*</i></li> <li>Guembelina, <i>M.-Chalm.*</i></li> </ul>	
IV. DACTYLOPORIDÆ.	<ul style="list-style-type: none"> <li>Dactylopora, <i>Lamk.*</i></li> </ul>	
V. NEOMERITÆ.	<ul style="list-style-type: none"> <li>Neomeris, <i>Lamk.</i></li> <li>Bornetella, <i>M.-Chalm.</i></li> <li>Terquemella, <i>M.-Chalm.*</i></li> <li>Maupasina, <i>M.-Chalm.*</i></li> <li>Zittelina, <i>M.-Chalm.*</i></li> <li>Uteria, <i>Mich.*</i></li> <li>Hagenmuelleria, <i>M.-Chalm.</i></li> <li>Carpenterella, <i>M.-Chalm.</i></li> </ul>	

The subgenus *Haploporella*, Gümbel, including, according to Prof. Zittel, the genera *Prattia*, *D'Arch.*, *Marginoporella*, *Park.*, and *Larvaria*, *Defr.*, is admitted by M. Munier-Chalmas under the name of *Larvaria*, and united with *Cymopolia*,

\* The genera marked with an asterisk are fossil; and those with two asterisks both fossil and recent.

Lamk. The genus *Petrascula*, Gümbl., is not admitted into the new system, at least not under that name.

The omission of Gümbl's genus *Gyroporella* is the more noticeable as that genus is particularly interesting with respect to the Alpine Formation, and was the first form which led to the group being referred to the Calcareous Algæ. Stache found it in the Dyasic (Permian) strata of the Gailthal massif. Gümbl, in 1871\*, ranked *Diplopora*, Schafh., among the truly vegetable "Nulliporæ," and subsequently, in 1872, among those which he referred to animals. M. Munier-Chalmas's *Guembelina* is possibly identical with this genus.

The living Corallines inhabit shallow seas; and thus strata including Dactyloporidæ may also be regarded as shallow-water deposits. These fossils are prevalent in the Alpine Limestones (Schlern Dolomite, Wetterstein Limestones), thus affording a new argument in favour of Baron Richthofen's and Von Mojsisovics's theory of Alpine Coral-reefs. The groups of *Gyroporellæ* may have long grown in shallow waters at remote periods, just as in our days groups of *Nulliporæ* thrive within the surf-zone, and branching Calcareous Algæ within the less exposed shallows of the reefs in the South Sea.

## XVII.—On the Classification of the British Polyzoa.

By the Rev. THOMAS HINCKS, B.A., F.R.S.

I PROPOSE to give in this paper an outline of certain portions of the classification adopted in the 'History of the British Marine Polyzoa,' which I hope shortly to publish. I shall confine myself for the present to the Cheilostomata, and shall merely sketch very slightly the general arrangement, adding a brief diagnosis of the new genera which I have found it necessary to constitute. I must reserve the discussion of many interesting points connected with the subject.

Class POLYZOA, J. V. Thompson.

Subclass HOLOBRANCHIA, E. Ray Lankester.

Group *a.* *Ectoprocta*, Nitsche.

Order GYMNOLEMATA, Allman.

Suborder i. CHEILOSTOMATA, Busk.

Fam. 1. *Aeteidæ*.

A single genus, *AETEA*, Lamx.

\* Abhandlung. d. k.-bayer. Akad. der Wiss. math.-phys. Cl. vol. xi. See also Ann. & Mag. Nat. Hist. ser. 4, vol. viii. pp. 70, 71.

## Fam. 2. Eucrateidæ.

This family includes the whole of the *Gemellariidæ*, Busk, except *Notamia*, an anomalous genus and type of a separate group, and *Didymia*, in which we find a totally distinct form of cell. *Eucratea*, the oldest genus, and one in which the family characters are strikingly represented, has been adopted as the type.

Genera: EUCRATEA, Lamx.

GEMELLARIA, Savigny.

SCRUPARIA, Hincks.

*Zoarium* erect, branches given off from the back of a cell, and facing in the opposite direction. *Zoæcia* subcalcareous, rising one from the other, so as to form a single series, or placed back to back; aperture small, unarmed, slightly oblique, terminal. *Ovicelligerous cells* imperfectly developed, placed back to back with the ordinary cells. No *avicularia* or *vibracula*.

Type *Scruparia clavata*, Hincks.

I have retained Oken's name *Scruparia*, with a new definition, for this form; it has been superseded by *Eucratea*, Lamx., and would otherwise lapse altogether.

HUXLEYA, Dyster.

(With revised character.)

BRETTIA, Dyster.

*Brettia tubæformis*, nov. sp.

*Zoarium* minute, transparent, dichotomously branched, surface smooth, attached by a number of tubular fibres. *Zoæcia* elongate, somewhat trumpet-shaped, slender and tubular below, and expanding gradually upwards, with a distinct joint a little above the base; aperture terminal, slightly oblique, suborbicular, with about ten short spines round the margin. *Oæcia* unknown.

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

*Localities*. South-east coast (*R. S. Boswell*): Hebrides (*Norman*).

## Fam. 3. Cellulariidæ.

Genera: CELLULARIA, Pallas.

MENIPEA, Lamx.

SCRUPOCELLARIA, Van Beneden.

CABEREA, Lamx.



Fam. 4. **Bicellariidæ.**

Genera : BICELLARIA, Blainville.

BUGULA, Oken.

Species new to Britain, *B. gracilis*, Busk, var. *uncinata*.

BEANIA, Johnston.

Fam. 5. **Notamiidæ.**

Genus NOTAMIA, Fleming.

Fam. 6. **Cellariidæ.**

Genus CELLARIA, Lamx. (part.).

Fam. 7. **Flustridæ.**

Genus FLUSTRA, Linnæus.

Fam. 8. **Membraniporidæ.**

In dealing with the section of the Polyzoa that includes the *Membraniporidæ* and *Escharidæ* of Busk, and some allied genera, there can, I think, be no doubt that, if we are seeking a natural classification, we must base the families, for the most part, on the characters of the zoecium. To found them on the manner of growth (however convenient the method may be as an artificial contrivance) would be to place the mere accident before the essential elements of structure. Groups thus formed, instead of fitting in with natural affinities, would traverse them at all points. The venerable family of the *Escharidæ* (auctt.) is a mere jumble of incongruous elements, and no more represents the order of nature (the actual relationships of the forms which compose it) than would a group of plants founded on the colour of their flowers. Whatever judgment may ultimately prevail respecting the constitution of *genera*, it will hardly, I think, be disputed that the first step towards a natural classification in this department must be the reform, in the sense which I have indicated, of the larger groups.

Genera : MEMBRANIPORA, Blainville.

MEGAPORA, Hincks.

Fam. 9. **Microporidæ.**

Genera : MICROPORA, Gray.

## STEGANOPORELLA, Smitt.

Species new to Britain, *S. Smittii*, mihi (= *Membranipora andegavensis*, Busk, 'Crag Polyzoa;' but not, I believe, the *Eschara andegavensis* of Michelin).

## SETOSELLA, Hincks.

## Fam. 10. Cribrilinidæ.

Genera: CRIBRILINA, Gray.

Type *C. radiata*, Moll.

## MEMBRANIPORELLA, Smitt.

Type *M. nitida*, Johnston.

## Fam. 11. Microporellidæ.

Genera: MICROPORELLA, Hincks.

Type *M. ciliata*, Pallas.

## DIPORULA, nov. gen.

*Zoæcia* calcareous, without a membranous area or raised margins; orifice arched and expanded above, contracted below, and slightly constricted by two lateral projections (horseshoe-shaped), lower margin straight and entire; a semilunate pore on the front wall. *Avicularia*. *Zoarium* (in the only British species) erect, with cylindrical branches.

Type *D. verrucosa*, Peach.

## CHORIZOPORA, nov. gen.

*Zoæcia* without a membranous area or raised margins, more or less distant, connected by a tubular network; orifice semi-circular, with the inferior margin entire; no special pore.

Type *C. Brongniartii*, Audouin.

## Fam. 12. Porinidæ (part.), D'Orbigny.

Genera: PORINA, D'Orbigny.

## ANARTHROPORA, Smitt.

## LAGENOPORA, Hincks.

## ? CELLEPORELLA, Gray.

Including *C. lepralioides*, Norman, and *C. pygmæa*, id.

I feel very doubtful as to the true position of these forms.

Their affinities are obscure; but they have no relationship with *Cellepora*, as their name might be taken to imply. The free tubular orifice with which both the species are furnished is a Porinidan character; and on the strength of it I place them, provisionally at least, in this group.

Fam. 13. **Myrizoidæ** (part.), Smitt.

Genera : SCHIZOPORELLA, Hincks.

This genus includes members of the old *Lepralia*, Johnston, with a semicircular or suborbicular orifice, and a sinus on the lower margin, however they may differ in superficial sculpture, in the number and position of the avicularia (most unstable characters), the shape of the cells, or the habit of growth. *Hemeschara sanguinea*, Norman, also finds a place in it, ranking alongside its near ally *Lepralia linearis*, Johnston.

I have not separated from it *Lepralia venusta*, Norman, notwithstanding the remarkable shape of its orifice, as we have transitional forms between it and the usual structure in this genus (e. g. in *S. sanguinea*), and the peculiarity lies in a mere matter of detail, and does not affect the type.

*Schizoporella cristata*, nov. sp.

*Zoæcia* small, short-ovate or rhomboidal, distinct, convex, divided by rather deep sutures; surface silvery, smooth or slightly furrowed, with a few punctures; orifice suborbicular, with a central sinus below, and five marginal spines; immediately under the lower margin a prominent mucro, from which the elevated peristome passes off on each side, forming with it a wall round a large proportion of the orifice; on the inner side of the mucro a very small and delicate *avicularium*, with pointed mandible directed straight upwards. *Oæcia* (proportionally) large, subglobose, punctured, with an erect, crest-like ridge running across them at the top.

*Primary cell* very small, suborbicular, sides sloping steeply upwards, the summit occupied by an oval area, at the upper part of which is placed the semicircular orifice, situated below; six spines round the orifice and three on the lower border of the area.

*Loc.* Hastings, on *Pecten maximus* (*Miss Jelly*).

MASTIGOPHORA, Hincks.

Type *M. Hyndmanni*, Johnston.

## SCHIZOTHECA, Hineks.

The two species included in this genus (*S. fissa*, Busk, and *S. divisa*, Norman) have the primary orifice sinuated, but are distinguished by their raised tubular secondary orifice, notched in front, and (as a subordinate character) by the fissured ovicell.

## HIPPOTHOA, Lamx.

I retain this genus for the forms with distant, caudate cells, and a small aperture completely covered (or nearly so) by the opercular valve (*i. e.* destitute of any membranous area). *H. catenularia* auctt. belongs, as Smitt has already pointed out, to the genus *Membranipora*.

## Fam. 14. Escharidæ.

Genera: LEPRALIA (part.), Johnston.

This genus is adopted as limited by Smitt, and embraces forms with a more or less horseshoe-shaped orifice, the lower margin of which is neither sinuated nor elevated into a mucro. I have ranged under it one or two species whose systematic position is somewhat doubtful, but which seem to agree with it more nearly than with any other group. One of these, *Lepralia pertusa*, Esper, has been much misunderstood; and very distinct forms have been referred to it by authors. I cannot agree with Smitt in ranging it alongside *Schizoporella sanguinea*, Norman, as it has in no true sense a sinuated margin. The two lateral projections by which the orifice is constricted are placed very near the bottom of it; and just beneath them the lower lip curves slightly outwards, as it commonly does in the present genus; but there is no approach to a sinus. The general character of the cell, as well as the structure of the orifice, ally it to this genus. Another doubtful species, *Lepralia polita*, Norman, is placed here on the strength of its simple semielliptical orifice, with a slightly curved lower margin, which is without sinus, denticle, or mucro.

*Eschara foliacea* auctt. of course finds its place beside *Lepralia Pallasiana*, Moll. Whatever amount of doubt there may be as to associating definitely branched with crustaceous forms in the same genus, there can, I conceive, be none as to the propriety of uniting the latter with such kindred species as are erect and *foliaceous*, whether they be unilamellate (*Hemeschara* of authors) or bilamellate (*Eschara*). The three conditions are met with in the same *species*, according to age and other circumstances. In some cases the crustaceous habit

prevails, as in *Lepralia Landsborovii*, Johnston, in which the relation of the three modes of growth may be well studied; in others the foliaceous, as in *Eschara foliacea* auctt. These differences involve neither change in the plan of gemmation nor any other structural peculiarity, and are really quite immaterial.

The following species belong to the genus *Lepralia* :—

- L. Pallasiana*, Moll.
- L. canthariformis*, Busk.
- L. foliacea*, Ellis and Solander.
- L. pertusa*, Esper.
- L. adpressa*, Busk.
- L. hippopus*, Smitt.
- L. edax*, Busk.
- ? *L. polita*, Norman (a somewhat aberrant form).

#### PORELLA, Gray.

*Zoecia* with the primary orifice semicircular; secondary (or adult) orifice elongate, inversely subtriangular or horse-shoe-shaped; an avicularium, usually with a rounded mandible, within the lower margin.

I place in this genus the following :—

- P. concinna*, Busk.
- P. minuta*, Norman.
- P. struma*, id. (*Hemeschara* auctt.).

With erect zoarium.

- P. compressa*, Sowerby (= *Cell. cervicornis*, Johnston).
- P. levis*, Fleming.

All the species here associated possess zoecia which are essentially identical in the adult state, and pass through the very same course of development. A minute and careful study of all the forms has convinced me that, *so far as the cell is concerned*, they are most intimately connected, and that none but specific distinctions exist amongst them. The various phases of the cell-growth correspond throughout the series. *Porella concinna* and *Porella compressa* (*cervicornis*) have precisely similar structural elements: their habit of growth is dissimilar. The question arises, Is the minute agreement of the cells, or the difference in their grouping the most important point? Is it more philosophical to unite them in one genus on the strength of their structural similarity or to separate them for their diverse habit? If they are separated, it must be on the single ground of the difference in the

grouping of the cells; and were this course adopted in such a protean class as the Polyzoa, we should have an indefinite multiplication of genera (see D'Orbigny's system of classification). The essential structure of the individual cell must certainly be accounted the most important point, both in itself and as a clue to relationship; and by giving the mere grouping a coordinate place beside it we should run the risk, it seems to me, of diverting attention from those natural affinities which it is the great object of all our classification, as far as possible, to indicate.

Unless we are content with the old (and certainly very simple) method of lumping all erect forms together, without any reference whatever to the cell, we have only a choice between these two courses—to found genera for the variations of growth as well as for the more important modifications of cell in each family, or to make the zoecium the basis of the genus and treat the ordinary variations of habit subsectionally. I was at one time inclined to the former method\*; but further experience of the practical work of classifying the Polyzoa has brought me, to a much greater extent, into sympathy with Prof. Smitt's views. In a case like the present the true end of classification, the display of natural relationship, will, I think, be best attained by throwing the species with similar cells into one genus, and marking by distinct headings the varieties of growth.

It may be noted here that no recent systematist, if we except D'Orbigny, has proposed to separate the crustaceous *Celleporæ* from those which are erect and ramose; yet the latter are as definite in their branching and the structure of their stems as the *Escharæ*. And, to take an analogous case in another section of the Polyzoa, by universal consent the incrusting and the up-growing ramified *Alcyonidia* are grouped in one genus.

#### SMITTIA, nov. gen.

(=*Escharella*, Smitt, not of D'Orbigny.)

*Zoecia* with the primary orifice suborbicular, the lower margin entire and dentate; peristome elevated and forming a secondary orifice, which is channelled in front; generally an avicularium below the sinus. The *zoarium* in British species is either incrusting or rises into foliaceous expansions, with the cells in a single or double layer.

For this group Smitt employs the name *Escharella*; and

\* *Vide* a paper by the author in the 'Annals' for December, 1877, p. 523.

there would be the weightiest reasons for respecting his practice if this designation had not been so variously used that nothing but confusion seems likely to be caused by perpetuating it. It was first introduced by Gray, accompanied by an unintelligible diagnosis, for a miscellaneous group of *Lepraliæ*, none of them referable to the present genus. D'Orbigny afterwards connected it with a very definite form, allied to our *Cribrilina* (or identical with it), and made it the type of a family, the Escharellidæ. Smitt himself has not been very constant in his mode of applying the name, having first given it to a somewhat heterogeneous collection of species and afterwards to a mere section of it.

It seems undesirable that terms which have been thus bandied about until they have been emptied of all fixed meaning should be retained. Science is only confused by the perpetuation of names which have been used as labels, now for one form and now for another. And especially may it be deemed objectionable to appropriate and put to a totally different use a term which has a place in so important a work as the 'Paléontologie Française.' I have great pleasure in substituting for this questionable name another which commemorates one of the most able workers in this department of zoology.

This is a very natural and well-defined generic group, and includes the following British species:—

- Species: *S. Landsborovii*, Johnston.  
*S. porifera*, Smitt.  
*S. crystallina*, Norman (?var. of *Landsborovii*).  
*S. reticulata*, Macgillivray.  
*S. affinis*, Hincks.  
*S. trispinosa*, Johnston.  
*S. cheilostoma*, Manzoni.  
*S. marmorea*, Hincks.  
*S. bella*, Busk.

PHYLACTELLA \*, nov. gen.

*Zoecia* with the primary orifice more or less semicircular, the lower margin sometimes dentate, surrounded by an elevated peristome, which is not produced or channelled in front. No avicularia.

- Species: *P. labrosa*, Busk.  
*P. collaris*, Norman.  
*P. eximia*, Hincks.

\* From φυλακτός, fortified.

This genus is instituted for two or three species which seem to lie outside the preceding group, though nearly related to it. *P. labrosa*, with its triplet of denticles, its elevated peristome, and its porous surface, exhibits much affinity with such forms as *S. Landsborovii* and *S. crystallina*. *P. eximia* agrees with it in most points; but the pores are only present round the margin. In *P. collaris* both pores and denticles have disappeared. The chief distinction between this genus and the last lies in the character of the secondary orifice, which in *Smittia* contracts in front into a deep channelled sinus, whilst in *Phylactella* it is rounded in front and entire. The primary orifice in the present group is almost semicircular; and there is a total absence of avicularia.

#### ESCHAROIDES or ESCHARA, Smitt.

Under one of these names two species may be associated, which, I believe, exhibit essentially the same structure of cell, though the zoarium is in one case compressed and branched, in the other cylindrical, and, as far as we know, simple—differences which are not of any special importance.

*Zoecia* with the primary orifice suborbicular; peristome much elevated, and forming a secondary orifice, arched above and with a sinus below, within which an avicularium is enclosed.

Species: *E. rosacea*, Busk.

*E. quincuncialis*, Norman.

#### MUCRONELLA, Hincks.

This genus is equivalent to the *Discopora* of Smitt, but not of Fleming, who originated the name for species belonging to a totally different section of the Polyzoa (the Cyclostomata), with which it is still connected in the slightly modified form *Discoporella*. It includes a considerable number of British species, which constitute one of the best-defined groups in this section.

Species: *M. Peachii*, Johnston.

*M. ventricosa*, Hassall.

*M. variolosa*, Johnston.

*M. laqueata*, Norman.

*M. abyssicola*, id.

?*M. microstoma*, id.

*M. coccinea*, Johnston.

?*M. pavonella*, Alder.

#### PALMICELLARIA, Alder.

From a careful study of the structure and development of the



zoecia in the three species rankel under this genus, I have little doubt that they are rightly associated. The form first described by Alder under this name had its cells disposed in four longitudinal series, and in this respect differs from its congeners; but the mere number of the rows can have no generic import\*.

*Zoecia* with the primary orifice orbicular, or varying from semicircular to semielliptical; the peristome elevated around it and carried out into a projecting palmate or mucronate process, with an avicularium on its inner aspect. *Zoarium*, in the British species, erect and ramose.

Species: *P. elegans*, Alder.

*P. Skenei*, Ellis and Solander.

*P. lorea*, Alder.

?? *P. cribraria*, Johnston.

#### RHYNCHOPORA, Hincks.

Species: *R. bispinosa*, Johnston.

#### Fam. 14. Celleporidæ.

In his later writings Prof. Smitt has abandoned this family, and has placed his genus *Cellepora* amongst the Myrionozoidæ. With great deference to his opinion, I venture to think that there are sufficient grounds for its retention. The erect habit of the cells and the confused way in which they are aggregated are not the only characters which distinguish this section and mark it off from the neighbouring families.

The character of the cells is very uniform and distinctive; in this respect the facies of the group is well marked and sufficiently differentiates it. The zoecium is more or less urceolate, with a perfectly terminal orifice; and the peristome is usually much elevated round it and carried up into one or more prominent rostra, supporting avicularia. The zoecial characters, as it seems to me, supply a good basis for the family, and, in combination with the vertical habit and the irregular gemmation, indicate a very natural group.

Genera: CELLEPORA (part.), Fabricius.

CELLEPORARIA, Smitt (not Lamx. or D'Orbigny).

The latter genus will include our British *C. Hassallii*.

\* I have not ranged the *Lepralia verrucosa*, Esper, under any of the foregoing genera. It is allied (and not distantly) to *Palmicellaria* through the structure of the zoecial orifice; but there are differences between the two forms which make me hesitate to unite them. Possibly it may be necessary to constitute a genus for the reception of this species.

## Fam. 15. Reteporidæ.

Smitt has also discarded this family in his latest paper\*, and distributed its members. In this I do not see my way to agree with him at present. The structure of the zoarium in *Retepora* is so remarkable and significant that it seems to me to be rightly regarded as the basis of a family. It seems hardly probable that forms exhibiting this marked zoarial peculiarity would be developed sporadically in various groups. It is a more reasonable supposition that the species in which it exists are closely connected genetically.

In taking this view I assume that the structural differences between the zoarium of *Retepora* and that of the other allied Cheilostomata go much beyond the mere reticulate character of the branching†.

Our two British species of this family may be ranked under one genus.

## Genus RETEPORA, Lamarck.

Species: *R. Beaniana*, King.

*R. Couchii*, Hincks.

The foregoing is little more than a mere indication of results. The detailed observations on which they rest and the discussion of doubtful points must be reserved for my 'History.'

No one who has not attempted to frame a natural classification of the Polyzoa can appreciate the peculiar and perplexing difficulties attendant upon the work. Those who have done so will best understand how much indefiniteness must of necessity attach to any system we may devise, how flexible and accommodating it must be to fit in with the facts of nature.

XVIII.—On the Occurrence of a Land-Rail (*Rallus*) in the Island of Aldabra. By Dr. A. GÜNTHER, F.R.S.

IN the year 1876 Commander Wharton started in H.M.S. 'Fawn' on a voyage of survey to the East-African coast; and

\* "Recensio systematica Bryoz. quæ ad insulas Novaja Semlja et ad ostium fluminis Jenisei invenerunt Doctores A. Stuxberg et H. Théel," *Öfv. Kongl. Vetenskaps-Ak. Förhandl.* 1878.

† A difficulty occurs in the case of the *Membranipora sigillata*, Smitt, described in his 'Floridan Bryozoa,' which, according to his account, combines a true Membraniporidan cell with a Reteporine mode of growth. But, on the whole, at present, the reasons for preserving the family seem to me stronger than those for dismembering it. The point requires more extended investigation.

I then took the opportunity of directing his attention to some zoological points which I thought worth investigating, as far as the main object of his mission would permit. Among them I mentioned the fauna of Aldabra.

Commander Wharton visited and surveyed this island, or rather group of islands, in July of last year; and thinking that he would not have withheld his permission, I insert here the following extract from his letter to me, which refers to the Tortoises of the island, and to a remarkable form of Land-Rail, which I propose to describe in this paper.

“H.M.S. ‘Fawn,’ off Zanzibar,  
Aug. 16, 1878.

“ . . . . I have just come from Aldabra, and after much trouble and search succeeded in getting one tortoise, a female, not very large—3 feet 2 inches in length, measuring over the arch of the carapace. . . . I wanted to get a male, as I know yours died; but this one was the only specimen we saw. I think your mind may be at ease as regards any probability of Aldabra being inhabited: a more uninviting place I never saw; the reports about fine timber &c. are pure fabrications. . . . Former reporters have been misled by the great height the mangrove attains, perfectly useless for any purpose, as you know. The surface of the island, which is an upheaved atoll, is coral rock, jagged and rough to a degree that makes it most laborious to get about, even were it not for a most stubborn and tangled brushwood which covers it and tears one’s clothes and person to pieces. There is not a tree in the island except the mangrove and a few casuarinas. The reptiles are now very scarce; we saw no traces of them, except where we captured our one trophy. There is no soil, no sand even for planting cocoanuts, no water except in the cavities of the coral. Mosquitoes are intolerable; and this is the best season of the year for them. Fishing-parties from the Seychelles are the enemies of the tortoise: those naked negroes know their haunts, and their tough skins do not mind thorns or mosquitoes much; and as they find the tortoises good to eat, they have nearly exterminated them. I am sure I am safe in saying that Aldabra will never be inhabited regularly, unless turtle or fish should become more valuable. We were on the look-out for animals of all kinds; but beyond a land-rail there is nothing. This bird never uses its wings, and was easily caught where the bush was not too thick. I have two alive, and, if you think they are worth any thing, can send them to you. I do not see how they could get to the island unless they are indigenous: the wings are quite small; and they never

even flapped them; the muscles, too, are too weak for flight. Except mosquitoes there was hardly an insect, and none that I did not know; very few spiders of a horned kind and large red ants were the only ones I saw, both African. There was a complete scarcity of all life, except sea-birds, frigate birds, boobies, terns, &c., which were found in thousands."

Thus the dove which is said to occur in Aldabra (*Turtur aldabranus*) does not appear to have been seen by Captain Wharton.

The two rails mentioned by Capt. Wharton seem to have died shortly after the date of his letter; for I received from him in December last two skins, one of which, at least, shows by the shortening of the claws that it had been kept in captivity. They are so similar to *Rallus gularis* from Madagascar in size and coloration, that, on first inspection, their identity with that bird seems beyond a question. The rufous colour of the head, neck, and chest, the blackish longitudinal streaks on the back, the sharply defined white patch on the throat, the white- and black-banded under wing-coverts, the white under tail-coverts, and, in the adult, the red coloration of the basal portion of the beak are exactly as in the typical form from Madagascar\*. Of the two specimens one is *adult*: its abdomen and the tibial feathers are of a uniform dull brown colour; and the under wing-coverts are greyish ash with narrow white fasciolæ. In the *younger* bird the abdominal and tibial feathers are brownish grey, neatly banded with white, each feather having a rufous tinge towards the tip. The under wing-coverts are nearly black, and the white bands broader than in the adult. This stage of plumage is exactly the same as in two specimens from Madagascar in the British Museum. Thus, with regard to coloration, there is nothing to indicate any difference between the Madagascar and Aldabra birds.

Neither is there any difference as regards size generally. On the other hand, an incipient reduction in the length of the wing is very conspicuous; this might have been expected as the consequence of insulation within so small an area. But, singularly, this reduction is not compensated by a greater development of the legs; on the contrary, the legs have become shorter (and weaker) in the Aldabra bird, as will be seen from the accompanying measurements:—

\* Hartlaub (*Vögel Madagascar's*, p. 337) introduces into his diagnosis of this bird, "uropygio pallidissime rufescente fasciolato." In the four specimens I have examined, the uropygial feathers are of the same uniform brown, which is the principal colour of the feathers of the back.

<i>Rallus gularis</i> from	Bill. millim.	Wing. millim.	Tarsus. millim.	Middle toe (without claw). millim.
Madagascar, no. 1 (jun.)	41	148	49	44
„ no. 2 (jun.)	39	147	46	41
Aldabra (junr.) . . . .	44	119	42	38
„ (adult) . . . .	45	116	42	34.5

From these measurements it would also appear that the bill (which I have measured along the culmen) is slightly longer in the Aldabra specimens. Hartlaub, who gives the measurements of five Madagascar specimens (including one from the Mauritius), states the length of the bill to vary between 41 and 43 millims., the longest bill observed by him thus being still 1 millim. shorter than in the Aldabra specimen.

The least difference in the length of the wings of our Aldabra and Madagascar specimens is as much as 28 millims. But in four Madagascar specimens examined by Hartlaub the wings were still longer than in ours, viz. 160-162 millims.; and only in one example, that from Mauritius, does he give the length as low as 145 millims. Thus Capt. Wharton's observation that the Aldabra bird never uses its wings is quite in accordance with the actual condition of the organ of flight, and could only be confirmed by an examination and comparison of the bones, if they were available for that purpose. Indeed, as far as it is possible to measure the bones covered by the skin, I have ascertained that the forearm of a Madagascar specimen measures 44 millims., whilst that of an Aldabra example is only 33 millims. long.

Less conspicuous than the reduction of the wing, is that of the leg; yet the fact that both our Aldabra specimens have a shorter tarsus than any of the specimens from Madagascar of which the measurements are known, and that more especially the middle toe is conspicuously shorter, is sufficiently significant to deserve the attention of future observers. Of the specimens examined by Hartlaub two had a tarsus of 52, one of 47, one of 45, and one of 43 millims. The minimum length of the tarsus observed by Schlegel and Pollen (Faune de Madag. Mammif. et Ois. p. 134) was 20½ lines = 47 millims.

*Rallus gularis* is a native of Madagascar, in which island, especially in the northern half, it is common: one specimen only, the type in the Paris Museum, is said to have been brought from Mauritius; but this is evidently only an isolated instance of an individual having strayed to Mauri-

tius. It never colonized that island, as has been the case in Aldabra. It is, of course, impossible to say by what means the bird, which is not a strong flier in its native country, reached Aldabra, an island in a direct line considerably nearer to Madagascar than Mauritius; but no one can doubt that the Aldabra race is a direct descendant from the Madagascar type, which having reached an island in which there was no occasion for exercising its power of flight, disused a mode of locomotion naturally distasteful to it. As an immediate consequence, the muscles and bones of the wing became aborted; and if we are allowed to judge from our domestic aquatic birds, the shortening of the limb, as we observe it in the Aldabra bird, may have been effected within a very limited number of generations. In such a case it seems to me as great an error to efface the evidence of close relationship by giving a distinct binomial term to the descendant race as it would be not to distinguish it at all from the parent type; and no method appears to me to be more appropriate and expressive than to designate the Aldabra bird as *Rallus gularis*, var. *aldabrana*.

XIX.—*On two Races or Subspecies of Indian Birds inhabiting Ceylon.* By Captain W. V. LEGGE, R.A., F.Z.S., &c.

*Acridotheres melanosternus*, n. subsp.

A comparison of the entire series of *Acridotheres tristis* in the national collection, from all parts of India, as well as from localities into which the Indian species has been introduced, such as the Mauritius and Bourbon, has convinced me of the propriety of separating the Ceylonese race; and for it I propose the above title.

Messrs. Blyth and Jerdon pointed out many years ago that the Ceylon birds of this species were darker than the Indian. The former, in his Catalogue of the Birds of the Asiatic Society's Museum (1849), has the following remark:—"No. 574, *Dark variety* from Ceylon. Presented by Dr. Templeton." Jerdon follows, in his 'Birds of India,' vol. ii., with "those from Ceylon appear to be always darker." It is true the Ceylon race is much darker, both as regards the coloration of the upper surface and the hue of the flanks; but the writers in question appear to have overlooked a feature in the plumage of the bird which is constant in the Ceylon race and always absent in the Indian, viz. that the black of the throat descends down the centre of the breast, and passes round above the white

abdomen, forming a sort of border to this region. In the Indian race this part is somewhat lighter than the surrounding plumage, instead of being darker. Specimens from the northern parts of the peninsula are less albescent down the centre of the lower breast, and the sides of it are a pale, though sullied-looking, isabelline colour.

The nearest approach to the coloration of the Ceylonese bird is found, as one would naturally expect, in those from Travancore, which have the black of the throat descending a little more upon the breast than in northern specimens, and have the *inner webs* of the feathers, exactly down the centre of the breast, blackish brown; but this is all, and this trifling amount of nigrescent marking does not continue down to the white of the abdomen.

*Pyctorhis nasalis*, n. subsp.

The Ceylonese race of *Pyctorhis sinensis* has the nostril as black as the bill, there being no trace of the yellow colour round the nostril which characterizes birds from all parts of the Peninsula and Burmah. It is altogether a darker bird than the continental, the latter having the head reddish brown and the outer webs of the quills cinnamon or pale chestnut-red. A comparison of a fine series of Ceylonese with an equally good one of Indian examples shows me that the pale character is constant in the latter, and the dark coloration equally so in the former. The insular bird has the primaries margined externally with reddish brown, which imparts a very different appearance from that which is noticeable in the red closed wing of the Indian form. It is somewhat remarkable that such a peculiar distinction should exist as that which I have noticed in regard to this bird's nostril; and I therefore have proposed the above title for our race, which I think will be found to be a well-marked subspecies of the genus in question.

I trust that ere long these two birds will be figured by Mr. Kculemans's talented pencil in Part II. of the 'Birds of Ceylon.'

MISCELLANEOUS.

*On the Genus Catagma.*

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

GENTLEMEN,—Will you allow me to correct a mistake which occurs in my paper on the genus *Catagma* \*? It is there stated that "no

\* 'Annals,' ser. 5, vol. ii. p. 359.

known calcareous sponge possesses long curved and undulating uniaxial spicules." Any one who looks into Hækel's monograph on the Calcspongia will see that such is far from being the case, several species of calcareous sponges possessing well-marked spicules of this form. My excuse is, that I was unable to consult Hækel's work at the time of writing my paper, and that my last reference to it dates some four years back, when my interest in the Calcspongia was of a more general kind, and not directed to special points of detail.

With regard to the axial canals of calcareous spicules I may take the opportunity to add now that I have come across some large deciduous triradiate forms in which these canals have become much enlarged by solution, and are indeed almost as obvious as in the generality of deciduous siliceous spicules.

I am, Gentlemen,

Your obedient servant,

W. J. SOLLAS.

University College, Bristol,  
Jan. 8, 1879.

*On the new Palæozoic Plant-Group Dolerophylleæ.*

By M. G. DE SAPORTA.

In April 1878 the author communicated to the Academy a note on a new genus of fossil Gymnosperms, for which he proposed the name of *Dolerophyllum*. It was founded in part on the existence of certain large conical buds referred by Göppert to the Musaceæ, and also upon leaves previously regarded as leaflets of *Næggerathia* or of ferns, and clearly allied to *Doleropteris*, Grand-Eury. In the opinion of the latter, *Doleropteris*, *Rhacophyllum*, and *Aphlebia* constituted forms wavering between *Næggerathia* and ferns, the true nature of which has still to be determined.

The author has now studied specimens of *Dolerophyllum* obtained from M. Grand-Eury and also those in the museum at Paris, where he had the cooperation of M. Renault, and he is preparing a memoir on the subject in conjunction with that gentleman. In the meantime he communicates the results of their joint studies.

The *Dolerophylla* constitute a group, probably an order, that of the Dolerophylleæ, equally distinct from the Salisburieæ, represented in the Carboniferous by *Gingkokophyllum*, and from the Cordaitææ, to which, however, this order is somewhat allied by means of certain forms recently observed in America by Mr. Lesquereux.

The leaves of the Dolerophylleæ, hitherto generally confounded with the leaflets of the Neuropteroid ferns under the names of *Cardiopteris*, *Cyclopteris*, *Nephropteris*, and *Aphlebia*, are clearly separated from these by their structure. They are simple, sessile, broadly oval or orbicular, and auriculate at the base, thick, encircled by a cartilaginous border, and constantly present a great number of flabellato-dichotomous nervures, which diverge from the point of attachment and radiate towards the margin, often bifurcating several times. The epidermis was of considerable relative thickness,



and the nervures were enclosed between the two epidermal laminae; but the leaves are especially distinguished by the extreme abundance of gummous ducts. These ducts, of which the true structure is not yet determined, accompany and surround the vascular bundles; in many cases these organs carbonized form filaments substituted, so to speak, for the true nervures, which they conceal while indicating their direction. This character occurs, though in a less degree, in the leaves of the Cordaïteæ.

The leaves of the Dolerophylleæ must have produced on the stems which bore them rounded or transversely ellipsoidal insertion-scars. Such scars occur on the surface of many of the stems hitherto placed under the Calamodendreæ, and the leaves of which are unknown.

The reproductive organs, discovered by M. Renault and ascribed by him to the Dolerophylleæ, are very singular at the first glance; but while they depart from what we are accustomed to see in the Phanerogamia, they attest the existence of a category of plants in which fecundation took place by the agency of corpuscles differing but little, notwithstanding their considerable dimensions and complicated structure, from the grains of pollen observed in the micropyle or in the pollinic chamber of several Palæozoic Gymnosperms.

Thus the Dolerophylleæ will represent, in the midst of a primitive vegetation, in which the Cryptogamia formerly appeared to have an uncontested predominance, an additional phanerogamic element, without any direct relationship to the existing Gymnosperms. But the distant alliance of the Dolerophylleæ with the Cordaïteæ, and the relations of the latter to the Cycadeæ, recently demonstrated by M. Renault, show clearly that in the Carboniferous epoch the Dolerophylleæ were related to a whole series of prototypic phanerogams, of which the Sigillariæ must also have formed part.—*Comptes Rendus*, September 9, 1878, p. 393.

*On the Development of the Chilostomatous Bryozoa.*

By M. J. BARROIS.

1. *Formation of the Larva.*—A. After the stage 32 (*blastema* we may distinguish in the ovum four series of cells, viz. :—1. Four central cells of the inferior surface (these are covered by the peripheral cells, and penetrate into the interior to form the endoderm); 2. Twelve peripherals of the inferior surface, which undergo segmentation transversely to form the oral surface; 3. Eight peripherals of the upper surface, which are segmented longitudinally to form the crown; 4. Eight centrals of the upper surface, which are segmented transversely to form the aboral surface.

B. The four endodermic cells increase rapidly, and soon separate into two distinct parts:—1, a full central mass with its cells irregularly arranged; 2, two peripheral series of large regular cells. The former appears to represent the internal lamella; the second the mesoderm.

C. The internal lamella changes into a voluminous mass of nutritive vitellus, which fills the embryo, whilst the series of mesodermic cells diminish until they become almost invisible.

D. While a nutritive vitellus is thus being formed, the exoderm, which seems here to act the part of blastoderm, begins to form the organs of the embryo. The two principal are the *internal sac* (formerly "stomach") and the *piriform organ* (formerly "pharynx"); the former originates by the invagination of the oral surface, the latter by a local hypertrophy of this same surface, perhaps at the level of the mesodermic bands.

E. The rest of the development is occupied by two important processes:—1. The growth of the crown above the aboral surface, dividing this surface into two distinct portions, the *fold* and the *hood*; 2. The separation of the oral surface into two distinct parts,—that which penetrates within the crown and bears the piriform organ (the *notched plate*), and that in the centre of which the internal sac opens (the *rounded plate*); these are separated from each other by a portion of the crown, to which I give the name of the *intermediate lobe*.

2. *Metamorphosis*. A. ESCHARINÆ (*Leprælia ciliatæ*).—The internal sac devaginates itself and becomes transformed into a plate (*opercular plate*), the lower surface of which serves for fixation. The *rounded plate* which covered this organ sinks down upon itself after its escape and becomes converted into a simple tubular body, which unites the inferior (oral) border of the crown to the middle of the upper surface of the opercular plate. At the same time the crown (containing the notched plate) is observed to turn suddenly and undergo a rotation of  $90^\circ$ , taking its inferior (oral) margin as a fixed point; its upper (aboral) margin describes a semicircle, and thus applies itself against the periphery of the opercular plate. In this movement the crown has carried with it the aboral surface, of which the portion folded back thus becomes visible externally, which from this time constitutes the whole of the external skin, the hood, however, being always distinguishable. At this period the embryo is in the form of a cupule entirely composed of the aboral surface, and having its aperture closed by the opercular plate. The entire crown is contained in this cupule, in the interior of which the vibratile cilia still project; it is contiguous to the whole inner surface of the cupule, and gives origin by its superior (oral) margin to the tubular viscus derived from the rounded plate, which traverses the cavity of the cupule from top to bottom. The lower surface of the opercular plate is destined to unite with the lower margin of the aboral surface to constitute the whole wall of the cell. Its upper surface, on the contrary, unites with the inferior (aboral) margin of the crown in such a manner as to form, with it and the central tubular viscus, a hollow ring, a torus, of the wall of which the notched plate which bears the piriform organ continues to form part. The whole of this ring is destined to degenerate; and it is from it that is derived the thick fatty mass so often described by all authors; nevertheless the notched plate and the piriform organ persist without undergoing this degeneration.

The polypide originates at this period by the invagination of the skin of the hood. In this way is produced an internal sac, which is

nothing but the internal epithelial lamella of the rudiment of the polypide; at the same time the piriform organ is seen to grow and envelop this first part so as to form the external muscular lamella of the same rudiment. Thus we are gradually led to the state of a cell containing a fatty mass and a rudiment of a polypide; the rest of the development is already known.

B. VESICULARÆ (*Serialaria lendigera*).—The notched and rounded plates are seen to bury themselves in the interior and cause fixation; at the same time the two *intermediate lobes*, as well as all the inferior (oral) margin of the crown, close up again above. Thus is produced a first cavity in the form of a double T, wider at the two extremities, which correspond to the sinking of the above-mentioned plates, narrower in the middle, at the level of the two lobes which form two thick projections above them.

Soon after we see the superior (aboral) half of the crown turn so as to surround these two projecting lobes; this turning is not produced by sudden rotation as in the *Escharinæ*, but by devagination like the finger of a glove. Finally there is thus formed a second semicircular cavity, which surrounds the two projecting lobes and is bounded by the superior (aboral) portion of the crown. The aboral surface is, of course, implicated in this movement, and after its closure it forms all the external skin.

At this period the embryo has the form of a rounded sac (the future cell), with an outer skin entirely composed of the aboral surface. Within and in the lower part of this sac there is a compact mass destined to fall into degenerescence, and composed of the long cells of the crown folded three times upon themselves and circumscribing two concentric cavities; this mass fills almost the whole interior; towards the top, however, there exists a cavity which corresponds to the general cavity of the larva, and in which we ought, theoretically, to recognize the *notched* and *rounded plates* with the organs which pertain to them. I have not yet succeeded in recognizing certain traces of the former; but I have often observed in this stage a peculiar mass which may originate from the internal sac.

The rudiment of the polypide seems to me to be formed differently from what we have seen in the *Escharinæ*: there is no invagination of the outer skin; and the internal sac may perhaps act a part in its formation.

C. CELLULARINÆ (*Scrupocellaria scruposa*).—Here we again meet with the same fundamental processes of turning of the crown and formation of the wall of the cell at the expense of the skin of the aboral surface. Attachment takes place by means of a sort of chitinous cupule, which is seen to issue through the aperture leading into the cavity of the turned crown, and which, no doubt, is derived from the secretion of one of the organs of the oral surface.

3. *Conclusions*.—(1) The development of the *Chilostomata* is, on the whole, *meroblastic*; the exoderm gives origin to all the organs, and plays the part of a true blastoderm; true inner lamellæ have only an ephemeral part, and act merely as nutritive vitellus.

(2) Attachment is always effected by the oral pole; and the fundamental fact consists in a turning of the ciliary crown, which, being at first incurved, in the form of a mantle, towards the aboral pole (as in the Cyclostomata), afterwards becomes inflexed towards the oral pole.

(3) The crown constitutes a provisional and essentially larval organ; it is from this that the thick fatty mass so often described in the metamorphosis originates.

(4) The oral and suboral surfaces appear to have each a well-defined part of the highest importance in the embryogeny: the aboral surface represents the cell; the oral surface seems to be destined to play a great part in the formation of the contents of the cell; everywhere we see it penetrate into the interior, wholly or partially, to furnish the rudiments which act in a manner still to be described in the formation of the organs of the adult.—*Comptes Rendus*, September 23, 1878, p. 463.

*Migration of the Aphides of the Galls of the Pistachio to the Roots of Grasses.* By M. J. LICHTENSTEIN.

When I first announced the curious migrations of one of the *Phylloxeræ* of the oak (*P. quercus*, Boyer), from *Quercus coccifera* to *Q. pubescens*, I had the vexation of finding the correctness of my observations doubted by French entomologists; and it was necessary for an Italian naturalist, M. Targioni-Tozzetti, to repeat my experiments upon *Phylloxera florentina*, and establish the fact of the migrations of that species from *Quercus ilex* to *Q. pedunculata*, before the change of *habitat* of the former insect between the second and third larval states was decidedly accepted.

Now I have a still more curious migration to bring before the Academy. The Aphis of the galls of the Pistachio (*Anopleura lentisci*) passes from those galls to the roots of grasses, or, at least, of two species of grasses (*Bromus sterilis* and *Hordeum vulgare*).

On the 12th June last I announced to the French Entomological Society that I had found on the roots of *Bromus sterilis* an Aphis resembling in all points that of the galls of the Pistachio, the characters of which are very strongly marked; for it is the only genus among the Pemphiginæ that carries its wings flat, and the genus has only a single species. But the new comer presented the peculiarity of producing *sexual insects without rostrum*, while that of the galls furnished *larval forms with a rostrum*.

At my suggestion, M. Courchet, a pupil at the School of Pharmacy of Montpellier, has just obtained, in captivity, the breeding of the winged *Anopleura lentisci* upon the young roots of barley sown in a tube; and at the same time I found the same insect at liberty upon the roots of *Bromus sterilis*. These young subterranean wingless forms, produced by the winged aerial form, have already increased in size and are ready to reproduce in their turn.

Applying to the evolution of this insect the theory that I have established with regard to the *Phylloxera quercus*, of the correct-

ness of which I am daily obtaining fresh evidence, I may represent as follows the biological cycle of the Aphis of the Pistachio.

In May and June the egg deposited on the Pistachio by the fecundated female hatches and produces an apterous insect; this is

The *Founder* (first larval form). It produces the gall; and after four moults it produces, in its quality of *viviparous pseudogynæ*, young Aphides, destined to acquire wings and to furnish, after four moults,

The *Emigrants* (second larval form), which quit the gall, fly to the grasses, and then produce apterous young, which are

The *Budders* (third larval form). These bud underground, producing a longer or shorter series of apterous generations, until the period of swarming and of the appearance of nymphs, which furnish

The *Pupifera* (fourth larval form), which issue from the ground and fly to the Pistachio, where they deposit their pupæ, which very quickly produce the sexual individuals which copulate, and of which the female deposits the fecundated egg which serves as the starting point.

I hope soon to be able to give the complete history of other insects of the group Pemphiginæ; for M. Courcelet has already been able to rear two more (*Pemphigus follicularius* and *P. semilunarius*) upon grasses, and those of the poplar and elm are too abundant long to escape our investigations with the data already acquired.—*Comptes Rendus*, November 18, 1878, p. 782.

*A new Order of Extinct Reptiles (Sauranodonta) from the Jurassic Formation of the Rocky Mountains.* By Professor O. C. MARSH.

The absence of the genus *Ichthyosaurus* in the extinct fauna of this country has long been a noteworthy feature; for up to the present time no traces of it have been detected, although its remains are especially abundant in Europe. An interesting specimen, recently discovered in the Rocky-Mountain region, presents, in most of its skeleton, the characteristics of that genus, but is *without teeth*. The vertebræ, ribs, and other portions of the skeleton preserved cannot be distinguished from the corresponding parts of *Ichthyosaurus*; and many features of the skull show a strong resemblance. The general form of the skull is the same. The great development of the premaxillaries, the reduced maxillaries, the huge orbit, defended by a ring of bony plates, are all present; but the jaws appear entirely edentulous and destitute even of a dentary groove.

The proportions of this reptile were very similar to those of *Ichthyosaurus*. The skull is about 2 feet (600 millims.) in length, and the facial portion especially produced. The orbits are very large, and the space between them is 140 millims. The sclerotic ring is composed of only eight plates; its diameter at the base is 106 millims., and at the apex 58 millims. These plates are not

arranged in a nearly flat ring, as in *Ichthyosaurus*, but form the basal segment of an elongated cone, as in the eyes of some birds. The vertebræ are short and deeply biconcave. The neural arch is articulated to the centrum. One trunk-vertebra measures 85 millims. in width, 38 millims. in length on the floor of the neural canal, and 21 millims. between the centres of the two rib-articular faces of the same side. The length of the entire animal was about 8 or 9 feet. The remains at present known are all in the museum of Yale College.

This reptile may be called *Sauranodon natans*, and the order it represents Sauranodonta. This genus bears a similar relation to the Ichthyosaurs that *Pteranodon* does to the true Pterodactyls; and it is interesting to find the two highly specialized forms preserved in the same region.

The geological horizon of the Sauranodontidæ, so far as now known, is in the Jurassic, immediately below the *Atlantosaurus*-beds. The accompanying fossils are *Anmonites* and *Belemnites*, showing more distinctly marine deposits, which may be called the *Sauranodon*-beds.—*Amer. Journ. Sci. & Arts*, January 1879.

Yale College, New Haven, Dec. 27, 1878.

#### Notice of a Tetrarhynchus.

Prof. Leidy stated that in the *Remora*, or Sucker, from our coast, presented this evening by Mr. Holbrook, he had found a curious parasite. This was enclosed in a compressed oval cyst, pearly white, thick-walled, and about half an inch long, tightly adherent to the intestine of the fish. The cyst contained a flask-shaped translucent whitish sac, which was feebly contractile, and furnished at the narrow end with two minute papillæ, which were slowly protruded and retracted. Within this sac-worm, coiled up about the centre, was an opaque white worm or scolex, which proved to be a *Tetrarhynchus*. Removed and extended it measured 7 lines long, and was divisible about equally into a broad anterior body portion, and a posterior narrow tail-like portion. The head was formed of a pair of obcordate bothria inclined from each other. Four long tortuous proboscides extended through the body and projected from the head. The projecting portions were successively elongated and shortened by eversion and inversion, and were armed with recurved hooks. The hooks extended within half the length of the proboscides, and, as they were everted and inverted, appeared like the streaming of liquid through narrow tubes. The tortuous proboscides at the bottom were continuous with as many elliptical pedestals placed at the back part of the body. The tail, about half the width of the body, was not segmented, but exhibited a disposition to assume this condition. The end was slightly tapering, and occupied by a bell-shaped sinus, opening externally, and alternately contracting and expanding. The interior of the sinus was lined, and its mouth thickly furnished with non-vibratile cilia. The species appeared to be undescribed, and was named *Tetrarhynchus tenuicaudatus*.—*Proc. Acad. Nat. Sci. Philad.* Oct. 15, 1878.

# THE ANNALS

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XX.—*On an Anomaly among the Hydromedusæ, and on their Mode of Nutrition by Means of the Ectoderm.* By C. MERESCHKOWSKY.

[Plate XX.]

IN one of my former articles on the Hydroids\* I mentioned, among other things, a new species of small Medusa belonging to the genus *Bougainvillea*, which I named *Bougainvillea paradoxa*, but without giving any description of it. A very short description of it has been given in Russian in the Transactions of the Society of Naturalists of St. Petersburg †.

Here I shall only speak very briefly of the normal Medusa itself, as it is my intention to make another journey to the White Sea, and to make a more detailed investigation of this interesting organism than I have hitherto been able to do. In the present note I shall refer especially to a strange anomaly which may be pretty frequently observed among the normal individuals of *Bougainvillea paradoxa*, and to its physiological consequences.

The adult Medusa does not much exceed 1 centim. in length. Its form (Pl. XX. figs. 1 and 5) is that of a bell slightly contracted at its aperture; there are four radiating canals, each furnished at its extremity with a tuft of from three

\* "Studies on the Hydroida," Ann. & Mag. Nat. Hist. ser. 5, vol. i. April 1878, p. 323.

† Protocoles de la Réunion du 14 Janvier 1878, in vol. ix. p. 33.

to seven tentacles and with a red ocellus. The manubrium, which is deep red, has, when looked at from above, the form of a cross (fig. 2, *a*), from each of the four ends of which starts a radiating canal (fig. 2, *b*). Round the mouth there is a circle of four tentacles dividing dichotomously into a great number of branches. The most remarkable thing about this Medusa is that the ova are developed immediately on the surface of the manubrium; so that the latter, when the ova have become converted into planulæ, acquires a tuberculate aspect, caused by a great quantity of planulæ, forming a layer covering its surface, with one of their ends projecting freely, and the other attached to the wall of the manubrium.

Among the innumerable individuals of this Medusa one occasionally meets with some which, at the first glance, attract the attention of the observer by the complete absence of the coloured manubrium. These are scarcely perceptible, in consequence of their perfect transparency, while ordinarily it is easy to follow their movements by the dark red colour of the manubrium. I thought at first that I had to do with a perfectly different species of Medusa; but on examining it more minutely under the microscope I convinced myself that I really had before me *Bougainvillea paradoxa*.

In fact the form of the bell (Pl. XX. fig. 3), the four radial canals, the four bundles of tentacles, and the four red ocelli are all identical with those of the Medusa that I have just described; but what I ascertained, to my great surprise, was the total absence of the manubrium. I thought at first that there might be a more or less complete atrophy of this organ; and I sought for some remains of it, but in vain. On the contrary, I convinced myself that the individuals in question were completely destitute of manubrium, and that the whole gastrovascular system consisted only of a circular canal and of the four radial canals, which were united at the summit without forming any thing resembling a stomach (figs. 3 and 4).

Moreover I ascertained beyond all doubt that all this gastrovascular system, which was in other respects of normal conformation, had absolutely no opening to the exterior, no buccal or other aperture which might establish a communication between this system and the circumambient water. On placing the Medusa in such a position that I could examine it in the direction of its principal axis, it presented me with the appearance represented in fig. 4. The four canals were seen to unite in the centre without forming any enlargement or cavity even of the most insignificant kind. Under a high power the entodermic cells of the canals and their long cilia in



movement could be easily distinguished; and I should infallibly have remarked an aperture if there had been one.

It is therefore an undoubted fact that among the individuals of *Bougainvillea paradoxa* there are some which have no buccal aperture, no communication between the exterior water and the gastrovaseular system of the Medusa—a fact which appears to me very curious, and furnishing no explanation how the nutrition and growth of the organism can be effected. The fact is the stranger because these anomalies are observed, and indeed most frequently, in Medusæ which are but very little exceeded in size by the normal adult individuals. They must consequently have been able to grow and to nourish themselves, since from microscopic embryos they have attained a size of more than half a centimetre.

Besides *Bougainvillea paradoxa* we find in the White Sea another Medusa belonging to the same genus, but distinguished from the former by the general form of the body (Pl. XX. fig. 6), which is more elegant, with a little cupola placed on the summit of the bell, and further by the possession of eight instead of four black ocelli, by the presence of three tentacles (never more) in each of the four groups, and, lastly, by the very short and sparingly ramified buccal tentacles. This Medusa occurs less frequently than the other; and it is also of rather smaller size.

As in the former species, although less frequently, I have met with individuals which differed from the normal type in having nothing coloured about them except the eight black ocelli, and no red coloration in the centre—that is to say, where the coloured manubrium ought to be situated. The cause was the same, namely the total deficiency of the manubrium (Pl. XX. fig. 7) and of the buccal orifice. As may be seen from the figure, the four radial canals unite without forming a stomachal cavity; and by examining the animal under the microscope the complete absence of any orifice, aperture, or pore by which the sea-water with its nutritive contents might penetrate into the canals is easily ascertained.

It may therefore be proved that, at least in two different species, the Medusa may live, increase in size, and develop itself without having any need of digestive organs, and even, apparently, without nourishment, since the latter cannot penetrate into the gastrovascular system. One cannot help asking how all these functions can be performed, how the Medusa can grow and become a complete Medusa from an almost imperceptible embryo, without the aid of organs of nutrition and without food. The supposition that all this can take place without nourishment is absurd and cannot be accepted; it is

absolutely necessary that the Medusa should be nourished in some way or another to be able to grow; it remains therefore to discover the means by which the nutrition of the normal animals is replaced in the case of the anomalies in question. After searching through all the possible means, I can only rest upon a hypothesis which seems to me the only probable one. We are led by the facts to admit that *the Medusa can nourish itself by means of its ectoderm by absorbing the organic material dissolved in the sea-water.*

This supposition is the more probable since, as I have demonstrated in the case of the sponges\*, these, in certain cases, also nourish themselves upon organic matter dissolved in sea-water, and also by means of their ectoderm. The comparatively large number of anomalies of this kind that I have been able to observe prove that it is by no means an impossible thing, or even very difficult, for a Medusa to dispense with its entoderm in order to live and attain nearly its normal size, just as is the case in certain sponges. We must therefore conclude that, in certain cases at least†, the ectoderm may fulfil the function of the entoderm; that is to say, it may, as well as the latter, extract and assimilate the organic matter dissolved in water‡. That we have really to do with organic matters dissolved in the water, and that it is not in the form of solid particles that the nourishment is absorbed, cannot be doubted; for the examination of the surface of the Medusa proves that it never contains any such particles. We should thus have two cases of such nutrition almost completely proved—in the class of Sponges, and in that of the Hydromedusæ. What has just been stated may be summarized as follows:—

1. Two species of Medusæ (of the genus *Bougainvillea*) present pretty commonly an anomaly which consists in the complete absence of the manubrium and buccal orifice, and which thus presents no communication of the gastrovaseular system with the circumambient water.

\* C. Mereschkowsky, "Études sur les Éponges de la Mer Blanche," Mém. Acad. Sci. St. Pétersb. tome xxvi. no. 7 (1878), pp. 12, 13.

† I say "at least," because it is more than probable that in the normal condition the ectoderm also assists in nutrition. There is no reason to endow the ectoderm with this faculty in one case, and to deprive it of it in another. It is probable that, in the two classes of the Sponges and the Hydromedusæ, the two layers are not yet entirely differentiated, although the experiments of Trembley with *Hydra* and the conversion of its entoderm into ectoderm have not been confirmed by the recent experiments of M. Engelmann (see 'Zoologischer Anzeiger,' 1878, no. 4).

‡ It is probably for this reason that we so often meet with this anomaly, that the Medusa can do without the entoderm, and yet nourish itself and grow.

2. As nutrition cannot take place by means of organs of digestion (*i. e.* of the entoderm) it must be effected by the ectoderm, by the absorption of the organic materials dissolved in sea-water.

St. Petersburg, Dec. 10, 1878.

#### EXPLANATION OF PLATE XX.

*Fig. 1.* *Bougainvillea paradoxa*, Mer., normal form, enlarged.

*Fig. 2.* The same, from above: *a*, manubrium; *b*, radial canal.

*Fig. 3.* An abnormal individual, destitute of stomach and of buccal aperture.

*Fig. 4.* The same, from above.

*Fig. 5.* A normal Medusa of the natural size.

*Fig. 6.* Another species, normal individual, rather more enlarged than figs. 1-4.

*Fig. 7.* The same, abnormal individual, without manubrium and buccal orifice.

XXI.—*On the Structure of Amphibola avellana.* By F. W. HUTTON, F.G.S., Professor of Natural History in the University of Otago, New Zealand.

[Plate XXII.]

MM. QUOY and GAIMARD were the first to study the anatomy of *Amphibola avellana*; and their researches were published in the 'Zoology of the Voyage of the Astrolabe' (vol. ii. p. 196, pl. xv. figs. 1-8). They ascertained that it was a true pulmonate, with the pulmonary cavity closed in front, and that it was hermaphrodite. So far as I know, this is the only description published of the anatomy of any member of the genus; and as their account is inaccurate in several points, the following results of an examination I have lately made of the same species will not be without interest.

The animal lives between tide-marks in salt or brackish water, on mud flats in sheltered bays. When found at all, it is always found in large quantities. It is very sluggish in its habits, and feeds on the vegetable matter contained in the mud, passing large quantities through its alimentary canal. Although air-breathing, it will live for a week or ten days in fresh water, and for more than a fortnight in salt water without being exposed to the air.

I have nothing to add to the description of its general form given by MM. Quoy and Gaimard, except to point out that they overlooked the two small, flattened, triangular tentacles just in front of the eyes (fig. 1, *c*). These tentacles can be

retracted, and are occasionally emarginate at the apex. I should also call the colour of the head-lobes, and the parts of the mantle hidden by the shell, blackish purple, and not dark brown.

The pulmonary cavity is large, ciliated, and completely closed in front; the opening is on the right side close to the anus (fig. 1, *a*, and 8, *a*). The principal opening is in front of the anus; but it is continued as a narrow slit above and behind it. Lying transversely on the roof of the cavity is a large, pale yellow, pectinate renal organ (fig. 2, *f*), which opens outwards at its apex on the right side above the pulmonary opening. This organ contains large quantities of loosely aggregated colourless spherical cells, from  $\cdot 0003$  to  $\cdot 00075$  inch in diameter, containing dark nuclei, similar to those found in this organ in other pulmonates. Two muscular slips, one of which divides into several portions, arise from the base of the columellar muscle, and are inserted into the roof of the pulmonary cavity.

The heart lies in the left anterior corner of the pulmonary cavity, close to the base, or broadest end, of the renal organ (fig. 2, *g*, and 3, *n*). The ventricle is yellow in colour and pyriform in shape, the larger end being turned to the auricle, which receives the blood from the renal organ. The ventricle is posterior to the auricle. The aorta soon divides; but I have not been able to trace out the circulatory system. The large vein (?), described by Quoy and Gaimard as lying on the roof of the pulmonary cavity, alongside the rectum, is plainly visible; but I have not succeeded in tracing its connexions. It certainly does not proceed from the heart in the way shown by Quoy and Gaimard's figure.

Throughout the whole animal, but especially on the oviduct, the connective tissue secretes oval calcareous granules, formed of concentric layers, which much resemble in appearance grains of wheat-starch (fig. 14). These granules do not depolarize light.

The mouth is soft, without any horny jaws. The buccal mass (fig. 3, *a*, and 4) is not large. The odontophore (fig. 5) is spatulate, with transverse rows of about thirty teeth. Each transverse row consists of a single median (or rachis) tooth, with about fourteen laterals on each side. The rachis-teeth (fig. 7) are blunt, bilobed at the base, and with two or three small cusps or denticulations on each side. The lateral teeth (fig. 6) are simple, strong, and curved, the apex being rather blunt; they are placed so that the convex side of each tooth lies inwards. The orbis radulæ is toothless; the anterior transverse rows form a double curve, the rachis-tooth occupy-

ing a salient angle directed anteriorly, from which the row curves backward and outward on each side. This salient gets smaller and smaller in the rows lying behind the first, until it disappears near the middle of the odontophore, and all the posterior rows form a single curve with the concavity directed forwards. The apices of the teeth point forwards\*.

The œsophagus tapers gradually, and then again dilates. It then suddenly contracts to form an oblong crop slightly constricted in the middle (fig. 3, *e*). From the crop to the stomach it is straight; and in the anterior half of this portion a small cæcal, clavate diverticulum opens on the right side (fig. 3, *f*). The stomach is complicated, being formed by a short simple anterior pouch and a long posterior one, which is curled and crenated on its posterior and left border (fig. 3, *g*). On the right of the stomach lies a globular gizzard (fig. 3, *h*), formed of two strong muscular hemispheres, with a double canal between them. The food passes into this canal on the left lower side of the gizzard, upward on the right side (where the canal forms a projection between the lobes), and out on the left upper side. The duodenum is large, and tapers gradually into the intestine, bending over to the left. The intestine runs straight forward to the heart; it then turns to the right and passes backward to the albumen-gland†, round which it makes five reversed coils (only three are shown in the figure), and ends with a straight rectum. The anus is bifid below (fig. 8, *b*). The œsophagus and the whole of the intestine are longitudinally folded; and the folds in the intestine form purple streaks. Both are ciliated internally. The liver is large, single, branched, botryoidal, and purple in colour. It contains numerous lenticular chocolate-brown concretions. The hepatic duct opens into the pylorus, just opposite the gizzard (fig. 3, *i*). The salivary glands are linear, sacculated, and attached by their ends to the upper surface of the œsophagus (fig. 3, *c*, and 4, *d*).

The nervous system consists of a gangliated œsophageal ring, sending fibres to all parts of the body. The two cerebral ganglia (fig. 9, *a*) are small and far apart, and connected by a strong supracœsophageal commissure. The pedal ganglia are approximated, connected together and with the cerebral ganglia (fig. 9, *b*). The parieto-splanchnic system consists of seven ganglia—three on each side (fig. 9, *c*), and an azygos

\* Some mistake must have been made with respect to the drawing of the teeth of *Amphibola*, given in the 'Catalogue of the Pulmonate Mollusca in the British Museum,' part i. p. 5; for it does not in the least resemble the real thing.

† This is the supposed testicle of MM. Quoy and Gaimard.

infracæso-phagal ganglion (fig. 9, *d*) connected with the others on either side. Of the lateral ganglia the anterior lies on the commissure connecting the cerebral and pedal ganglia, the middle one is small, and the posterior is the largest in the system. All the ganglia are coloured yellow. An auditory vesicle lies on the lower anterior face of each pedal ganglion (fig. 9, *b*, and 10, *a*). It is globular, sessile, about  $\cdot 006$  inch in diameter, and contains numerous small lenticular otoliths, which have a very active movement. These movements, however, soon cease; and it is necessary to examine the parts quickly in order to see them. A canal, often containing otoliths near the vesicle, leads away from it forwards; but I have not succeeded in tracing it out; no doubt it proceeds to the surface.

*Amphibola* is hermaphrodite; and the reproductive organs (fig. 11) are formed on the same pattern as those of other pulmonates; but there is no spermatheca. The ovo-testis is a large much-ramified organ, of a yellowish-brown colour, occupying with the liver the whole of the spiral portion of the animal. These two organs are so interramified that I have found it impossible to separate them completely. The spermatozoa are developed in the interior of the follicles, the ova at the ends of them only. From the ovo-testis leads a long zig-zagged hermaphrodite duct (fig. 11, *b*) \*, which is ciliated internally and displays active peristaltic movements. Towards its anterior end a small pyriform cæcum (fig. 11, *c*) opens into it, and a little below this the duct from the albumen-gland. This organ consists of two parts—a large globular albumen-gland proper (fig. 11, *e*) of a bright orange-colour, and an accessory gland (fig. 11, *d*) †, yellow-ochre in colour, formed apparently of convoluted ciliated tubes, the function of which I do not know. It contains small hyaline granules, similar to those in the albumen-gland, but much smaller.

Soon after receiving the duct from this gland the hermaphrodite duct appears to divide into a large sacculated oviduct and a narrower but still broad vas deferens. The oviduct, however, is so delicate and so firmly bound to the integument that I have not been able to satisfy myself as to how it leaves the hermaphrodite duct. The oviduct (fig. 11, *g*) gets gradually smaller anteriorly. It lies immediately inside of the rectum (fig. 2, *o*), to which it is firmly attached, and appears to open inside the respiratory cavity; but of this I am by no means certain. The vas deferens (fig. 11, *f*) ‡ pursues a tor-

\* This is the oviduct of Quoy and Gaimard.

† This is the swollen end of the uterus of Quoy and Gaimard.

‡ This is the uterus of Quoy and Gaimard.

tuous course forward, gradually narrowing, and then turns suddenly at a right angle to join the base of the penis. It is very muscular in structure, ciliated internally, and shows a well-marked peristaltic action. The penis (fig. 11, *h*) is short, thick, and bifid at the apex. At its base open two different organs: one, of a bright yellow colour, probably the prostate (fig. 11, *i*), is a long coiled tube, which can be opened out, as shown in fig. 11. It is much like the prostate in *Peronia*. The other (fig. 11, *k*) is white, and formed of highly muscular coiled tubes. It is probably a vesicula seminalis; but I have never found any spermatozoa in it. The opening for the penis is situated just behind the right eye (fig. 1, *b*). The retractor muscle is attached to the basal half. The spermatozoa are long and filiform, gradually enlarging anteriorly, but without a distinct head. The anterior portion is spirally twisted (fig. 13). They are active, and coil up on the application of fresh water. Their length is more than  $\cdot 01$  inch, while their greatest thickness is about  $\cdot 00005$  inch.

The ova are elliptical, with an average length of  $\cdot 006$  and an average breadth of  $\cdot 004$  inch. After passing from the oviduct they are lodged on the exterior of the mantle, in a circular patch, near the opening of the renal organ. I believe that they are impregnated here, as I have found what I took to be dead spermatozoa among them. Afterwards they acquire a thick coat, which gives them a bluish-white pearly appearance. The empty capsules have an irregular radiating structure and a circular hole at the top, through which the young animal has escaped (fig. 12).

I have not attempted to make out the development of the ova; but the embryo does not appear to possess any velum, and I have never observed it to be externally ciliated at any period.

#### EXPLANATION OF PLATE XXII.

- Fig. 1.* Animal in its shell. *a*, respiratory aperture; *b*, opening of penis; *c*, eye at the base of the tentacles.
- Fig. 2.* General view of the anatomy of the animal. *a*, œsophagus; *b*, gizzard; *c*, stomach; *d*, intestine; *e*, rectum; *f*, renal organ; *g*, heart; *h*, columellar muscle; *i*, foot; *k*, operculum; *l*, oviduct and liver; *m*, hermaphrodite duct; *n*, albumen-gland; *o*, oviduct; *p*, vas deferens; *q*, penis.
- Fig. 3.* Digestive apparatus. *a*, buccal mass (from above); *b*, extrinsic muscles; *c*, salivary glands; *d*, œsophagus; *e*, crop; *f*, cœcum; *g*, stomach; *h*, gizzard; *i*, liver; *k*, intestine; *l*, rectum; *m*, anus; *n*, heart; *o*, aorta; *p*, auricle; *q*, renal organ.
- Fig. 4.* Buccal mass, viewed from the right side. *a*, mouth; *b*, radula-sac; *c*, extrinsic muscle; *d*, salivary gland.
- Fig. 5.* Odontophore.
- Fig. 6.* A lateral tooth from the right side.

Fig. 7. A rachis-tooth.

Fig. 8. Right side of the neck. *a*, respiratory orifice; *b*, anus.

Fig. 9. Nervous collar. *a*, cerebral ganglia; *b*, pedal ganglia; *c*, parieto-splanchnic ganglia; *d*, azygos ganglion of parieto-splanchnic system.

Fig. 10. One of the pedal ganglia. *a*, auditory vesicle.

Fig. 11. Reproductive system. *a*, ovo-testis; *b*, hermaphrodite duct; *c*, pyriform cæcum; *d*, accessory gland; *e*, albumen-gland; *f*, vas deferens; *g*, oviduct; *h*, penis (retracted); *i*, prostate gland; *k*, vesicula seminalis; *l*, retractor muscle of penis; *m*, orifice of penis.

Fig. 12. Empty egg-case from a group on the outside of the mantle.

Fig. 13. Spermatozoa.

Fig. 14. Calcareous granule from connective tissue.

XXII.—On a Collection of Lepidoptera from the Island of Johanna. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

HITHERTO next to nothing has been known of the Lepidopterous fauna of the island of Johanna; it is therefore with great pleasure that I have drawn out the following list of species collected there in September last by C. W. Bewsher, Esq.

The collection contains twenty-four species of Butterflies and three of Moths; of these twenty-seven no less than twenty have a strongly marked Mascarene character, whilst fourteen are species found also in Madagascar: only twelve of the species have hitherto been received from Tropical Africa.

RHOPALOCERA.

Nymphalidæ.

DANAINÆ.

1. *Danais chrysippus*, Linn.

*Papilio chrysippus*, Linn. S. N. ii. p. 767 (1766).

Three pairs of this widely distributed species.

SATYRINÆ.

2. *Mycalesis fraterna*, Butler.

*Mycalesis fraterna*, Butler, Cat. Sat. p. 145, pl. iii. fig. 13 (1868).

Two forms of this species occur in about equal numbers, the typical form having the under surface of the wings wholly ochraceous with the outer line of the secondaries distinctly angulated, the second form having the apical and costal regions



of the primaries and the whole of the secondaries more or less suffused with bluish grey, with the outer line distinctly undulated: similar cases of dimorphism have been recorded in other species of *Satyrinæ*. In Madagascar the two forms of *M. fraterna* also occur; but the differences between them are much more strongly marked, and the greyish variety shows even greater modifications in the form of the outer line of secondaries.

### 3. *Mycalesis anynana*, n. sp.

♂. Dark fuliginous brown, external two fifths of primaries rather paler, limited by a straight transverse line; two round unipupillate black ocelli with pale irides, one small, near the apex, the other four times as large, upon the first median interspace; two dusky submarginal lines; marginal lines black: secondaries with an extremely small ocellus (a mere dot, although with pupil and iris) upon first median interspace; outer border pale, with dark lines as in the primaries. Wings below rather paler, the basal two fifths striolated with dark brown, limited externally by a continuous whitish-bordered dark brown line, convex beyond the cell of each wing; a whitish discal belt enclosing the ocelli; outer border whitish, with zigzag internal margin, intersected by a dark brown submarginal line; marginal line black; a dark brown line crossing the cells, pale-bordered and diverging from the postmedian line upon the primaries, indistinct, not pale-bordered, and almost parallel to the postmedian line on the secondaries: primaries with two ocelli, situated as above but larger, black with white pupil and brown-edged ochreous iris: secondaries with seven small ocelli, the fourth and fifth twice as large as the others. Expanse of wings 1 inch 7 lines.

♀. Larger and paler on both surfaces than the male; the ocellus on the upper surface of the secondaries equal in size to the subapical ocellus of primaries. Expanse of wings 1 inch 8-11 lines.

Four males and two females; the larger female is rather darker than the other, and the markings are not so well defined.

Allied to *M. technatis* of Hewitson.

### 4. *Panopea Bewsheri*, n. sp.

Nearly allied to *P. Drucei* of Madagascar (Trans. Ent. Soc. 1874, pl. vi. fig. 3), but the third large subapical white spot of primaries elongated, the submarginal series of white spots interrupted in the centre, the white lines close to the margin obsolete; outer margin more concave: secondaries with the

central area white, only tinted with yellow along its outer edge, almost circular, and therefore much smaller than in *P. Drucei*; submarginal spots smaller, lines near the margin wanting. Expanse of wings 2 inches 11 lines.

One male.

Several of the species in this collection which most nearly approach those of Madagascar are constant in their differences; otherwise I should hesitate to regard this as more than a well-marked variety of *P. Drucei*.

#### 5. *Junonia rhadama*, Boisduval.

*Junonia rhadama*, Boisduval, Faun. Madag. p. 44. n. 4, pl. 7. fig. 2 (1833).

Three males and a female: the males vary somewhat in intensity of colouring and in the black banding of the primaries.

#### 6. *Junonia clelia*, Cramer.

*Papilio clelia*, Cramer, Pap. Exot. i. pl. xxi. E, F (1779).

Four males and one female; all quite like Natal examples.

#### 7. *Hypanis anvatara*, Boisduval.

*Hypanis anvatara*, Boisduval, Faun. Madag. p. 56, pl. 7. fig. 5 (1833).

Three males and one female, all typical in coloration.

#### 8. *Atella columbina*, Fabricius.

*Papilio columbina*, Fabricius, Ent. Syst. iii. 1, p. 148. n. 453 (1793).

Five examples.

### ACRÆINÆ.

#### 9. *Telchinia manjaca*, Boisduval.

*Acræa manjaca*, Boisduval, Faun. Madag. p. 33. n. 9, pl. 4. fig. 6 (1833).

A pair.

#### 10. *Acræa percussa*, Keferstein.

*Acræa percussa*, Keferstein, Entom. Notiz. p. 13, pl. 1. figs. 1, 2.

A fine female of this beautiful species.

### Lycænidæ.

#### 11. *Lampides pulcher*, Murray.

*Lycæna pulchra*, Murray, Trans. Ent. Soc. 1874, p. 524, pl. 10. figs. 7, 8.

Three males and a female.

12. *Lycæna knysna*, Trimen.

*Lycæna knysna*, Trimen, Trans. Ent. Soc. 1862, p. 282.

A male and two females, slightly greyer below than Natal examples; one of the females very small, only  $8\frac{1}{2}$  lines in expanse.

13. *Deudorix anta*, Trimen.

*Deudorix anta*, Trimen, Trans. Ent. Soc. 1862, p. 402.

Two males and a female, rather worn.

## Papilionidæ.

## PIERINÆ.

14. *Terias anjuana*, n. sp.

Gamboge-yellow, base of wings black; the primaries with narrow black costal border and moderately broad, internally sinuated outer border; secondaries with a slender black outer border, interrupted at the internervular folds and emitting short black spurs upon the veins (giving it a sinuated character); body blackish. Wings below slightly paler, with an irregular discal series of spots formed of brown atoms; irregular brown-edged silvery discocellular spots: primaries with one or two irregular brown lituræ in the cell: secondaries with three subbasal brown-edged silvery spots, the central one in the cell frequently reduced to a brown dot; veins terminating in black dots. Expanse of wings 1 inch 4-7 lines.

Seven males.

This species is allied to *T. floricola* of Madagascar, but is of a clearer yellow colour (more like *T. hecabeoides*), has the external black border to the primaries much broader at the external angle, and is usually smaller; in other respects it agrees with that species.

15. *Terias decipiens*, n. sp.

Above closely resembling *T. hecabe*, but with the outer border of secondaries as in the preceding species: below similar to the preceding species and *T. floricola*. Expanse of wings 1 inch 8 lines.

One male.

This species differs from the preceding in its slightly superior size and the very dissimilar external black border of the primaries; this border is developed inwards at external angle and bidentate; the postdiscoidal situation is well marked, and the bisinnation on the median interspaces twice as deep as in *T. anjuana*.

16. *Terias Bewsheri*, n. sp.

Bright sulphur-yellow: primaries with the costal border of the male dark grey and the margin black; apical area black, beginning in an oblique, internally minutely quadrisinuate line from above the end of the cell, then abruptly angulated and transverse from the last subcostal or upper radial branch to the third median, where it is met by the black outer border forming a deep bisinuation on the median interspaces, slightly notched internally between the first median and internal veins; male with a few black scales at the end of the cell: secondaries with a rather narrow black border: body blackish. Wings below much as in *T. floricola*, but the silvery spots towards the base of secondaries less marked. Expanse of wings, ♂ 1 inch 8 lines, ♀ 1 inch 6 lines.

A pair of this pretty species. It is most nearly allied to *T. solifera* from Angola, but brighter in colour, the female yellow instead of whitish, the black border, particularly on the secondaries, narrower.

17. *Terias brenda*, Doubleday.

*Terias brenda*, Doubleday, Gen. Diurn. Lepid. pl. 9. fig. 6 (1847).

A single male, slightly smaller than examples from Ashanti, but otherwise identical.

18. *Terias chalcomiæta*, n. sp.

Above quite like *T. senegalensis*; below differing in having a large transverse sigmoidal subapical patch of cupreous brown on the primaries. Expanse of wings, ♂ 1 inch 8 lines, ♀ 1 inch 8½ lines.

A single pair.

19. *Terias dentilimbata*, n. sp.

Above much like *T. senegalensis*, but the angles bounding the median bisinuation of the outer border much more acute; the female decidedly paler; the primaries below with a transverse sinuous subapical dark ferruginous patch. Expanse of wings, ♂ ♀, 1 inch 7 lines.

A pair of this species. Its nearest ally is *T. bisinuata* of Abyssinia; its much paler female and the much more acute angles of the outer border render it improbable that it should be a variety of the preceding species. So far as I am aware, the borders of the wings are not markedly variable in outline; indeed, if such could be proved to be the case, nearly the whole of the species of *Terias* might be sunk.

20. *Catopsilia florella*, Fabricius.

*Papilio florella*, Fabricius, Syst. Ent. p. 479. n. 159 (1775).

One worn female.

21. *Catopsilia pyrene*, Swainson.

*Colias pyrene*, Swainson, Zool. Ill. i. pl. 51 (1820-21).

Three males and one female.

22. *Belenois Johannaë*, n. sp.

Allied to *B. elisa*, Vollenhoven (Pollen and Van Dam's Faun. Madag. Ins. pl. 2. figs. 3 ♂, 3 ♀), but the wings above pure white, the oblique black discocellular streak of primaries reduced to a small cuneiform costal spot and a black dot on the lower discocellular, internal limitation of the submarginal spots of secondaries in the male less strongly defined: the borders below reddish clay-coloured; the spots and the whole ground-colour of the secondaries rich cream-yellow. Expanse of wings, ♂ 1 inch 8 lines to 2 inches, ♀ 1 inch 8-10 lines.

Five males and two females.

## PAPILIONINÆ.

23. *Papilio demoleus*, Linn.

*Papilio demoleus*, Linn. Mus. Lud. Ulr. p. 214 (1764).

Three examples.

## Hesperiidæ.

24. *Pamphila umbrata*, n. sp.

Allied to *P. borbonica* of Madagascar: dark fuliginous brown with an elbowed discal series of hyaline white spots, the three uppermost only separated by the subcostal branches, the largest at base of first median interspace; male with two hyaline white dots in the cell; palpi white at the sides; anal tuft white tipped with black; centre of pectus and venter white: secondaries below with a white dot in the cell and four or five in a curved series halfway between the cell and the apical margin. Expanse of wings 1 inch 3-4 lines.

One pair in poor condition. The female has broader and rather shorter wings than the male.

## HETEROCERA.

## Lithosiidæ.

25. *Deiopeia venusta*, Hübner.

*Utetheisa venusta*, Hübner, Ex. Schun. Zutr. figs. 521, 522.

One female.

26. *Argina astrea*.

*Phalæna astrea*, Drury, Ill. Ex. Ent. ii. pl. vi. fig. 3.

One typical female and one of the variety named *A. guttata* by Rambur.

## Nyctemeridæ.

27. *Leptosoma consors*, n. sp.

Nearly allied to *L. insulare*, Boisduval (Faun. Madag. pl. xii. fig. 1), but the white belt of primaries more oblique, its inferior extremity continued to the outer margin, longitudinal streak less distinctly furcate, border of secondaries broader. Expanse of wings 1 inch 8 lines.

One female.

XXIII.—On the Bryozoa (Polyzoa) of the Bay of Naples.  
By ARTHUR WM. WATERS, F.G.S.

[Continued from p. 126.]

61. *Cellepora coronopus*, S. Wood.

*Madrepore rameux dont les branches rondes sont grainées en dehors*, Marsigli, Hist. Phys. de la Mer, p. 143, pl. xxxi. fig. 149, pl. xxxii. figs. 150–152.

*Cellepora pumicosa*, Linn. Syst. Nat. 12th ed. p. 1286.

*Cellepora coronopus*, Busk, Crag Polyz. p. 57, pl. ix. figs. 1–3.

*Cellepora tubigera*, Busk, loc. cit. p. 60, pl. ix. figs. 8–10.

*Cellepora coronopus*, Manz. Bry. Foss. Ital. cont. 4, p. 13, pl. iii. figs. 18, 19.

? *Cellepora tubigera*, Manz. loc. cit. p. 14, pl. iv. fig. 25; id. Bri. di Castrocaro, p. 34, pl. v. figs. 60–61.

Zoarium ramose or incrusting; cell-walls thick, smooth; small ascending processes immediately below the aperture or to the side, bearing small rounded avicularia, also very large zoecial avicularia scattered between the cells. Ovicells prominent, perforated.

I have pieces ramose and tapering in the characteristic way of Busk's *coronopus*, and another incrusting with similar cells.

Opercula suborbicular, slightly triangular at the proximal end, .14 millim. wide, .156 long.

*Loc.* Pliocene: Crag, Castrocaro, Sicily, and Calabria; Ficarazzi, Brucoli, Rhodes, Antwerp (*H. de L.*). Living: Britain and coasts of France (*B.*); Naples, 20 — fathoms. The ramose form figured by Marsigli is common in the Mediterranean.

62. *Cellepora avicularis*, Hincks. (Pl. XIV. figs. 11, 12.)

*Cellepora Redoutei*, Aud. in Sav. Egypte, pl. vii. fig. 6, p. 64.

*Cellepora avicularis*, Hincks, Ann. & Mag. Nat. Hist. ser. 3, vol. ix. p. 304, pl. xii. fig. 6.

*Cellepora ramulosa*, forma *avicularis*, Smitt, Krit. Fört. ö. Sk. Hafs-B. 1867, pp. 32 and 194, pl. xxvii. figs. 202, 210.

Zoecia raised, prominent; aperture suborbicular, with one or two raised avicularia usually turned inwards over the mouth, numerous large zoecial avicularia (scattered among the cells) with wide mandible rounded at the end. Ovicells raised, prominent, perforated.

It grows incrusting large seaweeds, and forms rather large masses. The avicularia are much more raised than I have been able to show in my drawing.

Opercula (12\*) suborbicular, the proximal end being the segment of a smaller circle than the distal end. Width 0.152 millim., length 0.136, muscular dots 0.08 millim. apart.

*Hab.* Britain, Arctic Ocean, Red Sea; Naples, 10 fathoms.

63. *Cellepora verruculata*, Smitt. (Pl. XIV. figs. 1, 7.)

*Cellepora verruculata*, Smitt, Floridan Bryozoa, Kongl. Svenska Vet.-Ak. Handl. vol. xi. pt. ii. p. 50, pl. viii. figs. 170-172.

The process (sometimes an avicularium) projecting as a tooth into the peristome is most marked in my specimens, and sometimes gives a triangular appearance to the aperture. The ovicells are smooth and imperforate; zoecia perforated round the edge, often with a large acute avicularium on ventricose avicularian chambers situated in the proximal part of the cell.

The young cells are granulated, with the oral avicularia at one side, but when a little older have an ascending process on each side of the orifice, and often an umbo in the centre—in this stage exactly resembling *Lepralia bicornis*, Busk; and it may be the same; but as I have not seen the fossil species, I cannot express an opinion.

The oral aperture has two small hinge-projections, which give the appearance of a distinct sinus, which is not shown in the operculum.

The operculum (fig. 7) is nearly orbicular, with hinge-notches near the distal end. Width 0·24 millim., length 0·108 millim., muscular dots 0·08 millim. apart.

*Hab.* West of Tortugas, 42 fathoms; Naples, brought by coral-fishers from considerable depths (the fishermen said from 500 fathoms; but it is not likely to be nearly as much).

#### 64. *Cellepora retusa*, Manz.

*Cellepora retusa*, Manz. Bri. di Castrocaro, p. 34, pl. v. fig. 59.

? *Cellepora coronopus*, Manz. Bry. Foss. Ital. cont. 4, p. 13, pl. iii. figs. 18, 19.

*Cellepora tubigera*, Waters, Bry. from Bruccoli, Trans. Manch. Geol. Soc. vol. xiv. p. 475, figs. 20, 21.

Decumbent tubular cells with usually two distinct avicularian processes at the side of the aperture. The surface is smooth in all specimens I have seen. Ovicell globular, perforate; aperture long and narrow.

This I have incrusting, in one layer, on *Eschara cervicornis*. It may be the form sometimes figured as *tubigera*, which, in my opinion, is only another stadium of *C. coronopus*.

The operculum is long and narrow, with an acute proximal end, edges entire; length 0·172 millim., width 0·128, muscular impressions 0·068 millim. apart.

The *Celleporæ* are such an intricate genus, and so much stress has been laid upon the mode of growth, that their determination is a matter of great difficulty and the synonymy very uncertain.

#### 65. *Cellepora retusa*, var. *caminata*. (Pl. XIII. fig. 1.)

Zoecia tubular, elongate, narrowing towards the distal end; peristome raised above the aperture, with two or three long tubular avicularia raised over the aperture; occasional zoecial avicularia; ovicell globular, flat on the upper surface, which is perforate. Operculum long and narrow.

The sketch (fig. 1) is not a camera-lucida drawing, but is drawn to show the cells when perfect and when worn at the ends. The walls are porcellaneous, thick, with fine tubes in a longitudinal direction; these in the inside end with a fine perforation. A somewhat similar structure is shown in some of Savigny's figures; but in older specimens this becomes scarcely visible, and ultimately cannot be made out.

Small adnate convex zoaria (about 5 millims. in diameter) of this species are common on seaweeds.



The operculum (5\*) is 0.168 millim. long and 0.132 wide, with a notch where the hinge is often seen in other species.

The shape, which is characteristic, is the same as the last, with the exception of the notch.

#### 66. *Cellepora Hassallii*, Johnst.

*Cellepora Costazii*, Aud. in Sav. Egypte, pl. vii. fig. 4.

*Cellepora Hassallii*, Busk, Cat. Mar. Polyz. p. 86, pl. cix. figs. 4, 5, 6.

*Cellepora Hassallii*, Smitt, Krit. Fört. 1867, pp. 33 and 197, pl. xxviii figs. 211.

*Cellepora Hassallii*, Manz. Bry. Foss. Ital. cont. 4, p. 17, pl. iv. fig. 22.

In some specimens, growing on seaweed from the Bay of Naples, the cylindrical cells are more erect and longer than in any of the figures. In all the ovicells have similar radiating lines; and I have not been able to verify Manzoni's and Smitt's remarks as to the variation in the ornamentation of the ovicell. Whether this is only a variety of the form which is called *Boryii* by Audouin is somewhat uncertain. There does not seem any reason for supposing this is *C. bimucronata* of either Moll or Lamouroux.

Operculum (10\*), distal end rounded, proximal end with a smaller radius; muscular prominences in the upper half of the operculum 0.06 millim. apart, width of operculum 0.1 millim., length 0.1 millim.

Loc. Pliocene: Pezzo, Archi, Carrubare (Calabria); Antwerp (*H. de L.*). Living: Scotland, Britain, Ireland, Red Sea (on a piece of seaweed drawn up on the sounding-line); Naples, on seaweed from moderate depth.

#### 67. *Cellepora Boryii*, Aud.

*Cellepora Boryii*, Aud. in Savigny, Descr. de l'Egypte, pl. vii. fig. 3.

Zoarium radiate; cells cylindrical, long, contracting near the distal end; peristome much raised, especially at the two sides, with prominent, mucronated, ascending avicularium on the lower lip overlooking the mouth; ovicell ornamented with radiating openings; peristome nearly meeting over it; aperture rounded on both lips.

At first I thought this was the *Hassallii* of Johnston; but the one prominent rostral avicularium instead of the two on each side of the mouth sufficiently distinguishes it. There can be little doubt that it is the *Boryii* of Savigny, as the mode in which the peristome nearly meets over the ovicell is in both the same, as well as the radiating lines of the ovicell. These were found on the same seaweed as *C. Hassallii*; and it is possible it should only be considered a variety. There are

large zoöcial avicularia, triangular, clavate, very wide, near the end of the mandible.

*Hab.* Red Sea (my collection); Naples from the depth of a few fathoms.

68. *Cellepora ramulosa*, L.

*Cellepora ramulosa*, L., Brit.-Mus. Cat. p. 87, pl. cix. figs. 1, 2, 3.

*Cellepora ramulosa*, Manzoni, Bry. Foss. Ital. cont. 4, p. 12, pl. v. figs. 29, 29', pl. vi. figs. 30, 30', 30'; and I Brioz. di Castrocaro, p. 34, pl. v. fig. 62.

*Cellepora ramulosa*, forma *ramulosa*, Smitt, Krit. Fört. 1867, p. 31.

Pliocene: Crag, Castrocaro, Pezzo, and Cannitello; Antwerp (*H. de Lehaie*). Living: Britain, Roscoff (*J.*), Scandinavia (*Sm.*); Naples from 40 fathoms (one piece only), most resembling Manzoni's figure.

This is rather less than 1 millim. in diameter, while a specimen I have from the coast of France, and which I believe resembles the British form, is about 2 millims. in diameter. The Naples specimen has only three cells in a complete circle, or six in the double row, while they are numerous in the Roscoff specimens.

69. *Cellepora sardonica*, nov. (Pl. XIV. figs. 2, 5, 5 a, 6.)

Zoarium incrusting; zoöcia irregularly ovate, heaped, an oral rostral avicularium turned over each aperture; small circular and spatulate avicularia scattered over the cells; avicularia of external cells acute, of subsequent cells rounded (occasionally an acute avicularium met with); ovicells plain, small, and deeply immersed, the rounded distal edge of the aperture with a large number of teeth projecting, the proximal straight edge plane.

The shape of the aperture, which is uncommon in the Celleporidæ, is the same as in *C. compressa*, Busk; but as the diagnosis is based on the general appearance, it is impossible to say if they are the same.

Fig. 2 is the form of the external zoöcia of several species of *Cellepora*, where the subsequent characters are entirely distinct; and a glance at figs. 2 & 5 will prove the utility of examining the opercula where it is available.

I have one nice specimen with only one layer of cells incrusting; and this and other species show how closely *Cellepora* and *Lepralia* are connected. It is usually about half an inch thick on the roots of seaweeds.

The species is named from the sardonic manner in which the teeth are shown.

The operculum (fig. 6) is very slightly contracted above

the proximal edge, and is ornamented with fine lines round the border, corresponding to the teeth of the aperture. Width of operculum ·148 millim., length ·124, muscular dots ·12 apart.

70. *Cellepora Cutleriana*, sp. nov. (Pl. XIV. figs. 9, 10.)

*Lepralia bispinosa*, Busk, Mar. Polyz. p. 77 (pars?).

Zoarium incrusting; zoecia irregular; proximal part of the peristome much raised and divided, sometimes bearing avicularia on long rostra; below the raised peristome there is usually a large avicularium, mostly turning outwards. The raised cells are bordered by large pores, some having avicularian covers. Young cells ovate-quadrangulate; aperture round above, nearly straight below, with two horns above the aperture.

I have only one small fragment of this from Naples, and the specific description would be more satisfactory if based upon more material; but the irregular position of the cells, and the great difference in form of the young and the old cells, and affinities with other forms with *Cellepora*-characters would seem to indicate its removal from *Lepralia* to *Cellepora*; but, at the same time, the near relationship of the two genera and the difficulty of separation is made apparent.

In looking through the British-Museum specimens I found this marked *Lepralia bispinosa*, var. *a. Cutleriana*, and have therefore retained this name. The entirely different characters of the cells in different parts is well shown in the Museum specimen. The openings round the cells are very large; and in between, in the same rows, are avicularia about the same size. *Cellepora digitata*, fig. 13, has similar avicularia; nor are avicularia taking the place of pores an exception; and these small avicularia are a difficulty for any prehensile theory, and rather indicate the same function as the pores, some of which have these covers while others are without.

71. *Cellepora digitata*, sp. nov. (Pl. XIV. fig. 13.)

Cells much raised, with avicularia and large pore-openings in the same line; peristome divided by four or five clefts.

Either this or the last species may be *C. Larreyi*, Aud. (in Sav. Egypte, p. 66, pl. viii. fig. 5).

I have only one piece from Naples, growing on stone (from about 20 or 30 fathoms), consisting of two or three layers. In consequence of the raised peristome it is difficult to study the aperture, as the opercula are lost; but since drawing and naming this one I have received specimens both from the

neighbourhood of Sydney and Adelaide, in which the peristome is similarly divided; but the avicularia are sometimes more raised, and the cells bristle with raised projections, mostly avicularian. In the Australian specimens there is a wide denticle in the peristome above the oral aperture, similar to that shown in *C. lobulata* (fig. 3), while in the Naples specimens I have only seen a narrow, somewhat acute denticle.

The shape of the opercula, young cells, and ovicells I can only give from the Australian specimens, but fully expect that future "finds" in the Mediterranean will show they are identical.

The exterior cells are ovate, elongate, and have a projecting mucro in front of the lower lip, and, in one stage, exactly resemble the figures of *Lepralia bispinosa* in the B.M. Cat. lxxx. fig. 1; then similar projections appear at the side and on the front of the cell, and gradually the characteristic digitate appearance is assumed. The ovicells are globose, imperforate, wide, and have one or two blunt spines or umbos on the top.

Opercula: distal edge formed by an arc of a large circle, proximal edge by an arc of a smaller one; somewhat similar in shape to those of *C. avicularis* (12\*), with a coarse cellular appearance. Width 0.08 millim., length 0.076 millim.

72. *Cellepora lobulata*, sp. nov. (Pl. XIV. figs. 3, 4.)

Peristome evenly raised from a flat surface, divided all round into several lobes. The young cells are slightly granular, and have oral avicularia which turn slightly over the aperture; in the young cells there are six spines. The old cells (fig. 3) show little resemblance to most Celleporidæ, while the younger ones, in the position of the avicularia, indicate this affinity.

73. *Cellepora pumicosa*, Busk (non Linné).

*Cellepora pumicosa*, Busk, Marine Polyzoa, pt. ii. p. 86, pl. ex. figs. 2-6.  
*Cellepora ceratomorpha*, Rss. Foss. Polyp. d. Wiener Tert. p. 80, pl. ix. fig. 25, a, f.

There is no doubt that this is not *C. pumicosa* of Linné, who refers to Marsigli's figure of *C. coronopus*, which I have seen named in several continental museums as *pumicosa*; and it is therefore unfortunate that Mr. Busk has given this name to the present species; but as he gave a detailed description it would be unadvisable to revert to the original signification.

Opercula orbicular, the proximal edge is the arc of a circle slightly smaller than that of the distal edge; width 0.13 millim., length 0.12; muscular impressions 0.065 millim. apart.

*Hab.* Seas of Europe. Other localities require confirmation. I have only a few pieces from Naples, occurring on seaweeds as small slightly raised patches about  $\frac{1}{4}$  inch in diameter. It may, however, have been overlooked and be more common than this would indicate.

74. *Cellepora margaritacea*, Pourt. (Pl. XXIV. fig. 8-10.)

*Vincularia margaritacea*, Pourtales, Cont. to Fauna of the Gulf Stream, Bull. Mus. Comp. Zool. Camb. U. S. no. 6, p. 110.

*Cellepora margaritacea*, Smitt, Floridan Bryozoa, pt. ii. p. 53, pl. ix. figs. 187-192.

*Buskea nitida*, Heller, Die Bry. des Adriat. Meeres, p. 89, pl. i. figs. 2, 3.

Zoarium cylindrical, dividing dichotomously; zoecia in alternate rows round the axis, smooth. Peristome scarcely raised, one or two minute avicularia in the proximal edge of the peristome. The area of the ovicell is raised; but the perforated portion is often depressed; 4-8 perforations.

This has much in common with *Cellepora ramulosa*; but should both have to be removed to another genus, the name given by Heller would have to be avoided, since Reuss named a fossil genus, allied to *Defrancia*, *Buskia* (Oberolig. p. 64). Alder called a Ctenostome *Buskia* (Cat. of Zooph. p. 156). We have the above *Buskea*; and Hutton named a genus of New-Zealand Lepralioid forms similar to *Lepralia discreta*, *Buskia*; besides which, I believe, the name has been used in other groups. As the shell is somewhat transparent, the shape of the two avicularian chambers which overlook the mouth can be readily seen. The space between these two avicularia often has the appearance of a sinus.

Operculum (fig. 10) nearly oval, with slight sinistral expansion at the proximal end. Width .084 millim., length .052, muscular dots .048 millim. apart.

*Hab.* Common in the Floridan seas (*Sm.*), Adriatic (20-35 fathoms) (*Heller*). Sand Key, 100 fathoms; Havana, 270 fathoms (*Pourt.*). Naples, dredged from 40 fathoms, rare. Capri, about 100 fathoms.

75. *Retepora cellulosa*, L. (Pl. XV. figs. 1, 2.)

This form is, I believe, the one which has usually been denominated *cellulosa*; but I must confess to finding great difficulty with the genus *Retepora*, as the specific variations are very great.

This species, which is the most common at Naples, has a very solid base, half an inch or more in thickness; it then spreads out, sometimes almost horizontally, at others more funnel-shaped; and, as a rule, the foliations are thicker and

more solid than in *R. Couchii*; the lower lip is not raised, but has a small rounded avicularium in the aperture. In this respect it agrees with fig. 7, pl. xii., in Busk's 'Crag Polyzoa,' which he calls *R. Beaniana*, King; but, from the descriptions, I cannot venture on giving synonyms. Scattered over the cells are minute round avicularia; and the same are fairly numerous on the dorsal surface. Both on the back and the front there are pores about the same size as the avicularia, differing only in having no cover; and the same thing occurs in the African *Eschara contorta*, where some of the pores have avicularian covers and some are open. In considering the function of the avicularia the small ones should receive as much consideration as the large sessile ones, which are more easily studied; and in these cases there seems a strong indication of the function being somewhat the same as that of the tube-pores, which are filled with the chylaqueous fluid. It is also an important fact that in the Cheilostomata the zoecia have covers (opercula), and also the avicularia (mandibles), while in the Cyclostomata the zoecia are open and the "adventitious tubules" are also without a cover.

Opercula somewhat saddle-shaped; distal edge rounded, proximal nearly straight; long muscular bosses at the side, 0.09 millim. wide, 0.084 long.

*Loc.* This occurs in the Crag, and generally in the Pliocene of Italy and Sicily; but, from the descriptions from other localities, it must remain uncertain whether this is the species described. Living: Arctic Seas, Mediterranean, Australia.

76. *Retepora Couchii*, Hincks.  
(Pl. XV. figs. 3, 4, 5, 6.)

*Retepora Couchii*, Hincks, On the genus *Retepora*, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 355, pl. xviii. figs. 1-6.

*Retepora Beaniana*, Hincks, Ann. & Mag. Nat. Hist. ser. 3, vol. ix. p. 306.

*Retepora cellulosa*, Manzoni, Bry. Foss. Ital. cont. 4, p. 19, pl. v. figs. 26, 28.

This is a most beautiful delicate form, which is not so abundant as the last. In some cases the raised avicularia are wanting, when we have Manzoni's *cellulosa* (fig. 28); and this is certainly the *cellulosa* of many authors. The young cells (fig. 5) have six spines; but, except in the youngest colonies, I have not found any spines. The round avicularia are larger than in the last species; and, besides these, there are long acute avicularia covering the lower part of a zoecium, and on the dorsal surface there are similarly rounded and large acute avicularia; between the zoecia is a slightly raised

tubular border. The zoarium is cup-shaped, but very wavy and irregular.

The large acute avicularia sometimes stand up at right angles to the axes of the zoecia.

In this species this is rare; but erect avicularia occur abundantly on *Retepora monilifera*, and among the *Lepralicia* there are several cases of avicularia being either horizontal or perpendicular to the axis.

Operculum: distal end rounded, proximal slightly rounded, 0.1 millim. wide, 0.06 millim. long. The opercula of the two species of *Retepora* are nearly the same; but this seems to differ slightly from the more solid form in suddenly contracting near the distal end.

### 77. *Myriozoum truncatum*, Pall.

*Madrepores rameux dont les branches sont rondes noueuses*, Marsigli. Hist. Phys. de la Mer, p. 145, pl. xxxii. figs. 154-156 (1725).

*Miriozoo*, Donati, Della storia nat. mar. del Adriat. p. 55, pl. vii. (1750).

"*Miriozoon* or *Pseudo-coralium album fungosum* of Aldrovandus," Donati, Phil. Trans. vol. xlvii. p. 107 (1750).

*Millepora truncata*, Pall. Elench. Zooph. p. 249 (1766).

*Millepora truncata*, Letter to Linnæus "On the Animal Nature of the Genus of Zoophytes called *Corallina*," by J. Ellis, Phil. Trans. vol. lvii. p. 404, pl. xvii. figs. 1-7 (1767).

*Millepora truncata*, L. Syst. Nat. 12th ed. p. 1283.

*Millepora truncata*, Lamouroux, Expos. des Polyp. p. 47, pl. xxiii. figs. 1-8.

*Millepora truncata*, Risso, Hist. Nat. de l'Europe, Mer, vol. v. p. 347.

*Myriopora truncata*, Mich. Icon. Zooph. p. 69, pl. xiv. fig. 7.

*Vaginopora polystigma*, Reuss, Die foss. Polyp. des Wiener Tertiärbeckens, p. 73, tab. ix. fig. 2.

*Myriozoum punctatum*, Phil. Beit. zur Kennt. der Tert. d. Nordw. Deutschl. p. 35, pl. xi. fig. 13.

*Myriozoum punctatum*, Reuss, Zur Fauna des deutsch. Oberolig. p. 50, tab. ix. fig. 2, and Bry. d. deutsch. Septarienthon, p. 190; Manz. I Briozoi fossili del Mioc. d'Aust. ed Ung. pt. ii. Denk. k. Ak. d. Wiss. xxxvii. 1877, p. 22, tab. xv. fig. 52, tab. xvii. fig. 55.

*Myriozoon truncatum*, Heller, Die Bry. des Adriat. Meeres, p. 126.

This is well figured by Donati in his Italian work, and also in the Phil. Trans. 1757, where, on p. 107, he describes the animal as "slender at the tail, thick at the belly, and again slender at the neck, to which is attached a little cover."

Ellis, in the Phil. Trans. 1767, used this species as an argument in his letter to Linné for the animal nature of the zoophytes. His figures of the zoarium are very good; but the polypide he speaks of as "a trumpet-like sucker," and figures it thus extending out of the aperture, with the operculum moved out in advance of the polypide.

The only difference in *M. punctatum* of Phil. and Reuss is

the manner in which the ends of the branches widen out laterally; but when a branch commences to divide it has just this appearance, and probably this character is founded upon tips about to divide.

Heller says, the "punctförmigen Zellenmündungen" are only present at the end of the branch, and speaks of a "Deckel," although he places it among Cyclostomata. In the lower part of a branch it is true that the aperture is obliterated by a subsequent calcareous growth.

The zoecia are placed in a radial direction round an irregular axis composed of the walls of cavities which open at the end of the branch in the growing parts. In section this has a somewhat cellular appearance. The external walls are in older portions very thick, the supergrowth ultimately entirely covering the oral apertures, when the opercula are found imbedded in the theca. This is perforated with pore-tubes, which are filled with the chylaceous fluid as in other species. The interior walls are a beautiful calcareous network, being much more fragile than in many less solid forms.

Operculum (15\*) rounded above, subtriangular below, elongate, hinge below the muscles, which are at the edge near the middle, 0.22 millim. wide, 0.23 long.

*Loc.* Miocene: Austria and Hungary. Pliocene: Castrocaro, Mt. Titano, Darsena, Parlascio, Leghorn, Amato (*A. W.*), Cunitello (*A. W.*), Asti, Bonpas, Vedennes, Villeneuve-lez Avignon (Gard), Chaux de Fonds (Suisse), and generally in the Pliocene of Sicily, Freden, Diekholz, Luithorst. Living: Mediterranean, common, 20-55 fathoms (*H.*). Specimen in the British Museum from Algeria. Naples from 40 fathoms and deeper.

[To be continued.]

XXIV.—*Notices of British Fungi.* By the Rev. M. J. BERKELEY, M.A., F.L.S., and C. E. BROOME, Esq., F.L.S.

[Continued from ser. 5, vol. i. p. 30.]

\**Agaricus* (*Lepiota*) *amianthinus*, Scop., var. *Broadwoodiae*. Pileo hemisphaerico luteo, subtiliter tomentososo; margine inflexo; stipite aequali annuloque furfuraceo-squamulosis; lamellis candidis adnatis quandoque decurrentibus.

Lyne, Sussex, Miss S. Broadwood.

A very distinct variety if not species.

1731. *A.* (*Lepiota*) *mesomorphus*, Bull. t. 506. fig. 1; Fr. Hym. Eur. p. 38.



Hereford, J. Renny. Mr. Renny's plant agrees in every thing with that of Bulliard, except in the less persistent ring, which, however, is sometimes attached to the stem, sometimes to the edge of the pileus.

1732. *A.* (*Lepiota*) *medullatus*, Fr. Hym. Eur. p. 38.

Glamis, Rev. J. Stevenson, Oct. 1874.

1733. *A.* (*Tricholoma*) *amethystinus*, Scop. Carn. ii. p. 437; Fr. Hym. Eur. p. 68.

Glamis, Rev. J. Stevenson, Sept. 1875.

\**A.* (*Tricholoma*) *inamænus*, Fr. Syst. i. p. 111. Var. lamellis decurrentibus, valde distantibus.

Coed Coch, 1878. The smell is so precisely like that of the normal *A. inamænus*, that I follow Fries in considering it a mere variety. The same form was exhibited at one of the Hereford shows.

1734. *A.* (*Clitocybe*) *rivulosus*, P. Syn. p. 369; Fr. Hym. Eur. p. 86.

By the grassy side of a road. Coed Coch.

1734 bis. *A.* (*Clitocybe*) *Sadleri*, B. Cæspitosus, olidus; pileo plano-depresso l. umbilicato flavo, centro fulvo, primum sericello, demum versus centrum glabrescente; stipite deorsum incrassato luteo fulvo-fibrilloso glabrescente; lamellis citrinis tenuibus confertissimis decurrentibus, margine integerrimis.

On an oak tub in conservatory at Edinburgh.

Pileus 2-2½ inches across; stem 3-4 inches high, about ⅙ inch thick, except at the base.

Allied to *A. illudens*, Schwein., which is a far coarser species. The taste is intensely acrid, like that of *A. fascicularis*. Allied to *A. crocophagus*, B. & Br., from Ceylon.

1735. *A.* (*Clitocybe*) *aggregatus*, Schæff. t. 305, 306; Fr. Hym. Eur. p. 90.

Abundantly on sawdust, Oct. 1878. Coed Coch.

1736. *A.* (*Clitocybe*) *tuba*, Fr. Hym. Eur. p. 99; Ic. t. 51. f. 2.

Coed Coch.

1737. *A.* (*Clitocybe*) *pausiacus*, Fr. Hym. Eur. p. 104; Ic. t. 58. f. 2.

Coed Coch, Oct. 1878.

1738. *A.* (*Clitocybe*) *obsoletus*, Batsch, f. 103; Fr. Hym. Eur. p. 105.

Grassy side of road, early spring. Coed Coch.

1739. *A.* (*Collybia*) *semitalis*, Fr. Hym. Eur. p. 111.

By the bare side of a road. Coed Coch.

1740. *A.* (*Collybia*) *hariolorum*, Bull. t. 585. f. 2; Fr. Hym. Eur. p. 117.

In woods. Coed Coch, Miss Ruth Berkeley.

1741. *A. (Collybia) ventricosus*, Bull. t. 411. f. 1; Fr. Hym. Eur. p. 120.  
Coed Coch, Miss Ruth Berkeley. Exactly the plant of Bulliard.
1742. *A. (Collybia) nitellinus*, Fr. Hym. Eur. p. 120; Ic. t. 65. f. 1, 2.  
Near Shrewsbury, W. Phillips.
1743. *A. (Collybia) nummularius*, Bull. t. 56; Fr. Hym. Eur. p. 120.  
Glamis, Rev. J. Stevenson, July 1874.
1744. *A. (Collybia) stolonifer*, Jungh. Linn. 1830, p. 396; Fr. Hym. Eur. p. 121.  
With *Marasmius porreus*.
1745. *A. (Collybia) tesquorum*, Fr. Hym. Eur. p. 128.  
In open pastures, Ascot.
1746. *A. (Mycena) tintinnabulum*, Fr. Hym. Eur. p. 140; Ic. t. 80. f. 4.  
Glamis, Rev. J. Stevenson, Oct. 1876.
1747. *A. (Mycena) leptcephalus*, Pers. Ic. et Descr. t. 12. f. 4; Fr. Hym. Eur. p. 141.  
Laxton Park, Northamptonshire.
1748. *A. (Mycena) plicato-crenatus*, Fr. Myc. Eur. p. 150; Ic. t. 84. f. 2.  
Amongst heath. Coed Coch, Oct. 1878. A single specimen only, and very distinct from all other *Mycenæ*.
1749. *A. (Mycena) clavicularis*, Fr. Syst. Myc. i. p. 158.  
Glamis, Rev. J. Stevenson, Oct. 1876.
- \**A. (Omphalia) umbelliferus*, L. Var. *viridis*, Fl. Dan. t. 1672. f. 1.  
King's Lynn, Messrs. Plowright and Phillips. Exactly the plant of 'Flora Danica.'
1750. *A. (Omphalia) retostus*, Fr. Icon. t. 76. f. 2.  
On the lawn. Coed Coch, Oct. 1878.
1751. *A. (Omphalia) abhorrens*, B. & Br. Fuscus, foetidissimus, caespitosus; pileo umbilicato lævi; stipite gracili, basi albo tomentoso; lamellis distantibus crassis decurrentibus, interstitiis lævibus.  
On the lawn. Coed Coch. Allied closely to *A. retostus*, but clearly distinct apart from its disgusting smell; stem sometimes pruinose when young.
1752. *A. (Omphalia) pseudo-androsaceus*, Bull. t. 276; Fr. Myc. Eur. p. 161.  
On the lawn. Coed Coch, Oct. 1878. Exactly the plant of Bulliard.
1753. *A. (Omphalia) bullula*, Brig. tab. xvi. fig. 1. "Spar-sus, minimus, totus candidus; pileolo membranaceo hemi-

sphærico diaphano; lamellis raris areuato-decurrentibus; stipite valde tenui filiformi."

On dead sticks. Coed Coch, Miss Ruth Berkeley.

1754. *A.* (Pleurotus) *Ruthæ*, B. & Br. Pileo flabelliformi, supra stratum gelatinosum hispidulo, albido; margine tenuissimo striato; stipite brevi laterali hispido; lamellis albis, latiusculis, postice acutis anastomosantibus eum stipite rufulis, interstitiis venosis.

On sawdust. Coed Coch, Oct. 1878, Miss Ruth E. Berkeley, to whom we are indebted for many of the novelties of the season.

Pileus  $1\frac{1}{2}$  inch across; colour dirty white, with a hyaline aspect; mycelium fibrous.

1755. *A.* (Pleurotus) *reniformis*, Fr. Hym. Eur. p. 177 Ie. t. 89. f. 3.

On sticks. Glamis, Rev. J. Stevenson.

1756. *A.* (Pleurotus) *fluxilis*, Fr. Hym. Eur. p. 180.

Glamis, Rev. J. Stevenson.

1757. *A.* (Volvaria) *temperatus*, B. & Br. Pileo convexo umbonato pulverulento striato; stipite gracili pellueido; volva ampla.

On soil in a greenhouse. Sibbertoft.

Pileus  $\frac{1}{4}$  inch across; stem 1 inch high, not 1 line thick.

1758. *A.* (Clitopilus) *stilbocephalus*, B. & Br. Pileo campanulato obtuso quandoque umbonato hygrophano, siceo albido subsericeo; margine recto; stipite cavo subæquali undulato-fibroso sericeo; lamellis latis adnatis postice quandoque emarginatis, venosis.

Ascot.

Pileus sparkling.

1759. *A.* (Leptonia) *nefrens*, Fr. Syst. Mye. i. p. 209.

Ascot.

Odour not farinaeous. Exactly *A. nefrens*, with the exception of the dark margin of the gills.

1760. *A.* (Nolanea) *infula*, Fr. Hym. Eur. p. 210; Ie. t. 100. f. 1.

Coed Coch. On the lawn, Oct. 1878.

\**A.* (Inocybe) *phæocephalus*, Bull. t. 155. f. 1.

Perfect specimens of this interesting and little-known species were received from Rev. J. Stevenson, confirming the opinion that it is a true *Inocybe*.

1761. *A.* (Inocybe) *Rennyi*, B. & Br. Minor, pileo hemisphærico cervino, centro brunneo; stipite deorsum attenuato fibrilloso; sporis reniformibus postice subito tumidis nucleatis.

Hereford, J. Renny.

Spores 0005-0007 long.

1762. *A.* (*Hebeloma*) *lugens*, Fr. Hym. Eur. p. 241.

Lyndhurst, under beeches. Odour pungent.

1763. *A.* (*Hebeloma*) *capniocephalus*, Bull. t. 547. fig. 2 ; Fr. Hym. Eur. p. 242.

Coed Coch, Oct. 1876.

1764. *A.* (*Naucoria*) *badipes*, Fr. Hym. Eur. p. 259.

Abundant under larch. Coed Coch, Oct. 1878.

1765. *A.* (*Crepidotus*) *calolepis*, Fr. Hym. Eur. p. 276.

Edinburgh show, 1878. A very beautiful species.

1766. *A.* (*Crepidotus*) *epibryus*, Fr. Syst. Myc. p. 275.

On mosses, grass, holly-leaves, living *Vaccinium*, &c.

Coed Coch, Oct. 1878. Shrewsbury, W. Phillips.

1767. *A.* (*Stropharia*) *Percevali*, B. & Br. Pileo viscidulo carnosio ex umbonato explanato ochraceo, hic illic, præcipue margine, albo floccoso; floccis tandem discedentibus; stipite transversim squamoso, sursum cavo pallido; annulo angusto plus minus persistente; lamellis valde distantibus adfixis latis ex albo subcinereis, demum pallide umbrinis.

On sawdust. Wallington, Northumberland, Cecil H. Sp. Perceval.

Pileus 2 inches across; stem 2-3 inches high, attenuated upwards,  $\frac{1}{3}$ - $\frac{1}{2}$  inch thick at base,  $\frac{1}{4}$  above; gills  $\frac{1}{3}$  inch wide. Flesh of pileus at length dull umber; stem umber within, rooting. Allied to *A. squamosus*, but abundantly distinct.

1768. *A.* (*Hypholoma*) *sublateritius*, Ic. Var. *Schæfferi*, Schæff. tab. 49. figs. 4, 5.

Coed Coch, Oct. 1878.

Pileus conical, at length depressed, wrinkled; gills narrow, decurrent, even in the youngest specimens. A very remarkable variety, but clearly not a distinct species.

1769. *A.* (*Psilocybe*) *scobicola*, B. & Br. Pileo convexo umbilicato albo glabro; stipite fibrilloso subæquali vel apice dilatato, fistuloso; lamellis latis adnexas.

On sawdust. Glamis, no. 1053, Rev. J. Stevenson.

1770. *A.* (*Psilocybe*) *atro-rufus*, Schæff. t. 234; Fr. Syst. i. p. 293.

Glamis, Rev. J. Stevenson, Nov. 1876.

1771. *A.* (*Psilocybe*) *hygrophilus*, Fr. Hym. Eur. p. 302.

Glamis, Rev. J. Stevenson, Nov. 1874.

1772. *Hiatula Wynnie*, B. & Br. Candida; pileo tenro striato pulverulento, centro obscuriore; stipite gracili striato; lamellis scariosis latiusculis.

In a stove at Kew. Mrs. Lloyd Wynne.

Pileus  $1\frac{1}{4}$  inch across; stem 1 inch high, 1 line thick. One specimen became darker in drying and had a longer and thicker stem.

1773. *Bolbitius rivulosus*, B. & Br. Pileo campanulato, alutaceo, rivuloso; stipite sursum attenuato; lamellis angustis einnamomeis.

On earth, in an orchard-house, Chiswick, July 1875.

Pileus about  $1\frac{1}{2}$  inch across, very different from any other known species.

1774. *Cortinarius* (Phlegmacium) *tormalis*, Fr. Hym. Eur. p. 336.

Glamis, Rev. J. Stevenson, Sept. 1874.

1775. *C.* (Dermocybe) *decumbens*, Fr. Hym. Eur. p. 366.

In woods. Epping.

1776. *C.* (Hydrocybe) *duracinus*, Fr. Hym. Eur. p. 388.

Rev. J. Stevenson. Dun, Forfarshire, Oct. 1876.

1777. *Hygrophorus ventricosus*, B. & Br. Albus; pileo convexo carnoso inæquabili; stipite solido basi apiceque attenuato; lamellis longe decurrentibus angustis.

Coed Coch, amongst grass. Often tinged with red from the growth of a little *Fusisporium*.

Pileus 2-3 inches across; stem  $2\frac{1}{2}$  inches high,  $\frac{1}{2}$  inch thick in the middle, solid, but at length partially hollow. Gills sometimes forked.

1778. *H. penarius*, Fr. Hym. Eur. p. 406; Ätl. Svamp. t. 38.

Stoke Poges, M. Terry.

1779. *H. micaceus*, B. & Br. Pileo hemisphærico, primum flavo, dein einerascente rugoso micaceo; stipite e flavo deorsum brunneo granulato solido; lamellis decurrentibus pallido-umbrinis.

On clayey soil, Miss Ruth Berkeley. Coed Coch, Oct. 1878.

Pileus  $\frac{1}{2}$ - $\frac{3}{4}$  inch across; stem  $\frac{3}{4}$  inch high, 1 line thick; mycelium white. When young it looks like a small specimen of *Leotia lubrica*. The whole plant turns dark brown when dry.

1780. *Hygrophorus fætens*, Phill. Fœtidissimus nauseosus; pileo ex hemisphærico convexo umbrino sicco, dein rimoso; stipite olivaceo-luteo squamis fibrosis transversis dissitis vestito; lamellis decurrentibus cinereis.

Near Shrewsbury, W. Phillips. Quélet refers this to *A. atropunctus*, placed by Fries in *Eccilia*. It seems, however, to us a true *Hygrophorus*, nearly related to *H. micans*. The disgusting smell is such as must have been mentioned by Persoon. Fries had no authority for referring Persoon's plant to *Eccilia*. He perhaps had a view to Bulliard's figure.

\**H. lacmus*, Fr.

Coed Coch, Oct. 1878. The base of the stem was in

every specimen yellow, which colour remains in the dried plant.

1781. *H. Wynnie*, B. & Br. Citrinus, hygrophorus; pileo umbilicato vel subinfundibuliformi tenui, striato; lamellis angustis tenuibus decurrentibus.

On chips, old stumps, &c. Resembling *Ag. mollis*, Bull., but on a smaller scale, a species which does not seem to have been noticed by Fries. Foetid when decayed, losing much of its lemon-colour when it parts with its moisture. Mr. W. Smith has given a figure of it in Gard. Chron., Oct. 1878, p. 476. It has lately been found also in Yorkshire.

\* *Cantharellus cibarius*, Fr. Hym. Eur. p. 455.

A curious variety, white, here and there tinged with pink, occurred at Coed Coch, approaching somewhat in character *C. Friesii*. When dry it was not distinguishable from the common form.

1782. *C. Friesii*, Quélet, Jur. p. 191.

Highfield, Sydenham Hill, F. Howse.

1783. *Lactarius scoticus*, B. & Br. Pileo e depresso-tomentoso glabro; margine involuto tomentoso; carne firma; stipite subæquali glabro subincarnato, lamellis tenuibus vix ramosis, lacte acri persistenter albo; odore pungente.

Amongst moss. Aboyne, 1862.

1784. *L. obnubilus*, Lasch., Fr. Hym. Eur. p. 438.

Glamis, Sept. 1875.

1785. *Russula elephantina*, Fr. Hym. Eur. p. 440 (non Bolt.).

Stoke Poges, M. Terry, Sept. 1878.

1786. *R. Linnæi*, Fr. Hym. Eur. p. 444.

Stoke Poges, M. Terry.

1787. *R. fellea*, Fr. Hym. Eur. p. 448.

Coed Coch, Oct. 1878. The whole plant lemon-coloured.

1788. *Marasmius varicosus*, Fr. Hym. Eur. p. 469.

Apethorpe, Sept. 1852.

1789. *M. impudicus*, Fr. Hym. Eur. p. 471.

Hanham, Sept. 12, 1871. C. E. Broome.

1790. *M. calopus*, Fr. Hym. Eur. p. 472.

Bristol, H. A. Stephens.

1791. *M. Vaillantii*, Fr. Hym. Eur. p. 472.

In great abundance in the stoves, Botanic Gardens, Regent's Park. Perhaps imported.

1792. *M. insititius*, Fr. Hym. Eur. p. 478.

Kings Cliffe, Aug. 1865.

1793. *M. saccharinus*, Fr. Hym. Eur. p. 479.

Kings Cliffe, Ketton, Northamptonshire; East Farleigh, Coed Coch.

1794. *M. Curreyi*, B. & Br. Pileo subplano sulcato pallide rufo subradiato, suleis pallidioribus, umbone fuseo; stipite insititio glaberrimo nitido nigro, apice albo; lamellis paucis subventricosis cremoricoloribus collariatis, interstitiis venosis alias lævissimis.

On leaves of grasses, Fineshade, Northamptonshire, Aug. 1859. Badminton.

1795. *M. Broomei*, B. Semiresupinatus; e pallide brunneo striato nigro; hymenio candido; lamellis distantibus venosis; interstitiis lævibus.

Batheaston, Jan. 1859, 1865. On dead twigs.

1796. *Panus Stevensoni*, B. & Br. Pileo spathulato olivaceo-flavo; stipite sursum dilatato convexo aureo hispidulo; lamellis angustis integris; carne viridi-flava.

This was forwarded from the Edinburgh Fungus show, and appears to be identical with one gathered by Mr. Stevenson on oak.

\**Lenzites flaccida*, Fr. Hym. Eur. p. 493.

Stoke Poges, M. Terry.

\**Schizophyllum commune*, Fr.

Undoubtedly indigenous specimens have occurred both in Buckinghamshire and Kent in 1878.

1797. *Boletus spadiceus*, Schæff. t. 126.

Glamis, Rev. J. Stevenson.

1798. *B. pusio*, Howse. Pulverulentus minimus; stipite deorsum inerassato nigrescente plicato e mycelio floeoso oriundo.

Kent, F. Howse, who believes the species, though very small, to be distinct.

1799. *Polyporus* (Anodermei) *alutaceus*, Fr. Hym. Eur. p. 545.

On fir-stumps. Glamis, Sept. 1876, Rev. J. Stevenson.

1800. *P.* (Anodermei) *cerebrinus*, B. & Br. Niveus pulvinatus subtiliter tomentosus glabrescens; margine erenato; poris rotundis integris dissepimentis erassis obtusis.

On fir. Glamis, Rev. J. Stevenson. About an inch across. Looks like a portion of some white brain.

1801. *P.* (Plæodermei) *roseus*, Fr. Hym. Eur. p. 562.

On dressed pine in hothouse. Glamis, Oct. 1877, Rev. J. Stevenson. A most interesting species, but possibly of exotic origin.

1802. *P.* (Inodermei) *polymorphus*, Rostk. iv. t. 56.

On fir in a fence. Forres, Rev. J. Keith.

1803. *P.* (Inodermei) *pubescens*, Fr. Hym. Eur. p. 553.

On broom. Menmuir, Rev. J. Anderson; Straan, Kincardineshire, Mr. J. Sim.

1804. *P.* (Inodermei) *cryptarum*, N. Myc. Eur. p. 566.

On fir trees. Not uncommon.

This is not *P. undatus*, P., which has a very different texture and colour, though there is a strong external resemblance. It is, in fact, more nearly related to *P. ferruginosus*, and is perhaps a mere state of it.

1805. *P.* (Inodermei) *Herbergii*, Rostk. xxix. t. 18.

Edinburgh Fungus show, Oct. 1878. This is referred with a mark of doubt to *P. spongiosus* by Fries. It is clearly the plant figured by Rostkovius.

1806. *P.* (Resupinati) *rhodellus*, Fr. Hym. Eur. p. 573.

Glamis, Aug. 1874, on Scotch fir, Rev. J. Stevenson.

1807. *P.* (Resupinati) *bathyporus*, Rostk. iv. t. 59.

On dead oak-branches. Coed Coch, 1873, &c. Exactly the plant of Rostkovius. It looks very like a resupinate form of *Dædalea confragosa*.

1808. *P.* (Resupinati) *radula*, Fr. Hym. Eur. p. 578.

On sticks. Straan, Kincardineshire, Mr. J. Sim.

1809. *P.* (Resupinati) *ramentaceus*, B. & Br. Suborbicularis; subiculo albo tomentoso, margine obsolete; poris melles amplis subhexagonis; dissepimentis tenuibus rigidiusculis acutis.

On dead sticks. Glamis, no. 284, Rev. J. Stevenson. Pores  $\frac{1}{3\frac{1}{2}}$  inch across. From the centre of one specimen an Anodermatous *Polyporus* of uncertain species was developed.

1810. *P.* (Resupinati) *reticulatus*, Weinm. p. 339; Fr. Syst. Myc. i. p. 385.

On rotten wood. Glamis, Aug. 1875, Rev. J. Stevenson.

1810 bis. *P.* (Resupinati) *hymenocystis*, B. & Br. Niveus, subtus margineque arachnoideus; poris amplis; dissepimentis scariosis collabentibus demum pallidis.

On dead wood. Glamis, Rev. J. Stevenson. A very curious species.

1811. *Trametes purpurascens*, B. & Br. Resupinatus, subcoriaceus, extus subtiliter tomentosus castaneus; hymenio purpuraseente; poris parvis, dissepimentis rigidis.

On a dead willow. Cotterstock, Northamptonshire, 1825. About  $\frac{3}{4}$  inch across; pores  $\frac{1}{100}$  inch in diam. Resembling some forms of *Polyporus abietinus*.

1812. *Dædalea heteromorpha*, Fr. Syst. Myc. i. p. 340; Obs. i. p. 108.

On an old post, apparently of fir. Sufton Court, Hereford, C. E. Broome. This is now referred by Fries to *Lenzites*; but our specimens clearly belong to *Dædalea*.

1813. *Hydnum sepultum*, B. & Br. Totum resupinatum aureum, margine albo, aculeis acutis mediis.



Forming little scattered patches on stones buried amongst pine-leaves. Glamis, no. 818, Rev. J. Stevenson. We have apparently the same species from Forres.

1814. *Radulum aterrimum*, Fr. Hym. Eur. p. 624.

Kensington Gardens. Sow. Herb. "Hydnum erectum."

\**Phlebia contorta*, Fr. Hym. Eur. p. 625.

Sussex, C. W. Spencer Preeceval.

1815. *Irpex spathulatus*, Fr. El. p. 146.

On larch. Wallington, Northumberland, Cecil H. Sp. Preeceval, Nov. 1878. Growing on the same sticks with the ruddy form of *Agaricus mitis*.

1816. *Thelephora undulata*, Fr. Hym. Eur. p. 633.

On the ground. Coed Coch, Oct. 1878. Exactly Schæff. t. 278. We have no authentic specimen of the plant of Fries.

1817. *Hymenochate Stevensoni*, B. & Br. Pallide cervina, rigida, margine obtuso elevato, setis rufis hispida.

On bark of yew. Glamis, no. 1023, Rev. J. Stevenson. A very curious and distinct species.

1818. *Stereum ochroleucum*, Fr. Hym. Eur. p. 639.

Glamis, Rev. J. Stevenson, Jan. 1874. Often resupinate.

1819. *Clavaria Kunzei*, Fr. Hym. Eur. p. 669.

Cecil H. Sp. Preeceval.

1820. *C. ligula*, Fr. Syst. Myc. i. p. 477.

Straan, Kincardineshire, Mr. J. Sim.

1821. *Corticium porosum*, B. & Curt. MSS. Resupinatum laetum, hic illie porosum; margine libero reflexo.

Aboyne. Apparently the same with specimens from Venezuela. The pores look as if little dew-drops had settled on the hymenium, which had in consequence contracted or, rather, retracted.

1822. *C. puberum*, Fr. Hym. Eur. p. 652.

On wood. Forres, Glamis, Aboyne, Hereford. Often confounded with *C. velutinum*.

1823. *C. subdealbatum*, B. & Br. Effusum candidum, hymenio e setulis pallide cervino.

On fir. Badminton, Dec. 1866. Apparently the same thing occurs in Pennsylvania, Michener. The colour is so different from any thing in *Hymenochate* that it is thought better to refer it to *Corticium*.

1824. *C. fetidum*, B. & Br. Olidum, effusum, resupinatum, subtus arachnoideum, ex albo ochraceum glabrum.

On sawdust. Coed Coel. Not apparently a resupinate form of *Thelephora fastidiosa*.

1825. *C. scutellare*, B. & Curt. Notices of N. Am. Fungi, no. 282, in Grevillea.

On *Ulex*. Mr. J. Sim. Glamis, Rev. J. Stevenson.

1826. *Octaviana compacta*, Tul. Fung. Hyp. p. 79, tab. xi. f. iii.

Shoreham, Kent, C. E. Broome and F. Howse, 1877.

\**Physarum Schumacheri*, Spreng.

Glamis, Rev. J. Stevenson. Interesting, as it has not been found since the publication of the 'English Flora,' where it appears as *Diderma citrinum*.

\**Helvella sulcata*, Afz., Fr. Syst. ii. p. 15.

Glamis, Rev. J. Stevenson. On gravelly soil.

1827. *Leotia Stevensoni*, B. & Br. Brevis, dense cæspitosa; pileo stipiteque viridibus.

Glamis, Rev. J. Stevenson. This has a very different habit from *Leotia lubrica*, and approaches *L. atrovirens*. There does not appear to be any decided difference in the fruit.

\**Peziza* (Sarcoseyphæ) *eclecta*, B. & Cooke.

On the naked ground. Sibbertoft, Oct. 1870. Cells of receptacle large; hairs few, nearly colourless; paraphyses clavate.

1828. *P.* (Humaria) *ollaris*, Fr. Syst. ii. p. 68.

Glamis, Rev. J. Stevenson, Sept. 1877. Sufton Court, Hereford; Symonds Yat, Monmouth, Oct. 1878, C. E. Broome.

1829. *P.* (*Patellea*) *euphorbiae*, B. & Br. Minuta sessilis, margine prominulo, nigro; hymenio albo, ascis clavatis, sporidiis subbiseriatis, globoso-ellipticis.

On stems of *Euphorbia amygdaloides*. Batheaston, Dec. 14, 1866, C. E. Broome.

Cups 0·016 inch in diam., sporidia 0·0002 long, nearly as much broad. Belongs clearly to the same section as *P. cerastiorum*.

1830. *Phacidium leptideum*, Fr. Syst. ii. p. 576.

Strathtay, Perthshire. On *Vaccinium myrtillus*, Rev. J. Stevenson.

1831. *Patellaria pallida*, B. Gregaria, sessilis, pallida; margine obtusiusculo; sporidiis biseriatis oblongis leviter curvulis.

On smooth bark. Rev. A. Bloxam.

Sporidia 0·0005 long.

\**Hypocrea parmelioides*, Mont. Syll. p. 210.

This curious species, which is *Sphaeria riccioidea*, Bolt., has lately been found on willow-twigs by the Rev. J. Stevenson at Glamis.

1832. *Hypomyces chrysospermus*, Tul. Sel. Fung. Carp. iii. p. 49.

On *Boleti*. Coed Coch.

XXV.—*Descriptions of four new Species of the Genus Inopeplus* (Coleoptera, Cucujidæ). By CHARLES O. WATERHOUSE.

I HAVE not had an opportunity of examining the species upon which Laporte established the genus *Ino*, and am therefore somewhat in doubt as to whether the species here described really belong to that genus. If the species described by M. Fairmaire (Ann. Ent. Fr. 1869, ix. p. 208) as *Ino picta*, Lap., is the same as that described by Laporte, it appears to me that all the eastern and American species at present included in the genus must be separated, on account of the form of the thorax and of their not having the penultimate joint of the tarsi bilobed. Laporte, however, does not mention this bilobed joint.

The generic name *Ino* being preoccupied in Lepidoptera, I have adopted *Inopeplus*, proposed as a substitute for it by Mr. F. Smith. In the event of the separation above mentioned taking place, the eastern species will fall into *Euryplatus*, Mots.

The following species are in the British-Museum collection.

*Inopeplus æneomicans*.

Elongatus, æneus, micans; capite coriaceo, sat crebre evidententer punctato; thorace coriaceo, sat crebre subtilius punctato, ante basin constricto; elytris subtiliter coriaceis, purpureo-æneis, sutura ænea; abdomine nitido, subtilissime coriaceo, parce subtilissime punctulato, cupreo et viridi-æneo micante; antennis pedibusque piceis, tibiis rufo-piceis.

Long. 2 lin.

Head a little broader than long, slightly narrowed before and behind the eyes, which are prominent; in the middle there is a distinct longitudinal impression. Antennæ pitchy, the basal joint æneous, club-shaped, as long as the two following together; 2nd joint short, scarcely longer than its width at the apex, the 3rd to 11th gradually and slightly increasing in length. Palpi pitchy, the apical joint of the maxillary pair elongate fusiform. Thorax scarcely broader than long, with a very slight angular projection rather behind the middle of the side; behind this it is gently sinuate and obliquely narrowed to the base. Elytra about as long as the head and thorax together, rather broader behind than at the base, separately obtusely rounded at their apices, coppery æneous, green at the suture, rather brighter coppery at the apex. Abdomen with four segments exposed above, shining,

with green and coppery reflections. Femora incrassate; intermediate tarsi with the basal joint a little longer than the second, 2nd and 3rd equal, 4th much smaller, simple, claw-joint as long as the four previous joints taken together; posterior tarsi 4-jointed, the basal joint elongate, as long as the 2nd and 3rd taken together, the 3rd joint very small, the claw-joint as long as the three previous joints taken together.

*Hab.* Jamaica.

Received from Mr. R. M'Lachlan with some *Tomicidæ* from Jamaica.

*Inoepplus violaceipennis.*

Latiior, niger, nitidus; capite thoraceque crebre subtiliter punctulatis; elytris violaceis, crebre subtilissimo punctulatis; palpis, antennarum articulo basali tarsisque piceis.

Long.  $2\frac{1}{2}$  lin.

A large broad species. Head more than twice as broad as long, finely, distinctly, and rather closely punctured. Thorax at its widest part a trifle broader than the head, finely, distinctly, and rather closely punctured, twice as broad as long, from the middle to the base very obliquely narrowed and rounded, base arcuate. Elytra violet, finely and rather closely punctured, as long as the head and thorax together. Abdomen æneous-black, broad and rounded, the two basal segments of those exposed above sparingly and very obscurely punctured, the apical segment closely and very finely punctured.

*Hab.* Dory, New Guinea (*Wallace*).

*Inoepplus terminatus.*

Piceo-niger, nitidus; capite thoraceque crebre evidententer punctatis; elytris piceis, brevibus, obsolete subtilissime punctulatis, apice testaceo; abdomine supra crebre subtilissime punctulato; tarsis piceo-testaceis.

Long. 2 lin.

Head twice as broad as long, slightly oblique behind the eyes, closely and very distinctly punctured. Thorax not quite twice as broad as long, much narrowed at the base, not quite so closely punctured as the head, with a slight smooth mesial line; the sides are rounded at the anterior third, and then very oblique and gently sinuous to the base. Elytra at the base as broad as the thorax, much broader posteriorly, as long as the head and thorax together, smooth, with only some obscure and extremely fine punctuation, pitchy, the sides darker, the apex pale yellow-testaceous. Abdomen with four segments exposed above, parallel at the base, rounded at the apex,

rather thickly and extremely delicately punctured, the margins reflexed.

*Hab.* Java (*J. C. Bowring, Esq.*).

*Inopeplus biguttatus.*

Piceus, nitidissimus; capite sat crebre subtiliter punctulato; thorace basi bene angulato, sat crebre subtilissime punctulato, angulis posticis distinctis; elytris discrete subtilissime punctulatis, singulis macula quadrata notatis.

Long.  $1\frac{1}{2}$  lin.

Head about twice as broad as long, with a longitudinal impressed mesial line, finely and rather closely punctured. Thorax a little broader than the head, rather more than twice as broad as long, very obliquely narrowed behind, finely and moderately closely punctured; the sides for the anterior third rounded, thence to near the base very oblique, but at the extreme base forming with the base a right angle. Elytra at the base as broad as the thorax, much wider behind, a little longer than the head and thorax together, irregularly, finely, and not very thickly punctured; each elytron with a transverse quadrate pale yellow spot on the disk. Abdomen rather thickly and extremely delicately punctured. Antennæ nearly black, distinctly longer than the head and thorax together.

*Hab.* Java (*J. C. Bowring, Esq.*).

XXVI.—*On Mammals and Reptiles from Johanna, Comoro Islands.* By Dr. ALBERT GÜNTHER, F.R.S., Keeper of the Department of Zoology, British Museum.

THE British Museum has received from Mr. C. E. Bewsher a small collection of mammals and reptiles made by him during a sojourn of six weeks in Johanna. The MAMMALS found by him were previously known to occur in the island, and belong to four species, viz.:—*Lemur anjuanensis*, Geoffr.; *Pteropus Edwardsii*, Geoffr.\*; *Centetes ecaudatus*; and *Mus musculus*.

*Lemur anjuanensis.*

The Lemur of the island of Johanna has been described by Geoffroy St.-Hilaire, in 'Annales du Muséum,' vol. xix.

\* *Pteropus Livingstonii* (Gray) is a second species occurring in Johanna. According to a communication from Dr. Hildebrandt the following species occur also in Johanna—*Miniopterus scotinus*, *Nyctinomus pumilus*, *Cynonycteris* sp., *Crocidura albicauda*, and *Viverra Schlegelii*.

p. 161, under the name of *Lemur anjuanensis*, in the following terms:—"Pelage roux-vif en dessus, gris-roux sur les membres: les parties antérieures du tronc cendrées."

This diagnosis can be applied to more than one species of *Lemur*; and therefore it is all the more satisfactory to find more definite details in Peters's 'Reise nach Mossambique,' p. 21, who obtained, during his visit to the island, a female and a young specimen. His description agrees entirely with a specimen of the same sex obtained by Mr. Bewsher. However, I am able to supply additional information on the *male* sex, of which three specimens are before me.

The specimen named *Lemur anjuanensis* by John Edward Gray, in P. Z. S. 1863, p. 139, and in the 'Catalogue of Monkeys,' p. 75, is a very different species, seemingly more allied to *Lemur mayottensis* of Schlegel, but of unknown origin.

It will be observed that Schlegel, in his recent Monograph of *Simia*, refers *mayottensis*, as well as *anjuanensis*, to *Lemur collaris* from Madagascar.

Our three males are exactly alike: the face before the eyes is white, the nose blackish, the forehead with mixed black and whitish hairs; the side of the throat below the eye, and the throat itself, bright brownish red; crown, back, outer side of the legs, and the greater part of the tail grey, with a not very perceptible rufous tinge on the rump; chest and abdomen greyish, with a rufous tinge; inner side of the legs with scarcely any white; hands and feet grey (in one specimen whitish); the terminal third or fourth of the tail blackish.

The female has the forehead and the face of a more decided black colour, only the nose before the eyes being whitish. Sides of the throat and the throat itself white, with a greyish collar just before the chest. Abdomen with a rufous tinge; præanal region chestnut-brown. Upper parts, legs, and tail as in the male.

#### Measurements.

	Male. in.	Female. in.
Length from the end of the nose to the root of the tail . . . . .	15	14½
Tail . . . . .	19½	18½
Distance from the end of the nose to the ear	2¾	2¾
Sole of fore foot, including fourth finger . . .	2	2
Length from the heel to the end of the fourth toe . . . . .	3½	3½

Mr. Bewsher writes that this species is very wild, and that he could not succeed in taming one of the four specimens kept by him in captivity.

*Centetes ecaudatus.*

That old specimens, presumably males, have the skull, and more especially the fore part of the snout, developed in an extraordinary manner is a fact which has been previously ascertained from Madagascar examples. Thus, the British Museum possesses, among others, an example from Vohima, which measures about 10 inches from the tip of the snout to the extremity of the rump, its skull being not less than  $4\frac{1}{8}$  inches in length. Specimens from Johanna grow to a still larger size, individuals 16 inches in length being apparently not scarce. As far as I can judge from these dried specimens, their skull cannot be less than 5 inches in length. The proportions between the head and the body seem, therefore, to be subject to great variation; and in no other respect do the Johanna individuals differ from those obtained in Madagascar or Mauritius. The young are banded in the same manner; and older ones have sometimes a whitish, sometimes a blackish crest of prolonged hairs along the median line of the hinder part of the back.

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Of the REPTILES collected by Mr. Bewsher, *Euprepes comorensis* (Ptrs.), *Phelsuma cepedianum* (Cuv.), and *Hemidactylus platycephalus* (Ptrs.) were previously known to occur in the island. The second is common throughout Madagascar and the Mascarenes; and the third has been probably imported from the mainland.

New to its fauna are:—an *Eremias*, of which there is only one example, too young to be specifically determined; an undescribed Phyllodactyline Gecko, *Parœdura sancti johannis*; *Typhlops pammeceus* (Gthr.), hitherto known from Southern India only; and an undescribed Lycodont snake, *Lycodryas sancti johannis*.

I subjoin the descriptions of the new species:—

## PARÆDURA, g. n. Geckotid.

This genus is allied to *Ædura* and *Discodactylus*; from the former it differs by its lepidosis, from the latter by the scutellation of the toes. Toes, as in *Phyllodactylus*, rather slender, each with a pair of dilated terminal lamellæ, between which the claw is lodged; each toe with a *double* series of plates beneath in its whole length. Claws five in front and behind. Upper parts covered with numerous large keeled tubercles, which are serially arranged, leaving but little space for the finer granulation. Tail cylindrical, tapering, with

transverse series of larger tubercles on its back. Underside with small imbricate scales. Neither præanal nor femoral pores.

*Parædura sancti johannis.*

Limbs rather slender. Head large, depressed, with the snout of moderate length. A series of large tubercles along the supereiliary margin and across the temple. A pair of chin-shields, which are much longer than broad. Ear-opening vertical, narrow. Brownish, marbled with darker; a black spot on the occiput. Lower parts whitish.

A single specimen was obtained,  $4\frac{1}{2}$  inches long, of which the tail takes  $2\frac{1}{2}$  inches; distance from the snout to the ear-opening  $8\frac{1}{2}$  lines; length of fore leg 11 lines; length of hind leg 15 lines.

LYCODRYAS, g. n. Lycodont.

Body slender and compressed, with the abdomen angular on the sides. Scales smooth, in nineteen rows, those of the back not conspicuously enlarged. Anal bifid; subcaudals bifid (partly simple). Eye with vertical pupil. Two nasals, the nostrils in the anterior; one loreal, not reaching the orbit. Anterior maxillary and palatine teeth longest, followed by other long teeth, which gradually decrease in length.

This genus is allied to *Hormonotus* and *Tetragonosoma*, but differs from the former in the scutellation of the side of the head, and the absence of large dorsal scales; from the latter also in the scutellation of the head, and, besides, in the dentition.

*Lycodryas sancti johannis.*

Head depressed, of moderate length, with rather broad snout, and very distinct from the very slender neck. Body and tail very slender, with an obtuse keel on each side of the abdomen. Eye of moderate size, with vertical pupil. Rostral broad, low, not extending to the upper surface of the snout. Anterior frontals about one third the size of the posterior. Vertical broad, but longer than broad, with parallel lateral edges. Occipitals pointed behind. Two small nasals, the anterior pierced by the nostril. Loreal long. Præorbital broadly in contact with the vertical. Three postoculars. Nine upper labials, the fourth and fifth and sometimes the third entering into the orbit; the sixth is small and triangular, in contact with the lower postorbital; the three posterior are low. Temporal scales rather irregular and numerous.



Scales in nineteen rows, smooth. Ventrals 261. Anal bifid; the twenty-three anterior subcaudals are simple, and followed by about eighty paired ones.

Upper parts reddish brown, irregularly mottled with darker. Lower parts yellowish, finely mottled with blackish.

The single specimen is 31 inches long, of which the tail takes 7 inches.

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XXVII.—*Notes on the Lepidoptera of St. Helena, with Descriptions of new Species.* By Mrs. T. VERNON WOLLASTON.

ALTHOUGH it is generally admitted that islands are, without doubt, for the most part, more unproductive (even in proportion) than continents, and that the smaller the area the less favourable will it be for the development of insect life, yet, perhaps, this very fact imparts to these restricted faunas a greater degree of interest than they would otherwise possess. Especially is this the case in *St. Helena* (more so even than in the other Atlantic islands which have been most carefully searched), not only from the fact of its greater remoteness from other land, which attaches to it an importance which the student of zoological geography cannot fail at once to recognize, but likewise on account of its botany, which resembles no other in the peculiarity of its indigenous vegetation. And as there appear to be few facts in entomology more extensively true than that the most peculiar insects of a region are usually found either to be dependent on or to inhabit the same area as its most peculiar plants, it may therefore, perhaps, be as well, before describing the *Lepidoptera*, just to take a brief glance at the general features of the flora of *St. Helena*. When first discovered, it is stated that the island was entirely covered with forests, the trees drooping over the tremendous precipices that overhang the sea. Now, however, it is sadly altered, and, with very few exceptions, it is only the loftiest and well-nigh inaccessible summits of the great central ridge that still retain the remains of the aboriginal vegetation. Near to the coast the rough lava is quite bare, and presents a most forbidding aspect to the stranger as he approaches it from the sea; nor will he, if a naturalist, be much more satisfied as he rides into the interior through districts of the most unmistakably introduced vegetation. Supposing it to be in the summer time, the stranger will probably be struck (as we were) by the picturesque groups of "hay-

makers" as they idly collect the fresh-cut grass from the precipitous slopes at the commencement of the deep ravines. Yet he may, perhaps, be tempted to feel that he might, after all, almost as well (except for the mere fact that it is summer at the time of year which he is accustomed, in more northern latitudes, to regard as mid-winter) be in the British Isles for what he sees in the surrounding country to indicate a tropical or even a distinctive fauna. But only let him scramble on for less than a mile, and he will be surprised at the complete change which presents itself. At least, daily as we returned to the crest of the great central ridge, we never failed to be astonished and delighted at the sudden transition from English broom, brambles, willows, Scotch pines, and gorse bushes, Cape-of-Good-Hope bushes, Australian trees, American weeds, and the somewhat choicer importations peeping from the various gardens and more highly cultivated spots, to the mass of native vegetation which still clothes the loftiest peaks. However, so small is the area that has been left in a state of nature that hardly more now remains than sufficient to give a tantalizing glimpse of what the island must have been like before the struggle for existence began between the imported\* and natural vegetation: amongst the latter the arborescent *Compositæ*, tree ferns, and two or three distinct species of *Wahlenbergias* are the most conspicuous.

Therefore, considering the extreme isolation of St. Helena, the smallness of its area†, and the deteriorated nature of the country, the following is, I imagine, as good a list as could be expected. Out of the ninety-four species that we met

\* The manifest deterioration of St. Helena during the last three hundred years is much to be deplored. The first step towards producing this alteration (fully five sixths of the island, which was once well-wooded, being now utterly sterile) was undoubtedly due to the introduction of goats. These multiplied so rapidly that they soon existed in thousands, and well-nigh destroyed all vegetation by their continuous nibbling at every fresh shoot or seedling that appeared; and as, at the same time, the trees were permitted by the inhabitants to be "chopped down ruthlessly for fuel, into a chaos of scoræ," it did not take long to bring about this undesirable result. However, even this is not all that the aboriginal vegetation has had to contend with; for the same Governor who at last took the strongest measures to exterminate the goats (or, at any rate, compelled them to be kept within bounds) for the sake of protecting the native plants, counteracted his measures, for the latter purpose, himself, to a great degree, by promoting the introduction, on a large scale, of exotic plants from all parts of the world, which have since propagated themselves with such rapidity, and grown with such vigour, that the *native* plants cannot compete with them, and are therefore gradually diminishing year by year.

† St. Helena is not calculated to be more than ten miles long by seven broad.

with during our six months' residence in the island there seems no reason to doubt that considerably more than half are truly indigenous. The remainder are, for the most part, insects of a very wide geographical range, and have, I believe, nearly all been recorded from Africa; whilst, notwithstanding that the island is a thousand miles nearer to America than is any part of the African coast, it contains scarcely any species that are characteristic of America.

## Order LEPIDOPTERA.

### Section I. RHOPALOCERA.

#### Fam. I. *Nymphalidæ*.

#### Genus 1. *DANAIS*, Latr.

#### *Danais chrysippus*, Linn.

This species appears to be a most widely distributed one, occurring in Greece, Asia Minor, Persia, and the Canary Islands, as well as in South Africa and the Mauritius. Indeed many localities even in South America are quoted as having produced it, viz. Guiana, Surinam, and Cayenne; and I believe that it has been met with also in Trinidad. In the north-western provinces of India it is said to be well-nigh universal; and it is called by Captain H. L. De la Chaumette one of the "commonest insects of India."

At *St. Helena* *D. chrysippus* is very abundant, especially in arid places more or less characterized by plants of the *Asclepias*, on which in the larva-state it subsists. It is at intermediate and rather low elevations that it more particularly abounds, seldom ascending higher than 1800 or 2000 feet above the sea. The greater number of my specimens I captured at Cleugh's Plain; and I also met with it commonly at Plantation. It is easily caught, especially late in the afternoon, when it may be taken in the hand off the *Asclepias* bushes.

The caterpillar of this *Danais* is rather more than an inch and a half in length, and of a delicate French grey, each segment being ornamented with five black transverse lines, the second and third ones of which are somewhat broader and enclose two large yellow transverse patches. There is a yellow spiracle-line very much interrupted, the skin being puckered, and the spiracles themselves scarcely visible. The head has three broad, transverse, arched, black lines, the anterior one of which encloses a yellow space, bordered in

front by a straight basal line. The third, sixth, and last segments are each furnished with a pair of conspicuous dark retractile horns, the anterior pair of which are almost twice the length of the others. When fully fed it suspends itself by its tail, and turns into an obtuse semitransparent chrysalis, beautifully marked with small golden spots, placed elliptically round the head, and with a black, raised, semicircular line near the tail, the posterior edge of which is of a brilliant gold; there is also a minute golden spot about the position of the centre of the enclosed wings. These golden markings, however, disappear, by the absorption of the fluids, as the enclosed insect approaches maturity.

## Genus 2. HYPOLIMNAS, Hübn.

### *Hypolimnas bolina*, Linn.

The female of this species might well be mistaken for *Danais chrysippus*, it being at first sight so exceedingly like that insect; but the different veining of the wings and the absence of the articulations of the fore tarsi are in themselves sufficient to show, upon closer examination, that it belongs, in reality, to what many authors regard as a distinct subfamily of the Nymphalidæ.

This handsome butterfly is not uncommon in various parts of the island, both at low and intermediate altitudes. My specimens I captured chiefly at Plantation, flying over the flowers of the *Acacia longifolia*, Willd. (known as the "Port-Jackson Willow"), on the grassy slopes behind the house; but I do not recollect seeing it at a higher level. Unfortunately I did not succeed in detecting either the larva or pupa of *H. bolina*. It appears to be tolerably abundant in many districts of North-western India, where the caterpillar is said to be reared on the *Portulaca oleracea*; and, according to Captain H. L. De la Chaumette, it is very common, throughout nearly the whole year, at Saugor. Mr. R. Trimen, in his "Notes on the Butterflies of the Mauritius," whence he records this species, remarks that "it is very interesting to observe how this insect, the female of which so precisely imitates the *Danais chrysippus*, almost rivals its model in geographical range, though it does not appear as yet to have extended into Southern Europe. Its occurrence in parts of the New World, where the *chrysippus* is unknown, seems to be regarded by many Lepidopterists as accidental—among others, by Mr. Bates (Proc. Zool. Soc., Nov. 1863), whose laborious researches for eleven years in South America give great weight to his opinion." It is found also in the Island

of Ascension, where it was met with (in 1860) by the late Mr. Bewicke.

### Genus 3. PYRAMEIS, Hübn.

#### *Pyrameis cardui*, Linn.

This well-known and almost cosmopolitan butterfly is quite abundant in the island, and is to be met with equally from the level of the sea to the summit of the highest ridge; but perhaps it abounds most in the intermediate districts, at which elevation the flowers of a large yellow everlasting are frequently quite covered with it. At Woodcot, too, it seems very plentiful; and most of my specimens I reared from some caterpillars which were brought to me from there by Miss C. Whitehead.

*P. cardui* occurs in the Canarian, Madeiran, and Azorean groups; but the St.-Helena examples are decidedly more highly coloured than a series of Madeiran ones which are now before me.

### Fam. II. Lycænidæ.

### Genus 4. CUPIDO, Schrank.

#### *Cupido baticus*, Linn.

Judging from what one ordinarily observes in butterflies, the sexes of the present species seem, as it were, to have exchanged places with each other; for whereas the males are, in most instances, more particularly adorned with the richest tints, I find, after a very careful investigation, that in *Cupido baticus* it is the females which retain the brightest colour.

This very pretty species is certainly the most abundant of the few Diurnal *Lepidoptera* which have, as yet, been found at St. Helena; and it is one which occurs more especially at a rather high altitude. At West Lodge it absolutely swarms; I have observed the flowers of the common blackberry literally covered with it. At Plantation I captured two or three of the males less than a third of the size of the ordinary ones; but they do not appear to possess any other peculiarity. *C. baticus* has a very wide geographical range; and it is found also in the Madeiran and Canarian groups, in both of which, though especially the former, it is well-nigh universal. Although common in many parts of the continent of Europe, in England it is of the greatest rarity, having been taken merely once or twice on the southern coast. The larva,

which seems to have a great partiality for the common garden pea, is of a green hue, short as well as very thick, and somewhat fusiform in outline, much resembling in shape the common woodlouse. However, we never succeeded in obtaining many of the caterpillars, though in Madeira we have often met with it.

The section Rhopalocera is very poorly represented at St. Helena, only four species having as yet been brought to light, whilst not one of even these can be looked upon as possessing the slightest claim to being indigenous. Indeed they happen all of them to possess an extremely wide geographical range; and it is interesting to know that the whole four occur in Africa. *Pyrameis cardui* may well-nigh be said to be the butterfly, *par excellence*, of all countries; and even *Danaüs chrysippus* goes far to emulate it in its roving propensities. Where the latter is found, too, it is, in most cases, accompanied by its mimic, *Hypolimnna bolina*, though, at the same time, I believe it to be true that *H. bolina* has been discovered in some parts of America where *D. chrysippus* has not yet been detected. Neither has *H. bolina* established itself as a European insect; but that may, in reality, be due to the mere fact of its requiring a higher temperature for its development. *Cupido baticus* too has a very wide acquired range, and is remarkable for the little variation of its markings in whatever climate it happens to be found.

It is somewhat strange, perhaps, that with so peculiar and wonderful a flora the little island should not produce a single butterfly which can be considered, in the least degree, aboriginal, more especially when we take into account the large number of new and curious forms which are indicated in the Heterocera, and which will speak for themselves further on. But, whatever be the case with the moths, it is certainly very surprising, considering the many facilities that must assuredly have arisen, from time to time, when this small oceanic rock was the recipient of such vast accumulations of plants from all parts of the world, and was in such constant use as a place of call under the old East-India Company's rule, that more exponents of the Rhopalocera should not have been accidentally introduced; for one would be apt to imagine that the self-same circumstances which favoured the transportation of these four would hold good for many other species. I believe, however, that this is very much in accordance with what may be observed in the generality of islands which are unusually remote.

## Section II. HETEROCERA.

## Fam. I. Sphingidæ.

## Genus 1. ACHERONTIA, Ochs.

*Acherontia atropos*, Linn.

This gigantic hawk-moth is now abundant at St. Helena, the caterpillars being especially plentiful at intermediate elevations. The latter feed on, amongst other plants, the *Brugmansia suaveolens*, Willd. (the great white "Datura"), though their principal and most favourite food-plant appears to be the prickly *Solanum Jacquinii*, Willd. (known on the island as the "Wild Bringas"), to which plant they are exceedingly destructive. Neither is the peculiar dark variety of the larva at all uncommon. Mr. Melliss records a curious fact about this moth—namely, that it first occurred on the island in the year 1835, and was afterwards very plentiful until 1854, when it disappeared simultaneously with the honey-bee (to which, as is the case with it in England, he says that it was a troublesome enemy). A few years ago, however, the honey-bee was reintroduced into St. Helena; and *atropos* has again made its appearance, seemingly more abundant than ever. I have had as many as twenty caterpillars brought to me in the course of a single afternoon.

## Genus 2. SPHINX, Ochs.

*Sphinx convolvuli*, Linn.

The only evidence which I possess for the occurrence of this *Sphinx* in St. Helena consists in a chrysalis which was brought to me from a cultivated piece of ground at "Fairy Land," on the eastern side of (but a little below) the great central ridge; but the characters of the chrysalis are so unmistakable as pertaining to *S. convolvuli*, that I have no hesitation whatever in adding the species to the fauna.

## Genus 3. DEILEPHILA, Ochs.

*Deilephila celerio*, Linn.

This exceedingly quick-flying *Deilephila*, which possesses so wide a geographical range, is, at some seasons of the year, most abundant at St. Helena. We were told that often it was quite difficult to carry, without inconvenience, even baskets of flowers (especially when containing the sweet-scented Gardenias), on account of the aggressive manner in which these moths would follow and dart around the baskets,

sufficient almost, in the dusk of the evening, to startle one. We were too late, however, in the season to see them in any great numbers, and at first I only met with a few examples (most of which were dead and enveloped in cobwebs behind the window-shutters of the house) at Plantation; but before leaving the island we managed to rear some remarkably perfect ones, from larvæ which had been sent to us by Mr. N. Janisch, from the Botanic Gardens in Jamestown.

The caterpillar of this species is of a dirty yellowish flesh-colour, and, when fully extended, about two inches and a half in length. From the fifth segment (which is the largest) to the head it gradually tapers; and it has a yellow band on either side, which likewise tapers to the head; the ground-colour also is darker on the second, third, fourth, and fifth segments. The head is of a pale greenish brown. The fifth segment is ornamented with a conspicuous eye-like spot (the centre of which is black, but having a few bluish dots), which is surrounded by a yellow ring. The sixth segment has a rather smaller, round, plain, yellow spot. There is a narrow black dorsal line throughout; and after the sixth segment the surface is ornamented with short black streaks (almost forming narrow longitudinal broken-up lines), which give the central space a reticulated appearance, which is interrupted by a black abbreviated transverse streak on either side of the fore part of the segments. There are some minute white dots sprinkled on each side of the spiracles; and the horn is small, straight, and almost black. This caterpillar, however, is in colour very variable, it being sometimes of a bright green throughout; and its principal food appears to consist of vine-leaves.

*D. celerio* is found in the island of Madeira, and also in the Mauritius and in Asia Minor.

## Fam. II. Noctuidæ.

### Genus 4. AGROTIS, Ochsenh.

#### *Agrotis obliviosa*, Walk.

This species is so similar to the British *A. segetum* that I should have concluded it to be at the most but a geographical variety of the latter had not Mr. Walker identified it with *A. obliviosa*, which he first described in 1856 from, I believe, some African examples.

#### *Agrotis pallidula*.

*Agrotis pallidula*, Walk. in Melliss, St. Hel. 183 (1875).

The widely spread and numerous represented genus



*Agrotis* seems to have but two representatives in the island; indeed I myself only observed *one*, namely the *obliviosa*—a species which appears at Helena to take the place, as it were, of the common *A. segetum* of the British Isles, the former being in like manner a pest to certain of the crops. There is decidedly no group of Lepidoptera in the island which is so devastating; and yet although somewhat annoying to the farmers at stated seasons, it is by no means so destructive (in the larva condition) as members of the same family often are in other countries; for in the case of the latter one can scarcely realize what utter devastation they are capable of causing, small though they be.

#### Genus 5. APAMEA, Ochsenh.

##### *Apamea subvelata*.

*Apamea subvelata*, Walk. in Melliss, St. Hel. 184 (1875).

I only met with a few examples of this *Apamea*—one of which recedes from the others in having the surface throughout of a darker tint, and in the orbicular stigma being represented by a very small, almost black, and somewhat X-shaped streak.

Mr. Moore informs me that it is near our English *A. unanimis*. However, this particular species seems peculiar to St. Helena, where it frequents the loftier heights, chiefly in the localities which are more particularly characterized by the "cabbage-tree" flora.

#### Genus 6. PERIGEA, Guén.

##### *Perigea punctosa*, Walk.

This species is not by any means uncommon in the island; however I did not meet with either the caterpillar or chrysalis of it. The moth seems fond of concealing itself beneath, or by the side of, stones which lie on the surface of the ground, and is very easily disturbed in the daytime. Most of my specimens were obtained at Plantation in the dusk of the evening. It may at all times be easily distinguished from any of the other St.-Helena Noctuids by its broader wings, as well as by its almost white orbicular stigma.

#### Genus 7. PRODENIA, Guén.

##### *Prodenia littoralis*, Boisid.

This prettily variegated *Prodenia* abounds in St. Helena, especially at intermediate elevations. In the caterpillar-state

it is very destructive to the foliage of the geraniums; it feeds also upon bramble, French ivy, and many other garden plants. The caterpillar is nearly 2 inches in length when fully grown and extended, quite smooth, and rather stout; the head is small in comparison with its size; each segment (except the first and second) has a wedge-shaped velvety black blotch on either side, the outer margin of each blotch being bordered with a yellow line, which line on the third, fourth, and fifth segments assumes more the shape of a spot, those on the fifth segment being very minute. It varies, however, very much in its ground-colour, sometimes being of a very dark brown, and at others of a very much paler hue.

Genus 8. LEUCANIA, Ochsenh.

*Leucania punctosa*, Treitschke.

This very ordinary-looking *Leucania* (which is found in the south of France, Sicily, and perhaps Spain) is rather abundant at St. Helena; and it may often be seen, in a drowned or partially drowned state, floating upon the surface of the water which has been collected in the little tubs or tanks which are so universal throughout the island. The majority of my specimens, however, I captured at Plantation, flying over the geraniums and other garden plants in the dusk of the evening.

Duponchel, in his 'Catalogue des Lépidoptères d'Europe,' includes under this species (*punctosa*) *Boisduvalii*, Dup., and also *putrescens*, Hübn., which he seems to regard as a mere variety. The figure, however, of *Boisduvalii* in Godart's 'Papillons de France,' pl. cv. f. 6, does not altogether correspond with the specimens from St. Helena. The surface of Godart's figure seems to me to be of a much more uniform and darker hue throughout; and it shows a postmedian transverse curved row of black dots, which are entirely wanting in my types. The figure of *Leucania putrescens* in the 'Entomologist's Annual' for 1862, pl. ii., is quite unlike my St.-Helena specimens, though the woodcut of *putrescens* in Newman's 'Natural History of British Moths' is exactly similar to *L. punctosa*.

*Leucania extranea*, Guén.

Although I did not meet with this *Leucania* during our residence at St. Helena, nevertheless, since its occurrence is recorded by Mr. Melliss, I think it ought not to be omitted from our present catalogue. I cannot, however, but feel it open to consideration whether the male of the preceding species

may not have been inadvertently identified by Mr. Walker with *L. extranea*. Nevertheless the two are in reality altogether distinct, *extranea* receding from *punctosa* in being of a more ochreous and rosy tint, as well as of a less harsh, or softer-looking, substance throughout, and in being free from a longitudinal darkened space or streak along the discoidal region. Moreover, whereas in *L. extranea* the stigmata are just discernible, in *punctosa*, on the other hand, they are altogether absent.

*L. extranea* is an insect of a very wide acquired geographical range, occurring in many parts of the world, though it has usually been looked upon as more particularly American. In Madeira it is one of the most universal of the Noctuas, being found (especially in cultivated grounds) from the sea-level to an elevation of at least 3000 feet; and it is said in Mr. Godman's work to be found at San Miguel, in the Azores. In England it has been met with on one or two occasions only, on the southern coast; so that the species is very likely a mere naturalized one as British, or, more probably still, only accidentally imported. Guénée states that it is very common, and he cites as localities for it North America, Columbia, Brazil, the East Indies, Java, and New Holland. It has also been met with in New Zealand.

#### Genus 9. CARADRINA, Ochsenh.

##### *Caradrina indicata*.

According to my experience this moth seems to be confined to the intermediate districts; but it is clearly nowhere very abundant. So far as I can recollect, I captured all my specimens at Plantation, flying over the flowers in the dusk of the evening; but I did not meet with either the caterpillar or the chrysalis.

#### Genus 10. COSMOPHILA, Boisd.

##### *Cosmophila indica*, Guén.

So far as my own observations are concerned, this extremely pretty Noctua is somewhat rare in St. Helena; for a single example is all that I could secure of it. Possibly, however, this may be partly due to the fact of our sojourn in the island not having been at the proper season of the year. The specimen alluded to I captured at Plantation, beaten out of a bank below some fir trees during the daytime; but although we visited the same spot repeatedly during the remainder of our stay, we never succeeded in meeting with a second. It has been recorded from Africa, Asia, and Australia.

*Cosmophila xanthindyma*, Boisd.

This appears to be a somewhat scarce moth at St. Helena. Indeed, we were not fortunate enough to meet with any examples of it during our visit, and only a single specimen has, I believe, been ever recorded for the island.

## GENUS 11. HABROSTOLA, Oehsenh.

*Habrostola commidendri*, E. Woll.

— Expanse 1 inch 4 lines to 1 inch 8 lines. With the palpi not much compressed, and having the terminal joint distinct; antennæ simple in both sexes. The fore wings of a suffused dark cinereous hue, the central space being just appreciably darker (though much more appreciably so near the central streak) and bounded by two undulating pale lines. The orbicular and reniform stigmata are both apparent, the former being oblique and narrow. Parallel with the outer margin is a black narrow vandyked line which emits short streaks at the angles in opposite directions, *i. e.* two of them pointing internally, and then two externally, and so on. Hind wings smoky brown, gradually darker towards the outer margin. Thorax of much the same dappled hue as the anterior wings, and with a large posterior crest. Body almost concolorous with the hind wings, but with darker crests near the base.

This member of the Plusiidæ is altogether one of the most interesting of the St.-Helena Lepidoptera; and since its caterpillar seems to feed exclusively on the few remaining gumwoods (*Commidendron robustum*, D.C.) which are now to be met with, we may feel pretty sure that it is one of the surviving members of the aboriginal gumwood fauna. So far, therefore, as my own observations are concerned, I need scarcely say that it does not extend into the higher parts of the island (for the gumwood does not extend beyond a certain altitude), but is strictly a native of the "intermediate" districts.

It was at Plantation that we chiefly met with it, where we first observed a young gumwood to be literally defoliated by its larvæ; and other gumwoods near were likewise found, on inspection, to be more or less similarly affected. This at least gave us an excellent opportunity of watching the caterpillars, and of rearing a certain number, though I cannot but regret now that I did not secure more.

*H. commidendri* is very nearly allied to *H. transfixa*, Walk. (a species from Ceylon and Moreton Bay), of which, indeed, it might almost be regarded as merely a geogra-

phical variety. The fore wings, however, are a little less deeply scooped out along their hinder edge; and their silvery line is a little more transverse (or less vertical) in position, as well as not *quite* so straight (or a little more curved) towards its base or commencement.

The caterpillar, when full-grown and extended, is about an inch and a quarter in length, tapering slightly towards the head. It has but four ventral elaspers, and arches its back when walking, after the manner of the Geometridæ. It is of a clear green, ornamented on either side of the dorsal region with irregular thread-like subconfluent undulating white lines, which are interrupted by minute white dots (each of which emits an erect dark bristle). The head is yellowish green, dotted sparingly with black; the spiracle-line is narrow and of a whitish yellow. When full-grown it spins a white silken cocoon, and changes into a chrysalis which at first is green, but which soon becomes dark brown. The imago emerges in about three weeks.

## Genus 12. PLUSIA, Ochsenh.

### *Plusia aurifera*, Hübn.

This beautiful *Plusia*, which abounds at Madeira, and which seems to have gained for itself a wide geographical range, is extremely common, and ascends to the highest central ridge. At Plantation and the immediate vicinity it often swarms, darting over the flowers early in the evening and rather before dusk. Godart observes (in 1829), "Cette belle espèce dont les premiers états ne sont pas encore connus, se trouve en Espagne et en Portugal; elle habite aussi les îles de Ténériffe et de Sainte-Hélène." It has also been found in Java, as well as along the western coast of Africa, and in Madagascar, Hindostan, and Ceylon.

The caterpillar of *P. aurifera* is very abundant, mainly on the foliage of the geraniums; but it is not easy to rear, unless each grub is kept in a separate box, on account of its grossly cannibal propensities. When fully extended it is about an inch and three quarters in length, cylindrical, and of a pale dingy olivaceous brown. The segmental folds are distinctly marked; and there is a black narrow dorsal band bordered with yellow, on either side of which (extending close to the spiracles) are a succession of yellow disjointed thread-like lines. A broadish ochreous band (bordered with yellow) extends the whole length of the caterpillar on either side, within which the spiracles are placed, the middle spiracles being rounded. The second segment is black, but ornamented

with a number of dirty-white spots and patches. The tubercular spots are visible as horny warts; and the bristle which they each emit is strong and erect. When quite full-grown the fore part of each segment assumes a much darker colour, causing the whole hue to be more pronounced.

*Plusia limberina*, Guén.

This is certainly one of the most abundant Noctuas in the island, and it is one which is more particularly plentiful at intermediate altitudes. It often swarms at Plantation, frequenting much the same plants as its congener. In the caterpillar-state it is especially destructive to the geraniums and many other low-growing garden shrubs.

*Plusia limberina* occurs in Central and Southern Africa, and it has likewise been met with in Madagascar.

*Plusia Dalei*, E. Woll.

Expanse 1 inch 6 lines to 1 inch 8 lines. With the palpi slightly more compressed than in *P. limberina*, and having the wings fuller and more robust, with their outer margin scarcely sinuated. The fore wings of a rich mottled golden brown, and having a very similar silver mark on the disk to that of the preceding species; but the oblong silver spot is not generally confluent with the letter-like marking. There are three interrupted transverse lines, the first one of which is near the base and abbreviated posteriorly, the second midway between it and the silver marking, the third being beyond the reniform. Parallel with the outer margin is a cloudy space, more often broken up into two or three ill-defined blotches. Above the anal angle is usually a pale-coloured dash, which in rather worn specimens is very distinct, and gives a good deal of character, as it were, to the wings, causing the insect when flying to be readily distinguished from *P. limberina*. The orbicular stigma is not discernible; but the reniform one (which is obscured) is slightly outlined at its lower extremity with an interrupted silvery line. Hind wings smoky brown, but rather paler near the base. Thorax of a palish uneven brown, with a dark crest posteriorly. Body very pale ochreous-brown, and with two dark crests near the base.

This handsome *Plusia* is not uncommon in various parts of the island. At Plantation I used often to meet with it (particularly towards the evening during rainy weather), hovering over geraniums, and more especially over the flowers of the *Pittosporum* trees. I also have had it brought to me from the Barn, secured from amongst the scrubwood; so that the species

(if truly indigenous) may perhaps have belonged to the now well-nigh extinct scrubwood fauna. Most of my specimens, however, I captured at Plantation, where I also procured two examples of a very handsome albino variety, which is most beautifully suffused throughout with a pale ochreous-golden hue.

Genus 13. *HELIOTHIS*, Treitschke.

*Heliothis insularis*.

*Anchoscelis insularis*, Walk. in Melliss, *St. Hel.* 182 (1875).

This is one of the handsomest and most abundant of the *St.-Helena* Noctuas, and one, too, of which I secured the caterpillar commonly enough at Plantation. However, unfortunately I seem to have mislaid the description which I took of the latter, and therefore am unable to add it here, as I should otherwise have done.

Genus 14. *ACHÆA*, Hübn.

*Achæa melicerta*, Drury.

This handsome moth appears to be somewhat scarce in the island, or, at any rate, very local. It occurs principally at low elevations about Jamestown; and the caterpillars are to be met with pretty abundantly in the Botanic Gardens, where they feed upon the leaves of the pomegranate. As, however, we were resident at Plantation (which is some 1800 feet above the sea), I had little opportunity myself of searching for the larvæ; but a chrysalis, which had a most beautiful bloom upon it of a purplish tinge, and which turned to a very perfect imago, was procured for me by Mr. N. Janisch.

Genus 15. *OPHIODES*, Guén.

*Ophiodes tirrhæa*, Cram.

This large and extremely handsome moth is not at all uncommon both at low and intermediate altitudes. I did not, however, myself meet with it lower than the Briars; and I had two or three chrysalises sent to me from Woodcot; but most of my imagos I found at Plantation. This species has a curious habit of lying concealed upon the grass in the daytime, where it is hardly distinguishable from the rough, mat-like, and often much-burnt-up surface, to which it wonderfully assimilates. *Ophiodes tirrhæa* occurs both in North and South Africa, as likewise in France, Spain, Carniola, Dalmatia, Greece, Asia Minor, Syria, Mauritius, and also in the Canary Islands.

[To be continued.]

## BIBLIOGRAPHICAL NOTICES.

*A Monograph of the Silurian Fossils of the Girvan District in Ayrshire, with special Reference to those contained in the "Gray Collection."* By H. ALLEYNE NICHOLSON, M.D., D.Sc., &c., and ROBERT ETHERIDGE, Jun., F.G.S. Fasciculus I. Svo. Pp. 135 and 9 plates. Blackwood: Edinburgh and London, 1878.

THE Silurian strata in the neighbourhood of Girvan, Ayrshire, in the south-west of Scotland, are much complicated by faulting and rolls, but so very fossiliferous in places that not only has their successional order been determined, but their organic remains are found to be of especial interest to geologists in working out the history of that portion of the Palæozoic deposits. Hence from 1849 and 1850, when Salter and McCoy noticed some Silurian fossils from Girvan, and especially when Murehison had studied the district soon after, this locality and its fossil fauna has received more and more attention, until the Royal Society granted £75 towards the description of the fossils, and Robert Gray, Esq., generously gave further aid.

Mrs. R. Gray's collection has been the chief source of materials; Mr. Lapworth has aided; and the authors have collected also for themselves, and carefully studied the collections in the national museums in London and Edinburgh.

This Fasciculus comprises descriptions and figures of the Protozoa, Corals, and part of the Trilobites. A Bibliography in prefixed, also a list of localities whence the fossils have been procured.

A so-called *Chondrites* is first described, but not figured. Such Algold fossils may be tracks or galleries of Annelids or Crustaceans. The avowedly obscure genus *Nidulites* is placed, with *Ischadites* (page 19), in the class Rhizopoda, at page 10, and considered to be very near to *Receptaculites*; but Mr. Billings's views of the Rhizopodal character of the latter are not referred to, and no other reasons for the collocation are given.

A *Saccamina*, like the Carboniferous and Recent species, has been recognized by H. B. Brady in the Girvan Limestone, as well as another, still more obscure, curved, tubular, allied organism, which the authors name *Girvanella*.

Of the Actinozoa, *Lyopora*, n. gen., *Tetradium*, *Favosites*, *Fistulipora*, *Chaetetes*, *Prasopora*, *Halysites*, *Thecostegites*, *Pinacopora*, *Heliolites*, *Stylarcea*, *Calostylis*, *Streptelasma*, and *Lindstrœmia* are the genera which give comparatively few species, of not very strong characters, but sufficient to indicate that the strata at Craighead and Balcletchie are of Lower-Silurian age; those of Mulloch Hill, Penkill, and Shalloch Mill, Upper Silurian.

Trilobites (still referred to "Entomostraca," at page 98) are not rare in the Girvan beds. Species belonging to *Phacops*, *Cheirurus*, *Encrinurus*, *Cybele*, *Dindymene*, *Staurocephalus*, *Acidaspis*, and *Lichas* are here described and figured.

The nomenclature of genera and species in this Fasciculus is



carefully attended to, and references to the many previous workers and writers conscientiously made throughout. The plates are good, and the printing is excellent; but we regret to see the German method of representing the diphthong *æ* used in some latinized names, such as ought to be *Kœnigii* and *Lindstrœmia*; and *Gotlandica* would be more correct than *Gothlandica*. These are very trifling drawbacks; and this joint production of the two enthusiastic and talented paleontologists is highly creditable to them, and will be of great service to geologists both at home and abroad.

*Annual Report and Proceedings of the Belfast Naturalists' Field-Club for 1876-77.* Ser. 2, vol. i. part 4. 8vo. Printed for the Club. Robinson: Belfast, 1878.

THE summer excursions in the north of Ireland were evidently sources of pleasure and instruction as usual. The winter session produced excellent papers, some of which are now printed. Mr. W. Gault gives a clear comparison of the Cretaceous strata of the Black Mountain, near Belfast, with a coloured plate. Mr. W. Gray indicates where stone implements are found in the district, and particularly notes that none are of "Palæolithic" age, whatever may have been written about them elsewhere. Mr. Joseph Wright reports on the recent Foraminifera of the Down and Antrim coasts, noticing some new or little-known species, which are illustrated by a good plate. He gives elaborate tables of the distribution and relative abundance of the 110 species enumerated.

Mr. W. Swanston, F.G.S., treats of the correlation of the Silurian rocks of the County Down, discriminating some belonging to the Upper Llandeilo, the Bala-Caradoc, the Lower Llandovery, and the Middle Silurian. These comprise rocks of the "Moffat series," as shown in the Table at p. 117 and in the extensive comparative Table of fossils opposite p. 124. The Graptolites discovered by Mr. Swanston in this part of Ireland, and so very characteristic of the Moffat series, have been examined and described by Mr. Lapworth, F.G.S., to whom they are familiar; and his results are given in full, with three plates. There are about 80 species (15 genera) of Graptolithina, besides *Dictyonema*, *Corynoides*, *Acrothele*, *Acrotreta*, *Discina*, *Dawsonia*, *Peltocaris*, and *Discinocaris*, all carefully figured.

*Journal of the Royal Microscopical Society.* Vol. ii. No. 1. February, 1879. Edited by FRANK CRISP, LL.B. &c. 8vo. 112 pages. 4 plates and numerous woodcuts. Williams and Norgate, London.

THE Royal Microscopical Society, among other reforms, have thrown more spirit and speculation into their Journal, containing their Transactions and Proceedings, with other microscopical and biological information. Eight original memoirs read before the Society, upwards of fifty notes and memoranda of observations,

discoveries, and new ideas from British and foreign sources, a careful bibliographic list of books, current periodicals, and papers on histological and related biological subjects, and, lastly, the Proceedings of the Society's Meetings, complete this well edited and valuable Part for February.

## PROCEEDINGS OF LEARNED SOCIETIES.

### GEOLOGICAL SOCIETY.

December 18, 1878.—Henry Clifton Sorby, Esq., F.R.S.,  
President, in the Chair.

The following communications were read:—

1. "On remains of *Mastodon* and other Vertebrata of the Miocene Beds of the Maltese Islands." By Prof. A. Leith Adams, M.B., F.R.S., F.G.S.

The author recognized the following Maltese formations:—

*Upper Limestone*.—Maximum thickness over 250 feet, passing into a sandy rock, and that into a hard red limestone. Fossiliferous, containing 4 Brachiopoda, several Lamellibranchs and Gasteropods, and 25 Echinodermata (10 being peculiar).

*Sand Bed*.—Maximum thickness about 60 feet, variable in character, characterized by vast abundance of *Heterostegina depressa*; 15 Vertebrata.

*The Marl Bed*.—Maximum thickness over 100 feet, but sometimes almost wholly thinned out. Organic remains rarer than in the Sand Bed.

*The Calcareous Sandstone*.—Maximum thickness rather over 200 feet. Contains bands of nodules, of which the second is rich in organic remains. Hence come the noted teeth of Squalidæ. Among its invertebrate fauna are many Pectens, with other Lamellibranchs, Gasteropods, and Brachiopods; also 22 species of Echinodermata.

*The Lower Limestone*.—Maximum thickness over 400 feet. *Scutella subrotunda* and *Orbitoides dispansus* are abundant in the upper part; and it is generally fossiliferous.

In a nodule seam in the Calcareous Sandstone in the Island of Gozo two rather imperfect teeth of a *Mastodon* have been found. Both are penultimate molars. They agree most nearly with the teeth of *Mastodon angustidens*; but the characters are not sufficiently well preserved to differentiate the species with certainty.

The same formation has furnished teeth of a *Phoca* to which the specific name *rugosidens* has been given by Prof. Owen. Large teeth referable to the Phocidæ are found in the nodule seams of the Calcareous Sandstone and in the Sand Bed; the Marl Bed has also furnished a portion of a jaw.

The Woodwardian Museum contains a part of a jaw of *Squalodon*, evidently from a nodule seam of the Calcareous Sandstone (found by Seilla circ. 1670). The Sand Bed and Calcareous Sandstone have furnished remains of more than one species of *Delphinus*; and large-sized Cetacean vertebræ are found in nearly all the beds, especially the Sand Bed. *Halitherium* has been obtained from the Sand Bed, Marl Bed, Calcareous Sandstone, Lower Limestone, and (?) Upper Limestone.

One specimen of *Ichthyosaurus gaudensis*, Hulke, has been furnished by the Calcareous Sandstone; the same has also furnished *Melitosaurus champsoides*, *Crocodylus gaudensis*, and *Sterroodus melitensis*. *Myliobates toliapicus* and allied species have come from all the deposits except the Upper Limestone; *Otobates subconversus* from the Sand Bed and Marl. The Squalidæ are abundant from all the deposits except the first. There are ten species, belonging to the following genera—*Carcharodon*, *Carcharias*, *Oxyrhina*, *Hemipristis*, *Corax*, *Odontaspis*, *Lamna*. Remains of *Notidanus*, *Platax*, and *Diodon* have also been found.

2. "Dinosauria of the Cambridge Greensand." Parts I.–VII. By Prof. H. G. Seeley, F.L.S., F.G.S.

The author stated that this paper was founded upon the collection of more than 500 Dinosaurian bones preserved in the Woodwardian Museum, for the opportunity of studying which he was indebted to the kindness of Prof. T. McKenny Hughes. He described the conditions under which the specimens occur, and accounted for the apparently worn state of the bones as the results of exposure to the air, and subsequent maceration.

I. "Note on the axis of a Dinosaur from the Cambridge Greensand." This bone was said to be very similar to the axis from the Wealden previously described by the author (Q. J. G. S. xxxi. p. 461), but differed in the neural arch being supported on pedicels of the centrum, in both articulations for the rib being on the centrum, in the compressed form of the odontoid process, and in the subhexagonal form of the oblique posterior articular surface of the centrum. There is no indication of a wedge-bone beneath the anterior articulation. The condition of the axis in other Dinosaurs, such as *Zanclodon*, was indicated, and reasons given for regarding the structure of the bone as a modification of the Crocodilian type.

II. "On the vertebral characters of *Acanthopholis horridus*, Huxley, from the base of the Chalk-Marl near Folkestone." The author stated that only dorsal and caudal vertebræ of *Acanthopholis* are at present known. The dorsal vertebræ have the visceral surface well rounded, the articular ends subovate, and the centrum laterally compressed. The early caudal vertebræ are deep, with strong compressed transverse processes, zygapophyses directed well forward, and the neural spine directed upward and backward. The

centrum is inclined obliquely forward; the facets for the chevron bone large, and the anterior articulation circular. The later caudals have nearly the same absolute length of centrum; and the transverse process is first reduced to a tubercle, and afterwards disappears entirely. A deep channel is developed on the underside of the centrum; and two more or less marked ridges run along each side of the centrum, making the articular ends subhexagonal.

III. "On the skeleton of *Anoplosaurus curtnotus*, Seeley." This genus and species are founded upon an associated series of about 80 bones from near Reach. The remains include a portion of the left ramus of the lower jaw, 5 cervical (axis and atlas missing), 13 dorsal, 6 sacral, and 8 caudal vertebræ (the tail being imperfect), the coracoids (one imperfect), the proximal end of the scapula, the proximal and distal ends of the humerus, the proximal and distal ends of the femur, a small fragment of the ileum, small portions of ribs, and fragments of the metatarsals and phalanges. The teeth were placed close together in sockets, 13 occurring in a space of  $2\frac{1}{4}$  inches. The general form of the vertebral centra indicates a convex curve in the back and sacrum, and a concave curve in the neck and tail, rendering it probable, in conjunction with the great development of the sacrum, that the animal affected a semierect attitude. The sacral vertebræ, as preserved, are all separate. The scapula is remarkably thick, with a strong spinous or acromioid process. The femur shows distinctive Dinosaurian features, but presents a form that has not previously been described. The vertebral centra indicate a near affinity to *Acanthopholis*; but no dermal armour has been met with, and the caudal vertebræ present differences which seem to justify its location in a distinct genus.

IV. "On the axial skeleton of *Eucercosaurus tanyspondylus*, Seeley." This genus is founded on an associated series of 19 vertebræ and a neural arch from Trumpington. Four dorsal vertebræ are preserved, which considerably enlarge towards the sacral region, so that probably the vertebral column was carried in a more than usually erect position. The underside of the centrum in the early part of the series has an angular or squeezed form; but this appearance is lost in the hinder centrams. The sacral region is represented by 3 vertebræ; there were probably, in all, 5 or 6. Twelve early caudal vertebræ are preserved; these become unusually elongated and prismatic posteriorly. The chevron bones were at first very large, but are small when the articular face of the centrum has acquired the hexagonal outline. The neural arch in the caudal region was very depressed. This genus was considered to be closely related to *Acanthopholis*, though the vertebræ differed so greatly in form.

V. "On the skeleton of *Syngonosaurus macrocerus*, Seeley." This genus is founded on a series of 19 vertebræ, representing the neck, back, sacrum, and tail. It shows affinities to several Dinosaurian types, especially *Eucercosaurus* and *Iguanodon*. The early dorsal vertebræ are remarkably compressed; and the neural arches are entirely united to the bodies of the vertebræ throughout the

series. In the lower dorsal region the ridge on the visceral surface disappears, and the centrum becomes deep. The visceral ridge reappears in the sacrum. The caudal vertebræ are at first compressed, and have the articular faces oblique and slightly procelous; the chevron bones have a large single facet united by suture to the lower half of the articulation. In these vertebræ the visceral surface is rounded and narrow. The proximal end of a humerus and distal ends of both humeri were obtained; they are of small size. Several metatarsal bones and phalanges have also occurred, and are large in proportion to the other remains. In doubtful association with these bones were 11 pieces of dermal armour, closely resembling that of *Acanthopholis*.

VI. "On the dorsal and caudal vertebræ of *Acanthopholis stereocercus*, Seeley." This species was founded on a small associated series of vertebræ, one of which is an imperfect cervical, 2 dorsal, and 8 caudal. The species differs from *A. horridus*, Huxley, in the form of the centrum, in the different character of the facets for the chevron bones, and in the deeper median channel of the visceral surface. The caudal vertebræ slightly decrease in length posteriorly.

VII. "On a small series of caudal vertebræ of a Dinosaur, *Acanthopholis eucercus*, Seeley." This species was founded on an associated series of 6 caudal vertebræ, which differed from those in the tail of *A. horridus* in the centrum being more elongated and constricted, and in the rapid diminution in length of the centra posteriorly. The species is slightly larger.

January 8, 1879.—Henry Clifton Sorby, Esq., F.R.S.,  
President, in the Chair.

The following communication was read:—

"Description of Fragmentary Indications of a huge kind of Theriodont Reptile (*Titanosuchus ferox*, Owen), from Beaufort West, Gough Tract, Cape of Good Hope." By Prof. R. Owen, C.B., F.R.S., F.G.S.

The author stated that among the fossils recently sent to the British Museum from the Cape of Good Hope by Mr. T. Bain, there were two boxes containing specimens of a most unpromising character, there being in them no entire bones, but only numerous more or less water-worn fragments. Among these was found a portion of a maxillary showing some traces of teeth; and sections having been made of this bone, the remains of several teeth were displayed, including a canine, the preserved portion of the socket of which was  $4\frac{1}{2}$  inches long. From the number and mode of implantation of the teeth, the author concluded that the animal to which they belonged resembled the Theriodont genera *Galesaurus* and *Galenops*. The anterior portion of the left ramus of the lower jaw, measuring  $7\frac{1}{2}$  inches in length, showed teeth presenting close analogies with

those of Theriodonts; and this alliance was confirmed by the study of other fragments. Some of the characters presented by these remains seem to suggest affinities with the carnivorous mammalia, such as have been already indicated by the humeri of Theriodonts and Carnivores.

The canine tooth of the new South-African reptile, which the author proposes to name *Titanosuchus ferox*, was six times as long as that of the allied form *Lycosaurus*; and we have in *Titanosuchus* evidence of a carnivorous reptile of more carnassial type than *Machairodus* and other Felines. The author suggests that *Titanosuchus* found its prey in the contemporary *Parciosaurs*, Oudenodonts, and Tapinocephalans of the same locality.

## MISCELLANEOUS.

### *Method of Investigating the Embryos of Fishes.*

By M. F. HENNEGUY.

THE ova of the Salmonidæ are generally employed by embryologists in the study of the development of the osseous fishes. It is difficult to examine them in the fresh state, either whole, by transmitted light, on account of the thickness of their envelope, or after opening them, in consequence of the small consistency of the germ, especially at the commencement of segmentation. Chromic acid, the reagent most frequently employed to harden these ova, readily alters the young cells, and deforms the embryos by compressing them between the unextensible envelope of the ovum and the solidified vitelline mass. For the last two years I have employed, in the Laboratory of Comparative Embryogeny of the Collège de France, a process which enables us to extract the germs and embryos from the ova of trout and salmon with the greatest facility, and without causing them to undergo the least alteration.

I place the ovum for a few minutes in a 1-per-cent. solution of osmic acid until it has acquired a light brown colour—then in a small vessel containing Müller's liquid; and I open it with a fine pair of scissors in the midst of this liquid. The central vitelline mass, which is coagulated immediately on contact with water, dissolves, on the contrary, in the Müller's liquid, while the solidified germ and cutical layer may be extracted from the ovum and examined upon a glass plate.

By treating the germ with a solution of methyle green and then with glycerine I have been able to observe in the cells of segmentation the very delicate phenomena lately indicated by Auerbach, Bütschli, Strasburger, Hertwig, &c., and which accompany the division of the nucleus—namely the radiate arrangement of the protoplasm at the two poles of the cell, the nuclear plate, the bundles of filaments which start from it, and the other succeeding phases.

This proves that the treatment undergone by the ovum does not at all alter the elements of the germ.

In order to make cross sections of the germs and embryos thus extracted from the ovum, I leave them for some days in Müller's liquid, and colour them with pierocarminate of ammonia. After depriving them of water by treatment with alcohol of spec. grav. 0.828 and then with absolute alcohol, I put them for 24 hours into collodion. The embryo is then arranged upon a small slab of elder-pith soaked with alcohol, and covered with a layer of collodion. When the collodion has arrived at a suitable consistency, very thin sections may be made, including the embryo and the plate of pith; and these are to be preserved in glycerine.

This process is applicable to all sorts of embryos which are not very thick, so that they may be coloured *en masse*. It has the immenso advantage of enabling one to see at what level in the embryo each section is made, to preserve each section in the midst of a transparent mass, which sustains all the parts and prevents their being damaged, as too often happens when an inclusory mass is employed from which the section must be freed before mounting.

In his 'Précis de Technique microscopique,' M. Mathias Duval has already recommended collodion in embryological researches, but without indicating his mode of employing it. We hope to be serviceable to embryologists by making known to them a process which they may find useful.—*Bull. Soc. Philom. Paris*, November 22, 1878.

*On a Gigantic Isopod from the Great Depths of the Sea.*

By M. A. MILNE-EDWARDS.

The Government of the United States has repeatedly caused dredgings to be made in the American seas; and recently it commissioned Mr. Alexander Agassiz to explore the bed of the Gulf-stream in the Straits of Florida, between the southern point of that State and the island of Cuba. In December 1877 that naturalist embarked on board the steamer 'Blake,' and made a series of dredgings, some of which were carried nearly to 2000 fathoms, and brought up a considerable quantity of animals. Mr. Agassiz, with the consent of the administration of the Coast Survey of the United States, has sent me all the Crustacea collected during this cruise, and begged me to investigate them. The collection is very extensive and rich; it will furnish me with the materials for a memoir, of which I shall have the honour hereafter to communicate to the Academy the general results. At present I shall confine myself to calling attention to one of the most extraordinary animals for which I am indebted to Mr. Agassiz, namely a gigantic Isopod, dredged at 955 fathoms, to the north-east of the bank of Yucatan, north of the Tortugas\*.

This Isopod, to which I have given the name of *Bathynomus giganteus*, is remarkable not only for its comparatively enormous

\* See, on this subject, A. Agassiz, Letter No. 1 to C. P. Patterson, Sup. Coast Survey, on the dredging-operations of the U.S. Survey steamer 'Blake' during parts of January and February 1878 (*Bull. Mus. Comp. Zool. Cambridge*, vol. v. p. 4).

dimensions (it measures about 0.23 metre in length, by 0.10 metre in breadth), but also for the peculiar arrangement of its respiratory apparatus, which is very different from that of all other known crustaceans.

It would appear that the respiratory apparatus of an ordinary Isopod would have been insufficient to supply the physiological needs of the *Bathynomus*, and that the addition of special organs of greater functional power was necessary. The abdominal false feet, which usually in this group constitute alone the branchial apparatus, only form in *Bathynomus* a sort of opercular system, beneath which occur the true respiratory organs or branchiæ. The latter, considered individually, resemble little trees or tufts originating from stems, which divide again and again, and thus form a regular hairy tussock. When examined under the lens they are seen to form a certain number of distinct and more or less developed bundles; each of these bundles originates in a tubular peduncle with membranous and flexible walls, which soon furnishes other trunks; and these speedily divide into a quantity of elongated appendages, nearly similar, but arranged with no regularity, and having the appearance of a spindle with delicate walls.

If a coloured liquid be injected into the sinus situated at the base of the branchial feet, the whole of this system may be easily filled, and the progress of the liquid may be followed, not only into the branchial tree, but also into an irregular network hollowed out in the interior of each of the leaflets of the abdominal false feet, and comparable to the entire branchial apparatus of the ordinary Isopods. A marginal vessel seems to collect the blood which has respired, and pours it into the branchio-cardiac trunk.

In all Isopods, on the contrary, the abdominal false feet are very simple; and when they are complicated in order to fulfil the requirements of a more active respiration, this is effected by the folding (which is always rudimentary) of the posterior lamina of these limbs.

We know, however, two genera of Isopods in which ramose appendages appear on the sides of the body, namely the genera *Ione* and *Kepon* in the family Bopyridæ; but between this rudimentary apparatus and that of *Bathynomus* there are fundamental differences, not only in the position of the branchial tufts, but also in their structure &c.

In its general construction, the grouping of its segments, the composition of the parts of its mouth, and the arrangement of its legs, *Bathynomus* undoubtedly belongs to the division of the *Isopodes marcheurs*. It differs from the Sphæromidæ by its free abdominal segments and the development of its caudal fin. These peculiarities approximate it to the Cymothoadæ, and among these to the *Cymothoadiens errants*; but in the structure of the head, antennæ, and eyes it presents certain characters which separate it from all known groups. The eyes are greatly developed, in opposition to what might be expected in an animal living at so great a depth and in a very obscure medium; each of them is formed of about four thousand square facets; and instead of being placed upon the upper



surface of the head, as in all the errant Cymothoadæ, they occupy the lower surface and are placed beneath the frontal margin, on each side of the base of the antennæ.

In the form of the parts of the mouth *Bathynomus* approaches the *Cirolani* more than the other representatives of the same group; in the arrangement of its legs it presents resemblances to the above crustaceans and the genus *Æga*. But the organic characters which I have indicated above seem to me to be sufficiently important to separate *Bathynomus* from all other Isopods, and to place it in a new group of the family Cymothoadæ, which I propose to name *Cymothoadiens branchifères*.—*Comptes Rendus*, January 6, 1879, p. 21.

*On the Termination of the Visceral Arterioles of Arion rufus.*

By M. S. JOURDAIN.

The author remarks that anatomists do not appear to have attempted by direct observation to ascertain the mode in which the blood of the arteries in mollusks flows into the visceral cavity. He says that if a fragment of one of the organs contained in the central cavity be separated by a tangential section and placed under the microscope, and the outer surface examined with a power of 200–250 diameters, the last ramifications of the arteries, the diameter of which is variable, are seen all to reach the free surface of the organ, where they terminate suddenly by a truncated and gaping extremity. It is through these orifices, which are nearly always funnel-shaped, that the arterial blood passes into the general cavity. In *Arion* the parts need not be injected, as very clear results may be obtained without any such precaution, owing to the calcareous corpuscles, which incrust their walls as far as and including the free mouth. Similar orifices exist in many other Mollusca.

The author thinks that this arrangement was perceived by Alder and Hancock, although its true interpretation escaped them. Their pl. iv. fig. 10 shows a close resemblance to his own drawings of the arterial orifices. It represents an enlargement of a terminal vesicle of the accessory salivary gland in *Doto*, and shows tubes ramifying after the fashion of arteries, and terminating at bodies which the English anatomists called *nucleated cells*. These are the funnel-shaped orifices of the arterial capillaries of the gland. Alder and Hancock were struck with the fact that the vasculiform tubes exactly correspond in diameter with the “nuclei;” and they add in a note that the latter might be the apertures of small vessels.

The author thinks that the orifices of the supposed aquiferous vessels of the Acephala and other Mollusca are anatomically of the same nature as the arterial funnels described by him.—*Comptes Rendus*, January 27, 1879, p. 186.

*The Eye in the Cephalopoda.* By Prof. S. RICHIARDI.

The author remarked that anatomists of the present day, still accepting completely Cuvier's opinion, deny the existence in the eye of

the Cephalopod of a choroid and of a vascular iris, and thence also of true ciliary processes, and admit, in the thickness of the retina, one layer of pigment. From a great number of preparations, obtained from eyes in which he injected the blood-vessels, the author demonstrated:—1. That in the Cephalopoda not only does a vascular choroid exist, but, especially in *Sepia officinalis*, that membrane in its three posterior fourths consists of three layers like that of Man and the Mammalia, and the middle one, as in these, is subdivided into two, a superficial one, formed of large arterial and venous vessels, and a deep-seated one, composed of a network of little arteries, veins, and capillaries (the *Balkennetz* of Hensen), in such a manner as to form a true *corio-capillary* or Ruyschian membrane. 2. The iris is moreover well developed, rich in blood-vessels, and comprised, in part, in the so-called equatorial furrow of the lens. 3. The *corpus ciliare* is complete, and the ciliary processes more numerous and richer in vessels than those of most of the Mammalia.

This existence of the iris, of the ciliary processes, and of the vascular choroid being demonstrated, the homology of the parts of the organ of vision of the Cephalopoda with those of the eye in vertebrates, which is now-a-days accepted by all naturalists, is no longer admissible. Prof. Richiardi passed in review the opinions expressed on the subject, and dwelt especially upon the memoir published by Hensen in 1865, from which he formulated the following conclusions:—1. The part which that author regards as corresponding to the transparent cornea is only a fold of the skin, the margins of which overlap for a short distance without forming extensive adhesions in the Octopods, and in all those Decapods in which the tentacular arms are not entirely retractile but only in part (Oigopsidæ), whilst in the Miopsid Decapods they are soldered in such a manner as to form a lamina, against which the globe of the eye rests during the compression exerted upon it by the tentacular arm when this is retracted into the pouch which extends beneath the eye, and thus undergo less variation in their diameters. 2. The cavity described as the anterior chamber is formed by the above-mentioned fold. 3. The membrane denominated *argentea externa* is the palpebral integument; and that considered as corresponding to the iris is the eyelid; whence the cavity regarded as the homologue of the posterior chamber is really that of the conjunctival sac. 4. The *corpus epitheliale* of Hensen is the true vascular ciliary body. 5. The so-called external or fibrous layer of the retina, which is produced into the ciliary body, is the choroid, upon the external surface of which radiate the nervous fibres arising from the ganglion of the optic nerve, which, in order to arrive at the so-called internal layer, or true retina, traverse its whole thickness, interpolated in small bundles among the blood-vessels, which, starting from the large superficial ones, run to its inner surface to form the corio-capillary network. 6. The pigmental layer, which is regarded as interposed between the two layers of the retina, is the true internal layer or pigment of the choroid.—*Società Toscana di Scienze Naturali*, January 12, 1879.

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XXVIII.—*On the Geological Distribution of the Rhabdophora.*  
By CHARLES LAPWORTH, F.G.S.

Part I. HISTORICAL.

### *Introductory.*

THE present paper was partly written in the autumn of 1873, as a sequel to my memoir on the Improved Classification of the Rhabdophora, which was published in the 'Geological Magazine' of November and December of that year\*. Its original purpose was to show that what are there classed as closely allied genera are invariably associated in synchronous deposits in widely separated portions of the Lower Palæozoics of the northern hemisphere—the justice of the classification there proposed receiving in this way a most striking confirmation. I have deferred its publication from time to time, hoping to be able to include the general results of a personal study of the Graptolite-bearing beds of Wales and the West of England. This investigation, however, I have hitherto been unable to accomplish, owing to my want of leisure and to the all-absorbing nature of my work among the Lower Palæozoics of the South of Scotland. In some respects this delay has been an advantage; for during the interval the progress in many departments of research among the Palæozoic rocks has been

\* Geol. Mag. vol. x. dec. 1, pp. 500, 555.

very rapid. The new facts obtained, and the new views promulgated, while they fully bear out my original generalizations in all essentials, raising much that I regarded merely as a high probability almost to the rank of an absolute certainty, also enable me to add many illustrative details previously unknown.

The evidences now at our command converge most distinctly to the general conclusion that the various species, genera, and families of the Rhabdophora are quite as restricted in time as those of the more carefully studied Braehiopoda and Tribolita, and are consequently quite as reliable exponents of the systematic place of their containing beds. If, as I am inclined to believe, the Graptolites are destined to play among the Lower Palæozoics the part filled by the Ammonites among the Jurassic rocks, in fixing the minor divisions of the deeper-water beds, and in determining their parallelism in areas now geographically separated, the importance of the study of their geological distribution can hardly be overestimated. At present our accumulated evidences are insufficient to justify this broad generalization; and the combined results of the labours of many investigators are necessary before we can hope to arrive at a correct estimate of the office of the Graptolites in the Palæontogeology of the Lower Palæozoics. British geologists can no longer afford to neglect these ancient fossils, unless they are willing to be distanced by foreign investigators. Tolerably correct figures and descriptions of our commoner forms are now extant and are accessible to all. In the present article I will endeavour to summarize the main facts already determined—fixing our present point of departure in such a way that our future progress may be easily estimated, and at the same time giving a general idea of the road upon which alone success is certain.

#### (a) *Geological Difficulties.*

Previous to 1873 the necessary data for a correct estimate of the range of even the main groups of the Rhabdophora were wholly wanting. We were fully aware of the presence of identical or representative species of *Graptolithina* in numerous localities, and in many different formations, on both sides of the Atlantic; but the most erroneous views prevailed among geologists with respect to the proper parallelisms of all the more prolific of these Graptolite-bearing strata. To such an extent was this the case, that graptolite-bearing beds which subsequent investigations have shown to be disjoined fragments of what was originally a single and continuous

deposit, or to be at least of one and the same geologic age, were assigned in Scotland to the middle of the Llandeilo period, in England to the Caradoc, and in Bohemia to the geological horizon of the Mayhill Sandstone.

This imperfect knowledge arose in the main from two special causes—the one geological, the other palæontological. The geological cause had its origin in the physical peculiarities of the ocean-bed upon which the fossiliferous and typical Lower Palæozoic rocks of Wales were laid down. The strata composing the formations of the Caradoc and Llandovery, which occupy the central portion of Murchison's original Silurian system, are, generally speaking, arenaceous, and therefore not of a nature to afford Graptolites. Nor did they appear to be abundant in the succeeding Ludlow and Wenlock formations. For many years only three British species were known as occurring in the entire series from the base of the Caradoc to the summit of the Silurian. On the other hand, they were found to be astonishingly abundant in Murchison's lowest formation—the Llandeilo, which consisted in great part of argillaceous and more or less carbonaceous schists. When the extra-Salopian areas came to be mapped, the same rule was found to hold good everywhere—the Llandeilo furnishing *Rhabdophora* in abundance, while in the succeeding formations they were either wholly wanting or, at most, were excessively rare.

In the south of Scotland a corresponding physical accident led to the erroneous opinion that the Graptolites were as strictly Llandeilo forms as they had proved themselves in Wales. The prolific Silurians of Girvan, whose Caradoc age was demonstrated by their numerous and well-preserved Crustacea and Brachiopoda, appeared to repose at once upon those vast thicknesses of non-fossiliferous greywackes and schists that floor the Southern Uplands, and which certainly bear a striking resemblance to the infra-Caradoc rocks of Wales and the west of England. These greywackes were therefore naturally paralleled with the Llandeilo rocks of Murchison's 'Siluria.' The black carbonaceous bands that are frequently met with amongst them were necessarily regarded as of the same general geologic age. These black bands, which form the well-known Moffat series, are the most prolific Graptolite-bearing strata in Britain; and their unhesitating reference to the Llandeilo formation by Murchison was for many years regarded by geologists as one of the best-founded generalizations in British geology.

The published results of the simultaneous investigations of foreign geologists appeared to point distinctly in the

same direction. In Scandinavia, where the strata are so uniformly fossiliferous, and, at the same time, are so little disturbed that the physical and palæontological succession is unequivocal, it was clear, from the researches of Kjerulf and Angelin, that the widespreading Orthoceratite Limestone of that country was both underlain and overlain by a mass of Graptolite-schist. Enough was known of the fossils of this limestone to enable Murchison to parallel it confidently with his Llandeilo beds. The Graptolite-schists below the limestone yielded the *Phyllograpti* and *Didymograpti* of the Welsh Llandeilos; those a little above it as distinctly furnished many of the most characteristic species of the Moffat series, especially of the genera *Diplograptus* and *Monograptus*; while above this horizon Graptolites were absent. Thus not only did these Scandinavian beds afford additional proof of the general restriction of Graptolites to the Llandeilo period, but they appeared also to furnish a satisfactory demonstration of the correctness of Murchison's reference of the Moffat rocks to the Llandeilo of Wales, in which their most characteristic forms are wanting.

The strict propriety of these deductions appeared to be fully borne out by the investigations which followed. Professor Harkness and Sir Roderick Murchison, after concluding their investigations of the Graptoliferous Skiddaw Slates (Lower Llandeilo &c. of Murchison), made the discovery that the Coniston Limestone of the same area of the Lake district was immediately surmounted by a group of highly fossiliferous Graptolitic shales (the Coniston Mudstones). The Coniston Limestone itself had long been universally recognized as the representative of the Bala or Caradoc Limestone of Wales; and the natural conclusion at which their discoverers arrived was that these Coniston Mudstones must also be of Caradoc age. A careful study of their Graptolites, subsequently made by Prof. Nicholson, made it clear that, palæontologically, these beds were closely allied to the Moffat series of South Scotland. At least half the Scotch forms were missing from the Coniston beds; but this was accounted for by the supposed difference in date between the two deposits, the missing forms having become extinct in Britain during the period which intervened between the Upper Llandeilo and the Upper Caradoc.

Nor did the discoveries in Bohemia, Thuringia, and on the continent of America appear to militate against these conclusions. Barrande had already shown that the strata constituting the basal zone (E e 1) of his Upper Division was crowded with Graptolites; but he also admitted, at the same time, that

they were present, though in far less abundance, in the "Colonies" imbedded in the schists of *D d 5*, the highest zone of his Inferior Division. The majority of the Bohemian forms were found to occur in the Coniston Mudstones; and the natural inference was drawn by many palæontologists that Barrande had placed the boundary between his two divisions at a lower systematic horizon than that of Murchison—an opinion Murchison himself appears to have regarded with favour ('*Siluria*,' p. 374).

In North America the first prolific graptolitic formation (the so-called Hudson-River group), detected by the New-York geologists, was the highest natural group of rocks that could with propriety be assigned to Murchison's Lower Silurian. It thus occupied a systematic position exactly equivalent to that of the Coniston Mudstone and the band *D d 5* of Bohemia. The much grander series of graptolitic rocks (the Quebec group) afterwards discovered by the Canadian geologists, were at first placed upon the same parallel; but the subsequent discovery of primordial genera within them led to their relegation to the base of the New-York system, into the exact place of Murchison's Llandeilo formation.

Thus, on both sides of the Atlantic, it appeared evident that, as regarded their vertical range and specific development, the Graptolites presented two distinct maxima—the one near the base of the Ordovician system, the other near its summit. Their total range appeared to be coincident with the limits of Murchison's original Silurian system; but, with the exception of a few scattered examples, they were wholly restricted to these two well-marked horizons.

The two maxima thus recognized in Britain and America were by no means, however, regarded as of equal importance. That at the summit of the Caradoc sank into comparative insignificance when compared with the maximum in the Llandeilo; and a tendency was soon developed among palæontologists to refer every prolific Graptolite-bearing stratum to the Llandeilo formation. Some of the examples of this tendency are very curious, as illustrative of the extent to which even the most cautious investigators will allow themselves to overlook or disregard facts when they stand in opposition to what appears to be a well-grounded generalization.

In the palæontological portion of Ramsay's '*Geology of North Wales*', Mr. Salter assigns the black shales of Conway to the Llandeilo formation for the sole reason that, like the Llandeilo of South Wales, they contain Graptolites in more than ordinary abundance—and this in the face of the admitted fact that they are surrounded on all sides by strata either of

Caradoc or later age, and are distinctly mapped by Jukes, on physical grounds, as lying far up in the Caradoc series\*. Similar strata interbedded with the highly fossiliferous limestones of Amlwch in Anglesey are regarded as Llandeilo for a corresponding reason, in distinct opposition to the circumstance that the limestones yield typical Caradoc forms†. The black shales, traps, limestones, and grey flags that form portions of the counties of Waterford and Wexford, in the S.W. corner of Ireland, afford us another instance of the same phenomenon. These strata, much contorted, are well seen upon the shores of the triple estuary of the Suir, Nore, and Barrow, where they are, in places, abundantly fossiliferous, the calcareous beds swarming with well-known Caradoc Testacea and Crustacea, and the interbedded dark shales yielding numerous and well-preserved Graptolites. Murchison himself is said to have expressed the opinion that, while the calcareous beds ought to be assigned to the Caradoc, there could be no doubt that the fauna of the associated black shales was as distinctly Llandeilo. Jukes, from personal knowledge of the rocks, on the other hand, confidently asserted that the so-called Llandeilo forms were intimately associated physically with the beds so rich in Bala fossils, and could not be separated from the rest of the series ‡. He admitted, however, without demur the correctness of the reference of the fauna of the graptolitiferous beds to the Llandeilo formation, eluding the difficulty by expressing his opinion that “the occurrence of small assemblages of Llandeilo species here and elsewhere in Ireland in peculiar beds, which are, as far as can be determined, interstratified with the beds containing Bala or Caradoc species, reminds us of Barrande’s colonies. He had long suspected that the two assemblages of species were contemporaneous in reality, and had each their peculiar habitat, their occurrence as fossils depending on the nature of the rock, quite as much as its period of formation” §. Mr. Baily||, a few years later, cited this opinion in support of his own more correct view that similar dark shales in Central Ireland were actually of true Caradoc-Bala age—a view he finds himself compelled to adopt in this instance, as they were clearly interstratified with beds affording typical Caradoc-Bala fossils.

\* Ramsay, ‘Geology of North Wales,’ pp. 107, 259.

† Ibid. pp. 189, 258.

‡ Jukes, Mem. Geol. Surv. Ireland, Explan. Sheet 167, p. 28.

§ Ibid. p. 30.

|| Baily, Mem. Geol. Surv. Ireland, Sheets 81, 82, pp. 13, 14; Sheet 49, p. 18.



As a rule, however, the simple occurrence of black shales with Graptolites is of itself regarded as affording sufficient evidence of the Llandeilo age of the surrounding rocks \* ; and this also appears to have been the sole reason for the authoritative opinion of the Irish Survey that the black graptolitic shales of Meath and Down rose in anticlinal lines from below the barren Proterozoics of those counties. The marvellous confusion and obscurity that has been the inevitable result of these erroneous views is very naïvely summed up in Mr. Kinahan's admirable 'Geology of Ireland,' published within the last few months. According to this author the Ordovician (Cambro-Silurian) rocks of Ireland are divisible into two successive formations :—a lower (Dark shale) series, characterized generally by fossils of Llandeilo type, associated in some places, however, with Caradoc species ; and a higher (Ballymoney) series, in which the assemblage of fossils "is to be compared with that of the Bala rocks, though Caradoc species are not uncommon, while † *whenever black shales occur, no matter on what horizon, they nearly always contain fossils of Llandeilo type.*"

In Scotland the same floating idea that the simple presence of Graptolites in association with black shales affords sufficient evidence of the Llandeilo age of the surrounding rocks, has had a similar influence. I have already pointed out how it weighed with Murchison in his estimate of the geological position of the typical Moffat shales themselves. On the subsequent discovery of similar black shales in the rocks of the mining district of the Leadhills, they were as unhesitatingly assigned to the Llandeilo period by the officers of the Geological Survey ‡, although some of them were known to be actually interstratified with beds crowded with Caradoc-Llandovery fossils, and at the same time were supposed to be many thousands of feet higher in the vertical series than the so-called "Upper Llandeilo" shales of Moffat. Even as late as 1872 we find similar rocks near the Mull of Galloway classed as of indubitable Llandeilo age on the evidence of a list of Graptolitic species, not one of which has ever been detected in Llandeilo rocks, or in any strata whatever lying below the base of the Llandovery §. Indeed the only palæontological evidence yet adduced of the Llandeilo age of the rocks of the Southern Uplands is the mere presence of Graptolites in seams of black shales.

\* Baily, 'Graptolites of Meath,' &c., Geol. Soc. Dublin, 1862; and Quart. Journ. Geol. Soc. London, 1869, pp. 158-162.

† Kinahan, 'Geology of Ireland,' 1878, pp. 24, 25.

‡ Memoirs Geol. Surv. Scotland, Explan. Sheet xv. p. 13.

§ Ibid. Sheet i. 1872, p. 7 and Appendix.

(b) *Palæontological Difficulties.*

The palæontological difficulties and misconceptions, though not so glaring as the geological, were nevertheless of such a nature as almost of themselves to prevent any one but a confirmed Graptolithologist placing the slightest reliance upon the typical Graptolite as a geological index of the systematic place of its containing stratum.

The title of *Graptolithus* was originally founded by Linnæus to include a group of natural objects which were regarded by him as resembling, but not being, actual fossils. Only one of the forms ultimately described by him as belonging to this family was actually a true Graptolite, as we now understand the term; and this did not make its appearance in his 'Systema' till it reached the twelfth edition. Their proper position in the animal world still remains unsettled after half a century of controversy. Relegated in turn to the Cephalopoda, Polyzoa, Actinozoa, and Hydrozoa, they are now doubtfully classed by the greatest of our modern authorities near the family of the Plumularidæ among the Hydroida, in the immediate neighbourhood of the humble Rhizopoda.

The figures and descriptions of Linnæus and Hisinger\* (who subsequently named four of the most common Scandinavian forms) were so imperfect that those palæontologists who relied upon them, and who attempted to compare them with similar extra-Scandinavian forms, fell into innumerable errors.

Linnæus's original "*Graptolithus scalaris*"†, a true monograptid, has not only been confounded with several Monograptidæ of different species, but all the more common forms of the genus *Climacograptus*, Hall, have been in turn referred to it. This general reference was considered to be so well founded by those who had most carefully studied the subject, that Linnæus' original specific name *scalaris*‡ is admitted by Hall to have actually formed the foundation of his generic term.

Linnæus' second species, "*Graptolithus sagittarius*," which was founded not upon a true Graptolite, but upon a well-marked fragment of *Lepidodendron*, was erroneously identified by Hisinger with a well-marked species of *Monograptus*. The specific name, thus interpreted, was subsequently applied to at least half a dozen different species of Monograptidæ. From 1840 to 1873 it was the general practice to refer to this species every fragment of the numerous genera belonging to

\* 'Lethæa Suecica,' 1839, and Supplement, 1840.

† Linnæus, 'Skånska Resa,' p. 147.

‡ Hall, Grapt. Quebec Group, p. 112, &c.

the much more ancient family of the Diehograptidæ, if its connexion with a compound form could not be satisfactorily proved.

Hisinger's *Diplograptus* (*Prionotus*) *pristis* was equally fertile of errors. It has been identified with nearly all our commoner Diprionidæ in turn, from the base of the Skiddaw to the horizon of the Wenlock shales. Portlock's species *Monograptus tenuis*, Barrande's species *Monograptus Nilssoni*, and Murchison's *Diplograptus foliaceus* afford us instances of the same phenomenon.

So generalized and defective were the original figures and descriptions of the graptolitic forms first detected, and so obscure or insignificant did their special characteristics appear to palæontologists, that the foregoing list could be greatly extended. Even forms belonging to the most diverse genera were long confounded. The cautious and painstaking Barrande himself placed all his *Climacograpti*\* in the genus *Monograptus*, supposing these diprionidian species to be seal-riform impressions of monoprionidian forms. Hall, again, placed the whole of the genera of the Diehograptidæ in the genus *Monograptus*†, on the ground that the simple and unilateral character of the polypary in the latter genus was incapable of demonstration. *Retiolites*‡ and *Diplograptus* were long confounded; and the strikingly distinct genus *Dicranograptus* remained undistinguished. Perhaps the most remarkable confusion reigned in the bifid forms. Even as late as 1873 the term *Didymograptus* was still employed by some of our greatest authorities so as to embrace forms belonging to the three groups *Didymograptus*, *Dicellograptus*, and *Leptograptus*, which are not only distinct genera, but are possibly the types of three distinct graptolitic families.

### (c) Previous Opinions.

In the face of such formidable difficulties and misconceptions, geological and palæontological, it could not but happen that the generalizations of those who attempted to fix the range of the various forms of the Graptolitidæ in space and time were frequently wide of the truth. Looking back, however, over the history of the progress of our exact knowledge of these fossils from our present standpoint, it becomes clear that those errors—though of sufficient moment to shake the faith of the

\* Grapt. de Bohême, pl. ii. figs. 7, 8, 14, 15; pl. iii. figs. 5, 6.

† Grapt. of Quebec Group, p. 42; Twentieth Report of State Cabinet, pp. 236, 237.

‡ Nicholson, Mon. Brit. Grapt. pp. 55, 63, &c.

general palæontologist of the time in the Graptolite as a geological index, yet compare by no means unfavourably with the preliminary efforts of systematists in other groups of fossils during the initiatory and obscure stages of their investigation.

The more noticeable efforts in this direction were the summaries in the works of Barrande, Salter, and Hall, and in the various memoirs published by Professor Nicholson.

In his classical work on the Graptolites of Bohemia, published in 1850, Barrande gave an exhaustive summary of the facts at that time recognized with respect to the geological range of the Rhabdophora\*. Misled by Professor Phillips's erroneous enumeration of *Didymograptus Murchisoni* (Beck) among the fossils afforded by the black *Olenus*-bearing shales of the Malvern Hills, and by Sedgwick's distinct assertion that the Graptolite-bearing Skiddaw slates were of the age of the Lower Cambrian, Barrande reluctantly looked upon the Graptolites as making their first appearance in, or immediately below, his Primordial zone. The upper limit of their vertical range he placed in the Ludlow formation. The epoch of their maximum development corresponded, he believed, to the middle of the Lower Palæozoic age; in other words, they reached their maximum at or near the period when the lowest beds of Murchison's original Upper Silurian formations were laid down. He recognized most distinctly the restricted range of the genera *Rastrites* and *Gladiolites*, and hinted that, in all probability, they would be found to be exclusively confined to the rocks of the third fauna. From the fact that the Rhabdophora attained their maximum development in the Llandeilo-Bala beds of the United States, Britain, and Scandinavia, while they do not become abundant in Bohemia till we reach the horizon of the Llandovery, he believed that the anteriority of the existence of the Rhabdophora in the former countries might even then be regarded as established, not only for the group as a whole, but also for many of its subordinate forms. This conclusion, which implied the presence of a fauna of a typical Silurian character in the higher strata of the Ordovician of America and North-western Europe at a time when the typical Ordovician fauna remained unchanged in the Bohemian basin, he fortified by coincident proof from the behaviour of the genera of the Crustacea and Brachiopoda; and it has often been employed by him subsequently with great effect in defence of his remarkable theories of migration and colonies.

\* Grapt. de Bohême, pp. 20-32.

Professor Hall\* confined his observations to a note of the vertical range of the *Rhabdophora* in American deposits. Their earliest appearance he showed to be in the Quebec Group of Lower Canada, at or near the general horizon of the Calciferous Sandstone of New York; they there attained their maximum development, both in genera and species. He distinguished also a second but less prolific horizon, viz. that of the Utica Shales and the Slates of Norman's Kiln in the valley of the Hudson river. These he placed at the summit of the Ordovician. The only Silurian rocks known to Hall as affording *Rhabdophora* were the shales of the Clinton formation, at the base of the Niagara group.

Mr. Salter was probably responsible for the lists of fossils appended to the several editions of Murchison's 'Siluria.' How naturally he felt impelled to assign every prolific graptolite-bearing stratum to the Llandeilo has been already pointed out. Even as late as 1868 the influence of this feeling was as apparent as ever. A glance at the list of Graptolites in the Table of British Silurian fossils, in the fourth edition of 'Siluria,' will make it evident that, if we exclude the few admitted Wenlock forms and the half-dozen species from the beds of Pomeroy and Girvan (whose occurrence in strata crowded with Bala Crustacea made it imperative upon the conscientious palæontologist to give them a place in the Caradoc column), almost all the British *Rhabdophora* are assigned to the Llandeilo. Of the fifty-one species there cited, forty are placed in the Llandeilo column; and thirty-eight of these were tabled as peculiar to that formation. Three species (*Climacograptus scalaris*, His., *Monograptus convolutus*, His., and *Monograptus Sedgwickii*, Portlk.) are given as common to the Llandeilo and Caradoc beds. *Climacograptus bullatus*, Salt., *Monograptus Conybeari*, Portlk., *Monograptus gries-tonensis*, Nicol, are noted as peculiar to the Caradoc, in all probability for the reasons given above. Beyond *Monograptus priodon*, Bronn, whose range is mentioned as extending from the Caradoc to the Ludlow, no Graptolite is noted as common to both the Ordovician and Silurian. To the latter only two other species are assigned—*Monograptus Flemingii*, Salter, and *Retiolites Geinitzianns*, Barr.

Professor H. A. Nicholson has made this question the subject of several important memoirs. In a paper contributed to the 'Annals and Magazine of Natural History' in 1868, he treated of the "Distribution in Time of the British Genera and

\* Grapt. Quebec Group, pp. 51-58.

Species of the Graptolites" \*, deriving many of the more important of his data from the results of his own extended researches. In this paper the range of the Rhabdophora was defined as extending from the base of the Skiddaw (Arenig) series to the summit of the Ludlow formation. The restriction of *Dichograptus*, *Tetragraptus*, and *Phyllograptus* to strata of Lower Ordovician date (Skiddaw) was pointed out, and the local stratigraphic position of many genera most carefully given. The general conclusions drawn by the author from the data before him are of great historical value, as showing the rapid advance in our knowledge of the distribution of these fossils within the last few years. To one who is at all familiar with the facts recently made known regarding the special horizons marked by these forms, it is interesting to read that *Climacograptus* and *Diplograptus* are exclusively Ordovician genera, that *Rastrites* and *Cyrtograptus* are unknown above the Caradoc rocks, and that the genus *Monograptus* (*Graptolites*) ranges from the Skiddaw Slate to the summit of the Silurian.

In his 'Monograph of the British Graptolitidæ,' published in 1872, Professor Nicholson treats of the geological distribution of the Rhabdophora in some detail. The graptolitiferous Lower Palæozoics of Britain are regarded by him as belonging to three successive periods. To the first of the periods (the Skiddaw or Arenig period) are assigned the genera *Trigonograptus*, *Climacograptus*, *Diplograptus*, and *Didymograptus* and its allies. In the second period (that of the Llandeilo-Caradoc formations) are placed the genera *Diplograptus*, *Climacograptus*, *Didymograptus*, *Dicranograptus*, *Cænograptus*, *Pleurograptus*, *Cyrtograptus*, *Rastrites*, *Retiolites*, and *Monograptus*. In the (Upper) Silurian the author only admits the presence of the genera *Diplograptus* and *Climacograptus*, but in Bohemia only, observing, "but for this as yet solitary exception, it might have been asserted that no diprionidian Graptolite, save the aberrant *Retiolites*, occurred in rocks younger than Murchison's Lower Silurian" †.

The general tendencies of the foregoing conclusions, read in the light of the favourite palæontological speculations of the time, are ably summed up by this author in his paper on the Migrations of the Graptolites, published during the same year ‡.

In this memoir Dr. Nicholson accepts, without reserve, the generally received opinions with respect to the systematic

\* Ann. & Mag. Nat. Hist. 1868, ii. pp. 347-357.

† Mon. Brit. Grapt. pp. 92-98.

‡ Quart. Journ. Geol. Soc. London, 1872.

place of the various graptolitiferous deposits of Europe and America; and, basing his argument on his intimate knowledge of their included and peculiar forms, he endeavours to trace out the progress of the several genera and species, both in space and time. He infers that the evidences at his command show that the Skiddaw forms migrated southwards and westwards into Wales, Ireland, and America. Four species emigrated northwards into the Moffat area of the south of Scotland. This Moffat area became subsequently the birth-place of the genera *Retiolites*, *Cænograptus*, *Rastrites*, and, most probably, *Pleurograptus* and *Monograptus*. It formed in its turn a grand centre of dispersion. To the south it furnished 55 per cent. of the later Coniston-Mudstone fauna. Its western emigrants, after peopling the Caradoc beds of the south of Ireland, crossed what is now the Atlantic, and reappeared in great force in the Utica Slates and Lorraine Shales at the summit of the Ordovician of New York and Canada. Easterly the course of the Moffat forms can be even more satisfactorily followed, their first resting-place being the Greywacke area of Saxony, whence they subsequently passed southwards into Barrandé's Colonies and the band *Ee 1* of the Bohemian Basin.

[To be continued.]

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XXIX.—*On the Occurrence of a small and new Phyllopod Crustacean, referable to the Genus Leaia, in the Lower Carboniferous Rocks of the Edinburgh Neighbourhood.* By R. ETHERIDGE, JUN., F.G.S., of the British Museum.

THE rapid increase in the number of invertebrate species lately discovered in the Calciferous Sandstone or Lower Carboniferous rocks of the south-east of Scotland, through the researches of the Geological Survey and of private collectors, has in a great measure tended to bridge over the gap which was formerly supposed to exist between the two important subdivisions of the Carboniferous system in Scotland—the Calciferous Sandstone series and the Carboniferous Limestone.

In continuing this subject\* it is with much pleasure that I have to chronicle the discovery, by Mr. James Bennie, of a

\* "On our Present Knowledge of the Invertebrate Fauna of the Lower Carboniferous, or Calciferous Sandstone Series, of the Edinburgh Neighbourhood, especially of that Division known as the Wardie Shales," Quart. Journ. Geol. Soc. 1878, xxxiv. p. 1.

small Phyllopod in the Wardie-Shale group of the rocks in question. It is either a new and peculiar form of the genus *Leaia*, or, as Prof. T. Rupert Jones was at first inclined to think, perhaps a species indicative of an undescribed genus.

The genus *Leaia* has not been previously unnoticed, however, in our Lower Carboniferous rocks. Many years ago the late Mr. J. W. Salter discovered a variety of the type species in the rocks of the Fifeshire coast, which was described by Prof. T. Rupert Jones as *L. Leidyi*, var. *Salteriana*.

A form of *Leaia* was found in an ironstone nodule from the Wardie Shales at Wardie, near Edinburgh, by Mr. C. W. Peach; and the discovery was noticed by Prof. Jones\* and Mr. Peach †.

*Leaia*, notwithstanding its limited number of species, is now known to range from the uppermost part of the Old Red Sandstone (or lowest part of the Carboniferous?) of Pennsylvania to the Coal-measures ‡, although, so far as I am aware, it has not yet been met with in the Carboniferous Limestone.

The genus is described by Prof. Jones as possessing a markedly quadrate bivalved carapace, thin and horny, truncated and slightly curved behind, boldly rounded in front, and straight on the dorsal edge. The surface of the valves is concentrically ridged with lines of growth, and ornamented with a delicate reticulation in the intermediate furrows. Each valve is crossed by two conspicuous ridges: one of these passes directly across the valve from a slight anterior umbo to the antero-ventral angle; the other and longer forms a diagonal to the postero-ventral angle, thus dividing each valve into three unequal triangular areas. The concentric ridges (passing from one transverse ridge to the other) vary in their proximity one to another and in their relative strength of development. These are the characters derived from the type species and its varieties.

The form described by Meek and Worthen as *Leaia tricarinata* § leads us a step further, and overrides the foregoing description as to one point. It corresponds in all essential particulars with the type species, but is said to possess a third carina or ridge, lying along the dorsal margin of each valve and enclosing what the authors term a "lanceolate corselet," or

\* Geol. Mag. 1871, viii. p. 96.

† Brit. Assoc. Report for 1871, pt. 2, p. 109.

‡ Jones, Mon. Foss. *Estheria*, p. 117, &c.

§ Illinois Geol. Report, 1868, iii. p. 541; Jones, Geol. Mag. 1870, vii. p. 219.



“ lanceolate false area.” Meek and Worthen, however, admit that this peculiarity is not always to be seen, but only in those individuals which have not undergone pressure.

On this point Prof. Rupert Jones observes, “ Messrs. Meek and Worthen have shown that in some species of *Leaia* there is evidently a third (dorsal) carina on each valve, bounding a dorsal depression (their ‘ lanceolate false area ’), along the bottom of which is the hinge-line. In compressed specimens this is not distinguishable; and whether or no it is present in all they leave an open question ”\*. He adds, “ As to outline and proportions, the many individuals on the shales found by Mr. W. Adams in South Wales comprise all the forms yet figured by Lea, Dawson, Meek and Worthen, and myself, and may be due to differences in age or sex, or conditions of preservation . . . . It is, of course, probable that different ‘ species ’ did exist, and are represented amongst the different forms found in distant countries; but we still wait for further and decided evidences of specific characterization.”

The sum of this evidence appears to be that, if further researches bear out the characters originally assigned to *Leaia*, as typified by *Cypricardia Leidyi*, Lea, and if the ridges have an important physiological meaning, then Meek and Worthen’s species *L. tricarinata* should be considered generically distinct, provided the third carina on each valve, and the “ lanceolate false area ” enclosed thereby, are constant and well-defined characters, as, indeed, there does not appear any reason to doubt from the evidence of Meek and Worthen’s figures B 2 and B 3.

On this point Prof. Jones has favoured me with the following remarks:—“ It is possible, however, that if the two valves of *L. tricarinata* be opened out, in apposition, by their dorsal edges only, these particular dorsal carinæ may become obscured by pressure and imbedment; whereas if preserved in a good state with closed valves, and seen on the dorsal edge (as in Meek and Worthen’s fig. B 3), the carapace then clearly shows the above-mentioned dorsal carinæ and the intervening elongate dorsal lunette. Certainly none of the published figures of open pairs of valves give any indication of the lanceolate corselet; and, unfortunately, *L. tricarinata* does not appear to have occurred in the opened-out position, so as to show its behaviour under pressure.

“ One of the published species which is figured in the expanded condition of the valves is *Leaia Klieveriana*, Golden-

\* Proc. Nat.-Hist. Soc. Cardiff, 1869, ii. p. 117; Geol. Mag. 1870, vii. p. 219.

berg\* ; and this shows no dorsal carina ; but (if we interpret it aright) it has a peculiar short oblique ridge on each valve, intermediate to the vertical anterior and the longer oblique hinder ridge, starting with them from the umbo, but reaching across only about a third of the valve's width."

Let us now pass on to the fossil more recently discovered by Mr. Bennie, and compare it with *L. Leidyi* and *L. tricarinata*. The Granton species possesses to a great extent the quadrate form assumed by the others ; but the angles and ventral edge are somewhat more rounded than in the type species and its variety *Williamsoniana*, and its angles are blunter than those of *L. tricarinata*. The surface is concentrically ridged, and the hinge-line straight, as in the others. The interesting feature, however, in connexion with this species, lies in the single ridge which crosses each valve in place of the two of *L. Leidyi*, the two and a half of *L. Klieveriana*, and the three of *L. tricarinata*. Instead of one from the umbo to the antero-ventral angle, and another forming a diagonal, as in the first—or a similar arrangement with the addition of a small, short, intermediate ridge, as in the second—or of a dorsal carina, as in the last,—the Granton specimens have only one cross ridge, that from the umbo to the antero-ventral angle, the diagonal and the dorsal ridges being, so far as we at present know, quite absent.

In the specimens before me this character is constant ; and if, in the imperfect state of our knowledge of the species of this genus, the number of ridges on the carapace is to be taken as one of the chief points upon which to base separation, I think there can be no impropriety in assigning a special name to these individuals with a single ridge. Indeed Prof. Rupert Jones at first suggested to me the possibility of this being the type of a distinct "genus;" but he is now inclined to think that the cross ridges had better be regarded (provisionally at least) as specific characters, as we know nothing of the animal itself, and as there is but little in the shape of the valves that can be relied on as a constant character. Under these circumstances I shall content myself with describing the Granton specimens as *Leaia Jonesii*, as a slight recognition of the kindness and assistance I have always received at the hands of Prof. T. Rupert Jones, F.R.S. &c.

*Leaia Jonesii*, sp. nov. (Figs. 1, 2.)

*Sp. char.* Valves of the carapace oblong, very slightly and obliquely acuminate anteriorly, subtruncate and rounded

\* Die fossilen Thiere aus der Steinkohlenformation von Saarbrücken, 1877, Heft 2, p. 46.

posteriorly; dorsal margin straight, ventral gradually rounded; convexity of valves unknown. Umbo inconspicuous in the crushed state. Surface ornamented with numerous (18–20) sharp concentric ridge-lines, and divided into two very unequal portions by a ridge proceeding vertically from the umbo to the antero-ventral curve, gradually losing its marked character as the umbo is receded from. The smaller of the two spaces is roundly triangular, and sometimes intruded on by an accidental fold due to pressure; the larger, comprising the greater part of each valve, is almost quadrate or oblong in form, allowing for the rounded infero-posterior margin.

Fig. 1.

Fig. 2.

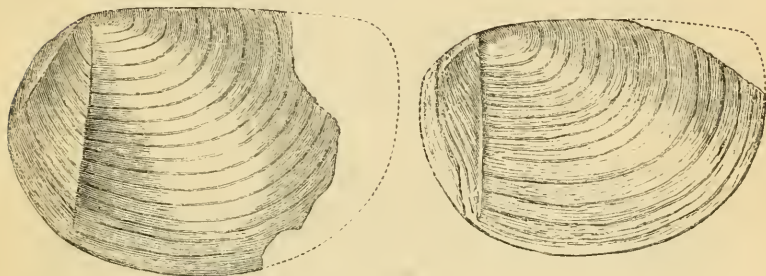


Fig. 1. A valve in which the posterior end has been destroyed; anterior to the ridge from the umbo is a furrow caused by pressure. It is quite distinct from the ridge.

Fig. 2. Another valve, with the rounded posterior end somewhat deficient; the same fold occurs here.

The figures are magnified to about eight times the natural size. The specimens are contained in the Geological-Survey-of-Scotland collection.

*Obs.* Exclusive of the single ridge existing in the present species, it has much less angularity of outline than *L. Leidyi*, Lea, and somewhat less than *L. tricarinata*, M. & W., and in this respect corresponds more closely with *L. wettinensis*. It is longer than *L. Bentschiana*.

*Form. and Loc.* Shore of the Firth of Forth at Granton Quarry, near Edinburgh, in a fine-grained shale of the Wardie-Shale group, Lower Carboniferous or Calciferous-Sandstone series. Collection of the Geological Survey of Scotland.

*Collector.* Mr. James Bennie.

I have to express my thanks to Prof. A. Geikie, F.R.S., for permission to make use of the specimens, and to Prof. T. Rupert Jones, F.R.S., for material assistance in working out the form here described.

The following synopsis of the species of *Leaia* known to me may be found useful:—

Genus *LEAIA*, Jones, 1862.

*Leaia Leidy*, Lea (1856).

*Cypricardia Leidy*, Lea, Proc. Acad. Nat. Sci. Philad. 1856, vii. p. 341, t. 4.

*Leaia Leidy*, Jones, Mon. Foss. Estheriæ, 1862, p. 116, t. 5. f. 11, 12; Dawson, Acadian Geol. 1868, p. 256, f. 78 c; Jones, Proc. Nat. Hist. Soc. Cardiff, 1869, ii. p. 117, t. 3. f. 11-14; Jones, Geol. Mag. 1870, vii. p. 219, t. 9. f. 11-14; Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 740, t. 16. f. 3; Miller, Cat. American Pal. Foss. 1877, p. 219; Woodward, Cat. Brit. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Foss. Heft 2, 1877, p. 45, t. 2. f. 22; Bigsby, Thes. Dev.-Carbonif. 1878, pp. 250, 251.

*Loc. and Horizon.* Tumbling-Run dam, near Potsville (Penn.), in the uppermost portion of the Old Red Sandstone (? or base of the L. Carboniferous); Coal Measures of South Wales.

*Leaia Leidy*, var. *Williamsoniana*, Jones (1862).

*Bivalvular shell*, Williamson, Phil. Mag. 1836, n. s. ix. p. 351.

*Aptychus*?, Phillips, Murchison's Sil. Syst. 1839, p. 89.

*Leaia Leidy*, var. *Williamsoniana*, Jones, Mon. Foss. Estheriæ, 1862, p. 117, t. 1. f. 19-29; Woodward, Cat. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Foss. Heft 2, 1877, p. 45, t. 2. f. 23; Bigsby, Thes. Devon.-Carbonif. 1878, p. 251.

*L. Williamsoniana*, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 743, t. 16. f. 4.

*Loc. and Horizon.* Ardwick, near Manchester, in uppermost portion of Coal-measures.

*Leaia Leidy*, var. *Salteriana*, Jones (1862).

*L. Leidy*, var. *Salteriana*, Jones, Mon. Foss. Estheriæ, 1862, p. 119, t. 1. f. 1; Woodward, Cat. Foss. Crustacea, 1877, p. 76; Goldenberg, Fauna Saræpontana Fossilis, Heft 2, 1877, p. 45; Bigsby, Thes. Dev.-Carbonif. 1878, p. 251.

*L. Salteriana*, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 744, t. 16. f. 5.

*Loc. and Horizon.* Cottage Row, Crail, Fife, in rocks of the Lower Carboniferous or Calciferous Sandstone series.

*Leaia Bantschiana*, Geinitz (1864).

*L. Bantschiana*, Geinitz, N. Jahrbuch, 1864, p. 657; id. ibid. 1865, p. 389, t. 1. f. 2, 3.

*L. Leidy*, var. *Bantschiana*, Beyrich, Zeitschr. deutsch. geol. Gesellsch. 1864, xvi. p. 364.

*L. Bantschiana*, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. p. 744, t. 16. f. 2.

*L. Leidyi*, var. *Baenschiana*, Goldenberg, Fauna Sarapontana Fossilis, Heft 1, 1873, p. 24.

*L. Leidyi*, var. *Baenschiana*, Goldenberg, *op. cit.* Heft 2, 1877, p. 46, t. 2. f. 24.

*Loc. and Horizon.* Near Neun Kirchen, in rocks of Lower Permian age.

*Leaia tricarinata*, Meek and Worthen (1868).

*L. tricarinata*, M. & W. Illinois Geol. Report, 1868, iii. pp. 540, 541, f. B. 1-3, and ? C; Miller, Cat. American Pal. Foss. 1877, p. 219; Bigsby, Thes. Dev.-Carbonif. 1878, p. 250.

*Loc. and Horizon.* La Salle County, in lower portion of true Coal-measures; ? St. Clair County, in Upper Coal-measures; Vermillion County, Illinois, in the Lower true Coal-measures.

*Leaia wettinensis*, Laspeyres (1870).

*L. Wettinensis*, Laspeyres, Zeitschr. deutsch. geol. Gesellsch. 1870, xxii. pp. 733-745, t. 16. f. 1; Bigsby, Thes. Dev.-Carbonif. 1878, p. 251.

*Loc. and Horizon.* Wettin, Coal-measures.

*Leaia Klieveriana*, Goldenberg (1873).

*L. Leidyi*, var. *Klieveri*, Goldenberg, Fauna Sarapontana Foss. Heft 1, 1873, p. 24, t. 1. f. 22.

*L. Leidyi*, var. *Klieveriana*, Goldenberg, *op. cit.* Heft 2, 1877, p. 46, t. 2. f. 20, 21.

*Loc. and Horizon.* Saarbrück, Coal-measures.

*Leaia*, sp. ind.

*Leaia*, sp., Jones, Geol. Mag. 1871, vii. p. 96; C. W. Peach, Brit. Assoc. Report for 1871, pt. 2, p. 109; Etheridge, Jun., Quart. Journ. Geol. Soc. 1878, xxxiv. pp. 5, 23.

*Loc. and Horizon.* Ironstone nodule in Wardie Shales, at Wardie, near Edinburgh, Lower Carboniferous series.

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XXX.—Notes on the *Species of Peripatus*, and especially on those of *Cayenne and the West Indies*. By H. N. MOSELEY, F.R.S., Fellow of Exeter College, Oxford.

ABOUT two years ago Dr. Günther kindly sent to me for examination a specimen of *Peripatus* received by him from the Amazons; and I also received about the same time a further specimen from the late Mr. Thomas Belt. In attempting to determine the species of these specimens I found many difficulties in the way; and I therefore examined the series of

specimens of *Peripatus* preserved in the British Museum, with a view to clearing up the matter. I came to the conclusion that the species of *Peripatus* as hitherto described were in some considerable confusion, and that only the careful examination of the minute structure of the feet, skin, and other organs in the case of each species would yield a satisfactory result. Being unable to devote the necessary time to the matter, I drew up the following notes, intending to publish them as an assistance to future workers; but hearing that Prof. Perceval Wright was about to prepare a revision of the entire species of *Peripatus*, I sent the notes to him.

Press of other work has prevented Prof. Wright from issuing as yet his monograph, although some most beautiful figures of *P. novæ zelandiæ* have been prepared for it. I therefore publish these somewhat scanty notes to draw attention to the discrepancies which exist in the various accounts.

(1) The genus *Peripatus* was first described by Guilding in 1825 and 1826, in the 'Zoological Journal,' vol. ii. p. 444, tab. xiv. (1826) art. xlvii. Mollusca Carribæana; Isis (1828), Bd. xxi. Taf. ii.

Guilding's specimens came from the forests of St. Vincent in the Antilles. He names his species *Peripatus juliformis*.

This species is said by Blanchard, on the authority of Macleay (reference?), to be found also in Cuba.

(2) Audouin and Milne-Edwards obtained specimens of a *Peripatus* from a spot three leagues distant from the mouth of the river Approuague in Cayenne. These specimens they referred to Guilding's species *juliformis*, considering the differences found by them between their specimens and Guilding's description due to imperfect observation of Guilding. ("Classification des Annélides et description de celles qui habitent les côtes de France," Ann. des Sci. Nat. 1<sup>e</sup> sér. xxx. p. 411, pl. xxii. 1833.)

(3.) Wiegmann obtained a specimen of a *Peripatus* from the neighbourhood of Valentia Lake in Columbia. He considered this of the same species as Guilding's, though differing in the number of pairs of feet. (Wiegmann Arch. 1837, i. p. 199.)

(4) C. Moritz found a *Peripatus* in abundance in the island of St. Thomas, D. W. I., in 1839. He found the animal in the valley of Aragua. He gives a very good account of the manner in which the animal squirts out the tenacious fluid, and of the meshworks which this fluid forms as it dries. He further observed that the fluid came not from the mouth, but from each side of the fore part of the body. He says that the large *Julus* of the Antilles does squirt a fluid from its mouth

as an offensive act, and that the fluid is highly irritant, even causing blindness sometimes, according to the natives. (Archiv für Naturg. 1839, Bd. i. p. 175.)

(5) Blanchard considered Milne-Edwards's specimens to have belonged to a different species from Guilding's, and named Edwards's species *P. Edwardsii* from the descriptions published. (Ann. des Sci. Nat. 3<sup>e</sup> sér. t. viii. 1847, pp. 139, 140.)

(6) Grube ("Ueber den Bau von *Peripatus Edwardsii*," Müller's Arch. 1853, p. 322) obtained specimens of *Peripatus* from Venezuela, in the neighbourhood of Colonia Jowar. These he referred to *Peripatus Edwardsii*.

The principal distinction hitherto made between the various species of *Peripatus* appears to be in the numbers of feet. A difficulty occurs, because the first pair of feet are mere tubercles without claws, and perforated by the apertures of the ejaculatory ducts of the slime-glands. The last pair of limbs also in some species (*P. capensis*, e. g.) appear as tubercles only. Hence some mistake may occur in the counting of the numbers of the feet in the various species. Guilding and Milne-Edwards appear both to have mistaken the pair of tubercles perforated by the ducts (oral papillæ) for eyes.

Guilding describes his species (*juliformis*) as having thirty-three pairs of feet, not including the oral papillæ.

M.-Edwards and Audouin describe their specimens (*P. Edwardsii*, Blanchard) as having thirty pairs of feet besides the papillæ.

Wiegmann found the same number (thirty) in his Columbian specimen, and concluded that the number must vary with age, because Guilding found thirty-three pairs in his St.-Vincent specimen.

Grube found twenty-nine pairs in one of his three specimens from Venezuela, and thirty in the two others. Nevertheless in his figure (*l. c.* Taf. ix. fig. 1) thirty-one pairs are plainly to be counted besides the oral papillæ. It is doubtful whether the counting of the feet is an error or the drawings are incorrect.

Dr. Günther's specimen of *Peripatus* from the Amazon has thirty-one pairs of feet besides the oral papillæ, just as in Grube's figure.

Further, the late Mr. Thomas Belt kindly permitted me to examine a specimen of a *Peripatus* referred to by him, in his 'Naturalist in Nicaragua',\* as "a Myriapod of the division *Sugentia* of Brandt." This specimen, which is dried, has

\* The 'Naturalist in Nicaragua,' by T. Belt, F.G.S. London: John Murray, 1874, p. 140.

thirty-one pairs of feet also. It was obtained at Santo Domingo in Nicaragua.

Two species are described from the Cape of Good Hope, *P. brevis* and *P. capensis*, with fourteen and seventeen pairs of feet respectively. It is possible that these are identical; and it is also possible that *P. juliformis* with thirty-three pairs is not distinct from *P. Edwardsii* with from twenty-nine to thirty-one.

Singularly enough I have seen no variation in the Cape or New-Zealand specimens obtained by me; and Captain Hutton found no variation in the case of the latter.

In the British Museum there are, besides the *Peripatus* from the Amazons, several other specimens of the genus.

(1) A bottle contains three specimens purchased of Mr. Cuming, collected by Mr. Gosse, 1846. These specimens are labelled "from Jamaica."

Two of the specimens, one large and the other small, have each thirty-one pairs of feet and appear = *Peripatus Edwardsii*.

The third specimen has thirty-seven pairs of feet, and differs from the other two in general appearance, and in having the surface of the body finely granulated instead of more or less tubercular, and also in having the pits (spiracular?) on the under surface of the foot-cones well marked and circular, and not rather indistinct and linear as in *P. Edwardsii*.

(2) Another bottle contains one specimen marked *Peripatus Blainvillei* (Gay and Blanchard) by Baird. This is from St. Thomas, Danish West Indies. This has twenty-eight pairs of feet. In its outward appearance it resembles the smaller specimen (bottle 1) from Jamaica, which has thirty-one pairs. A note is put on the bottle by Baird, that in Blanchard's description nineteen pairs of feet are described as occurring in *P. Blainvillei*, whilst in his figures there are in one twenty-seven or twenty-eight, and in the other thirty-two to be counted.

(3) A bottle contains a small specimen from the Cape from Mr. Roland Trimen. This has, as in all the Cape specimens I examined, seventeen pairs.

(4) There is a specimen marked *P. Blainvillei* without locality being given. This has thirty-three pairs of feet, and is finely granular on the body-surface like the Jamaica specimen with thirty-seven pairs.

The descriptions of the South-American and West-Indian species are vague, since the figures do not correspond with them.

It is probable that in the case of the three specimens in the



British Museum labelled "Jamaica" there may be an error. The two specimens with thirty-one pairs may be from the mainland and be *P. Edwardsii*. The other may be a true Jamaica species.

The following questions arise :—

Is there a St.-Thomas species with twenty-eight pairs of feet?

A Jamaica species with thirty-seven?

A St.-Vineent species with thirty-three?

*P. Edwardsii* with thirty-one, with twenty-nine and thirty sometimes?

A Chilian species with nineteen or twenty-seven or thirty-two?

A Cape species with fourteen and another with seventeen? or are these the same?

In the Australian and New-Zealand species the number of feet seems fixed. Mr. Wood-Mason has informed me that he has obtained a new species from the Cape, which he will shortly describe. I trust that he and Prof. Pereeval Wright may be able by more careful investigation of the various forms to clear up the confusion which certainly prevails as yet with regard to the species of this isolated genus.

XXXI.—On the Bryozoa (*Polyzoa*) of the Bay of Naples.

By ARTHUR WM. WATERS, F.G.S.

[Plates XXIII. & XXIV.]

[Continued from p. 202\*.]

CYCLOSTOMATA.

The classification of the Cyclostomata is even more difficult than that of the Cheilostomata, which partly arises from there being fewer characteristics upon which it can be grounded.

The winter time, when I made the collection, seems to have been specially unfavourable for studying this suborder; for I seldom received colonies with active polypides, and I have been surprised to find what a large number have no oocidia.

We shall probably ultimately have to adopt an arrangement with the Cyclostomata somewhat similar to that introduced by

\* Note to page 199.—I find there is a fifth genus *Buskia*, created by the Rev. Tenison Woods, in Proc. Roy. Soc. Tasmania, 1876. This has already been shown by Mr. Etheridge, Jun., to be a duplicate name.

Prof. Smitt for the Cheilostomata, and indicate the mode of growth as stadia: thus compound colonies of *Discoporella* form *Radiopora*; *Alecto*, *Entalophora*, *Tubulipora*, *Idmonea* have their allies erect and adnate.

78. *Crisia cornuta*, L.

*Crisia cornuta*, Smitt, var. *a*, Krit. Fört. 1864, p. 115.

*Crisidia cornuta*, var. *geniculata*, Busk, Mar. Polyz. pt. iii. p. 3, pl. i. figs. 1, 4.

*Hab.* Scandinavia, Finland, Greenland (*Sm.*); Britain and France (*B.*); Naples, rare.

79. *Crisia producta*, Smitt.

*Crisia producta*, Smitt, Krit. Fört. öf. Sk. Hafs-Bry. 1864, p. 116, pl. xvi. figs. 4, 5, 6.

*Crisia eburnea*, var. *producta*, Norm. Rep. of the Shetland Crust. &c., Brit. Assoc. Rep. 1868, p. 309.

Some parts closely resemble the last variety; but it is very variable: sometimes an internode occurs near the growing extremity with only one cell; others adjoining have from two to six. It is larger than the last, with cells half as large again, and longer. Ovicell axillary.

As there are connecting links between this and *cornuta*, it might well be called *C. cornuta*, var. *producta*, or even *C. geniculata*, var. *producta*.

*Hab.* Scandinavia (*Sm.*); Shetland, 100–170 fathoms (*Norm.*); Naples, littoral, among seaweeds, rare.

80. *Crisia fistulosa*, Heller (non Busk).  
(Pl. XXIII. fig. 3.)

*Crisia fistulosa*, Heller, Die Bry. des Adriat. Meeres, p. 118, pl. iii. fig. 5.

? *Crisia eburnea*, Smitt (pars), Kr. Fört. öf. Sk. Hafs-Bry. 1864, pl. xvi. fig. 7.

*Crisia Haueri*, Reuss, Foss. Poly. des W. T. B. p. 54, pl. vii. figs. 22, 24.

? *Crisia eburnea*, Manzoni, I Bri. foss. del Mioc. d'Austr. ed Ungh. p. 3, pl. i. fig. 1.

This would certainly seem to be the species thus named by Heller; and the one so called by Mr. Busk is quite different, and does not at all correspond with Heller's figure or description. Prof. Heller's comparison with *C. geniculata* would be most inappropriate for the *C. fistulosa* of Busk, whereas for the present form it is apparent.

*Loc.* Miocene: Nussdorf, Berchtoldsdorf, Wieliczka. Pliocene: Rhodes (*M.*). Living: Naples.

81. *Crisia elongata*, M.-Edw. (Pl. XXIII. fig. 1.)

*Crisia elongata*, M.-Edw. Sur les Crisies &c. p. 202, pl. vii. fig. 2, Ann. des Sc. Nat. 2<sup>e</sup> sér. vol. ix.

*Crisia attenuata*, Heller, Die Bry. des Adr. Meeres, p. 117, pl. iv. figs. 1, 2.

The great length of the internodes and the fewness of the branches make it appear extremely delicate and narrow; and it created surprise, upon measurement, to find it as wide as species appearing much thicker. Branches arising at the fifth to fiftieth zoëcium.

*Hab.* Adriatic (*H.*), 35-55 fathoms; Naples, 40 fathoms.

82. *Crisia elongata*, var. *angustata*.

(Pl. XXIII. fig. 4.)

*Crisia fistulosa*, Busk (non Heller), Mar. Polyz. pt. iii. p. 5, pl. vi. A. figs. 1, 2.

?*Crisia Edwardsii*, Reuss, Die foss. Polyp. Wiener T. p. 53, pl. vii. fig. 20.

?*Crisia Edwardsii*, Manzoni, I Bri. foss. del. Mioc. d'Austr. ed Ungh. pt. iii. p. 4, pl. i. fig. 2.

Fourteen to twenty-six zoëcia between the joints of the same branch; branches arising usually from the fifth to eighth zoëcium of a branch; and at about the same distance a fresh branch grows on the other side.

This differs from *elongata* in having more branches, which arise from nearer the joint, and is usually slightly more slender. The zoëcia are 0.04 millim. apart. This looks much like the fossil *Crisia Edwardsii*; but it is difficult from fragments to decide between this and the last variety.

*Hab.* Naples, shallow and deep water.

83. *Crisia denticulata*, Lamx. (Pl. XXIII. fig. 2.)84. *Crisia eburnea*, L.85. *Idmonea atlantica*, Forbes.

*Idmonea atlantica*, Manzoni, I Bri. foss. del Mioc. d'Austr. ed Ungh. p. 5, pl. ii. fig. 6.

*Idmonea gracillima*, Reuss (non Busk), Die foss. Anth. und Bry. der Schicht. von Crosaro, Denkschr. k.-k. Akad. Wien, vol. xxix. p. 70, pl. xxxv. figs. 1, 2.

Mr. Busk seems to have overlooked the fact that Reuss had named a fossil *Idmonea gracillima*; and therefore the name given to a species in the British Museum (Cat. p. 14) will have to be changed.

Specimens I have from the Val di Lonte correspond with recent *atlantica*.

*Loc.* Miocene: Eisenstadt, Steinaubrunn, Val di Lunte, Montecelio, Maggiore (Italy). Living: Arctic Seas, Shetland; Naples, 40 fathoms (only one piece).

86. *Idmonea marionensis*, Busk.

*Idmonea marionensis*, Busk, Cat. Mar. Polyz. p. 13, pl. xiii. figs. 3-5, pl. vii. figs. 7, 8.

The British-Museum specimen has four cells in a series, although the diagnosis in the Catalogue gives two to three. I have a few specimens from Naples, one of which exactly corresponds with the Museum specimen.

It differs from *I. atlantica* chiefly in the series being further apart (viz. 0.7 millim.). The dorsal surface is usually round; but this varies with age.

I have a species, in habit much resembling the typical *marionensis*, which has six cells in a series and the dorsal surface flat.

This is not the *Crisina Hochstetteriana* of Stoliezka, fossil from New Zealand, which has large pores somewhat resembling those common in *Hornera*.

*Hab.* Marion Island, 80 fathoms (B.); Naples, 40 fathoms, not common.

From the diagnosis it would seem as if Mr. Busk had written it from some material more nearly corresponding with *Crisina Hochstetteriana*, Smitt (non Stol.), than the specimen mounted, which has cells all down the two sides.

87. *Idmonea irregularis*, Menegh.

*Idmonea irregularis*, Meneghini, Polipi della fam. dei Tubul. p. 12; Acad. di Sc. di Padova, vol. vi.

*Idmonea irregularis*, Heller, Die Bry. des Adriat. Meeres, p. 121.

*Idmonea irregularis*, Busk, Cat. Mar. Polyz. pt. iii. p. 13, pl. xii.

?*Filisparsa Pourtalesii*, Smitt, Floridan Bryozoa, p. 9.

Zoarium dichotomously branched; branches round; mostly four cells in each lateral series, the outside cells the longest; these are nearly at right angles to the axis of the zoarium, and are very prominent and conspicuous; dorsal surface rounded, and the divisions of the cells inconspicuous. Cells between the lateral series irregularly placed.

*Hab.* Adriatic (M. & H.); Mediterranean (B.); Naples, common, from 40 fathoms; Tortugas? (Sm.).

88. *Idmonea Meneghinii*, Heller.

*Idmonea Meneghinii*, Heller, Die Bry. des Adriat. p. 120, pl. iii. figs. 6, 7.

The dorsal surface is normally flat, or slightly concave and striated; but the growing ends are convex, as is also the basal

portion. The end fronds have only two cells in each series, while the older portions have usually four or five. The series are 0·4 millim. or slightly wider apart, with very long and raised cells.

Fragment's of such a form, if found fossil, would probably be made into more than one species.

Living: Adriatic (*H.*); Naples, 40 fathoms, not very common.

### 89. *Idmonca triforis*, Heller.

*Idmonca triforis*, Heller, Die Bry. des Adriat. Meeres, p. 120.

This is a smaller and more delicate species than the last, and is distinguished by having three cells in a series. These are 0·5 millim. or more apart. The dorsal surface is concave, with the ends convex.

*Hab.* Adriatic, 20–55 fathoms (*H.*); Naples, 40 fathoms, rare.

### 90. *Idmonca concava*, Reuss.

*Idmonca concava*, Reuss, Die foss. Anth. und Bry. der Schicht. von Crosaro, Denkschr. k.-k. Ak. Wien, vol. xxix. p. 70, pl. xxxv. figs. 3, 4.

The dorsal surface is distinctly striated and usually slightly concave; but the growing ends are convex.

The zoarium, after growing straight for about 7 millims., divides dichotomously at an angle of about 60°, and sometimes divides again after growing for about 4 millims. There are usually four cells in a series; the cells are long and project laterally; the series are a little more than half a millim. apart.

This corresponds with specimens I have from the Val di Lonte, &c.

*Loc.* Miocene: Val di Lonte, Montecchio-Maggiore (*Reuss.*).  
Living: Naples, 40 fathoms.

### 91. *Tubulipora serpens*, Linn.

*Tubulipora serpens*, Smitt, Krit. Fört. öf. Sk. H.-Bry. 1865, p. 399, pl. iii. figs. 1–5, pl. ix. figs. 1, 2.

*Idmonca serpens*, Manzoni, Bry. foss. Ital. cont. 4, p. 27, pl. vi. fig. 32, et I Bri. del Plioc. di Castrocaro, p. 42, pl. vi. fig. 78.

*Obelia tubulifera*, Lamx. Expos. Méth. p. 81, pl. lxxx. figs. 7, 8.

The specimens I have are adnate on seaweed and are only from 3–6 millims. long, commencing with a single zoöcial tube. The colony rapidly widens; on each side of the median line much raised regular series with six cells in a series; cells closely joined. Some specimens divide dichotomously. This is smaller and more regular than *T. phalangea*, which has the zoöcial tubes free at the end.

This is sometimes reddish; but this should not be made a specific character, for at Naples *Filisparsa tubulosa*, *Entalophora proboscidea*, *Idmonea concava*, &c. are found both red and white.

*Loc.* Pliocene: Ficarazzi (Sicily), Castrocaro. Living: Northern Seas; Naples, on seaweed, from 2 fathoms and also 20-30 fathoms; Adriatic (*Heller*).

92. *Tubulipora phalangea*, Couch.

*Tubulipora phalangea*, Busk, Cat. Mar. Polyz. pt. iii. p. 25, pl. xxiii. fig. 2.

The specimens I have from Naples are strap-shaped or formed of elongated lobes. The tubular cells are very long, with a tendency to form in series; the ends of the tubes are free. This is the *T. serpens* of some authors; but there does not seem any hard and fast line by which *serpens* can be separated from *phalangea*, which also passes into *flabellaris*.

Naples, on *Pinna*, from considerable depth.

93. *Tubulipora incrassata*, D'Orb.

*Tubulipora incrassata*, Smitt, Krit. Fört. öf. Sk. 1866, p. 402, pl. v. figs. 1-7, pl. vi. fig. 1.

The zoöcial tubes are about 0.16 millim., which is smaller than in the northern form.

*Hab.* Arctic Seas generally (*Sm.*).

94. *Diastopora latomarginata*, D'Orb.

(Pl. XXIV. fig. 12.)

*Diastopora latomarginata*, D'Orb. Pal. Franç. p. 827, pl. 758. figs. 10-12.

*Diastopora hyalina*, var. *latomarginata*, Smitt, Krit. Fört. 1866, p. 397.

*Tubulipora complanata*, Menegh. Polipi della fam. dei Tubulip. p. 6.

*Discosparsa complanata*, Heller, Die Bry. des Adriat. p. 122.

?*Diastopora sparsa*, Manzoni, I Bri. foss. del Mioc. d'Austr. ed Ungh. pt. iii, 1877, p. 14, pl. xiii. fig. 51.

Colony orbicular, 10-15 millims. in diameter, with zoöcial tubes, indistinctly radial, short in the centre, very long and raised towards the edge; no adventitious tubuli; zoöcial apertures (*a*) small, not much raised. In the centre is often a small, round or triangular, open space; and from this can be seen that the growth is similar to *Tubulipora flabellaris*; and it might with equal propriety be called *Tubulipora* or *Diastopora*, though, in fact, it would seem most reasonable to call it *T. flabellaris*, var. *latomarginata*. I have specimens confluent; but this is, perhaps, accidental, arising from independent colonies joining.

*Hab.* Arctic Seas (*Sm.*); Adriatic (*H.*); Australia (*D' Orb.*); Naples, deep water.

95. *Diastopora flabellum*, Reuss.

*Diastopora flabellum*, Reuss, Die foss. Poly. der Wien. Tertiärb. p. 51, tab. vii. fig. 9.

*Diastopora flabellum*, Manzoni, I Bri. foss. del Mioc. d'Austr. ed Ungh. pt. iii. p. 14, pl. xiii. fig. 52.

*Diastopora simplex*, Busk (non *D' Orb.*), Crag Polyz. p. 113, tab. xx. fig. 10; id. Mar. Polyz. pt. iii. p. 28, pl. xxix. figs. 3, 4.

?*Diastopora simplex*, Smitt, Krit. Fört. 1864, p. 396, pl. viii. figs. 7, 8.

Although the ends of the zoecia project, I think we are justified in uniting it with *D. simplex*; but that name cannot be retained, as *D' Orbigny* called a fossil *D. simplex*; and although the genus was afterwards changed by him to *Discosparsa*, it would now be *Diastopora* or *Discoporella*.

*Loc.* Miocene: Eisenstadt, Wildon, &c. Pliocene: Crag. Living: Northern Seas (*Sm.*); Britain generally; Naples, 2-6 fathoms.

96. *Diastopora obelia*, Johnst.

*Diastopora obelia*, Busk, Cat. Mar. Polyz. pt. iii. p. 28, pl. xxvi.

*Diastopora obelia*, Heller, Die Bry. des Adr. Meeres, p. 123.

The adventitious tubules are very abundant; in some parts they are as numerous as the zoecia.

*Hab.* Arctic Ocean; Norway, Spitzbergen, Britain, France (*Joliet*); Adriatic, 20-55 fathoms (*H.*); Naples, from 6 fathoms and deeper.

97. *Alecto repens*, Wood.

*Diastopora echinata*, Reuss, Foss. Polyp. des W. T. p. 52, pl. vii. figs. 14, 15.

*Diastopora repens*, Smitt, Krit. Fört. 1866, p. 395.

The zoarium is much raised and inflated, with 3-4 zoecia irregularly arranged. The width of a fully developed branch is 1 millim.; but some branches are thrown off with only one or two cells in a series; and then the branch measures 0.4 millim.

*Loc.* Miocene: Eisenstadt (*Rss.*). Pliocene: Crag, Castrocara (*Manz.*). Living: Scandinavia, Finland, Britain (*B.*); Gulf of Kara (*Sm.*); Naples, 20 fathoms.

98. *Alecto repens*, Wood, var.

Nearly all the specimens of *Terebratula vitrea* which I have seen from the neighbourhood of the Bay had long and very slightly raised colonies of *Alecto*. The zoecia are 1-2-serial, and are rather wider than in the last variety. The

surface is beautifully ornamented with white spots, in the centre of which are the openings of the pore-tubes. In some there is an expansion at the end of the branch; and in these the area of one or two cells is tumid, and the pores in this oecium are much more numerous than in other parts.

For the present I propose to call this var. *vitriensis*; and as it is from much greater depth than the others, it may be only the deep-water form.

As the *Alectos* described in the British-Museum catalogue are not yet in the possession of the Museum, I have been unable to make any comparison with these, but do not see how the species are to be divided by the characters there given.

### 99. *Entalophora proboscidea*, Forbes.

*Entalophora attenuata*, Reuss, Die foss. Anth. und Bry. von Crosaro, p. 74, pl. xxxvi. figs. 1, 2.

In a very large number dredged up in the Secca (Bay of Naples) there are great variations, some being much thicker than others and with more numerous cells; some show rugosity, which apparently depends mostly on age. In many the ends are clavate. The free ends of the zoecia measure about 0·15 millim.

*Loc.* Miocene, Val di Lonte, &c. Shetland seas (*F.*)?; Mediterranean (*M.-Ed.*); Teneriffe and Canaries (*D'Orb.*); Madeira, Adriatic (*H.*); Naples, 40 fathoms, &c. Common.

### 100. *Entalophora deflexa*, Couch.

*Tubulipora deflexa*, Couch, Corn. Fauna, iii. p. 107, pl. xix. fig. 4.

*Pustulopora deflexa*, Johnst. Brit. Zooph. ed. 2, p. 279, pl. xlviii. fig. 5.

*Pustulopora clavata*, Busk, Crag Polyz. p. 107, pl. xvii. fig. 1.

*Pustulopora deflexa*, Heller, Die Bry. des Adriat. p. 125.

*Entalophora deflexa*, Smitt, Floridan Bry. pt. i. p. 11, pl. v. figs. 28-30; Kongl. Svenska Vet.-Ak. Handl. vol. x. 1872.

Zoaria 0·3-0·4 millim. in height. The end of the branch thickens; zoecial tubes freer and smaller (0·08-0·09 millim.) than the last species.

*Loc.* Pliocene: Crag. Living: Cornwall, Plymouth (*Johnst.*); Shetland (*Norm.*); Adriatic (*H.*); Florida (*Sm.*); Naples, shallow water, probably about 2 fathoms.

### 101. *Entalophora rugosa*, D'Orb.

*Entalopora rugosa*, D'Orb. Pal. Franç. p. 795, tab. 754. figs. 18-20.

*Pustulopora rugulosa*, Manz. I Brioz. foss. del Miocene d'Austr. ed Ungh. pt. iii. p. 11, tab. x. fig. 38; Denkschr. Ak. Wiss. Wien, xxxviii. 1877.

*Pustulopora rugosa*, Waters, Bry. from Plioc. of Brucoli, Manch. Geol. Soc. vol. xiv. p. 481, fig. 15.



Zoarium erect, cylindrical, dividing dichotomously several times. Zoecia, tubular projecting cells, the tubes and interspaces usually more or less rugose, surface finely punctured.

The cells are closed after a time by a diaphragm across the tube, about the point where it becomes free.

*Loc.* Chalk, étage 22<sup>e</sup>, as *rugosa*: Vendôme, Trôot (Loir et Cher), Venles (Seine Inf.). Miocene: Kostel, Lapugy, Wildon, St. Nicolai, Gartsenthal, Steinabrunn, Niederleis, Nussdorf, Grussback. Pliocene: Bruceoli (A. W.). Living: Naples, 30–40 fathoms.

### 102. *Hornera frondiculata*, Lamx.

*Hornera frondiculata*, Manzoni, I Bri. del Plioc. di Castrocaro, p. 42, pl. vii. fig. 80; id. I Bri. foss. del Mioc. d'Austr. ed Ungh. p. 8, pl. vi. fig. 22.

*Loc.* Miocene: Austria and Hungary. Pliocene: Castrocaro (M.), Secaux, Doué (Mich.). Crag: Fiearazzi, Bruceoli, Pruma, Gerace, &c. (Sicily). Living: Adriatic, Mediterranean; Naples, 40 fathoms and deeper.

### 103. *Filisarsa tubulosa*, Busk.

*Hornera violacea*, var.  $\beta$ . *tubulosa*, Busk, Cat. of Mar. Polyz. p. 19, pl. xviii. figs. 1, 4.

*Filisarsa*, sp., Manzoni, Bry. du Plioc. de Rhodes, p. 69, pl. iii. fig. 18, a & b; Mém. de la Soc. Géol. de France, 3<sup>e</sup> sér. vol. i. pt. ii.

I am indebted to Mr. A. M. Norman for the sight of a true northern *Hornera violacea*, and see that the present form has hardly any thing in common; but I cannot doubt that it is the var. *tubulosa* of Busk, and therefore retain his specific name. As the museum specimen is not yet returned, I have not had the opportunity of comparison.

The genus *Filisarsa* is, as pointed out by D'Orbigny, intermediate between *Hornera* and *Idmonea*; and somewhat similar forms are known from the European chalk, Miocene, and Pliocene, and also the Australian Tertiaries. I am, however, somewhat in doubt as to whether the genus will permanently stand.

The zoecia, which are only upon the front of the branch, are long and free for a great part of their length; the zoecial tubes are 0.17 millim. in diameter; dorsal surface smooth, with fine punctures; lines of cells and of growth indistinct. Oocidium irregular enlargement of the front of the branch.

*Loc.* Pliocene: Rhodes. This is very common from 40 fathoms in the Bay of Naples; and I am surprised it has not been noticed before from the Mediterranean. In habit it much resembles *Entalophora proboscidea*, and perhaps has been overlooked on that account. If we imagine *E. probosci-*

*dea* with the zoëcia on the front only, we should have the present species.

104. *Discoporella radiata*, Aud. (Pl. XXIV. fig. 11.)

*Melobesia radiata*, Aud. in Sav. Egypte, p. 60, pl. vi. fig. 3.

*Discoporella flosculus*, Hincks, Ann. & Mag. Nat. Hist. ser. 3, vol. ix. p. 468, pl. xvi. fig. 3.

*Discoporella radiata*, Busk, Mar. Polyz. pt. iii. p. 32, pl. xxxiv. fig. 3.

? *Discoporella Houldsworthii*, Busk, *loc. cit.* p. 33, pl. xxx. fig. 4.

*Discoparsa patina*, Heller, Die Bry. des Adr. p. 122.

? *Discocavea aculeata*, D'Orb. Pal. Fr. p. 958, pl. 776. figs. 5, 8.

*Discoporella*, sp., Manz. Bry. du Plioc. de Rhodes, Mém. Soc. Géol. de France, 3<sup>e</sup> sér. vol. i. pt. ii. p. 71, pl. iii. figs. 26, 27.

The peristome of the zoëcial cells is raised on the inner side, and also slightly on the outer. The outer cells are trifid instead of simply acuminate. The cancelli between the rows of cells are formed of ribs connecting the rays, and form an open network.

In most specimens the cancelli appear open; but in well-preserved ones a delicate calcareous cover is found covering the aperture; and this is perforated with about 2–10 holes (fig. 11, *a*). A similar covering is present in a large number of Cyclostomata, but seems to have been overlooked. On the internal walls of the cancelli are delicate hair-like teeth growing from the side. These spines have globular terminations. These occur not only near the surface, but also down the tube; but sometimes near the surface there are as many as six or eight nearly in the same plane (fig. 11, *b*). Similar denticles are to be seen in the British-Museum specimen of *D. Houldsworthii*, Busk; and I have the same in *D. novæ-zelandiæ*, Busk.

The *Defrancia prolifera*, Rss., is composed of coalescent subcolonies resembling *Discoporella radiata*.

*Loc.* Pliocene: Rhodes (Manz.), Brucoli (Sicily). Living: Adriatic, 20–55 fathoms (*H.*), Mediterranean (*B.*), Devon (*Hincks*), ? Calvados (*D'Orb.*); Naples, abundant on *Laurencia papillosa* and other seaweeds from shallow water; Ceylon (as *D. Houldsworthii*).

105. *Discoporella verrucaria*, Fab.

*Discoporella verrucaria*, forma *verrucaria*, Smitt, Krit. Fört. öf. Sk. H.-Bry. 1866, p. 405, pl. x. figs. 6, 8, pl. xi. figs. 1, 6.

I have this adnate as a single disk, and a specimen from the same *Pinna* with two confluent colonies, and have also specimens, growing on Bryozoa and other organisms, irregular in shape with small attachment. The disks are about 6–10 millims. The rays are very distinct and raised; near the

centre they are simply acuminate or trifid, while near the circumference in the quincuncial cells they are trifid. In the centre are three or four tumid areas, with ribs at the edge, forming a row of pores round them. These oöcial swellings often extend among the rays; and the slightly funnel-shaped tubes opening out the oöcium are three times as wide as the zoöcial cells.

This in many respects resembles *D. radiata*. It is not the *D. verrucaria* of Manzoni (Bry. foss. Ital. 4<sup>a</sup> contr. pl. vi. fig. 33), which may be *Diastopora flabellum*.

*Hab.* Arctic seas generally, Novaja Semlja (*Sm.*); Scotland; Naples, 40 fathoms and deeper.

106. *Discoporella hispida*, Flem.

*Loc.* Pliocene: Bruccoli. Living: Scandinavia (*Sm.*); Naples, littoral.

107. *Discoporella mediterranea*, Blainv.

The only two specimens I have are flat on the underside, with a wide attachment. On the upper surface the short rays are raised up in bundles round the circumference. The centre has a thin calcareous papyraceous cover divided into raised irregular and round divisions; at one edge of these cell-like areas there is sometimes a round opening.

I find the front surface so similar to the British-Museum specimen of *Defrancia lucernaria*, Sars, that I am convinced they are very closely allied, and perhaps may be northern and southern varieties.

108. *Radiopora pustulosa*, D'Orb. (Pl. XXIV. fig. 15.)

*Radiopora pustulosa*, D'Orb. Prodr. p. 176; et Pal. Franç. p. 994, pl. 649. figs. 1-4.

Rays uniserial, mouths of cells and cancelli of the same size; peristome of radial cells raised, and acute (*a*) on the inner side (the side nearest the centre of the zoarium); peristome of cells beyond the regular rays trifid (*b*), the centre prong much the longest, cells confluent.

It may also be the *R. simplex* of Busk; but from the small fragment it is difficult to decide. Two specimens appear quite thin, as if only a thin covering; another is 2-4 millims. thick, and the broken surface shows long zoöcial and cancelli-tubes, which, however, in the lower half are divided across the axis by septa, giving this part a somewhat cellular appearance; but no separate layers are distinguishable. The surface of the colony is irregularly raised and depressed, depending

on the substratum; each subcolony is slightly raised, with the rays elevated above the central portion.

*Loc.* Upper Greensand (étage 20<sup>e</sup>), Le Havre, l'île Madame. Living: Naples, brought on a stone with *Gorgonia* &c. which must have come from a depth of over 50 fathoms.

109. *Reticulipora dorsalis*, nov. (Pl. XXIII. figs. 5-11.)

*Reticulipora nummulitorum*, Smitt, Krit. Fört. öf. Sk. 1866, p. 433, pl. ix. D. 1, 2, pl. x. A, B, C.

This elegant species commences as a flat disk, or *Diastopora* stage; soon one or more radiating projections are formed, which become erect foliations (fig. 8), and from which dichotomously and irregularly further foliations spring (fig. 10); sometimes they curve over, and several branches may point in the same direction (fig. 7). There are on both faces of the foliations series of cells, alternate; the series of cells are usually very regular, but occasionally the rows can scarcely be distinguished. The number of zoecia in a series diminishes towards the ends of the branches, which are sometimes quite pointed. The dorsal surface is rounded, with cells immersed, often with faint median ridge; on the dorsal surface all the cells I have examined have a cover with projecting tubule (fig. 5) in the centre; and on other cells they are very frequent. Similar covers are found on many of the Cyclostomata; but, from the constancy on such a species as the present, I doubt if their signification is fully understood. I have not any specimens which could be called reticulate, though the foliations occasionally join; but in the British Museum there is one from Algiers, collected by J. Y. Johnson, as distinctly reticulate as any from the chalk (see fig. 9).

This Algerian specimen is first a wide irregular *Diastopora* from which a wide foliation grows. This resembles the fossil from the Pliocene of Bruccoli which I called *Mesenteripora*, sp. The mode in which it develops in the perfect stage (fig. 9) is not shown; but, as far as I have had the opportunity of examining this, it appears to be the same as the Naples species, though growing somewhat differently.

This is closely allied to *Reticulipora nummulitorum*, D'Orb., *R. papyracea*, D'Orb., and *Idmonea compressa*, Rss. & Manzoni; but the dorsal surface distinguishes it.

The calcareous septum distinguishes it from *Idmonea*; but I am not sure that it should not be united to *Mesenteripora*. At one time I thought it was a variety of *M. meandrina*; but this was upon insufficient grounds.

Fig. 6 is the end *a* of fig. 7, more magnified. Fig. 11 shows a transverse section.

110. *Fron dipora verrucosa*, Lamx.  
(Pl. XXIV. figs. 1-7.)

*Madrépore rameux* &c., Marsigli, Hist. Ph. de la Mer, p. 150, pl. xxxiv. figs. 165, 166.

*Krustensterne verrucosa*, Lamx. Expos. Méth. p. 41, pl. lxxiv. figs. 10-13 (juv.), pl. xxvi. fig. 5.

*Fron dipora reticulata*, Blainv. Man. d'Actin. p. 406, pl. lxix. fig. 1; Smitt, loc. cit. 1866, var.  $\alpha$  and  $\beta$ ; Busk, Mar. Polyz. pt. iii. p. 38, pl. xxi.

*Fron dipora verrucosa*, Busk, loc. cit. p. 39.

?*Fron dipora Marsiglii*, Mich. Icon. Zooph. p. 68, pl. xiv. fig. 4.

Fig. 7 represents a colony growing on a shell. It is about 2 inches high and 3 wide. There is first an irregular expansion; and then a cup has been formed (of which the detailed irregularities are not shown); and it is specially noteworthy that the poriferous face is on the outside, whereas in *Retepora* it is inside. This same mode of growth is also exhibited in a somewhat less perfect specimen; but it is not quite clear how it takes place, since in the young (figs. 4, 5, 6) the poriferous face is seen to be internal (in figs. 4 and 5 the top should be shown flatter).

This is the common Mediterranean species; but when worn the fasciculi appear confluent, and ultimately the whole surface seems poriferous; and from my specimens I do not doubt that *F. reticulata* and *verrucosa* are the same.

The young colonies are in some stages much like the *Fasciculipora ramosa*, D'Orb.; and it appears very probable that many species and some genera have been formed from the young of this and allied groups, though of course the complete growth of one genus may resemble the young of another.

*Fungella*, Hag., looks like a young stage; and *Fungella trifida*, Busk, from the Crag, resembles a stage a little younger than figs. 4 and 5.

Near the base the surface is marked with "hexagonal areolæ," while the rest of the surface is striated and finely punctured.

#### CTENOSTOMATA.

111. *Pherusa tubulosa*, Ell. & Sol. (Pl. XXIV. figs. 13, 14.)

*Flustra tubulosa*, Ellis & Sol. Nat. Hist. of Zooph. p. 17. no. 11.

*Pherusa tubulosa*, Lamx. Hist. des Polyp. p. 119, pl. ii. fig. 1, et Expos. Méth. p. 3, pl. lxiv. figs. 12-14.

*Pherusa tubulosa*, Heller, Die Bry. des Adriat. p. 93.

The membranous zoaria grow as flexible fronds, usually erect, but also decumbent, forming an orbicular lobed expansion in the centre of which grow other fronds. The ends of the zoecia are raised; and when the polypide is withdrawn the end appears quadrangular; when the polypide is exerted,

the tube is much lengthened by the sheath of the polypide, which is continuous with the outer cover. The tentacles are numerous, thirty to forty. This species being semitransparent, the position of the polypides can be seen, as figured; and it would probably well repay physiological examination in detail.

*Hab.* Dominica (*Ell.*); Brazil; Archipel de la Chine (*Tilesius?*, teste *Lamour.*); Adriatic (*Hell.*); Naples, on seaweed, from slight depths, rare.

There is a specimen in the British Museum with similar zoëcia; but the fronds are narrow, as in *Flustra truncata*. As my attention was directed to calcareous forms, I have but few Ctenostomata, and am not in a position to discuss that group.

*Zoobotryon pellucidus*, Ehr., has been found in great abundance in the Bay; but during my stay none was brought in. The *Entoprocta* from Naples have been physiologically studied by Nitsche and others; *Pedicellina echinata* is not uncommon; of *Loxosoma* four species (*Kefersteini*, Clap.; *alata*, Barr.; *raja*, O. Sch.; *neapolitana*, Kow.) are known from the Bay.

Since writing Part I., I have found among the material brought home:—112. *Lepralia Hyndmanni*; 113. *Caberea Boryi*, Aud.

Although the total number is now large, I am convinced it could be most materially increased; for when I was in Naples I had none of the most important works to refer to, and was not sufficiently acquainted with the Bryozoan characters; consequently doubtless many species escaped my attention. And a collection made in one winter would of necessity be imperfect; for forms sometimes abundant, at others are not met with.

The wide distribution of many species must strike any one making careful comparison—and also the large number which occur fossil, not only in the younger Tertiaries, but also in the Miocene and Eocene. Within a day's row from Naples there is no water deeper than 40 fathoms; but at this depth in the Secca the dredge came up full of sponges, *Holothuria*, &c., and a great number of Bryozoa, mostly *Hornera*, *Idmonea*, *Entalophora*, and *Eschara*. These apparently resemble in facies the fauna found in most places at a greater depth. And this is of great importance geologically; for the conclusion seems to be that, in a closed sea like the Mediterranean, where there is no tide, these animals can flourish at a less depth than they would with more disturbance of the water. It is therefore not justifiable to conclude that, where a plentiful fossil Bryozoan fauna occurs, of necessity the depth was very great.

This paper has become much longer than was intended, and I must not add to it a long list of friends to whom I am indebted for assistance; but I cannot close without specially thanking Dr. Hugo Eisig, the acting director of Dr. Dohrn's Aquarium, whose knowledge of the locality and constant kindness enabled me in a short time to collect material for the present communication.

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XXXII.—On a new Genus of *Pycnogon* and a Variety of *Pycnogonum littorale* from Japan. By HENRY H. SLATER, B.A., F.Z.S.

By the kindness of Dr. Günther I have recently been enabled to examine all the *Pycnogonoidea* in the British Museum; and he has also been good enough to permit me to describe two species from Japan, which form part of the collection.

The first is a remarkable one allied to *Zetes* (Kröyer), but possessing distinct generic characters. It was recognized by Mr. Miers, of the Zoological Department, as new, and was provisionally named by him *Parazetes*, which name I gladly adopt.

PARAZETES, Slater, gen. nov.

Corpus gracile. Rostrum pedunculatum, ad basim valde constrictum, ad apicem paulatim attenuatum. Appendices primæ biarticulatæ, non cheliformes; secundæ 9-articulatæ, pedibus ovigeris 10-articulatis. Segmentum primum corporis processum tenuem, quasi collum, usque ad rostrum antice provehens. Abdomen clavatum.

Body slender; rostrum pedunculated, broad in the centre, gently decreasing in diameter towards its distal extremity, which is minutely four-cleft; first pair of appendages (maxillipeds) 2-jointed, not chelate; second pair (palpi) 9-jointed; ovigerous legs 10-jointed; first (cephalic) segment sending forward a long slender neck-like process towards the rostrum, on the middle of which the oculiferous tubercle is seated; legs smooth and slender.

*Parazetes auchenicus*, Slater, n. sp.

Animal slender; rostrum resembling that of *Zetes* (Kröyer in Gaim. Voy. en Scand. Lap. &c. Crust. pl. 38. fig. 1 a-g), fusiform; it also hangs down in the same manner as that of *Zetes* (ib. fig. 1, b), but is distinctly four-cleft at its apex—a

peculiarity, as far as I know, hitherto unknown amongst Pycnogons.

The first segment is produced into a sort of long neck, upon which the three pairs of appendages and the oculiferous tubercle are placed.

The appendages of the first pair (maxillipeds) arise from the end of the "neck," close to the base of the rostrum; they are short (1.45 millim.); and their terminal joint is a roundish knob, as in the genus *Achelia*.

Those of the second pair (palpi to the first) are long and slender, 9-jointed, and nearly 6 millims. in length; they arise from two tubercles at opposite sides of the "neck," and near its distal end; their third and fifth joints are much the longest, the first, second, and sixth much the shortest, the fourth and three terminal joints being nearly equal, and each about half the length of the third; the last three joints have a fringe of stiff hairs on their outer side: these hairs are curious as being of two thicknesses, the terminal third of each hair being only about half as thick as the basal part; there are also on the fifth joint a few long bristles which are similarly formed. I have not noticed any thing of the kind in any other genus.

The ovigerous legs are 10-jointed, slender, and about the same length as the palpi; they arise near the bottom of the "neck;" the four joints preceding the terminal claw have a fringe of beautifully denticulated spines; these, with the bristles just mentioned of the palpi, are the only hairs or spines on the animal.

The abdomen is of moderate length and clavate, its least diameter being at its middle.

Colour in spirit is pale straw.

The one specimen, from which I have taken my description, was dredged by Capt. St. John off Cape Sima, Japan; depth not mentioned; bottom, sand and broken shells; date 1873. Presented to the British Museum by J. Gwyn Jeffreys, Esq., and numbered in the Catalogue 73. 28.

#### Measurements.

	millim.
Rostrum (including constricted portion) to where it joins the "neck" . . . . .	3.5
Quasi-neck, to insertion of first pair of legs . . . . .	3.5
Abdomen, length of . . . . .	1.35
Total length . . . . .	11
Breadth of body at second pair of legs . . . . .	3
Length of leg of second pair . . . . .	16
Total breadth (16+16+3) . . . . .	35

This genus comes pretty near to *Zetes* as figured by Kröyer (*loc. cit.*); but if *Zetes* is there correctly represented, there are



certain very material differences. In *Zetes* the fusiform rostrum is connected with the cephalic segment by a joint, so that the rostrum may be said to be two-jointed; in *Parazetes* no joint intervenes; in the latter the rostrum is directly united to the long neck-like process of the first segment by its own constricted base. In *Zetes* the maxillipeds (first pair of appendages) are four-jointed and chelate, in *Parazetes* two-jointed and not chelate. The palpi in *Zetes* have ten joints, in *Parazetes* nine. In *Zetes* the abdomen is two-jointed and furnished at the articulation with four long serrated spines; in *Parazetes* it is one-jointed, clavate, and without appendages. In *Zetes* the spines of the ovigerous legs are slightly serrated, in *Parazetes* deeply "runcinate;" and *Parazetes* has the apex of the rostrum four-chefed; *Zetes* has not.

*Pycnogonum littorale* (Fabr.), var. *tenuë*, Slater.

This is a very interesting Japanese variety of the common *Pycnogonum littorale*, which is equally common on the east and west sides of the North Atlantic from 40° northwards.

It is of a much slenderer build than the ordinary *P. littorale*, the rostrum longer in proportion and not nearly so broad, the body less flat and shield-like, the leg-bearing lateral processes with considerable spaces between them, there being little or none in *P. littorale*; the oculiferous tubercle more prominent, and the eyes larger; the row of tubercles down the median line of the dorsal surface much longer, not so sharply pointed, and somewhat scabrous, as is also the abdomen.

Legs longer and slenderer, the fourth joint equal to the first three in length (in *P. littorale* equal to the second and third), and with the prominences less marked; the rest of the leg as in *P. littorale*, except that the spines in var. *tenuë* are somewhat longer.

I subjoin the measurements as compared with a British specimen of about the same size.

	<i>P. littorale.</i> millim.	Var. <i>tenuë.</i> millim.
Length of rostrum .....	3	3·5
Length of body from base of rostrum....	7	6
Length of leg .....	9	9
Breadth of body without leg .....	4·15	3·5
Total breadth .....	22·15	21·5

Colour, in spirit, dirty yellow.

Dredged by Capt. St. John off South-west Japan (33° 15' N., 129° 18' E.), July 1876. Presented to the British Museum by J. Gwyn Jeffreys, Esq., and numbered in Catalogue 78. 11.

XXXIII.—*Contributions to our Knowledge of the Spongida.*  
By H. J. CARTER, F.R.S. &c.

[Plates XXV.-XXVII.]

THE following contributions to our knowledge of the Spongida consist of more or less illustrated descriptions of nineteen new species taken from one wet and eighteen dry specimens, together with the types of two new groups of flesh-spicules (viz. *Spinispirula* and *Sceptrella*) and a few of their varieties respectively.

Although the spiculation in most instances is exquisitely beautiful, as may be seen by the representations in the Plates, yet the soft parts of only one species, viz. *Axos spinipoculum*, from Australia, which was taken alive and immediately put into preservative fluid, have admitted description and delineation, whereby, however, not only features of unusual interest have been elucidated, but additional testimony afforded of how much more is to be gained by dissecting a specimen in this condition than after desiccation.

As regards the measurement of sponge-spicules, it should be remembered that they must be small before they can be large, and that therefore, as they are successively developed, there must be all sizes present; further, that the spicule generally loses in length what it gains in thickness, so that, in the matured forms, the thicker are shorter than the more slender ones; and, lastly, that the maximum size may differ with the specimen. Hence my measurements are taken from the *average* largest size in all respects of the specimen examined, and therefore can only be considered approximate.

In the matter of form, too, the terms "gradually" and "abruptly," applied to the pointing of the spicule, mean that in the former case it is gradual and in the latter sudden.

HOLORHAPHIDOTA, Cart.

Family 2. Suberitida, Cart.

Genus AXOS, Gray (1867).

In 1864 Dr. Bowerbank (*Mon. Brit. Spongiadæ*, vol. i. pl. x. fig. 197) gave a representation of a spicule which, at p. 260 (*ib.*), is stated to have come from a "very beautiful branching sponge from Nicol Bay, Australia," sent to him by Mr. George Clifton of Freemantle. To this sponge Dr. Gray, in 1867 (*Proc. Zool. Soc.* May 9, p. 546), gave the name of *Axos Cliftoni*, together with a short description of

the flesh-spicule *only*. In 1870, Mr. Clifton wrote from Portland (Engl.) to Dr. Gray concerning this sponge (I possess the note) as follows:—"Some I dredged up; and others I secured on the beach after heavy gales. They are very common, and in some instances are over 6 feet in length, and when alive of a bright red colour." Finally, in 1873 (Proc. Zool. Soc. p. 321, pl. xxix.), Dr. Bowerbank gave a description, with most accurate illustrations, of this sponge (having been drawn on stone by his faithful artist, the late Mr. Lens Aldous), under the name of *Dictyocylindrus dentatus*; but as Dr. Gray's name of *Axos Cliftoni* is more applicable than *Dictyocylindrus*, Bk., to the nature and structure of the sponge (simply because it is not a *Dictyocylindrus*, Bk.\*), and possesses the priority of half a dozen years, I shall adopt Dr. Gray's name as the generic appellation of those new species which I am about to describe. But before doing this it is desirable, for comparison, that I should briefly allude to the figures of the skeleton and flesh-spicules respectively of *Axos Cliftoni* in the dried state (Pl. XXVI. figs. 5, 6, a-c).

Thus the skeleton-spicule (fig. 5) is long, acute, smooth, curved and sharp-pointed, 1-360th by 1-1800th inch in its greatest dimensions; and the flesh-spicule (fig. 6, a), which is stelliform and crucially sexradiate, has, when fully developed, a globular body surrounded by six thick short arms, equidistant from each other, and each arm terminated by four or more comparatively large spines, or with the arms thinner, expanded at their point of union in the centre, and terminated respectively at their free ends by a globular head, which is microspined (fig. 6, b)—both originating in small, simple, smooth-armed, sexradiate stars (fig. 6, c), from which every grade of development may be traced to the first-described form, which, in size, is 1-1200th inch in diameter, and, so far as is known, as remarkable as it is unique in figure.

*Axos flabelliformis*, n. sp. (Pl. XXVI. figs. 1-4.)

Flabelliform, plicate, papyraceous, sessile, aculeated over the surface, especially on the margin, which is undulating,

\* The applicability of Dr. Gray's name in other respects may be learned from the following prefatory paragraph taken from his proposed arrangement of the Spongida, viz.:—"I may state that many of the names used for the genera have no derivations, but are mere fortuitous combinations of letters; so that compilers of indices of genera need not attempt to find derivations for them, or to correct the formation of some of them, as being more consistent with the derivations they may gratuitously assign to them, as has been done with some generic names of the same kind by Agassiz and others." (Gray, "Notes on the Arrangement of Sponges," P. Z. S., May 9, 1867, p. 500.)

convex, and plicate longitudinally. Colour white. Texture cork-like. Surface extremely irregular and pitted, which pits, in many parts, would be open fenestrations but for being tympanized with sarcode; thickly aculeated throughout (Pl. XXVI. fig. 1). Internal structure cellular or cavernous, influenced in the form of its cavities by the presence of a reticulated, anastomosing framework composed of a condensed sarcode (? chondroid when fresh) charged with skeleton-spicules, which extends into and forms the axial part of the spines respectively. Spicules of two kinds, viz.:—1, skeleton-, acute, smooth, sharp-pointed, 1-66th by 1-3000th inch in its greatest diameter (fig. 2); and 2, flesh-spicule, stelliform, crucially sexradiate, with the rays short and expanded at their point of union in the centre; globular and microspined at their free ends; size about 1-1714th inch in diameter (fig. 3). Skeleton-spicules chiefly confined to the framework and the flesh-spicules to the surface-layer on each side. Size of entire specimen  $4\frac{3}{4}$  inches high,  $4\frac{1}{2}$  inches wide, and papyraceous in thinness, except where thickened by the presence of the fibre composing the "framework."

*Hab.* Marine.

*Loc.* ? Australia.

*Obs.* Examined in the dried state. This specimen is in the British Museum, and, from possessing no number, must have been there for many years before the present "Register" was commenced. It bears the letter "c," and now has attached to it in addition my running-number, viz. 212, E, h, 20. The specimen is complete so far as the base or point of attachment and the circumference are concerned; while from the generally aculeated surface, form, texture, and spiculation, it may be seen to be chiefly allied to *Axos Cliftoni*; but the colour now is white or brownish, as it is in dried specimens of *Axos Cliftoni*, although in the fresh state it might have been "light red" like the latter as stated by Mr. Clifton.

*Axos spinipoculum*, n. sp. (Pl. XXV. figs. 1-9.)

Globo-cylindrical, oblong, massive, robust, thick, cup-shaped, excavated, sessile (Pl. XXV. fig. 1). Colour dark grey externally, whitish yellow within. Texture subcartilaginous and spongy respectively. Surface extremely irregular, deeply pitted here and there; thickly aculeated over the outside, less so over the surface of the excavation, which is deep, conical, and compressed. Aculeations short, thick, and stout, irregularly distributed, sometimes sharp-pointed, at others obtuse. Vents opening over the lower third of the outside, through simple holes in cribriform patches, chiefly in deep depressions

between the aculeations, the "patches" overlying a larger cavity beneath, into which many excretory canals may open; or opening singly into the bottom of an excavation. Internal structure composed of dense, soft, spongy or areolar sarcode of a yellowish-white colour, charged with spicules, and probably bearing the spongozoa (fig. 4, *aa*), traversed by the fibrous skeleton of the sponge (fig. 4, *b*) and branches of the excretory canal-system (fig. 4, *e*), altogether defined outwardly by a tough transparent cortex (fig. 4, *cc*). Areolar sarcode filling up the interstices of the fibroskeleton, whose larger branches, being composed of chondroid substance charged exclusively with the linear spicules (fig. 2) arranged longitudinally, contrast strongly from their transparency with the opaque yellowish-white colour of the areolar sarcode, which they permeate in all directions, finally terminating in the aculeations of the surface (fig. 4, *dd*), where they are covered by the cortex thinning out towards their extremities. The dark grey cortical layer, which, on its part, also contrasts strongly in translucency and homogeneous appearance with the yellowish-white areolar sarcode which it limits towards the surface, is 1-24th inch thick, composed of wavy parallel fibres about 1-6000th inch in diameter (fig. 7, *a*), arranged horizontally, and traversed by a minute white tubular (?) reticulation (fig. 7, *b*), which appears to pass inwardly into vertical lines (fig. 7, *c*), altogether indicative of pore-tubulation opening into the subdermal cavities; wavy parallel fibres, when teased out, often presenting an attenuated extremity (fig. 8), and found to be composed of extremely fine fibrillæ (fig. 8, *a*). Excretory canals furnished with transverse circular folds like the *valvulæ conniventes* of the small intestine, often uniting into a *rugæ*-reticulation (fig. 5, *cc*); composed of three coats, viz. an inner, a middle, and an outer coat (viewing the surface of the canal as the outside); the inner coat consisting of wavy, parallel, translucent fibres, like those of the cortex, arranged longitudinally and in contact with the areolar sarcode (fig. 6, *aaa*); the middle coat consisting of the same kind of fibres arranged transversely or circularly upon the last, and confined to the folds of the *rugæ* (fig. 6, *bbb*); and the outer coat of a mucous layer of cells and granular material (fig. 9), the cells in form frequently resembling those of the spongozoa, but now without the presence of the cilium (fig. 9, *a*). The longitudinal appear to be a little larger than the transverse fibres (that is, about as 1-6000th to 1-9000th of an inch in diameter), both being compounded of extremely fine fibrillæ like those of the cortex (fig. 8, *a*), of whose ultimate form I am ignorant; while the outer or epithelial layer, being apparently composed

of mucus *only*, suspending and holding together a number of cells and granular material, thus contrasts strongly with the fibre-layer beneath. It should also be observed that this layer is *exclusively* charged with the flesh-spicules (fig. 3). Spicules of two kinds, viz. :—1, skeleton-, long, more or less straight, acuate, smooth, more or less abruptly sharp-pointed, 1-92nd inch long, by 1-4000th inch broad in the centre, which is slightly larger than the blunt end (fig. 2) ; 2, flesh-spicule, consisting of a straight shaft, spined at each end and in the centre ; spines mostly recurved at the ends of the shaft, but often projecting in various directions, the terminal one frequently in a line with the shaft and the lateral ones recurved, thus hastiform (fig. 3, *a*), distributed generally about the centre of the shaft irregularly, but frequently aggregated into two circlets situated at equal distances from each other and the extremities (fig. 3) ; shaft, exclusive of the spines, about 1-375th inch long by 1-9000th inch broad. Skeleton-spicules chiefly confined to the chondroid fibrous skeleton ; flesh-spicules to the epithelial layer on the surface of the excretory canals ; both equally mixed in the areolar sarcode. Size of entire specimen  $5\frac{3}{4}$  inches high, 4 inches in diameter at the upper or free end, 2 inches in diameter at the lower or fixed end ; excavation conical,  $3\frac{1}{2}$  inches deep ; orifice compressed, elliptical, elongate, 2 inches by  $\frac{7}{12}$  inch in its greatest diameters. Thus the wall at the brim is an inch thick ; and increasing downwards, in accordance with the conical form of the excavation, just below the latter the sponge becomes at least 4 inches in diameter, continuing thus solid to the base. Hence the great general solidity and thickness characteristic of this sponge. The photographed representation, which has been lithographed (fig. 1), is about 4-6ths of the natural size.

*Hab.* Marine, on hard objects (fig. 1, *a a*).

*Loc.* Australia, Port Jackson.

*Obs.* Examined in the wet state. This remarkable sponge, now bearing the no. "619," came, as just stated, from Port Jackson, in Australia, and was presented to the British Museum by the late J. B. Jukes, Esq. It appears, from its present state, to have always been preserved in spirit as it now is, and thus rendered more satisfactory for examination than if it had been previously dried ; for such is the difference between a sponge taken alive, immediately placed in spirit and kept in this state, and one that has been dried, that, for the most part, it may be fairly stated to lose more than one third of its natural characters by the latter method of preservation ; while if it has been worn away by the action of the

waves, and washed about on a beach, perhaps for years, before it is picked up for our museums, as most of the sponges in our collections are and must necessarily be from their inaccessible habitations, it may be easily conceived how unsatisfactory species-descriptions of a great number of specimens must indefinitely remain.

The rigid, aculeated surface, the soft opaque granular character of the areolar sarcode, the hard chondroid tissue of the fibro-skeleton, and the spiculation generally, although slightly modified in form, ally this sponge equally to *Axos Cliftoni* and *A. flabelliformis*, while the thick fibrous cortex and general solidity of the body constitute differences as great as they are peculiarly characteristic, so far as is known, of *Axos spinipoculum*.

The colour of the surface is now dark grey, as above stated, while that of *A. Cliftoni* and *A. flabelliformis* in the dried state respectively is white; but as Mr. Clifton has observed that "when alive" the former is "light red," this also may have been the case with *A. spinipoculum*; for it is worthy of notice that *Donatia* (olim *Tethya*) *lyncurium*, whose general structure and chondroid cortex closely resemble those of *A. spinipoculum*, is also light or orange red when alive, whether the specimen be British, Cape, or Australian, but loses this colour and becomes white or grey when dried or kept in spirit.

We thus analogically meet with the chondroid cortex of *A. spinipoculum*, so far as its cartilaginous nature goes, in *Donatia lyncurium*, which is also so nearly allied to the genus *Axos* in most other respects, that it seems necessary to place the latter in a neighbouring group. When portions of *A. spinipoculum* are dried, the cortex and skeleton assume the consistence and colour of dried glue, which is just the case with *Donatia lyncurium* under similar circumstances.

Nor should the striking likeness that exists between the aculeated surface of *A. spinipoculum* and the coarser forms of *Hircinia* pass unmentioned, from which, until the former is minutely examined, it might be very easily taken for the latter.

Another very striking character presents itself in the canals of the excretory system in *A. spinipoculum*, by which they are immediately distinguished from the branches of the chondroid skeleton in the midst of the areolar sarcode, viz. the transverse folds or *rugæ*, already described, which, but for the means of touching the branches (say with the point of a needle) when a section of the sponge is examined under water, would be sure to be taken for branched canals through

optical delusion, so transparent is the cartilage against its point of contact with the opaque areolar sarcode.

These "folds" and the composition generally of the "coats" of the canals forming the excretory system are well worth attention. In the first place, when at most only 1-48th of an inch in diameter (fig. 4, *e*), they may, with a common lens, be seen to commence in the subdermal cavities (that is, just inside the cortex), and, joining each other, thus to become enlarged and finally terminate in the vents above mentioned; while if the "vertical lines" of the fine reticulation which is seen in the translucent cortex under water (fig. 7, *c*) are pore-tubes, as above suggested, which extend from the pores themselves on the surface to subdermal cavities as in other sponges, corresponding to those of the "investing membrane" of *Spongilla* ('Annals,' 1857, vol. xx. p. 25, pl. i. figs. 1, *b b*, "Ultimate Structure of *Spongilla*"), then I have already figured and described an excretory canal commencing in this way with the same kind of "folds" in *Greyella cyathophora* ('Annals,' 1869, vol. iv. pp. 192, 193, pl. vii. fig. 5, &c.).

It may be questionable how far the longitudinal and transverse fibres of the excretory canal, together with those of the cortex, may not be the same—and the whole, bundles of muscular fibrillæ; for the fibres lie parallel to each other, and are not united as in "elastic tissue."

Lastly, it may be conjectured that the cells of which the mucous layer or epithelium is composed were once monociliated, and that, when living, the action of the cilia was to propel the contents brought in through the pores &c. towards the vents respectively, so as to keep up that aqueous circulation which appears, while it brings in nourishment, to be also the process by which the respiratory and excretory functions of the sponge are accomplished.

The cribriform patches of vents overlying a large cavity; which is the combined end of several excretory canals below, also seems to indicate that this arrangement was for the better closing of these vents—which in *Spongilla* I have shown to be the case, for a while, after taking food ("Ultimate Structure," *op. et tom. cit.* p. 30). We may assume this also from the diaphragm sphincter of transparent sarcodes often present and half-closed in the vents of the excretory canals of many sponges. As a necessary consequence, this should be attended by a closure of the pores also; and this, too, has been demonstrated in *Spongilla* (*loc. cit.*).

How delicate and transparent must be the muscular fibrillæ in these diaphragms, if such should exist here! and who can doubt it when observing the form and transparency of the



infusorium *Euplotes*, whose legs, being as numerous and active as those of a crab, must have their moving powers all regulated by similar contrivances? yet we might as well look for these as the structure in glass! To assume that such fibrillæ do not exist because they are not appreciable by our senses is to assume that the finite can comprehend the infinite.

Of course I can say nothing of the "ampullaceous sacs," which are made up of the spongozoa ("Ultimate Structure of *Spongilla*," 1857, *loc. cit.*), the "*Wimperkörbe*" and "*Geisselkammern*" of the Germans, as these delicate parts have long since passed out of sight with the freshness of the sponge; but it is desirable to state here that Dr. F. E. Schulze, in a preeminent paper on the recent species of *Spongelia*, *Nardo apud Schmidt* (Spong. Adriat. Mceres, 1862, p. 28, = *Dysidea*, Johnston), has observed that the ultimate branches of the porctubulation open through numerous small holes or fissures into the ampullaceous sac (*Geisselkammer*), and that the latter, on the other hand, opens by one large one into the excretory canal (*Zeitschrift f. wiss. Zool.* 1878, Bd. xxxii. p. 134). This is somewhat different from what I have stated of *Spongilla* in 1857 (*op. et tom. cit.* p. 27, &c.), and may be more to the purpose; at the same time, as it is so easy to grow the young *Spongilla* from the seed-like body in a watch-glass, and, feeding it with carmine, to observe what takes place with a high power ( $\frac{1}{4}$ -inch objective), immersed, it would be desirable, since Dr. Schulze's description, although taken in part from living specimens, was not made under the same circumstances, to repeat the observations on *Spongilla* in the way that I have described (*loc. cit.*), always remembering that the soft parts of a sponge, being in their active state, ever changing in form like the *Amœba*, can apparently extemporize an aperture or close it, temporarily or permanently, wherever required. Dr. Schulze's paper and drawings are alike admirable, and the lithographed photographs a model for all time in the matter of sponge-representation.

Lastly, I would direct attention to the typical form given of the flesh-spicule of *Axos spinipoculum*, as a variety of that group which I propose to describe and illustrate hereafter under the name of "*Sceptrella*."

## ECHINONEMATA, Cart.

### Family 1. Ectyonida, Cart.

#### Genus TRIKENTRION, Ehlers.

In 1864, Dr. Bowerbank (*Mon. Brit. Spongiadæ*, vol. i.

p. 267, pl. x. fig. 234) gave a representation of a quadriradiate spicule, which is described as a specimen of a "spiculated inequiangulated triradiate" (?spined inequiangulated quadriradiate) spicule, with "cylindrical entirely spined radii" (?chiefly terminally spined), from "*Dictyocylindrus Vickersii*, Bk. MS." In 1877, Mr. T. Higgin, F.L.S. ('Annals,' vol. xix. p. 296, pl. xiv. figs. 9, 10), represented the same kind of quadriradiate accompanied by an acute spicule, which he found in small quantity on the piece of rock supporting his *Higginsia coralloides*, which was brought from the West Indies. To this I alluded ('Annals,' 1876, vol. xviii. p. 391), from a mounted specimen kindly sent me by Mr. Higgin. In 1878 I found, in the late Dr. Bowerbank's collection, a fragment of the sponge from which his figured spicule was probably obtained, with the following label on it, viz. "*Dictyocylindrus Vickersii*, West Indies;" but as the rest of the spiculation, together with the sponge itself, has never been described or illustrated, I now propose to do this from the fragment mentioned under Dr. Bowerbank's name, which, so far as the characters of his genus *Dictyocylindrus* (Mon. Brit. Spong. vol. ii. p. 6, type *D. hispidus*, Bk., = *Raspalia*, Schmidt) go, is well-chosen.

*Dictyocylindrus Vickersii*, Bk. (Pl. XXVII. figs. 5-8.)

Fragment thick, triangular, wedge-shaped, composed of branched columnar structure, radiating from the inner angle, indicative of its having been broken out of a convex radiated mass (Pl. XXVII. fig. 5); columns hollow, tubular, smooth within and rough without, wherein the spicules are implanted (fig. 8); branches terminating in lacinulated heads, which, in juxtaposition, form the convex or outer surface. Colour now black-brown. Texture loose, hollow, columnar, not fibrous. Surface of the columns setose from the projection of the long spicule (fig. 8, *a*). Wall of columns composed of dark brown arcolar sarcode, charged, on the *outside*, with the spicules of the species. Spicules of four different forms, viz. :—1, long, setose, acute, smooth, slightly curved, sharp-pointed, 1-14th by 1-1800th inch in its greatest diameter (fig. 6, *a*); 2, short, thick, acute, smooth, slightly curved, towards the blunt end chiefly, sharp-pointed, 1-45th by 1-900th inch (fig. 6, *b*); 3, fine, acute, irregularly undulating, smooth, slightly inflated in the centre, sharp-pointed, 1-51st inch long and of extreme thinness (fig. 6, *c*); 4, echinating spicule, quadriradiate, arms cylindrical, more or less obtuse, for the most part equal in length, and radiating at nearly equal angles from each other, each spined, chiefly over the free extremity, about 1-360th

inch long by 1-1800th broad, the echinating arm a little longer than the rest, sharper, and standing out from the others at a greater angle (fig. 6, *d*, and fig. 7). Nos. 1 and 2 project obliquely upwards and outwards from the surface; no. 3 is sparsely mixed among them, and no. 4 very plentifully distributed about their fixed ends (fig. 8, *a, b, c, d*). No. 4 also is often quinquerradiate (fig. 6, *e*), and as often presents itself under the form of three- and four- smooth-armed radiates whose rays are sharp-pointed (fig. 6, *f, g*). Size of fragment about 1 inch long in the direction of the radiated structure (that is, vertically), and  $\frac{1}{4}$  inch thick.

*Hab.* Marine.

*Loc.* West Indies.

*Obs.* Examined in the dried state. From the dirty and insignificant appearance of this fragment, which appears to represent the total vertical thickness of the sponge, it is not improbable that, growing on rocks in shallow muddy water in the form of a crust with plane and unbranched surface, it has often been overlooked. Nevertheless, from the above description, it is evidently very desirable that better specimens of it should be obtained; for being one of the Echinonemata in which *radiate* spicules at once like those of *Pachastrella* and those of the Calcispongiaë are present, it is important that this fact should be made public, as the two following sponges are, in spiculation, allied to it, and all might be confounded, in the fossil state, with the Calcispongiaë, if the latter were *alone* supposed to contain the triradiate and quadriradiate spicules, as Mr. Sollas's illustrations and descriptions of his fossil genus "*Catagma*" show ('Annals,' 1878, vol. ii. p. 353, &c.).

The splitting-up or subdivision of the columnar structure towards the surface into lacinulated heads is a common feature of *Dictyocylindrus*, but not less characteristic of the surface of many of the Echinonemata, where the projecting lacinula may vary in form from flat to round, being frequently spatulate or tongue-shaped with a caudate extremity.

*Trikenrion muricatum*, Ehlers, 1870.

(Pl. XXVII. fig. 13.)

In 1756 Pallas (Elench. Zoophytorum, p. 389. no. 237) described this sponge under the name of *Spongia muricata*, stating, on the authority of Seba, that it comes from "Guinea." In 1794 Esper (Die Pflanzenthierie &c. pl. 3) figured and described it under the same name from a specimen now in the museum at Erlangen, which, after microscopic examination, Dr. Ehlers, in 1870, considered it desirable to distinguish

by the generic name of "*Trikentrion*" (Esper'schen Spongien &c. in der zool. Samml. der k. Universität Erlangen). Finally, Mr. Sollas, in January last, published an account of it from a specimen in the Bristol Museum, under the name of *Plectronella papillosa*, as "a new Genus and Species of Echinonematous Sponge" ('Annals,' 1879, vol. iii. p. 17, pls. iv.-vi.).

Of this sponge there are several specimens in the British Museum, whose spiculation consists of tufts of smooth, curved, acerate spicules attached to indistinct or ill-defined fibre, echinated with triradiate spicules, one of whose arms is cylindrical, obtuse, spined especially over the free end, and three times the length of either of the other two, which are comparatively short, smooth, sharp-pointed, and fixed in the sarcode, the long, spined arm being the echinating one (Pl. XXVII. fig. 13, *a, b, c, d*).

All the specimens come from the western coast of Africa; and each bears my running no. 252, D, *h, 1*, also respectively the nos. 31 *a*, 41. 5. 13. 37, and 72. 10. 9. 1, to the last of which is added "Volta, Fantee, presented by Governor Ussher." With them will be found another but much smaller sponge, numbered 252 *a*, D, *h, 2*, and 48. 10. 4. 6, which, differing from the foregoing in spiculation and general form, though also from the west coast of Africa, claims the following distinctive appellation and description.

*Trikentrion læve*, n. sp. (Pl. XXVII. figs. 9-12.)

Specimen a small globular bunch of short, cylindrical, obtuse branches, arising from the subdivision of a small, equally short, round stem. Colour now purplish. Texture loose, compressible. Surface even, reticulate, slightly setose. Structure throughout fibro-reticulate, charged with the spicules of the species (Pl. XXVII. fig. 10). Spicules of three forms, viz. :—1, long, setaceous, acute, smooth, curved, sharp-pointed, 1-33rd by 1-3600th inch in its greatest diameters (fig. 9, *a*); 2, short, acerate, smooth, curved, sharp-pointed (fig. 9, *b*), 1-120th by 1-3600th inch, sometimes bent in the middle (fig. 11, *a*), or inflated in the centre (fig. 11, *b*), occasionally acute (fig. 11, *c*); 3, echinating spicule, triradiate, arms cylindrical, obtuse, about 1-200th by 1-2000th inch in their greatest dimensions, for the most part equal in length and radiating at nearly equal angles from each other, the echinating arm alone spiniferous, chiefly over the free extremity, the two others smooth (fig. 9, *d*, and fig. 12, *a-c*), occasionally quadriradiate (fig. 12, *b, c*). No. 1 (fig. 10, *a*) projects setaceously from the midst of a tuft of very thin acuates

(fig. 10, *c*); no. 2 (fig. 10, *b*) chiefly forms the fibre; and no. 3 is the echinating spicule, plentifully distributed about the latter (fig. 10, *d*). Size of entire specimen about 1 inch, and the branches about 3-24ths inch in diameter respectively.

*Hab.* Marine.

*Loc.* West coast of Africa.

*Obs.* Examined in the dried state. This sponge, numbered as above mentioned, may be found in a little pill-box in the British Museum, and was presented by the Rev. Mr. Allen. To render it more easily recognizable, it bears on its surface the remains of a parasitic polype (*Palythoa*). Its spiculation is very much like that of *Triken-trion muricatum*, but has, in addition, the setaceous acute very common among this kind of sponges, although absent in *T. muricatum*. When, however, the general form and internal structure of *T. leve* is compared with *T. muricatum*, there is a still greater difference; for while the surface of the latter is covered with little conical processes of the sponge-substance (another common feature of many of the Echinonemata, particularly well-shown in Esper's and Mr. Sollas's representations of this sponge respectively), that of *T. leve* is even and setaceous, more like that of a *Dictyocylindrus* or *Axinella*, Sdt.; again, while the structure generally of *T. leve* is composed of loose or compressible, reticulated fibre, that of *T. muricatum* is just the opposite, viz. hard, dense, and compact, becoming still more so towards the axis of the branch—another character almost peculiar to many of the Echinonemata. These, together with other differences, viz. in size, colour, and general form, are ample for making *T. leve* a distinct species; but it is remarkable that both this and *T. muricatum* should come from the west coast of Africa, and that, as yet, they should not have been shown to have come from any other part of the world, even going so far back as Pallas in 1756.

#### DICTYOCYLINDRUS, Bk.

Order ii. Silicea, Suborder i., Genus 10 (pp. 3, 6,  
*op. et loc. cit.*).

Allied to the genus *Triken-trion*, and typical of one of the groups into which the Pluriformia will hereafter have to be divided, is Dr. Bowerbank's genus *Dictyocylindrus*, which, so far as his diagnosis goes (*op. cit.* p. 6), is well defined, but would have been better if the echinating spicule, although very sparse in many species, had been mentioned, as this at once would have placed it in my order Echinonemata, under the family Ectyonida. My object, however, in introducing

the subject here is, first, to point out that the echinating spicule of *Dictyocylindrus* is the preceding grade in form to the more complicated one of *Trikentrion*—that is, while the former may be viewed as a single arm fixed to the fibre by an inflated and spined extremity (Pl. XXVII. fig. 14), the latter presents a more complicated one, in which this is effected by two additional divergent arms, making the spicule triradiate,—and, secondly, to take this opportunity of reordering the descriptions, respectively, of two remarkable species of the genus illustrative of this, which were found by Col. Pyke (U.S. Consul) at the Mauritius, and sent to me by Dr. Dickie, late Professor of Botany in the College at Aberdeen, in 1872. For one of these I propose the name of *Dictyocylindrus laciniatus*, and for the other *D. Pykii*, commencing with the former first.

*Dictyocylindrus laciniatus*, n. sp.

(No figures are given of this and the following species, beyond the echinating spicule, which is the same in both.)

Hemispheroidal, laciniate, radiating, sessile. Colour light slate-grey. Texture tender, compressible. Pores and vents not visible, the latter probably from their smallness, owing to the excretory systems in this kind of sponges being much subdivided. Structure consisting of long spatulate laciniae, radiating from a basal point, dividing and subdividing upwards, proliferous, plicate, and slashed towards the surface; composed of indistinct, anastomosing fibre, charged with the spicules of the species; setigerous or hairy throughout from the projection of the long acuates, which will now be described. Spicules of three forms, viz.:—1, very long, setaceous, acute, smooth, curved, sharp-pointed, slightly inflated, pin-like at the base, 1-6th inch long by 1-750th inch broad in its greatest dimensions; 2, acerate, curved, smooth, sharp-pointed, 1-45th by 1-1500th inch; 3, echinating spicule, short, acute, conical, straight, inflated at the base, sub-pointed at the free extremity, spiniferous, spines most numerous about the extremities respectively, slightly recurved about the free end, 1-272nd inch long by 1-1500th in diameter at the inflated end. No. 1 is based in the indistinct fibre (which is chiefly formed of no. 2), and, projecting from the surface of the lacinia obliquely upwards, gives the latter, from its great length, a strongly setose character; while no. 3 sparsely echinates the fibre. Size of specimen 2 inches in diameter.

*Hab.* Marine, growing on hard objects.

*Loc.* Mauritius.

*Obs.* Examined in the dried state. This specimen had grown on a branch of decayed coral, and, from the quantity of sand in it, was probably picked up upon the beach. Its hemispheroidal form, long radiated lacinate structure, great length and projection of the long acuate, together with the light slate-colour mentioned, are its principal characters.

It is also remarkable for the presence of a number of malformations of the long setaceous spicule, consisting of globular and elliptic bodies composed of concentric layers, thus traceable through their elongated forms into the normal development. Not an uncommon occurrence.

*Dictyocylindrus Pykii*, n. sp.

Subglobular, clathrous, massive, sessile. Colour dark purple. Texture tender, loose. Surface uniformly composed of the ends of the clathrous structure. Pores and vents not seen, the latter for the reason just mentioned. Internally consisting of clathrous anastomosing branches, composed of indistinct fibre charged with the spicules of the species, and tympanized by the dark purple sarcode characteristic of the sponge. Spicules of three forms, viz.:—1, setaceous, acuate, curved, smooth, sharp-pointed, 1-18th long by 1-1800th inch in its greatest transverse diameter; 2, acerate, smooth, curved, sharp-pointed, 1-50th by 1-1800th inch in its greatest dimensions; 3, echinating spicule, acuate, conical, straight, inflated at the base, subpointed at the free extremity, spiniferous, spines most numerous over the extremities, slightly recurved about the free end, 1-272nd long by 1-1500th inch in diameter at the inflated end, the same in form as the last (Pl. XXVII. fig. 14). No. 1 projects obliquely upwards from the fibre, which is formed of no. 2, so as to give the surface of the clathrous structure a slightly setose character; while no. 3 in great abundance forms the echinating spicule. Size of specimen  $3\frac{1}{2}$  inches high by 3 inches in diameter between the base and the summit, which is the largest part of the sponge.

*Hab.* Marine, growing on hard objects.

*Loc.* Mauritius.

*Obs.* Examined in the dried state. This sponge is chiefly remarkable for its deep purple colour, presenting, in this respect, the appearance of Mr. T. Higgin's *Halichondria birotulata*; but the clathrate structure and echinated fibre, together with the spiculation generally, at once point out the difference. The indistinctness of the fibre in this and the foregoing described species is chiefly owing to the projection of the long setaceous and echinating spicules. Still there is a great difference between the loose and the compact structure

respectively characterizing these echinated sponges, as seen between *Trikentrion leve* and *T. muricatum*, the latter resembling in its structure that density and hardness which seems to me, as before stated, to exclusively belong to some of the Echinonemata, while the looser structure is common to all orders of the Spongida.

*Latruncula corticata*, n. sp. (Pl. XXVII. figs. 1-4.)

Erect, solid, lobate, covered with a thin chondroid dermal layer, apparently (the point of attachment having been broken off) subsessile (Pl. XXVII. fig. 1). Colour now yellowish white. Texture chondroid on the surface (fig. 1, *a*); reticulated, stiff, gum-like internally (fig. 1, *b*). Surface smooth as varnish to the unassisted eye; but under the microscope presenting the pointed ends of the skeleton-spicules in groups, just projecting beyond the chondroid layer, which is papyraceous in thinness (fig. 2, *b*). Pores between the groups, now 1-1200th inch in diameter and about 1-333rd inch apart (fig. 2, *a*). Vents not seen, chiefly on account of the imperfect state of the specimens. Internal structure fibroreticulate, stiff, arranged so as to present a plumose appearance; fibre composed of the spicules of the species held together by the now dried, glutinous sarcode. Spicules of two kinds, viz.:—1, skeleton-, acerate, curved, smooth, sharp-pointed gradually, 1-60th by 1-4000th inch in its greatest diameters (fig. 3); 2, flesh-spicule, stout, straight or crooked (subspiral), spined, 1-857th inch long (fig. 4); spines grouped at the ends and on the shaft in two places respectively at equal distances from each other (fig. 4, *a*), or dispersed more or less generally over the shaft (fig. 4, *b*), or subspirally, giving the flesh-spicule a crooked form (fig. 4, *c*). Skeleton-spicules mixed with the flesh-spicules in the interior, the latter most abundant on the surface. Size of the largest specimen  $3 \times 2\frac{1}{2}$  inches.

*Hab.* Marine.

*Loc.* Red Sea (so stated by the dealer).

*Obs.* Examined in the dried state. There are three fragmentary specimens of this sponge in the British Museum, which look as if they had all come from the same mass. Each bears my number 359 E, *h*, 23, and the register numbers 40. 5. 6. 56-58. Its generally stiff consistence, rendered flexible by soaking, makes it look very much like one of the Gumminida; while the transitional forms of the flesh-spicule (fig. 4, *a*, *b*, *c*) show how the shaft may be spiral like that of the spinispirular, or straight like that of the sceptrella, whose typical forms respectively will be pointed out hereafter.



*Chondrilla sacciformis*. (Pl. XXVI. figs. 9, 11, and 12.)

Saccular and cylindrical (Pl. XXVI. figs. 9 *a*, 9 *a*), or adnate and depressed (fig. 9 *b*); sessile, corticate. Colour dark brown. Texture stiff and hard externally, soft internally when dry, chondroid and flexible when wet. Surface even, formed of the globular spicules (fig. 12) arranged in a tessellated manner like shagreen. Pores uniformly present all over the surface between the globular spicules, provided respectively with a splanchnal diaphragm of sarcode, 1-164th inch in diameter and a little wider apart. Vents single and large at the end of the sacciform growth (figs. 9 *a*, 9 *a*), or numerous and scattered over the adnate portions (fig. 9, *b*, *c*), projecting and papillary when wet. Structure cortical and internal; cortex stiff and hard when dry, about 1-138th inch thick, chondroid and flexible when wet, charged with the globular spicule and traversed by the canals of the pores and vents, respectively ending in their apertures on the surface; internal structure compressible, tough, resilient, consisting of areolar sarcode charged with groups of brown pigment granules (which give the colour to the sponge) and the spicules of the species, traversed by the branches of the excretory canal-systems. Spicules of two kinds, viz.:—1, skeleton-, accrate, smooth, curved, sharp-pointed gradually, 1-25th by 1-900th inch in its greatest dimensions (fig. 11); 2, flesh-spicule, spherical, globo-stellate, moriform, 1-225th inch in diameter (fig. 12); granules arranged hexagonally (fig. 12, *a*), conoid, truncate, and spined over the extremity (fig. 12, *b*), or simply conoid (fig. 12, *c*). No. 1 (spicule) is confined to the internal structure, mixed with no. 2 in different stages of development; no. 2 in full development, exclusively to the cortex. Size of largest sacciform portion about 1½ inch long by ½ inch in diameter, that of the adnate portions various.

*Hab.* Marine, on hard bodies.

*Loc.* Mauritius.

*Obs.* Examined in the dried state and after soaking in water. In the former it is stiff, hard, and corrugated, while in the latter it is soft, flexible, and smooth. The globo-stellate or moriform spicule, although a strikingly beautiful object *in situ*, and separate from its great size, is but an enlarged form of that of *Chondrilla nucula*, Sdt., which, together with *Chondrosia*, Nardo, also occurs at the Mauritius. *C. nucula* also grows in the West Indies and at the Molucca Islands, in the South Pacific Ocean, so that it probably has a world-wide extension in the warmer climates. The presence of the acerate spicule makes it differ from *Chondrilla nucula*,

and together with its erect growth, remarkably large globo-stellate spicules, and rich dark brown colour are its distinguishing characters. The specimens from which my description is taken, now in the possession of the British Museum, were presented to the late Dr. Bowerbank by Dr. Ayres, and bear my running no. 701. According to Dr. F. E. Schulze's arrangement (*Zeitschrift f. wiss. Zool.* 1870, Bd. xxix. p. 37, Separat-Abdruck), *Chondrilla sacciformis*, from possessing a cortex, would be one of his family "Chondrosiadae." His recension of the species generally I commend to the student's notice, as well as all Dr. Schulze's papers on the Spongiadae (*op. cit.*), as affording, so far as they go, some of the most valuable information that has ever been communicated on the recent sponges.

Schmidt has described and illustrated a sponge under the name of *Chondrilla phyllodes* (*Grundz. Spongienf. atlantisch. Geb.* 1870, p. 26, Taf. vi. fig. 1), with pin-like skeleton and spinispirular flesh-spicule, possessing a "violet-brown colour." A similar sponge occurs at the Mauritius, which, possessing none of the characters of a Gummina, I have set down as a Suberite—that is, belonging to the family Suberitida in my order Holorhaphidota. No doubt there are many species among these Suberitida which come very near to those that undoubtedly belong to the Gumminida in the order Carnosa, c. g. *Donatia lyncurium* &c. The preceding species, viz. *Latruncula corticata*, would, if the chondroid consistence were to be considered the distinguishing character of the Gumminida, be made one, like *Chondrilla phyllodes*.

The application of the term "spicule" to the globo-stellate seems ill adapted; but "body," which has often been used, is worse, as it conveys no idea of the *nature* of the object; while the term "spicule," if, apart from its derivation, applied to the siliceous elements of a sponge which have a definite form, whatever it may be, is readily understood. Otherwise a "globo-stellate spicule" would be as unintelligible as a "round square."

*Rhaphidhastia spectabilis*, n. sp.  
(Pl. XXVI. figs. 10, 13, and 14.)

Lamelliform, extremely thin, sessile, taking the shape of the surface over which it may have grown, like a wet veil (Pl. XXVI. figs. 10, 10). Colour now whitish yellow. Texture delicate. Surface even, puckered here and there into little monticular projections (fig. 10, *a*), which appear to have been surmounted by the vents, otherwise (together with the pores) not recognizable. Internal structure loose, consisting

of delicate areolar sarcode charged with the spicules of the species. Spicules of two kinds, viz. :—1, skeleton-, acerate, long, curved, smooth, pointed gradually, 1-40th by 1-1800th inch in its greatest diameters (fig. 13); 2, flesh-spicule spinispirulate, straight or curved irregularly, variable in length and thickness, the longest averaging 1-300th by 1-3000th inch in its greatest diameters (figs. 14 and 14 a). Spicules of both kinds equally mixed throughout the structure. Largest specimen about 1 inch square and of extreme thinness.

*Hab.* Marine, on hard objects.

*Loc.* Mauritius.

*Obs.* Examined in the dried state. There are several patches of this sponge, of various sizes under that mentioned, on fragments of old reef-coral which bear the name "Dr. Ayres," in the late Dr. Bowerbank's collection; three of them are on that bearing the specimens of *Chondrilla sacciformis*, just described. Being loose and crumbling in its consistence, both when dry and after soaking in water, it fails to present the chondroid peculiarity of the Gumminida, while its Holorhaphidote character and spiculation seem to claim for it a place in the family Suberitida. The spinispirulate flesh-spicule is a common form under various phases among the Suberitida; and one of the average largest specimens in *Rhaphidhistia spectabilis*, presenting *ten bends*, has been represented under a highly magnified form, perhaps with a little more regularity than is natural, to show its elementary figure and composition (fig. 14 a). It is a strikingly beautiful object, separately or together, in *Rhaphidhistia spectabilis* when viewed under the microscope, and hence the specific designation. When alluding to the different forms assumed by the spinispirula hereafter, it will be more particularly noticed.

*Hymenaphia spiniglobata.* (Pl. XXVI. figs. 15, 16.)

Laminiform, immeasurably thin, taking the form of the object over which it may be growing. Colour pellucid white. Texture loose. Surface even, echinated with long spicules. Pores, vents, and internal structure not recognizable in the dried state, from the extreme thinness of the layer. Spicules two kinds, viz. :—1, skeleton-, pinlike, straight, fusiform, sharp-pointed gradually, 1-43rd by 1-1500th inch in its greatest diameters; head terminal, globular, a little larger in diameter than the shaft (Pl. XXVI. fig. 15); 2, flesh-spicule, spiniglobate or spiniglobospiral, the former about 1-857th inch in diameter (fig. 16, a, b, c, d). Skeleton-spicules projecting

from a thin layer of the flesh-spicules. Size of largest specimen 3-12ths inch in horizontal diameter.

*Hab.* Marine, on hard objects.

*Loc.* South Sea, on the older and deciduous parts of *Stylaster sanguineus*.

*Obs.* Examined in the dried state. The beautiful spiculation of this delicate little sponge is remarkable, when dry, for its pellucid white colour. It is so thin that much care is required in raising a portion for examination by the microscope, without which, even *in situ*, it can hardly be recognized. Answering to Dr. Bowerbank's characters of his genus *Hymenaphia* (Mon. Brit. Spong. vol. ii. p. 7), I have given it this appellation, together with the specific distinction of "spiniglobate," to mark the existance of a globular flesh-spicule with thin spines instead of thick conoid rays, like the "globostellate" of *Donatia lyncurium*, accompanied by the subspiral transitional form (fig. 16, *b, d*), which illustrates the connexion between the spinispirular (*Spiralstern*) and the stellate, noticed by Schmidt in accounting for the differences between his two figures of the spiculation of *Vicia Johnstonii* (Spongienf. d. atlant. Geb. 1870, p. 5).

#### EXPLANATION OF THE PLATES.

##### PLATE XXV.

- Fig. 1.* *Axos spinipoculum*, n. sp. (4-6ths of the natural size). From a photograph. *aa*, pieces of old coral detritus on which the sponge has grown.
- Fig. 2.* The same. Skeleton-spicule (scale 1-24th to 1-6000th inch). *a*, length on scale of 1-24th to 1-1800th inch, for comparison.
- Fig. 3.* The same. Flesh-spicule. *a*, occasional form of terminal spines (same scale).
- Fig. 4.* The same. Diagram of elementary parts, relatively magnified (on scale of 1-6th to 1-24th inch), showing:—*aa*, yellowish-white areolar sarcode; *b*, chondroid skeleton; *cc*, cortical layer, traversed by reticulation of ? pore-canals (fig. 7, *b*); *dd*, spines; *e*, portion of commencement of excretory canal, lined with transverse folds or rugæ.
- Fig. 5.* The same. Portion of commencement of excretory canal, much more magnified, showing:—*aaa*, wall of canal; *bbb*, openings into smaller branches; *ccc*, transverse folds or rugæ.
- Fig. 6.* The same. Inner layer of excretory canal, greatly magnified, showing that it is composed of:—*aaaa*, longitudinal fibres; *bbb*, transverse fibres, corresponding in position with the rugæ.
- Fig. 7.* The same. Cortical layer, much magnified, to show:—*a*, horizontal fibres; *b*, minute reticulation; *c*, vertical lines or straight portions of the same, terminating on the inner side.
- Fig. 8.* The same. End of single fibre, to show its pointed form, and that the fibre is made up of fibrillæ (*a*).
- Fig. 9.* The same. Epithelial or outer layer of the excretory canal, to

show that it is composed of a granular mucus charged with cells. *a*, cells, magnified, to show their prevailing shape.

## PLATE XXVI.

- Fig. 1.* *Aros flabelliformis*, n. sp. (3-5ths of the natural size). From a photograph.
- Fig. 2.* The same. Skeleton-spicule (scale 1-24th to 1-6000th inch).
- Fig. 3.* The same. Flesh-spicule (same scale).
- Fig. 4.* The same. Length of skeleton-spicule on scale of 1-24th to 1-1800th inch, for comparison with *fig. 7* of same Plate and *fig. 2*, Pl. XXV.
- Fig. 5.* *Aros Cliftoni*, Gray. Skeleton-spicule (scale 1-12th to 1-1800th inch).
- Fig. 6.* The same. Flesh-spicules. *a*, common form; *b*, less common form; *c*, ? embryonal form (scale 1-24th to 1-6000th inch).
- Fig. 7.* The same. Length of skeleton-spicule on the scale of 1-24th to 1-1800th inch, for comparison.
- Fig. 8.* Portion of coral detritus bearing *Chondrilla sacciformis* (9) and *Rhaphidhistia spectabilis* (10), nat. size.
- Figs. 9, 9, 9.* *Chondrilla sacciformis*, n. sp. (nat. size). *aa*, saccular forms; *b*, adnate form; *c*, vents, papillary.
- Figs. 10, 10.* *Rhaphidhistia spectabilis*, n. sp. (nat. size).
- Fig. 11.* *Chondrilla sacciformis*. Skeleton-spicule (scale 1-24th to 1-1800th inch).
- Fig. 12.* The same. Flesh-spicule (same scale). *a*, portion of the granular mulberry-like surface, more magnified, to show the arrangement and form of the "granules" *in situ*; *b*, lateral view of a single granule, showing spinous truncate extremity; *c*, the same, simple conical form.
- Fig. 13.* *Rhaphidhistia spectabilis*. Skeleton-spicule (scale 1-24th to 1-1800th inch).
- Fig. 14.* The same. Flesh-spicule (same scale). *a*, the same, much more magnified, to show the sinuous (spiral) form of the shaft and spiral arrangement of the spines.
- Fig. 15.* *Hymenaphia spiniglobata*, n. sp. Skeleton-spicule (scale 1-12th to 1-1800th inch).
- Fig. 16.* The same. Flesh-spicule. *a*, spheroidal or globular form, same scale; *b*, spiro-globular form; *c, d*, the same, more magnified, to show the spines and figures respectively.

## PLATE XXVII.

- Fig. 1.* *Latruncula corticata*, n. sp. Natural size of specimen. *a*, chondroid layer or cortex; *b*, internal structure.
- Fig. 2.* The same. Surface of cortex, much magnified, to show:—*a*, pores; and *b*, points of skeleton-spicules, relatively situated.
- Fig. 3.* The same. Skeleton-spicule (scale 1-12th to 1-1800th inch).
- Fig. 4.* The same. Flesh-spicule (scale the same). *a, b, c*, the same, more magnified, to show the transitional forms present, viz.:—*a*, sceptrella; *b*, intermediate form between the sceptrella and (*c*) the spinispirular form.
- Fig. 5.* *Dictyocylindrus Vickersii*, Bk. Fragment. Natural size.
- Fig. 6.* The same. Spiculation relatively magnified (scale 1-24th to 1-1800th inch). *a*, long setaceous acuate; *b*, thick short acuate; *c*, undulating acuate; *d*, echinating quadriradiate spicule; *e*, quinqueradiate form; *f*, smooth-armed triradiate form; *g*, the same, quadriradiate.

- Fig. 7.* The same. Echinating spicule, more magnified (scale 1-12th to 1-1800th inch). *a*, echinating arm.
- Fig. 8.* The same. Portion of *surface* of a "column," showing the spicules *in situ*. Diagram, much, but relatively, magnified. *a*, long setaceous acuate; *b*, thick short acuate; *c*, undulating acuate; *d*, echinating spicule.
- Fig. 9.* *Trikentrion læve*, n. sp. Spiculation relatively magnified (scale 1-24th to 1-1800th inch). *a*, long setaceous acuate; *b*, short thick acerate; *c*, fine acuate; *d*, echinating triradiate spicule.
- Fig. 10.* The same. Portion of fibre showing the spicules *in situ*. Diagram much, but relatively, magnified. *a*, long setaceous acuate; *b*, short, thick acerate; *c*, fine acuate; *d*, echinating triradiate spicule.
- Fig. 11.* The same. Different forms of acerate spicule, viz.:—*a*, bent; *b*, inflated in the centre; *c*, acuate.
- Fig. 12.* The same. Echinating spicule, more magnified (scale 1-12th to 1-1800th inch). *a*, normal form, triradiate; *b*, occasional form, quadriradiate; *c c*, echinating arms. For comparison with *figs. 7, 13 c*, and *14*, all of which are drawn on the same scale.
- Fig. 13.* *Trikentrion muricatum*, Ehlers. Portion of fibre, showing the spicules *in situ*. Diagram, but relatively magnified (scale 1-48th to 1-1800th inch, the same scale as *figs. 8 and 10*, for comparison). *a*, acerate spicule; *b*, echinating triradiate spicule; *c*, the latter more magnified; *d*, echinating arm.
- Fig. 14.* *Dictyocylindrus laciniatus*, n. sp., and *D. Pykii*, n. sp. Echinating spicule.

[To be continued.]

XXXIV.—*Studies on Fossil Sponges*.—III., IV., V. *Monactinellidæ*, *Tetractinellidæ*, and *Calcispongiæ*. By KARL ALFRED ZITTEL\*.

### III. MONACTINELLIDÆ, Zittel.

In my memoir "Zur Stammesgeschichte der Spongien" †, I adopted the following orders of sponges, founded chiefly upon the grouping proposed by O. Schmidt (Atlant. Spong. p. 83), namely:—1. Myxospongiæ, Hæck.; 2. Ceraospongiæ, Bronn; 3. Monactinellidæ, Zitt.; 4. Tetractinellidæ, Marsh.; 5. Lithistidæ, O. Schmidt; 6. Hexatinellidæ, O. Schmidt; 7. Calcispongiæ, Blainv.

To the Monactinellidæ I refer all sponges the skeleton of which consists of *uniaxial siliceous spicules*.

Of the numerous uniaxial siliceous spicules from Tertiary

\* Translated by W. S. Dallas, F.L.S., from the 'Abhandlungen der k. bayerischen Akademie der Wissenschaften,' II. Classe, Bd. xiii. pp. 93-138.

† Festgabe der philosophischen Facultät zum 50-jährigen Doctor-jubiläum des Professor von Siebold. Munich, 1878.

or Cretaceous deposits, which Ehrenberg has figured and named in his 'Mikrogeologie,' many were probably derived from Monactinellidæ; but it is rarely that these spongoliths possess so characteristic a form that they could be determined with certainty when isolated.

Among the few uniaxial siliceous structures of unmistakable habit are the grappels and mattocks from the Upper Cretaceous of Vordorf, figured by me under the name of *Esperites Carteri*\*, which agree precisely with those occurring in living *Esperia*.

Carter † refers to the Renierinæ a circular, cushion-shaped, discoidally compressed sponge (*Pulvillus*), consisting of large bacillar spicules, from the Carboniferous Limestone of Scotland.

A second genus (*Rhapidhistia*, *ibid.* p. 140), seated like a crust upon *Hydractinæ*, from the same formation, is most nearly allied, according to Carter, to the existing genus *Hymerhaphia*, which, according to Schmidt's classification, should be referred to the Chalinopsinidæ.

The most favourable state of preservation among the fossil Monactinellidæ is presented by certain Suberitidæ, of which coherent skeletons sometimes occur. Of these I know three fossil genera.

#### OPETIONELLA, Zitt.

Sponge nodose or bark-like, of irregular form; oscula, pores, or canal-system not preserved; skeleton consisting of a layer, about 12 millims. thick, composed of parallel bacillar spicules closely pressed together. The spicules are 5-10 millims. long, awl-shaped, acutely pointed at both ends, thickest in the middle.

I have not observed in the specimens before me any special cortical layer with smaller bacillar spicules, or stellate or spherical bodies; possibly they have been washed away, possibly they were never present. Notwithstanding their absence I place the genus *Opetionella* in the neighbourhood of *Donatia* (*Tethya*) *lyncurium*, Nardo, as the spicules of the two genera show not only the same form, but also the same arrangement. Carter's *Trachya* (*Ann. & Mag. Nat. Hist.* ser. 4, vol. vi. (1870) p. 178, pl. xiii. figs. 11-16) must be still more nearly allied. In this Suberitic genus the whole sponge-body likewise consists only of bacillar spicules of two sizes and forms, and a cortical layer is also wanting. *Tra-*

\* "Ueber *Cæloptychium*," *Abhandl. der k. bayer. Akad. der Wiss.* II. Classe, Bd. xii. pl. iv. figs. 27-29.

† *Ann. & Mag. Nat. Hist.* ser. 5, vol. i. (1878) p. 137.

*chya* is distinguished from *Opetionella* solely by the presence of the smaller bacillar spicules in the outer layer, and by the arrangement of the larger spicules around several nuclei.

I regard as the typical species of the genus *Opetionella*, *O. radians*, Zitt., from the *Cuvieri*-Pläner of the Windmühlenberg, near Salzgitter. A great number of fragments of a second, smaller, lamellar, and quite irregularly shaped species (*O. jurassica*, Zitt.), in which the spicules are always converted into brown ironstone, have been sent to me by Inspector Klemm from the *Impressa*-limestones of Geislingen in Württemberg.

The same state of preservation is also exhibited by some funnel-shaped bodies, entirely composed of bacillar spicules pointed at both ends, from the same locality, which, in external appearance, possess a certain resemblance to *Sporadopyle obliqua*. I refer these provisionally to *Opetionella*, and name them *O. Klemmi*, in honour of their discoverer.

#### SCOLIORHAPHIS, Zitt.

Sponge massive, nodular, or crust-like, very irregular, sometimes full of holes, and composed of mæandricly contorted laminae; surface undulated, or with wart-like elevations separated by curved and anastomosing depressions.

The whole mass of the sponge-body consists of undulated, simple, cylindrical spicules, obtuse at the ends, and rendered rugged throughout their whole length by collar-like swellings. With these are mixed a small quantity of simple bacillar spicules, pointed at one end, somewhat thickened at the other. In both forms of spicules the axial canal may be very well observed; it is rather wide, traverses the whole spicule, and opens freely at its ends. No oscula or water-canals are preserved in the fossil skeletons.

Of this remarkable genus I know two species from the Upper Cretaceous of North Germany. Among the living Suberitidæ there exists no form with vermiform and rugged spicules. I have found very similar spicules in an undescribed living form of Lithistid belonging to the genus *Coralistes*; and Bowerbank (Monogr. Brit. Sponges, i. pl. i. fig. 14) figures a "nodulated-cylindrico-vermiculate" spicule from the Atlantic Ocean at a depth of 2070 fathoms, which differs from those of our fossil genus only by its slenderer form. The sponge from which this spicule of Bowerbank's was derived seems not to have been yet discovered. O. Schmidt also has found similar spicules in an Ancorinid genus (*Craniella tethyoides*, Schmidt, Atlant. Spong. p. 66, pl. vi. fig. 9).



1. *Scoliorhaphis cerebriformis*, Zitt.

Sponge nodular or incrusting, with a convex surface, upon which project crests and tubercles of various forms, separated by mæandrically twisted and anastomosing depressions. The skeleton consists almost exclusively of rugged, vermiform, rather short spicules, with isolated smooth bacillar spicules.

The original specimen of this species was contained in the palæontological collection at Munich under the denomination "*Amorphospongia*, sp. nov.," and comes from the *Quadratus*-chalk of the Sutmberg.

2. *Scoliorhaphis anastomans*, Zitt.

Sponge nodular, perforated, consisting of thin contorted and anastomosing lamellæ. Skeleton with tolerably long, vermiform, rugged spicules, with which simple bacillar spicules of various sizes and forms are intermixed in great quantities.

*Quadratus*-chalk of Linden and Ahlten in Hanover.

## CLIONA, Grant.

*Vioa*, Nardo; *Clionites*, Morris; *Entobia*, Bronn.

To this genus belong sponges which possess a skeleton composed of horny fibres and bacillar spicules, and which bore into shells and stones. In the interior of the bodies inhabited by them they form much-branched passages, which are in part narrowed and then again widened, so that thus they divide into chamber-like sections. They are connected with the surface only by cylindrical passages, which open by a small round orifice.

Notwithstanding all my endeavours, I have never succeeded in finding spicules in the above-described cavities of fossil bivalve and univalve shells; but the passages agree so well with those of the existing *Cliona*, that they have long since been referred to this genus of sponges. The boring sponges seem most frequently to seek out the shells of *Ostrea*, *Pecten*, *Inoceramus*, *Placuna*, and *Avicula*; but I have also observed them in *Pectunculus*, *Venus*, and *Cytherea*, and in *Cerithium giganteum*.

Hancock has published detailed investigations upon the living species of *Cliona*\*.

From the occurrence of perforations, the existence of the genus may possibly be traced back even to the Silurian formation; but the perforations in Cretaceous *Ostrea* and

\* Ann. & Mag. Nat. Hist. 1849, vol. iii. p. 321-347, and vol. iv. pp. 355-357; and Nat. Hist. Trans. Northumberland and Durh. 1868.

*Inocerami* belong with more certainty to *Cliona*. They occur most abundantly, however, in the Tertiary formation.

A number of species have been established by Conybeare, Michelin, D'Orbigny, and Pomel, partly under the generic name of *Cliona*, partly as *Vioa*; but as the skeletal spicules have not been detected in any one of these species, no great importance can be assigned to them.

The simple or ramified perforations and passages occurring in Belemnites and fossil shells, for which Hagenow\*, Quenstedt†, and Etallon‡ have proposed the genera *Talpina*, Hag., *Dendrina*, Quenst., *Hagenowia* and *Cobalia*, Et., I regard as quite problematical. Among living sponges I am acquainted with no form that hollows out similar passages; and I am therefore rather inclined to ascribe them to boring worms.

#### IV. TETRACTINELLIDÆ, Marshall.

Siliceous sponges with spicules of the pyramidal type (quadriradiates, octoradiates, anchors).

The order Tetractinellidæ embraces the two families Geodinidæ and Ancorinidæ of O. Schmidt, or that part of Carter's Holorhaphidota in which the skeleton is composed of siliceous structures based upon the axial cross of a three-sided pyramid. These are all the representatives of the family Pachytragida and the group Pachastrellina of the family Pachastrellida, to which Carter also refers the Lithistidæ.

The most ancient Monactinellid spicules have been described by Carter § from the Lower Carboniferous Limestone of Cunningham-Baidland in Ayrshire. For the first demonstration of fossil spicules of the present order we are indebted to the same meritorious spongologist.

As long ago as 1871 Carter || figured among the isolated sponge-spicules in the Greensand of Haldon a considerable number which, in their form, most closely resemble the anchors, quadriradiates, and siliceous spherules of the genera *Geodia*, *Pachastrella*, *Tethya*, and *Stelletta*. Although a part of these might be derived from Lithistidæ, others certainly belong to the Tetractinellidæ. Carter describes the fossil spicules under the generic names *Geodites*, *Dercites*, and *Stelletites*, according to their relationships to existing forms, and gives a series of figures on plates ix. and x. of his memoir.

\* Jahrb. für Min., Geol. und Petref. 1840, p. 671.

† Petrefactenkunde Deutschlands, Cephalop. pl. xxx. figs. 36, 37.

‡ Actes de la Soc. Jurass. d'Emul. de Porrentruy, 1860.

§ Ann. & Mag. Nat. Hist. ser. 5, vol. i. (1878) p. 139.

|| Ann. & Mag. Nat. Hist. ser. 4, vol. vii. (1871).

A group of fossil bacillar spicules, quadriradiates, and anchors with annular constrictions, as yet only known in the fossil state, are embraced under the name of *Monilites* (*l. c.* pl. ix. figs. 44-47), and constitute an exceedingly characteristic extinct type. I have detected isolated spicules of the same form in the North-German Cretaceous of Ahlten; and they are also mentioned by Rutot from the Eocene sands of Brussels.

In my monograph of the genus *Cæloptychium* I have likewise figured a great number of isolated siliceous structures, which I at that time erroneously referred to *Cæloptychium*. The radiate siliceous spherules and disks (*l. c.* pl. v. figs. 18-26) are probably derived from fossil species of *Stelletta* or *Geodia*; the spinous spherules (*l. c.* pl. v. figs. 27-30) probably belong to *Pachastrella* or *Geodia*, and the radiate stars (fig. 31) to *Tethya*, *Callites*, or *Pachastrella*. How many of the four-, seven-, and eight-rayed stars and anchors figured on pls. v., vi., and vii., as also of the uniaxial spicules represented on pls. iv. and v., are derived from Pachytragidæ, Pachastrellidæ, Lithistidæ, or other groups of sponges, it is impossible to decide, owing to the indifferent character of these structures. I believe, however, that I must now definitely refer the dense, non-radiate, ovate bodies (pl. iv. figs. 52-59), as also the spherules (*l. c.* fig. 66), to the *Geodia*, as I have found precisely concordant bodies in the Upper Jura in great quantities lining a cavity in which numerous forked anchors and quadriradiates were scattered. Similar elliptical, oval, and spherical bodies occur very abundantly in the White Jura, associated with bacillar spicules and anchors.

The existence of Tetractinellidæ may also be recognized in the Lias and Rhætic. I have received, through Mr. Nelson Dale, from the Upper Lias of the valley of Conzei near Pieve di Ledro, in South Tyrol, a piece of rock about 70 millims. long and 35 millims. thick, which entirely consists of large siliceous spicules. A tenth part of these are simple, pointed at both ends, and about 4-5 millims. in length. Among them are isolated large quadriradiates (cross-spikes).

Precisely similar straight or slightly curved bacillar spicules, intermixed with forked anchors and fragments of Hexactinellidæ, form a deposit several centims. thick, in the horizon of *Arvicula contorta*, on the Hochfell, in the Bavarian Alps.

The occurrences in the Greensand of Haldon are most in accordance with the sponge-spicules described by Joseph Wright\* from the Irish Cretaceous, among which the genera

\* Report Belfast Nat. Field Club, 1873-74, Appendix.

*Geodites*, *Stellettites*, *Dercites*, and *Monilites* are also represented.

Numerous anchors and spicules belonging to *Geodia* and *Donatina* also occur in the tubes met with near Brussels in the Eocene sands, which have been described by Carter\* under the name of *Broeckia*. The sponge-spicules themselves were first carefully investigated and figured by Rutot†.

Under the denomination *Esperites giganteus*, Carter ‡ mentioned a sigmoidally curved uniaxial form of spicule of considerable size from the Greensand of Haldon. Similar spicules were subsequently described by Rutot (*l. c.* pl. iii. figs. 5 and 29) from the Eocene sands of Brussels, and by myself (*Abhandl. k. bayer. Akad. 2te Cl. Bd. xii. pl. iv. figs. 25, 26*) from the Upper Cretaceous of Westphalia. I have also repeatedly found them in the residue left after treating Upper Jurassic sponges with acid. When Carter § had observed spicules of exactly concordant size and form in a collection of living deep-sea sponges associated with three-pointed anchors, he considered that they must be referred to the Pachastrellidæ, and proposed for them the name of *Ophirhaphidites*.

The University Museum at Göttingen possesses the somewhat compressed fragment of a siliceous sponge from the *Quadratus*-chalk of Linden, near Hanover, measuring 80 millims. in length, 16 millims. in breadth at the upper, and 9 millims. at the lower extremity, and consisting of simple, more or less undulated, smooth spicules, which exactly agree with those of *Ophirhaphidites*. The length of these spicules, which have unusually wide axial canals, varies between  $1\frac{1}{2}$  and 5 millims.; they all lie, closely packed together, in the direction of the long axis, are intimately interlaced, and have no free space between them for either longitudinal or transverse canals. Among these curved bacillar spicules simple quadriradiates occur quite isolatedly, having one arm usually much elongated—as a rarity also forked anchors with a long shaft and short prongs. I name this remarkable form *Ophirhaphidites cretaceus*.

I have received another interesting Tetractinellid form allied to *Tethya* from the *Quadratus*-chalk of Ahlten, through Dr. Steinmann. It forms a distinct genus:—

\* *Ann. & Mag. Nat. Hist.* ser. 4, vol. xix. (1877) p. 382.

† *Ann. Soc. Malac. Belg.* vol. ix. (1874) pl. iii.

‡ *Ann. & Mag. Nat. Hist.* ser. 4, vol. vii. (1871) p. 131, pl. x. fig. 79.

§ *Ibid.* vol. xviii. (1876) p. 458.

## TETHYOPSIS, Zitt.

Of irregular, nodular, or clavate form. Skeleton composed chiefly of very large, straight or slightly curved, bacillar spicules, as much as 5 millims. long, sharply pointed at both ends, which, being laid together in a parallel direction, give the interior of the sponge-body a radiate structure. The surface is formed by a layer of smaller three-pronged anchors, the long shaft of which is turned inwards. The three prongs are generally equally developed, and spread out horizontally with their points a little recurved. Among these large anchors there are scattered smaller ones, in which the three short prongs are recurved like hooks. The cortical anchors are further associated with small somewhat curved bacillar spicules and with isolated quadriradiates.

Although the anchors, quadriradiates, and small bacillar spicules just described are chiefly concentrated at the surface, they are also to be observed in the interior of the sponge-body, but only in radial lines, therefore probably as the lining of canals.

This form comes very near to the living *Tethya cranium*, Risso, and the allied species to which Carter\* would limit the name *Tethya*, whilst O. Schmidt has proposed for them the designation *Tetilla*. I have, however, hesitated to unite the fossil form with the living ones under the same generic name, as the superficial anchors in *Tethyopsis* rather resemble those of *Geodia* and *Stelletta* than those of *Tethya lynceurium*.

At present I know only a single specimen of this species, for which I propose the name of *Tethyopsis Steinmanni*.

## PACHASTRELLA, Schmidt.

This genus was established in 1868 by Oscar Schmidt ('Spongien der Küste von Algier,' p. 15), and characterized as follows:—"A Compaginean without epidermis, with spicules of the character partly of the Compagineæ, partly of the Corticatæ." In the Atlantic sponge-fauna two other species (*P. abyssi* and *connectens*, Schm.) are figured; but we are indebted to Carter† for the first sufficient and detailed characterization of the genus, and for satisfactory figures of the skeletal elements.

According to him, *Pachastrella* embraces massive, nodular or lamellar, frequently parasitic or incrusting sponges, without determinate external form, and without any special cortical

\* Ann. & Mag. Nat. Hist. ser. 4, vol. viii. (1871) p. 103.

† Ann. & Mag. Nat. Hist. ser. 4, vol. xvi. (1875) p. 68, and vol. xviii. (1876) pp. 406-410.

layer. Oscula, pores, and canals are distinctly visible only in fresh specimens furnished with sarcodæ. Skeleton with no horny fibres, consisting of irregularly intermixed spicules of various forms. The true skeletal spicules are chiefly quadriradiate; but one ray is very frequently developed into an elongated shaft, or reduced so as to form a button-like swelling, or so completely that a simple triradiate results. Certain arms, or sometimes all the arms, of the quadriradiates may fork once, or rarely more than once. Simple bacillar spicules also occur more or less abundantly; and these, as well as the tri- and quadriradiates, are generally of different sizes. Besides the true skeletal corpuscles there are great numbers of minute flesh-spicules, distinctly recognizable only under a high power; and these are of very various forms and may chiefly be employed for the discrimination of the species. The flesh-spicules are sometimes small, spinous, straight or curved bacilli, sometimes spherical spinous stars, sometimes minute spherules like those of *Geodia*, sometimes smooth elliptical lamellæ, &c. In fossil specimens the flesh-spicules are not preserved, any more than those of the Hexactinellidæ and Lithistidæ.

In examining the splendid sponge-material from the Upper Cretaceous of Ahlten, in Hanover, which was entrusted to me by my friend Prof. von Seebach, I met with two insignificant-looking nodular fragments of small size, which I at once recognized as typical *Pachastrellæ*, when they proved, after treatment with muriatic acid, to be composed of isolated quadri- and triradiates. As objects for comparison Mr. Carter had sent me the existing species, *Pachastrella abyssii*, Schm., and *P. geodioides*, Cart., and also two fragments from the Upper Chalk of Flamborough Head, the last of which, notwithstanding their unfavourable state of preservation, exactly agreed with the form from Ahlten.

*Pachastrella primæva*, Zitt.,

consists principally of very large, stout, simple quadriradiates (cross-spikes), the thick arms of which gradually diminish in thickness from the centre to the ends, and terminate in points. Sometimes the arms are of unequal length and one or more of them curved; more rarely certain arms, but never all of them, are divided at the ends into two or more points. Among these large bodies there lie numerous small regular quadriradiates, as well as isolated forked anchors, with a simple shaft and trifurcate prongs. Bacillar spicules pointed at both ends also occur, but rarely.

[To be continued.]

XXXV.—*Description of two new Species of Birds from South-eastern New Guinea.* By R. BOWDLER SHARPE, F.L.S., F.Z.S., &c., Senior Assistant, Department of Zoology, British Museum.

IN a collection of birds recently sent to England by Mr. Kendal Broadbent from the interior of South-eastern New Guinea, there are two apparently new species, which, in justice to that energetic collector, should, I think, be made known at once. I therefore append diagnoses of these birds.

Fam. **Muscicapidæ.**

Genus **PÆCILODRYAS.**

*Pecilodryas flavicincta*, sp. n.

*P. supra flavicanti-viridis*: tectricibus alarum remigibusque fusciscenti-nigris, viridi dorsi colore marginatis: reetricibus fusciscenti-brunneis, extus viridi limbatis et vix albedo terminatis: pileo nuchaque saturate cinereis: mento, genis anticis et regione parotica pileo concoloribus, hac paullo nigricante: genis posticis, gula ima et jugulo læte flavis, ut et colli lateribus, fasciam latam transversalem jugularem exhibentibus: præpectore et pectore summo flavicanti-viridibus: corpore reliquo subtus lætissime flavo: subalaribus axillaribusque albidis læte flavo lavatis. Long. tot. 5·3, culm. 0·7, alæ 3·65, caudæ 2·2, tarsi 0·9.

Of the same group as *P. capito* and *P. leucops*, but quite different from either of them in its coloration.

Fam. **Platycercidæ.**

Genus **APROSMICTUS.**

*Aprosmictus Broadbenti*, sp. n.

*A. similis A. calloptero*, Salvad. et D'Albert., sed minor, occipite nuchaque, ut et interscapulio summo, læte cæruleis, subcaudalibus cærulescenti-nigris, coccineo terminatis distinguendus. Long. tot. 14, culm. 1·0, alæ 7·6, caudæ 8·7, tarsi 0·7.

The types of both the species here described are in the British Museum.

## BIBLIOGRAPHICAL NOTICE.

*The Structure of Eozoon canadense compared with that of Foraminifera, by his own Investigations.* By Professor KARL MÖBIUS, Professor of Zoology at Kiel. 4to. Extracted from TH. FISCHER'S 'Palæontographica,' vol. xxv. (pp. 175-192, and plates 33-40), 1878.

[Der Bau des *Eozoon*, &c.]

THE author first enumerates the published memoirs on *Eozoon*, and states how he was led to look specially into the matter, having met with his *Carpenteria raphidodendron*, of Mauritius, which at first sight he thought would present some striking analogy to the presumed Laurentian fossil. The sources whence he obtained Eozoonal preparations and the methods of examination are also mentioned. The form and size of *Eozoon*, as recognized by Dawson and Carpenter, and their comparison of its structure with that of certain Foraminifera, are given in some detail; also the shape, size, and arrangement of the serpentine bodies ("chamber-casts," "concretions," &c.), their connexion, and the fibrous layer ("acicular crust," "nummuline layer," &c.) between these bodies and the limestone (calcite) are treated of as figured in the accompanying plates. The little Eozoonal stalk-like bodies traversing the associated limestone (calcite), and regarded by Eozoonists as "casts of canals," are next dealt with (p. 185). The structure, as a whole, is compared with that of Foraminifera at pages 186-189. The absence of any primary or central chamber, the apparently capricious distribution of both the "tubuline layer" and the "canals," the impossibility of representing the *Eozoon* as a whole by any drawing of one natural specimen, and the consequent necessity of using diagrammatic figures to illustrate the reconstructed body, are points dwelt upon in this chapter, leading to Prof. Möbius's conclusion that he does not believe *Eozoon* to be a Foraminifer or organic at all.

At pages 189-191 the author refers to the brief published observations on *Eozoon* emanating from the lamented Max Schultze, who stated that he could not agree in the opinion that the so-called "nummuline layer" was really of Foraminiferous origin, and expressed his intention of giving further study to the other peculiar structure, which had been referred by Dawson and Carpenter to the "canal-system," and with specimens of which his friends were supplying him.

The reasons for referring the structure of Eozoonal marble to a Rhizopodal organism have been given in detail, with illustrations, in many papers and notes by Carpenter and Dawson in this and other periodicals. The objections now again raised by our author have been already dealt with in those papers. Of the structures treated of by Prof. Möbius the branching and lobular infillings of the "canal-system" are particularly valued by Eozoonists as good evidence, on account of their peculiar arrangement, so agreeable to the disposition of canals in certain Foraminiferous shells. Such



appearances in *Calcarina* &c. were figured and published without reference to and before the discovery of *Eozoon*. That ancient organisms, though belonging to the same groups as are represented in nature to-day, should differ widely in details of structure, is a truism illustrated by many newly discovered fossil (and even recent) forms of life, whose structure is found to be wonderfully different from, and yet wonderfully consonant with, the make-up of the already known types of organic structure; and this invalidates our author's objection to a reliance on the possibilities of Nature. What zoologist or botanist can predicate the structural details of the next discovered plant or animal, however narrow the limits we may suppose to define its alliance to any previously known form?

Although many mineralogists regard the Eozoonal rock as having been as inorganic in its origin as it now is in its material, yet Dr. Sterry Hunt, for one, who has long studied it, thinks that its peculiarities are not due to a mineral genesis alone. We know also that not only Foraminiferal shells, but other calcareous tests and skeletons, both recent and fossil, have their tubes and cavities filled by various minerals, with results very similar to what is regarded as having taken place and as being visible in *Eozoon*.

It is not that here and there, and, indeed, in very many parts of a true Eozoonal rock there are lines and patches, fibrous and concretionary, of purely mineral origin, as well as their mineral matrix; the point to be kept in view is that the structure of certain portions is best explained by reference to mineral infiltration of tubular and cavernous shells, which grew and spread after the manner of Foraminifera, though not identical with any known form in particular. Also it has to be remembered that not only has the enclosing rock been itself subjected to mineral changes, but has been crushed, broken, and twisted, and that the scarcity of large areas of perfect and undisturbed structure, in such a relatively large Rhizopod, has to be supplemented, in the study of its whole, by such diagrammatic constructions of what the experienced observer recognizes and wishes to explain, as our author condemns at p. 188, because, he thinks, the Eozoonists in their diagrams have overstepped the line of probability. Without such illustrations, showing (like models) both the elevation and perspective of internal arrangements, we may remark, external appearance and microscopic sections would very imperfectly elucidate the descriptions of large Foraminifera. The correlation of the mineral representatives of at least the "canal-tubes" and "chambers" in *Eozoon*, both of which are cut at many different angles in sections, and can rarely be seen in elevation, and then only to a small extent, are best shown by this method—especially, too, as the student has, in this case, to make a mental translation of threads into tubes and nodules into chambers.

At page 198 Prof. Möbius consoles the Eozoonists with his opinion that the doctrine of evolution need not be despaired of because he removes the primordial *Eozoon* from the category of Beings. We do not see the value of this commonplace and wordy

little chapter, except to illustrate what (at pp. 178, 179) he warns Eozoonal and other naturalists to avoid, namely, time-wasting and immature talk, in which words take the place of ideas.

Plates xxiii. to xxxiv. inclusive contain carefully drawn figures (coloured) of preparations of the Eozoonal ophitic marble, as thin slices, as etched surfaces, and as separated particles, communicated by Drs. Carpenter and Dawson.

Plates xxxv. to xl. inclusive (excepting one figure) contain enlarged sections of the shell-structure of *Polytrema miniacum*, *Cycloclypeus*, *Nummulina*, *Calcarina Spengleri*, *Tinoporos baculatus*, *Orbitoides papyracea*, *Polystomella*, and *Carpenteria raphidodendron*. All (except one) of these drawings have been made by the Author himself.

In none of the preparations of known recent and fossil Foraminifera here figured does Prof. Möbius see any thing more than a very distant resemblance to Eozoonal structure, which latter, as before said, he regards as inorganic.

This memoir is a handy *résumé* of the objections made by anti-cozoonists to the presumed organic origin of the object under notice; and the plates brought together by Prof. Möbius, with no little labour and skill, are useful as a compendious set of sectional figures of *Eozoon* and many of its more modern relations; and though he fails to see their alliance, close as the analogies may be, yet his work is highly useful and praiseworthy; it is disinterested, straightforward, and conscientiously offered for the advancement of true knowledge.

T. R. J.

## PROCEEDINGS OF LEARNED SOCIETIES.

### GEOLOGICAL SOCIETY.

February 21, 1879.—Henry Clifton Sorby, Esq., F.R.S.,  
President, in the Chair.

The following communications were read:—

1. "Note on *Poikilopleuron Bucklandi*, of Eudes Deslongchamps (père), identifying it with *Megalosaurus Bucklandi*." By J. W. Hulke, Esq., F.R.S., F.G.S.

The author stated that the genus *Poikilopleuron* was founded by Deslongchamps, after much hesitation, to receive some Megalosauroid fossils found in a quarry near Caen, and that he gave them the specific name "*Bucklandi*," with the view of facilitating the union of the two genera, should this be found necessary. The author reviewed the evidence on which the genus *Poikilopleuron* rests, indicating the close resemblance of the remains to those of *Megalosaurus*, and showing that a medullary cavity exists in the vertebræ of the latter, thus getting rid of the most important difference between the two supposed genera. The author's conclusion was that *Poikilopleuron* and *Megalosaurus Bucklandi* were identical.

2. "Note on a Femur and a Humerus of a small Mammal from the Stonesfield Slate." By H. G. Seeley, Esq., F.L.S., F.G.S., Professor of Geography in King's College, London.

The author described a small femur and humerus preserved in slabs of Stonesfield Slate in the collection of the British Museum, to which they were presented many years ago by Mr. Pease Pratt. The bones nearly correspond in size; and, in the absence of evidence to the contrary, the author preferred to regard them as possibly belonging to the same animal. From their characters the author was inclined to associate them with the jaw known as *Phascolotherium*, and to believe that they represented a special, probably insectivorous, monotreme type, with indications of marsupial tendencies, such as, on the hypothesis of evolution, might well be expected to occur early in the development of the Mammalia.

3. "A Review of the British Carboniferous Fenestellidæ." By G. W. Shrubsole, Esq., F.G.S.

In this paper the author gave the results of his investigation of the Fenestellidæ from the upper beds of the Carboniferous Limestone on Halkin Mountain, in Flintshire. He stated that the described Carboniferous species of *Fenestella* now number 24, of which he has been able to examine 19, and finds that they have been needlessly multiplied, owing especially to the neglect on the part of describers to allow for difference in the structure at various stages of growth and in different parts of the polyzoarium. His investigations led him to refer the forms known to him to only 5 species, namely, *Fenestella plebeia*, M'Coy, *F. crassa*, M'Coy, *F. polyporata*, Phill., *F. nodulosa*, Phill., and *F. membranacea*, Phill.

## MISCELLANEOUS.

*New Observations on the Development and Metamorphoses of the Tapeworms.* By M. P. MEGNIN.

THE author refers to the well-known investigations of Van Beneden, Von Siebold, Leuckart, Küchenmeister, and others, from which it was concluded that the vesicular worms must be swallowed by a carnivorous animal in order to attain their perfect, reproductive, ribbon-like form—and remarks that, while this hypothesis accounted well for the production of the hooked *Tæniæ* of the Carnivores and Omnivores, it did not explain the origin of the unarmed *Tæniæ* of Herbivores, such as the horse, ox, sheep, rabbit, &c., which do not devour any animal capable of harbouring the scoleces of their tapeworms. He finds in horses and rabbits that the vesicular worms (an *Echinococcus* in the case of the horse, *Cysticercus pisiformis* in the rabbit), when they are developed in adventitious cavities in direct communication with the interior of the intestine, resulting from the enlargement of follicles or glands into which the six-

*Ann. & Mag. N. Hist.* Ser. 5. Vol. iii. 22

spined embryos have made their way, or even when they are set free in the peritoneal cavity (in the wild rabbit), continue their metamorphoses *in situ*, and arrive at the adult sexual state without quitting the organism into which they penetrated as a microscopic ovum (only 0.030–0.070 millim. in diameter); only, in this case they furnish an unarmed *Tenia*. On the other hand, if the same vesicular worm is swallowed by a Carnivore or an Omnivore, it becomes, in the intestines of the latter, an armed *Tenia*; that is to say, it retains the hooks of the scolex from which it originates. In the former cases it loses them.

He adds that certain unarmed and armed *Teniac* are therefore two adult and parallel forms of the same worm; and the differences, often very great, which they present (as in the case of *Tenia perfoliata* of the horse, and *Tenia echinococcus* or *T. nana* of the dog, which originate from the same vesicular worm) are due exclusively to the difference of habitation and medium in which their final metamorphoses have been accomplished.—*Comptes Rendus*, January 13, 1879, p. 88.

*On the Segmental Organs and Genital Glands of the Sedentary Polychætal Annelids.* By M. L. C. E. COSMOVICI.

Although many naturalists have paid attention to the organization of the Polychætal Annelids, it still remained to be ascertained in this group what is to be understood by the term *segmental organ*, and what is the nature of the organs of reproduction. Researches carried on for two years at Roscoff and at the Sorbonne, in the laboratories of experimental zoology of M. Lacaze-Duthiers, have led me to the following results.

The glandular sacs found in the interior of the body in these animals, and regarded by many authors as genital glands, were taken by Claparède, Keferstein, Ehlers, and others for segmental organs. Now their organization is more complex.

In a certain number of sedentary annelids, such as *Arenicola*, *Terebella nebulosa*, and others, these sacs are composed of two very distinct parts—one glandular, with very vascular walls, opening outwards by a special pore, and in the interior of which we detect, by means of reagents, a great number of crystals which appear to be formed of uric acid; this is incontestably a urinary organ or a *corpus Bojani*; the other part, which is not granular, is composed of a pavilion with two lips, more or less provided with very ciliate fringes, followed by a tube which is applied to the surface of the corresponding *corpus Bojani*. A communication exists between the two parts in the point of attachment; so that all bodies collected by the pavilion of one of these organs passes into the *corpus Bojani*, and is afterwards carried by the ciliary current towards the external opening. It is to the second part of these sacs that the name of *segmental organ* must be given.

The distinction between these two parts is observed with the utmost clearness in a great number of sedentary annelids. Thus in *Terebella conchilega* there are three pairs of these pouches which

are composed only of the glandular part, and which consequently have no communication with the interior of the cavity of the body; but further back we find two pairs of normally constructed segmental organs opening directly outwards by a pore. *Ophelia bicornis* presents a still more striking example. We find here five pairs of segmental organs placed on the sides of the nervous chain, followed by five other pairs of glandular pouches destitute of any communication with the interior. Lastly, the *Sabellæ* and the *Myxicolæ* have only one pair of renal pouches on the sides of the œsophagus, and in all the rest of the body each segment has its pair of segmental organs of the typical form. It must be added that the histological and chemical characters prove that these glandular sacs are really urinary organs, and that the segmental organs, sometimes borrowing from them, sometimes not, are perfectly independent parts, having no other function than that of collecting the products of generation in order to pour them out.

There is still much uncertainty with regard to the genital glands. My observations lead me to assert that in the sedentary annelids the ova and spermatozooids never originate either in the Bojanian sacs or in the epithelial cells of the peritoneum, nor are they derived from the nuclei surrounding the blood-vessels, nor even from the adipose tissue (sexual tissue of Claparède); but there exist very distinct glands in intimate connexion with the blood-vessels. Thus in *Arenicola piscatorum*, *Terebella conchilega*, and *Ophelia bicornis* the male or female genital gland is attached to the vessel which comes from the central part of the circulatory apparatus and runs to the segmental organs. The position varies in each of these genera; but the number is always equal to that of the pairs of segmental organs. In the *Terebellæ nebulosæ* the genital gland is on the median line around the supranervian blood-vessel, and only in the thoracic portion. In *Chaetopterus pergamentaceus* the glands are situated in pairs in each segment and on the sides of the intestine. In the *Sabellæ*, again, they are placed in pairs in each segment, around the inferior lateral vessel.

These glands, during the period of repose (winter), consist of a certain number of small acini, the structure of which presents nothing very distinct. Towards the commencement of the spring the glands enter into activity, with differences according to the genera. The amorphous mass increases; each acinus becomes more and more defined; and in its interior we see small nuclei appear, around which a portion of protoplasm soon becomes limited. The ova are soon marked out, and at the same time they are displaced by fresh quantities of protoplasm developed at the base of the acinus. The gland acquires the form of a bunch of grapes; and the most mature ova arrive at the periphery, the youngest remaining at the base. The vitellus gradually becomes granular; and the germinal vesicle shows itself. Finally the ovum is detached and falls into the cavity of the body.

The same thing is observed in the case of the testes. The spermatogenic mother cells detach themselves from the glands; then their

walls dissolve, and their mulberry-like contents float for some time in the fluid of the cavity, after which the spermatozoids, hitherto united by their heads, separate and become free.

Oviposition takes place at different periods, according to the genera and species, and it is effected through the segmental organs.—*Comptes Rendus*, February 24, 1879, p. 393.

*On Glodium quadrifidum, a new Genus of the Group Protista.*

By M. N. SOBOKIN.

This new type of the Protista has been found at Kasan in a fresh-water aquarium. It consists of a small mass of protoplasm, about 0.03 millim. in diameter, of a more or less spherical form, and without an enveloping membrane. It exhibits a clear and transparent ectosarc, an endosarc containing reddish and yellowish granules of different sizes, and a contractile vesicle occupying a variable position, but usually situated in the ectosarc. There is generally a lapse of three or four minutes between the first appearance and the disappearance of this vesicle.

The changes of form of the outline of this creature are slow; and it only emits short processes having a slight tendency to bifurcate. A division which occurs in it begins to show itself in the ectosarc; but before it has had time to become well-marked, there appears a second constriction, perpendicular to the first, so that the mass soon forms four parts, only attached to one another by slender peduncles united in the middle, and which finally separate completely. The contractile vesicle, which had at first withdrawn to the middle of the body, afterwards reappears in each of the four new individuals.

Under the influence of conditions which are still unknown, this Protistum undergoes an encystment. The outer layer of the ectosarc gives origin to a thin but resistant membrane; then, within this first envelope, other similar, more or less distinct layers successively make their appearance. Upon one point of the envelope of the cytode thus formed there is a funnel-shaped canal, which is closed at the outer surface only by the first membrane of the cyst. The protoplasm of the *Glodium* soon passes into this canal, ruptures the membrane which closes it, and passes outside. The organism which is thus set free is usually smaller than before the encystment. Multiplication by division takes place afresh, either immediately or after two or three successive encystments.

*Glodium* is distinguished from the true Amœbæ by the absence of a nucleus, and from the Monera by the existence of a contractile vesicle, and (except the Lepomonera) by its faculty of encystment.

However, as passages exist between the Amœbæ and the Monera, the most striking character which distinguishes this new form is the quaternary division. In the *Vampyrellæ*, indeed, a similar division is observed; but it is effected during the encystment, while here it takes place in the free phase.—*Morphologisches Jahrbuch*, vol. iv. 1878, p. 398; *Bibl. Univ.* March 15, 1879, *Arch. des Sci.* p. 287.

# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 17. MAY 1879.

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XXXVI.—*Descriptions of new Species belonging to the Genus Solenopus, with some Observations on their Organization.*  
By J. KOREN and D. C. DANIELSSEN \*.

It is about thirty years since one of us (Koren) first found the animal which will be described below under the name of *Solenopus nitidulus*. Koren's investigations, however, went no further at that time than to convince him that it was a mollusk; for he had not sufficient material for a more thorough-going examination. Some years later it was also found by our late friend Prof. M. Sars; but he got no further than Koren, having only one specimen at his disposal. Nevertheless he quite agreed with Koren that the animal must be referred to the Mollusca. In the course of years we found single examples in various localities; and these we submitted to investigation, as it was our purpose to produce a monographic description of this remarkable animal. But the difficulties in the way of submitting it to a minute anatomico-histological examination, combined with the extremely scanty material at our disposal, led to our deferring the final working up, so as not to furnish a misleading work. During the last three or four years Prof. G. O. Sars, who knew that we had

\* Translated by W. S. Dallas, F.L.S., from a separate copy of the paper in the 'Archiv for Mathematik og Naturvidenskab,' Christiania, 1878.

been occupying ourselves for a long time with the animal in question, most kindly furnished us with numerous specimens, many of which, however, are of different species; and we commenced our investigations, which are now so far advanced that we can give a brief description of the forms of which we are in possession, in the hope, however, that, in the course of next year, we shall be able to complete a more exhaustive memoir, accompanied by figures. That this abridged description makes its appearance now is owing to the fact that we are urged thereto by Prof. G. O. Sars, who is just engaged upon a work on the Arctic mollusk-fauna, in order that he may be able to include in the latter the arctic species of this genus.

But although we, at intervals of many years, have only had scanty opportunities of occupying ourselves with the animal under consideration, seeing that we very seldom found it and then only in isolated examples, it has nevertheless, during the long period which has elapsed since Koren first met with it, been detected by other naturalists, such as, especially, the older and younger Sars, Dalyell, S. Lovén, and T. Tullberg. Dalyell, in the 'Powers of the Creator,' has given a description with figures of the animal, which he refers to the *Vermes*, and calls *Vermiculus crassus* \*. There is no doubt that this belongs to the molluscan genus that we describe below; and, so far as we can judge from Dalyell's description and figures, it is probably the species to which we have given the name of *Solenopus Dalyellii*. If we had not feared that the generic name *Vermiculus* would lead to error and confusion, we should have retained it for our mollusk, as it had the priority of date; but, in order to avoid all such dangers, we have adopted M. Sars's name, both for the genus and for the single species which was known at that time, namely *Solenopus nitidulus* †. Sars, indeed, has not given any description of the animal; so that it was not well possible for any one but ourselves, who were acquainted with it, to know what animal was meant by *Solenopus nitidulus*; and it is certainly only this circumstance that has caused Hr. Tullberg not to adopt Sars's designation, but to give it a new name (*Neomenia carinata* ‡). If we now adopt Sars's name, it is both because it has the right of priority and because it applies better to the genus, which is essentially characterized by the

\* 'The Powers of the Creator,' vol. ii. p. 88, pl. x. fig. 11.

† Forhandl. i Videnskabs-Selsk. i Christiania, Aar 1868, p. 257.

‡ Bihang til Svenska Vet.-Akad. Handl., Band iii. no. 13; "*Neomenia*, a new Genus of Invertebrate Animals," by Tycho Tullberg.



furrow (fissure) which occurs on the ventral surface, and within which the foot is concealed; there is, so to speak, a cleft for the foot; whereas "crescent" (*Neomenia*) really only applies to the species which Hr. Tullberg has described after the animal is preserved in spirits; for in the living state it has properly no crescent-shape; and as regards the other six species now described by us, it does not at all apply to them.

We have already stated that Koren and M. Sars regarded *Solenopus nitidulus* as a mollusk; and our subsequent investigations have most decidedly confirmed this. But, as it differs considerably from previously known mollusks, we have not been able to bring it under any of the established orders of Mollusca, although it may well be referred to the great subclass Opisthobranchiata of Milne-Edwards. We have accordingly formed for it a third order of Opisthobranchiata, which we have called Telobranchiata\*, because the branchiæ are situated at the hinder extremity of the animal.

After what we have said above, of course we have been unable to adopt Dr. Ihering's classification † with regard to the mollusk here treated of; for, although there is an anomaly in the generative organs of *Solenopus nitidulus*, which might indicate that, from a phylogenetic point of view, it was derived (had descended) from the Platyelmia, it is nevertheless certain that it is a true mollusk, and may be classified as such.

We shall follow the brothers H. and A. Adams's classification of the Gasteropoda.

### Subclass OPISTHOBRANCHIATA, Milne-Edwards (1848).

#### Order 3. *TELOBRANCHIATA*, Koren and Daniëlssen.

The Telobranchiata are naked marine animals, with more or less worm-like bodies. They are hermaphrodite, and have neither tentacles, eyes, radula, or jaws. The foot is long and narrow, and can be completely concealed by the mantle. The branchiæ, which are placed at the posterior extremity of the animal, are retractile. Heart with a pretty well developed vascular system. Body-cavity almost entirely filled by the visceral mass. Generative organs situated along the back, above the stomach and intestine. Nervous system composed

\* From *τέλος*, end, and *βράγχια*, gills.

† *Jahrbücher der Deutschen malakozoologischen Gesellschaft*, 1876, Heft ii. p. 136; *Vergleichende Anatomie des Nervensystems und Phylogenie der Mollusken*, von H. von Ihering, 1877, pp. 31-42.

of an œsophageal ring with one cerebral and two pedal (infra-œsophageal, Tullb.) ganglia.

Family I. *Solenopodidæ*, K. & D.

(*Neomeniade*, Ihering.)

Along the ventral surface a furrow, within which the long narrow foot is concealed. Branchiæ filiform.

Genus 1. *SOLENOPUS*, M. Sars, 1868.

*Vermiculus*, Dalyell, 1853.

*Neomenia*, T. Tullberg, 1875.

Body cylindrical, with filiform branchiæ at its posterior truncated extremity. Above the branchial cavity in the posterior margin of the mantle a genital pore, and in the bottom of the branchial cavity an anal orifice. Buccal mass thick, muscular, capable of being completely covered by the mantle, which is covered all over with diversely formed calcareous spicules. Along the ventral surface a furrow, in which the foot is concealed.

1. *Solenopus nitidulus*, M. Sars.

*Neomenia carinata*, T. Tullb.

The body is nearly round, but a little flattened on the ventral surface, 30 millims. long, 10 millims. broad. Back convex, furnished with a keel. The ventral surface has a furrow, which is formed by the lateral margins of the mantle, and commences 6 millims. from the anterior extremity of the animal, and extends towards the posterior extremity, terminating 8 millims. from the latter. In the bottom of this furrow lies the foot, the anterior part of which is thick, round, 3 millims. in breadth, and becomes narrower and narrower as it approaches the animal's posterior extremity. The lateral margins of the mantle can shut close together; and then only a fine stria is visible; whilst when they separate from each other the furrow becomes tolerably broad, and then the foot comes into view. In the anterior part, towards the ventral surface, the mantle forms a longitudinal fissure, which can expand and contract; within this there is a cavity, surrounded by a fold of skin, which is broader towards the sides, narrower anteriorly and posteriorly. In the bottom of the cavity, somewhat posteriorly, appears the round buccal aperture. At the posterior extremity, likewise towards the ventral surface, there is also a fissure in the mantle, which can expand and

contract, and forms the proper entrance to the branchial cavity. This is ovate from behind forwards, 6 millims. in length and 4 millims. broad in the middle. The branchiæ are arranged in the form of an oblong eirelet, consisting of thirty filiform tubules, of which those nearest the back are the longest, and those towards the ventral surface are extremely short. At the bottom of the branchial cavity is the round anal orifice. Above and behind the branchial cavity, exactly upon its margin towards the dorsal surface, there is a thick round papilla, in the middle of which is a fine aperture for the generative organs.

The skin or mantle, which is thick and firm, is beset all over with numerous calcareous spicules, which give it a shining appearance. These calcareous spicules are of four different forms: on the dorsal keel they are alternately spear-shaped, lancet-shaped, and needle-like; on the rest of the mantle they are lancet- and needle-shaped. The skin is covered with a single layer of cylindrical epithelial cells, in the midst of which there are, at tolerably regular distances apart, large round cells, which project above the level of the rest of the epithelium, and are filled with a granular mass. These are probably unicellular mucus-glands, and are most likely the bodies described by Tullberg as warts in the skin. Beneath the epithelium the mantle consists of a homogeneous tissue, in which a fine striation may be detected here and there. Imbedded in it are vessels, muscles, and nerves. The vessels are tolerably numerous, partly empty, partly filled with detached oblong cells; in many places they run into pointed canals, terminating cæally, which are completely filled with a granular protoplasm. The muscles run partly in bundles, partly as single fibres in all directions; only towards the inner surface are they somewhat regularly arranged in longitudinal and annular positions.

#### *Alimentary Organs.*

The buccal mass is thick and muscular, and has anteriorly a round aperture without teeth, from which start two long cushions, which project down into the œsophagus; the latter is tolerably wide in the middle, but where it passes into the stomach it is narrowed and surrounded by a sphincter. The stomach occupies nearly the whole of the body-cavity; its walls are firmly affixed to the mantle, except above, along the back, where the genital gland is placed between the mantle and the stomach. Its inner surface is strongly folded. The folds are broadest in the middle, between the dorsal and

ventral surfaces, where they form leaf-like processes. In its walls there are many large round cells, the contents of which consist of fine dark granules (hepatic cells). Towards the hinder part of the body the stomach contracts considerably, as it passes into a short intestine, which opens into the branchial cavity. The whole of the inner surface of the alimentary canal is furnished with ciliated epithelium.

#### *Circulatory Apparatus.*

In the posterior end of the body there is between the mantle and the intestine (rectum) a space in which the heart is situated. Into its hinder margin opens the common stem of two vessels, which come from the still more posteriorly situated branchiæ; and from the anterior end issues a single vessel, which passes into the mantle above the posterior termination of the genital gland, and at once begins to ramify. Along the middle line of the belly, just above the course of the mantle-furrow, runs a vessel which we have been unable to trace.

#### *Generative Organs.*

Along the dorsal surface of the animal, in the same direction as the keel, and between the latter and the stomach, lies the hermaphrodite gland, which is lobate, consists of a number of acini, and has in the middle a tolerably wide efferent duct. When this has come a little way out of the gland, it divides into oviduct and *vas deferens*. Into the oviduct open the efferent ducts of the albumen-gland, which is three-lobed and oblong. As regards the *vas deferens*, we have reason to think that it divides, but cannot state any thing with certainty upon this point; for we have seen the connexion between the *vas deferens* and the penis-sheath only on one side, without being able to observe any division. On each side of the vestibulum there opens in its lateral margin a penis-sheath, which is extraordinarily muscular, and is clothed inside with cylinder-epithelium. Each of these sheaths encloses a compressed horny sheath, which is open along one margin, and at the posterior extremity beset with numerous small appendages; within this sheath, again, lies the true style (penis), which is likewise compressed, and terminates in a sharp point. The vestibulum is tolerably wide, with firm walls clothed with ciliated epithelium; and into it, besides the two penis-sheaths already described, there opens a small oblong vesicle with a short efferent duct (*receptaculum seminis*), as well as two looped mucus-glands with a common duct. The little oblong

vesicle was filled with a cream-like fluid, in which spermatozooids swarmed. In the hermaphrodite gland we have seen both spermatozooids and ova in different stages of development, but at different times.

With regard to the nervous system, we may for the present confine ourselves to confirming Tullberg's statements about it in essential points. Future investigations will probably carry us somewhat further.

*Colour.* Body light rose-red, with a greyish tinge, which has a pearly lustre and is somewhat iridescent. Branchiæ bright red. Foot and buccal mass red.

When the animal is brought up from the bottom and kept in a glass for observation, it generally lies quite quiet and somewhat rolled up, like a small thick worm, showing small signs of life. But it may happen that it begins to move: the margins of the mantle are thrown apart, and the foot comes forth; and then it can creep up over the surface of the vessel with great quickness, just like other mollusks; nay, sometimes it floats at the surface of the water, the back being turned downwards and the crooked foot upwards.

*Habitat.* Near Eivindvig (Sognefjord), at a depth of 60 fathoms by Koren in 1846; near Manger, a few years later, by M. Sars, 300 fathoms; near Lofoten, by G. O. Sars; Moldefjord, 60 fathoms, and in Korsfjord, at 200 fathoms, by Koren and Danielssen, but only single examples. It appears to be extremely rare near the Norwegian coast. In Bohuslehn it is found by J. Lovén and T. Tullberg; but here also it seems to be rare.

## 2. *Solenopus affinis*, Kor. & Dan.

Body somewhat curved in the direction of its length, furnished along the back with a very high keel, 16 millims. long, 6 millims. broad, 6 millims. in height, of which the keel makes 2 millims. Mantle beset all over with calcareous spicules. It somewhat resembles *S. nitidulus*, but has a much more elevated and prominent keel.

*Habitat.* Messina (Prof. G. O. Sars), 20-30 fathoms; only a single example.

## 3. *Solenopus Dalyellii*, Kor. & Dan.

*Vermiculus crassus*, Dalyell?

Body round, thick, somewhat elongate; back convex, without a keel; belly flat. The largest specimen 20 millims. long, 7 millims. broad in the middle; towards the anterior

extremity it decreases in thickness; the posterior extremity obliquely truncated. Calcareous spicules all over the body.

*Habitat.* Lofoten, 2–300 fathoms, Hasvig (Finmark), 60–150 fathoms (Prof. G. O. Sars); Sondfjord, 100 fathoms (Koren). Station 79 (Norwegian Atlantic expedition), lat.  $64^{\circ} 9' N.$ , long.  $6^{\circ} 6'$ , 157 fathoms. Temperature  $46^{\circ} 22$  F. Clayey sand.

#### 4. *Solenopus incrustatus*, Kor. & Dan.

Body cylindrical, 30 millims. long, 3 millims. broad, pointed towards the anterior, truncate at the posterior extremity, strongly incrustated with particles of sand, so that it has a rugged appearance. Mantle destitute of the spear-shaped calcareous spicules along the back.

*Habitat.* Hasvig, Finmark, 2–300 fathoms (Prof. G. O. Sars).

#### 5. *Solenopus margaritaceus*, Kor. & Dan.

Body round, thick, strongly glistening, pointed towards the anterior extremity, almost transversely cut off at the hinder end, 12 millims. long, 1.5 millim. in thickness at the broader posterior extremity. Mantle covered with needle- and lancet-like calcareous spicules.

*Habitat.* Hvidingsøerne, Stavanger, 40–60 fathoms (Prof. G. O. Sars).

#### 6. *Solenopus borealis*, Kor. & Dan.

Body cylindrical, 25 millims. long, 3 millims. broad, rounded and rather narrower at the anterior end, truncate at the hinder extremity, and incrustated with sand. Along the whole of the back runs a rather fine but sharp line, which is but slightly elevated, and richly beset with short, thick, needle-shaped calcareous spicules.

*Habitat.* Lofoten, 40–50 fathoms (Prof. G. O. Sars). Station 18 (Norwegian Atlantic expedition, Danielssen), lat.  $62^{\circ} 8' N.$ , long.  $1^{\circ} 8'$ , 400 fathoms, clayey sand. Temperature  $29^{\circ} 66$  F.

#### 7. *Solenopus Sarsii*, Kor. & Dan.

Body cylindrical, 70 millims. long, 3 millims. broad; the hinder end cut off transversely, the anterior prolonged like a beak.

*Habitat.* Christianiafjord, 100–200 fathoms (Prof. G. O. Sars).

XXXVII.—Notes on the Lepidoptera of St. Helena, with Descriptions of new Species. By Mrs. T. VERNON WOLASTON.

[Continued from p. 233.]

Fam. III. Deltoidæ.

Genus 16. HYPENODES, Guén.

*Hyphenodes costæstrigalis*, Steph.

It is curious that the only example which we obtained of this little Deltoid in the island should happen to be such a remarkably dark variety. It was on the loftiest portion of the central ridge that we captured it, where it was adhering to the underside of a large and rotten block of cabbage-tree wood which was lying on the damp grass; although we frequently visited the same spot and made the most careful research, we were unable to obtain even a second specimen. At first sight it looks extremely like a member of the Phycidæ; indeed I concluded that it actually was one until Mr. Barrett recognized it as undoubtedly *Hyphenodes costæstrigalis*.

Genus 17. HERMINIA, Latr.

*Herminia rectalis*, Eversm.

This somewhat dingy-looking little moth (which occurs also in Casan and Orenburg) does not appear to be common at St. Helena. At any rate I obtained only two examples of it, and these at intermediate altitudes; but, as they were both of them found shortly before we left the island, it is not unlikely that our visit was not at the season when the moth is most plentiful.

Fam. IV. Geometridæ.

Genus 18. ACIDALIA, Treits.

*Acidalia separata*.

*Acidalia separata*, Walk., in Melliss's Saint Hel. 186 (1875).

This and the following *Acidalia* I have endeavoured to identify as well as I can from Mr. Walker's descriptions. I cannot but feel, however, that the result is not altogether satisfactory, inasmuch as I have no knowledge of either of them in their earlier stages; and I am inclined to suspect (at any rate until the contrary has been proved from an observation of the larvæ) that they are probably but varieties of a single variable form. More particularly am I inclined to this view since Mr. Walker had evidently not seen a male of his *A. separata*.

Even amongst the comparatively few specimens which I possess, hardly any two are exactly similar. Some, for instance, are without the confluent postmedian lines, having only a very faint single one; others, again, have them very large and conspicuous and forming almost a band; whilst in others the ground-colour is quite white and not irrorated with dusky scales.

*Acidalia atlantica.*

*Acidalia atlantica*, Walk., in Melliss's Saint Hel. 187 (1875).

This pretty little Geometer is not uncommon in St. Helena, both at low and intermediate elevations, more especially perhaps the former, where it attracts the eye as a very pretty object, resting, with its wings horizontally expanded, on the rough stone walls which fringe the outskirts of the unprofitable tracts of the prickly pear (*Opuntia vulgaris*, Mill.) above Jamestown.

Genus 19. STERRHA, Hübn.

*Sterrha sacraria*, Linn.

This extremely pretty and widely distributed Geometer is not uncommon in the intermediate districts of St. Helena; but I did not observe it so high as the central ridge. Indeed even Plantation is rather above its normal range, though during our residence there I obtained it sparingly. But about Woodcot, which is distinctly lower, it was quite abundant (particularly on open grassy slopes); and at Cleugh's Plain it was even commoner still. It therefore evidently prefers hot and sunny spots rather below what I have usually cited as strictly intermediate. My specimens are of a light pale delicate hue, and do not present that variety of colouring which characterizes this species in more northern climes, and which has been considered by some writers to be partly owing to this delicate tropical species adapting itself to a colder climate, when it has been observed that their texture is denser and their general form more robust. It occurs in Madeira and the Canary Islands, as also in Asia Minor, Cyprus, Syria, throughout Africa, and India; and specimens of it are constantly recorded as being found in the British Isles; indeed each year it seems to be becoming more plentiful.

Fam. V. Pyralidæ.

Genus 20. PYRALIS, Linn.

*Pyralis farinalis*, Linn.

The common European *P. farinalis* has completely esta-



blished itself at St. Helena, as, indeed, it seems to have done in most countries of the civilized world, its meal-infesting habits rendering it extremely liable to accidental transportation through indirect human agencies. As elsewhere, it more particularly abounds in old unused outhouses and barns, as well as about stables; and under such circumstances I met with it very commonly at Plantation.

*Pyralis helenensis*, E. Woll.

Expanse 11 lines. With the fore wings of a dull pale speckled griseous brown, and having two transverse brownish lines, the first one of which is antemedian, and the second one postmedian. Between these two lines the surface is rather darker (especially towards the costa) and with the discoidal spot almost undistinguishable. There is a small yellowish inconspicuous spot, or blotch, on the costa adjoining the exterior side of the postmedian line. Hind wings very pale cinereous, minutely speckled with black scales, and having two undulating darker lines, which are united near the inner margin. Thorax and body concolorous with the anterior wings.

The maxillary palpi are slightly longer and more conspicuous than in *P. farinalis*; the wings also, though smaller, are comparatively rather broader.

As this very ordinary-looking little moth is not mentioned by Mr. Melliss as occurring in the island, and I only met with one example, I think it must be a somewhat rare species. I was inclined at first to regard it as merely a geographical variety of our British *P. glaucinalis*; however, as far better judges have pronounced it to be a distinct and hitherto apparently unknown species, I have accordingly named it *helenensis*. Nevertheless I think it is but fair to add that the only example of it that we met with was captured under somewhat suspicious circumstances—namely, in the kitchen-garden at Plantation, amongst the various introduced European vegetation, where one would not naturally have expected to find the unique specimen of a species which was truly indigenous; especially is this the case when the peculiarly local character of most of the native St.-Helena Lepidoptera is taken into account. Indeed (as I shall have occasion to allude to further on) many species are so *ultra*-local, that although abundant enough in their exact *habitat*, yet a few feet away there is absolutely no trace of them whatever to be seen.

*Pyralis helenensis* differs mainly from *P. glaucinalis* in having the upper wings broader and slightly more rounded at the apex; and the undulating darker lines of the under wing are more transversely placed, as well as united near the inner

margin. The texture, too, of the wings appears in the present species to be thicker and more robust, or of a less delicate and shiny substance, than in *P. glaucinalis*.

### Genus 21. HYMENIA, Hübn.

#### *Hymenia recurvalis*, Fab.

There is probably no Lepidopterous insect in St. Helena (excepting, perhaps, the common *Scoparia nigritalis*) which is so abundant as the present one. Nevertheless it seems to be confined to the low and intermediate districts; or, at any rate, I did not observe it above the altitude of Plantation. At Plantation, however, and at Cleugh's Plain it swarms; and it was likewise in the utmost profusion about Jamestown, particularly in the Botanic Gardens and towards Maldivia. It flies by day, and is especially fond of the *Solanum nigrum*, Linn., or nightshade, over the low shrubby plants of which it may be seen to hover in multitudes. Unfortunately, however, I did not meet with it in either its larva or chrysalis state.

*H. recurvalis* occurs also at Ascension; and it is a species of a wide geographical range, being recorded from Western Africa, India, China, New Zealand, and South America.

### Genus 22. PHAKELLURA, L. Guild.

#### *Phakellura indica*, Saund.

This exceedingly pretty moth (so well distinguished by its transparent silken-white wings) would appear, as far as my own experience is concerned, to be decidedly scarce; for I met with but a single example of it during our sojourn in the island, and that one at Plantation. I was assured, however, that it was not uncommon at the Briars; so that, perhaps, it prefers a lower altitude than where we were principally located.

*Phakellura indica* was described by W. W. Saunders, Esq., in the 'Transactions of the Entomological Society' (new series), vol. i. p. 163, in a paper enumerating some insects which are injurious to the cotton-plant. He says that it is very nearly allied to *Pyralis hyalinata*, Linn., Poey, Cent. Lep. Cuba, pl. 19 (which belongs to the genus *Eudiptes*, Hübn.); but it differs from it in the somewhat smaller size, broader band round the wings, also in the nature of the chrysalis-case; and up to that date (1850-51) he says that *P. indica* had been found only in the East Indies, while the species described by Poey seemed to be as exclusively limited to the New World, and is found in Cuba, Jamaica, Brazil, and Honduras. A

third closely allied, but distinct species, he adds, is found on the west coast of Africa.

As Mr. Walker has identified the above insect as *Phakellura indica*, I give it on his authority, not having had any opportunity myself of examining the allied forms; still I think it might not be impossible that the St.-Helena species is the one referred to by Mr. Saunders as inhabiting the west coast of Africa. But, on the other hand, the island having been so long in the hands of the East-India Company might well account (as in many other cases) for the Indian form of *P. indica* having been introduced into St. Helena.

### Genus 23. SCOPARIA, Haw.

#### *Scoparia nigritalis*.

*Scoparia nigritalis*, Walk., in Melliss's Saint Hel. 190 (1875).

This is without doubt the most abundant moth in St. Helena, and one which swarms to such an extent, especially throughout the intermediate districts, as to be absolutely a pest. It resides more particularly upon the trunks of the trees, from which it will often start, when disturbed, in such clouds as well nigh to confuse one with its numbers. So far as my own observations are concerned, it would appear to occur everywhere, though it is certainly far more abundant in places of about the altitude of Plantation than it is either higher or lower down. Nevertheless it clearly ascends to the great central ridge; and I also met with it commonly in the Botanic Gardens. Although a somewhat insignificant little species when merely glanced at superficially, it will nevertheless be seen, when examined beneath a Coddington lens, to be a most beautiful object, the "cinereous" scales with which it is more or less besprinkled or adorned shining, when highly magnified, with a metallic silvery lustre; whilst the ochreous tufts combine to give a more variegated appearance to the entire surface. It is very fond of flying into open windows at night when the candles are lighted; and I have frequently seen the panes of glass, when the windows were closed, literally covered with it. This was particularly the case at Plantation.

#### *Scoparia similis*, E. Woll.

Expanse 4-5 lines. With the fore wings of a smoky-greyish hue, the central portion of the disk being darker and having a somewhat band-like appearance. The base is dark brown, followed by a greyish space which exteriorly is bor-

dered with a narrow blackish line. The stigmata are more or less distinct and contain pale ochreous scales. There is an undulating greyish postmedian transverse line, which is very much pointed exteriorly a little before the middle. The outer margin is pale with a few black points. Hind wings whitish grey. Thorax brown; body concolorous with the posterior wings.

This pretty little moth is decidedly rather scarce in St. Helena; and although very like the former species, it is readily distinguished from it on account of its smaller size and narrower wings. I obtained it principally at Plantation, where it made its appearance much later than *S. nigritalis* (for the latter was equally abundant throughout the whole of our six months' residence there), and gradually became more abundant just as we were preparing to leave the island.

Though I felt sure of *S. similis* being a distinct species, yet I am glad to be able to add that Prof. Zeller accepted it at once as distinct from *S. nigritalis*, which in some respects it very much resembles.

#### *Scoparia lucidalis*.

*Scoparia lucidalis*, Walk., in Melliss's Saint Hel. 190 (1875).

Of the St.-Helena *Scopariæ* this is the most variegated and beautiful, its speckled black-and-white hue giving it quite a conspicuous appearance. This is peculiarly the case when seen adhering to the rocky and earthy banks at the sides of the roads in the direction of the central ridge, where its bright appearance at once separates it from the common species, with which it is usually associated. Although I met with it sparingly so low down as Plantation (attracted mostly to the lighted windows at night), it is on the less-elevated parts of the central ridge that *S. lucidalis* more particularly occurs, such as Cason's, High Peak, and West Lodge. In the last-mentioned locality it was on the blossoms of the rare *Aster gummiiferus*, H. R. fil. (or "Little Bastard Gumwood") that it was chiefly found. Although comparatively rare, I occasionally observed it even on the very highest portion of the ridge, about Diana's Peak and Acteon.

#### *Scoparia helenensis*, E. Woll.

Expanse 8-9 lines. With the antennæ (which are very minutely pubescent in the male) subserrate and very much thickened about the middle, but tapering again towards the apex. The fore wings are of a suffused brownish hue, with a very slight ochreous tinge; at the base is a dark blotch con-

taining ochreous scales exteriorly; this dark blotch is followed by a pale ill-defined space, beyond which the orbicular reniform and claviform stigmata are distinct, though not conspicuous; the postmedian line is commenced on the costa as an ochreous blotch, after which it is continued very slenderly and indistinctly to the inner margin. Hind wings pale at the base, but gradually of a darker smoky hue towards the outer margin; the male with a faint submarginal line and discoidal streak. Thorax and body of a very pale brownish hue.

This is a somewhat rarer *Scoparia* than the preceding one, and found more particularly (so far at least as my own experience would imply) on the loftiest parts of the great central heights, in the direction of Acteon and Diana's Peak. Nevertheless it extends, though less abundantly, along the whole length of the ridge, and I met with it likewise at Cason's and at West Lodge. Until I had found the male I was rather inclined to take it for the female of *S. lucidalis*, the habits of the two species being somewhat similar. However, now that both sexes are in my possession, I have no doubt as to its distinctness. *Scoparia lucidalis*, too, I observed was more abundant throughout those regions which are more particularly characterized by the Aster and the Gumwood flora, whereas the present species is far more plentiful in the more exclusively cabbage-tree districts.

*Scoparia scintillulalis*, E. Woll.

Expanse 7-9 lines. With the labial palpi very hairy or brush-like, especially in the female, and the maxillary palpi larger, resting more on the labial ones than is usually the case amongst the *Scoparie*. The fore wings in the male are of a dark bronzy hue, and very minutely and sparingly dusted about the middle with opal and pale ochreous scales; the usual letter-like marking (characteristic of most of the species belonging to this particular genus, and which more or less resembles a Greek  $\chi$ ) is merely represented by two extremely small and inconspicuous patches of ochreous scales having no distinct outline; the middle portion of the costa is pale yellow, between which and the apex is a slightly triangular yellowish patch, adjoined generally by a smaller opal one; parallel with the outer margin is an irregular line of small opal patches. Hind wings pale yellowish, the outer margin, however, being broadly bordered (gradually) with bronzy brown, along which *interiorly* is a narrow yellowish line (more or less apparent in different specimens). The female with the fore wings of a rich dark brown, and much more irrorated with opal (or bluish-white) scales throughout

the wing, and forming almost a broad central band; the letter-like markings, too, are more distinct in this sex than in the male. Hind wings bronzy brown, but having a slightly yellowish tinge towards the base. Thorax concolorous with the base of the anterior wings; body of a paler and duller hue.

This is one of the prettiest of the smaller moths of St. Helena, and so dissimilar in colour to the usual greyish tints which prevail amongst the hitherto known members of the *Scopariæ* that we were indeed surprised to hear from Mr. Stainton, who most kindly examined this and the following species, that they undoubtedly belong to the present genus. *S. scintillulalis* is particularly a species of the higher districts; for although it occurs as low down as Plantation, it becomes gradually more and more plentiful as we ascend the mountains, until about Diana's Peak and Acteon it is most abundant. In fact it may be said to occupy the regions which are characterized by the various cabbage trees; and not improbably therefore (after the habit of its allies) it may be attached to the lichen (*Leptogium tremelloides*, Fr.) which clings to the branches of those particular arborescent Compositæ.

There can be no fear of mistaking *Scoparia scintillulalis* for any other species—the rich dark brown but partially blackened colour of the upper wings, beautifully bespangled with small opaline or bluish-white scales (which, however, are more concentrated in a median band and a few conspicuous subapical specks, as well as in an undulating but broken-up apical line, than elsewhere), being more than enough to distinguish it. Although we met with it somewhat sparingly throughout the whole time of our sojourn in St. Helena, viz. from September to February, yet it did not become abundant until about December, and remained so up to the time of our departure from the island.

*Scoparia transversalis*, E. Woll.

Expanse 7–9 lines. With the antennæ subserrate, but not pubescent in the male. This species is very easily distinguished from either of the above on account of the upperside of the labial palpi, and the brush of the maxillary ones, as also the head and centre of the thorax, being of a conspicuously pale yellowish-white hue. The fore wings in the male are of a dark brown throughout, and with the letter-like marking more distinct than in *S. scintillulalis*; there is an exceedingly indistinct postmedian undulating line, which commences as a small yellowish patch on the costa, not far from the apex; between the black points and the outer

margin is a very narrow, faint, ochreous line. In the female the fore wings are of a slightly darker brown, with a conspicuous straight narrow transverse antemedian band of a whitish-yellow tint; the letter-like marking almost as distinct (though not so *raised*) as in the male. Hind wings smoky brown, rather paler and more transparent near to the base. Thorax with a broad, central, pale yellowish band; body rather darker than the posterior wings.

Like *S. scintillulalis*, the present species may be defined, essentially, as occupying the higher districts of the island, which are characterized by the presence of the various arborescent Compositæ known as the "cabbage trees;" and although it may be met with as low down as Oakbank and Plantation, it is not before we reach the great central ridge that it becomes absolutely abundant. In the vicinity, however, of Diana's Peak and Acteon, as well as along Stitch's Ridge and the Cabbage-tree road, it may be said to swarm, flying, when disturbed, out of the masses of fern and other vegetation which hang about the rocks almost everywhere; and I should say that there is scarcely a Lepidopterous insect in those elevated regions which is, on the whole, more common. It is very readily distinguished, at any rate the male—the dark, rich, brownish-black hue of the anterior wings, which is *mainly* relieved by a straight, transverse, yellowish antemedian band, in conjunction with the pale dorsal stripe of the same hue which extends throughout the centre of the thorax, rendering it easy to recognize.

#### GENUS 24. HELLULA, Guén.

##### *Hellula undalis*, Fab.

Widely spread over the low and intermediate districts of the island; but I am not sure that I observed it so high as the central ridge; indeed I think that Plantation is about its upper limit, so far, at least, as my own experience is concerned. In the neighbourhood of Jamestown I do not recollect that it was very abundant, though I certainly met with it in the Botanic Gardens and at Maldivia; but at Cleugh's Plain it appeared to be common, and at Plantation tolerably so. It frequents open grassy places, as well as weedy spots about gardens and cultivated grounds, being soon aroused into flight in the daytime. In all probability it has been naturalized at St. Helena: at any rate it possesses a considerable geographical range; for it is not uncommon, I believe, in some parts of Europe, and I have taken the species abundantly in the less-elevated regions of Madeira.

## Genus 25. BOTYS, Latr.

*Botys abstrusalis*.

*Botys abstrusalis*, Walk. Lep. Brit. Mus. xviii. 663 (1859); Melliss, Saint Hel. 189 (1875).

There are few moths more universal and abundant at St. Helena than the present one. Around Jamestown it swarms, and is scarcely less common at Plantation. It seems to have acquired for itself a wide geographical range, being quoted from Ceylon and China.

*Botys creonalis*.

*Botys creonalis*, Walk. Lep. Brit. Mus. xviii. 579 (1859); Melliss, Saint Hel. 189 (1875).

There are few moths more abundant at intermediate and lofty altitudes than this pretty little *Botys*. About Plantation it is extremely common, and becomes still more so as we approach the central heights, where it absolutely swarms about Stitch's Ridge, Diana's Peak, Acteon, and especially along the Cabbage-tree walk and at West Lodge. I generally captured it by beating the dense masses of vegetation (particularly ferns) which hung about the rocks; but, as I did not obtain the larva, it is difficult to conjecture to what plants it is more particularly attached. At any rate it has all the appearance of being indigenous to the island, though it is stated by Mr. Melliss to occur also at St. Domingo in the West Indies.

*Botys ruficostalis*, Led.

*Botys adipodalis*, Melliss, Saint Hel. 189 (1875), non Guén.

This pale and rather large *Botys* appears to be decidedly a local moth in St. Helena, and one which is confined, so far as my own experience is concerned, to the lower and warmer parts of what may be termed generally the "intermediate" districts. In fact the whole of my examples were obtained at Cleugh's Plain, which can scarcely be more, I should imagine, than about 1200 feet above the sea; but in that particular locality it is not at all uncommon; and being a slow flier and conspicuous, it is extremely easy to catch. Its larva seems to feed upon *Asclepias*, the leaves of which it spins loosely together, and changes into a chrysalis within; but our visits to Cleugh's Plain were, unfortunately, too late in the season to enable me to preserve more than the pupa and imago. Whether the species, however, is more than an introduced one into the island, is, I think, extremely doubtful, though, as it is recorded by Dr. Staudinger from Andalusia,



Italy, and Syria, in all probability it was originally naturalized.

The specimens of this moth from St. Helena recede from the examples of *Botys ædipodalis* which are in the British Museum in the much less acute tip of the fore wings, in their much paler colour, and also in having no dark hind-marginal border. Professor Zeller, who has kindly examined one of my St.-Helena specimens, remarks that it exactly agrees with his *Botys ruficostalis* from Palestine.

#### Genus 26. MEYNA, Hübn.

##### *Meyna polygonalis*, Hübn.

*Meyna rusticalis*, Melliss, Saint Hel. 190 (1875).

Although probably only introduced into the island (for it occurs in Europe and is a common moth at Madeira), this *Meyna* is one of the most conspicuous of the St.-Helena Pyralidæ. It is abundant in the intermediate and lofty districts, particularly the former, while the bright orange of its underwings makes it quite a feature on the open grassy slopes, where it more especially resides. About Plantation and Oak-bank I observed it often in great profusion; but I did not meet with it, so far as I can now recall, at a very low elevation, though at Cleugh's Plain it was common enough; and I imagine therefore that it must be looked upon (whether naturalized or not) as belonging essentially to the intermediate altitudes.

The caterpillar of this moth is slightly over an inch in length and of an elongate fusiform shape, somewhat narrow in comparison with its length. The head is globular, but rather flattened in front. The segmental folds are distinct, though not conspicuously so, and with white longish erect hairs throughout the subdorsal region. The head is black, emitting a few short white hairs; the second segment is small and black, with three pale lines, the central one of which is continued throughout the segment (the others hardly extending to the middle) and adjoins a much broader dorsal stripe or space, which ornaments the rest of the segments to the anal angle (on which it appears as small spots). There is a narrow, yellowish-white, spiracle-line, adjoining the upper side of which is a row of bright yellow blotches. The space between the latter and the dorsal stripe is black, with three brighter black warts, each of which emits one of the white longish hairs which ornaments the sides.

*Meyna polygonalis* seems to have been much confused with *M. diversalis*, Hübn. The figures in the eighth volume

of Duponchel's 'Histoire Naturelle des Lépidoptères ou Papillons de France' (pl. 220) are quite identical with my St.-Helena examples; and one of my specimens even approaches rather near in colour to his figure of *M. diversalis* in the same volume (pl. 233); but there is more black on the hind wings of the St.-Helena one.

### Genus 27. SCOPULA, Schr.

#### *Scopula ferrugalis*, Hübn.

I did not meet with this little moth at St. Helena; but since Mr. Walker identified it from amongst the material which was collected in the island by Mr. Melliss, I can scarcely do otherwise than admit it into the present catalogue. I am bound, however, to add that I cannot but feel it doubtful whether Mr. Walker, who does not always appear to have been precise in his determinations, may not have mistaken one of the smaller specimens of the following rather inconstant species for *S. ferrugalis*; however, the two insects are most thoroughly and permanently distinct. *S. ferrugalis* occurs in Europe, and is exceedingly abundant in Madeira; I have also received specimens of it from North Africa, collected there by the late Mr. Trovey Blackmore.

#### *Scopula delineatalis*.

*Scopula delineatalis*, Walk. in Melliss's Saint Hel. 189 (1875).

This is a most universal insect in the intermediate districts of St. Helena, occurring at about the altitudes of Plantation and Oakbank almost everywhere, and ascending up to the highest parts of the central ridge. In fields and on open grassy slopes it is often extremely common, starting into flight in the daytime as one passes its locality. But the particular spot in which I met with it in the greatest profusion is a little ravine between Oakbank and Hutt's Gate, and below Halley's Mount, called Vine-Tree Gut, where sometimes it was in great abundance, flying over the curious *Lachanodes prenanthiflora* (or "she cabbage tree"), which grows plentifully in that particular ravine.

### Genus 28. PRIONAPTERYX, Steph.

#### *Prionapteryx Whiteheadii*, E. Woll.

Expanse 4-5 lines. With the fore wings of a dull whitish hue and having numerous ill-defined longitudinal, brownish, somewhat powdered streaks. There are two transverse indistinct lines, the first one of which is near to the middle, very

much pointed exteriorly just below the costa, and continued obliquely to the inner margin (where it becomes more suffused and patch-like); whilst the second one (which is better defined) is angulated in the same way below the costa, and almost joins (anteriorly) a conspicuous brownish spot on the inner margin. The extreme tip of the apex is white, truncated by a straight narrow black line. Hind wings pale smoky glossy white, the outer margin having a black line at the apical angle. Thorax concolorous with the anterior wings; body similar in hue to the posterior ones.

This extremely small *Prionapteryx* (which Professor Zeller observes is the smallest known to him) does not appear to be common; indeed, judging from my own observations, it is decidedly rare, the very few examples which I obtained having been met with at West Lodge, immediately beyond the house. It was about the foliage of the common white *Brugmansia*, or "moon plant," that I captured my specimens; but whether the habitat was merely an accidental one I am unable (not having observed the larva) to say. I have dedicated the species to the Rev. H. Whitehead of Woodcot, from whom we received much kindness and valuable assistance during our six months' residence at St. Helena.

#### Genus 29. NEPHOPTERYX, Hell.

##### *Nephoteryx privata*.

*Nephoteryx privata*, Walk. in Melliss's Saint Hel. 190 (1875).

This single little representative of the Phycidæ appears to be decidedly a scarce moth at St. Helena, and one which occurs (so far, indeed, as I am able to judge from the capture of merely two individuals) at intermediate altitudes. One of my examples was taken at Plantation, and the other from an old gumwood between Peak Dale and Lufkins; and I think it far from unlikely, therefore, that the species belongs properly to the now fast disappearing gumwood fauna. If so, we may expect it to be found more abundantly in the few spots where those curious and interesting trees are still left; and the probability that the Plantation district was once well supplied with gumwoods, is rather in accordance with this supposition.

#### Fam. VI. Tortricidæ.

#### Genus 30. STEGANOPTYCHA, Steph.

##### *Steganoptycha obscura*, E. Woll.

Expanse 7-7½ lines. With the fore wings of a somewhat

variable mottled brown, some specimens being much paler and more suffused than others. The basal portion is of a darkish brown to about a third of the length of the wing, followed by a pale almost fascia-like space. The ocellated spot near the anal angle (which often forms one of the most distinct features in many of the Tortricidæ) is only just discernible, and contains two very small black longitudinal lines; adjoining it, near to the inner margin, is a conspicuous small dark triangular patch, also containing a black streak. The costa itself is variegated with minute white and brown alternate streaks, which are more particularly conspicuous towards the apex, the last white line being circular, and thus causing the actual apex to appear as a somewhat rounded small brown spot. Hind wings pale smoky brown. Thorax concolorous with the anterior wings; body of the same hue as the posterior ones. The female is altogether paler, the fore wings having the basal portion, except towards the inner margin, quite as pale as the fascia. Nevertheless, as I only possess two examples (a male and a female), I cannot feel sure that these colour-distinctions will prove after all to be permanent.

The only examples of this obscure little Tortrix which I obtained were captured at Cleugh's Plain; so that it is probably a species of intermediate altitudes, though perhaps descending rather lower than many which have what I would define as an "intermediate" range. At first sight it has much the appearance of many ordinary European forms; and Mr. Barrett informs me that it is closely allied to the common British *Spilonota dealbana*, Fröl.

### Genus 31. CHOREUTIS, Hübn.

#### *Choreutis Bjerkandrella*, Thunb.

This is a very pretty little species, the dark-brown but variegated surface of the anterior wings (which have three black blotches exteriorly and two ochreous longitudinal dashes at their extreme base, and two somewhat powdered and diffused cinereous transverse fasciæ) being elegantly besprinkled with small metallic spots or *fascicles* of scales. These scales vary greatly in lustre, being more often of a pinkish opal, but occasionally (particularly towards the base of the costa) of an emerald-green.

*Choreutis Bjerkandrella* is decidedly a rather scarce moth at St. Helena, and one which appears to be confined to intermediate or rather lofty altitudes. I met with it at Plantation and Cleugh's Plain sparingly, but more frequently at

West Lodge. It was chiefly from the foliage of the common bramble that I obtained it.

Mr. Barrett, who has kindly examined it, says that very likely this *may* be the var. *petrosana*; and indeed it agrees very well with Duponchel's figure of the latter on his sixty-fifth plate.

[To be continued.]

XXXVIII.—*Contributions to our Knowledge of the Spongida.*

By H. J. CARTER, F.R.S. &c.

[Plates XXVIII. & XXIX.]

[Continued from p. 304.]

*Trachycladus lævispirulifer*, n. gen. et sp.  
(Pl. XXVIII. figs. 1-5.)

Shrub-like, more or less compressed, stiff, consisting of a short irregularly round stem dividing at first dichotomously and then polychotomously into many branches, which terminate in digitations, more or less united laterally (Pl. XXVIII. fig. 1). Colour white on the surface, whitish yellow internally. Texture hard, dense. Surface reticulate, honeycomb-like, stiff, with small scopuliform processes along the lines of the reticulation, bearing a white incrustation composed of the flesh-spicules of the species. Internal structure of the stem and branches consisting of dense, compact, arcolar sarcod, especially towards the centre, charged with the spicules of the species, expanding in lines from the axis of the branch upwards and outwards, so as to end in the little scopuliform processes mentioned. Spicules of three forms (viz. one skeleton- and two flesh-spicules):—1, skeleton-spicule, acerate, curved, smooth, pointed gradually, acutely or obtusely, sometimes acute, 1-85th by 1-2400th inch in its greatest dimensions (fig. 2); 2, flesh-spicule, minute, filiform or vermiculate, consisting of an open spiral coil of one turn and half, smooth (that is, without spines), 1-1714th inch long (fig. 3); 3, flesh-spicule, bacillar, consisting of a short, thick, cylindrical, straight shaft, with rounded ends and narrow, linear, central inflation (fig. 4). The skeleton-spicules mixed with a few flesh-spicules of both forms are confined to the interior, while the white incrustation is exclusively formed of the flesh-spicules. Size of largest specimen  $4 \times 3 \times 1\frac{1}{4}$  inches; stem about 1 inch long and  $\frac{3}{4}$  inch thick.

*Hab.* Marine.

*Loc.* South Australia

*Obs.* Examined in the dry state. There are now two specimens of this sponge in the British Museum, one of which is extremely small and insignificant-looking, about  $1\frac{1}{2}$  inch in diameter, and the other, that above described, which came from the late Dr. Bowerbank's collection. The former bears my running number 385, but no other, while the glue about its stem shows that it was once attached to a board, and therefore has been a very long time in the Museum; the latter, which was also without label, now bears my no. 695. The hard, dense structure of the stem, combined with the white incrustation over the honeycomb or reticulated stiff structure of the surface, are all as much characters of the Echinonemata as they are opposed to those of the Suberitida in the Holorhaphidota; while, if we regard the flesh-spicules as equivalent to the "echinating" spicules, it seems to me that a place for *Trachycladus* should be sought for in the family Ectyonida, among the groups now included under the provisional name of Pluriformia. The characters of the sponge above given, together with the flesh-spicules, are quite sufficient for recognizing the species. Especially characteristic are the spiral flesh-spicules of the incrustation, which, under the microscope, look like myriads of little worms broken into pieces. So far, however, as their spiral form goes, this occurs in a sponge of a very different kind, viz. *Suberites spinispirulifer*, to be described hereafter; but here it is not only much larger, but *spined* all over.

*Amorphina stellifera*, n. sp.  
(Pl. XXIX. fig. 10, *a*, *b*.)

Massive, amorphous, lobate, pierced and suspended by the fine branches of the seaweed among which it has grown. Colour originally white, but subsequently rendered pink by the presence of a pink *Palmella*-like cell. Texture crumb-of-bread-like. Surface even, thickened by the accumulation of broken spicules and sand, probably from having been rolled about in the shore-waves. Pores in the sarcode tympanizing the intervals between the broken spicules, as well as between those which have not become broken. Vents in pit-like depressions of the surface. Internal structure consisting of arcolar sarcode charged with the spicules of the species and traversed by the canals of the excretory system; of a light yellow colour. Spicules of two forms, viz. :—1, skeleton-, acerate, curved, smooth, sharp-pointed gradually, of various sizes, the largest averaging 1-35th by 1-1500th inch in its greatest diameters (Pl. XXIX. fig. 10, *a*); 2, flesh-spicule, very delicate, stelliform, composed of eight or more micro-

spined rays parting from the centre directly (that is, without inflation there), 1-1500th inch in diameter (fig. 10, *b*). Skeleton- and flesh-spicules scattered throughout the sponge generally, the latter rather sparsely. Size of largest specimen about  $2 \times 1\frac{1}{4} \times \frac{3}{4}$  inch.

*Hab.* Marine, growing in the Laminarian zone.

*Loc.* South Australia.

*Obs.* Examined in the dried state. There are two specimens of this sponge now in the British Museum, almost exactly alike in every particular, viz. one labelled "69. 1. 22. 25, Van Diemen's Land," and the other from the late Dr. Bowerbank's collection without label, except that of "South Australia," on the box in which it was contained, both now bearing my no. 315 E, *h*, 19. But for the presence of the little, delicate, stellate flesh-spicule, there would be no distinguishing *Amorphina stellifera* from the worldwide *Halichondria panicea*, Johnst., perhaps the commonest sponge on the coasts of Great Britain. It is remarkable, too, that the pink colour should be owing to the presence of the little parasitic cell mentioned, apparently identical with that of *Palmella spongiarum*, Cart. (Ann. 1878, vol. ii. p. 165), which I found to be the origin of a similar colour in a specimen of *Halichondria panicea* picked up on this beach (Buddleigh-Salterton).

Besides the pink cell in *Amorphina stellifera*, both specimens are charged with one which I think it advisable to note for future reference, as I do not know what it is. This cell, which is much larger than that of the *Palmella*, is colourless and ovoid, measuring 1-875th inch in its greatest diameter, containing a transparent nucleus 1-2000th inch in diameter, and surrounded by a number of still smaller cells, each of which is 1-6000th inch in diameter, the transparent spherical nucleus in the centre contrasting with the translucent ones that surround it.

As these specimens of *Amorphina stellifera* have grown from an embryo attached to the seaweed, the branches of the latter have become enveloped by them respectively during growth, like bits of grass &c. in a Fungus, and thus they have become suspended.

*Suberites spinispirulifer*, n. sp.  
(Pl. XXVIII. figs. 6, 7.)

Specimens solid, elliptical, probably having obtained this form by forced separation from the place of growth and subsequent rolling about on the beach in the midst of the waves. Colour now chiefly yellowish white, with patches of purple on the surface, indicating that this, if not the whole of the sponge,

was once so tinted. Texture loose, open, crumb-of-bread-like. Surface without cortex, corrugated. Pores not visible. Vents numerous among the corrugations. Internal structure consisting of light, loose, areolated, flaky sarcode charged with the spicules of the species and traversed by the excretory canals. Spicules of two kinds, viz.:—1, skeleton-, stout, pin-like, curved, smooth, and sharp-pointed; pin-like head chiefly produced by a circular inflation of the shaft just inside the blunt end, 1-45th by 1-1542nd inch in its greatest diameters (Pl. XXVIII. fig. 6); 2, flesh-spicule, filiform, consisting of an open spiral coil of one turn and a half thickly spined (but *not* spirally) throughout; coil 1-1714th inch long by 1-3000th inch broad (fig. 7, *a*, *b*). Both mixed together in the body of the sponge, the latter most plentiful on the outer surface and on the surface of the excretory canals. Size of largest specimen about 2½ by 2 inches in its longest diameters.

*Hab.* Marine.

*Loc.* Port Elizabeth, Cape of Good Hope.

*Obs.* Examined in the dried state. There are several specimens of this sponge in the British Museum, all bearing the register no. 71. 5. 12. 1, with my running no. E 13, *h*, 15. A more magnified view of the spinispirulate flesh-spicule has been given in fig. 7, *b*, to show its elementary composition, and the specific designation taken from its peculiar spiral form, which, together with the presence of the *spines*, affords a combination that I have not met with in any other kind of sponge, the spiral flesh-spicule of *Trachycladus* being smooth (that is, without spines). It should be observed that the spines are not arranged spirally on the shaft.

*Suberites angulospiculatus*, n. sp.

(Pl. XXVIII. fig. 8, *a*, *b*.)

Plano-convex, cake-shaped, elliptical, depressed, spreading, sessile. Colour dark brown. Texture fine, compact, cork-like. Surface uniformly dimpled, irregularly undulating, without cortex. Pores and vents not evident. Internal structure compact, cork-like, consisting of fine areolar sarcode charged with the spicules of the species and traversed by the excretory canals, which are small; colour internally tawny yellow. Spicules of one kind only (no flesh-spicule), viz. acerate, undulating, smooth, straight, sharp-pointed, gradually angulated in the centre (Pl. XXVIII. fig. 8, *a*), or larger and less angulated (fig. 8, *b*), the former 1-246th by 1-12000th, and the latter 1-25th by 1-1200th of an inch in their greatest



diameters respectively. Size of specimen  $4\frac{1}{2}$  inches in its longest horizontal diameter by  $\frac{1}{2}$  inch high.

*Hab.* Marine, growing on hard bodies.

*Loc.* Jamaica.

*Obs.* Examined in the dried state. The dark-brown colour of the surface appears to arise from the tendency of the sarcode superficially to a glutinous consistence. Internally it is precisely like that of *Halichondria suberea*, Johnst., = *Suberites domuncula*, Sdt., and but for the form of the spicules, which can only be determined by microscopical examination, might be mistaken for it. There are three specimens of this sponge in the British Museum, all of which come from Jamaica, viz. :— that above described, which is registered 43. 2. 13. 53, with my running no. E 55, h, 14; another about the same size on the back of a crab, numbered 707, which came from Dr. Bowerbank's collection; and a third about the size of a small hazelnut, growing round the stem of a zoophyte, registered 50. 5. 8. 35; also a minute white parasitic patch of it on the surface of an undescribed species of *Reniera* with nodular surface, large conical crateriform lobes and sausage-shaped spicule, registered no. 40. 16. 12. 49, and no. 504 E, c, 7 (? from Madeira), in which the angulated spicule attains the "larger size" mentioned (viz. fig. 8, b), and abnormally is often accompanied by a third arm growing out from the middle of the shaft at right angles, so as to give the spicule a triradiate form.

*Suberites fuliginosus*, n. sp.  
(Pl. XXVIII. fig. 9, a, b.)

Massive, spreading, botryoidal, lobular, corrugated, sessile. Colour soot-black. Tissue cork-like. Surface uniformly subbotryoidal. Pores not seen. Vents numerous, scattered over the botryoidal elevations, often grouped. Internal structure composed of a multilocular or cellular labyrinthic skeleton, densely charged with the spicules of the species; the labyrinthic cavities filled with black sarcode also charged with similar spicules, contrasting strongly in the section with the lighter colour of the skeleton. Spicules of two forms, both skeleton-, no flesh-spicule, viz. :—1, straight or slightly curved, fusiform, smooth, inflated and spined at each extremity, 1-857th by 1-4800th inch in its greatest diameters (Pl. XXVIII. fig. 9, a); 2, cylindrical or acute, thicker and shorter than the foregoing, spined all over, 1-92nd by 1-1500th inch in its greatest diameters (fig. 9, b). Both mixed together throughout the sponge, but the latter very sparingly. Size of largest

specimen 4 inches in diameter horizontally; highest lobe  $1\frac{3}{4}$  inch.

*Hab.* Marine.

*Loc.* ? Torres Straits.

*Obs.* Examined in the dried state. This is a very remarkable sponge, chiefly on account of its "soot-black" colour, but not less so in its spiculation. In structure and consistence it is almost identical with the type of my group *Cavernosa*, viz. *Rhaphyrus Griffithsii*, = to the free form of *Cliona celata*, and thus like *Spongia Dysoni*, Bk., from Belize (the largest sponge on record, of which the specimen is in the British Museum). While, however, *S. fuliginosus*, like *Rhaphyrus Griffithsii*, has no flesh-spicule, it nevertheless more nearly represents *Spongia Dysoni* (whose form of flesh-spicule is given in Plate XXIX. fig. 11) in the nodular surface and cribriform grouping of the vents over the nodules, if not in the colour also, which appears to have a slight tinge of purple, allying it to the lilac tint of the dried specimens of *Spongia Dysoni*. There are two pieces of *Suberites fuliginosus* in the British Museum, bearing the register no. 46. 8. 5. 8, with my running no. 379 E, h, 13. They were presented by the late J. B. Jukes, Esq., and, both being alike, probably form parts of one original mass.

*Stellettinopsis corticata*, n. gen. et sp.

(Pl. XXVIII. figs. 10-15.)

Globular, smooth, corticate, broadly sessile (Pl. XXVIII. fig. 10). Colour yellowish grey. Texture hard on the surface, soft internally. Surface smooth and even; cortex thin, hard when dry, fleshy when wet, about 1-48th inch thick, presenting a uniformly granular surface composed of minute convolutions of the dermal sarcode, like in form to those of the brain (but of course microscopic), charged with flesh-spicules of the species and grains of quartz sand (fig. 15, c, d, e). Pores in the grooves between the convolutions. Vents chiefly congregated about the summit of the sponge (fig. 10, a), twelve or more in number, of different sizes, the largest 1-6th inch in diameter, each partly closed by a thick, opaque, sphinctral diaphragm of sarcode in radiating folds surrounded by a raised margin (fig. 15, a, b). Internal structure cancellous in the section, subradiating from a more condensed centre, increasing in the size of its areolation towards the circumference, where it becomes continuous with the cortical layer; composed of areolar sarcode densely charged with the spicules of the species, altogether very like the interior of *Geodia* and *Stelletta*. Spicules of three kinds (viz. one skele-

ton- and two flesh-spicules), to which must be added the foreign material, viz. the quartz grains:—1, skeleton-spicule, acerate, long, smooth, curved, sharp-pointed gradually, 1-22nd by 1-1800th inch in its greatest dimensions (fig. 11); 2, flesh-spicule, stelliform, very minute and delicate, composed more or less of eight rays, radiating from the centre direct (that is, without inflation there), 1-2000th inch in diameter (fig. 12, *a, b*); 3, flesh-spicule, bacilliform, straight, cylindrical, obtuse at the ends, spined all over, about 1-666th by 1-6000th inch in its greatest dimensions (fig. 13, *a, b*); 4, quartz grains, variable in size, about the diameter of the flesh-spicules (fig. 14). No. 1 is confined to the interior, mixed with a few of the flesh-spicules; nos. 2 and 3, together with the quartz grains and a few fine acerates, are more abundant in the cortex. Size of specimen  $1\frac{1}{8}$  inch high by  $1\frac{1}{2}$  inch in transverse diameter about the middle, and 1 inch at the base.

*Hab.* Marine, on hard objects.

*Loc.* Port Adelaide, Australia (*Cuming*).

*Obs.* Examined in the dried state and after soaking in water. This specimen is in the British Museum, and bears the register no. 55. 3. 14. 8, with my running no. E, 301 *h*, 18. It has grown upon the outside of the flat valve of a large *Pecten*, where, at first, it looks very much like a specimen of *Hulichondria ficus*, Johnst. On examining it, however, more attentively and after soaking, it is found to have a fleshy cortex not unlike that of the Gumminida in consistence; in form and structure it is like *Geodia*, and its internal spiculation is like that of both *Geodia* and *Stelletta* so far as the acerate spicule goes; but there is no trifid spicule, and no zonular arrangement, of course, at the circumference. With all these characters it is impossible to assign it to either; and therefore a new genus has been made for it under the name of *Stellettinopsis*, after *Stelletta*, whose spiculation generally, minus the trifid forms, its spiculation so nearly resembles that at first sight there appears to be no difference. Its place should, perhaps, be in the order Holorhaphidota, among or after the Suberitida, and before the Pachytragida.

*Stellettinopsis simplex*, n. sp.  
(Pl. XXVIII. figs. 16-18.)

Massive, convex, lobate, sessile. Colour tawny brown. Texture loose. Surface firm, even, irregularly undulating, without cortex. Pores not seen. Vents grouped in a depression on the lower aspect. Internal structure confused, consisting of open areolar sarcodc, crumb-of-bread-like, charged with spicules of the species, and traversed by the excretory

canals. Spicules of three forms (viz. one skeleton- and two flesh-spicules):—1, skeleton-, large, acerate, curved, smooth, sharp-pointed gradually, 1-19th by 1-900th inch in its greatest dimensions (Pl. XXVIII. fig. 16); 2, flesh-spicule, stellate, very variable in form, from the variable number and irregular position of the rays, from two to twelve, arising from a slight central inflation—very variable also in size, from 1-1200th to 1-428th of an inch in diameter (fig. 17, *a, b*), rays microspined (fig. 17, *c*); 3, flesh-spicule very minute, sceptrelliform, consisting of a straight shaft, spined at intervals, viz. at the ends and at two points on the shaft, all equidistant, but very variable in this respect, 1-1500th inch long (fig. 18 *a*). Skeleton-spicules, with a few flesh-spicules, generally distributed throughout the mass; the latter most abundant on the surface. Size of specimen  $2\frac{1}{2}$  inches long and 1 inch high.

*Hab.* Marine, on hard objects.

*Loc.* Freemantle, Australia.

*Obs.* Examined in the dried state. This specimen, now in the British Museum (numbered 691), came from the late Dr. Bowerbank's collection, and is labelled "Thomas Ingall," in addition to the locality. I also possess a mounted fragment, taken from a specimen from Hayti belonging to the Liverpool Free Museum, which was sent to me by Mr. Thomas H. Higgin for examination. In spiculation *S. simplex* is so much like *Stellettinopsis corticata* that I have placed it in the same genus, assuming that the sceptrelliform flesh-spicule is but another form of the entirely spined bacillar one of the latter; the large size of the acerate, however, renders it still more like that of the acerate body-spicule of *Stelletta*.

In the Haytian specimen (which is attached to the base of one of *Luffaria fistularis*) the spiculation, generally, is a little larger, the spination of the sceptrella more irregular than that of the Australian one, and the rays of the stellate slightly inflated elliptically at their free ends.

*Samus anonyma*, Gray. (Pl. XXIX. figs. 1-4.)

Minute amorphous masses of dry contracted sarcode, furnished with filiform extensions, and charged with spicules of the species, in cavities formed by an excavating *Cliona*. Colour now like that of dried sarcode, *i. e.* yellowish. Texture also that of dried sarcode, viz. gum-like. Pores, vents, and internal structure not visible, from the dried state and minuteness of the specimens. Spicules of three forms, viz.:—1, very large, consisting of a short, stout, smooth, subtriangular shaft, terminated at each end by a similar development,

viz. three divergent smooth arms, each ending in three smooth prongs, nearly on the same plane, one of which is central and in a line with the arm, and the other two lateral, viz. one on each side divergent, 1-150th to 1-90th inch long by 1-225th inch across the head (Pl. XXIX. figs. 1, 2), subject to great variation in size and form of the terminal elements in the same and different specimens; 2, small, consisting of a short shaft, similar in form to the last, with a similar development at one end, but with only three undivided arms at the other end (fig. 3, *b*), all except the shaft minutely spined and showing the central canal very plainly, 1-600th inch in diameter across the large head (figs. 3, 3 *a*); 3, flesh-spicule minute, bihamate (*fibula*), C- and S-shaped, microspined, 1-3000th inch in diameter (figs. 4, 4 *a*). No. 1 is the largest and staple form, no. 2 smaller and less plentiful, no. 3 very abundant. Size of specimen varying with the size of the excavation of the *Cliona*.

*Hab.* Marine, in cavities of old stony coral excavated by a *Cliona*.

*Loc.* West Indies and Australia, in *Millepora alcicornis*; and in old *Stylaster sanguineus*, South Seas.

*Obs.* Examined in the dried state. Wherever I have found this sponge it has been in the said excavations *in company* with *Cliona mucronata*, Sollas ('Annals,' 1878, vol. i. p. 54), *but separate*. Hence, as *Cliona* is the only excavating sponge with which I am acquainted, I conclude that *Samus anonyma* is not a *Cliona*. The filaments that are appended to the little masses of dried sarcode appear to be portions of the latter, which originally occupied the finer passages of the *Cliona*, drawn out by the contraction of the mass now occupying the excavated chamber. The specimen from Australia, to which I have alluded, was in the late Dr. Bowerbank's collection now in the British Museum; it bears my running no. 699, and came from a box of specimens labelled by Dr. Bowerbank "From Mr. Ingall, Australia."

Heretofore I have found a spiculation like that of *Dercitus niger*, Cart., = *Battersbya Bucklandi*, Bk., in the cavities of *Cliona mucronata*, as indicated by the presence of the latter with it, in old coral from the island of Cuba; and having often observed this *black* sponge (*D. niger*) here, at Budleigh-Salterton, growing into the minute crevices of the red rock, it seems, from its gummy sarcode and confused spiculation, to be not only allied to *Samus*, but to the Gumminida also. No. 2 spicule (Pl. XXIX. fig. 3) is very like that of a *Corticium* ('Annals,' ser. 4, vol. xii. p. 19, pl. i. fig. 5, &c.). But, be this as it may, the "large spicule" was first figured by

Dr. Bowerbank (Mon. Brit. Spong. vol. i. p. 234, pl. ii. figs. 41, 42), who merely states that the sponge producing it was found lining the tortuous tube of an Annelid in soft limestone (? *Millepora alvicornis*), like *Hymeniacion celata*, Bk. (1866), = *Cliona celata*, Grant (1826), and *Vioa*, Nardo (1839); it should be remembered that Dr. Bowerbank considered the excavations of *Cliona* to have been formed by an Annelid (Mon. Brit. Sp. vol. ii. p. 220),—after which Dr. Gray proposed the generic name “*Samus*” for the kind of sponges producing this spicule, and *S. anonyma* for the species (Proc. Zool. Soc. 1867, p. 526). My dear old friend was wrong, however, in allying it to *Axos Cliftoni* or to any of Duchassaing's species of *Vioa*, if the inference of the nature of *Samus* above given be correct.

This brings us to the question whether Hancock, in his first excellent paper on the Excavating-powers of *Cliona* &c. ('Annals,' 1849, vol. iii. p. 321), has not based his genus “*Thoosa*” (ib. p. 345) upon spicules belonging to a *Samus*, seeing that those represented by him (ib. pl. xii. figs. 10, *b*, and 11, *a, b*) are essentially like the spicules of *Dercitus* and *Samus* respectively, while there is a total absence of the *pin-like* spicule, which appears to me to be invariably the form of the skeleton-spicule of the Clionidæ.

Further corroboration of this view seems to be derived from the fact that, in the mountings of the minute detritus of the root-bunch of *Euplectella cucumer* from the Seychelles, which present an innumerable variety of sponge-spicules, the large ones of *Samus anonyma* are present, together with a still more complicated and beautiful form, and a flesh-spicule (Pl. XXIX. fig. 21) almost identical with that which is figured by Hancock as characteristic of both species of his genus “*Thoosa*” (pl. xii. fig. 10, *a*, and pl. xiii. fig. 2, *b*); while of the spicule referred to *Thoosa cactodes*, to which I have before alluded (viz. pl. xii. figs. 11 *a* and 11 *b*), Hancock has stated (p. 347) that he was not able to determine whether or not it belonged to the species, although he felt inclined to the affirmative.

It might be urged against my view that the representation of *Thoosa cactodes* (pl. xiii. fig. 1) is evidently that of a *Cliona*. But then, as *Samus anonyma* fills the cavities of *Cliona*, it, of course, would present the same shape; while the absence of the pin-like spicule here, and the presence of *Samus* together with *Cliona mucronata* in the instances that have been mentioned, show that both may be in the same excavation, and, from the inference that the excavation was made by the latter, that *Samus* is not a *Cliona*.

*Corticium Wallichii*, Cart. (1874).

(Pl. XXIX. figs. 5-9.)

Minute, amorphous, laminiform. Colour that of dried sarcode, *i. e.* yellowish. Texture like dried sarcode—that is, gum-like. Pores, vents, and internal structure not visible, from the minuteness and dryness of the specimens. Spicules of two kinds, viz. :—1, skeleton-, large, acerate, curved, tubercled throughout in twelve longitudinal lines (Pl. XXIX. fig. 5); tubercles alternate in adjoining rows, constricted in the centre, expanded at the free ends, the latter circular and convex (fig. 5, *aaa*), extended over the extremities of the spicule so as to give them an obtuse irregular form. Central canal bent angularly in the middle towards the convexity of the spicule, undulating afterwards towards the extremities (fig. 5, *b*), 1-31st by 1-200th inch in its greatest diameters, including the tubercles—or the same spicule in an earlier stage of development, without tubercles, and with an angular projection in the centre of the convexity (fig. 6), opposite the bend in the central canal (fig. 6, *a*); 2, flesh-spicule, sceptrelliform (fig. 7), consisting of a straight shaft, abruptly pointed at each end, and microspined throughout, except in the middle (fig. 8, *a*), provided with two circles of horizontal rays, separate from each other, and a little nearer one end of the shaft than the other (fig. 8, *bb*), rays eight or less in number, straight, smooth, capitate, each terminated by a globular inflation, shaft 1-1000th inch long, circle of rays 1-3000th inch in diameter (fig. 9, *a, bb*). Skeleton-spicule in different degrees of development, mixed together with the flesh-spicule in the sarcode. Size that of the excavated cavity in the piece of *Stylaster* where it was found, viz. about 1-18th inch in diameter.

*Hab.* Marine, in the cavities of ?*Cliona mucronata* in dead old *Stylaster sanguineus* (coral).

*Loc.* South seas.

*Obs.* Examined in the dried state. In 1864 Dr. Bowerbank (Mon. Brit. Sp. vol. i. p. 270, pl. xi. fig. 244) gave a figure of the skeleton-spicule of this sponge that had been frequently found in the washings of *Oculina rosea* = *Stylaster sanguineus*, from the South Seas, noting that the sponge itself from which it came had “never been determined.” In 1871 Dr. G. C. Wallich kindly sent me some of his “dredgings” on the Agulhas Shoal, Cape of Good Hope, made in 1857; and among these I found and mounted a spicule of this kind, from which the description and figure were taken (‘Annals,’ 1874, vol. xiv. p. 252, pl. xv. fig. 46), when I proposed for the

sponge producing it the name of *Corticium Wallichii*, conjecturing that, hereafter, the latter might be found to belong to the Gumminida. (Here I may observe that the characters of the Gumminida are not absolutely like gum, but like gum or glue only when dry, and when wet flexible and insoluble like india rubber.) Subsequently, in going through the late Dr. Bowerbank's collections for the British Museum, I found a piece of *Stylaster*, and examining it, under the microscope, by chance met with a small excavation in the dead or older part, lined with the specimen of *Corticium Wallichii* above described, also a few of its characteristic spicules in another part. Finally I found one of the fully developed skeleton-spicules in some of the minute detritus which came from the root-bunch of the specimen of *Euplectella cucumer* from the Seychelles. Hence *Corticium Wallichii* may be fairly inferred to exist at least in three distinct localities, viz. the South Sea, the Cape of Good Hope, and the Seychelles.

Owing to the smooth acerate form of the earlier stages of development of the skeleton-spicule, it is almost impossible to detect the presence of this sponge unless the fully matured tubercled spicule or peculiarly shaped flesh-spicule is witnessed.

Occurring, too, in the midst of the excavations of *Cliona mucronata*, like *Samus anonymus*, it is difficult to decide whether, like the latter, it be a follower of the former, or its own excavator, because, as yet, the presence of *Cliona mucronata* in the same excavation has not been observed. Again, *Corticium Wallichii* has hitherto been found to line the excavation, instead of being contracted into the centre of it like the specimens of *Samus anonymus*. But both these circumstances may be accidental; and therefore nothing but a further observation of *Corticium Wallichii* can determine its real nature. The creeping into small cavities is rather a habit of the Spongida generally than of any particular species.

*Proposed Names for two new Groups of Flesh-spicules in the Spongida, viz. SPINISPIRULA and SCEPTRELLA.*

In my "Notes Introductory to the Study and Classification of the Spongida" (Ann. 1875, vol. xvi.), at pp. 30-34 I have given a short account of the "flesh-spicule," with illustrations of a few of the commonest types, to which I now propose to add two more under the names respectively of "*Spinispirula*" and "*Sceptrella*," as a more extended knowledge of the Spongida shows this to be desirable, if not necessary.



Varieties of both these types are represented, in Dr. Bowerbank's 'Monograph of the British Spongiadae,' as "defensive spicula"—the former under the designation of "spinulo-multiangulated cylindrical" (vol. i. p. 239, pl. iii. fig. 72), and the latter under that of "vertically-spined cylindrical" (ib., ib. fig. 69).

Each type, like those already mentioned in my "Notes, &c.," presents itself under a great variety of forms; and although it is necessary to remember these forms in connexion with the species to which they belong, yet it is equally necessary that the respective typical ones upon which each group is constructed should be first understood.

#### THE SPINISPIRULA.

*Spinispirula*, as its etymology indicates, is a spiniferous, spirally twisted spicule (*ex. gr.* Pl. XXVI. fig. 14, *a*, and Pl. XXIX. fig. 11), which may be long or short, thick or thin; thus in *Rhaphidhastia spectabilis* (Pl. XXVI. fig. 14, *a*) it is long and thin; while in the Suberite from the crab's back to be hereafter mentioned (Pl. XXIX. fig. 12) it is short and thick. Again, the spines may be long and thin, as in *Dactylocalyx Masoni*, Bk. (Proc. Zool. Soc. 1869, pl. vi. fig. 4); or long and thick, as in *D. Bowerbankii*, Johnston (ib. fig. 8, *b*), or obtuse (ib. fig. 8, *a*). The spines may be arranged on the spicule in a spiral line, corresponding with that of the shaft, as in *Rhaphidhastia spectabilis* and *Spongia Dysoni*, Bk. (*l. c.*), or they may be scattered over the shaft less regularly,—in all cases over the extremities, and sometimes entailing an elongation of the surface of the shaft (Pl. XXIX. fig. 11). Lastly, the shaft may consist of many or be reduced to one spiral bend only, as in *Rhaphidhastia spectabilis* and *Hymenaphia spiniglobata* (Pl. XXIX. figs. 14, *a*, and 16, *d*) respectively, when the latter may pass into a globular form, hence Schmidt's name "Spiralstern" (Spong. Küste Algier, p. 17).

To convey an idea of the plan upon which the *Spinispirula* and its varieties are formed, let us conceive a thin globe of india rubber over which a number of spines are arranged in a spiral or less regular manner, the spiral line having its poles opposite each other; now let the globe be more or less elongated in the direction of its axis, and at the same time twisted, when it will be possible to represent thereby most of the varieties of the *Spinispirula*. In many instances, the transparency of the spicule allowing all its spines to be more or less seen at once, it will be necessary to study their arrangement carefully by altering the focus of the magnifying-power, when the

optical delusion will be discovered and the spiral arrangement in most instances satisfactorily recognized.

I have already noticed the *smooth* form of this spirula under the name of "sinuous subspiral" ("Notes," &c. p. 32), which is well seen in *Cliona abyssorum* (Ann. 1874, vol. xiv. p. 249, pl. xiv. fig. 33).

As regards the extent to which the *Spinispirula* under various forms occurs among the Spongida, I have as yet not seen it in any of the orders but that of Holorhaphidota—and here confined to the families Suberitida, Pachytragida, and Pachastrellida, where it is very common among the groups Cavernosa, Compacta, and Laxa, and also in *Placospongia melobesioides*, which may have to come into the same family; rarer in the Pachytragida, where its great abundance, though, and almost peculiar form, in *Tethea muricata*, Bk. (= *Wyvillethomsonia Wallichii*, Wright), becomes a character, as first shown by the late Dr. Bowerbank (Phil. Trans. 1862, pl. xxxi. figs. 14, 15)—used again by him as an illustration of this kind of spicule, described and represented under the designation of "elongo-attenuato-stellate" (Mon. Brit. Sp. vol. i. p. 233, pl. i. fig. 35); also abundant, but in a minuter form, in *Stelletta aspera* (Ann. 1871, vol. vii. p. 7, badly illustrated). Minute, although constant and varied in form, in the Pachastrellina, and present also in some of the Corallistes, *ex gr. Dactylocalyx Masoni*, Bk. (*l. c.*).

As the C-shaped bihamate flesh-spicule or *fibula* is contortly subspiral, and not simply bent upon itself, which may be seen by viewing it on a flat surface, while the S-shaped form is still more spiral, the latter when spined throughout, as in some species of *Tethyina* (Ann. 1876, vol. xviii. pl. xvi. fig. 49), literally becomes a *spined spire*; but for memory's sake the line of distinction must be drawn somewhere, and therefore this had better be still considered as a variety of the bihamate rather than one of *Spinispirula*; so should the spiniferous coil or open spire, represented by the flesh-spicule of *Suberites spinispirulifer* (Pl. XXVIII. fig. 7), whose spines cover the spiral shaft uniformly—that is, without any *spiral* arrangement.

In noticing the transition of the stellate to the spinispirula in *Vioa Johnstonii*, Schmidt (Spongien d. atlant. Gebietes, p. 5) alludes to his *Spirastrella cunctatrix* and *Chondrilla phyllodes*. The former was "violet or reddish," and the latter "violet-brown" in colour, together with identical spiculation; but, from the spinispirula (flesh-spicule) in the latter being a little shorter and its consistence gelatinous, especially in

the cortex, *Chondrilla phyllodes* seems to have been placed among the Gumminida, and *Spirastrella cunctatrix*, on account of its crust, among Schmidt's Corticatae (Spongien von Algier, p. 17).

Now precisely the same species in point of spiculation occur at the Mauritius and on the south coast of Australia, as I learn from specimens in the late Dr. Bowerbank's collection and that of the Liverpool Free Museum respectively. In all there is the usual condensed layer of flesh-spicules on the surface; and all present the fine crumb-of-bread-like consistence (areolated sarcode) observed in *Halichondria suberea*, Johnst., = *Suberites domuncula*, Nardo. But while the former possess spinispirulate flesh-spicules like those of *Spirastrella cunctatrix*, represented by Schmidt (Spongien, 1. Suppl. Taf. iv. fig. 12, and Spong. von Algier, Taf. iii. fig. 8), that of the specimen in the Liverpool Museum, which has grown on the back of a little crab, is, together with the skeleton-spicule, a little shorter and stouter (Pl. XXIX. fig. 12). Indeed there is much the same difference between the two as there is between Schmidt's illustrations of the flesh-spicule of *Spirastrella cunctatrix* and *Chondrilla phyllodes* respectively, all having the same pin-like skeleton-spicule.

Hence it becomes questionable, with such varietal differences *only* in the spiculation, whether the difference in consistence may not be local, viz. gelatinous in *Chondrilla phyllodes* from the Antilles, and crumb-of-bread-like in the Suberite on the crab's back from the Mauritius.

There were five of these little crabs from the Mauritius sent for examination, each of which was about half an inch in diameter, and each overgrown by a different organism. Thus they bore respectively *Halichondria incrustans*, *Isodictya*, the white Suberite mentioned, *Chondrilla nucula*, *Chondrosia*, sp., and a calcareous white compound tunicated animal; so that I had ample means of contrasting the friable consistence of the Suberite with the gelatinous one of the Gumminida; while the spiculation of the former only differing from the other Suberites in the way above mentioned, led me to regard the whole as specimens of Schmidt's *Spirastrella cunctatrix*, one of which, viz. that from Australia (Freemantle), now numbered "708," measures  $6 \times 4 \times 2$  inches in its greatest dimensions. Both this and those from the Mauritius, although dry, still present the remains of the violet-red colour which they had when fresh, together with some great variety in the length, size, and general form of the flesh-spicule; while that on the crab's back is white and the spiculation more robust.

## THE SCEPTRELLA.

*Sceptrella*, meaning a little sceptre, differs from *Spinispirula* in having a cylindrical, straight shaft with its spinal developments arranged in groups circularly about the ends, and at more or less equal distances on the shaft. The spines may be smooth and simple, as in *Podospongia Loveni*, Bocage (Journ. d. Sci. Math., Phys. et Naturelles, no. iv. Lisbonne, 1869, pl. x. fig. 1, &c.), or microspined, as in *Sceptrella regalis*, Sdt. (Spongien d. atlant. Gebietes, p. 58, Taf. v. fig. 24, a); or the groups on the shaft may be transformed into circular plates with serrated margin, as in *Latruncula cratera*, Bocage (*op. et loc. cit.*, pl. xi. fig. 2, c, d, e); for illustrations of these respectively see Pl. XXIX. figs. 13, 14, and 15; or the plates round the shaft may be cup-shaped (figs. 16, 17, and 18), or the shaft stout with few and large spines (fig. 19), or the circular plates inflated on the margin and, together with most of the shaft, uniformly covered with minute spines (fig. 20); or, finally, the shaft may be almost obscured by the groups at the extremities being transformed into a single globular inflation, and those on the shaft into four or more such globular inflations, all microspined (fig. 21); the latter is almost a fac-simile of one of the spicules characterizing Hancock's genus *Thoosa* among the excavating sponges, to which I have already alluded. All the illustrations of the sceptrella are drawn on the same scale for comparison; and figs. 16 to 21 inclusive are present in greater or less number among my mounted specimens of the minute detritus from the root-bunch of *Euplectella cucumer*, obtained at the Seychelles, in which the number of known and unknown forms of spicules of the Spongida is truly wonderful, to say nothing of the other siliceous organisms, viz. the Radiolaria and Diatomaceæ, all of which, having been boiled in nitric acid, are preserved (at the expense, of course, of the calcareous Foraminifera), mixed up with gold dust and blue sapphire, &c.

As regards the extent to which the sceptrella under various forms occurs in the Spongida, I have never seen it in any species but those which I should be inclined to place among the Suberitida in the order Holorhaphidota, viz. those above mentioned, i. e. *Axos spinipoculum*, *Stellettinopsis simplex*, and perhaps *Corticium Wallichii*, together with the sponges from which the sceptrellæ in the mounted detritus from the root-bunch of *Euplectella cucumer* came, a few only of the forms of which have been briefly described and added to the illustrations of this beautiful flesh-spicule.

Schmidt's *Sceptrella regalis* seems to me to be an anomaly, since there are anchorates of both kinds present, viz. equi- and inequianchorates. May not these be adventitious?—just as we find the skeleton- and smooth spirular spicule of, to me, Hancock's *Cliona northumbrica* (Ann. 1867, vol. xix. p. 237, pl. vii. fig. 1) mixed with or appropriated by an *Esperia*, forming part of Kent's *Rhaphidotheca Marshall-Hallii* (Ann. 1870, vol. vi. p. 222, pl. xv. figs. 3 and 6).

It remains to be seen whether *Corticium Wallichii*, which I conjectured, from the form of the skeleton-spicule only, to belong to the Gumminida, does so or not.

That *Sceptrella* may be a *Spinispirula* under another form, the flesh-spicules of *Latruncula corticata* (Pl. XXVII. fig. 4, *a*, *b*, *c*) plainly demonstrate.

## EXPLANATION OF PLATES.

## PLATE XXVIII.

- Fig. 1.* *Trachycladus lævispirulifer*, n. sp. (natural size). *a*, stem; *b*, branches.
- Fig. 2.* The same. Skeleton-spicule (scale 1-24th to 1-6000th inch).
- Fig. 3.* The same. Flesh-spicule, spirular (same scale).
- Fig. 4.* The same. Flesh-spicule, cylindrical (same scale).
- Fig. 5.* The same. Length of spicule on scale of 1-12th to 1-1800th inch, for comparison.
- Fig. 6.* *Suberites spinispirulifer*, n. sp. Skeleton-spicule (scale 1-12th to 1-1800th inch).
- Fig. 7.* The same. Flesh-spicule, spinispirulate. *a*, same scale; *b*, more magnified, to show the spination.
- Fig. 8.* *Suberites angulospiculatus*, n. sp. *a*, smaller and more angulated form; *b*, larger and less angulated form. Scale 1-24th to 1-6000th inch.
- Fig. 9.* *Suberites fuliginosus*, n. sp. *a*, smooth skeleton-spicule; *b*, spinous skeleton-spicule. Scale 1-24th to 1-6000th inch.
- Fig. 10.* *Stellettinopsis corticata*, nov. gen. et sp. (nat. size). *a*, vents; *b*, base.
- Fig. 11.* The same. Skeleton-spicule (scale 1-24th to 1-1800th inch).
- Fig. 12.* The same. Flesh-spicule, stellate. *a*, on scale of 1-48th to 1-6000th inch; *b*, the same, more magnified.
- Fig. 13.* The same. Flesh-spicule, bacilliform, spinous. *a*, on scale of 1-48th to 1-6000th inch; *b*, the same, more magnified.
- Fig. 14.* The same. Quartz grains in the cortex.
- Fig. 15.* The same. Vent and portion of the surface, magnified respectively and relatively, to show:—*a*, aperture in the centre of the sphinctral diaphragm; *b*, elevated border; *c*, form of the convoluted dermal sarcode; *d*, the same, more magnified, showing the position of *c*, the quartz grains.
- Fig. 16.* *Stellettinopsis simplex*, n. sp. Skeleton-spicule (scale 1-24th to 1-1800th inch).
- Fig. 17.* The same. *a*, flesh-spicule, stellate (scale 1-48th to 1-6000th inch); *b*, the same, more magnified; *c*, arm, still more magnified, to show the microspination.
- Fig. 18.* The same. *a*, flesh-spicule, sceptrella; *b*, the same, more magnified. Scale 1-24th to 1-6000th inch.

## PLATE XXIX.

- Fig. 1.* *Samus anonymus*, Gray. Skeleton-spicule; end view (scale 1-12th to 1-1800th inch).
- Fig. 2.* The same. Skeleton-spicule; lateral view (same scale).
- Fig. 3.* The same. Flesh-spicule, (large) spined; end view (same scale). *a*, more magnified, to show the spined surface as indicated by the serrated margin; *b*, end of shaft, with smaller and unbranched arms.
- Fig. 4.* The same. Flesh-spicules (small), bihamate (*fibula*). Scale 1-12th to 1-1800th inch. *a*, one more magnified, to show the microspination.
- Fig. 5.* *Corticium Wallichii*, Cart. (1874). Skeleton-spicule (scale 1-6th to 1-1800th inch). *a a a*, tubercles; *b*, central canal.
- Fig. 6.* The same. Skeleton-spicule without tubercles, early stage of development. *a*, central canal. Same scale.
- Fig. 7.* The same. Flesh-spicule, sceptrellate (same scale).
- Fig. 8.* The same. Flesh-spicule, more magnified (scale 1-6th to 1-6000th inch). Lateral view. *a*, shaft; *b b*, radiated disks.
- Fig. 9.* The same. Flesh-spicule, radiated disks of; end view. *a*, shaft; *b*, capitate radii.
- Fig. 10.* *Amorphina stellifera*, n. sp. *a*, skeleton-spicule; *b*, flesh-spicule, stellate. Scale 1-24th to 1-1800th inch.
- Fig. 11.* *Spinispirula*. Flesh-spicule of *Spongia Dysoni*, Bk., much magnified (scale 1-4th to 1-6000th inch).
- Fig. 12.* The same. Flesh-spicule from *Spirastrella cunctatrix*, Sdt., mihi, from the variety on the crab's back (scale 1-12th to 6000th inch).
- Fig. 13.* *Sceptrella*. Flesh-spicule of *Spongia Loveni*, Bocage.
- Fig. 14.* The same. Flesh-spicule of *Latruncula cratera*, Bocage.
- Fig. 15.* The same. Flesh-spicule of *Sceptrella regalis*, Sdt.
- Figs. 16-21.* The same. Various forms from the minute detritus of deciduous sponge-spicules in the root-bunch of *Euplectella cucumer* from the Seychelles. *Fig. 16.* End view of one, so situated in the detritus.
- N.B. All the figures from 16 to 21 respectively are drawn to the same scale, for comparison, viz. 1-12th to 1-6000th inch.

XXXIX.—*An Account of a small Series of Coleoptera from the Island of Johanna.* By CHARLES O. WATERHOUSE.

A SMALL series of Coleoptera has recently been added to the British-Museum collection from the island of Johanna. The specimens were collected by Mr. Bewsher; and among them I have detected three species new to science, for one of which I propose to establish a new genus. The following species were obtained:—

1. *Cicindela melancholica*, Fabr.

Three examples of this widely distributed species.

2. *Anisodactylus Bewsheri*, sp. n.

Niger, nitidissimus; thorace postice utrinque creberrime subtiliter punctulato, lateribus rotundatis, margine ipso piceo, angulis posticis obtusis; elytris vix æneo tinctis, fortiter striatis, striis sublævibus, interstitiis sat convexis, subtilissime crebre punctulatis; antennis, clypeo, palpis pedibusque piceis. ♂.  
Long.  $4\frac{1}{2}$  lin.

Somewhat the form of *A. binotatus*, but a little less parallel at the sides, very shining, black, very slightly tinted with pitchy. Head smooth, the line separating the clypeus scarcely perceptible, the oblique impressions at the ends of this line moderately distinct. Thorax gently convex, one quarter broader than long, almost smooth anteriorly, all the region of the posterior angles densely and very finely punctured, the base in the middle less densely punctured; the sides are distinctly more rounded than in *binotatus*, especially posteriorly, very slightly impressed above, the impression within the posterior angles scarcely noticeable; the extreme margins are slightly pitchy, not reflexed, the posterior angles are marked, but are very obtuse. Elytra very little broader than the thorax, a little more narrowed at the apex than in *binotatus*, very slightly tinted with æneous, the striæ very deep, with no visible punctuation, the interstices distinctly convex, (when seen with a strong magnifying-glass) extremely delicately and very closely punctured. Legs pale pitchy; the terminal spur to the anterior tibiæ slender and simple; the basal joint of the tarsi is distinctly narrower than the following, the dilated joints are cordiform, not so transverse as in *binotatus*.

3. *Aphodius mæstus*, Fabr.

There are examples of this species in the Museum collection from Madagascar, Bombay, Ceylon, and Hong Kong.

4. *Apate francisca*, Fabr.

Two specimens appear to be referable to this species.

5. *Bostrichus unicornis*, sp. n.

Cylindricus, nitidus, niger; clypeo medio tuberculo fulvo-tomentoso instructo; thorace ruguloso, antice asperato, utrinque dentibus quinque munito; elytris crebre fortiter punctatis, dorsaliter sublineato-punctatis, apice declivo, margine incrassato, callo subapicali bituberculato, tuberculo exterioro perparum elevato; antennis piceis.  
Long.  $4\frac{1}{3}$  lin.

Head dull, densely and finely punctured, the clypeus in

front furnished in the middle with a small prominence, which is clothed with fulvous hair, and thus appears like a small conical horn. Antennæ pitchy, the club paler. Thorax about as broad as long, slightly narrowed in front of the middle, convex, the posterior angles rounded; the sculpture is of the usual character, but is much less strong than in most of its allies, somewhat closely rugulose punctate posteriorly, gradually becoming more and more asperate anteriorly, where on each side are five small, reflexed, sharp tubercles, placed obliquely in the ordinary way, the anterior one on each side being the anterior angle (which is not prolonged). Elytra scarcely broader than the thorax, two and a quarter times as long, closely and very strongly punctured (the punctures having a tendency to form lines), the intervals not raised; no costæ; the apex obliquely deflexed, scarcely concave, the apical margin much thickened and slightly reflexed, within the margin the surface is nearly smooth; at the subapical callosity there are two tubercles, the outer one obtuse and scarcely raised, the inner one is well developed, acutely conical, directed upwards and slightly towards the suture.

#### 6. *Cratopus ditissimus*, Bohem.

Two examples. This species was originally described from the island of Johanna.

For the next species, which is a new genus of Calandridæ, I propose the name *Perissoderes*, characterized as follows:—

#### PERISSODERES, n. gen.

Rostrum robust, rather suddenly deflexed from the base, very gently arcuate, swollen at the base; the antennal scrobes inferior, deep, elongate-ovate. First joint of the funiculus of the antennæ short, obconic; the second as long as broad; third to sixth slightly transverse, the spongy part of the club nearly hidden. Thorax as long as broad, quadrate, scarcely narrower immediately before the anterior constriction than at the base; the base bisinuate, the mesial lobe acute and covering the scutellum. Pygidium longer than broad, deflexed, curvilinear. Prosternum furnished with a strong post-coxal projection, which is emarginate posteriorly. The meso- and metasterna are on the same plane.

There are only two genera, *Barystethus*, Lac., and *Dia-thetes*, Pascoe (Journ. Linn. Soc. 1876, xii. p. 71), which have the scutellum covered by the lobe of the thorax; and this latter has it only partially covered. In the present genus



the scutellum is invisible. From *Barystethus* it differs in having the thorax not narrowed anteriorly, the spongy part of the club of the antennæ scarcely at all visible, the pygidium deflexed and not transverse. From *Diathetes* it differs in having the scutellum entirely concealed; and I do not discern any grooves in the tibiæ as described by Mr. Pascoe.

7. *Perissoderes ruficollis*, sp. n.

Niger, opacus; thorace quadrato, rufo, discrete punctato, margine antico nigro, basi media acute producta; elytris thorace parum latioribus, postico angustatis, subtiliter striatis, striis punctis distantibus, interstitiis planis, uniseriatim punctatis.

Long. (rostr. excl.)  $3\frac{1}{3}$  lin.

Rostrum stout, as long as the thorax, rather strongly and closely punctured at the sides of the base, finely punctured above. Thorax dull rusty red, not very closely or distinctly punctured (although the punctures are not small), as long as broad, suddenly narrowed in front, a trifle broader before the posterior angles than before the anterior constriction, the sides subparallel, obtusely rounded anteriorly, slightly sinuate in the middle, the base bisinuate, the mesial lobe produced over the scutellum, acute at its apex. Elytra at the base a little broader than the thorax, and not quite one third longer, gently narrowed posteriorly; the striæ are very fine, and are interrupted by distinct punctures, which are placed rather far apart; the interstices are flat and furnished with a single regular line of distinct punctures, which are about twice as close together as those on the striæ. Pygidium closely and strongly punctured. Femora strongly punctured; tibiæ with finer punctures arranged in lines.

8. *Sternotomis cornutor*, Fabr.

Two examples. This species was originally described by Fabricius as coming from America. It has since been recorded (under the name *S. comes*) by Prof. Westwood, with doubt, as coming from Madagascar.

See note on the locality and synonyms of this species, Ann. & Mag. Nat. Hist. 1878, i. p. 424.

9. *Praonetha obsoleta*, Fairm.

A single example which agrees very fairly with the description of this species.

British Museum,  
March 7, 1879.

XL.—*Studies on Fossil Sponges*.—V. *Calcispongiæ*.

By KARL ALFRED ZITTEL.

[Continued from p. 312.]

## V. CALCISPONGIÆ.

Thanks to Ernst Hæckel's brilliant monograph\*, the Calcispongiæ, of all the sections of existing sponges, are the most accurately known. As regards palæontology, however, the path-making work of the zoologist of Jena did not appear to possess the great importance which might *à priori* have been expected of it, considering the opinions previously prevalent upon fossil sponges. Hæckel very decidedly and quite justly opposed the notion that the majority of the fossil sponges must have had a calcareous fibrous or latticed skeleton. "Hitherto," he says (Bd. i. p. 341), "*no fossil Calcispongiæ are known*. It is true that in various collections of fossils there exist certain specimens with the tickets of 'fossil Calcispongiæ.' But whatever I have myself seen and had sent to me of such, most certainly do not belong to the Calcispongiæ. Moreover, *of all the descriptions and figures of fossil sponges, not a single one can be referred to a calcareous sponge*. Any one acquainted with the living Calcispongiæ will find this deficiency of petrified Calcispongiæ perfectly natural, considering their great delicacy and destructibility. We might, indeed, at least expect to find their microscopic calcareous spicules fossil in various rocks; and probably such will often be found by more accurate microgeological investigations. As yet, however, nothing of the kind has been described or figured."

When such an authority as Hæckel denies the existence of fossil Calcispongiæ so decidedly, it may seem a bold thing for me to say that I nevertheless refer to the Calcispongiæ a considerable portion of the fossil sponges with a vermiform fibrous skeleton, denominated *Vermiculata* by Oscar Schmidt. After the separation of the *Hexactinellidæ*, *Lithistidæ*, *Tetractinellidæ*, and *Monactinellæ*, there still remains a considerable residue of fossil sponges, distinguished by the calcareous and at the same time fibrous nature of their skeleton. By their anastomosing fibrous texture and partly also by their external habit, they remind one most of the existing horny sponges. They have indeed frequently been taken for such; and it has been supposed that the horny fibres had, in course of time, been converted into carbonate of lime.

\* *Die Kalkschwämme, eine Monographie*. Berlin, 1872.

In my first publications upon fossil sponges\* I characterized these as "*Calcispongia fibrosa*," and regarded them, on account of the peculiar radiate microstructure of the calcareous fibres which frequently occurs in them, as a perfectly isolated extinct order. Continuing my investigations, and especially by the employment of higher powers, however, the fibres in well-preserved specimens proved sometimes to be composed of spiculiform bodies. This observation, which was soon afterwards confirmed by W. J. Sollas † in the case of a fibrous sponge consisting of carbonate of lime from the Greensand of Cambridge (*Pharetrospongia Strahani*), led to new points of view, and in the first place to a comparison with the existing *Calcispongiæ*.

In the latter the skeleton consists of calcareous spicules, of triradiate, quadriradiate, or uniaxial form, isolated, never amalgamated or cemented together, and usually regularly arranged. The triradiates are by far of the most general occurrence.

According to Hæckel, there are among existing *Calcispongiæ* eighteen species of which the skeleton consists exclusively of triradiates, forty-four species which possess tri- and quadriradiates, and sixty-one species which have triradiates, quadriradiates, and bacillar spicules; in eight species the skeleton is exclusively composed of quadriradiates; and only in six species are bacillar spicules alone met with.

Hence Hæckel concludes that in the *Calcispongiæ* the triradiates originally and primarily play the principal part, and that the quadriradiates are to be regarded only as internal adaptive structures of the gastral surface, and the bacillar spicules as external adaptive structures of the dermal surface.

A noteworthy peculiarity of the calcareous spicules is their small average size. Tri- or quadriradiates in which the longest limb attains a length of half a millimetre are among the larger ones; very often they remain considerably under this measurement. The bacillar spicules also are of correspondingly small dimensions. In opposition to most siliceous spicules, the axial canals of the calcareous ones are so extraordinarily fine that they only become visible under a very high power. For all further details relating to the form, structure, and arrangement of the skeletal elements in the living *Calcispongiæ* I may refer to the exhaustive descriptions of Hæckel (*l. c.* Bd. i. pp. 170-209).

\* *Zeitschr. der deutsch. geol. Gesellsch.* Bd. xxviii. p. 651; and *Neues Jahrb. für Min. &c.* 1877, p. 338.

† *Quart. Journ. Geol. Soc.* vol. xxxiii. p. 242.

The next question is, whether the above-mentioned "*Calcispongia fibrosa*" can be placed with the existing *Calcispongiae*, or whether they belong to another section of sponges.

The chemical constitution of the skeleton, which furnishes the most reliable character in the living sponges, can only be employed with great caution in the case of the fossil ones; for not only do originally siliceous sponges occur in a calcareous state, but calcareous petrifications often pass into the siliceous condition. It is therefore by no means unusual for one and the same species to occur with a siliceous and with a calcareous skeleton.

The microstructure of the skeleton alone is of decided importance for the determination of all sponges. In this respect the fibrous sponges present exceedingly remarkable phenomena, which, however, are not difficult to explain by subsequent chemical and physical alterations.

According to the genera and species, the fibres vary between 0.3 and 1 millim. in thickness; and upon this depends the more or less loose texture of the skeletal tissue. They are always irregularly curved, frequently of different strengths (primary and secondary fibres) in one and the same skeleton; and the interspaces produced by anastomosis are of unequal size and always of irregular form. The old denomination, sponges with "vermiform skeleton," best suits certain *Calcispongiae* with coarse irregularly crooked fibres.

For microscopic examination thin sections alone can be employed, as in silicified specimens the finer structural conditions are destroyed. Higher powers (100-150 diameters) are necessary, however, than with the fossil *Hexactinellidae* and *Lithistidae*, in order to obtain distinct images, as the constituents of the fibres are of very small size.

If we examine a thin slice of a well-preserved *Corynella* from the Tourtia of Essen, or of a *Peronella* from the Greensand of Le Mans, under a moderate power (about 50 diameters), the fibres appear indistinctly striated parallel to the surface. By the employment of higher powers the longitudinal lines are resolved into small bacillar spicules closely applied to one another, which compose the whole fibre. Sometimes they are clearly separated from each other by a surface-layer which appears dark by transmitted light; but more commonly the fibre appears like a light mass of calc spar in which the spicules are not easily recognized. Usually the spicules are observed only in the longitudinal direction of the fibre, and, indeed, so arranged that their extremities overlie one another; so that their whole length is rarely visible. Quite exceptionally, thin transverse sections may be detected as packets of minute trans-

parent circles\*. From this it appears that the spicules possess a cylindrical form. Their length varies between 0·08 and 0·1 millim., and therefore remains within very modest dimensions. In general the bacillar spicules of the fibres are of almost exactly the same size and form. In a specimen of *Peronella multidigitata* from the Greensand of Le Mans, the bacillar spicules lie separately in a homogeneous light-coloured mass, from which they are very clearly distinguished; in certain parts they become sparse, whilst in others the whole fibre, as in the first case, appears to be composed of spicules. The occurrence here of a few minute triradiates is worthy of notice. Such triradiates, scattered among bacillar spicules, occur more or less frequently in several genera. They differ considerably in their dimensions, and sometimes attain a considerable size. Their arms are either straight or somewhat curved, but never forked at the ends. It is a comparatively rare occurrence to find sponges in which the fibres consist exclusively of *triradiates*. A remarkable example of this kind is presented by *Peronella cylindrica* of the Upper Jura. In this the individual triradiates (with which quadriradiates also appear to be intermixed) may be clearly distinguished in well-preserved specimens, especially at the periphery where individual spicules have been somewhat separated and project with one or two of the arms from the fibre.

I have been unable to detect axial canals either in the bacillar spicules or in the triradiates.

It is not often that the spicules are to be seen so distinctly as in the preparations just described. Frequently an incipient crystallization has effaced their contours and form, and the skeletal fibres show an indistinctly lamellar structure, or appear as if composed of prismatic corpuscles of calc spar, which sometimes completely coalesce with one another. In the sponges of the North-German Hills and the Triassic marl of St. Cassian, this state of preservation is common.

Very frequently a total destruction of the spicules, evidently after the imbedding of the sponges in the strata, occurs. A *Peronella* from Le Mans has already been mentioned, in which the spicules lie here and there quite separate in a homogeneous mass. Fibres are also not unfrequently met with, of which one end still appears distinctly to be composed of spicules, whilst the other has acquired a perfectly dense constitution. In certain localities (*e. g.* near Maestricht) most of the sponges are characterized by structureless homogeneous fibres.

A further alteration is effected by recrystallization of the

\* Sollas on *Pharetrospongia*, Quart. Journ. Geol. Soc. vol. xxxiii. (1877) p. 246, pl. xi.

skeletal fibres. Centres of crystallization are formed, from which fine rays issue in all directions; and as these centres are situated, in great numbers, sometimes in the middle and sometimes near the margin of the fibres, the latter acquire an extremely fine spheroidally-fibrous microstructure. This state of preservation sometimes also occurs in specimens in which individual fibres still distinctly show that they are composed of spicules.

In certain localities, for example near Wathheim, Muggendorf, and Ambey, in the Swabio-Franconian Jura, as also in the "Terrain à chailles" of Switzerland, the fibrous sponges occur entirely or partially in a siliceous condition, like most of the fossils occurring with them; these, especially when they are imbedded in a calcareous rock, can be completely freed from the matrix by dilute muriatic acid, and then do not yield at all in beauty and freshness to the associated Hexactinellidæ and Lithistidæ. But if we examine their siliceous fibres under the microscope, no trace of spicular structure is to be discovered; the siliceous mass appears turbid, and as if composed of minute, rough, granular, or vermiform corpuscles of no definite form. In contrast to the hyaline latticed meshes of the Hexactinellidæ, or the transparent Lithistid elements which occur in the same localities, the silicified skeletons of the fibrous sponges are at the utmost translucent, and always produce the impression of fissured and chemically altered structures. Sometimes only an outer rind of the sponge-body is silicified, the fibres of the interior remaining calcareous. In such cases I have always found the silicified fibres of the rough nature above described, the calcareous fibres, on the contrary, filled with distinct spicules. Now and then, indeed, the spicules appear to be able to preserve their form even after silicification; at least Sollas (*l. c.* p. 253), in treating *Pharetrospongia Strahani* with dilute acid, obtained silicified parts, consisting of spicules, at the surface of calcareous fibres. I have never seen such examples; but I certainly know several Jurassic fibrous sponges and one Triassic one (*Stellispongia variabilis*) both in the calcareous and in the siliceous state; and in the latter every trace of minute structure is destroyed.

This circumstance seems to me to furnish a satisfactory proof that *the fibres were originally composed of calcareous spicules, and only subsequently became converted into silica. I therefore regard the fibrous sponges as true Calcispongiae.*

This opinion contradicts the above-mentioned dictum of Hæckel, that no fossil *Calcispongiae* are known; it is also in opposition to the views of Sollas and Carter, according to which a decidedly fibrous sponge from the Greensand of

Cambridge (*Pharetrospongia*) belongs not to the calcareous but to the siliceous sponges. The form and position of the spicules and the observation that in fossil sponges originally siliceous skeletons often appear converted into calcite, decided Sollas to place *Pharetrospongia* in the group Holorhaphidota.

Carter\* summarizes the arguments which render it improbable that *Pharetrospongia* belongs to the Calcispongiæ as follows:—1. All existing Calcispongiæ are not only very small, but for the most part absolutely minute. 2. With the exception of half a dozen species, the skeleton of the Calcispongiæ consists of triradiates or quadriradiates, and the bacillar spicules are always straight, never curved in the form of an arc. 3. The Calcispongiæ are so perishable, that immediately after death they become diffuent, and indeed, in consequence of the absence of horny fibres and siliceous constituents. 4. The spicules break up very rapidly even in Canada-balsam preparations, pass into watery spherules, and in a short time leave no trace of their existence.

All these objections, raised with respect to *Pharetrospongia*, apply also to the other fibrous sponges; if they hold good, the possibility of the occurrence of any fossil Calcispongiæ is most seriously shaken.

In the first place, with regard to comparative size, it must be admitted that the living Calcispongiæ rarely attain any considerable magnitude; but nevertheless Hæckel describes stocks from 50 to 100 millims. in height in all the three existing families; and among the Leucones there are even individuals 30–40 millims. long and 15–20 millims. broad. These latter, in size and external form, are almost undistinguishable from the most common forms of fossil fibrous sponges, such as *Peronella* and *Corynella*. Just as the recent Calcispongiæ yield considerably in size to the other sponges, so also the fossil fibrous sponges are generally distinguished, in comparison with the Hexactinellidæ and Lithistidæ, by their small dimensions. The genus *Pharetrospongia*, described by Sollas, chances, with *Pachytilodia*, to contain the largest known forms of fibrous sponges. The difference of size between the living and fossil Calcispongiæ is by no means so considerable as to exclude the possibility of their relationship.

The objection relating to the form of the skeletal elements is of more weight. That in living Calcispongiæ bacillar spicules only exceptionally (in eight species) form the skeleton, cannot be disputed; but among the Ascones, as well as the Sycones and Leucones, there are genera consisting

\* Ann. & Mag. Nat. Hist. ser. 5, vol. i. (1878) p. 136.

entirely of bacillar spicules. It need not surprise us, therefore, if the skeletons of all fibrous sponges were composed entirely of bacillar spicules; for it is a matter of observation that extinct families, or such as are richly developed in the older formations, are much more frequently closely allied to rare and isolated existing forms than to those which at the present day stand at the height of their development. The uniformity in the size and form of the spicules in the fossil fibrous sponges, as also the absolute deficiency of bowed spicules and fibulæ (*Spungen*), may also be cited in favour of their originally calcareous nature.

The predominance of bacillar spicules in the fossil *Calcispongiæ* seems to me, however, to be of special significance from another point of view. According to the concurrent observations of Metschnikoff, F. E. Schulze, and Barrois, the bacillar spicules first make their appearance in the embryo of most *Calcispongiæ*, and only afterwards the tri- and quadriradiates. Hence, according to the biogenetic fundamental law, the bacillar spicules are the oldest and primary skeletal elements, and they must therefore, even on theoretical grounds alone, be assumed to have been especially present in the fossil ancestors of the *Calcispongiæ*.

Moreover, that the characteristic triradiates of the *Calcispongiæ* are not wanting in the fossil forms has already been mentioned. They sometimes lie singly among the bacillar spicules; sometimes, in association with quadriradiates, they form the whole skeleton. With a little caution any confounding of the tri- and quadriradiates of *Peronella* with similarly formed skeletal elements of siliceous sponges (*e. g.* *Stelletta*, *Pachastrella*, &c.) is impossible. The spicules of the *Calcispongiæ*, in comparison with the above-mentioned siliceous structures, are of diminutive size; their straight or curved arms are pointed or truncate, *always simple, never forked*; and their axial canals are excessively fine, in fossil forms generally invisible.

Carter's third objection relates to the small power of resistance of the calcareous skeletons to the force of the waves and chemical influences. According to the observations of that experienced spongologist, the recent *Calcispongiæ*, which live almost exclusively in shallow water, are completely destroyed in a very short time. In the fossil calcareous sponges the peculiar arrangement of the spicules in fibrous trains, as also the frequent presence of a delicate superficial layer, certainly seems to have furnished some protection against mechanical destruction; but that the spicules, exactly like those of the living forms, only made a feeble resistance to chemical action,



is a necessary consequence of the constitution of the calcareous fibres. Specimens with well-preserved, clearly-distinguishable spicules occur very rarely; much more frequently the minute skeletal elements are entirely or partially destroyed, and the fibres have acquired a structure which scarcely allows one to assume the former existence of spicules.

It seems to me, therefore, that neither the size and the external form, nor the constitution of the skeleton of the fossil fibrous sponges are opposed to their relationship to the *Calcispongiæ*\*.

In the consideration of the fossil fibrous sponges their occurrence in *decidedly littoral deposits* must also be of significance, as the existing *Calcispongiæ*, for the most part, live only at a very small depth. Most of them occur attached to stones in the littoral zone from high-water mark to a depth of 2 fathoms. Very few of them go down to 20 fathoms; but isolated forms have been brought up from 60–70 fathoms, and a single species (*Leucaltis bathybia*) even from a depth of 342 fathoms according to Hæckel.

Although after the observations that have been made upon the metamorphosis of the fossil siliceous sponges into calcite, the chemical constitution of the skeleton can only be taken into consideration with great caution, it cannot be a matter of indifference that perhaps nine tenths of all the known fossil fibrous sponges, and these from the most diverse formations and localities, are in the calcareous state, and that silicified specimens usually occur only where nearly all the formerly calcareous shells and skeletons are converted into silica.

Now that I have endeavoured to prove that the fossil fibrous sponges belong to the *Calcispongiæ*, it remains to discuss the further question, whether they enter one of the existing families or constitute an independent group.

According to Hæckel the *Calcispongiæ* are divided into three families—*Ascones*, *Leucones*, and *Sycones*. In the *Ascones* the thin wall is permeated only by transient cutaneous pores or orificial canals; in the *Leucones* a rather complex system of branching canals is developed in the thick wall; and in the *Sycones* the whole sponge-body consists of simple radial tubes, which open into the stomachal cavity.

The *Sycones* are represented in the fossil state by a single genus occurring in the Upper Jura. The calcareous fibrous sponges agree in respect of their canal-system neither with the *Ascones* nor with the *Sycones*; but there are among the

\* To my great satisfaction Mr. Carter, after I had sent him a number of fossil specimens, together with some microscopic preparations, has declared the existence of fossil *Calcispongiæ* to be indubitable.

living Leucones forms with an absolutely identical arrangement of the water-canals. In this respect, therefore, the fossil calcareous sponges most approach the Leucones; but their union with these is decisively opposed by the extremely peculiar arrangement of the spicules in fibre-trains.

In general there is a close agreement in the distribution and arrangement of the skeletal elements within the different families of the Calcispongiæ. Thus, for example, in the Ascones the triradiates lie almost all in a single layer and are completely imbedded in the syncytium; of the quadriradiates, on the contrary, the three facial limbs are placed entirely in the plane of the dermal lamella, whilst the fourth or apical ray projects freely into the stomachal cavity. The bacillar spicules also are originally entirely enclosed in the syncytium; but subsequently they usually protrude more or less, and form tufts, circlets, and bristles.

The spicules in the Sycones are exceedingly regularly distributed. The composition of the wall of radial tubes gives rise to peculiar conditions of differentiation in the skeleton and to a definite radial arrangement of the individual parts. We consequently always distinguish the true skeleton of the wall and radial tubes from the skeleton of the gastral and dermal faces. The former usually consists only of triradiates, very rarely of bacillar spicules or quadriradiates; in general the triradiates form several parallel layers, and are always so arranged that the sagittal ray turns outwards, while the two lateral (usually short) arms diverge obliquely inwards nearly in the same plane. In the dermal and gastral skeletons also the spicules are remarkable for their regular arrangement.

The skeletal elements of the Leucones are quite otherwise arranged. In them also the outer surface and that of the stomachal cavity exhibit a constitution different from that of the true wall; so that we can likewise distinguish a dermal, a parenchymal, and a gastral skeleton. In the interior of the thick wall the parenchymal skeleton is composed of a mass of calcareous spicules of different forms and sizes, as it were thrown together *without any definite arrangement*. The triradiates generally predominate; and with them a few quadriradiates and bacillar spicules are intermixed. The surface of the Leucones is either smooth or spiny. The *smooth dermal skeleton* is produced by the spicules being pressed close together, and rather more regularly arranged than in the interior of the wall. The *spiny dermal skeleton* is formed by large bacillar spicules which project beyond the surface with their distal part. The smooth or spinose skeleton of the gastral surface is produced in the same way as the dermal skeleton.

As may be seen from this rapid description of the skeletal characters of the recent *Calcispongiæ*, the fossil forms are essentially distinguished from the *Ascones*, *Sycones*, and *Leucones* by their generally uniaxial spicules being grouped in fibre-trains, in which they lie close together, parallel to the longitudinal axis of the fibres, like the arrows in a quiver. This peculiarity, in combination with certain characters of the canal-system and external form, justifies the establishment of a distinct family, for which I propose the name of *Pharetrones* (from *φαρέτρα*, a quiver).

#### PHARETRONES, Zitt.

*External form.*—As in all other orders, the external form of the calcareous sponges, from its instability and multifariousness, furnishes no characters of decisive systematic importance. We find among the *Pharetrones* nearly all the peculiarities of form which occur among the *Lithistidæ*; here also cylinders, clubs, basins, cups, leaves, nodules, and ramified bushes or twigs are the most common forms. In general, however, the *Lithistidæ* attain much more considerable dimensions; whilst among the *Pharetrones* basins of 70–80 millims. diameter, or cylinders of equal length, are to be regarded as unusually large forms. Nevertheless in average size the *Pharetrones* considerably exceed the existing *Calcispongiæ*.

The *walls* are of considerable thickness, and consist of solid anastomosing calcareous fibres.

The *stomachal cavities* may generally be very clearly distinguished from the canal-ostia or pores of the surface. They are sometimes tubularly prolonged and reach from the vertex to the base, sometimes funnel-shaped, sometimes shallow or even scarcely sunk into the skeletal mass.

All *Pharetrones* attach themselves firmly to a support.

*Canal-system.*—In many *Pharetrones*, especially in those with a well-developed, impressed stomachal cavity, the canal-system agrees with that of the *Leucones*. Crooked branching canals, commencing with their fine ramified ends near the surface, and uniting towards the interior to form a stem gradually increasing in thickness, open into the stomachal cavity. These canals generally have a radial course, but in the middle of the sponge-body, especially when the stomachal cavity is shallow, they sometimes take a perpendicular direction, and convey the water from below to the cavity. The canal-ostia upon the gastral surface are placed irregularly, and in size dependent upon the thickness of the canals.

In forms with undeveloped stomachal cavity fine crooked

canaliculi penetrate from one or both surfaces into the wall, without traversing it.

Not unfrequently definite canals are entirely absent; and this phenomenon is observed both in forms with a tubular stomachal cavity, and in those without any oscula and stomachal cavities. In all cases where the canals are wanting the skeletal tissue presents a looser constitution, which enables the circulation of water to go on without hindrance.

Exceedingly peculiar phenomena of water-circulation are met with in the genera *Verticillites* and *Celyphia*. In the first-named genus the cylindrical individuals with a tubular stomachal cavity consist of hollow rings placed one upon the other, and of which the cover of one always serves as the base of the next. Only the walls of these rings consist of spicular fibres; the interior is hollow. From the cavities of the rings fine orificial canals lead into the stomachal cavity; and they are placed in communication with each other by similar canals. In *Celyphia* the stocks are composed of hollow globular individuals which possess no common stomachal cavity, and communicate with the outer world only by small round apertures.

*Skeleton and State of Preservation.*—These have been already described in detail; so that nothing essential remains to be stated in regard to the fibres and their structure. A noteworthy peculiarity of the Pharetrones is that isolated surface-spicules of characteristic form or remarkable size never occur in them. The fibrous skeleton either comes naked and unprotected to the surface, or it is enveloped by an external smooth *dermal skeleton*, which, however, does not consist, as in the Lithistidæ, of differently formed surface-spicules, but of exactly the same small spicules as the whole of the rest of the skeleton. To the naked eye the dermal layer of the fossil calcareous sponges appears smooth or concentrically wrinkled, and exactly in agreement with the so-called *epitheca* of the corals. It has therefore hitherto always been designated by the same name. It is rarely, however, that one can succeed in demonstrating its spicular structure, as it is precisely at the surface that the chemical influences have been particularly effective, and have generally led to the complete destruction of the skeletal elements.

*Classification.*—We must not for the present attempt a special classification of the rich and varied family Pharetrones, as the skeletal spicules can be observed with sufficient distinctness only in a few genera. In general we have to content ourselves with ascertaining the actual existence of spicules; and it is only exceptionally that we are able to distinguish

their form exactly. All other characters, derived from the external form, the structure, and the canal-system, prove insufficient for the establishment and especially for the sharp discrimination of natural groups. In the special part I have therefore enumerated the genera in the sequence in which they can best be arranged in accordance with the totality of their characters which are accessible to observation.

*Occurrence, Distribution in Time, and Pedigree.*—In opposition to the Hexactinellidæ and Lithistidæ, the Pharetrones occur associated together and in considerable numbers only in deposits of littoral origin, and most frequently in marly and sandy rocks, usually mingled with numerous Gastropoda, Pelecypoda, Brachiopoda, Bryozoa, and Echinodermata. The most ancient calcareous sponges which I have been able to examine are derived from the Devonian *Stringocephalus*-limestone of Vilmar in Nassau, a locality celebrated for its wealth of well-preserved Gastropods and Bivalves. These belong to the rich genus *Peronella*. According to an oral communication from Prof. de Koninck numerous undescribed forms are found in the Carboniferous Limestone of Tournay in Belgium. Among the sponges of the Dyas described by Geinitz and King, *Eudea tuberculata*, King, may belong to *Corynella*; but most of the others are very doubtful, and some of them certainly of inorganic origin.

The extra-Alpine Trias has furnished a genus of Pharetrones (*Corynella*) only in Silesia; but, on the other hand, there is in the Alps near St. Cassian, and in the Seeland Alp near Schluderbach, the first rich Calcispongian fauna, in which thirteen genera with numerous species have been discovered. These deposits bear the most decided stamp of littoral formations, and are filled with that characteristic pygmy fauna which, according to Fuchs, lived in the fields of Laminariæ of that epoch. The genera *Eudea*, *Peronella*, *Corynella*, *Verticillites*, *Colospongia*, *Stellispongia*, *Leiospongia*, *Pharetrospongia*, &c. already represent the most important modifications which occur in the structure and external appearance of the Pharetrones in general.

From the Rhætics of the Bavarian Alps I am acquainted with some badly preserved and in part silicified Calcispongiæ, which, however, cannot be accurately determined. The Lias appears to have been very unfavourable to the development of sponges; it has hitherto furnished only isolated siliceous spicules, but no coherent skeletons of either siliceous or calcareous sponges.

From the Inferior Oolite of Bayeux and Port-en-Bessin, in Calvados, Michelin and D'Orbigny mention numerous sponges,

for the most part belonging to the Pharetrones (*Peronella*, *Corynella*, *Pharetrospongia*, *Stellispongia*). The same genera occur still more abundantly in the Great Oolite of Ranville, St. Aubin, and Langrune, as also in strata of the same age in the Cracow district, especially near Balin.

The Upper Jura, which contains such astonishing quantities of Hexactinellidæ and Lithistidæ in the Sponge-limestones of the Jura chain, is poor in calcareous sponges. The most ancient representative of the Sycones (*Scyphia punctata*, Goldf.) occurs here as a rarity, accompanied by *Myrmecium rotula*, Münst., and *Peronella cylindrica*, Goldf. On the other hand, the Terrain à chailles, the Coral Rag of Nattheim, and the siliceous Jurassic limestone of Amberg may be indicated as horizons for Calcispongiæ. In these localities there are found various species of *Peronella*, *Corynella*, *Eusiphonella*, *Crispispongia*, *Eulea*, and *Blastinia*, and, indeed, generally in a silicified state. From the neighbourhood of Bruntrut and Chambéry also a number of Upper-Jurassic Calcispongiæ of the above-named genera have been described by Etallon\* and Fromentel†.

In the Cretaceous formation the Pharetrones appear to have attained the zenith of their development. They occur in great quantities in various horizons of the lower division of that formation (Valenginian, Neocomian, and Aptian); and the North-German Hills, the Neocomian of St. Dizier, Germiney, Vassy, Morteau, Fontenoy, &c., in France, the Valenginian of Arzier, the Neocomian of Mont Salève, the Urgonian of La Rusille and Landéron, the Aptian of La Presta in Switzerland, and the inferior sand of Farringdon in England, especially, have attained a certain celebrity through the writings of Fromentel‡, F. A. Römer§, Loriol||, and Sharpe¶.

In the Cenomanian, the Tourtia of Essen, and the Green-

\* Thurmman und Etallon, "Lethæa Bruntrutana," Neue Denkschr. der schw. naturf. Gesellsch. vols. xix. & xx.

† Pillet et Fromentel, 'Description géologique et paléontologique de la colline de Lemenc,' Chambéry, 1875.

‡ E. de Fromentel, "Introduction à l'étude des éponges fossiles," Mém. Soc. Linn. Norm. vol. xi. 1859; and "Catalogue raisonné des Spongitaires de l'étage Néocomien," Bull. Soc. Sci. de l'Yonne, 1861.

§ F. A. Römer, "Die Spongitarier des norddeutschen Kreidegebirges," Palæontographica, vol. xiii. 1864.

|| P. de Loriol, 'Description des animaux invertébrés fossiles du Néocomien moyen du Mont Salève,' 1863; and "Monographie des couches de l'étage Valenginien d'Arzier," in Pictet's 'Matériaux pour la Paléontologie Suisse,' 4<sup>e</sup> sér. 1868. P. de Loriol et Gilliéron, "Monographie de l'étage Urgonien inférieur de Landéron," Mém. Soc. Helv. Sci. Nat. vol. xxiii. 1869.

¶ Sharpe, Quart. Journ. Geol. Soc. vol. x. 1854.

sand of Le Mans and Cambridge are remarkable for the abundance of beautifully preserved *Calcispongiæ*; and, finally, the Cretaceous tuff of Maestricht is the locality which harbours the last representatives of the *Pharetrones* in considerable numbers.

As will be seen from the following Table (p. 378), most of the Cretaceous genera agree with those already occurring in the Jura.

It is remarkable that, with the exception of isolated spicules in the Red Crag, which are referred by Johnson to *Grantia compressa*, no *Calcispongiæ* have been detected in the Tertiary formation; consequently the *Pharetrones*, which are evidently the most resistant forms, seem to have become extinct at the close of the Mesolithic epoch.

Contrary to what occurs in the siliceous sponges, we find in the *Pharetrones* a tolerably continuous development. Many genera overstep the bounds of one or two formations, and are remarkable for their unusual longevity. The change of form within the genera is also confined within moderate limits, so that, under certain circumstances, the species from the uppermost Cretaceous present a delusive resemblance to those from the Jura and Trias.

The former mode of life of the *Calcispongiæ* probably furnishes the simplest explanation of their closed sequence. They were inhabitants of the coasts; and as, in general, more littoral than deep-sea formations are accessible to examination, it cannot surprise us if the *Calcispongiæ* occur in more numerous localities and on more horizons than the *Hexactinellidæ* and *Lithistidæ*, which belong to deep-sea deposits.

From a phylogenetic point of view the *Pharetrones* may be regarded as the forms from which the existing *Leucones* and *Ascones* have been developed. If we assume, with Hæckel, as the stem-form of the *Calcispongiæ* (leaving out of consideration the problematic preceding and unpreservable embryonic types) an adherent *Olynthus* furnished with osculum and stomachal cavity, we must imagine this provided with bacillar spicules; for not only are the uniaxial skeletal structures the first to make their appearance in the larvæ of the existing *Calcispongiæ*, and consequently to be regarded as genetically the oldest, but in the most ancient *Pharetrones* they exclusively compose the skeleton.

Any detailed discussion of the genetic connexion of the genera of *Pharetrones*, such as Hæckel has given to the genera of the three living families, must be abandoned in the face of our still imperfect knowledge of the details of the skeletal constitution; it could only lead to unreliable results. For

*Distribution of the Calcispongiæ in Time.*

	<i>Ascones.</i>	<i>Leucones.</i>	<i>Sycones.</i>
RECENT.	Ascetta. Ascylla. Ascysa. Ascaltis. Ascortis. Asculmis. Ascandra.	Leucetta. Leucylla. Leucyssa. Leucaltis. Leucortis. Leuculmis. Leucandra.	Sycetta. Sycylla. Sycyssa. Sycaltis. Sycortis. Syculmis. Sycandra.
TERTIARY.	Isolated Spicules.		
	<i>Pharetrones.</i>		
UPPER AND MIDDLE CRETACEOUS.	Verticillites. Peronella. Corynella. ?Hippalimus. Synopella.	Oculospongia. Elasmostoma. Diplostoma. Pharetrospongia. Pachytilodia.	
LOWER CRETACEOUS.	Verticillites. Peronella. Elasmocœlia. Conocœlia. Corynella. Stellispongia.	Sestrostomella. Synopella. Oculospongia. Elasmostoma. Diplostoma. Pharetrospongia.	
UPPER JURASSIC.		Eudea. Peronella. Eusiphonella. Corynella. Myrmecium. Stellispongia. Sestrostomella. Blastinia. Crispispongia.	Protosycon.
MIDDLE JURASSIC.		Eudea. Peronella. Corynella. Lymnorea. Stellispongia. Sestrostomella. Pharetrospongia.	
LIAS.			
TRIAS.	Eudea. Colospongia. Verticillites. Celyphia. Himatella. Peronella.	Corynella. Stellispongia. Sestrostomella. Crispispongia. Pharetrospongia. Leiospongia.	
PERMIAN.		? Peronella. ? Corynella.	
CARBONIFEROUS.		?	
DEVONIAN.		Peronella.	



the present also we have no sound data for deciding whether, how, and when the Ascones and Leucones were developed from the Pharetrones. It is, however, certain that the family Sycones branched off very early (at least in the Jurassic period).

[To be continued.]

XLI.—*Descriptions of new Coleoptera belonging to the Genera Monomma, Silis, and Lithinus.* By CHARLES O. WATERHOUSE.

Monommidæ.

*Monomma quadrimaculatum*, sp. n.

Elliptico-ovale, convexum, piceum, nitidum; elytris nigro-piceis, maculis rotundatis rufis notatis.

Long.  $2\frac{3}{4}$  lin.

General form of *M. philippinarum*. Head very closely, finely, but distinctly punctured. Thorax densely and rather strongly punctured; the sides not reflexed, but narrowly impressed within the margin. Elytra rather strongly and closely striate-punctate; the punctures in the scutellar region much larger, the first stria very short; the interstices rather closely, very delicately, but distinctly punctured; each elytron with two rather large round spots, one near the shoulder, the other subapical.

*Hab.* Philippine Islands (*Cuming*).

*Monomma pilosum*, sp. n.

Elliptico-ovale, leviter convexum, nitidum, nigro-fuscum, fulvo-pilosum; thorace subtiliter irregulariter punctulato, angulis anticis productis obtusis, marginibus piceis; elytris sat fortiter striato-punctatis, striis apicem versus evanescentibus; prosterni projectura valle marginata, medio fortiter parce punctato; tarsis longis.

Long.  $6\frac{1}{2}$  lin.

Rather an elongate species, not very convex, blackish brown, with very short fulvous pubescence above. Thorax not quite twice as broad as long, very finely and not very thickly punctured, the lateral margins flattened but not reflexed. Elytra scarcely broader than the thorax, three times as long, rather attenuated towards the apex; the lines of punctures are well marked, but disappear towards the apex;

the punctuation of the interstices is fine and sparse. The pubescence is very short and rather coarse, and would probably never be very close. The mesial projection of the prosternum has a deep impressed line all round, the enclosed part sparingly and rather strongly punctured; mesosternum rather thickly but obscurely punctured. The epipleura of the elytra is very closely, finely, and obscurely punctured. Tarsi long, especially the posterior pair.

The only described species which appears to have long tarsi like the present species is *M. grande*, Thomson, from which it differs in having the thorax more transverse, and the epipleuræ of the elytra not smooth.

*Hab.* Fianarantsoa, Madagascar (*Rev. W. Deans Cowan*).

*Monomma abstrusum*, sp. n.

Ovale, leviter convexum, nitidum, piceo-nigrum, brevissime fulvo-pubescentibus; thorace irregulariter subtiliter punctato, angulis anticis prominentibus, obtusis; elytris thorace  $2\frac{3}{4}$  longioribus, sat fortiter striato-punctatis, striis apicem versus evanescentibus, circa scutellum fossato-punctatis; prosterni projectura vix marginata, lævi; tarsi sat longis.

Long.  $4\frac{1}{2}$  lin., lat.  $2\frac{3}{5}$  lin.

Rather a short broad species, closely allied to the preceding, but much smaller and relatively shorter and more oval. The thorax is very distinctly but not very thickly punctured, the punctuation unequally distributed. Elytra with lines of rather strong punctures, which do not extend to the apex, the interstices almost without punctuation; the rather coarse fulvous pubescence is irregularly distributed. The prosternal projection has its margins slightly raised, quite smooth and shining, as is also the mesosternum.

This species is closely allied to the preceding, and has long posterior tarsi; but it is a much shorter species; the projection of the posterior margin of the thorax over the scutellum is unusually acute. Scutellum transversely cordiform. The punctures of the elytra around the scutellum are large and horseshoe-shaped. The prosternal process and the mesosternum are smooth.

*Hab.* Fianarantsoa, Madagascar (*Rev. W. Deans Cowan*).

**Telephoridæ.**

*Silis madagascariensis*, sp. n.

Fulvo-ochracea, opaca, sericea; antennis pedibusque (femorum basi excepta) nigris.

Long. 6 lin.

♂ thorace angulis posticis profunde excisis, calcaratis; disco postice impresso utrinque bituberoso, medio nigro.

♀ thorace angulis posticis simplicibus, rotundatis; disco minus impresso.

Somewhat the appearance of *Telephorus lividus*, L., but larger and opaque. Head subquadrate, flat above, parallel at the sides in the male, slightly narrowed posteriorly in the female; mandibles large, curved, pitchy at the apex; antennæ three fourths the length of the elytra, slender. Thorax one fourth broader than long, obtusely rounded in front, impressed within the margins; the disk with a slight mesial carina in front, impressed in the middle behind, the sides obtusely bituberoso; the posterior angles are deeply excavated above, elevated behind, excised at the sides, and with a sharp spur directed forwards over the excavation. Elytra the same width as the thorax, parallel, opaque, silky, with very slight indication of two costæ on each.

*Hab.* Antananarivo (*Rev. R. Toy*) and Fianarantsoa (*Rev. W. Deans Cowan*).

#### Lithinidæ.

##### *Lithinus penicillatus*, sp. n.

Elongatus, cylindricus, niger, fulvo-squamosus, cristis plurimis fulvis ornatus; elytris crebre fortiter punctatis.

Long. 7-9½ lin.

Forehead with two approximate tufts of fulvous hairs. Thorax a little longer than broad, rounded in front, straight at the sides, scarcely narrowed posteriorly, strongly but not very thickly punctured, with six tufts of fulvous hair on the anterior margin, and four on the disk, the posterior pair of which are very small and sometimes partly black. Elytra very little broader than the thorax, parallel, with close lines of large deep punctures or fossæ (the intervals narrow), with very numerous tufts of fulvous hair, and six of black hair arranged as follows:—two large tufts in the middle of each elytron near the base, black, fulvous behind, with a smaller fulvous tuft at its side; there are eight arranged in a circle on the back behind the middle, the four posterior ones more or less black; below these there are four others, one on each subapical callosity and two close to the suture; there is one on the margin below the shoulder, another about the middle, and three on each side of the apical margin. Legs clothed with fulvous scales; knees black.

*Hab.* Antananarivo (*Rev. R. Toy*).

This species is closely allied to *L. nigrocristatus*, but is much more elongate and cylindrical. It appears from description to be nearer *L. planus*, Coquerel (Ann. Fr. 1859, p. 251); but I can see nothing that can be termed a tubercle either on the thorax or elytra; and the punctures of the elytra are certainly not "distant."

XLII.—On the Zoological Position of the Ophiurans obtained by Dr. Wallich, F.L.S., during the Voyage of H.M.S. 'Bulldog' in 1860. By Prof. P. MARTIN DUNCAN, F.R.S. &c.

WHILST on board H.M.S. 'Bulldog' in 1860, Dr. Wallich had the good fortune to be instrumental in obtaining, from the depth of 1260 fathoms, the first evidence of a satisfactory nature that higher animals than Foraminifera, Rhizopoda, and Spongida inhabit the ocean-floor at considerable depths.

He wrote in his description of the voyage\* as follows:—

"What wisdom and ingenuity failed to achieve, hunger or curiosity accomplished; and thus whilst the sounding-apparatus only succeeded in bringing up, from a depth of 1260 fathoms, a number of minute shell-covered creatures so simply organized as to render them incapable of perceiving or escaping a danger, thirteen starfishes varying in diameter from two to five inches came up, convulsively embracing a portion of the sounding-line which had been paid out in excess of the already ascertained depth, and rested for a sufficient period at the bottom to permit of their attaching themselves to it. These starfishes arrived at the surface in a living condition, and, what is still more extraordinary, continued to move their long spine-covered rays for a quarter of an hour afterwards."

Dr. Wallich had these interesting specimens placed in spirit; and one was figured clinging to the sounding-line and presenting the disk to the observer. He did not describe the forms; and consequently many names have been given to them, and some criticisms have been elaborated in reference to these names. Unfortunately the value of all this is not great; for the specimens have hitherto never been examined.

Being engaged in a description of the Ophiurans collected in Smith's Sound, during the late voyage of Arctic discovery under Sir George Nares, F.R.S., I was anxious to see some

\* G. C. Wallich, M.D., F.L.S., F.G.S., &c., 'The North-Atlantic Seabed, comprising a Diary of the Voyage on Board H.M.S. Bulldog in 1860' (London: Van Voorst, 1862), p. 68.

deep-water forms from the neighbouring seas, in order to obtain evidence regarding the method of the continuity of the Arctic shallow-water forms over such a vast extent of area as some possess.

Dr. Wallich granted my request for an examination of his treasures at once, and has been good enough to permit me to anatomize one of his specimens. My examination of the well-preserved little Ophiuran has not only satisfied a very reasonable curiosity to know what the genus and species of this firstfruits of the deep might be, but it has explained the presence of a well-known species, which is celebrated for its variability, on both sides of the North Atlantic.

The Ophiuran sent to me by my friend from 1260 fathoms, lat.  $59^{\circ} 27' N.$ , long.  $20^{\circ} 41' W.$  (collected Oct. 1860), belongs to the genus *Ophiacantha*, Müll. & Trosch.; and on comparing it with specimens from Maine, Norway, and Smith's Sound, there is no doubt that it must be classified under the species *spinulosa* of the authors of the genus.

*Ophiacantha spinulosa*, Müll. & Trosch. (Syst. Asterid. p. 107), is a handsome Ophiurid so far as its geometrically shaped oral structures are concerned; and it has more striking minute beauties, some of which are very well known, such, for instance, as the microscopic structure of the spinules of the disk. But it follows the law of all widely distributed species, and it varies considerably according to locality; and when it is known that the bathymetrical range varies from 16 fathoms in Smith's Sound, through intermediate depths elsewhere, to probably 90 fathoms, and that it grows to a considerable size at a depth of 1260 fathoms, this variability is not surprising.

It is essentially a lover of cold water, and it flourishes in the icy regions of Franklin-Pierce Bay in shallow water, as well as in the low temperature of the ocean's floor. So far as size is concerned, the disk of the deep-sea specimen measures  $\frac{1}{2}$  an inch in diameter, and the limbs are about 2 inches in length; and this is a greater dimension than is usual. Perhaps the crowds of *Globigerina* which crammed the inside of the deep-sea specimen, and which must have been there when it made its ambitious clasp, and were its usual food, account for the size. But it is difficult to explain what nourishment the smaller forms, from the very high latitudes, can derive from a mud with much crushed silica and but a very few Foraminifera in it. These had apparently a harder life than their deep-sea fellows, and their stomachs were frequently empty; and such is the condition of some of the Smith's-Sound specimens. One might suggest that the mor-

phological differences between the two sets of specimens might have arisen from the differences in their struggle for existence. The deep-sea form is suggestive of plenty of food got with little trouble, and of want of exercise in the profound depths; it is coarser than the others; and its tentacular apparatus and tentacle-protectors are the least developed. The spines of the *side arm-plates* are smaller in relation to the arms in the deep-sea form than in the others; and the *mouth-papillæ* are coarser, larger, and wider apart in the first-mentioned kind.

The spinulation of the upper part of the *disk* is very close and tolerably equal in all the specimens, whether from deep or shallow water; but there is much variety in the shape of the spines. In the shallower-water forms the typical short round-topped cylinders, with a crown or head of numerous and minute thorns, are seen in some specimens; but in others, and in the specimen from the great depth, the spines are longer, slender, tapering, and terminate in from one to four or five very sharp unequal thorns. Underneath the disk, in the interbrachial spaces there is the same ornamentation. Moreover, whilst in some specimens the spine is situated on a very distinct scale of its own, marked with concentric rows of dot-like appearance, and which consist of very minute spinules, in others, and in the deep-sea form, I have failed to notice this very elegant ornamentation.

The lower arm-plates bulge somewhat in the deep-sea form, and the side arm-plates have as great a development as is possible in a member of the genus.

In perfect specimens of the species there is a large rounded tentacle-scale just above the outer mouth-papilla, and the tentacle comes out between it and the papilla. This is not so well seen in the form under consideration. Under the arm, on the edge of the first side arm-plate which does not come quite to the median line, is a large tentacle-scale, broad and projecting directly downwards. The other tentacle-scales are large and rounded. This is the case in typical specimens; but in the deep-sea form the projecting scales are less evident, and the others are small, often narrow, and even like a small spine. Far out on the arm, where the side arm-plates form the greater part of the under surface, the scale is still seen, but it is like a minute spine in shape.

The main morphological details, however, of the specimens obtained by Dr. Wallich are the same as those decided to be characteristic of the species *Ophiacantha spinulosa* by Müller and Troschel.

XLIII.—*Researches on Cosmetira salinarum, a new Paludicolous Medusa of the Environs of Cette.* By Dr. DU PLESSIS\*.

THE Medusæ are almost exclusively pelagic zoophytes, inhabiting the open sea. They form a great part of the transparent and gelatinous animals that we meet with floating at the surface or at various depths under water.

These creatures dread nothing more than fresh water, which is a destructive poison to them. Even brackish water, that of the sea mingled with more or less fresh water, kills them instantaneously. Moreover they constantly need a water rich in oxygen, fresh and incessantly renewed by the perpetual movement of the waves and currents. The Medusæ, in fact, have an almost equal dread of fresh water, of stagnant sea-water, and of a slightly too high temperature. All these considerations will enable the reader to understand how we were surprised, at the end of the month of June 1876, at finding, in the middle of the discharging-canal of the salt-works of Villeroy, near Cette, a charming Medusa, of a new species, which inhabits these salt marshes in the summer.

It belongs to the genus *Cosmetira*, a section of the numerous group of the *Oceanidæ*; and it is curious that it is a miniature copy of a much larger species, *Cosmetira punctata*, which occurs frequently in the sea near Cette, and at Nice, Naples, and elsewhere.

All the interest possessed by this pretty little Medusa is concentrated around the novel conditions to which this frail and charming creature must have accommodated itself in order to be able to exist in the localities where we now meet with it. The canal, which serves for the discharge of the salt works of Villeroy, is a narrow trench, not more than 2 or 3 metres broad, and never exceeding 1 metre in depth. The soil is formed throughout of a black putrid mud, stinking of sulphuretted hydrogen. The water is perfectly stagnant, for this canal, which is several leagues in length and surrounds all the salt-pans like an immense oval, is almost completely horizontal. Except for the imperceptible currents caused by the strong winds which sometimes blow over the pool of Thau (into which this canal opens by several passages), the water is therefore most frequently quite immovable. It is a true marsh-ditch, such as may be seen in the canals of the plain of the Orbe, canals which in all points resemble

\* Translated by W. S. Dallas, F.L.S., from the 'Bulletin de la Société Vandoise des Sciences Naturelles,' sér. 2, vol. xvi. p. 39 (1879).

that of which we now speak, even as regards the physiognomy of the vegetation; for in both places a cincture of murmuring reeds fringes the banks, and the surface shows great accumulations forming actual islets of brown and green marine Algæ. These are Confervaceæ of the genera *Chaetophora*, *Cladophora*, *Bryopsis*, &c. These mingled masses harbour a multitude of creatures of all the divisions of the animal kingdom from fishes to Zoophytes, Infusoria, and Rhizopods.

It was in exploring the floating islets that we discovered, in the middle of the canal, half way between Cette and Agde, the creatures under consideration. These little bells were always found suspended by their long tentacles from the lower surfaces of the masses of Algæ. They thus found food and shelter, protected from the sun.

In fact this is the place to remark that, in the summer months, the water of this long shallow canal, flanked by hot sands and without any shade, is almost all day long exposed to the burning sun of Languedoc, and often exceeds 25° C. (77° F.) in temperature. When the arms or legs are immersed in it the impression of a tepid bath is produced.

Moreover this water is very brackish. In the first place it is recruited by the pool of Thau, which is itself very far from being pure sea-water. This lagoon receives the southern canal, which opens into it near Agde, and pours into it an immense quantity of fresh water; several small streams and the springs of l'Abîme and Enversac also discharge into it. But, in addition, the canal of the salt-works is constantly receiving the mother liquor of the pans from which the salt has been obtained; frequently the canal is overflowing with water which is sea-water less the salt, that is to say, without its essential part. The strength and concentration of this brine vary according to the state of the works, the dryness or humidity of the season, storms, &c. In summer it is very concentrated, in winter very dilute.

How could we expect at so many leagues from the sea, and with no communication with it except through the immense lagoon of Thau, to find a *Medusa*, that is to say, one of the creatures most difficult to suit in the matter of its watery medium?

Every zoologist who has attempted to keep these creatures in captivity has been reduced to despair by seeing them perish in a little time, whatever may have been done to render the aquarium comfortable for them. But this marsh species that we had just discovered, forced, no doubt, by vital competition to accommodate itself very gradually to great



vicissitudes, has become hardened by this process; and the proof of this is that it may be very well preserved for weeks together in the smallest bottles, with a few hundred grammes of the water of the canal and a few green Algæ to keep up a small supply of oxygen. Under these circumstances we have transported specimens with the greatest facility from Cette to Lausanne, and kept them for months without the least trouble. This species, being so accommodating, will be very welcome to those who desire to observe these animals for a long time in captivity.

We are aware, indeed, that *Cladonema radiatum*, Duj., and other microscopic Medusæ also bear captivity; but these are creatures scarcely visible to the naked eye, whilst ours, being of the size of a half-franc (Swiss money), is much more suitable for all sorts of manipulation.

Moreover (and this is the most interesting point) it presents one of the clearest examples of the influence of the circumambient medium upon the gradual modification and, finally, transformation of one species into another; for certainly our Medusa has originated from an importation through the pool of Thau of the large *Cosmetira punctata*, the form of which it reproduces on a small scale, repeating its whole organization *en diminutif*.

#### *Description.*

*Form.* In repose the animal resembles a little basin or saucer, the circumference of which is furnished with long and equal fringes. These fringes are the *tentacles*; and the basin is what is called the *umbrella*.

In motion (that is to say, when the animal swims by alternately contracting or relaxing the muscles of the umbrella) the form becomes that of a more or less open bell, according to the muscular contraction.

At the bottom of this bell, starting from the centre of the cup, hangs a clapper in the form of a bottle with a quadrangular neck. This clapper is the trunk [*manubrium*], which can elongate and contract, become rounded, and turn and bend in all directions to enable the animal to seize the animalcules upon which it feeds. The end of the trunk terminates in four angles, surmounted by a small knob or inflation. Even in repose it passes beyond the margin of the umbrella; it is therefore longer than the depth of the bell.

*Size.* Usually the bell or umbrella when spread out scarcely exceeds the dimensions of a half-franc or piece of 50 centimes (Swiss money). Very old examples, however, sometimes attain the size of a franc, and the young are scarcely above

that of a piece of 5 centimes. As the size increases, the number of tentacles which border the umbrella increases also.

*Colours.* The umbrella is transparent and limpid, like cut crystal. It is traversed in the form of a cross by four canals starting at right angles from the centre of the umbrella, where the trunk and stomach are implanted, of which they are the continuation. These gastrovascular canals are of an amber-yellow or reddish tint, darker or lighter in different specimens; and they are bordered nearly to the margin of the umbrella by a very elegant green fringe, folded like a shirt-frill, and containing the ova in the females and the spermatozoids in the males.

The four canals reach the margin of the umbrella, and there open into a circular canal, which borders its periphery. This periphery is not simply sharp-edged, but it bears a veil or circular border of a red colour, which, by erecting itself, closes a part of the opening of the bell, and bears in the centre only an orifice large enough for the passage of the trunk. It is a regular mobile diaphragm. It is thus reddish like the canal. The trunk from which the latter starts is of a malachite-green colour, with its quadrate lower extremity marked at the four corners with spots of a superb violet. These same violet spots also occur in some old examples along the folded fringes of the gastrovascular canals and at the bottom of the stomach.

The tentacles, which flow in elegant fringes from the edge of the umbrella, are in repose conical and pointed, and all of equal length. They are ringed, at equal intervals, by small black inflations; and when they are contracted they, in consequence, appear quite black by the approximation of these rings, which are only cushions of urticating batteries which the medusa makes use of to strike its prey. When elongated these tentacles may exceed ten times the length of the body. They then appear grey by the separation of the rings, and, from being conical, become cylindrical.

Between these tentacles at regular intervals there are also some little reddish sacs, which contain a pigment spot and some crystalline concretions. These marginal corpuscles are rudimentary organs of sense. To the naked eye they appear like a row of very small reddish pins' heads.

From the preceding it will be seen how elegant are the form and coloration of the animal. When it springs from the bottom, swimming with the rapidity of lightning, the long fringes of the umbrella extend through the water, and make for it a cloudy train like the tail of a comet.

*Habitat.* The canal of the salt-works of Cette, near the

footbridge of a station at an equal distance from Cette and Agde. The Medusa always inhabits the lower surface of the islets of floating Algæ. On removing these it is seen elinging like a flake of jelly, shining like crystal. On reimmersing these Algæ in the water the frightened Medusæ separate by swimming in all directions, which is a very pretty sight. The season of their occurrence is limited to June and July. We did not find them in September and October, any more than in the spring.

*Relations with Allied Species.* In the sea which approaches the canal of the salt-works, and also in the great canal of the lagoons, we find a Medusa of the same genus (*Cosmetira punctata*). This is always at least as large as a crown piece. It only occurs in pure and fresh sea-water. It has exactly the same form and proportions and the same organs as the species from the salt-works, but all on a larger scale.

The colour is very different; all the tints are lighter. The umbrella, the velum, and the tentacles are colourless. The gastrovascular canals and the trunk are scarcely tinged with reddish. The genital fringes are of a delicate rose-colour, as also the angles of the trunk.

Thus, reduce the whole animal to the dwarf size of a half-franc piece, colour the canals and the stomach green, change the rose-colour into violet, blacken the tentacles, and you have by these modifications transformed the *Cosmetira* of the sea into that of the salt marshes. It is these peculiarities which make us believe that our species may perhaps be derived from an emigration, with slow transformation, of *Cosmetira punctata*. This is why we present this new-comer as being at present perfectly separated from its starting-point, from which it is distinguished by its size, its colours, and, especially, its domicile. This is also why we name it *Cosmetira salinarum*, to indicate its strange place of abode.

#### MISCELLANEOUS.

*Note on two Bermuda Fishes recently described as new.*

By DR. A. GÜNTHER.

IN the February number of this Journal, page 150, I described two new species of fish from the Bermudas, named *Gerres Jonesii* and *Belone Jonesii*, in which Mr. G. Browne Goode believes he has recognized two fishes previously described by himself (Amer. Journ. 1879, April, p. 340).

With regard to the former, *Gerres Jonesii*, I beg to observe that,

of course, the species described by Mr. G. Browne Goode in 1874 as *Diapterus Lefroyii* did not escape my notice, but that I considered and still consider the fish sent by Mr. Matthew Jones to the British Museum to be distinct, as it differs in the number and proportions of the anal spines from Mr. Browne Goode's fish. The character mentioned is one of considerable weight in the determination of the fishes belonging to the genus *Gerres*; and therefore I am not yet inclined to unite the two species, as Mr. Browne Goode appears to have done, if he was really in possession of two- as well as three-spined specimens.

With regard to *Belone Jonesii* I admit that I was not acquainted with Mr. Browne Goode's description published in 1877; and it is a very fortunate circumstance that we both happened to choose the same name.

I may mention, in palliation of this my oversight, that the report on fishes for that year in 'The Record of Zoological Literature' was not published at the time of the publication of my description, and that I am only one of the numerous victims who suffer from the tardiness of publication into which that work has been allowed to fall.

*On the Presence of a Segmental Organ in the Endoproct Bryozoa.*

By M. L. JOLIET.

In October 1877 Hatschek indicated in *Pedicellina echinata*, both in the larval and adult state, a vibratile canal, of which, however, he seems not to have well made out the form, and which he compares to the vibratile organs of the Rotatoria. I am in a position to confirm the statements of the zoologist of Prague, at the same time correcting and completing them, and to extend them to the whole group of Endoproct Bryozoa.

In a spineless variety of *Pedicellina echinata* which abounds at Roscoff, whence the keeper of the laboratory sent it to me alive within the last few days, the vibratile organ is double, and situated in the cavity of the body, in the space included between the œsophagus, the stomach, and the matrix.

It consists of a short tube, ciliated internally, inflated at its middle, which, on the one hand, opens into the matrix, not far from its external aperture, and, on the other, opens obliquely into the cavity of the body by a slightly funnel-shaped passage furnished with active vibratile cilia. This organ, furnished with a vibratile pavilion, and placing the cavity of the body in communication with the outer world, has all the characters of a segmental organ. It appears very early in the bud. When the stomach is only sketched out, and before the arms are indicated, we already see a ciliary movement at the place that it will occupy.

In a still undescribed species of *Pedicellina* from the island of St. Paul, I have recently detected the same vibratile organ. Lastly, in the *Loxosoma* of *Phascolosoma*, I last summer, at Roscoff, recog-

nized a perfectly similar canal, terminated by a pavilion and placed in the same situation. As in *Pedicellina*, it appears very early in the bud.

In the group Endoprocta, including the highest forms of the Bryozoa, we may therefore regard as constant the presence of a segmental organ—that is to say, an organ which is very generally diffused among the Vermes.

Considering the endeavours that have been made of late years to approximate the Bryozoa to the Annulata, I have thought it an advantage to bring this new argument into the debate, as it seems to me to possess a real value.—*Comptes Rendus*, February 24, 1879, p. 392.

*The Origin of the specialized Teeth of the Carnivora.*

By E. D. COPE.

The specially developed teeth of the Carnivora are the canines and sectorials. The former are large in many orders of Mammalia; and their origin is probably to be sought among the Theromorphous Reptilia\*, such as *Clepsydraps* and *Deuterosaurus*, if not in still lower types. The successive modifications of form which have resulted in the existing specialized single sectorial tooth of the Felidæ have been already pointed out †. They were shown to consist in the gradual obliteration of the internal and posterior tubercles and the enlargement of the external anterior tubercle in connexion with an additional anterior tubercle. The modification in the character of the dentition, taken as a whole, was shown to consist in the reduction in the number of teeth, including the sectorials, until in *Felis* &c. we have almost the entire function of the molar series confined to a single large sectorial in each jaw.

Observation on the movements of the jaws of Carnivora shows that they produce a shearing motion of the inferior on the superior teeth. This is quite distinct from the subhorizontal movement of Ruminants, or the vertical motion of hogs and monkeys. Examination of the crowns of the sectorials shows that the inner side of the superior and the external side of the inferior are worn in the process of mastication. The attempt to cut the tough and stringy substances found in animal bodies is best accomplished by the shearing of the outer edge of the lower molar on the inner edge of the external tubercles of the superior molar in an animal with simple tubercular teeth. The width of the mandible is too great to allow the inferior teeth to shear on the inner edge of the inner tubercles of the superior series. The cusps of both superior and inferior teeth engaged in this process have developed in elevation at the expense of those not engaged in it, viz. the internal cusps of the same teeth. The atrophy of the latter cannot have been due to friction, since the internal cusps of the inferior series, which have

\* 'American Naturalist,' 1878, p. 829.

† Cope, 'Proceedings Academy Philad.' 1865, p. 22.

not been subjected to it, are reduced like those of the superior sectorial, which have. Indeed it is possible that some of the Creodonta, the carnivores of the lower Eocene, may have been derived from ancestors without or with rudimental inner cusps. In any case the effect of use in lengthening the cusps appears to have operated in the Carnivora, as it has done to a greater degree in the Ungulata; and the lateral vertical wear would appear to have resulted in the blade-form, as transverse wear in the Ungulates has resulted in the plane grinding surface.

The specialization of one tooth to the exclusion of others as a sectorial, appears to be due to the following causes. It is to be observed, in the first place, that when a carnivore devours a carcass, it cuts off masses with its sectorials, using them as shears. In so doing it brings the part to be divided to the angle or canthus of the soft walls of the mouth, which is at the front of the masseter muscle. At this point the greatest amount of force is gained, since the weight is thus brought immediately to the power, which would not be the case were the sectorial situated much in front of the masseter. On the other hand, the sectorial could not be situated further back, since it would then be inaccessible to a carcass or mass too large to be taken into the mouth.

The position of the sectorial tooth being thus shown to be dependent on that of the masseter muscle, it remains to ascertain a probable cause for the relation of the latter to the dental series in modern Carnivora. Why, for instance, were not the last molars modified into sectorial teeth in these animals, as in the extinct *Hyænodon* and various Creodonta? The answer obviously is to be found in the development of the prehensile character of the canine teeth. It is probable that the gape of the mouth in the *Hyænodons* was very wide, since the masseter was situated relatively far posteriorly. In such an animal the anterior parts of the jaws with the canines had little prehensile power, as their form and anterior direction also indicates. They doubtless snapped rather than lacerated their enemies. The same habit is seen in the existing dogs, whose long jaws do not permit the lacerating power of the canines of the Felidæ, though more effective in this respect than those of the *Hyænodons*. The usefulness of a lever of the third kind depends on the approximation of the power to the weight; that is, in the present case, the more anterior the position of the masseter muscle, the more effective the canine teeth. Hence it appears that the relation of this muscle to the inferior dental series depended originally on the use of the canines as prehensile and lacerating organs, and that its insertion has advanced from behind forwards in the history of carnivorous types. Thus it is that the only accessible molars, the fourth above and the fifth below, have become specialized as sectorials, while the fifth, sixth, and seventh have, first, remained tubercular as in the dogs, or, secondly, have been lost, as in hyenas and cats.—*American Naturalist*, March 1879.

# THE ANNALS

AND

## MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 18. JUNE 1879.

XLIV.—*Remarks upon the Memoirs on Loxosoma.*

By OSCAR SCHMIDT\*.

WHEN I was working in Naples in the winter of 1874–75, the good opportunity led me to what I may call a thorough investigation of *Loxosoma*. The points in which I had failed were most thoroughly brought home to me, immediately after the publication of my memoir, by Nitsche, the monarch of the Bryozoa. As a matter of course, I was convinced by him, in the first place, that *Loxosoma* belongs to *Pedicellina*, and, secondly, that my attempt to conceive of the gemmation as egg-development was not successful. My full acceptance of these main points is contained in the last edition of the ‘Handbuch der vergleichende Anatomie’ and in the new edition of the ‘Thierleben,’ Band x. p. 181. On the other hand, I have to refute a series of special statements of Nitsche’s, some of them not unimportant. This appears to me the more necessary, as in the meanwhile the two detailed investigations of Vogt and Salensky have appeared, and Hatschek, in his memoir on the embryonic development and gemmation of *Pedicellina echinata* (Zeitschr. für wiss. Zool. Bd. xxix. 1877), has also referred to the developmental processes of *Loxosoma*. My remarks will therefore extend from Nitsche’s preliminary communication on the structure and gemmation of *Loxosoma*

\* Translated by W. S. Dallas, F.L.S., from the ‘Zeitschrift für wissenschaftliche Zoologie,’ Band xxxi. (1878) p. 68.

*Kefersteini*, Clap. (Zeitschr. für wiss. Zool. Bd. xxv. 1875), to Vogt's remarks upon Hatschek's memoir (*ibid.* Bd. xxx. 1878), and are intended, as far as possible, to reconcile the numerous contradictions contained in these works. They relate in part to the establishment of the species, in part to anatomy, and partly to the development of the buds—in the latter connexion furnishing the correction of an error into which Nitsche has fallen. I can, in fact, confirm by direct observation, what Hatschek supposed from theoretical grounds, that the ectoderm of the parent animal by no means furnishes the whole foundation of the bud.

*The Species.*—For the continuation of the investigation, which is very desirable, a criticism and comparative summary of the described species is above all things necessary. We do this in connexion with the annexed Table, in which the species are arranged in accordance with the number of tentacles, the development of the pedal gland, and the number of buds simultaneously developed.

LOXOSOMA *.	Ten- tacles.	Pedal gland of the adult animal	Buds on each side.	Lives upon	Locality.	Described in
1. * <i>cochlear</i> , Schmidt, 1875.	8	developed.	1	Horny sponges.	Naples.	Arch. f. mikr. Anat. xii.; Thierl. 2te Aufl. x. p. 181.
2. <i>neapolitanum</i> , Ko- walevsky, 1866.	10	developed.	1	<i>Phyllochaeto- pterus</i> .	Naples.	Mém. Acad. St. Pé- tersb. x.
3. * <i>pes = singulare</i> , Schmidt, 1875.	10	developed.	1	<i>Euspongia</i> .	Naples.	Arch. f. mikr. Anat. xii.
4. <i>singulare</i> , Kefer- stein, 1863.	10	0	1	<i>Capitella</i> .	St. Vaast.	Zeitschr. f. wiss. Zool. xii.
5. * <i>tethya</i> , Salensky, 1877.	12	developed.	1	<i>Tethya</i> .	Naples.	Ann. Sci. Nat. 6 <sup>e</sup> sér. v.
6. * <i>raja</i> , Schmidt, 1875.	12	developed.	1	Horny sponges.	Naples.	Arch. f. mikr. Anat. xii.
7. <i>phascolosomatum</i> , Vogt, 1877.	18	0	1	<i>Phascolosoma</i> .	Roscoff.	Arch. d. Zool. expér. v.
8. * <i>crassicauda</i> (?), Salensky, 1877.	18	0	4	Annelid-tubes.	Naples.	Ann. Sci. Nat. 6 <sup>e</sup> sér. v.
9. <i>Kefersteini</i> , Clapa- rède, 1867.	20	0	4-6	<i>Zoobothryum</i> , <i>Acamarchis</i> .	Naples.	Ann. Sci. Nat. 5 <sup>e</sup> sér. viii.; Zeitschr. f. wiss. Zool. xxi., xxv., xxv. Suppl.

*L. cochlear* is not, as Vogt is inclined to think, a young state of *L. raja*, but a good species, never varying in the number of tentacles in the many hundred examples seen by me. The absence of a figure in my memoir in the 'Archiv für mikroskopische Anatomie' is now remedied by the figures on page 181 of my tenth volume of Brehm's 'Thierleben.'

\* The species marked with an asterisk are known to me by my own observations.



As my figure of *Loxosoma raja* is also true to nature, and the mature buds of the latter always already possess the full number (ten) of tentacles, and transitions were never observed by me, no further objection to the distinctness of these two species will probably be made.

*L. neapolitanum* must remain as it is until it has been re-discovered. I do not believe in the suetorial adhesive organs which Kowalevsky describes at the pedal extremity. At any rate it belongs to the forms with the pedal glands remarkably developed throughout life.

*L. pes* may be hereafter the name of the species in which I thought I recognized *L. singulare*. That this is not the case has been shown to be exceedingly probable by Nitsehe. I should regard it as perfectly certain, if it were actually established that Keferstein's species possesses no pedal gland in the adult state. In the species found by me at Naples it is extraordinarily developed. The specific name is justified by the striking similarity of the form of the end of the stem to that of the human foot. It has only to be remarked that the true extremity, the point of the foot, is turned towards the dorsal surface of the animal.

*L. singulare*.—This species also requires a fresh investigation. Its distinctness with relation to the preceding species, or rather *vice versâ*, will no longer be doubtful if the atrophy of the pedal glands with advancing age be confirmed. According to Keferstein's figure, the stem ends in a disk. With regard to the buds he says, "In a specimen 4 millims. in diameter I saw on the outer integument an oval body measuring 0.04 millim. seated like a bud; and on the same specimen one measuring 0.2 millim. was attached to the outer integument by its stem-foot." As in the multigemmous species mature buds are never found without younger ones standing by their side, *Loxosoma singulare* will certainly belong to the species which push forth only one bud at time.

*L. tethya* has constantly twelve tentacles. The greatest breadth falls in the middle of the tentacular disk. The body narrows towards the peduncle, so that the walls of the stomach are closely embraced by the integuments of the body. A further peculiarity, overlooked by Salensky in consequence of the want of species for comparison, is the unusual length of the peduncle, which attains from four to six times the length of the body. I obtained in Naples a middle-sized *Tethya*, among the villosities of which some thousand of this *Loxosoma* were seated.

*L. raja*.—The outline of this species which I have given in my memoir is perfectly true to nature. Variations in the

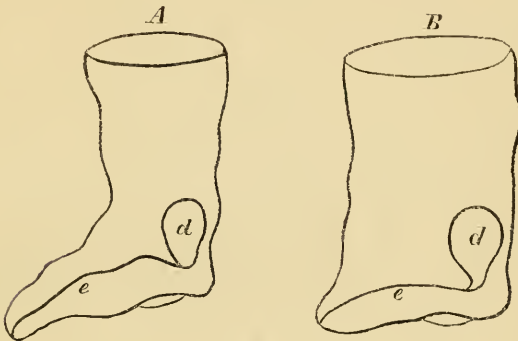
number of tentacles, which are already developed in their full number in the buds, scarcely occur, any more than varieties of the whole animal, which lives in innumerable multitudes in the passages of the horny sponges, often in company with *L. cochlear*.

*L. phascolosomatum*, in the form of the body and the length of the peduncle, comes next to *L. tethyæ*. It is distinguished therefrom by the number of tentacles, which, according to Vogt's statement, run up to eighteen in individual examples, while the ordinary number seems to be fourteen or sixteen. Vogt's figure (pl. xi. fig. 5) with fifteen tentacles is evidently founded upon a mistake, as is also the case with Claparède's figure of a *L. Kefersteini* with thirteen tentacles (Zeitschr. f. wiss. Zool. 1874). As regards another (pl. xi. fig. 2) of my honoured Genevan friend's figures, I must admit, without prejudice to the unqualified recognition of his artistic preeminence, that I should see in it a sea-serpent rather than a female *Loxosoma*. On Vogt's assertion that his *Loxosoma* is of separate sexes we shall speak hereafter. Moreover I am not convinced of the disappearance of the pedal gland in the adult state. Of this we shall speak under the next species. Vogt has not stated on what *Phascolosoma* his species lives. I have from Naples a *Phascolosoma Strömii* beset with *Loxosoma*; the contractions produced by the alcohol prevent identification.

*L. crassicauda*.—Salensky made his observations in Naples in the summer of 1874, but only published them in the autumn of 1877. The present species is characterized by the numerous tentacles (as many as eighteen), the buds sprouting forth four on each side at the same time, and the disappearance of the pedal gland. Upon Salensky's remark that of the eighteen arms two are rudimentary (he shows seventeen arms in his fig. 1), no stress is to be laid, as in his fig. 10 we see all the eighteen arms completely developed. Upon its mode of occurrence its discoverer remarks, "*Loxosoma crassicauda* inhabits the tubercular shells of an Annelid of which I have been unable to determine the species." I think I can hardly be mistaken in regarding the unknown Annelid as *Phyllochætopterus socialis*, Clap.; and I further believe that Salensky, who witnessed the remarkable alteration in the form of the end of the peduncle during the transition of the bud into the adult condition, overlooked the retention of the gland. Thus, in the spring of 1877, when I was seeking in vain for *Loxosoma neapolitanum* upon *Phyllochætopterus socialis*, I found abundant specimens of another species, which I regarded as new until I obtained Salensky's memoir. The agreement is complete both in the figure and description, except as regards the

pedal gland. Salensky says that his *Loxosoma crassicauda* belongs to the species in which the pedal gland, present in the buds, subsequently undergoes complete suppression. During my investigation of the first examples of the animal living on the tubes of *Phyllochaetopterus* I was of the same opinion. The end of the peduncle of the adult form looks like the foot of an elephant (fig. 1, B), whereas the buds of the same animal possess the well-marked human foot, carefully described by me in *L. pes* (fig. 1, A). The gland in the latter is exceedingly

Fig. 1.



distinct; but in the mature peduncle it becomes indistinct only in consequence of the thickening of the integument and the usual adhesion of particles of dirt. It is present and of the same nature and extent as in the bud, but stands in a somewhat altered position relatively to the wall of the peduncle, as the figure shows: *d* is the gland, *e* the efferent duct. I am therefore convinced that Salensky has remained in the error into which I at first fell, and that *Loxosoma crassicauda* does not belong to the species with an aborted pedal gland. Judging from this instance, I think we are even justified in doubting whether this reduction of the pedal gland takes place in any of the described species.

*L. Kefersteini*.—The doubt just expressed applies especially to this form. Of it Claparède has given only outline drawings from living objects without any details; whilst Nitsche's investigations were made only on material hardened in alcohol, and in part treated with osmic acid. As regards Claparède, who evidently occupied himself only *en passant* with *Loxosoma*, the overlooking of the pedal gland on his part would be very easily explained. As I have, moreover,

made the observation on my preparations, that in the animals preserved by Nitsche's method the histological details often become very obscure, of which I shall hereafter adduce evidence, and that in most of the osmic-acid and alcoholic preparations of *L. pes* and the rest the gland is only recognizable with difficulty, I do not regard Nitsche's statement with regard to the absence of the pedal gland as decisive. If my supposition be confirmed that both *L. crassicauda* and *L. Kefersteinii* have pedal glands even when adult, or if it be proved that both of them have none, the sole, unimportant difference between them is the peculiar attachment of the buds of *L. Kefersteinii*. Whilst in all other species the pedal end of the bud is amalgamated with the body-wall of the mother, both investigators assert that in *L. Kefersteinii* this "Nabel" exists above the foot. I should here dispute this statement, which is by no means reconcilable with the development of the buds of the other species, if Claparède did not say of the animals observed alive, "The freely waving peduncles of the buds extend themselves in the most various directions."

Various other forms, described by others than the above-named authors, have been referred to the *Loxosomata*, and especially *Cyclatella annelidicola*, Van Ben. and Hesse. Vogt says justly that the figure is at the utmost a caricature of a *Loxosoma*. But the description also does not suit. Of the peduncle it is said, "the very *retractile* peduncle terminates in a *sucking-disk*;" and this sucker is exactly like that of a Trematode. "The cilia of the appendages, in *constant movement*, are *all round* these appendages:" the words are quite irreconcilable with *Loxosoma*; and as we cannot suppose that these distinct statements with regard to the simplest characters are fictitious, it seems to me that *Cyclatella* must no longer figure in the list of the *Loxosomata*, in spite of Van Beneden himself ('Schmarotzer,' p. 54). I have therefore felt no hesitation about placing *Cyclatella* in the same neighbourhood as before, as a Trematode-like animal (Thierleben, 2nd edit. p. 155).

*Anatomy*.—The differences in the anatomical descriptions, by myself on the one hand, and by Nitsche and Salensky on the other, are not of much importance. Nitsche says that *Loxosoma* has no collar (*Ringkragen*); but it seems unmistakably, from my figure of *L. raja*, Vogt's of *L. phascolosomatium*, and Salensky's of *L. tethyce* and *crassicauda*, not only that the simple tentaculiferous margin of the cup is constricted about the base of the infolded tentacles, but that a part occurring outside, close to the base of the tentacles, can be drawn over the tentacles as a hood.

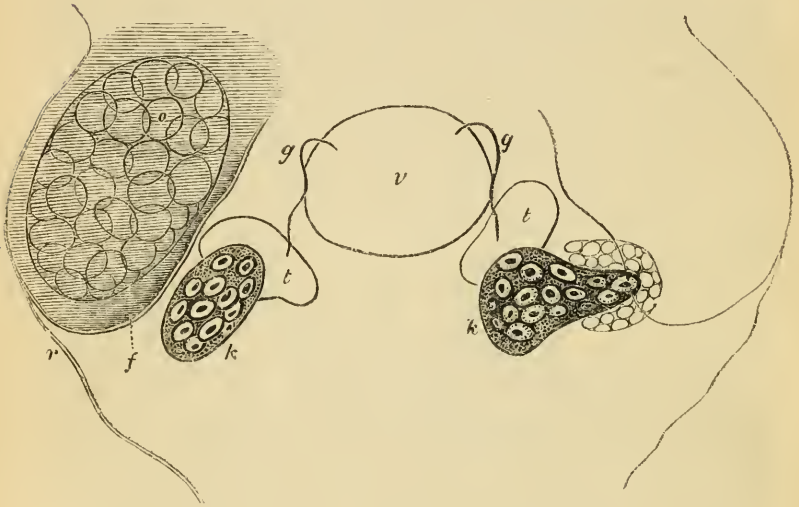
With regard to parts which might be regarded as belonging to the nervous system, Nitsche and I have only put forth uncertain conjectures. It is otherwise with Salensky. He describes a central ganglion and a paired nerve running to a tuft of tactile setæ. He says, "The observation of the ganglion is very difficult, as it is hidden from the eye of the observer by the genital organs, and by different glandules situated in the middle of the body. I found it very difficult to discover the ganglion in adult animals already possessing genital organs; whilst this organ could be found without trouble in young individuals of which the genital organs were not developed." The figures (pl. xii. figs. 2, 3), however, show the ganglion in immediate contact with glandular bodies (*gs*), which, in my opinion, can be nothing but the testes; and in this connexion Salensky's ganglion looks exactly like the emptied seminal vesicle. I go still further, and cannot but compare the two large nerves described by Salensky to the ducts which lead from the seminal vesicle into the interior of the ovaries (see my Memoir, pl. ii. fig. 8). Here, therefore, new observations are necessary, and the more as my observations upon the reproductive organs, the only ones extant, are not complete.

Nitsche finds that by my statements upon these parts the agreement with *Pedicellina* is fully established. Both are hermaphrodite. It is, indeed, not unexampled that in an otherwise hermaphrodite genus there may be a species with separate sexes; and so Vogt's assertion that *L. phascosomatium* is such a species would not be surprising in itself. But Vogt has not proved this. From his figures it appears only that he sometimes recognized the testes, sometimes the ovary, more distinctly, or that he has even confounded them.

According to the following figure I have to correct myself, so far as *Loxosoma pes* is concerned, only in one point. In the 'Archiv für mikroskopische Anatomie,' Bd. xii. Taf. ii. fig. 8, I represented two divisions of the testes, but in fig. 9 only one, on each side. With regard to this I find in my notes the remark, "in the lower division *t'* no mature semen." As I shall show more clearly below, I took the germ-cell layer or the bud-cell-stock for a part of the seminal gland, *k* in the figure. The error arose naturally from my referring the foundation of the bud to the ovary (*o*) lying above it. No efferent ducts from the seminal vesicle, except the funnels leading into the ovaries, are known to me; nor do I know the efferent ducts of the ovaries. Vogt gives the following account of the nature and action of the seminal vesicle of his supposed male *Loxosoma*:—"I observed a male, furnished

with a bud of medium age, which showed me the ventral surface, and the seminal vesicle gorged with spermatozoids. While I was taking a sketch of it with the camera lucida the whole twisted packet of spermatozoids contained in the vesicle was suddenly expelled by a violent contraction of the entire animal. The packet slipped rapidly forward behind the peristome, and appeared free in the cavity of the vestibule between the tentacles. After a few minutes the animal closed the tentacular curtain with a jerk; the packet was then shot out into

Fig. 2.



Reproductive organs of *Loxosoma pes*. *r*, margin of the body; *o*, ovary; *v*, seminal vesicle; *t*, testes; *g*, seminal ducts; *k*, bud-cell-stock; *f*, bud-pit.

the water, and escaped my subsequent researches. After this expulsion the seminal vesicle, which was before so prominent, could only be distinguished with the greatest difficulty, it was so collapsed. As to the canal by which the seminal packet must have passed to reach the bottom of the vestibule, I found it impossible to distinguish it."

I have cited this whole passage (which is supposed to prove that a transfer of the semen outside the body takes place by means of the water) because I can furnish a very simple explanation of it. As early as 1875 I observed (and the drawing and notes upon it are now before me), in *Loxosoma*

*raja*, that in the buccal canal, in a shallow diverticulum or a sort of crop, the tough contents of the canal, which had not yet passed into the stomach, were collected into a ball, and gradually drawn out into the likeness of threads and twisted into a coil, so that the complete ball presented a delusive resemblance to a packet of semen. It seems to me certain that some such pseudoseminal ball, which was vomited forth by the animal in consequence of gentle pressure, led Vogt into error. Even when the animals were most roughly treated, I have never witnessed a rupture of the seminal vesicle, which is furnished with an exceedingly firm wall.

*Gemmation.*—I come now to the difficult question of the origin of the buds. I was very quickly convinced by Nitsche that my reference of this process to an egg-development was a misconception, although my numerous sketches always drove me back to seek in the foundation of the bud for something else than one or more cells of the skin. Nitsche declared "the most important result" of his investigation to be the definitive proof that the whole bud is formed from the ectoderm of the parent—a result which, when closely examined, was at least quite as remarkable as my assertion. Salensky has supported Nitsche, as also did Vogt previously. "The production of buds," he says, "only proceeds from the hypodermic layer"\*. Nevertheless "this most important result" is erroneous; and as Nitsche finds my error partially explicable by my having been reminded of egg-development by the very remarkable formation of germ-layers, so I also believe that Nitsche would have been preserved from his mistake by the investigation of living material. At least *Loxosoma Kiefersteinii* appears to me to be one of the species in which the position of the viscera renders the tracing of these conditions not impossible.

Whilst I was occupied in Naples, in the spring of 1877, with my renewed investigation of *Loxosoma*, and attained the result which will be mentioned immediately, Hatschek was tracing the gemmation of *Pedicellina* very carefully at Trieste. He referred the primitive germ-layers of the bud to the corresponding parts in the parent animal, in accordance with the observations made in other classes of animals, and declared himself to be in absolute contradiction to Nitsche, who derives the bud of *Loxosoma* from the single-layered ectodermal lamina of the parent animal. "I believe," he says, "that in the bud-forming region, which Nitsche represents as a single-layered cell-lamina, all the germ-layers are present just as in *Pedi-*

\* Repeated in Zeitschr. für wiss. Zool. Bd. xxx. 2, p. 377.

*cellina*, and will be referable to the germ-layers of the primary bud present in the larva." These so-called primary buds have been seen in *Loxosoma* by all observers; they are indicated by myself, Nitsche, and Vogt as genital foundations, by Salensky as "buds." They are very striking in *Loxosoma crassicauda*, and still more so in *L. pes*. The name "primary bud" cannot be suitable, as in no case are the germ-layers as such contained in them, nor is the mesoderm of the future bud preformed in them. The simplest and most appropriate expression still seems to me to be "germ-stock," in case there is any objection to speaking of a "bud-stock."

In the bud, the two bud-stocks, so soon as they have distinctly separated from the mesodermic material, are always united by a median bridge. This may disappear in the adult animal. This, however, does not always happen, as I have seen clearly in one case in *Loxosoma pes*. In most cases the mature bud-germ-stocks are separated (see fig. 2, *k*). In our species they are characterized by a finely granular mass intervening between the cellular elements; and this causes the whole organ to appear as if darkly pigmented. When one is once convinced of the identity of the primary foundation in the bud with the organ *k* of the adult, one can no longer regard it as a somewhat hypertrophied part of the ectoderm. To the left of my figure, seen from the ventral side, the stage is shown in which a bud has been set free and a new one is not yet commenced. We see the greatly developed fold of skin which covers the bud-pit or bud-cavity. In the extent of this fold, of the pit, and the whole depression thereby caused, the species vary much from each other. No exposure (*Freiliegen*) of the umbilicus of the bud, such as Claparède and Nitsche describe in *Loxosoma Kefersteinii*, is observed in any of the other species. In *L. raja* the sinus, in which almost the whole mature bud finds its place, is bowl-shaped; of course, as indeed my drawing shows, the inner angle of this bowl is covered.

On the right side of our figure we see the decisive stage in which the germ-stock has given off a process externally, which will separate and furnish the foundation of a bud. I will and can only affirm this fact, without deciding whether one or several cells separate from the germ-stock, and without being able to state what is the signification of the hood of pale indistinct cells which is seated upon the process of the germ-stock. As to the main point, *namely that the bud does not originate from one or more ectodermic cells of the mother*, there cannot well be any doubt. It will now also become intelligible how I was misled by similar but indistinct images to my first erroneous conception. Nitsche, who justly censures my "inde-



finite statements" as to the earliest developmental processes, has been no more fortunate himself; so that Hatschek also justly says of him, "Truly, with regard to the most important conditions (the earliest stages), Nitsche's statements also leave us in the lurch."

Probably, therefore, in my investigation of 1875, I saw rightly that a cell-material from the interior of the *Loxosoma* is employed in forming the bud, and must have been the more induced to assume an egg-development because a formation of germ-layers takes place such as had previously been observed only in the egg. Upon this circumstance my *collaborateurs* have not laid the emphasis that it deserves. We have to do either with an exceedingly remarkable inheritance and transfer from the egg-development to the bud-development, or with a convergence the mechanical causes of which must probably also throw light upon the process of true germ-layer formation.

Hatschek shows that in the larva of *Pedicellina* the foundation of the bud is thus produced: from the three germ-layers of the larva the materials of the germ-layers of the bud are in contact. There are divisions in which no germ-layer oversteps its own sphere; the resemblance to egg-development is not very close. Hatschek is inclined to suppose that something of the same kind occurs in *Loxosoma*, namely a so-called "primary bud" in the larva and bud, in the formation of which all the germ-layers take part. But this comparison cannot be carried out. The primary bud in *Loxosoma* is represented by the bud-stock, which originates solely from the mesoderm, and in this respect agrees with the true generative organs. The agreement of the gemmation with sexual reproduction, however, possibly goes much further, and approaches parthenogenesis if only one cell of the bud-stock is employed for each bud. If this were the case, which can be decided only by continued investigations, we should also have an explanation of the formation of germ-layers in gemmation.

Hatschek's hypothesis as to all the body-layers taking part in constituting the bud of *Loxosoma* springs from the desire to establish as completely as possible the homology with *Pedicellina*. At the same time *Loxosoma* appears, both to him and to other observers, to be the lowest type among the Eutoprocta. For this very reason we may the more readily drop the first, untenable part of the hypothesis.

As regards the position of the bud in relation to the parent animal, I have expressed myself quite definitely. I say (*loc. cit.* p. 7) that the bud grows out *perpendicularly to the longi-*

*tudinal axis*, and (p. 9) that *the ventral surface of the embryo corresponds to the ventral surface of the parent*, and, further (p. 11), that the embryo adheres to the mother by the end of the peduncle. When, therefore, Nitsche complains that, owing to my inaccurate statements, orientation is not possible, he has certainly not been sufficiently careful. Vogt's reproach also, that my drawings are "plus que schématiques," is not correct. Certainly, as Vogt could discover in the younger buds no cells, but only amorphous sarcode masses, while *my figures give the most accurate outlines of the cells according to their form, number, and arrangement*, such as are to be found in none of the other memoirs, his statement is intelligible. My figures on plate iii. are therefore all concordantly oriented; and I do not merely appear to suppose, as Nitsche says, that in all the figures the upper and lower ends of the drawings are equivalent, but they are equivalent. If therefore, where my successors show a few indistinct cell-like bodies as the mesoderm, I, in my figures, show distinct cells coming together, and the mesoderm developing itself from the ectoderm before our eyes, I am bold enough to regard this as an excellence of my work.

Of the development of *Loxosoma* we at present unfortunately know only fragments. The complete series of observations which J. Barrois appears to have before him are still delayed in publication. My question whether the organs designated by *o* in my figure of the swarming larva (Taf. ii. fig. 25), repeated in the 'Thierleben' (p. 181, fig. *b*), are provisional eyes, I now retract. It seems to me more correct to suppose that these two dark ovate bodies are the bud-stocks, which appear so early in the bud.

XLV.—*On Pharetronema zingiberis, a new Genus and Species of Renierid Sponge.* By W. J. SOLLAS, M.A., F.G.S., &c.

[Plate XXX.]

*Pharetronema zingiberis* (mili).

(Examined in the dried state.)

*Sponge* single, attached?, stipitate, in general form palmato-digitate or hand-shaped; stem short and compressed, widening about one inch above its base into an irregular palmate expansion, which is slightly curved from side to side and divides into a number of irregular cylindrical or com-

pressed nodulose finger-like branches (Pl. XXX. fig. 1). Branches bifurcating near their extremities, uniting where grown in contact, terminated by smooth ends, or more usually by the frayed ends of the skeletal fibres. Surface smooth on the outer or convex side, irregularly embossed with gently rounded eminences; on the inner or concave side irregularly wrinkled concentrically with the base. Oscules and pores inconspicuous.

*Skeleton* consists of (1) an internal and dermal network of spicular fibres, and (2) of dispersed flesh-spicules. Fibres of the internal network chiefly following a longitudinal direction, radiating upwards and outwards, to end against the surface of the sponge in the dermal layer; composed of spicules of one kind, viz. slender, straight or slightly curved acerates, more or less sharply pointed, 0·0117 inch long and 0·00035 inch in breadth (Pl. XXX. figs. 5, 6, 8), lying together side by side in an axial direction, with overlapping ends, somewhat like the woody cells of a flax fibre (Pl. XXX. fig. 3). Dermal network formed by the arching over and joining together of the ends of the internal fibres into a superficial reticulation, which supports on its exterior face a layer of erect pencils of spicules (Pl. XXX. fig. 4). The spicular pencils, being given off from the underlying fibres, are arranged in rows, which follow approximately the form of the network below (Pl. XXX. fig. 2). Spicules of the superficial pencils of the same form as those of the internal fibre, but most of them much smaller (fig. 7). Meshes of the dermal network very minute, very slightly larger on the inner than on the outer face of the sponge. Meshes of the interior network coated with the dried sareode of the sponge, in which are dispersed irregularly straight or once- or twice-curved filiform flesh-spicules, 0·008 inch long, and only just showing a double outline under a magnification of 435 diameters (fig. 9).

*Hab.* Marine.

*Loc.* Jamaica.

*Coll.* Bristol Museum.

*Obs.* This sponge was presented by Mr. Whereat to the Bristol Museum, where I found it labelled *Lobularia manus-diaboli*. In general appearance it bears a somewhat striking resemblance to a hand affected by gout, so that the specific name "*manus-diaboli*" might be considered not inappropriate; but as it is too long for convenient use, I have replaced it by "*zingiberis*," in allusion to the ginger-like form of the branches.

The ends of the branches are seldom neatly rounded off and covered over with the dermal layer; on the contrary they

usually exhibit the internal skeleton uncovered, either as a projecting tuft of frayed fibres, or as forming the sides of a conical cavity excavated axially from the end of the branch inwards.

The absence of distinct oscules and aquiferous canals, together with the incomplete closure of the ends of the branches and the greater openness of the internal skeleton along lines radiating from the centre of the branches obliquely forwards and outwards, lead one to conjecture whether the external water, after finding access to the interior of the sponge through the pores of the dermal layer, may not have found its way outwards along the lines of least obstruction in the skeleton, and finally have discharged itself by the more or less open ends of the branches. This, however, is merely conjecture; and without actual observation of the sponge in the living state one cannot expect the nature of its water-circulation to be made clear.

The variations in form of the spicules are chiefly manifested in the character of their terminations. The somewhat sharp points of fig. 5 are the most usual; but very frequently the termination is more abrupt, and we have the conical form of fig. 12; this readily passes into the shouldered and pointed end of fig. 11, a very common form of termination, which, by losing its mucrone, passes into the rounded-off ends of the rare form (fig. 14). The tendency of these variations appears to be in the direction of lateral development towards the point, which, in its most exaggerated form, is shown by the pin-headed spicule of fig. 13, of which a few instances have been observed.

Budding occurs occasionally, as in fig. 10, where the small offshoot on the left side of the spicule is mucronate, like the normal point of the spicule, though the latter, in this case, is twice shouldered, or diminishes to a point by two stages.

There is an obvious resemblance between this recent sponge and the extinct *Pharetrospongia* of the Cambridge Greensand: the thickness of the plate-like wall in the one is very nearly the same as that of the palmate expansion of the other; both possess a spiculo-fibrous reticulate skeleton; both are distinguished by the inconspicuous character of their oscules and excretory canals; both agree in the form and size of their spicular elements; and the only marked differences which distinguish them are to be found in the branched form of the recent sponge, and the absence of flesh-spicules in the fossil one. The chance of flesh-spicules being preserved in the fossil state is so remote, however, that *Pharetrospongia*, if it originally possessed them, would certainly betray no signs of

the fact now; and hence the absence of such spicules in the fossil sponge proves nothing one way or the other; they may, or, just as possibly, they may not have been present in the living form. But while this uncertainty prevents us from placing the sponge just described in the same genus as *Pharetrospongia*, we need not be deterred by a difference of so slight a value as that of external form, while so many and marked resemblances exist between the two sponges, from placing them very near one another in our classification; and there is no reason why this approximation should not be indicated by a similarity in their generic names.

#### EXPLANATION OF PLATE XXX.

- Fig. 1.* *Pharetronema zingiberis* (n. gen. et sp.),  $\frac{2}{3}$  nat. size. From a photograph.
- Fig. 2.* Fragment of the dermal layer.  $\times 25$  diameters.
- Fig. 3.* Spicular fibres of the internal network, showing their mode of branching and anastomosing. *a*, adherent sarcode containing flesh-spicules.  $\times 25$ .
- Fig. 4.* Fibres terminating in the dermal network. *a*, layer of arches or vaults formed by the curving together and junction of the internal fibres; *b*, layer of spicular pencils.  $\times 25$ .  
(Figs. 5-14 all magnified 435 diameters.)
- Fig. 5.* Spicule of the fibre, typical size and shape.
- Fig. 6.* Similar spicule, but smaller, from the dermal layer.
- Fig. 7.* Very common variety, mucronate at one end.
- Fig. 8.* Straight form of typical spicule.
- Fig. 9.* Flesh-spicules, one on the left straight, the other two curved.
- Fig. 10.* Variety of fibre-spicule with a mucronate bud and a "mucronated mucrone" for a point.
- Fig. 11.* Mucronate point commonly assumed by the fibre-spicules.
- Fig. 12.* Conical point, also common.
- Fig. 13.* Variety with a spherical head and a mucronate point.
- Fig. 14.* Variety with both ends rounded off.
- Fig. 15.* Longitudinal section of a branch, showing the radiate arrangement of the skeletal fibres (nat. size).

The Museum, Bristol,  
Oct. 7, 1878.

#### XLVI.—Notes on *Foraminifera*.

By H. J. CARTER, F.R.S. &c.

FOR the better understanding of what I am about to mention respecting some of the Foraminifera that I have lately described, it is desirable to premise the following brief epitome of their general organization and structure.

Dujardin was the first to point out their real nature, by stating, in 1835, that their soft parts were composed of granu-

lar sarcode capable, in the living state, of extending itself by filaments uniting more or less with each other into a network, through which progression was effected, and that, with reference to reproduction, the sarcode in some cases presented globular masses like the green matter in *Zygnema*.

In 1840 Ehrenberg added the presence of a horny, brown-yellowish mass in each segment of the sarcode but the last, together with the frustules of Diatomaceæ which had been drawn in by the pseudopodia (filamentous prolongations) for nourishment\*.

In 1854 Max Schultze (in the finest work, both for text and illustrations, that has ever been or is ever likely to be published on the subject, 'Organismus der Polythalamien') noticed coloured and fatty globules in the sarcode, together with spherules of different sizes more or less charged with molecules, and presenting in the aggregate a dark colour.

In 1861 I pointed out, by illustration and description, that these spherules of different sizes might be seen in the channels of the "canal-system," as well as in the "chambers," and, therefore, that they were probably discharged in this way; also that each spherule possessed a circumferential, transparent zone round the internal contents, which thus appeared like a capsule. All this was seen not only in recent *Operculina arabica*, but also in fossil nummulites &c. infiltrated with red oxide of iron (Ann. 1861, vol. viii. pp. 318 and 325 respectively, pl. xvii. figs. 12-15).

Lastly, in 1876, Professors F. E. Schulze and R. Hertwig respectively demonstrated the nucleus, which, in a beautiful preparation of *Polystomella striatopunctata* kindly sent me by the former, appears only in the seventeenth segment from the commencement of a specimen consisting of thirty-eight, where it is filled with spherical utricles.

All these discoveries together bring us to consider the position, in point of organization, of the Foraminifera to be much the same as that of *Amœba* and *Euglypha*, figured in my illustrations of the "Infusoria of the Island of Bombay" (Ann. 1856, vol. xviii. p. 243, pl. v.), with the exception of the "contracting vesicle," which one day, under favourable circumstances, might also be seen in some of the Foraminifera composed only of a single chamber and

\* Extracted from a paper entitled "On Foraminifera, their Organization and their Existence in a Fossilized State, in Arabia, Sindh, Kutch, and Khattayar," by H. J. Carter, Assist. Surgeon Bombay Establishment (Journal of the Bombay Branch of the Royal Asiatic Society, 1849, vol. iii. pt. 1, p. 158). My attention to the sponges was commenced about the same time, as may be seen by my publications in the 'Annals,' and both have gone on, hand in hand, up to the present day.

transparent test. But, be this as it may, the appearances are so similar in *Foraminifera*, and so like that of reproduction in all, that one cannot help assuming that both the marine and the freshwater *Rhizopoda* are propagated in this way, whatever the process may be that precedes it.

It seems to me that in studying the *Foraminifera* one should always remember Bory St. Vincent's observation to Dujardin, viz. that a great analogy exists between the filamentous prolongations of the *Rhizopoda* and those of the ever-changing *Amœba*—thus viewing the animal of *Foraminifera* in the light of an *Amœba*, whose possible changes may account for the endless variety of tests presented by the former.

So far as the embryo is concerned, the "spherule" of *Foraminifera*, on being discharged, may follow the changes observed in that of *Euglypha alveolata* (Ann. l. c. fig. 21); that is, it may become amœbiform, or it may extemporize cilia for the purpose of locomotion. But here, again, favourable and fortunate opportunities are required for the description of this short interval. One thing is certain, however, viz. that (from the form of the embryonal chamber in the nautiloid tests of *Foraminifera*) it becomes spherical and covered with a poriferous calcareous layer, except at one point called the "aperture," and that through this aperture the sarcode is extended, which forms a second chamber of the same kind, but of a different shape, which is successively followed by a third, and so on, until the ultimate form and development of the species is attained.

As it may be assumed that the embryonal chamber possesses a nucleus, so it may also be assumed that each chamber is successively supplied with one by duplicative division of that preceding it, although, after all, a nucleus may only be demonstrable in *one* chamber, as in the instance of *Polystomella striatopunctata* above mentioned—unless it be inferred that all the thirty-eight segments are but parts of one "cell," and that thus there is only one nucleus. But this would hardly apply to *Gypsina melobesioides*, where there are millions of cells in its thalloid expansion which must have been formed plant-like, *i. e.* one after another.

Assuming, then, that the embryonal cell represents the simplest form of *Foraminifera*, we have this in Max Schultze's genus *Squamulina*, reduced from its original spherical or embryonal to a plano-convex form to meet the requirement of the species, viz. that of fixing itself by its flat surface to a convenient object. It is true that the test of *Squamulina levis*, according to Max Schultze's statement, was calcareous, smooth, and poreless—that is, probably porcellanic (smooth and glisten-

ing, like the inside of a shell). But if a similar form can be found with pores, or one whose test is formed of foreign objects (that is, arenaceous, like the arenaceous *Miliola*), it seems to me that it is equally entitled to the name of "*Squamulina*," and therefore that my *Squamulina varians* (Ann. 1870, vol. v. p. 321, pl. v. figs. 1, 2) must belong to the genus, inasmuch as change of material in a garment does not alter the generic character.

"A man 's a man for a' that."

Of course there is no development of the canal-system here; but the moment a second chamber is formed, as in the nautiloid tests, the canal commences in the marginal cord, where it may be seen by grinding down an *Operculina* horizontally—and still more strikingly in a split infiltrated nummulite, where the shell-substance, remaining white while the canal-system (which forms a double spire &c., viz. one on each side of the cord) is filled with red oxide of iron, thus distinctly appears in each half of the cord. (I do not know any one who possesses specimens of this kind but myself, which came from the Eocene of the Rajpipla range in Western India.)

But although *Squamulina* would at first appear to be the simplest of Foraminiferal forms, yet *Gypsina* (*Tinoporus*, Carpenter) *vesicularis*, Carp., ap. Carter, is still more simple; for here the chambers have no "aperture" nor is there any "canal-system," indeed no other means of communicating with the exterior than through the successive "pore-tubulation" of the horizontal and the intercameral holes of the vertical walls. De Montfort's genus *Tinoporus* possesses all three.

I wish particularly to direct attention to the absence of these parts in *Gypsina*, because when we find a form of the latter spreading like a *Melobesia*, as in *G. melobesioides* (Ann. 1877, vol. xx. p. 172, &c.), *i. e.* extending itself horizontally over several square inches and ten to twenty layers deep, we seem, but for the direct communication with the exterior through the pores (which enables the animal to nourish itself with *crude* food), to have a true vegetative structure. Hence, too, the necessity of making *Gypsina*, with its different forms, a distinct division of the Foraminifera.

Here I would observe that, in an excellent paper on "The recent Foraminifera of Down and Antrim" (Ireland), by Mr. Joseph Wright, F.G.S., of Belfast, a copy of which the author had the kindness to send me, with type specimens of *Tinoporus levis* and *T. lucidus*, Brady, MS., the latter, which is represented in Mr. Wright's plate iv. figs. 4, *a, b*, and 5, is not a



*Tinoporus* (*Gypsina*), but *Planorbulina vulgaris* (Recent Brit. Foraminifera, by Williamson, pl. v. figs. 119 and 120), as indicated not only by the general character of the specimens, but also, where not much broken, especially by the presence of the "aperture" in the cells respectively, which, as I have just stated, does not exist in *Tinoporus laevis*, olim *Orbitolina laevis*, Park. and Jones, = *Tinoporus vesicularis*, Carp., = *Gypsina vesicularis*, Carp., apud Carter, i. e. *Gypsina*.

*Apically-branched Forms of Foraminifera.*

Of these we know three kinds, viz. *Polytrema*, *Carpenteria*, and *Squamulina scopula*, var. *ramosa*. All present the peculiarity of having no canal-system separate from the tubulation, which, containing the great bulk of the sarcodæ, extends inwards from the apertural openings respectively.

In *Polytrema* this tubulation is dendriform, and extends inwards from a plurality of apertures more or less situated and grouped together at the ends of short processes or of compressed branches (*Polytrema miniaceum*, var. *alcicorne*, MS., C.), by becoming subdivided, to the confines of a mass of cells heaped together (acervuline)—also outwardly, becoming equally divided at the apertural ends when extended during lifetime into the usual kind of filamentous prolongation; so that the sarcodic mass is then branched in both directions.

In *Carpenteria*, of which I have indicated three species by the characters of their tests respectively, the chambers represent so many poriferous sacs thrown together into a conical heap spirally upon each other, so that their apertures respectively and successively open centrally into a kind of columella terminating for the most part in a *single* apical tube, which, dividing at first dichotomously and then polychotomously, at last represents a little dendriform bush on the summit—the wall of those branches where the calcareous material fails (which is often the case either naturally or from accidental fracture) being supplied by foreign material, viz. sand grains, sponge-spicules entire and fragmentary, &c. cemented together by a chitinous substance; so that here the sarcodic mass, which arises from a combination, not of dendriform branches as in *Polytrema*, but of simple stoloniferous prolongations from the respective chambers, is prolonged, again not as in *Polytrema*, nakedly, but through an almost infinite division of tubulation already prepared for it; and this being common to all three species, their specific distinctions must be sought for in the tests. Hence Prof. Möbius's name of *Carpenteria raphiodendron*, which forms

one of the beautiful illustrations in his exhaustive refutation of the eozoonal myth (pl. xl. fig. 58, *Palæontographica*, xxv. iii. F. i.), applies to all three.

In *Squamulina scopula*, var. *ramosa* (Ann. 1870, vol. v. p. 389), the tubulation arises singly from a pseudopolythalamous test, whose sareodie segments uniting together in the centre, as in the columella of *Carpenteria*, are continued upwards and outwards within a single tube that divides dichotomously two or three times, when each of the branches is terminated by a seopuliform head consisting of foreign bodies, chiefly sponge-spicules, entire and fragmentary, kept in their situation by chitine, in the midst of which is a single aperture, from which the sarcode issues in the usual form of foraminiferal filamentous prolongation. The whole of the tubulation, together with the test, is formed of foreign bodies, viz. sand and sponge-spicules, and thus is but an apertural extension from the summit, of a simple form, like that of *Squamulina varians*.

With reference to *Squamulina scopula*, = *Haliphysema Tumanowiczii*, Bk., the Rev. A. M. Norman, after having stated (Ann. 1878, vol. i. p. 265) that he has "undertaken to edit the fourth and last [posthumous] volume of my late friend Dr. Bowerbank's 'Monograph of the British Spongiadæ,'" observes that "the genus *Dysidea* or *Spongelia* affords an almost exact parallel" of *Haliphysema*—finally proposing a new order of Sponges for the species and allies of *Haliphysema* under the name of "Psammoteichina" (ib. p. 272). A more unfortunate announcement, arising from an utter disregard of structural peculiarities, can hardly be conceived, as Mr. Saville Kent's subsequent communication (Ann. 1878, vol. ii. p. 68, pls. iv. & v.), which is confirmative of my original descriptions and illustrations (ib. 1870, vol. v. pls. iv. and v.), proves. After this Mr. Norman, from the same kind of disregard, not recognizing at once the real nature of his *Technitella legumen* and *T. melo*, which any one microscopically acquainted with the testaceous Rhizopoda could hardly doubt, ends by observing, of *Technitella* and *Marsipella*, that "they appear to be genera incertæ sedis, to which it is desirable to call attention in common with *Haliphysema*."

Since this was published, specimens of *Technitella legumen* have been submitted for my examination from Scotland; and the neat and regular manner in which the test is formed of marine sponge-spicules of the same shape, arranged side by side all in the same longitudinal direction, so as to form a comparatively long sac with constricted and margined aperture, forcibly recalls to mind one of the most striking although common features of the freshwater testaceous Rhizopoda, in

which a minute Diatomacean, or other object of a like kind, is used for this purpose (*ex. gr.* Perty's 'Kleiner Lebensformen,' 1852, Taf. ix. fig. 8).

Here is the "old story" again of classifying from resemblances without knowledge of structure, which so characterizes the history of the Foraminifera even up to the present day—to wit, the *Dactylopora*! Of course it is much easier to describe from dried specimens than to follow up the organization of an animal, both living and dead, anatomically and microscopically; hence the egregious mistakes that are committed in classification by what may be termed the "lazy method."

My answer to Mr. Norman's objections to using the term *Squamulina* for *S. varians*, and identifying it with Max Schultze's diagnosis ('Organismus der Polythalamien,' p. 56), may be found above in the discussion of this question.

As to the absence of pores in arenaceous and porcellanic tests (*IMPERFORATA* auctt.), so insisted on by some, and stated by Max Schultze to be the case in *Squamulina*, I do not share in this opinion as regards the former, simply because I have seen them in *Bdelloidina aggregata*, Cart. (Ann. 1877, vol. xix. p. 202, &c.); and as regards the "porcellanic" test, wherein they have not as yet been demonstrated, inference, as well as the aqueous character of the living active sarcode in *Æthalion*, makes me doubtful of the extreme degree of minuteness to which this, if stretched out, may extend—perhaps sufficient to be beyond the power of the most aided vision, like that of the Diatomaceæ. If we do not suppose this, we must infer that the additions to the external surface of the test are made by a reflection of the sarcode from the aperture analogous to that of the mantle in *Cypræa*. At the same time, among some siliceous casts of extreme beauty from the sea-bottom near Panama, kindly presented to me by Mr. F. Kitton, there is a perfect one of a *Miliola* on which, in several parts, but especially about the angle, there are processes representing casts of the pores which originally pierced the porcellanic test.

With reference to Mr. Norman's strictures on my changing Dr. Bowerbank's name of *Haliphysema Tumanowiczii* to *Squamulina scopula*, I must refer the reader to the 'Rules for Zoological Nomenclature, drawn up by the late H. E. Strickland, M.A., F.R.S., assisted by many Zoologists, British and Foreign, at the instance of the British Association,' ed. P. L. Sclater, 1878, p. 10, viz. :—

"§ 11. A name may be changed when it implies a false proposition which is likely to propagate important errors."

The original specimens of *Haliphysema Tumanowiczii*, Bk., from the collections of the late Dr. Bowerbank now in the British Museum, bear respectively the labels, "My own dis-

covery" and "The most perfect sponge," apparently in M. Tumanowicz's handwriting. After this, Dr. Bowerbank, in 1866, published it among his British sponges, under the name above mentioned, as "the smallest known British sponge" (vol. i. fig. 359, vol. ii. p. 76). Wishing, therefore, to *destroy all trace* of this "important error," I, in 1870, changed the name to *Squamulina scopula*, and by my descriptions and illustrations, as I thought, made it equally clear to the spongiologist as well as the foraminiferalist that this organism belonged to the latter. Nevertheless, in April 1878, the Rev. A. M. Norman, as above stated, reverted to the old doctrine, and, repeating the "important error," made *Haliphysema* a new order of sponges under the name of "Psammoteichina." But in the month of July following, Mr. Saville Kent having studied the living animal in the "Channel Islands," finally published (Ann. 1878, vol. ii. p. 68, pls. iv. and v.) his descriptions and illustrations, wherein it is stated (*l. c.* p. 72), "The foraminiferal nature of the organism (*viz.* *Haliphysema*) and the accuracy of Mr. Carter's first deductions relating thereto were now therefore established beyond dispute." It is necessary also to add that the species which I gave to my friend Mr. Norman and that studied by Mr. Kent is the same.

*Rotalia spiculotesta*, Cart.

*Rotalia spiculotesta*, Cart. Ann. 1877, vol. xx. p. 470, pl. xvi.

Lastly, I have to advert to the composition of the test of *Rotalia spiculotesta*, in order to point out the great resemblance that exists between its spicular bodies and the scales of *Euglypha alveolata* &c. among the freshwater Rhizopoda, inasmuch as the "scale," like the spicular body, is formed by the *animal itself* and subsequently cemented together by chitinous substance to form the test—thus differing from the tests of the other Rhizopoda to which I have above alluded (where the particles are *foreign* and all of the same size) in being *proportioned in size* to that of the chamber which they respectively cover.

Moreover it was pleasant to me, as I had only seen one specimen and with great labour could not find another, to learn from Dr. H. B. Brady's letter of November last that, while working over some of the late Mr. M'Andrew's dredgings from the Red Sea, he had found "four fine specimens" of *Rotalia spiculotesta*, and that by testing one with a number of reagents he had found the "spicula" to be "calcareous."

Budleigh-Salterton,  
April 10, 1879.

XLVII.—Notes on the Lepidoptera of St. Helena, with Descriptions of new Species. By Mrs. T. VERNON WOLLASTON.

[Continued from p. 343.]

Fam. VII. Tineidæ.

Genus 32. EUPLOCAMUS, Latr.

*Euplocamus ursella*.

*Tinea ursella*, Walk. in Melliss's St. Hel. 190 (1875).

Expanse 11–13 lines. With the fore wings of a rich velvety mottled brown, and having a very glossy or silken appearance on the first emergence of the insect from the chrysalis, which, however, the mere fact of flight (more so, perhaps, in this particular group than in any other) tends greatly to destroy. Most frequently, indeed, it is captured of a palish brown hue, dappled more or less with very dark velvety brown, a dark blotch on the inner margin being then *generally* the most permanent marking, although sometimes it is altogether absent. Along the outer margin is a row of five or six remote yellowish spots, more or less apparent in different specimens, being sometimes conspicuous and at others nearly absent. Hind wings of a pale glossy subhyaline whitish cinereous, gradually becoming more smoky towards the apex, and with the extremely long fringe of the same hue as the rest of the surface. Thorax concolorous with the anterior wings, body with the posterior ones.

Var.  $\beta$  with the basal article of the antennæ thicker than in those of the type. Indeed I should have been inclined almost to have considered it even a distinct species, had not Prof. Zeller (who has kindly examined my specimen) pronounced it to be merely a variety of the present species. The fore wings are certainly of a more uniform brown (or less clouded with coarse black scales) throughout and more rounded at the apex; the fringe too of the posterior wings is appreciably darker. On measuring a series of the typical one (although varying greatly, which, indeed, is quite characteristic of this group), it does not in any instance exceed 15 lines, whereas the var.  $\beta$  is exactly 17 lines when expanded. Unfortunately, however, I only met with a single example, the chrysalis of which, I believe, I secured from the interior of a rotten log of the "cabbage-tree" wood.

Var.  $\gamma$  with the fore wings somewhat narrower and of a

paler or more freckled hue than the type, and having a few distinct blackish dots below the costa.

The *Euplocamus ursella* is one of the most universal moths throughout the intermediate and lofty districts of the island, though I have no evidence that it exists below the altitude of Plantation. It appears, I think, to belong more especially to the "cabbage-tree" fauna, in the wood of which (particularly, though by no means always, when in a rotten or decomposed condition) I have repeatedly found the larva. The latter is of a dirty whitish hue, extremely unattractive in appearance, and most active if disturbed; when fully fed it spins a firm and somewhat silken cocoon, generally immediately under the loosened outer bark of the "cabbage trees." The chrysalis is reddish brown, having the five posterior segments, on the upperside, armed at their base with a row of minute closely set spinules, the apex itself being furnished above with two strong recurved hooks, and below with two shorter and obtuse spine-like tubercles.

*Euplocamus anticella.*

*Cerostoma anticella*, Walk. in Melliss's St. Hel. 192 (1875).

Expanse 8-12 lines. With the fore wings of a glossy bronzy brown, and quite free from any spots or markings whatever; but the fold is rather darker, so that in worn specimens it has somewhat the appearance of being a dark longitudinal streak. Hind wings glossy greyish cinereous. Thorax rather paler than the anterior wings; body concolorous with the fringe of the posterior ones.

Var.  $\beta$  with the fore wings of a pale golden ochreous, gradually paler and duller towards the base, and entirely without markings. This is a very beautiful insect when fresh; but it is more often captured as a mere whitish and insignificant-looking moth. Hind wings glossy cinereous, with a very faint iridescent tinge. Thorax concolorous with the anterior wings, body with the posterior ones. Mr. Barrett informs me that this variety is very close to the British *Tinea pallescens*, nevertheless without the characteristic irregular longitudinal line of that species. To me it appears as if it might eventually prove to be a distinct species from the typical *anticella*; however, as I am extremely unwilling to multiply species, which, after a more careful research on the spot, may possibly turn out to be but varieties of a single variable species, I have considered it better to treat this particular form merely as an albino variety of Mr. Walker's *anticella*.

*E. anticella* is not uncommon throughout the intermediate districts of St. Helena, ascending occasionally to the

central ridge. I think, however, that it is probably more strictly a member of the aster and gumwood fauna than of the cabbage trees; otherwise it possesses in the larva state the same characteristics as the *E. ursella*.

I can only partly conjecture that this is in reality the species indicated by Mr. Walker's *Cerostoma anticella*; but, judging from the few types only which I have been able to examine of the St.-Helena Lepidoptera on which Mr. Walker erected his descriptions, I can only feel surprised that he was able from such mutilated exponents to draw descriptions with any degree of accuracy.

*Euplocamus sanctæ helene.*

*Gelechia sanctæ helene*, Walk. in Melliss's St. Hel. 192 (1875).

*Gelechia ligniferella*, id. ibid. 192 (1875).

Expanse 10-14 lines. With the fore wings pale brownish cinereous, dusted (especially exteriorly) with minute blackish scales. The wings are very uniform throughout, their only marking being a small black postmedian spot; the female, however, does not retain this marking, and is on the whole less irrorated with minute black scales. Hind wings glossy cinereous and slightly iridescent. Thorax in the female concolorous with the anterior wings, but in the male of a rather darker hue. Body concolorous with the posterior wings.

This is certainly one of the commonest members of the group, and better defined perhaps by its pale dusted surface, and its general absence of obscure blotches or markings, than by any positive character which is immediately conspicuous. The male, however (in examples which are fresh and un-rubbed), has a distinct blackish spot towards the apex of its anterior wings. I possess a single variety of this species in which the costa and inner margin of the fore wings are of a much paler, indeed almost yellowish, tint, giving the latter at first sight a somewhat longitudinally striped appearance; and there is also a small blackish blotch on the inner margin near the base.

*E. sanctæ helene* occurs in intermediate and lofty altitudes; in fact it is abundant throughout those regions which are more or less clothed with the arborescent Compositæ.

Genus 33. *TINEA*, Linn.; Staint.

*Tinea flavofimbriata*, E. Woll.

Expanse 3 lines. With the maxillary palpi developed but very slender and thread-like; the labial palpi are porrected

horizontally, with spine-like hairs beneath the second joint. The fore wings are of a pale whitish yellow, with two conspicuous transverse fasciæ, the first one of which is basal and the second median; the exterior edge of the second fascia is adjoined in the middle by a curved longitudinal blotch-like marking which unites it to a blackish hind-marginal border; the fringe is a little yellower than the rest of the surface, and, moreover, concolorous throughout, there being no indication of the blackish scales which are so apparent in the following species at the base; nevertheless there is usually a very diminutive blackish speck immediately beyond the extreme apex of the wing. Hind wings silken cinereous. Thorax brownish. Body pale yellowish cinereous.

Although this species and the following one are very similar, yet, on the average, *Tinea flavofimbriata* is decidedly the smaller of the two; the uniformly *immaculate* yellow fringe of its anterior wings will suffice to distinguish it (even at first sight) from *T. bicolor*. There is also a much more decidedly yellow shade about the pale portions of its surface; and its transverse fasciæ, as stated in the description, are conspicuously less oblique. It was chiefly at Plantation that I obtained this minute moth—and, moreover, very sparingly, my few specimens having been captured for the most part after showers. I cannot recall meeting with it on the high central ridge, where *T. bicolor* is so abundant; and I am inclined therefore to think that it may perhaps occupy a slightly lower range (as regards its *habitat*) than that species.

*Tinea bicolor*, E. Woll.

Expanse 4–4½ lines. With the maxillary palpi scarcely discernible; the labial palpi are very slightly deflexed, divaricating, and with a few distinct longish hairs beneath the second joint. The fore wings are white (sometimes with a faint tinge of yellow), with three very oblique transverse dark-brown or blackish fasciæ, the first of them (the costal half of which is broadest) being at the base, the second (which is very oblique to the anal angle, where it joins a line of black scales along the outer margin) being median, and the third one (which is very narrow, and sometimes represented by merely a small spot on the costa) subapical. The second fascia being very oblique from the costa to the anal angle, and the hind marginal line of dark scales being oblique in exactly the contrary direction, give to that region of the wing the appearance of having a curved blackish line or inverted arch-shaped marking, with a black spot in the centre, the latter being constituted by the ill-defined and abbreviated third



fascia. Hind wings dark smoky cinereous. Thorax brownish. Body concolorous with the posterior wings.

This elegant little *Tinea*, the black-and-white fore wings of which give it so conspicuous an appearance, is decidedly common in the higher altitudes of St. Helena, where I used principally to meet with it, resting on the lichen on the more or less perpendicular faces of the rocks, along the "Cabbage-tree Road," below Actæon and Diana's Peak. Nevertheless, although much less abundantly, it occurs occasionally as low as Plantation (some 1800 feet above the sea), where I have not unfrequently obtained it. During the early part of our visit to the island it seemed to be extremely rare; but as the summer approached (about the end of December) it became very plentiful in the loftier portions of the great central ridge, even its brightly ornamented black-and-white surface rendering it, however, by no means easy to detect (that is, in a state of repose) on the many-coloured lichen to which it is specially fond of adhering. The chrysalis of *Tinea bicolor* is of a very pale yellowish white, enveloped in a narrow and somewhat parallel-sided cocoon, which is a good deal flattened, so as to cause either edge to be sharply angular. The cocoon is almost white, being very little concealed or obscured by earthy particles.

*Tinea pulveripennis*, E. Woll.

Expanse  $3\frac{1}{2}$ – $4\frac{1}{2}$  lines. With the fore wings narrow and about equally speckled with scales of a dark brown and an ochreous white (the latter having a slightly golden tinge). In general appearance, however, the darker portions seem to take the form of ill-defined and somewhat mottled or fragmentary transverse fasciæ (about four in number); but the whole wing is so completely irrorated with lighter or darker scales, that it becomes difficult to define for certain the exact pattern that they respectively assume. The fringe is of a pale straw-colour, with a few darker scales intermingled. Hind wings silvery grey, but with the fringe rather paler.

This pretty little species, remarkable for the narrowness of its speckled and somewhat ochreous-tinted fore wings, is, I should say, perhaps the most abundant of all the *Tineidæ* which are found at a lofty elevation. Like its congeners, it is accustomed to rest during the daytime (exposed to full view) upon the moss and lichen which more or less clothe the rocks; and it is not uncommon also on the trunks of trees. I do not remember, however, to have met with it at a much lower altitude than Plantation; but on the high central ridge it absolutely swarms.

*Tinea aureomarmorata*, E. Woll.

Expanse 5-5½ lines. With the fore wings of a pale whitish straw-colour, but much suffused or mottled with pale yellowish brown and somewhat gilded, broken up, exceedingly fragmentary fasciæ. Until closely examined, the general appearance of the species is that of a very pretty little yellow *Tinea* with slightly darker markings. The cilia quite at the apex of the fore wings are more or less marked with a blackish wavy line, more distinct in some specimens than in others; and there are also a few blackish scales (in highly-coloured examples) towards the apex of the wing. Hind wings of a smoky grey. Thorax concolorous with the anterior wings; body with the posterior ones.

A not very uncommon little species throughout St. Helena, at high and intermediate altitudes. I constantly met with it at Plantation, and likewise at West Lodge, resting upon the trunks of the gumwoods and of the aborescent asters, generally in the most exposed and windy spots. When disturbed, it is very apt to simulate being dead by lying motionless upon its back, under which circumstances it is difficult to secure without injuring the wings. The prettily but rather *lightly* marbled upper wings, which seem at first sight to be faintly *shot* with a somewhat golden-yellowish gloss, will sufficiently distinguish *T. aureomarmorata* from its immediate allies.

These three species (viz. *Tinea piperata*, *T. aureomarmorata*, and *T. pulveripennis*) perhaps more naturally belong to the small true *Tineæ* than any of the other species; they apparently possess very similar habits, being found in the same localities; and, except that the very thin palpi in *T. pulveripennis* help to distinguish it from its congeners, they otherwise depend upon their specific characters for their identification.

*Tinea piperata*, E. Woll.

Expanse 4-5½ lines. With the fore wings of a dull, mottled, obscure buff (dusted everywhere with minute brown scales), and having some irregular, small but unequal and ill-defined spots (which are generally placed both on the costa and the inner margin) of a dark brown. In one of my examples the spots towards the apex form two somewhat arrow-shaped fasciæ. No two specimens, however (taken from a tolerably good series which is now before me), seem to be exactly similar in the precise position of the darker spots and the more or less condensed irrorated scales. Hind wings silvery grey, the

cilia paler. Thorax concolorous with the anterior wings; body much paler.

This obscure little moth is a plentiful species in the island, becoming gradually more abundant as we ascend towards the central ridge, though its mottled hue renders it by no means easy to detect on the moss- or lichen-covered rocks amongst which it principally resides.

The following species (viz. *pulverulenta*) differs from the above in having its labial palpi rather arched and more densely covered with long bristle-like hairs (except the basal joint, which is bare, short, and slender), and the second joint with a long protruding bunch of scales, which extends beyond the terminal joint and gives the palpi a very brush-like appearance; anterior wings, too, with their apex most curiously curved back in the male, thus causing the hind margin to seem blunt or somewhat *Tortrix*-like.

*Tinea pulverulenta*, E. Woll.

Expanse 4-4½ lines. With the fore wings recurved at the apex in the male (though *not* in the female), but in a less degree than those of *Elachista recurva*, and of a speckled or irrorated (or somewhat powdered) appearance, the most distinct markings being alternate pale and dark (but usually ill-defined) oblique dashes from the costa. The darker portions are very much intermingled or suffused, giving to the whole surface a somewhat *pulverose*, but at the same time rather mottled aspect. Hind wings narrow and of a dark smoky hue, being generally a little blacker at the *extreme* tip. Head and thorax concolorous with the anterior wings; body the same as the posterior ones.

This somewhat obscure little moth is exceedingly abundant in the higher elevations of the island, descending also, though more sparingly, into the intermediate districts; and there can be no doubt that it is a truly indigenous member of the fauna. On the lofty central ridge, towards Diana's Peak and Actæon, the faces of the rocks are often thickly studded with its flat, oblong, earthy cocoons, which are lined with a strong, whitish, silken substance; but the imago, common as it is, is less easy to be observed, not merely on account of its minute size, but from its wonderful resemblance in colour to the rocks and mottled lichen on which it is accustomed to settle. The coarse scales (of dark brown and yellowish white) with which its fore wings are everywhere dusted, and which are so intermingled as to shape-out markings which are exceedingly ill-defined, render it a difficult species to secure in a perfect condition; for there is scarcely any moth which is so fragile

and easily rubbed as *T. pulverulenta*, the very act of impaling often rendering it totally unfit for inspection.

*Tinea ferruginella*, Hübn.

Expanse  $5\frac{1}{2}$ – $6\frac{1}{2}$  lines. With the fore wings of a brownish tinge mottled with paler scales, the basal portion being slightly darker. The inner margin is of a pale yellowish white; and there is likewise a rather conspicuous spot on the disk of the same pale hue; the fringe is concolorous with the inner margin, but interrupted with blackish scales. Hind wings cinereous, the fringe being of the same tint. Thorax concolorous with the anterior wings, except the centre, which is of a pale yellowish white.

This little *Tinea* is not at all abundant in the island. The few specimens I met with do not appear in any way to differ from those in my British collection, except that the fore wings are less glossy and without the purplish tinge of the latter, though this may, indeed, be partly owing to my St.-Helena examples not being in very good condition.

*Tinea pellionella*, Linn.

Expanse 5– $6\frac{1}{2}$  lines. With the fore wings of a dull pale brownish hue, and having near to the middle of the disk two rather longitudinally placed dark brown spots, which are generally more or less distinct; there is also a third, more conspicuous and likewise more rounded, dark brown, postmedian spot. On close inspection it will be observed that there are numerous cinereous scales throughout the wing, intermingled with the pale brownish ones; in fact the number of each is perhaps well nigh equal; the cilia are also cinereous. Hind wings of a pale (rather brownish) cinereous throughout.

As I only met with two examples of this little *Tinea*, I conclude that it must be a somewhat scarce species in the island, and perhaps even only recently introduced. Especially might this, I think, be the case, as it was not observed by Mr. Melliss. So far as I can judge from merely two specimens, it does not appear to differ much from the European type, though possibly, on the whole, it may be a trifle *darker* than the ones with which I have compared it in my British collection.

*Tinea binotatella*.

*Tinea binotatella*, Walk. in Melliss's St. Hel. 191 (1875).

Expanse 7–9 lines. With the fore wings of a dull and opaque dark cloudy brown, more or less besprinkled with blackish scales. Some specimens, however, are darker, and

have a small palish triangular spot or obscure blotch on the inner margin at the extremity of the fold. Hind wings of a glossy silken cinereous, rather darker at the apex. Thorax concolorous with the anterior wings. Body somewhat paler.

It was chiefly at Plantation that I met with this species, where it abounds; indeed it is much too abundant, as in the caterpillar-state it is most destructive to the potato-crops. Mr. Melliss observes, "The larva of this moth is well known in the island as the potato-worm. It is a small, translucent, maggot-like creature, of a dirty whitish hue, marked with four longitudinal rows of small brown spots, and having a few long hairs on its body. In length it varies from a half to three quarters of an inch. The head is hard, and of a chocolate-brown colour; and the little creature moves backwards quite as easily as it does forwards. It abounds in the island, and is a thorough pest to the potato-crops. Either the eggs are laid in the potatoes, or the larva enters them in an early stage of its growth, and, through its depredations, renders them quite unfit for food. When changing to the pupa-state it wraps itself up in a strong web, in the form of a close, tough envelope; and the chrysalis is of a light mahogany colour, with the positions of the wings and legs, even in its early stage, strongly marked longitudinally down the outside of the case or skin." It would therefore appear to be only in the more cultivated parts of the island that this species has established itself; and on rapping the trunks of trees in such situations the imagos fly off in showers; nevertheless they very quickly settle again.

*Tinea compositarum*, E. Woll.

Expanse 5-6 lines. With the maxillary palpi rather long, though folded and concealed; the labial ones are projected horizontally, divaricating, and gradually thickened towards the apical joint; the head is rough, but having the face somewhat globose and covered with imbricated scales. The fore wings are of a suffused greyish cinereous, densely irrorated with darker scales; the costal margin is somewhat paler, below which (particularly on the basal half) there are usually a few minute blackish specks. The whole surface, however, very obscure and rather variable, and has often the costal margin uniform with the rest of the wing. At the apex there is a small and somewhat wedge-shaped marking composed of a few blackish scales; and the fringe is also intermingled with similar ones. Hind wings smoky cinereous, but having the fringe slightly paler. Thorax concolorous with the anterior wings, body with the posterior ones.

If extreme inconspicuousness and the want of a definite character could form the distinctive feature of any moth, this obscure little *Tinea* ought certainly to be easy of recognition; yet, although it undoubtedly cannot be referred to any thing else in the St.-Helena list, it seems next to impossible to describe it in any manner which must make it at once intelligible. The almost uniformly dull subeinerous brown of its upper wings (which, however, are more properly defined as densely covered with dark scales on a rather paler base) is at first sight only relieved by a few somewhat black ones at the apex and occasionally on the inner margin. It was chiefly about the trunks of the old gumwoods, at intermediate elevations, that I obtained this obscure little moth.

The following species chiefly differs from the *compositarum* in having the posterior wings narrower than in the latter.

*Tinea congenera*, E. Woll.

Expanse  $5\frac{1}{2}$  lines. With the fore wings of a dull brownish or blackish hue, slightly suffused with pale yellowish or straw-coloured scales, which are more conspicuous along the costa and the inner margin than on any other portion of the surface. The posterior wings are narrower than in the preceding species, which otherwise it very closely resembles. It is not, however, of quite so uniform a tint as *T. compositarum*, or of such a silken or shiny surface. Hind wings pale silvery eincereous. Thorax concolorous with the anterior wings; body somewhat paler.

I should almost have looked upon this little moth as merely a variety of *T. compositarum*, had not Professor Zeller (who has most kindly examined my specimens) pronounced it to be a distinct species. Unfortunately I only obtained two examples, one of which is very much darker than the other, indeed almost black.

*Tinea brunneo-marmorata*, E. Woll.

Expanse 7 lines. The fore wings of a griseous straw-colour, but densely and conspicuously suffused with brown scales. There are also several small dark brown or almost blackish blotches, the most conspicuous of which are two or three on the inner margin, and a third near to the apex, the extreme apex itself being black, and one or two smaller and more variable ones along the costa. The fringe is concolorous with the lighter portions of the surface, and very sparingly besprinkled with blackish or brownish scales. Hind wings smoky eincereous, with the fringe rather paler.

Thorax dark brown. Body concolorous with the posterior wings.

The dark brown scales and fragmentary markings of this *Tinea* are rather more conspicuous and defined than in some of the allied species, giving to the upper wings (the straw-coloured ground of which is nearly concealed by these obscure portions) a somewhat marbled appearance. Moreover the presence of usually two or three indistinct but nevertheless rather larger and blacker blotches imparts a still more freckled aspect to the whole. Although not always easily traceable, the small and irregular darker patches are placed, two of them on the inner margin and a third near to the (more blackened) apex, not to mention one or two, which are generally more obsolete, along the costa.

*Tinea vilis*, E. Woll.

Expanse 5-6 lines. The fore wings of an obscure brownish or dingy cinereous, and very much speckled or suffused with blackish scales, which more or less form broken-up and very indistinct transverse fasciæ. On the inner margin there is generally at least one blackish blotch which is rather larger than the rest and very irregular, and which is often supplemented by a second; but the one at the anal angle is almost always the most distinct, as well as the most permanent. Hind wings silvery cinereous. Thorax concolorous with the darker portions of the anterior wings; body somewhat paler.

This inconspicuous, dingily speckled, but nevertheless interesting little moth is not uncommon throughout those regions of *St. Helena* where the remains of the gumwood-thickets are still lingering; and there cannot, I think, be much doubt that the species is a thoroughly indigenous one. Like its congeners, it is generally to be met with resting upon the old trunks, the dingy and rough surface of which it so closely resembles that when its wings are folded closely over its body (as is its custom), and its head a little raised it might well be mistaken for a portion of the bark.

*Tinea fasciculata*, E. Woll.

Expanse 10-11 lines. The fore wings of an unequal griseous or pale cinereous brown, but densely crowded with ill-defined darker markings, especially along the costa, and having small longitudinal streaks or broken-up lines near the base. About the middle of the wing (arising from the inner margin and extending across the fold) is a narrow transverse line of raised palish scales; and near to the costa (slightly

more towards the base) is often a second batch or elongated fascicle of them. The whole surface is much suffused with blackish scales, and is of a very uneven appearance, varying somewhat in different specimens. Near to the apex are two small, curious, but not conspicuous folds, extending obliquely from the costa to nearly halfway across the wing; the latter is *fringed* anteriorly from the apex to nearly a third of the distance to the base. Hind wings of a glossy greyish cinereous, with a slight metallic lustre. Thorax rather paler than the anterior wings. Body concolorous with the fringe of the posterior ones.

The only examples which I have seen of this distinct and very interesting species were captured by myself at an intermediate elevation on the south-eastern or *inner* side of the great Sandy-Bay crater, and below the central ridge—namely, amongst the old gumwoods in Peak Gut, and, under similar circumstances, between Peak Dale and Lufkins. We may be almost certain, therefore, that the species is a member of the original gumwood fauna. The variegated nature of the upper wings (which, although pale cinereous, are crowded with irregular little patches and short line-like markings of a darker hue), in conjunction with the tufts of transverse fascicles of raised scales on the disk, and the fact of the costa being fringed with long hairs from the apex to nearly a third of the distance to the base, will suffice to separate *Tinea fasciculata* at once quite easily.

#### *Tinea subeneella.*

*Tinea subeneella*, Walk., in Melliss's St. Hel. 191 (1875).

Expanse 6–8 lines. With the fore wings very variable in the intensity of their hue, some specimens approaching almost to fuscous brown, while others, again, are comparatively pale. But the general surface (of whatever tint it be) appears at first sight to be almost plain and uniform throughout, being scarcely suffused with either darker or paler scales; but below the fold there are nevertheless often obsolete indications (barely traceable) of a few indistinct paler blotches. The fringe is more or less concolorous with the rest of the wing, except that its base is sparingly besprinkled with blackish scales. Hind wings silvery cinereous. Thorax concolorous with the anterior wings; body slightly darker than the posterior ones.

Plentiful as is this inconspicuous little species at intermediate elevations in St. Helena, yet, from their sluggish habits and from the trick which they possess of feigning to be dead when captured in a net, it is not one that is very readily taken. My examples I got principally from the kitchen-garden at



Plantation. It might be easily mistaken for *T. binotatella* (especially as they abound in the same localities), which it very much resembles both in size and colour; however, a glance at the palpi will at once show that it is in reality quite distinct.

*Tinea scalaris*, E. Woll.

Expanse  $5\frac{1}{2}$  lines. The fore wings of a dull brown, but adorned with transverse abbreviated cinereous blotch-like fasciæ, which are a good deal elevated or raised, the first one being before the middle of the wing, and the second one almost median. These markings, however (which are sometimes confluent), do not quite reach to the fold, but adjoin a small cluster of slightly darker scales (not always very traceable) which extends beyond the fold to the inner margin. There is also a third transverse fascia, which is similar to these two, but postmedian in position. The whole of the outer marginal area is suffused with somewhat coarse cinereous scales (which are a little more concentrated into an obscure spot-like marking on the costa), the apex being defined by a few blackish ones. Hind wings dark smoky cinereous. Thorax yellowish brown; body rather paler.

This would appear to be a somewhat local or scarce species in St. Helena, the few examples which I have seen having been captured by myself at Thompson's Wood. They were concealed beneath the loose stones on the top of a low wall encircling the gradually diminishing cluster of native gumwood trees, which I believe to be about the oldest remaining ones of that kind in the island. *T. scalaris* is therefore most likely a member of the gumwood fauna, though until further material has been obtained I would not wish to state this with any certainty.

*Tinea helencæ*, E. Woll.

Expanse  $8\frac{1}{2}$  lines. The fore wings of a dirty yellowish white, but much streaked towards the apex with minute longitudinal blackish lines formed of closely-packed subiridescent scales; and along the fold are others which are more conspicuously darkened. Hind wings of the same colour as the anterior ones, but without markings. When examined through a powerful lens this is a most beautiful little moth, all the wings being richly adorned with metallic scales (which are scarcely visible to the naked eye), those on the fore wings being composed of a variety of tints, whilst on the hind wings opaline ones prevail. Thorax concolorous with the anterior wings, body with the posterior ones.

This most interesting little moth, which is well distinguished from any of the other species (except, of course, *T. heleneoides*) by its narrow, pointed, lanceolate wings, and by its pale straw-coloured glossy surface (which on the fore wings is slightly variegated anteriorly, and within the fold, with a few irregular and more or less diffused subconfluent longitudinal streaks, composed of densely-packed darkish scales), is in all probability a gumwood species, and therefore truly indigenous in the island. At any rate the only spot in which I remember to have met with it is in Thompson's Wood, where I captured it amongst loose stones on an old wall which was overhung by the branches of *Commidendron robustum*, which grows to so large a size in that remote and somewhat inaccessible locality.

*Tinea heleneoides*, E. Woll.

Expanse 7 lines. With the fore wings of a very pale straw-colour, having small, longitudinal, brownish, fragmentary, diffused streaks throughout, more especially at the apex; along the fold there is a short disjointed blackish streak. As in *T. helena*, there is an iridescent tinge, but considerably fainter. Hind wings glossy cinereous, but when viewed beneath a powerful lens having an opaline lustre. Thorax concolorous with the anterior wings; body somewhat paler.

Having but a single example of this interesting little species from which to judge, I am unable to say whether its anterior wings are always so much marked as in the type now before me with longitudinally-disposed and somewhat broken-up brownish lines; nevertheless I do not think it can possibly be looked upon as a diminutive and highly-coloured variety of *T. helena*. Apart from the peculiarity of its coloration, it is very much smaller than the preceding species, and also less resplendent (when viewed beneath a high magnifying-power) with opaline and iridescent scales. I am not absolutely certain where my unique specimen was obtained; but I feel *almost* sure that I captured it at Thompson's Wood; and if this was the case, the species is, in all probability, another member of the old gumwood fauna.

I am glad to be able to add that since the above was written I have been satisfactorily confirmed in my opinion regarding this moth by Prof. Zeller, who looks upon it as a new and distinct species.

*Tinea apicalis*, E. Woll.

Expanse 5-6 lines. The fore wings of a yellowish-white or straw-colour, and powdered almost uniformly, yet sparsely,

with minute brownish scales. At the extreme apex (intermingled with the fringe) there are a few scales which are of a darker brown or nearly black, and which form a somewhat wedge-shaped ill-defined spot, the only distinct marking that the wing possesses. Hind wings of a glossy or silken cinereous, with the fringe rather paler. Thorax yellowish white; body concolorous with the anterior wings.

It was chiefly from the trunks of the few remaining gumwoods at Plantation that I obtained this interesting little *Tinea*; and from the fact of its appearing to belong to those singular arborescent Compositæ, which are now so fast dying out, I have little hesitation in citing it among the species which are truly indigenous. I think, moreover, that it may be reckoned as one of the commonest Lepidoptera which are strictly aboriginal.

Apart from its small size, *T. apicalis* may usually be recognized without much difficulty by the simplicity of the colour of the fore wings, which are more or less of a pale straw or yellowish white, but sparingly dusted over with a few diminutive brownish scales, a little cluster of darker or blackish ones at the extreme apex (which have a tendency to form a small and somewhat wedge-shaped, ill-defined spot) being almost the only marking that gives to the surface a character which is tolerably appreciable.

#### *Tinea irrorata*, E. Woll.

Expanse 9 lines. The fore wings of a pale brownish or straw-coloured tinge, and speckled with numerous irregular black dots (particularly on the basal half), each composed of a few dark scales, those near the costa having a faint tendency to be placed *somewhat* in transverse pairs. The apex and outer margin are speckled more minutely, as is also the fringe. Hind wings pale glossy cinereous, and, when viewed beneath a high magnifying-power, with a pearly and somewhat opaline lustre. Thorax slightly darker than the anterior wings; body much the same as the posterior ones.

The only examples which I have seen of this moth I captured, I believe, at Thompson's Wood; but whether the species is in any way connected with the gumwoods I have no means of deciding. At any rate there is no reason to suspect that it is otherwise than truly indigenous in the island. The rather dotted, or *speckled*, surface of its upper wings will be sufficient to distinguish it from its more immediate allies.

*Tinea atlantica*, E. Woll.

Expanse 4-5 lines. The fore wings of an extremely pale ochreous, being very uniform in colour throughout, though just perceptibly darker towards the outer margin; the cilia are whitish, except quite at the apex, where it is concolorous with the surface of the wing. Hind wings glossy cinereous. Thorax of the same hue as the anterior wings; body slightly paler.

A few specimens of this species I met with which are of a pure white throughout all the wings, as well as rather smaller than the type.

*Tinea atlantica* is not particularly scarce in St. Helena at intermediate and lofty elevations; nevertheless I did not succeed in obtaining many examples, chiefly owing, I believe, to the fact of this little moth being more especially attached to the arborescent asters (or "little gunwoods"). And as the latter abound mostly in the less sheltered parts of the island, where the wind is invariably blowing violently, it renders the capture of all such small and inconspicuous species as the present one often well nigh impossible.

*Tinea fasciolata*, E. Woll.

Expanse 3-3½ lines. The fore wings of a dull smoky cinereous. There is an indistinct oblique broken-up fascia of dark scales near the base, a second one (rather more conspicuous) antemedian, and a third one postmedian; but they are nearly always so much interrupted, or broken into, before the fold as to constitute mere isolated (although irregular) markings or spots, three of which are costal and three on the inner margin. There are two other small tufts of the same kind of dark scales, one of which is generally large and conspicuous, and placed at a little distance before the apex; the second is smaller and placed at the extreme apex itself. The fringe is concolorous with the rest of the surface, and sprinkled minutely with blackish scales, a little tuft of which latter is often conspicuous (adjoining the dark patch) at the anal angle; but the ornamentation is more or less variable, some specimens being much paler and with the first fascia-like marking hardly traceable. Hind wings smoky cinereous. Thorax brown; body concolorous with the anterior wings.

This is a better-defined little moth than many of the preceding ones, its pale cinereous fore wings, which are rather conspicuously adorned with about eight irregular darker markings made up of clusters of blackish scales, giving it a

somewhat ornate or variegated appearance. Much depends, however, as I need scarcely add, on the state of the examples inspected; for when in a worn or rubbed condition, some portion of the spots or blotches are pretty sure to be absent. It is evidently one of the commonest of the St. Helena Microlepidoptera, particularly at intermediate and rather lofty altitudes. At Plantation it simply swarmed, the small, brown, somewhat cylindrical, fusiform cases of the larva often covering the walls and trunks of the trees to a perfectly marvellous extent.

*Tinea minutissima*, E. Woll.

Expanse 3 lines. The fore wings of a pale cinereous hue, and very much suffused with dark brown scales, the latter usually forming somewhat indistinct transverse oblique fasciæ, though becoming more blotch-like towards the outer margin; the cilia are also interrupted by dark brown scales. Hind wings smoky cinereous and very deeply fringed.

At first sight this little moth might well be mistaken for *T. fasciolata*; however, on closer examination, it will be found to be a decidedly smaller species than the above one; the anterior wings, too, are of a much paler cinereous hue, besides having their surface seemingly *smoother* or with less appearance of being tufted by the dark brown scales.

So far as I can recollect, I obtained *T. minutissima* in the same situations as the preceding species, but much more sparingly, although this might probably be accounted for by my not distinguishing at first between the two.

*Tinea divisa*, E. Woll.

Expanse 4-5 lines. The fore wings distinctly and broadly marked with brown throughout the costal region, the posterior edge of the brownish portion being usually more or less jagged; the rest of the surface is of a creamy whitish buff; so that the wings are pretty equally divided (as it were) into two longitudinal compartments, or narrowish line-like spaces—namely, a dark costal one, and an inner marginal palish one. The fringe is thickly speckled with black along its base, at the outer margin of the wing—which causes the latter to appear terminated by an oblique, black, powdery line, the most apparent and the least variable of all the markings. Between the fold and the inner margin there are generally a few minute raised blackish tufts of scales. The female is rather more uniform in colour throughout, it being of a rather yellower or more gilded hue, and with the costal and inner marginal divisions more blended into each other.

Hind wings of a silvery white, and, in the male, having a dark cinereous blotch at the base. Thorax yellowish; body somewhat paler.

This pretty little moth is very abundant in most parts of the island, but especially at intermediate altitudes. Near West Lodge, which is situated at a less elevated part of the great central ridge, it is exceedingly plentiful amongst the native arborescent asters; nevertheless the majority of my specimens were beaten out of a single hedge in the kitchen garden at Plantation—a hedge which was formed almost exclusively of overgrown masses of the common passion-flower (*Passiflora cærulea*), and must have been at least two yards in thickness. I do not imagine, however, that the moth was in any way actually dependent on that particular plant, more especially as there were the remains of some native gumwood trees a little distance off.

*Tinea flavotincta*, E. Woll.

Expanse 4-5 lines. The fore wings of a pale gilded yellowish buff, which is more or less uniform throughout, except on the inner margin, where there are two somewhat triangular whitish blotches, the first of which is placed about the middle and extends over the fold, and the second one near to the anal angle. Towards the apex of the costa there are *occasionally* rather faint traces of a third whitish, oblique, indistinct blotch. The fringe is white, sparingly speckled with gilded scales. Hind wings silvery cinereous. Thorax white.

This pretty little moth is not uncommon in many localities throughout St. Helena, especially at intermediate altitudes. I found it principally at Plantation and at West Lodge. In the latter locality they were generally adhering to the trunks of the native aster trees, in the very eye of the strong and boisterous trade-winds; and although the latter seemed to have wonderfully little effect on them, they nevertheless made them extremely difficult to capture, on account of the sandy soil, which was so blown into one's eyes as well nigh to blind one. It is marvellous, however, how these and other equally minute moths are able to withstand the tempestuous atmosphere of those elevated regions, the almost constant and violent breeze appearing to have no power to destroy even their finest scales.

*Tinea actæon*, E. Woll.

Expanse 4-5 lines. With the fore wings of a dark blackish brown, and conspicuously adorned with two rather broad yel-

lowish-white bands, the first of which is somewhat oblique and antemedian, and the second postmedian; between these two bands, on the inner margin, there is a large and usually somewhat triangular yellowish-white blotch; and the apex also is relieved by a few pale scales immediately before the extreme point. The fringe has the slightly yellowish tinge rather more pronounced than the other portions of the surface, and it is nearly, or even quite, immaculate. Hind wings smoky cinereous. Thorax brownish. Body concolorous with the anterior wings.

This somewhat scarce little *Tinea* I obtained on the highest portions only of the great central ridge, principally about the summit of Actæon; and it would seem, therefore, to be not only rare but local. It is quite a summer species there; indeed, so far as I can recollect, it did not make its appearance before the end of December or the beginning of January.

In the conspicuous black and yellowish ornamentation of its fore wings *Tinea actæon* has a good deal in common, at first sight, with *T. flavofimbriata*; nevertheless the pattern of its markings is quite different, and it is also appreciably larger in stature. Moreover it is very much scarcer than the other, and, so far as my present experience would imply, is confined to the loftiest altitudes. Indeed I only met with it a few times, and then invariably on the summit of the ridge called Actæon.

*Tinea niveopicta*, E. Woll.

Expanse  $3\frac{1}{2}$ – $4\frac{1}{2}$  lines. The fore wings of a clear snowy white, which extends to about a third of the distance from the base and there ends abruptly. The remaining portion of the surface is of a yellowish buff, the latter, however, being interrupted above the anal angle by an obscure transverse line of minute blackish scales (which are seldom altogether absent); and the apex has a few scattered whitish ones. The white basal region has often a few very faint buffish scales towards the costa. The fringe is of a yellowish white, entirely immaculate. Hind wings greyish cinereous, with the fringe slightly paler. Thorax white; body concolorous with the posterior wings.

There is no single moth at St. Helena which is better defined and more truly remarkable in its ornamentation than this beautiful little *Tinea*—the extreme coarseness of the scales with which its fore wings are clothed, and which are of a clear snowy white on the basal area, but of a pale yellowish buff on the remaining two thirds of the surface, giving it a most

extraordinary appearance. Nevertheless, although these two compartments of the wing are suddenly and abruptly marked out by the unusual colours to which I have just called attention, the latter, when closely inspected, will be seen to be not *quite* uniform throughout; for the buff (or larger) portion is more or less dusted with a few minute blackish scales above the anal angle, which have a tendency to arrange themselves in a small transverse fascia, whilst the white (or smaller) one has generally faint traces of a certain number of very obscure buffish scales towards the costa. Its limbs, too, are of a snowy white, with the extreme tips of the feet generally of a deep black. It is at intermediate and lofty altitudes that *T. niveopicta* particularly abounds, especially, perhaps, the former; and since I met with it more than elsewhere within the cultivated districts, it at once struck me that it might perhaps be introduced. Nevertheless, as I cannot ascertain that it is known elsewhere, I have ventured to describe it as new. Throughout the grounds of Plantation this quaint little moth is universal; and when adhering to the walls and pillars of gateways, to which it might constantly be seen attached, there are few moths of so small a size which would be so readily discerned or more pleasing to the eye. From an old hedge in the kitchen-garden at Plantation I used to beat it out in prodigious numbers.

#### Genus 34. PLUTELLA, Schr.

##### *Plutella xylostella*, Hübn.

This little European moth, which is also found at Madeira, and which possesses a very wide acquired range, is tolerably abundant at St. Helena, where, in all probability, it was originally imported from higher latitudes along with its principal food-plant, the common honeysuckle (*Lonicera periclymenum*, Linn.), which grows commonly enough on many parts of the island.

#### Genus 35. ŒCOPHORA, Zell., Staint.

##### *Œcophora splendidula*, E. Woll.

Expanse 4-4½ lines. With the labial palpi reflexed, slender, somewhat divaricating, and rather longer than the head; head smooth; antennæ of moderate length, and ciliated in the male. The fore wings are of a brownish tint, with an elongate yellowish antemedian spot, which extends from the costa to the fold, between which and the apex there is a second one, which is smaller and shorter, but more distinctly defined, than



the other ; between these two costal patches there is a broad median fascia of a pale opaline metallic lustre ; parallel with the outer margin there is a brilliant fascia composed of large iridescent, reddish coppery scales. Hind wings narrow and of a glossy greyish hue. Body concolorous with the posterior wings. Antennæ and head dull testaceous.

This most brilliant little moth, which seems to reflect on its fore wings all the prismatic colours (though its chief *markings* are two yellowish costal patches and a median iridescent band between them), appears to have much the same habits as *Ecophora pictipennis* ; and it is certainly quite as rare as that species—indeed, perhaps, somewhat rarer. My few specimens, from which the above description has been drawn out, I captured on the great central ridge, in the vicinity of Diana's Peak ; but unfortunately I did not meet with it in any of its earlier stages.

*Ecophora pictipennis*, E. Woll.

Expanse  $4\frac{1}{2}$ –5 lines. With the fore wings very shiny, and chiefly of an iridescent leaden bronze, but containing two transverse golden bands, the first one of which is just before the middle of the wing, and the second (which is broader and more distinctly defined) parallel with the outer margin, but attenuated towards the anal angle. This latter fascia is bordered on either side with a dark line, as is likewise the antemedian one exteriorly. The outer margin is of a very metallic bronze, with the cilia towards the apex of the wing yellow, but towards the anal angle darker and much more metallic. Hind wings glossy grey and very pointed. Thorax and body brownish.

This pretty little moth, which appears to be somewhat scarce, is confined, so far as I am aware, to the highest districts, it having been captured on our first arrival in the island on Diana's Peak, and subsequently a little below the extreme ridge on the Cabbage-Tree Road. It seems probable that there are two broods of it in the course of the year ; for our first specimens were found in September, after which we did not find any more until about the following January ; yet in both instances they were quite fresh, as though just emerged from the chrysalis. Although searching constantly in that particular locality, we did not observe any traces of it during the interim. It is rather quick and peculiar in its flight, concealing itself again very rapidly, after being disturbed, among the long grass and vegetation which clothe the banks at the sides of the pathways.

*Ecophora pseudospretella*, Staint.

This exceedingly commonplace European *Ecophora* has all the appearance of being but an introduced species at St. Helena, where it occurs principally at intermediate elevations, about houses, and more particularly about unused and empty outhouses. The dull tawny-brown surface of its anterior wings, which are minutely dusted with darker scales and have two somewhat rounded blackish blotches (accompanied occasionally by a smaller and more streak-like additional one) on the disk, will serve sufficiently to recognize it.

## Genus 36. GLYPHIPTERYX, Hübn.

*Glyphipteryx semilunaris*, E. Woll.

Expanse  $3\frac{1}{2}$ –4 lines. With the labial palpi divaricating, somewhat curved or arched, and acute at the apex; antennæ about the same length as the body; head covered with shining imbricated scales. The fore wings are of a rich golden and iridescent bronze, with an indistinct fascia about the middle (rectangular and almost disjointed in the centre), which is much thickened (or abruptly expanded) towards the inner margin, and contains a white semilunate dash, which is the most conspicuous marking that the species possesses. The apical half of the costa is more or less ornamented with minute alternate white and black oblique dashes, the latter being somewhat the longer of the two. The space above the anal angle is usually more coarsely sprinkled with iridescent scales than the rest of the surface. Hind wings of a dark smoky leaden colour. Thorax of the same iridescent bronze as the anterior wings; body of a rather duller hue, but at the same time (unlike the hinder wings) slightly metallic.

This very interesting little *Glyphipteryx* is one of the prettiest of the St.-Helena moths, the bright iridescent reddish-bronze hue of its anterior wings, which are elegantly marked with a narrow semilunate patch of white just before the middle of their inner margin, and have the apical half of their costa ornamented with oblique abbreviated alternate darker and palish stripes or dashes, gives it a very beautiful appearance. Indeed, when the insect is at rest, the white submedian spot unites at its base with the corresponding one of the opposite wing, forming a distinct crescent-shaped marking which is very conspicuous.

*Glyphipteryx semilunaris* is exceedingly abundant at a high elevation and in many parts of the island, occurring

more especially along the great central ridge. I have met with it on the Cabbage-Tree Road, below Diana's Peak and Actæon, and in still greater profusion at Cason's, flying over the foliage, more especially of the common bramble. With its previous states, however, I am not acquainted, though constantly on the look-out for the unmistakable signs of mines on the adjacent foliage (whatever it happened it be); and I am inclined therefore to think that it may be a seed-infesting larva.

Genus 37. STAGMATOPHORA, H.-S.

*Stigmatophora trifasciata*, E. Woll.

Expanse  $3\frac{1}{2}$ —4 lines. With the labial palpi divergent, somewhat arched, and having the terminal joint longer than the second one; head covered with coarse imbricated coppery scales. The fore wings are of a rich velvety brown, with three large, conspicuous, transverse fasciæ formed of brilliant metallic scales (in which silvery or coppery tints prevail); the first fascia is at the base, the second (which is straight and much more *elevated* or gibbose) just before the middle, and the third one (which is more arcuated or internally scooped out) parallel with and near to the outer (truncated) margin. Even the dark portion of the wing between the fasciæ is dusted with a few coarse metallic and more or less coppery scales. Hind wings of a dull, smoky, blackish brown and quite free from metallic lustre. Thorax of the same dark metallic hue as the upper wings. Body smoky black, but more or less sprinkled with paler scales. Antennæ long and black, the extreme apex being of a pure white.

It was only on the highest portion of the central ridge that I obtained this extremely beautiful *Stigmatophora*; and, indeed, so remarkably circumscribed was it in its range that, although we constantly visited that particular region during our six months' residence in the island, I was never able to meet with it except on the precipitous declivities on the mountain known as Actæon. On the northern slopes it was extremely rare; but on the southern side (overlooking the great Sandy-Bay crater) I found it quite abundantly, especially along a damp and rocky pathway which leads up to the side of the ridge immediately before arriving at the place called Newfoundland; and it was out of the tangled bushes of the common bramble that I principally beat it.

There is no fear of confounding *S. trifasciata* with any thing else that has hitherto been observed at St. Helena, the three brilliantly metallic bands with which the rich coppery brown

of its anterior wings is adorned, added to the pure white apices of its long and black antennæ, giving it a character which it is impossible to mistake.

Genus 38. ENDROSIS, Hübn.

*Endrosis lacteella*, Staud.

This common European species has become naturalized in St. Helena; notwithstanding, we did not observe it there in any very great abundance.

Genus 39. COSMOPTERYX, Hübn., Staint.

*Cosmopteryx flavofusciata*, E. Woll.

Expanse  $3\frac{1}{2}$ – $4\frac{1}{2}$  lines. With the labial palpi much curved, very divergent, and pointed at the apex; head smooth and having the forehead convex. The fore wing nearly black, but ornamented with a broad and conspicuous yellow post-median fascia, which is bordered on either side with bright silvery metallic scales. Within the fascia, on either extremity, there are usually two or three minute black specks. The antemedian portion of the wing contains several white, or silvery, excessively minute, thread-like longitudinal lines; and on the costa, towards the apex, there is a small white line, as well as a similar but more oblique and larger one from the apex. Hind wings very narrow and of a blackish smoky hue. Head and thorax black, but marked with a few minute longitudinal white lines.

A most elegant little moth, easily recognized by the fact of its narrow blackish fore wings being brightly ornamented with a transverse yellow band, edged (on either side) with scales of a shiny silvery hue. It is decidedly a common species at St. Helena, particularly at intermediate altitudes, though ascending also to the central ridge. Most of my examples were captured at Plantation, where it was abundant in grassy places and amongst herbage; but I also met with it at Cleugh's Plain, which is at least 500 feet lower than Plantation.

Mr. Stainton observes of this species that it comes very near to the European *C. scribaiella*, Zell.

Genus 40. ELACHISTA, Treit., Staint.

*Elachista recurva*, E. Woll.

Expanse  $3\frac{1}{2}$ –4 lines. With the maxillary palpi nearly as long as the labial ones, but thread-like and very much con-

cealed or folded; the labial palpi are divergent, slightly curved, and scarcely attenuated towards the apex; antennæ about the same length as the anterior wings, having a distinct longish basal joint, and alike in both sexes. The fore wings are of a pale fawn hue up to about the middle, the remaining portion being of a deep velvety black, but divided from the former by a conspicuous transverse white line; and there are also a few white specks or scales towards the apex, almost forming a second, broader (though, at the same time, broken-up and fragmentary) white line. The chief characteristic, however, of this moth, is the singularly attenuated and upwardly recurved apex of the fore wings, which is turned back like a ciliated black-and-white hook. Hind wings narrow and of a blackish smoke-colour. Thorax fulvous; body somewhat paler.

This extremely curious little *Elachista* (so remarkable for the apically recurved fore wings) is exceedingly local, and appears to be a true native of St. Helena. I found it tolerably plentiful (although within a very circumscribed area) on Actæon and the high ridge which connects that mountain with Diana's Peak, particularly on the loftiest points; and, singularly enough, it does not seem to descend lower than a few dozen feet at the utmost. I could not detect it in any of its previous stages; nor was the imago particularly attached (so far as I could tell) to any particular plants; for I usually captured it flying indiscriminately over the fuchsias, cabbage trees, and ferns through which we were compelled to scramble (as best we could) along the precipitous sides and acclivities by which alone the summit of Actæon can be reached. Although free from strictly metallic tints, *Elachista recurva* is nevertheless one of the most brightly marked and beautiful of the Microlepidoptera of the island.

#### Genus 41. LITHOCOLLETIS, Zell.

##### *Lithocolletis aurifascia*.

*Lithocolletis aurifascia*, Walk., in Melliss's St. Hel. 192 (1875).

This exceedingly pretty and peculiarly marked little *Lithocolletis* is a somewhat difficult species to describe accurately, not only on account of its minute size, but likewise from its slightly variable markings, especially towards the apex, where the characteristic fasciæ are much broken up and confused. Nevertheless the first two or three alternate paler and darker oblique markings are generally quite distinct throughout the width of the wing. As this was the only member of the present genus which we met with after a most careful search,

I conclude that it must be the same species which Mr. Walker recorded from the island; and the following is his description:—"Steel-colour, silvery beneath fore wings, with a broad silver-coloured band beyond the middle." He adds that the state of the specimen recorded will not allow a more minute description.

*Lithocolletis aurifascia* is one of the rarest of the St.-Helena Tineidæ. Indeed we only met with it sparingly in one locality, which was at Thompson's Wood, where we found it occasionally concealed under the loose stones of a wall encircling probably the oldest gumwood trees in the island, or still more rarely flying over the foliage of the trees themselves, the leaves of the latter being abundantly mined by the larvæ.

#### Genus 42. CEMIOSTOMA, Zell.

##### *Cemiostoma auronivea.*

*Cemiostoma auronivea*, Walk., in Melliss's St. Hel. 193 (1875).

This is one of the very few of the native moths, which have as yet been discovered, that we did not meet with—indeed the only already described member of the Tineidæ from the island that we did not succeed in obtaining. Although I possess no evidence to point to such a conclusion, still I cannot help thinking that the present species may be found in those regions which are characterized by the "scrubwood" (*Aster glutinosus*, Roxb.), one of the aboriginal arborescent Compositæ which we had no opportunity of investigating, and which (although once so abundant that large tracts of a comparatively low altitude towards the coast were literally covered with it) is becoming year by year more scarce. Nevertheless I only offer this as a probable conjecture, and partly to account for our not having detected any trace of it amongst the other Compositæ which we were always so constantly searching.

#### Fam. VIII. Pterophoridæ.

#### Genus 43. ADACTYLA, Curt.

##### *Adactyla sanctæ helenæ*, E. Woll.

Expanse 9–9½ lines. With the fore wings not cleft or divided, and of a pale greyish cinereous, the costa and inner margin being rather paler, which gives the central area (which is large, elongate, and wedge-shaped) a somewhat darker appearance. Hind wings greyish cinereous, being

uniform in tint throughout, except the inner margin, which is slightly paler.

This species, so far as I could ascertain, appears to be exceedingly rare; and I only met with three examples of it—one of which I captured at Plantation, the other two being found in a very remote and inaccessible part of the island, namely amongst some gumwood trees between Peak Dale and Lufkins.

#### Genus 44. *PLATYPTILUS*, Hübn.

##### *Platyptilus subnotatus*.

*Platyptilus subnotatus*, Walk., in Melliss's *St. Hel.* 193 (1875).

During our sojourn in *St. Helena* we did not meet with this scarce little moth.

Mr. Walker's description was taken from a unique example which was found in the island by Mr. Melliss at the *Hermitage*.

#### Genus 45. *OXYPTILUS*, Zell.

##### *Oxyptilus rutilans*, Walk.

The present *Oxyptilus* seems to have been first described by Mr. Walker (who regarded it as a *Pterophorus*) in 1863, from examples which had been received from Natal; and as it is especially throughout the cultivated districts that it occurs in *St. Helena*, there seems every reason to conclude that it may have been imported originally into the island, perhaps amongst the quantity of plants which must from time to time have been introduced from South Africa. Although principally abounding at intermediate altitudes, such as Plantation, Oakbank, Cleugh's Plain, and elsewhere, it ascends likewise, though more sparingly, to the lower parts of the great central ridge, being exceedingly common at West Lodge. But around Plantation it may be said often to swarm; and I have frequently observed several examples at the same time on a single flower at rest, with the fore wings spread horizontally so as to conceal the under ones (after the manner of the genus), and, moreover, so sluggish that one might pick them easily from the flowers and grass on which they happened to be settled.

XLVIII.—*On the Architecture and Habits of the Cutting Ant of Texas (Atta fervens).* By the Rev. H. C. McCook\*.

THE observations of which the following is an abstract were made during an encampment, for purposes of study, south of Austin, Texas.

1. *Exterior Architecture.*—Two forms were noted. The first, seen at a point distinguished as Camp Wright, was that of a mound, 21 feet long and about 4 feet high, which had been accumulated around the trunk of a double live-oak tree (*Quercus virens*) which stood on the side of a road. The second form was located at a point distinguished as Camp Jeanes. It was on a high, flat, upland prairie, and was a bed of denuded earth, in the midst of the grassy open, 8 feet 9 inches long, and 7 feet, more or less, across. Over this denuded surface were scattered between twenty and thirty circular, semicircular, and S-shaped elevations of fresh earth pellets. The circular moundlets had the appearance of an American spittoon, the resemblance being stronger by reason of a round open entrance or gallery-door in the centre. All had apparently been naturally formed by the gradual accumulation of the pellets of sandy soil, as they were brought out and dumped upon the circumference of the heap. The moundlets were massed at the base, and gradually sloped off towards the top. They were from 3 to 4 inches high. This "bed" (as the natives call it) was quite free from grass, as was also the mound at Camp Wright. Another nest of the same character was found at Camp Jeanes; this was situated in a grove, but was fully exposed to the sun. A fourth nest was found about a mile distant from this spot, of the same character. This is, therefore, probably the normal form of the external architecture of the formicary, the mound at Camp Wright being probably formed by accumulations around the tree, caused by the bordering road, which restricted the limits of the gates, and so threw the separate moundlets back upon each other.

2. *Gates or Doors.*—His first view of the mound at Camp Wright led Mr. McCook to fear that he had made a mistake, and pitched his camp near an abandoned nest. There was not a sign of life. The mound was covered over with earthen knobs or warts of various sizes; but the action of a recent shower upon the black soil gave the hill the appearance of an old one. Here and there were scattered over the surface small

\* From the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' Feb. 11, 1879.



irregular heaps of dry leaves, bits of leaves, and twigs. Otherwise the mound seemed lifeless, deserted. As the evening began to fall the scene was wholly changed. Hosts of ants of various sizes and in countless numbers were hurrying out of open gates into the neighbouring jungle; and two long double columns were stretched from the bottom to the top of the large overhanging live-oak. The ants in the descending columns all carried above their heads portions of green leaves, which waved to and fro and glanced in the lantern-light, giving to the moving column a weird look as it moved along. It seemed like a procession of Liliputian Sabbath-school children bearing aloft their banners. It is this habit which has given this insect in some quarters the popular name of the "Parasol Ant." It is also called in Texas the "Brazilian Ant," but is quite universally known as the "Cutting Ant," certainly a most appropriate name.

The opening and closing of the gates occurs before and after every exit from the nest. The process is a long, careful, and complicated one, and was studied fully. Towards evening the gates are gradually thrown open, and so remain until morning, when they are gradually closed, the process continuing in some cases until 10.30 A.M. The closing is done by carrying into the gallery bits of dry twigs of various lengths, some as long as  $1\frac{1}{2}$  inch, dry leaves, and other refuse. A number of closed gates were opened to note the depth to which this refuse was placed. It varied from half an inch to an inch and a half from the surface. In some cases the gallery had been sealed up with sand pellets *below* the refuse. The galleries quite often slant inward from the gate, and at as great an angle as  $45^\circ$ . They also sometimes divide a short distance from the surface. These conformations allow more readily the process of closing. In carrying in the refuse the larger forms of the ant are engaged; as the hole gradually closes, only the very smallest appear. The last touches are carefully and delicately made by the minims, who in small squads fill in the remaining interstices with minute grains of sand; and finally the last labourer steals in behind some bit of leaf, and the gate is closed. It then presents to the casual observer the appearance above described of a little heap of dry chips accidentally accumulated upon the mound. The galleries at Camp Jeanes were closed in the same manner.

When the gates are opened at dusk this process is reversed. The minims first appear, deporting from the heap particles of sand. Larger forms follow, carrying away bits of refuse, which they drop a couple of inches, more or less, from the gate. This is a slow process; and apparently little is accom-

plished for a long time; but evidently the whole mass of refuse is thus loosened. Then comes the final burst, with soldiers, majors, and minors in the lead, who rush out bearing up before them the rubbish, which flies here and there, and in a few moments is cleared away from the gallery, and spread around the margin of the gate. These chips are evidently gathered together for this purpose and are among the "treasures" of the ants, being kept near by for this use. The pieces were easily identified as being thus used several days in succession.

The above observation points out at least the use found for the extremely small forms peculiar to this species. At least ten distinct castes (forms or sizes) were exhibited to the Academy. They vary as follows, the measurements being in sixteenths of an inch, viz. ♀, 14; ♂, 11; soldier 7; worker major 6, minor 5; and the remaining castes in the proportion  $3\frac{1}{2}$ , 3,  $2\frac{1}{2}$ , 2,  $1\frac{1}{2}$ , 1. A more careful comparison may possibly reduce this series one or two; but the result as above will probably stand.

The gates first opened are the first closed, and those last opened are the last closed.

3. *Leaf-cutting Habit.*—The whole process of cutting and carrying leaves from trees and shrubs was observed at Camp Wright and at a vegetable-garden near Austin. In order better to see the mode of cutting, small tender branches of live-oak were thrust into the mound near the gates. These were soon covered with ants; and as the lantern could thus be used conveniently, the operations of the cutters were completely in view. The cutter grasps the leaf with outspread feet, and makes an incision at the edge by a scissor-like motion of her sickle-shaped toothed mandibles. She gradually revolves, steadily cutting as she does so, her mandibles thus describing a circle, or the greater portion thereof. The feet turn with the head. The cut is a clean one, quite through the leaf. The cutter will sometimes drop with the excision to the ground, sometimes retire when the section has dropped, sometimes (it is inferred) seize the section and carry it down the tree. A division of labour was apparent. At the foot of one tree was a pile of cut leaves, to which clippings were continually being added by droppings from above. Carriers on the ground took these up and bore them to the nest. The loading of the cuttings is thus: the piece is seized by the curved mandibles; the head is elevated; the piece is thrown back by a quick motion, seeming to be lodged on the head within the deep furrow that runs along the entire median line of the head (except the clypeus), and supported between pro-

ninent spines on the edge of this furrow and on the prothorax. The furrow and spines thus appear to serve a very useful end. The cutting and carrying were not done (so far as noted) by the smaller castes. The soldiers rarely engaged in this work, but were seen to precede the excursion columns as they moved out and up the tree, and afterward to return, as though engaged as scouts or pioneers.

The principal leaves gathered at Camp Wright were those of the live-oak. The young saplings in the neighbourhood of the mound were in great part or entirely defoliated. The great tree above was in parts stripped to the very top; so also was some wild vine unknown to the author. In beginning work, the cutters seem to aim first at the topmost leaves. A nest on the grounds of an intelligent nurseryman and gardener near Austin was visited; and from the proprietor many facts were learned. Ants were here seen at work late in the afternoon. They had come up through the garden from the formicary, 300 feet distant. They prefer trees with a smooth leaf; are severe upon grapes, peaches, the China tree, radishes, take celery, beets, young corn and wheat, plum, pomegranate, honeysuckle, cape-jessamine, crape myrtle, althæa. They do not like lettuce, will not take the paper mulberry, nor figs and cedar, except the bud-ends in the scant days of winter. They love sugar, grain, and tobacco! This proprietor assured Mr. McCook that the ants made foraging excursions into his house, entered his desk-drawers, and carried away a portion of his chewing-tobacco before he discovered the robbery. He had to be very careful thereafter where he deposited the delectable weed. Mr. McCook saw at another plantation an immense column engaged in plundering a granary of wheat, which was being carried away to the nest.

4. *Interior Architecture.*—The use of this leaf material, in part at least, was unfolded when the work of excavation began. Two trenches were made, one 10 feet long, 5 feet deep, and a second at right angles to it and wide enough to allow free entrance and study. The number of insects that swarmed to the defence of their home is simply amazing. They were, however, not so difficult to manage as sometimes when disturbed at their night work, as the swift use of the spade by the assistants and the general convulsion of their emmet world quite dazed most of them. However, when the speaker himself entered the trench to work with trowel, knife, rule, &c. the ants rallied, and attacked so fiercely that the men were compelled to brush them off. The wound inflicted by them was sharp, but nothing to compare with the severe sting of the agricultural ant. The interior of the formicary

may be briefly described as an irregular arrangement of caverns communicating with the surface and with each other by tubular galleries. These caverns or pockets were of various sizes, 2 feet 10 inches long and less, and 12 inches deep and 8 inches high and less. Within these chambers were masses of a very light delicate leaf-paper wrought into what may properly be called "combs." Some of the masses were in a single hemisphere, filling the central part of the cave; others were arranged in columnar masses  $2\frac{1}{2}$  inches high, in contact along the floor. Some of these columns hung, like a rude honeycomb or wasp-nest, from roots which interlaced the chamber. The material was in some cases of a grey tint, in others of a leaf-brown. It was all evidently composed of the fibre of leaves which had been reduced to this form within the nest, probably by the joint action of the mandibles and salivary glands. On examination the masses proved to be composed of cells of various sizes, irregular in shape, but maintaining pretty constantly the hexagon. Some of the cells were half an inch in diameter, many one fourth of an inch, most of them one eighth of an inch, and quite minute. Large circular openings ran into the heart of the mass. Some of the cells were one inch deep; they usually narrowed into a funnel-like cylinder. Ants in great number, chiefly of the small castes, were found within these cells. In the first large cave opened were also great numbers of larvæ. The material was so fragile that it crumbled under even delicate handling; but a few specimens of parts of the ant-comb, with entire cells, were preserved and exhibited. Reference was made to the late Mr. Belt's opinion that these leaf-paper masses were used as a sort of "mushroom garden," a minute fungus being purposely cultivated upon them, which the ants used for food. Mr. McCook's specimens, when submitted to the microscope, did indeed show the appearance of such growth, which, however, is only what might have been expected under such environment. The belief was expressed that the ants fed upon the juices of the leaves. But (if investigations in progress should succeed) it was hoped that the subject of the true food of the cutting ant would be hereafter solved.

5. *Tunnelled Tracks*.—The ability of these emmet masons to excavate vast halls and subterranean avenues is remarkable. Several holes in the vicinity of Austin were visited, out of which "beds" or nests of ants had been dug, by an old man who used to follow the business of ant-killing. These holes were nearly as large as the cellar for a small house. One such excavation, about three miles from Austin, was 12 feet in diameter and 15 feet deep. At the lowest

point had been formed the main cavity, quite as large as a flour-barrel, in which were found many winged insects, males and females, and quantities of larvæ. This nest was situated 669 feet from a tree that stood in the front yard of a house and which the ants had stripped. Mr. McCook took the range of the underground way traversed by the ants to reach this point, from which an accurate route was constructed and exhibited. The course varied very little from a direct line. Two branch tunnels were made to a peach-orchard 120 feet distant. Reference was made to a paper by Dr. Lincecum in the Proceedings of the Academy, which gave an account of the tunnelling of a stream by these ants. There is nothing improbable in this, as the tunnel above referred to went down in places as deep as 6 feet, the average, however, being about 18 inches. At the exit hole the tunnel was 2 feet from the surface. The digging operations were described, in which the small forms alone seemed to take part. The large forms would therefore appear to assist in opening the gates, make the excursions, and do the cutting; the small forms to do the digging, or, at least, the carrying out of excavated earth; while the minimis, or least forms, assist in opening and closing doors and keeping charge of the larvæ. The minimis are quite ferocious in attack, and gallantly support the large-headed soldiers.

6. *Origin of Castes by Evolution.*—This wide differentiation of form among the insects of one species and nest is one of the most serious special difficulties which the English evolution hypothesis has encountered. Mr. Darwin, with that candour which always wins him the respect and confidence of all sincere-minded opponents, fully admits this, and endeavours at some length to meet it. The knot of the difficulty lies in the fact that the worker castes are sterile, and are produced from eggs laid at different periods by the female. Supposing, therefore, that profitable or other modifications had occurred in the workers, how, on the principle of natural selection and hereditary transmission, could these operate upon such workers? All modifications of structure must be wrought and transmitted through the female alone, affecting thus the worker-life enwrapped in the egg. But it appears quite impossible to comprehend how any structural modifications could act from the worker upon the queen in order to thus react upon a succeeding generation of workers. The illustrations which Mr. Darwin cites\*, the variation of domestic cattle by interbreeding, and M. Verlot's experiments

\* 'Origin of Species,' p. 227.

with certain double annual flowers, if admitted to throw some light upon the inquiry, yet require an efficient superintending human intelligence, which cannot be supposed to have its analogue in the perpetuation and development of ant forms, unless, indeed, we may believe that the evolution hypothesis implies and requires the interposition of a Personal Intelligence infinitely superior to that of both ant and man.

The precise sense in which the workers may be called "sterile" admits of some question. Sir John Lubbock has recently shown that parthenogenetic eggs are sometimes produced by worker-ants in artificial formicaries, from which males alone are hatched. This is according to the analogy of other Hymenoptera, as, for example, bees and wasps. Here, then, there may be possible escape from Mr. Darwin's difficulty more satisfactory than that which he himself suggests; for it is conceivable that an opportunity might thus be opened for the transmission of a profitable variation which might arise in a worker. Still the difficulty appears impassable. One must suppose the growth and maturity of one such parthenogenetic male, produced from a worker with such useful modification, to have been contemporaneous with the maturity of the females of a "swarm;" this male, together with the males hatched directly from eggs laid by the queen, shall have gone forth, as is the habit of ants, in the regular marriage flight, or "swarming;" and therein shall have met a virgin queen. As the modification thus supposed to be transmitted must, on the hypothesis, be very minute, it could have been saved from obliteration only by supposing it fortified by the recurrence of other contingencies of like character in succeeding generations. Mr. McCook therefore concluded that the development by natural selection, according to Mr. Darwin's hypothesis, of so many and widely varied forms as exist in the cutting ant, requires a series of contingencies so multiplied and remote as to forbid a reasonable hope of its probable occurrence, even with the additional favouring circumstance of occasional males parthenogenetically produced.

He added that some of the points which Mr. Darwin had raised as to the structure of the driver ant of Africa were being carefully examined by him in the case of *Atta fervens*, with the best microscopic helps at his command. Thus far, however, after a quite careful examination, nothing that can suggest the idea of an interblending of the castes by rudimentary forms had been discovered. The lowest castes of minims, in all specimens examined with special reference to

the mouth-organs and eyes, showed the same structure, in equal definiteness and perfection, as the larger castes. Allusion was also made to the ravages of these destructive insects; and some of the modes for exterminating them were explained.

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XLIX.—*On the Geological Distribution of the Rhabdophora.*  
By CHARLES LAPWORTH, F.G.S.

Part I. HISTORICAL.

[Continued from p. 257.]

(d) *Recent Research.*

GEOLOGICAL.—It has been already shown that those geologists whose leanings were mainly palæontological accepted without question the reference of all prolific Graptolite-bearing strata to the general horizon of the Llandeilo formation, and endeavoured to escape from the numerous difficulties in which they consequently found themselves involved by appeals to the recognized rule of the restriction of certain fossil groups to special sediments, by references to the phenomenon of migration, by the adoption of the theory of "Colonies," and the like. But there were, in addition, a few influential geologists who looked upon geology almost wholly from the physical side, and who naturally relied only upon such palæontological testimony as distinctly coincided with the inferences they drew from the stratigraphical evidences. These viewed all attempts to correlate strata of disconnected areas by means of the Rhabdophora with the gravest suspicion, passing over with a careless indifference the clearest indications of a natural succession afforded by those entered upon their fossil lists. When, as occasionally happened, the palæontological testimony afforded by these fossils conflicted with that drawn from the apparent physical evidences, no matter how scanty or ambiguous, they at once set it aside with undisguised contempt.

However mortifying it may be to the graptolithologist to admit the fact, it cannot be denied that this course was at all events quite as reasonable as the habit of the over-credulous majority. The cautious field-geologist, on consulting the works of those who had made these fossils the subjects of special study, learnt at once that, according to the best authorities, many of the most characteristic Llandeilo Graptolites of Britain occurred in America in the very highest beds of the

representative of the Bala group, that the Upper Llandeilo forms of Scotland predominated in the highest Caradoc rocks of Westmoreland, and that in Bohemia they passed up unaltered far into the rocks of the Third Fauna. In the face of such startling discoveries, he could not fail to reach the conclusion that either the enormously extended vertical range of the various Graptolitic species was out of all proportion to that of the species of the Brachiopoda and Crustacea, or else that our knowledge of the fossils in question was so defective that no reliance could be placed upon it. In either case the result was the same: the Graptolites were clearly valueless as exponents of the geological age of their containing beds.

*The Moffat Series.*—The special point upon which former theories of the geological range of the British Graptolites may be said to have turned was the distinct reference, by Sedgwick and Murchison, of the richly graptolitic Moffat series to a systematic place inferior to that of the Bala Limestone of North Wales. It is the complete disproof of this erroneous view that has had the most important influence in determining the current of recent research in this direction, as it has necessitated a searching review of the supposed consentaneous evidences upon which former theories were founded, with the result of effecting a marked revolution in many of our previous opinions.

To the hasty investigator these remarkable Moffat rocks appear to be merely a few local bands of black graptolitic shales imbedded in a vast thickness of barren greywackès. Their small vertical extent, and their peculiar physical relations, naturally led all their original investigators to consider them as of very insignificant importance. I have shown elsewhere\*, however, that these Moffat beds (instead of forming a single deposit of subordinate geological value, and affording a heterogeneous fauna subject to great local variations, as generally believed) actually embrace three successive formations palæontologically distinct, and of an importance approximating to that of the so-called formations of Siluria. Not only has each of these three formations everywhere a collective fauna peculiarly its own, but the majority of the graptolitic species that characterize it have a very restricted range within it. In the same way it has been made clear that, instead of belonging wholly to the Upper Llandeilo, only a fraction of the Moffat series can, with doubt, be assigned to that sub-formation, its two higher formations representing most distinctly the Caradoc and the Lower Llandovery.

\* Quart. Journ. Geol. Soc. vol. xxxiv. p. 240, &c.



*Girvan Rocks*.—The Girvan district, whence Salter procured the few Caradoc Graptolites enumerated upon his lists, has also been partially worked out by myself. The general succession will be given in the sequel. Its strata, instead of being wholly of Caradoc age, have been found to include representatives of the Lower and Upper Caradoc, the Lower and Upper Llandovery, and the Taranon. The asserted intermingling, in this area, of species elsewhere peculiar to distinct formations has also been ascertained to be purely mythical. Its Graptolites, which are those of the Moffat and Gala groups, correspond precisely in their vertical range with the same species in the eastern districts.

*The Coniston Mudstones*.—The mistaken views of the geological age of the graptoliferous beds of Westmoreland known as the Coniston Mudstones, or Skellgill shales, were long almost equally effective with those already noticed in delaying a true estimate of the vertical range of the British *Rhabdophora*. By Professors Harkness and Nicholson\*, as we have seen, they were at first unhesitatingly assigned to the Bala formation. Professor Sedgwick placed them sometimes in the Bala†, sometimes at the base of the true Silurian. Professor Hughes and Mr. Aveline‡, who have most fully investigated their physical relations, parallel them with the Taranon shales of North Wales. By myself they have long been regarded as of Lower Llandovery age—a view first published by Dr. Nicholson§ and myself in 1875, and subsequently adopted by Professor Harkness|| and Dr. H. Hicks¶. Mr. Marr, the latest student of these beds, agrees with the officers of the Survey in referring them to the Upper Mayhill\*\*. Their Llandovery-Mayhill age may thus be now regarded as practically settled.

*Arenig and Llandeilo*.—The Arenig and Llandeilo rocks of the neighbourhood of St. David's were carefully studied by

\* On page 248, by an unaccountable oversight, Professor Harkness and Sir R. Murchison are together credited with the honour of having originally worked out the general distribution of the fossils in the Lower Palæozoic rocks of the north of England. It is almost needless to point out that the latter name should be that of Professor H. A. Nicholson, whose many accurate and beautiful memoirs upon this subject have (especially for the graptolithologist) made the Lake district classic ground.

† 'Palæozoic Rocks and Fossils,' Introduction, p. xxi; and Quart. Journ. Geol. Soc. vol. i. p. 442.

‡ Geol. Surv. England and Wales, Explan. Sheet 98 N.E. p. 3, &c.

§ Report British Association, 1875.

|| Quart. Journ. Geol. Soc. vol. xxxiii. p. 478.

¶ Geological Magazine, 1876, p. 336, &c.

\*\* Quart. Journ. Geol. Soc. vol. xxxiv. p. 879.

Dr. Hicks in 1874\*, and separated for the first time into subordinate groups upon the combined physical and palæontological evidences. Their included Graptolites were subsequently made the subject of a supplementary memoir† by Mr. Hopkinson and myself. Here, for the first time, do we find proofs of the Arenig age of the more typical Skiddaw Slate of the north of England; the distinctness of the Llandeilo graptolitic fauna as compared with that of the true Arenig is rendered tolerably clear; and some progress is made in fixing the peculiar species of its subdivisions.

The Graptolite-bearing rocks of Conway, Tremadoc, Shelve, Meadowtown, Ludlow, Builth, &c. have been partially examined either by Mr. Hopkinson or myself; but our knowledge of the range of the Graptolithina in Wales is still miserably defective.

*Ireland.*—The rich Graptolite fauna of the Lower Palæozoic rocks of County Down has been most carefully worked out by Mr. William Swanston, F.G.S., and illustrated with great care and completeness‡.

*Extra-British Rocks.*—The new facts brought to light in Thuringia, Brittany, New York, and the Western Territories will be referred to in their proper place, when the distribution of the extra-British species falls to be discussed.

By far the more important of our new data in this respect are owing to the industry of the Scandinavian palæontologists. As early as 1874 Dr. Tornquist§ marked the presence of many British Graptolites of the Coniston type in the rocks of Dalaruc, but, relying upon the documents published up to that date, erroneously paralleled their containing beds with the English Caradoc. M. G. Linnarsson has recently made the vertical distribution of the Graptolites in the Swedish rocks the object of a persevering and most successful study. He has already enriched the literature of the subject with several important memoirs||; and the material he has collected goes far to demonstrate the general identity in range of the forms common to Britain and Scandinavia.

No exhaustive summary of these recent discoveries has hitherto appeared; but several palæontologists have given distinct indications of an appreciation of the value of these new data and of the results to which they converge.

\* Quart. Journ. Geol. Soc. vol. xxxi. p. 167.

† Quart. Journ. Geol. Soc. vol. xxxi. p. 631.

‡ Proceedings Belfast Nat. Field Club, Appendix, 1876-77.

§ Öfversigt af K. Vetenskaps-Ak. Förhandlingar, Stockholm, 1874, no. 4, p. 26.

|| Geol. Mag. 1876, p. 241; *ibid.* 1878, p. 278, &c. &c.

In a most important note appended to M. G. Linnarsson's paper on the "Vertical Range of the chief Graptolitic Types of Sweden"\* , Professor H. A. Nicholson shows that at least four of the successive life-groups of *Rhabdophora* occurring in Sweden are now recognizable as characterizing corresponding formations in Britain.

In his paper on the "Graptolitic Schist of Kongslena" †, M. G. Linnarsson makes a successful comparison of the faunas of the *Lobiferus*- and *Retiolites*-beds of Sweden with those of their equivalents in Britain and Bohemia, and points out the vital bearing of these new facts upon the doctrine of "Colonies."

The geological distribution of the more important genera of the *Rhabdophora* in the five main zones of graptolitic life recognized in the most recent memoirs will be found ably summarized by Dr. Zittel in his recently published 'Manual of Palæontology.'

PALÆONTOLOGICAL.—The palæontological difficulties are also slowly disappearing. In my paper on the "Improved Classification of the *Rhabdophora*" ‡, the majority of the known genera were for the first time united into families, in the order of what appeared to be their natural relationships. The union of *Dicellograptus*, Hopk., and *Dicranograptus*, Hall, in the single family of the *Dicranograptidæ*, and the differentiation of the well-marked families of the *Leptograptidæ* (*Nemagraptidæ*), *Dichograptidæ*, and *Monograptidæ* freed us from much of the prevalent confusion, and served to indicate the special lines along which we might expect the more important generic distinctions. The provisional arrangement of the diprionidian forms served also to direct special attention to many structural points of paramount value in the discrimination of homomorphous but distinct species.

The detailed study of the *Rhabdophora* of the prolific South-Scottish rocks has led to the detection of many fresh criteria in the separation of allied species, and has enabled us to correct at a glance the previously inevitably erroneous specific identifications made by our predecessors. The discovery of the distinct invariability of many characters formerly regarded as varietal, in corresponding forms obtained from England, Ireland, and the continent of Europe, has given us a clearer insight into the relative value of specific characters, and has added largely to our ideas of the abundance and variety of the graptolitic species. The careful examination of authenticated examples of the species described by early authors has not

\* Geol. Mag. 1876, p. 245. † Ibid. 1878, p. 278. ‡ Ibid. 1873, p. 555.

only demonstrated the erroneousess of many previous identifications, but has resulted in freeing many forms hitherto undescribed, and thus greatly restricting the supposed extended geological range of the earlier and less perfectly described species.

(e) *Classification.*

*Classification of the Rhabdophora.*—Since the publication of the memoir last referred to, many new facts bearing upon the inter-relationships of these fossils have been detected, but none of sufficient moment to justify us in modifying to any material extent the scheme then proposed. It was pointed out at that time that our available evidence was sufficient to lead us to hope that the monoprionidian forms would be found to be grouped according to their natural affinities. This opinion is distinctly supported by our new data. The arrangement of the diprionidian or petaloid genera, on the other hand, was confessedly temporary and provisional. Here subsequent discoveries show most distinctly that the view then advocated of the possible separation of these forms into two main natural groups, by characters founded upon the presence or absence of the sicula and the single or double character of the cœnosarcal canal, is no longer tenable. This is demonstrated by the fact that the sicula has been detected in the Lasiograptidæ; while several typical Diplograptidæ have been found to possess a single cœnosarcal canal, as in *Retiolites* proper.

The following scheme will be adhered to in the present paper:—

*Table of the Families and Genera of the Rhabdophora.*

- Fam. I. MONOGRAPTIDÆ. Gen.: *Monograptus*, Gein.; *Cyrtograptus*, Carr.; *Rastrites*, Barr.
- Fam. II. LEPTOGRAPTIDÆ. Gen.: *Leptograptus*, Lapw.; *Pleurograptus*, Nich.; *Cœnograptus*, Hall; *Azygograptus*, Nich. & Lapw.; *Amphigraptus*, Lapw.
- Fam. III. DICHOGAPTIDÆ. Gen.: *Didymograptus*, M'Coy; *Tetragraptus*, Salt.; *Dichograptus*, Salt.; *Loganograptus*, Hall; *Temnograptus*, Nich.; *Schizograptus*, Nich.; *Ctenograptus*, Nich.; *Clematograptus*, Hopk.; &c. &c.
- Fam. IV. DICRANOGRAPTIDÆ. Gen.: *Dicranograptus*, Hall; *Dicellograptus*, Hopk.
- Fam. V. DIPLOGRAPTIDÆ. Gen.: *Diplograptus*, M'Coy; *Climacograptus*, Hall; *Cephalograptus*, Hopk.
- Fam. VI. LASIOGRAPTIDÆ. Gen.: *Lasiograptus*, Lapw.; *Glossograptus*, Emmons; *Retiograptus*, Hall; &c.
- Fam. VII. RETIOLIIDÆ. Gen.: *Retiolites*, Barr.; *Clathrograptus*, Lapw.; *Trigonograptus*, Hall; &c.
- Fam. VIII. PHYLLOGRAPTIDÆ. Gen.: *Phyllograptus*, Hall.



TABLE SHOWING THE CLASSIFICATION AND CORRELATION OF THE GRAPTOLITE-BEARING ROCKS OF EUROPE AND AMERICA.

	Wales.	West of England.	Lake District.	South Scotland.		Ireland.	Norway.	Sweden.	Bohemia.	France.	North America.
SILURIAN SYSTEM.	Upper Division (Downtonian).	(c) Downton Sandstone, (b) Bone Beds, (a) Lower Ludlow.		Kendal Rocks.		Dingle Beds.	Sandstone.	Gotland Sandstone.	H. G. F.		Lower Helderberg Series.
	Middle Division (Salopian).	(d) Aymestry Limestone, (c) Lower Ludlow, (b) Wenlock Rocks, (a) Woolhope Beds.		(c) Bannisdale Beds, (b) Coniston Grits, (a) Coniston Flags.		(b) Craghmarlin Beds, (a) Ferritors' Cove Beds.	8. 7. 6.	Gotland Marl and Limestone.	Et <sup>2</sup> .		Guelph and Niagara Series.
	Lower Division (Valentian).	(c) Tarannon Shales, (b) Mayhill Sandstone, (a) Lower Llandovery.	(c) Purple Shale and (b) Pentamerus-Beds of Shropshire.	Conistow Mudstones.	(b) Hawick and Gala Rocks, (a) Birkhill Shales.	Upper Girvan or Penkill Group.	Upper Pomeroy and Coalpit-Bay Beds.	5 b. 5 a.	(d) Leptaena-Limestone, (c) Retiolites-Beds, (b) Lobiferus-Schist, (a) Brachiopod-Schist.	Et <sup>1</sup> and Colonies.	(b) Ampelite-Limestone, (a) Ampelite-Schists.
ORDOVICIAN SYSTEM.	Upper Division (Caradoc).	Hirant and Bala Series of North Wales.	Caradoc Sandstone of Shropshire.	(b) Conistow Limestone, (a) Duftou Shales.	(b) Hartfell Shales, (a) Glenkiln Shales.	(b) Lower Girvan, (a) Craighead Limestone.	(c) Lower Pomeroy, (b) Carnalea, and (a) Ballygrot Beds.	Trinucleus-Shales.	D <sup>1</sup> .	Schiste ardois.	(d) Lorraine Shales, (c) Utica Slate, (b) Trenton Limestone, (a) Chazy.
	Middle Division (Llandeilo).	Llandeilo Series of Builth and Aberiddy.	Llandeilo Flags of Meadowtown.	Borrowdale Volcanic Rocks.				Middle Graptolite Schists and Chasmops-Limestone.	D <sup>1</sup> to D <sup>2</sup> .		Quebec and Calcareous Groups.
	Lower Division (Arenig).	(b) Arenig Series of St. Davids, (a) Upper Tremadoc.	(b) Arenig Rocks of Shelve, (a) Upper Stones.	(b) Upper Skiddaw, (a) Lower Skiddaw Slates.				(c) Orthoceras-Limestone, (b) Phyllograptus-Schist, (a) Ceratopyge-Limestone.	3 a. 2 b.		
CAMBRIAN SYSTEM.	Upper Division (Olenidian).	(d) Lower Tremadoc, (c) Dolgelly Group, (b) Ffestiniog Group, (a) Maentwrog Group.	(b) Shineton Shales, (a) Olenus-Shales of Malverna.					(b) Dictyonema-Schists, (a) Olenus-Schists.			Potsdam Group.

It will also be convenient to regard (with Professor Zittel) the first four families of the Rhabdophora as forming the artificial division of the *Monoprionida*, and the last four as constituting the similar division of the *Diprionida*.

*Classification of the Lower Palæozoic Rocks.*—The systems at present assigned to the Palæozoic age fall into two main groups—an older group, including the Cambrian, Ordovician, and Silurian systems, and a younger group, including the Devonian, Carboniferous, and Permian. The period during which the former were deposited may be denominated the *Lower Palæozoic or Proterozoic Age*; that in which the latter were laid down may be called the *Upper Palæozoic or Deuterozoic*. Broadly speaking, the Proterozoic rocks include all the sedimentary formations to which the name *Silurian* has at any time been applied by the most extreme adherents of the Murchisonian party in geology. With this extended interpretation the well-known generalization of Murchison that the Graptolites (Rhabdophora) are restricted to the Silurian system (Proterozoic period) still holds good. With one doubtful exception no Rhabdophora have hitherto been recorded from Deuterozoic rocks; their highest known limit in Britain lies near the horizon of the Aymestry Limestone. Until very recently no British species had been recognized in rocks of earlier date than the Lower Arenig of Hicks; but the interesting researches of Dr. C. Callaway show that Rhabdophora are certainly present in the highest zones of the Shropshire Cambrian. The strata, therefore, that will necessarily be referred to in this connexion are comprehended between the base of the Upper Cambrian and the summit of the Silurian. Our accumulated knowledge of the sequence and fossils of the rocks in question is as yet too scanty to enable geologists to attempt more than their provisional correlation. The arrangement of the known Graptolite-bearing rocks which appears to myself most fully to harmonize our present evidences is that given in the accompanying Table.

#### MISCELLANEOUS.

*The Cochineals of the Elm: a new Genus, Ritsemia pupifera.*

By M. LICHTENSTEIN.

THE discovery of a new species of cochineal living on the elm would not be a proper subject for communication to the Academy of Sciences, if the curious form of this new comer and the peculiar circumstances of its development did not render it a very strongly

marked distinct genus, forming the transition between the Coccidæ and the Phylloxerians, with which I have already frequently occupied the Academy. This is what I have been able to observe.

In the months of August and September, I saw, running about upon the trunk of a young elm (*Ulmus campestris*), some small red plant-lice 0·45 millim. in length, of an elongate-oval form, with six-jointed antennæ. These insects attach themselves in the crevices of the bark, and then gradually lose their Aphis-like form, to acquire that of a small flattened reniform gall or vesicle, as is the case in many Coccidæ. At this period the present form approaches the genera *Nidularia*, Targioni, and *Gossyparia*, Sign., inasmuch as it exudes a cottony mass underneath it, in which it deposits ovoid bodies which are not true ova, but analogous to what I have denominated *pupæ* in the Phylloxerians. In fact, in March these little ovoid bodies, which are of various dimensions, acquire traces of segmentation, which become more and more visible; and in April we see small red insects, which are the males, issue from the cottony mass.

Their antennæ, moniliform and of nine joints, are like those of the Coccidæ, especially those of *Gossyparia ulmi*, Sign. ("le Pro-gallinsecte de l'Orme" of Réaumur), which, however, have one joint more (ten); but in other respects the form is by no means that of the male Coccidæ, but that of the Phylloxerians. The head, thorax, and abdomen are united as in the sexual individuals of *Phylloxera* (or, I might add, of all the Pemphigians), and not separated as in the Coccidæ. Lastly, the little animal is completely apterous, destitute of a rostrum, and provided with a projecting penis; its length is 0·40 millim.

Here I cannot refrain from indicating a very curious fact in the males of the Coccidæ of the elm. Four different genera live upon this tree. Two of them, *Lecanium* and *Mytilaspis*, have the male form winged; a *Gossyparia* presents males with rudiments of wings; and, lastly, the one I am now describing, *Ritsemia*, has a perfectly apterous male.

A few days after the appearance of the males, the little ovoid pupæ which have remained in the cottony mass are developed in their turn, and furnish the female, which is a little larger than the male (0·45 millim.), and very similar to the form that appears in the month of August; only it has *eight* joints in the antennæ instead of *six*, and is therefore not the same biological phase.

Copulation takes place at the time; and I do not know what occurs between May and August. Notwithstanding this gap, I think it desirable to make known what I have observed, in order to call attention to the study of the plant-lice of the elm in general, which is still so incomplete. I know eight upon this tree, the four Coccidæ cited above and four Aphididæ—*Tetraneura ulmi*, *T. alba*, *Schizoneura ulmi*, and *S. lanuginosa*. These insects occur in millions upon every elm; the problem of their biology has been set ever since the time of Réaumur, and it is still to be solved. We are acquainted



with half the cycle of existence of each of them ; the other is still to be discovered.

I have given to the new insect the name of *Ritsema*, in honour of M. C. Ritsema, the curator of the Museum at Leyden, who is well known in the entomological world. I have added the specific name *pupifera*, to recall to mind the mode of reproduction (*anthogenesis*), in which there intervenes a form furnishing male and female pupæ, from which the sexual individuals issue and copulate immediately. It is this form that I have called "Pseudogyno pupifère." This form exists among the *Phylloxeræ* and all the Pemphigians. I find it here among the Coccidæ.—*Comptes Rendus*, April 28, 1879, p. 870.

*On Gordius, and on some Parasites of the Rat.*

Prof. Leidy exhibited a curious knotted mass of living hairworms (*Gordius robustus*?) which had been sent to him by Dr. S. T. Roman, of Conowingo, Cecil Co., Md. The mass had been picked up in a gutter at the edge of a forest near Conowingo, on the rainy morning of Dec. 15, 1878. It contained fifty-two male individuals, and seven females. The former ranged from 8 to 25 centims. in length, by  $\frac{1}{2}$  to  $\frac{2}{3}$  of a millim. in thickness ; the latter range from 14 to 19  $\frac{1}{2}$  centims. in length, by 1 millim. in thickness. The females are generally of much lighter colour and more robust character than the males. In both sexes the body is most attenuated anteriorly ; but in the female the body is nearly as thick at the posterior extremity as it is at the middle. Some of the smaller males are pale brownish white ; but most of them, from the smallest to the largest, are of various shades of brown to chocolate-brown. The females are pale brownish to darker brownish. In both sexes the head forms a convex whitish eminence, encircled by a narrow black ring, from which a band of brown extends dorsally and ventrally along the body. The posterior end of the body is likewise of darker colour than the part just in advance.

The tail of the male makes a spiral turn inwardly and is furcate. The forks are short, curved, slightly divergent, blunt conical processes. Just in advance of their conjunction internally there exists an inverted crescentic fold of browner colour than the contiguous parts ; and immediately in advance is the genital pore. The interval of the caudal forks is smooth, or free from papillæ.

The tail of the female appears truncated, is bluntly rounded, feebly clavate, or slightly thicker than just in advance, and nearly as thick as the middle of the body. It presents a terminal pore, marked by a brown spot and encircled with a brown ring.

Under a moderate magnifying-power, the brown integument is minutely mottled with whitish spots, and it exhibits fine longitudinal and diagonal striation. In sunlight it is beautifully iridescent as in the earthworm.

The worms are still quite lively. When disentangled and left

alone they soon become again knotted together in a compact rounded mass as at present, with the heads divergent, and writhing so as to remind one of the head of the fabled Medusa.

Prof. Leidy then directed attention to several other specimens which had been sent to him for information. One of these is a bunch of tapeworms, fifteen individuals of *Tenia diminuta*, from the intestine of a rat. The other is the liver of a rat with a multitude of cysts, the size of large peas, containing *Cysticercus fasciolaris*. In a letter accompanying the specimens, Dr. John R. Hewett states that last spring he had examined about 500 rats (*Mus decumanus*), in Carroll Co., Mo., and only in half a dozen instances did he find the liver free from the parasite.—*Proc. Acad. Nat. Sci. Philad.* Jan. 28, 1879.

*On some Plesiosaurians of the Upper Jurassic Strata of  
Boulogne-sur-Mer.* By M. H. E. SAUVAGE.

Of the same age as the beds of Shotover and Kimmeridge, the Upper Jurassic deposits of Boulogne-sur-Mer have in part the same herpetological fauna. Thus, to cite only Plesiosaurians, the following were stranded upon the Jurassic shores of the Boulonnais:—*Pliosaurus gamma*, *P. grandis*, *Polyptychodon Archiaci*, *Plesiosaurus carinatus*, *infraplanus*, *plicatus*, and *ellipsospondylus*, belonging to the family Plesiosauridæ, and *Polycotylus suprajurensis*, *Marcenosaurus Manselii*, and *M. brachyspondylus*, to that of the Elasmosauridæ. These Reptiles were not the only Plesiosaurians frequenting those shores; with them lived *Colymbosaurus Dutertrei*, *Plesiosaurus morinicus*, *P. Phillipsi*, and *Pliosaurus suprajurensis*.

This last species, found in the upper part of the Portlandian, is distinguished from *P. brachydeirus* by the greater length of the cervical and dorsal vertebræ. In the cervicals the lower surface of the centrum, which is strongly rounded, bears a broad and salient crest, the articular surfaces are nearly smooth; the neurapophysis is wide, the zygapophysis slightly passes the level of the centrum. The length being 100, the width will be 154, and the height 130.

Under the name of *Plesiosaurus carinatus*, sp. n., Phillips has figured a small species from Buckinghamshire; this species not being the same as that described by Cuvier under the same name, we may call it *P. Phillipsi*. Among distinctive characters between the two species, the cervical vertebræ of *P. Phillipsi* are longer, the form of the articular surface of the pleurapophyses is different, and the relations between the surface for the attachment of the rib and the extremity of the suture which unites the neurapophysis to the centrum are quite different.

Although allied to *Plesiosaurus carinatus*, Cuv., *P. morinicus* is distinguished therefrom, as regards vertebræ occupying the same place in the cervical series, by the form of the articular surfaces and the greater breadth of the inferior surface of the centrum, and because

the surface of attachment for the rib, instead of occupying nearly all the breadth of the lateral surface of the centrum, is, on the contrary, of but small extent. The length being 100, the breadth is 159 and the height 112.

The genus *Colymbosaurus*, belonging to the family Elasmosauridæ, known only from the Cretaceous in England, is represented in the upper part of the Kimmeridgian at Boulogne by a species, *Colymbosaurus Dutertrei*, Sauv., the cervical vertebræ of which are remarkable by the form and size of the articular apophyses. The centrum is elongated; and its three diameters are nearly equal; the lower surface, scarcely excavated in the direction of its length, is divided by a narrow keel; the plenrapophyses, intimately soldered to the centrum, spring from it in the form of a flattened plate; the articular surfaces are flat and nearly circular in form; the præzygapophyses are in the form of rounded ribs; the postzygapophyses are in the form of plates; the neural spine is much compressed in the form of a thin plate; the medullary canal is very narrow and rounded.—*Ann. des Sci. Nat.* sér. 6, tome viii.

### *The Nebaliid Crustacea as Types of a new Order.*

By Dr. A. S. PACKARD, Jun.

The Nebaliadæ, represented by the existing genus *Nebalia*, have generally been considered to form a family of Phyllopod Crustacea. Metchnikoff, who studied the embryology of *Nebalia*, considered it to be a "Phyllopodiform Decapod." Besides the resemblance to the Decapods, there is also a combination of Copepod and Phyllopod characteristics. The type is an instance of a synthetic one, and is of high antiquity, having been ushered in during the earliest Silurian period, when there were (if we regard the relative size of most Crustacea, and especially of living *Nebaliæ*) gigantic forms. Such was *Dithyrocaris*, which must have been over a foot long, the carapace being seven inches long. The modern *Nebalia* is small, about half an inch in length, with the body compressed, the carapace bivalved as in *Limnalia*, one of the genuine Phyllopods. There is a large rostrum overhanging the head; stalked eyes; and besides two pairs of antennæ and mouth-parts, eight pairs of leaf-like, short, respiratory feet, which are succeeded by swimming-feet. There is no metamorphosis, development being direct.

Of the fossil forms, *Hymenocaris* was regarded by Salter as "the more generalized type." The genera *Peltocaris* and *Discinocaris* characterize the Lower Silurian period, *Ceratiocaris* the Upper, *Dictyocaris* the Upper Silurian and the lowest Devonian strata, *Dithyrocaris* and *Argas* the Carboniferous period. Our existing north-eastern species is *Nebalia bipes* (Fabricius), which occurs from Maine to Greenland.

The Nebaliads were the forerunners of the Decapoda, and form, we believe, the type of a distinct order of Crustacea, for which the name Phyllocarida is proposed.—*American Naturalist*, Feb. 1879.

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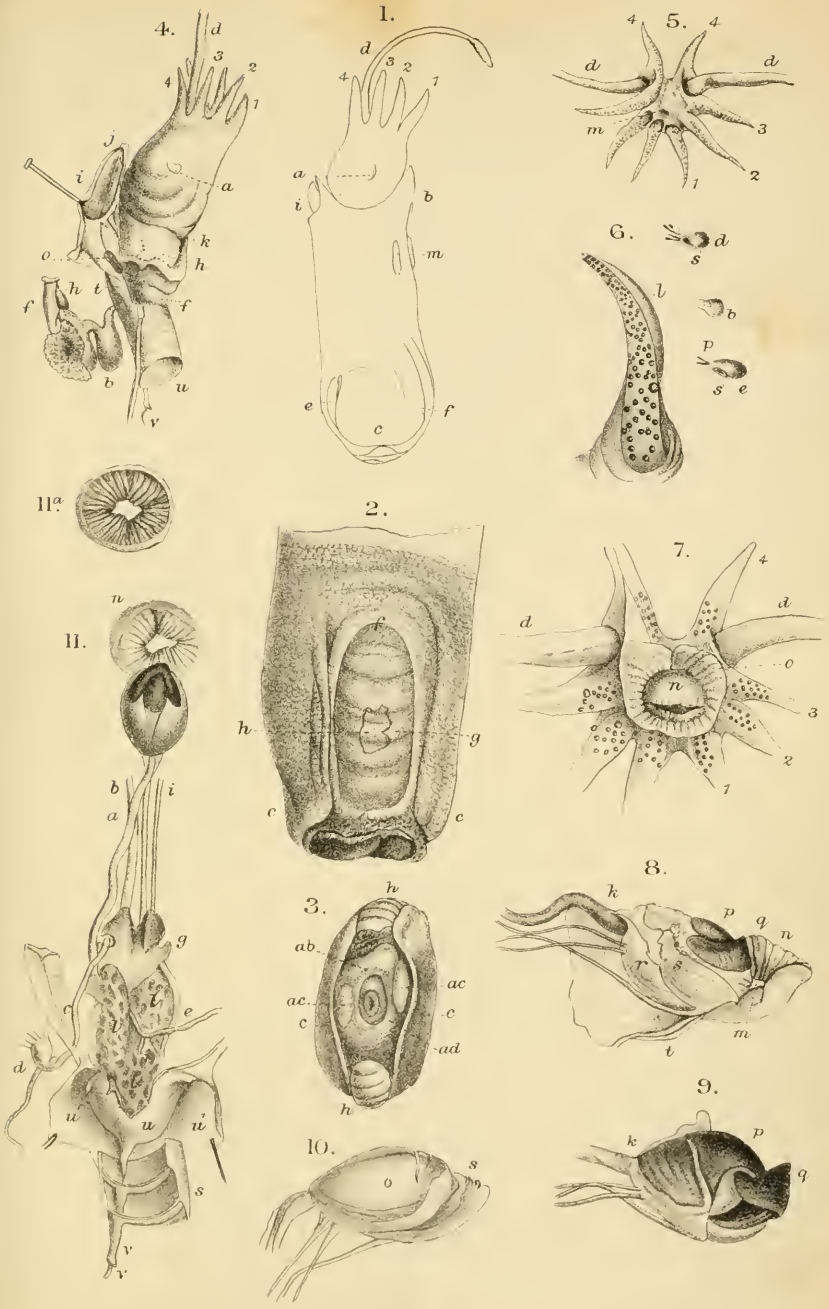
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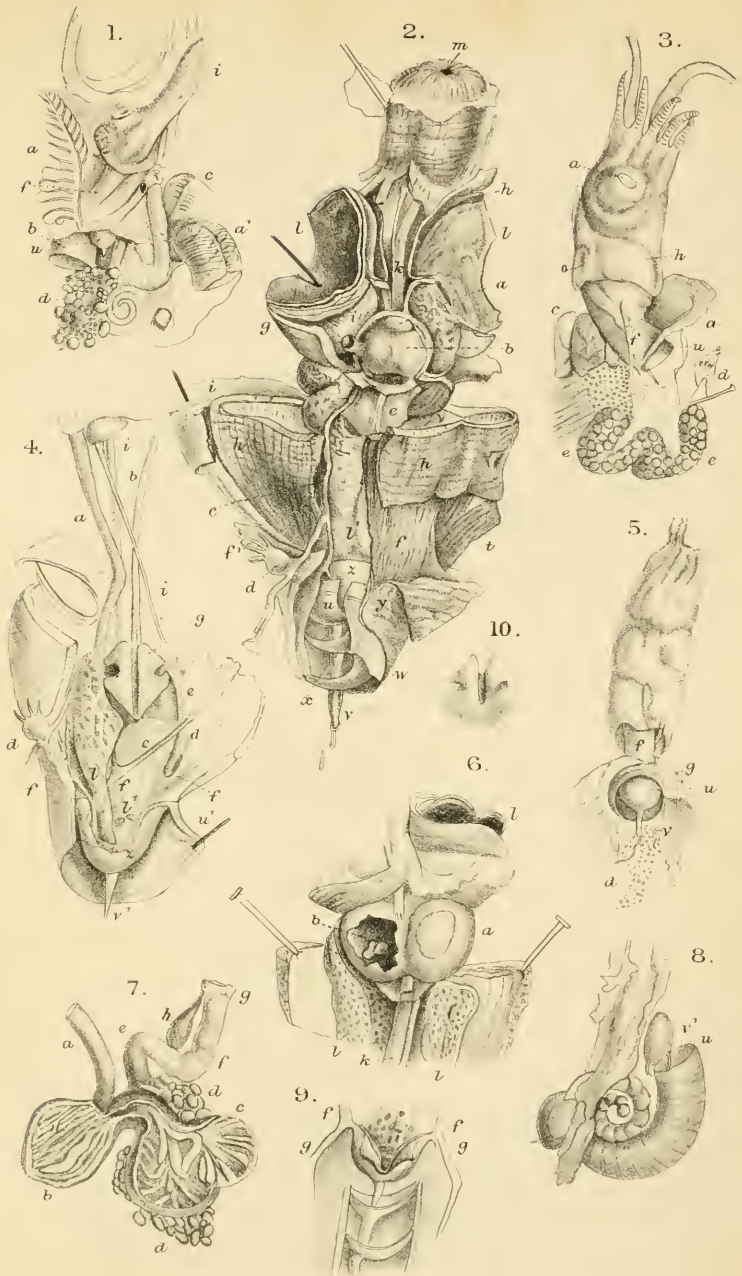
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END OF THE THIRD VOLUME.





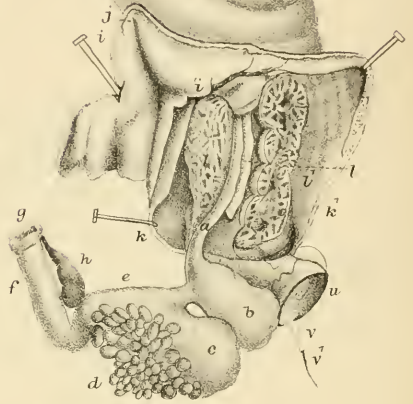
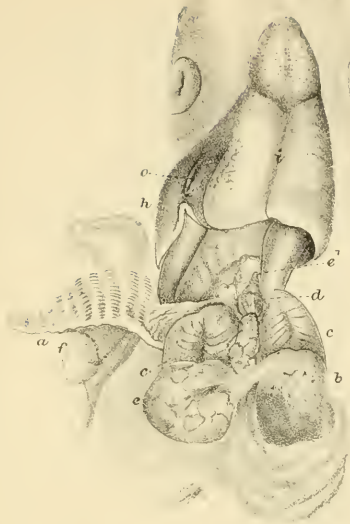






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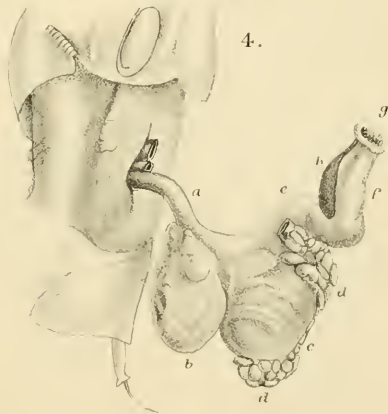
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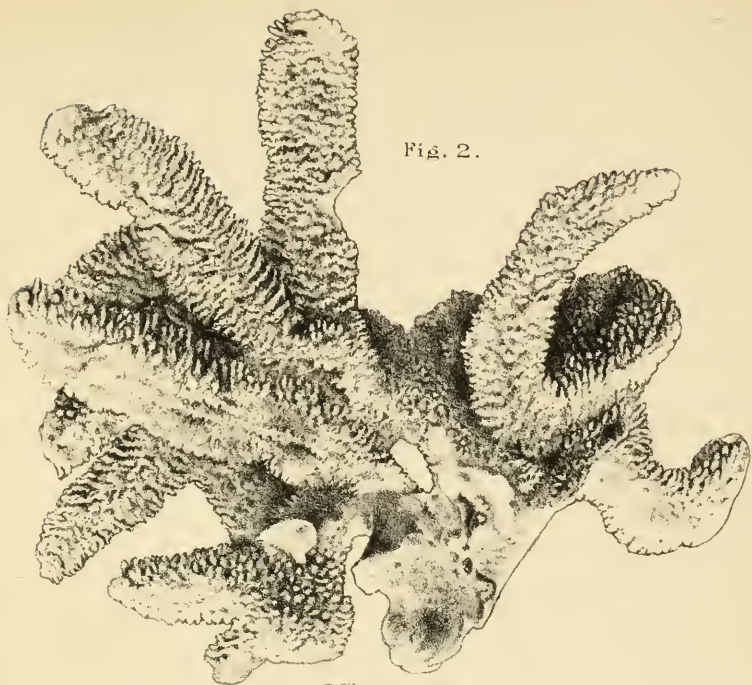


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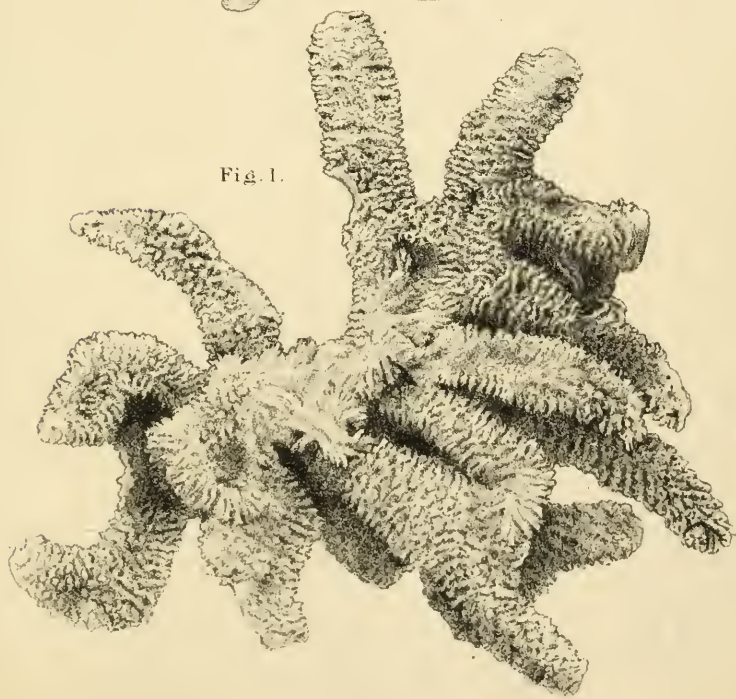
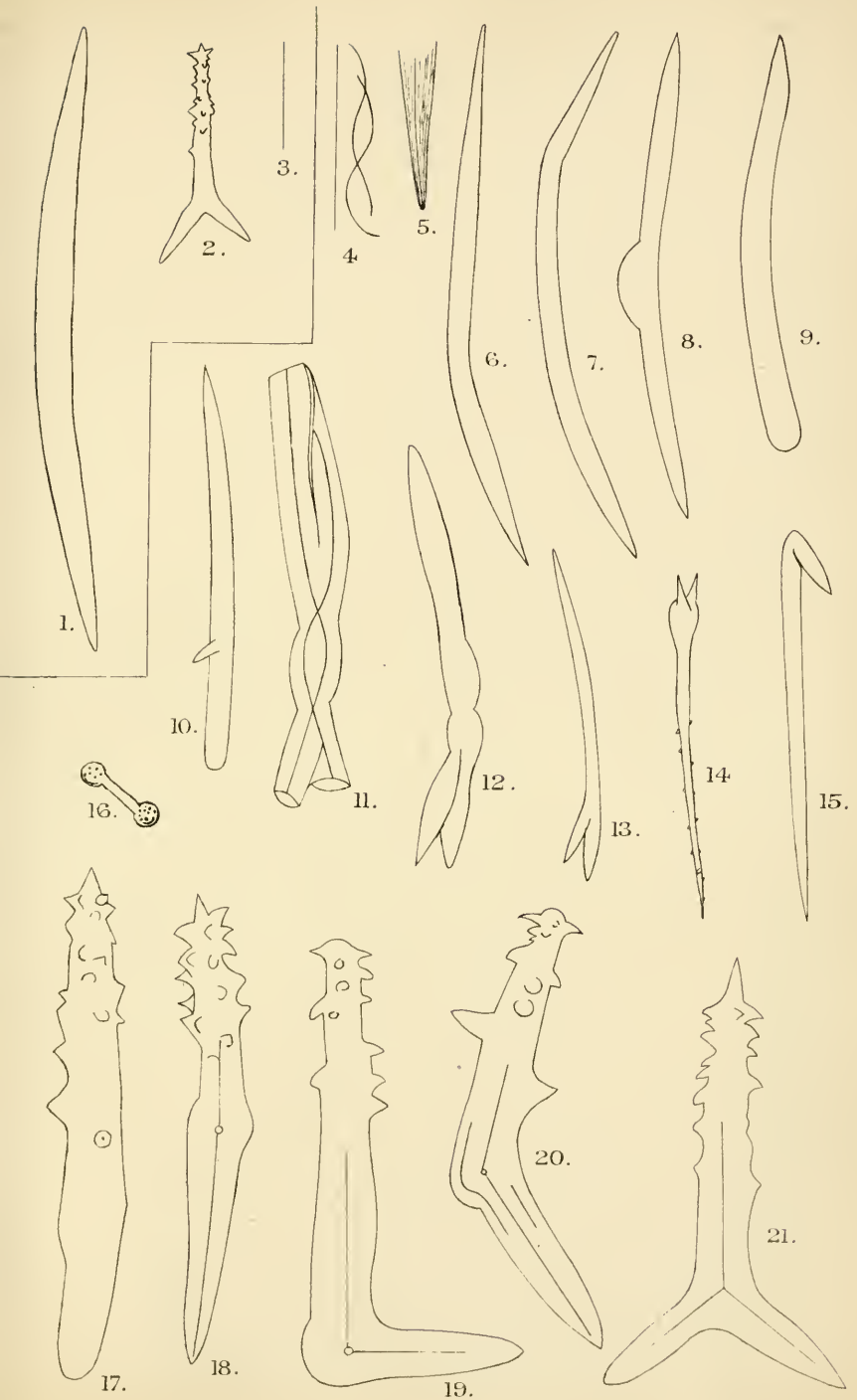


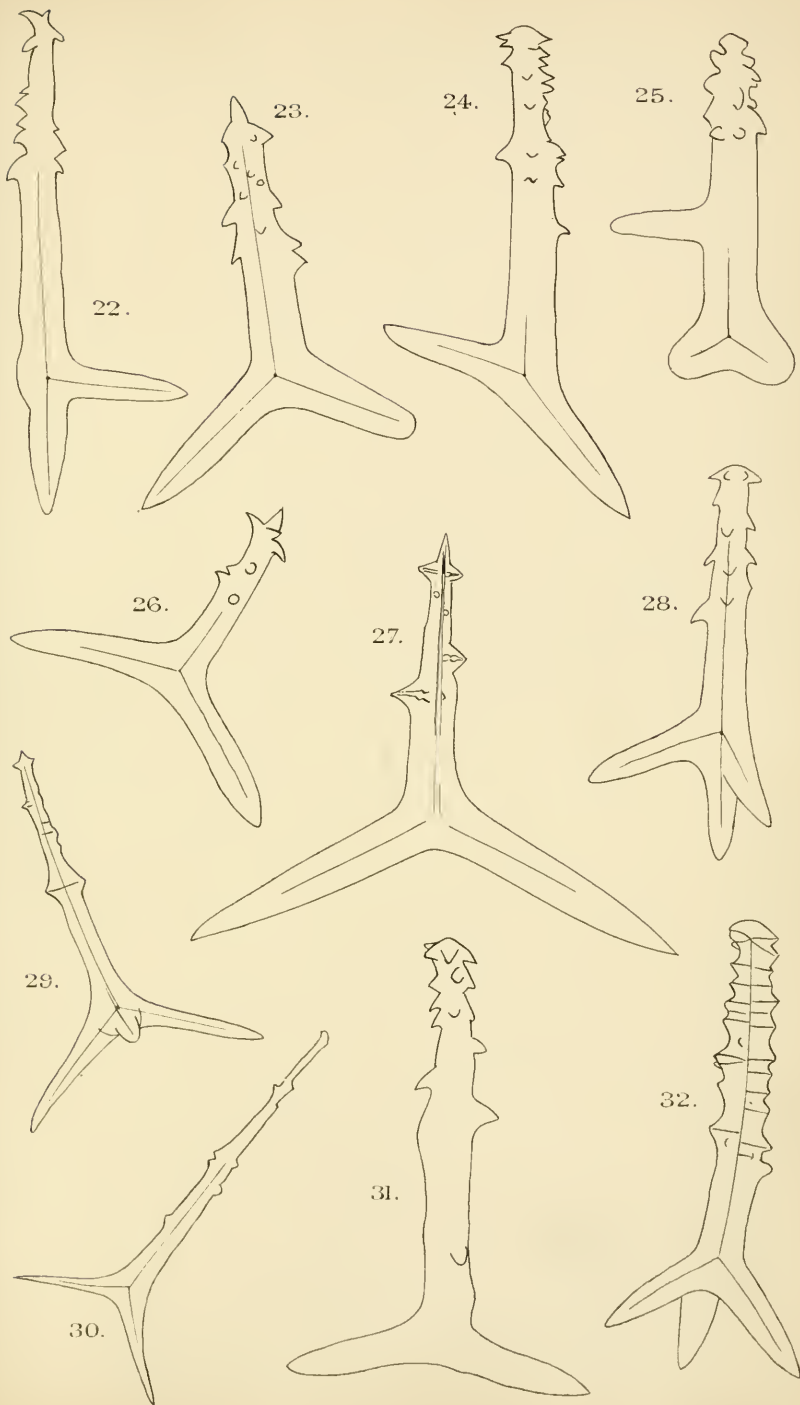
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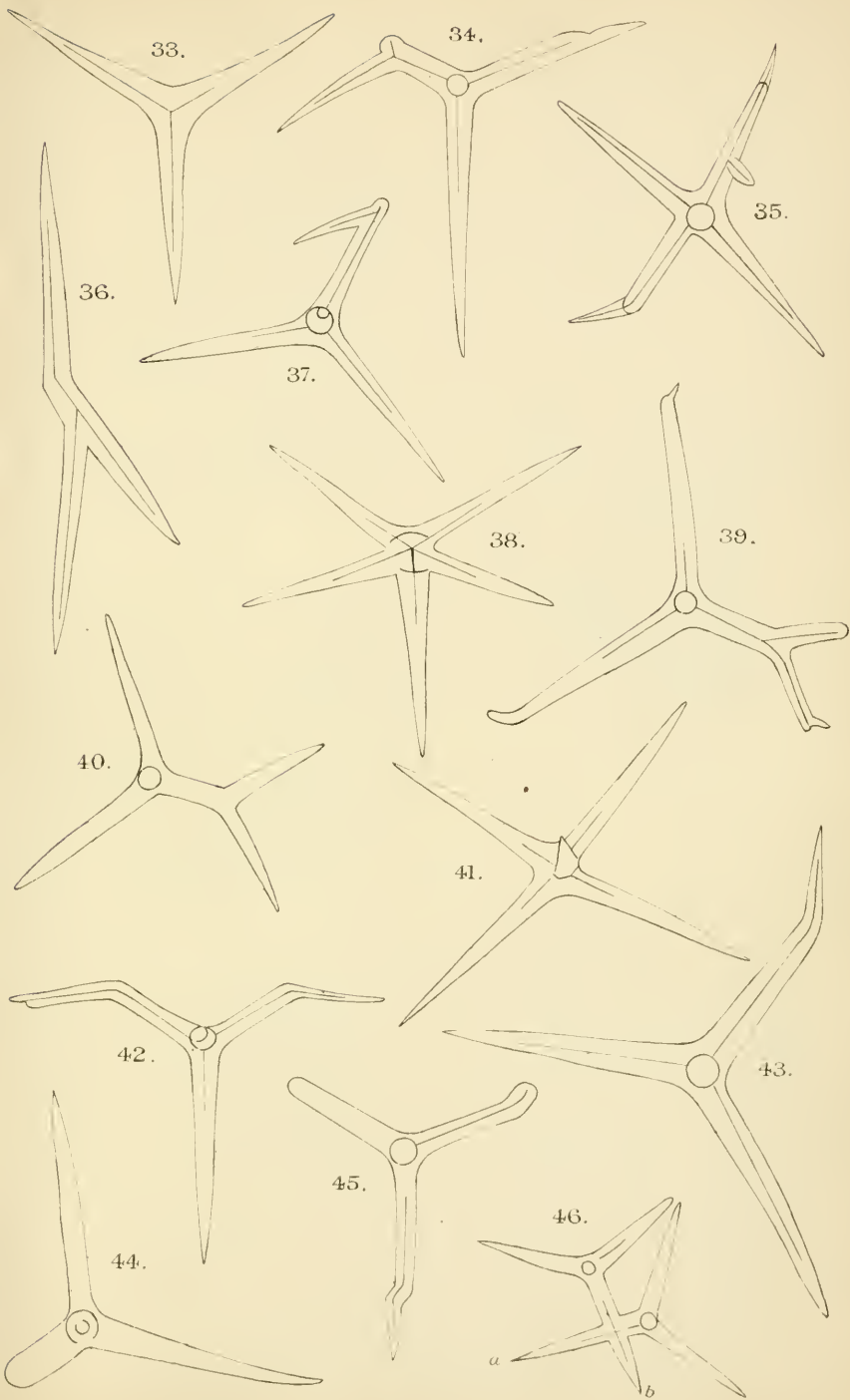




Fig 1



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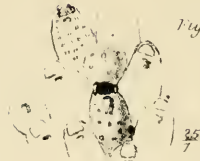


Fig 3.



Fig 4



Fig 5

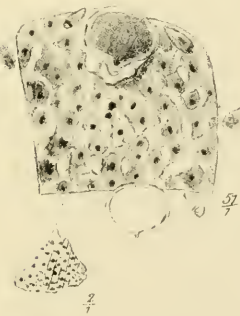
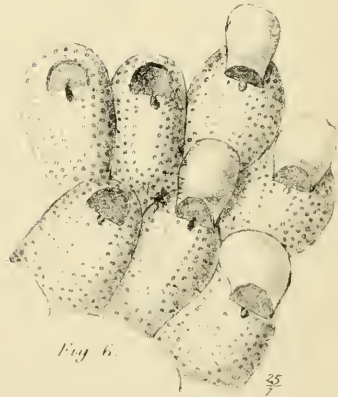
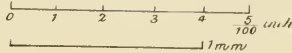


Fig 6.



all waters lth



1, *Lepralia arrogata*, nov 2, 3, *Lepralia bimucronata*, Moll. 4, *Lepralia ventricosu* Hass 5, *Lepralia pertasa*. 6, *Lepralia Ceclui* Aud





Fig 1.

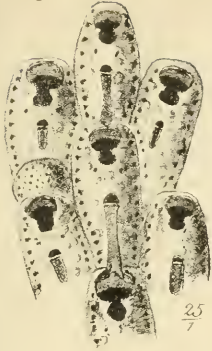


Fig 2



Fig 3



Fig 4.



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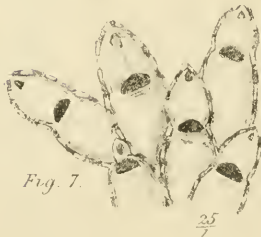
Fig 6.



Fig 6<sup>a</sup>



Fig. 7.



an'waters lichi.

1, *Lepralia reticulata*, var. *ghesbriana*. 2, *Lepralia linearis*, var. *secundaria*, Sm 3, *Lepralia*. 4, *Lepralia eribrosa*, Heller 5, *Lepralia auriculata* 6, *Lepralia Gattva*, Lands 7, *Lepralia Brongniartii*, Aud.





Fig. 1.



Fig. 2.



Fig. 3.

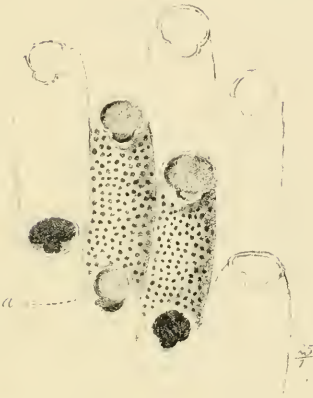


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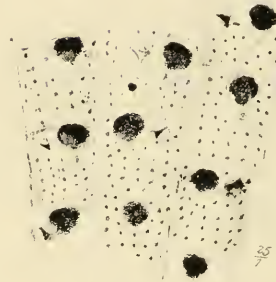


Fig. 5.



Fig. 6.



Fig. 7.

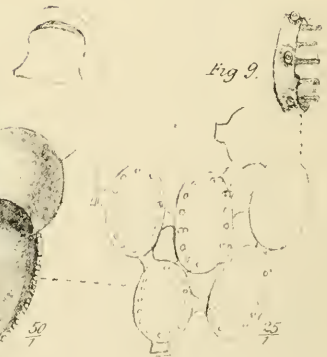


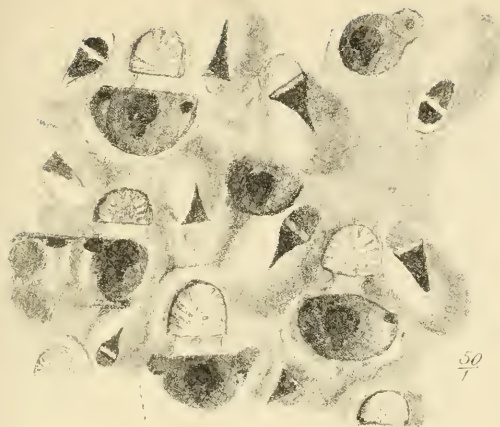
Fig. 8.

Fig. 9.

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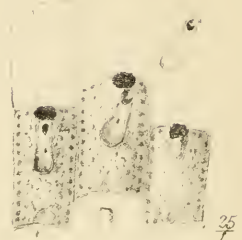
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*projecta* 4. *Leprulia cucullata*, Bush. 5, *Leprulia errata*, stadium.  
*Hemeschara* 6, *Diachoris patellaria* Moll.





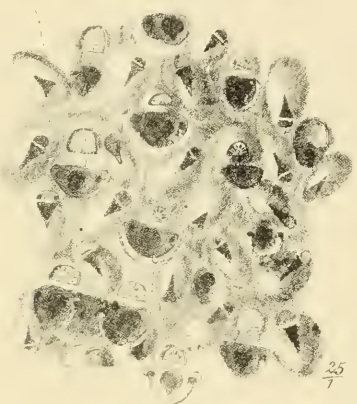
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Fig 3.



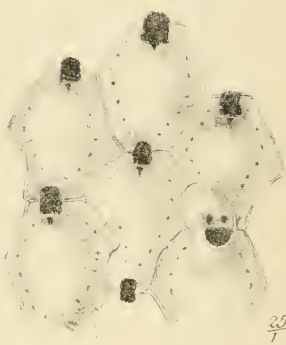
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Fig 2



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Fig 4



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Fig 6



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Fig 5



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uWale: 111

1 2 *Lipralia uncuris*, var *biaperta* 3 *Lipralia sarcoluca*  
 4 5 *Eschara foliacea*, stadium *limboeschara* 6, *Lipralia fissa*, Finck



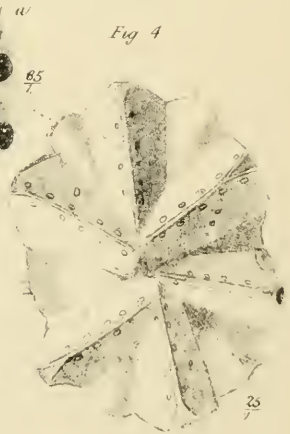
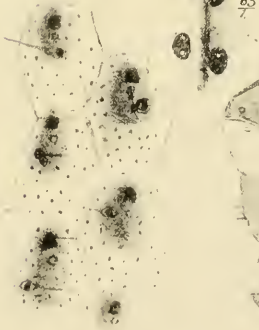
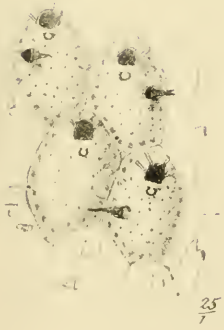


Fig 1

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Fig 1

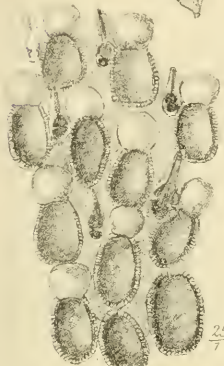


Fig 2

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Fig 3

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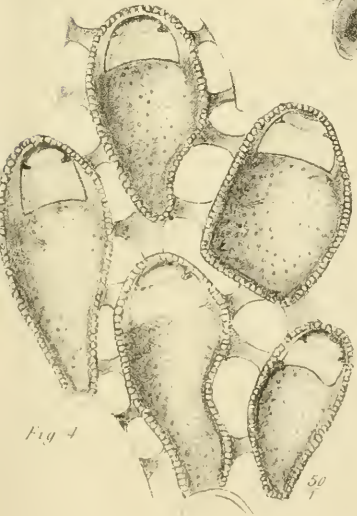


Fig 4

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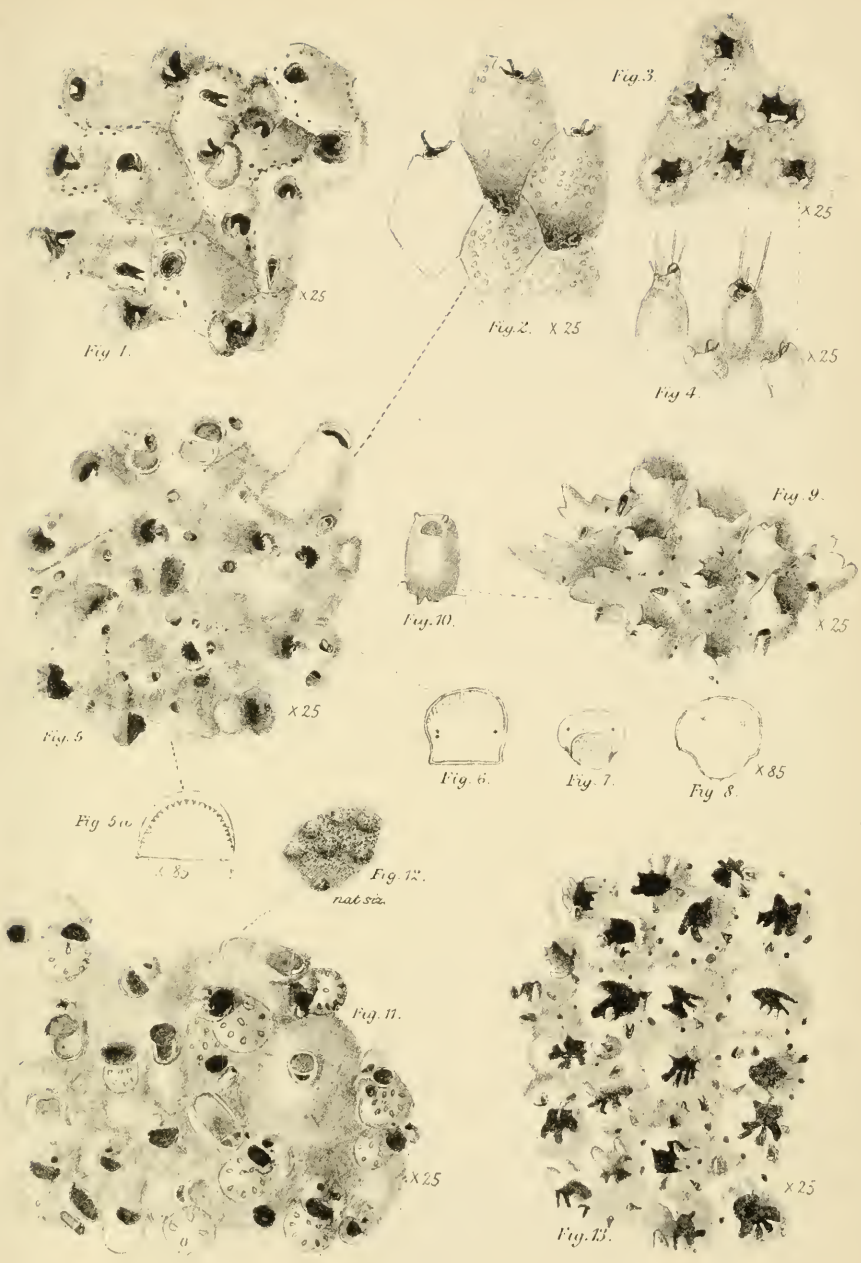
Fig 5

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anwaters, lch

- 1, Cellepora 2, Membranopora Flemingi, Busk
- 3 Membranopora angulosa Ros 4, Drachores patellaria, Mill var

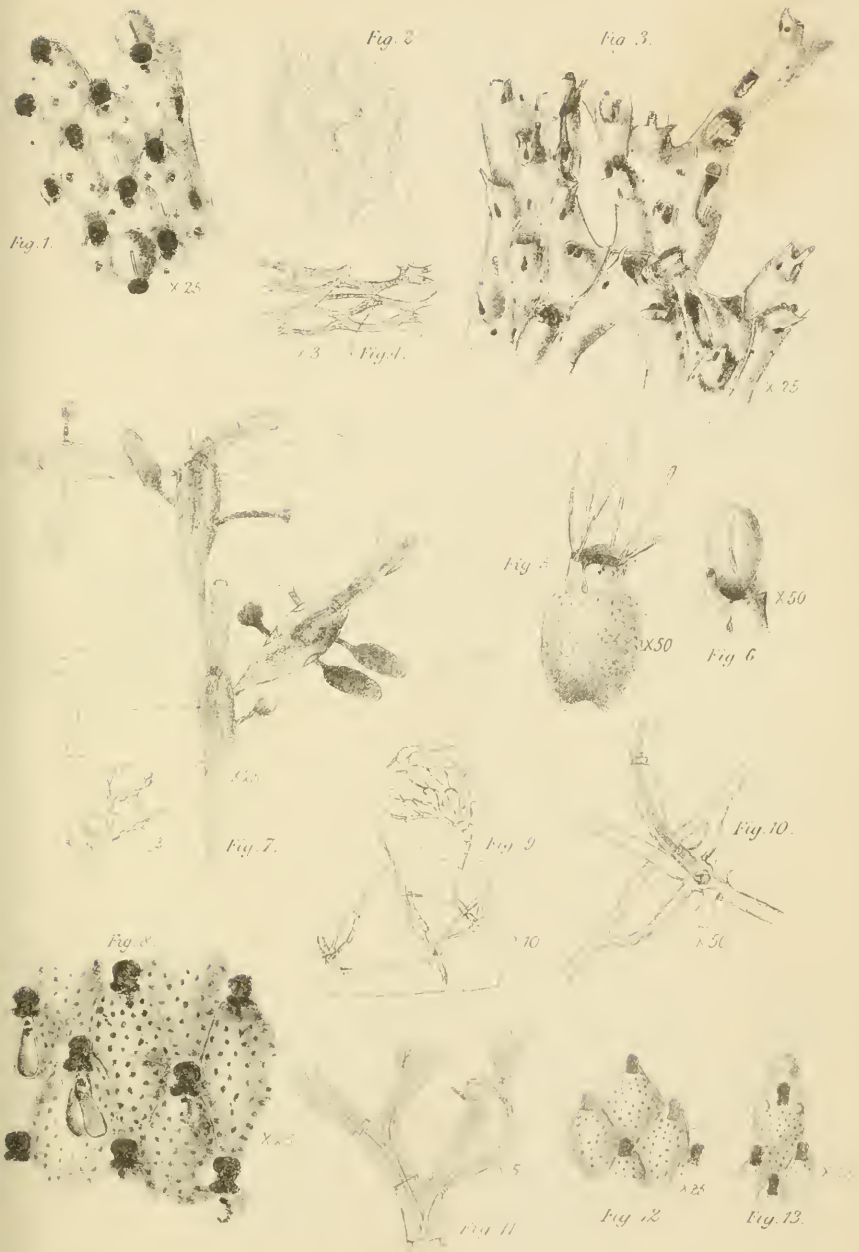




A. W. Waters. lith.

- 1, *Cellepora verruculata*, Smitt. 2, 5, *Cellepora sardonica*, nov.  
 3, 4, *Cellepora lobulata*, nov. 6, Operculum of *Cellepora sardonica*.  
 7, do of *verruculata*. 8, do of *avicularis*. 9, 10, *Cellepora Gudemannia*, nov.  
 11, 12, *Cellepora avicularis*, Hanks. 13, *Cellepora digitata*, nov.





W. Waters, del.

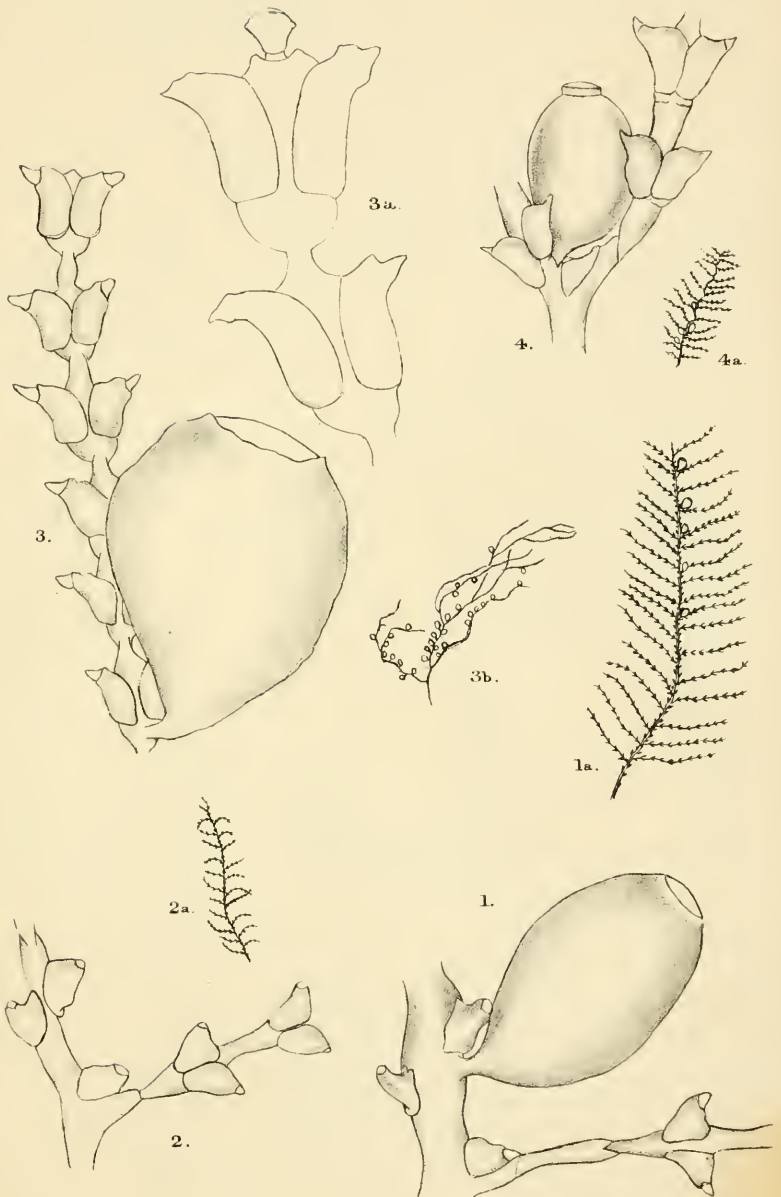
1 2, *Retepora cellulosa* L. 3 4 5 6 *Retepora Couchii* Hincks  
 7, *Aleu anguina* forma recta. 8 *Eschara solivora* Ellis  
 9, 10, 11, *Eucratea Cordieri* Aud. 12, *Leopoldia lata* Bush



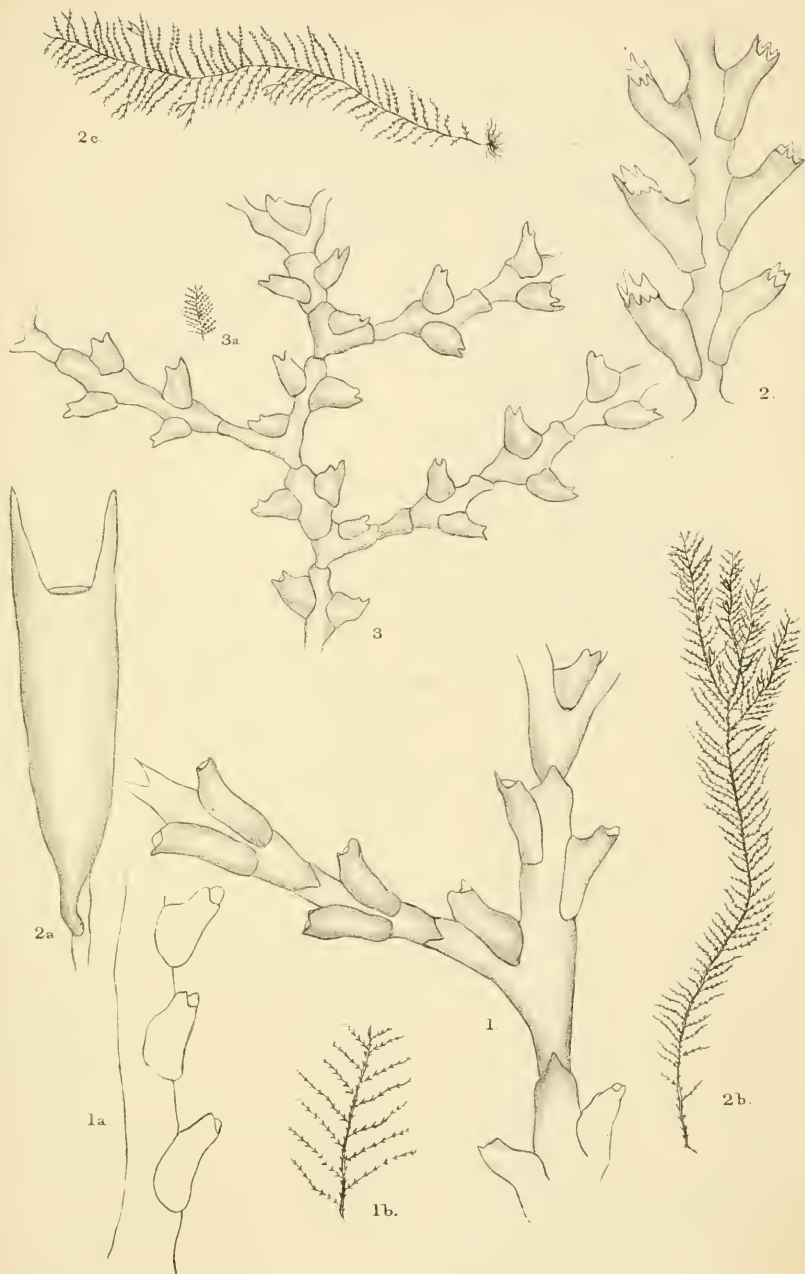




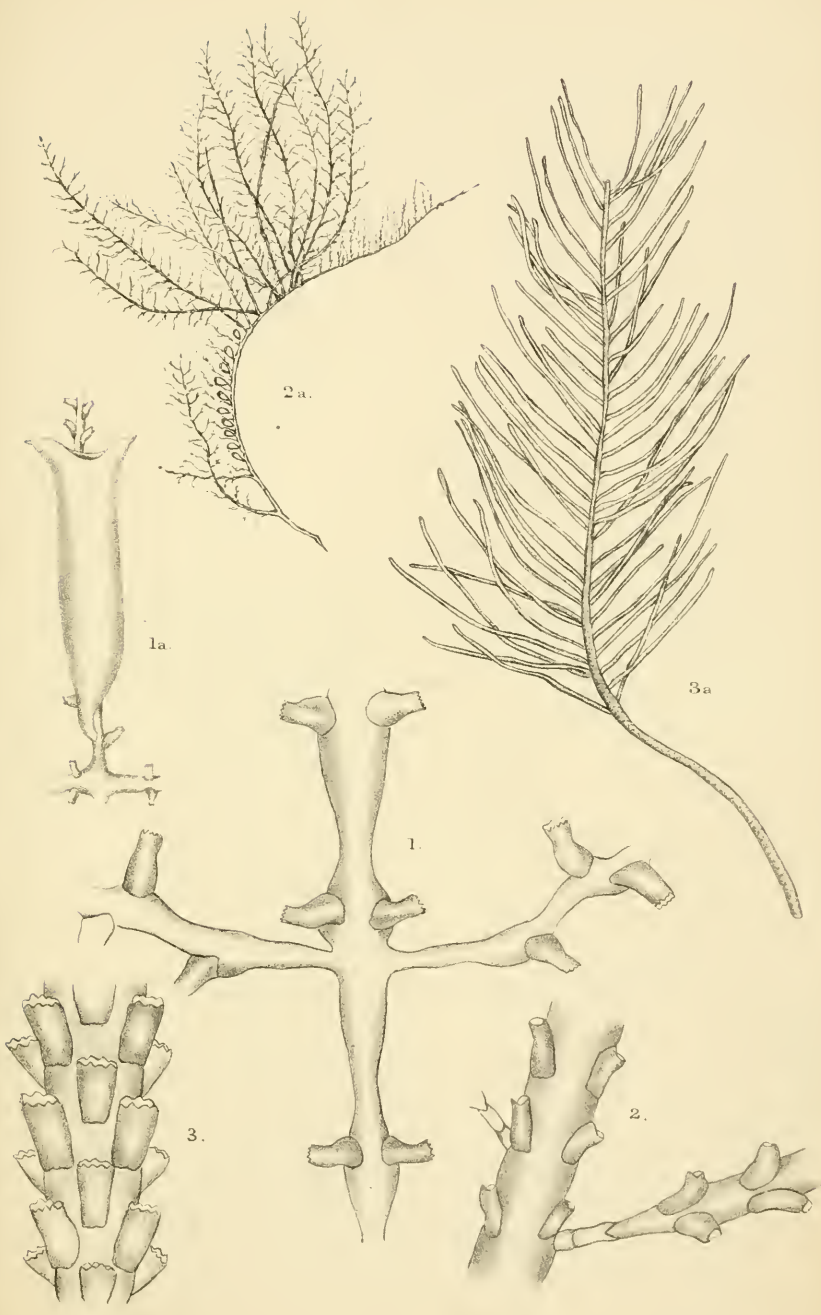














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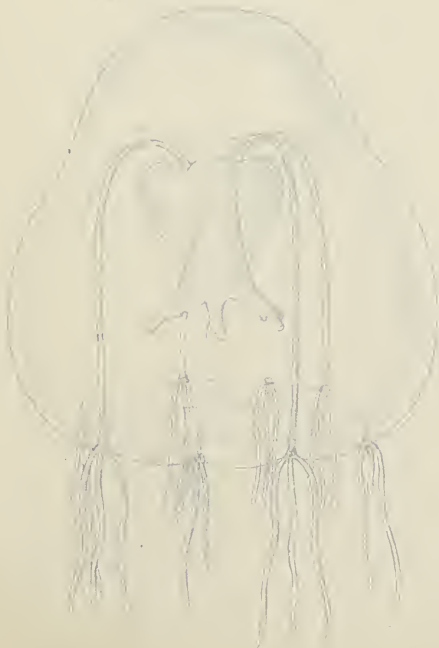
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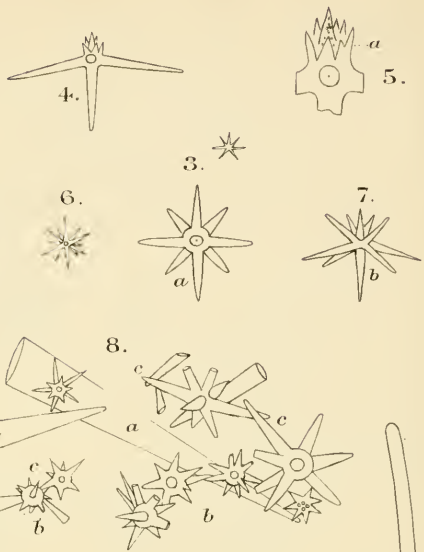
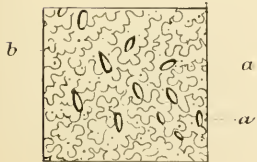




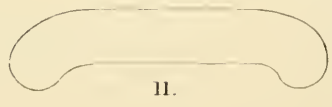
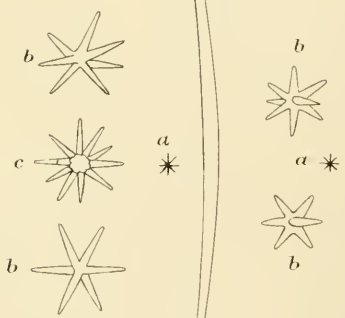




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A. W. Waters, lch.

1 *Grisea elongata* M. Edw. 2 *Grisea denticulata* M. Edw. 3 *Grisea histulosa* Hell  
 4 *Grisea demissa* var. *angustata* 5-11 *Peltigera* sp. *dorsalis* var. *E. Fucratea* Gardner and



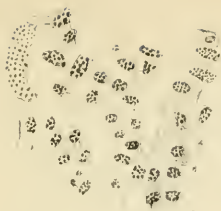


Fig. 1.



Fig. 2.

Fig. 4. x12

Fig. 5.

Fig. 6. x12

Fig. 2. x12



Fig. 7.

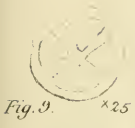


Fig. 9. x25

Fig. 10. x85

Fig. 8.

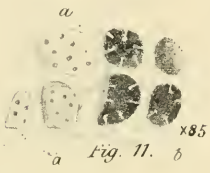


Fig. 11. x85



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Fig. 13. x2

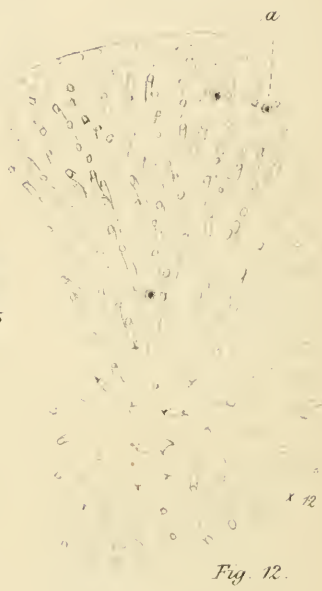


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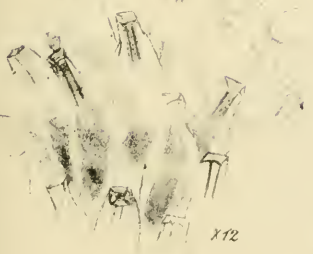


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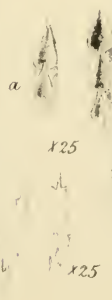


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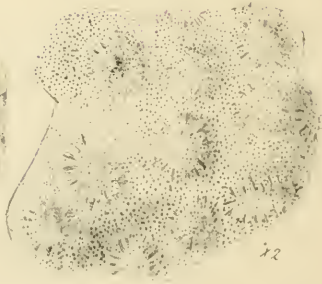


Fig. 15. x2

A. W. Waters, lith.

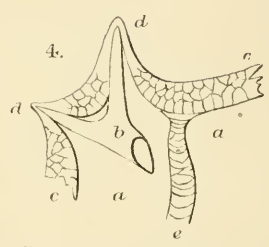
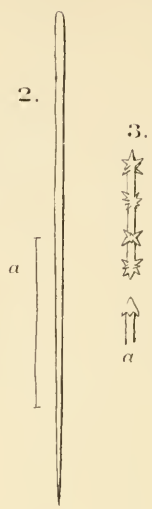
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11, *Discosporella rotundata* Aud. 12, *Dhastopora latomarginata* d'Orb.

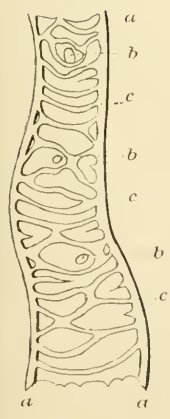




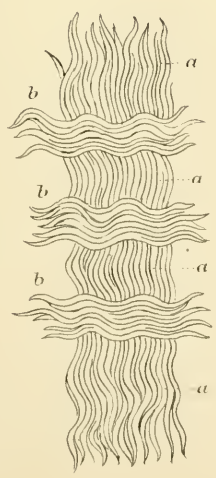
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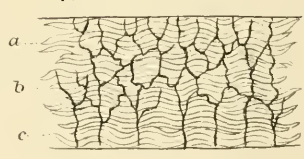
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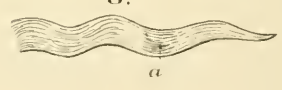
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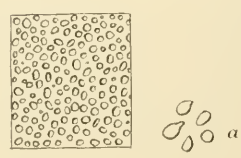
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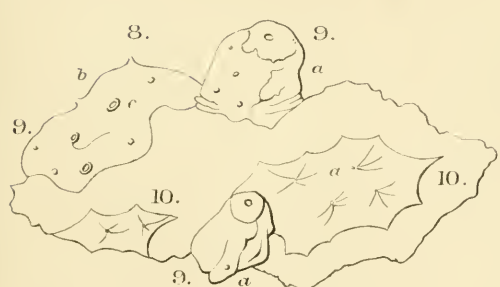


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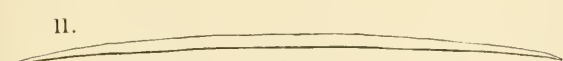
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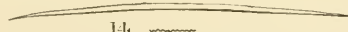


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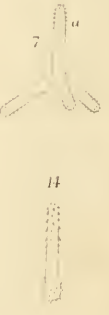
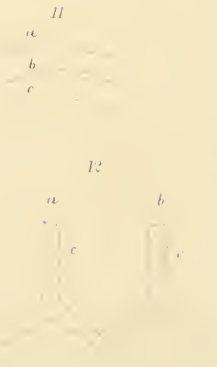
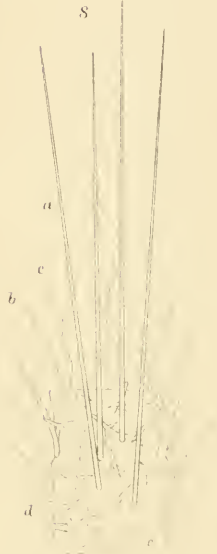
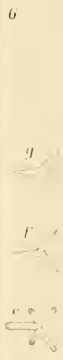
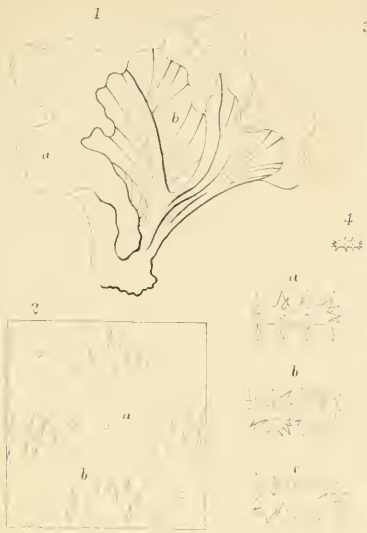
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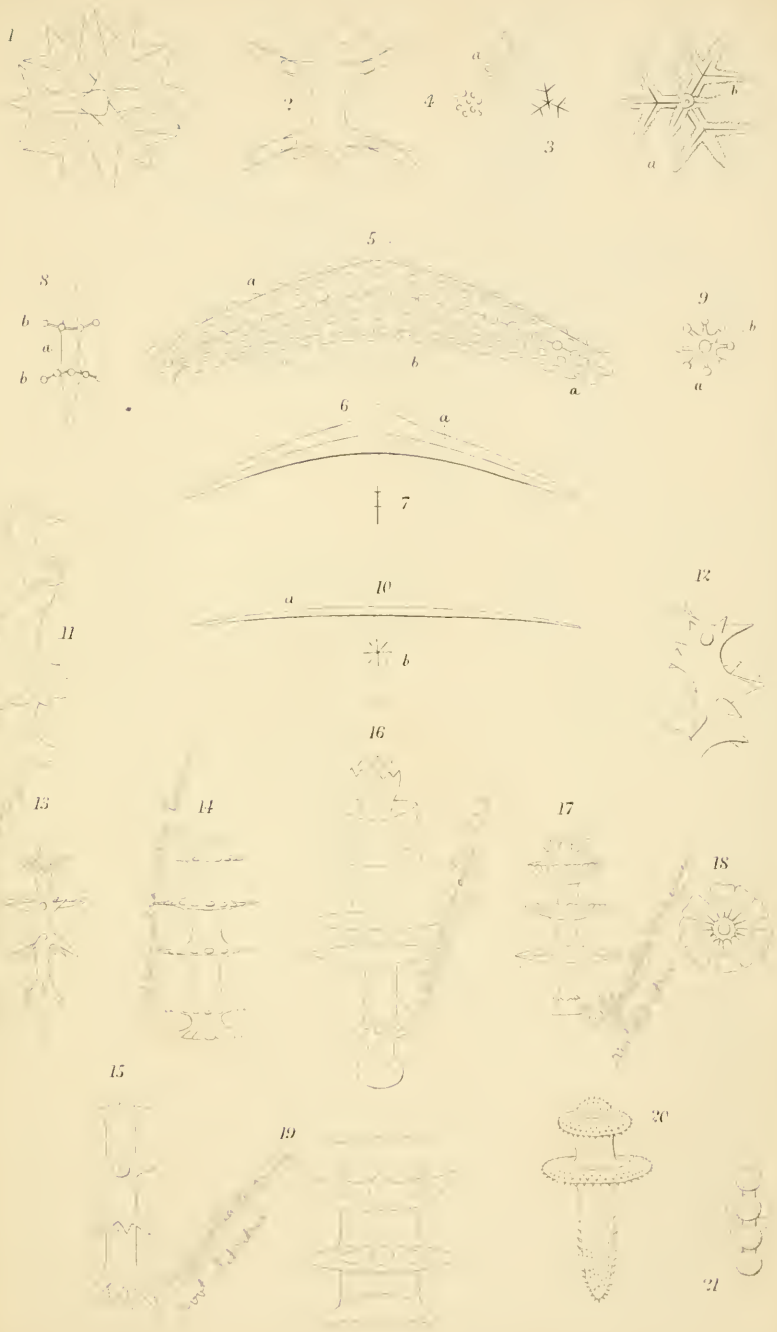
















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