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XL.—*Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Capt. W. H. Cawne Warren.* By H. J. Carter, F.R.S. &c.

[Plates XVIII. & XIX.]

The Gulf of Manaar is an inlet of the Indian Ocean, between Ceylon and the southern extremity of India, 150 miles in width at its entrance; and the specimens, which were dredged up by Capt. W. H. Cawne Warren, in 65 fathoms and less, off the town of Negombo, near Colombo, on the coast of Ceylon, and Tuticorin on the coast of India respectively, towards the end of 1878, were presented to the Liverpool Free Museum about a year afterwards, when they were sent to me for examination by Mr. Thomas H. Higgin, F.L.S.

As they all possess a similar facies, it will only be necessary to allude to them hereafter as "from the Gulf of Manaar," without specifying the particular locality more than has already been done.

Altogether they would hardly fill a quart measure; and the largest was not more than three inches in its longest diameter; so that the amount of material is insignificant. But the representatives of species are comparatively enormous, as will be seen hereafter; indeed, if this material is to be taken as typical of what is to be found in the Gulf of Manaar generally, I should think that this little inlet must contain an epitome of

nearly all the marine organisms that exist in the Indian Ocean.

The "specimens" consist of calcareous nodules of different sizes, which may be said to originate, in the first place, in the agglutination of a little sea-bottom by some organism into a transportable mass, which, increasing after the same manner as it is currented about, may finally attain almost unlimited dimensions. They are therefore compounded of all sorts of invertebrate animals, whose embryos, swimming about in every direction, find them, although still free and detached, of sufficient weight and solidity to offer a convenient position for development; and hence the number of species in and about them.

They vary in form and weight in proportion to the amount of loose or solid material in them, some being round, hollow, clathrous, others more solid, but much crevicced, and some almost entirely solid; while they may be more or less rugged on the surface from the nature of the organisms of which they are chiefly composed, whether through development *in situ* or subsequent agglutination. Perhaps no family of organisms has entered into their composition or increased their solidity more than the calcareous Algæ (*Melobesiæ*), which, in successively laminated or nulliporoid growths, has rendered these nodules almost solid throughout or covered with short, thick, nulliporiform processes. I am not sufficiently acquainted with the calcareous Algæ to say what the species are; but the common incrusting one hardly differs from our *Melobesia polymorpha*; and this seems also to have produced the nulliporoid growths to which I have alluded. There is also another laminar species with larger cells which are quadrangular; but this does not appear to be so common, while the loose, deciduous, flat, reniform articulations of *Flabellaria opuntia* are agglomerated with every thing, showing that this calcareous alga or coralline, which is very common in the tropics generally, is not less so in the Gulf of Manaar.

As it is upon these agglutinated compounds, as well as in their crevices and the excavated cavities formed by lithodomous sponges in them, that the organisms to be hereafter mentioned have been developed, I shall henceforth allude to the former under the term of "Melobesian nodules."

Next to the part which the *Melobesiæ* have taken in their formation may be mentioned the sessile Foraminifera; and these have, in their turn, been overgrown, in many instances, by Polyzoa, which, too, is a class of which I know so little that I am not able to point out the different species present;

but observing them to be abundant and as beautiful as they are varied in form, while many are evidently not British, I have placed such of them as, in breaking up the nodules for other organisms, were necessarily separated, in a box by themselves, for some one who, desirous of describing the exotic species, may one day be permitted to examine them for this purpose.

For my own part, the Foraminifera and Spongida are as much as I can pretend to undertake; and these, together with a new genus of the Hydractiniidæ and a new species of *Tubipora*, will be found described and illustrated in the following pages.

But although the forms of the Foraminifera that I have mentioned are fully developed, and therefore admit of complete description and illustration, those of the Spongida in several instances are not so. Then it should be remembered that the form of a fully developed sponge is frequently by no means constant, while every fragment of it is almost sure to contain its whole spiculation; and this alone is what is found in many cases on the Melobesian nodules. Hence, the name of a sponge being for the most part derived from the form of its spicules, this enables us to supply it, together with a description of the latter, which is all that is required until a fully developed form is found.

Before commencing these descriptions, however, I would observe that the mountings that I have made of some of the dust that fell off the root-branch of *Euplectella cucumer* (now in the British Museum) which was hooked up by a fisherman in deep water off the Seychelle Islands afford a complete index to the Manaar specimens, with many other forms besides, which may yet exist in the neighbourhood; but I have not met with any traces of gold among the sand obtained from some of the nodules, although the blue sapphire which is found in Ceylon is as evident in them as in the sea-bottom from the Seychelles ('Annals,' 1878, vol. i. p. 102).

Another fact I would also here mention, viz. that throughout my examinations, which have chiefly been conducted under the microscope, and often with high powers, I have never observed a *Coccolith*, *Coccosphere*, or *Rhabdolith*.

The descriptions and illustrations respectively of the new genus of Hydractiniidæ and new species of Tubiporidæ will be found in this part of my communication for convenience of publication &c., rather than on account of proper sequence; this will be corrected in the terminal list of the "Report."

Foraminifera.

Sessile Species.

Genus Carpenteria, Gray.

Generic characters. Test conical, sessile; composed of elongated more or less triangular chambers developed successively in a spire, more or less regularly round a hollow axis, towards which they are inclined and into which they open. Chambers foraminated on the surface, and more or less filled in the interior with fragmentary sponge-spicules. Hollow axis prolonged from the summit into a branched fruticose head.

Carpenteria utricularis and *Carpenteria monticularis.*

The former abounds on the Melobesian nodules of the Gulf of Manaar; but of the latter I have only found one specimen. In 1876 (Ann. vol. xvii. p. 210, pl. xiii. figs. 11–16), I described and illustrated *C. utricularis* under the name of *Polytrema utriculare*, and in 1877 (Ann. vol. xix. p. 211) reverted to the old generic appellation, viz. *Carpenteria*, adding at the same time (*ibid.* pl. xiii. figs. 9–12) a new species, viz. *C. monticularis*; while in 1878 ('Palæontographica,' [3] xxv. 1, Taf. xl. figs. 58–61) Prof. Möbius figured the same *en masse*, under the name of *Carpenteria rhaphidodendron.*

Genus Polytrema.

Gen. char. Test massive, more or less divided at the summit, composed of cells or chambers developed laminarly upon each other, the outer ones foraminated on the surface and opening into the inner ones, whose cavities, communicating with each other, finally terminate at the ends of the branches or laminæ into which the summit may be divided, where they are more or less filled with fragmentary sponge-spicules.

Polytrema miniaceum, De Blainville.

This species, which abounds everywhere in the tropics (but is rare, perhaps, beyond the 35th parallel on each side of the equator), varying in colour from deep red to pink, cinnamon, and pure white, is in its pink colour equally abundant in the Gulf of Manaar, growing apparently indiscriminately on every organism that will bear its weight. Accompanying it is another species, which, although not so frequent, being new I shall designate as *P. cylindricum*, in reference to its form, as will be seen hereafter. Finally, there is a third organism on the

Melobesian nodules, which, being polytrematous (literally), possessing fragmentary sponge-spicules in its interior, and presenting the same red colour as *P. miniaceum*, I at first thought to be another new species; but on further examination it was found to be a reptant *Tubipora* so like *T. musica* that, but for its stoloniferous growth and consequent modifications, together with the presence of the fragmentary sponge-spicules incorporated with its corallum, it might be considered identical. This species I shall designate *Tubipora reptans*; and, although belonging to the Polypifera, it will be described here for convenience, as before noticed, on account of the great resemblance to *Polytrema* just mentioned.

Here also I would take the opportunity of introducing another species of *Polytrema*, which accidentally came into my possession, in a rolled state, having probably been picked up upon some beach; but where, I am ignorant. Imperfect as it is, however, it is remarkable for its size and other characteristics: with a *Polytrema*-like structure and pink colour, it is so much larger and so differently formed from any hitherto published, that it must be considered a new species, which I propose to designate (also in reference to its form) *P. mesentericum*.

These species will now be respectively described, beginning with

Polytrema cylindricum, n. sp. (Pl. XVIII. fig. 1, *a–g*.)

Erect, cylindrical, consisting of a thick round pillar developed from a slightly expanded base, dichotomously divided at the free end into two short thick branches, which are equal in length and opposite, terminating respectively in an expansion, from the centre of which radiate a number of more or less fragmentary sponge-spicules. Consistence stony. Colour red, cinnamon, or crimson; translucent (Pl. XVIII. fig. 1). Surface of the pillar and branches uniformly divided into gentle convexities, pierced with foramina which are sunk into a subreticulated lineation whose interstices vary in prominence with the development of the organism—being most prominent in the oldest parts, and *vice versâ* (fig. 1, *e*); ends of the branches rendered irregular by the outgrowth of cells, which are otherwise hidden in the pillar and branches, as will appear presently. Cells at the ends of the branches bearing respectively a large aperture, similar in form, position, and margination to that of the cells of *Planorbulina* (fig. 1, *c*), which they further resemble in the form of their pore-tubulation; divided into two groups by a central rima, presenting a number of apertures, out of which project the fragmentary sponge-spicules

before mentioned, some of which may be seen in the large apertures as well as cavities respectively of the terminal cells themselves (fig. 1, *d*). Internal structure consisting of cells or chambers of different sizes, the largest and most regularly formed of which are arranged cortically (fig. 1, *a*), where their outer wall, corresponding to the "gentle convexities" on the surface, is pierced by the pore-tubules (fig. 1, *f*, *g g*), whose sunken apertures there are the holes also before mentioned (fig. 1, *e*); opening internally into a cancellated axial structure (fig. 1, *a*), whose cavities, communicating freely with each other, finally terminate in the rima between the groups of free cells at the ends of the branches respectively. Cells generally more or less filled with fragmentary sponge-spicules, especially the free ones at the ends of the branches (fig. 1, *b*). Size of specimens (which are very constant in this as well as in their form) about 1-3rd inch long and 1-12th inch thick; branches 1-16th inch long and a little less in diameter than the pillar.

Hab. Marine, growing on hard objects.

Loc. Gulf of Manaar.

Obs. This is undoubtedly a species of *Polytrema*, as evidenced by its structure, colour, and the presence of fragmentary sponge-spicules at the ends of the branches, in the interior of the cells, and on their way to them respectively through the apertures mentioned. Its size and form appear to be very constant, as above stated, although in one instance there was a tendency to divide in one of the groups of cells at the ends of the branches. What the object of taking in alone so many "fragmentary sponge-spicules" can be with these Foraminifera, when there are so few comparatively incorporated with the substance of the test, I am unable to conceive, especially as the very fact of their being "fragmentary" shows that they must have been drifting objects unaccompanied by any sponge-sarcode for nourishment, since "fragmentary spicules" do not, as a rule, exist in a living sponge.

Tubipora reptans, n. sp. (Pl. XVIII. fig. 2, *a–k*.)

Corallum strong, stoloniferous, vermiculate or crooked, not branched, flat, following the form of the surface on which it may be growing, bearing short, erect, cylindrical calycles situated at unequal distances from each other. Colour crimson, translucent (Pl. XVIII. fig. 2). Surface uniformly rough and foraminated, from the holes being sunk in the substance of the coral and the intervals in relief (fig. 2, *h*). Calycle sur-

mounted by an octotentaculated head (fig. 2, *a*), which is almost colourless, especially towards the centre, and from its more tender nature now, in the dried state, sunk into the calycle, while the firmer wall of the latter thus gives it the appearance of having been truncated. Tentacles composed towards the extremities of small, cylindrical, curved and colourless spicules (fig. 2, *f*), becoming larger, longer, and tuberculated towards the base (fig. 2, *g*), where they begin to assume a pink colour, and finally becoming red their tubercles unite with those of the neighbouring spicules, and thus the whole is transformed into the foraminated, fully formed, red, continuous corallum. Calycle charged at the bottom with fragmentary sponge-spicules, which are more or less incorporated with the red substance of the corallum there, and projecting upwards present, when the soft parts above them are removed, an echinated appearance, in which the ends of the spicules are simply branched or otherwise terminated in accordance with their forms respectively (fig. 2, *k*). Stolon compressed vertically (fig. 2, *b*); its wall in structure the same as that of the calycle; its cavity compressed in like manner, so as to be reduced to a minimum, like that in the horizontal plate of *T. musica* (fig. 2, *c*).

Size of specimen described about 6-12ths inch long, upon which there are eight calycles at variable distances from each other below 1-10th inch. Stolon, of which the growing ends are broken off up to the part where their spicules have become consolidated into the fully formed structure of the corallum, about 1-50th inch broad and 1-130th inch high, including the walls above and below, which reduces the vertical thickness of the cavity to 1-450th inch. Calycle about 1-36th inch high and 1-30th inch broad, including the walls; a little larger above than below.

Hab. Marine, on hard bodies.

Loc. Gulf of Manaar.

Obs. As before stated, the striking resemblance of this corallum to the test of *Polytrema miniaceum* in composition, structure, and colour, together with the presence of fragmentary sponge-spicules more or less incorporated with the corallum, led me to regard it at first as a species of this Foraminifer; but subsequent microscopical examination showed that it was almost identical with *Tubipora musica*, as the above description proves. However, I prefer its insertion here, and alluding to this hereafter by name in its proper place, for the purpose of pointing out its several characters in common with *Polytrema*, which otherwise might pass unnoticed.

Polytrema mesentericum, n. sp. (Pl. XVIII. fig. 3, *a–h*.)

(Rolled specimen.) Test massive, composed of more or less erect, thick, meandering laminæ united mesenterically. Consistence stony. Colour pinkish red (Pl. XVIII. fig. 3, 3 *a*). Surface (*i.e.* vertical sides of lamina) uniformly dimpled and foraminated (fig. 3 *b*, *h*); margin worn away by attrition (fig. 3, *c*). Internal structure of lamina consisting of cells or chambers of different sizes, the largest and most regularly formed of which are arranged cortically, where their outer wall is pierced by the pore-tubulation, whose apertures on the surface are the foramina before mentioned (fig. 3, *c*, *d*, *e e*); opening internally into a cancellated axial structure, whose cavities, communicating freely with each other, finally open at the margin in a corresponding position with respect to the cortical chambers (fig. 3, *d*, *g*); thus presenting a more compact structure between the layers of the latter, which, in the absence of the real margin now worn away, presents the appearance of a stony polyzoarium of a similar form. Fragments of sponge-spicules incorporated here and there with the substance of the test (fig. 3, *d*, *i*). Size of specimen, which is now rounded by attrition, subelliptical and compressed vertically, 3-4th inch by 7-12th inch in its greatest horizontal diameters, and about 1-4th inch thick; lamina 1-16th inch in transverse diameter.

Hab. Marine.

Loc. ?

Obs. Although none of the exposed chambers at present contains any sponge-spicules (probably from their having been washed out), and the structure of the margin is worn away, yet by the presence of fragments of sponge-spicules incorporated with the substance of the test, and the character of the structure of the lamina internally, there can be very little doubt that when in a perfect condition it closely resembled *Polytrema cylindricum* in these respects. Still its peculiar form and size not only claim for it a separate designation, but the latter precedence also of all other species of *Polytrema* that have been publicly noticed. Comparing its form with that of the figure of *Theone*, Lamouroux (Jurassic fossil from Caen), given by De Blainville, Man. d'Actinol. Atlas, pl. lxvii. fig. 2, one cannot help being struck with their great resemblance. In many respects also it closely resembles the mesenteric forms of several exotic Polyzoaria.

Genus Gypsina.

Gen. char. Massive, sessile or free, incrusting indefinitely or circumscribed and defined; surface uniformly tessellated

by foraminated interstices variable in form and separated from each other by reticulated lines of translucent shell-substance, which is frequently very prominent and transparent at the angles, forming the ends of a columnar structure in which the cells are united laterally by holes of intercommunication, and above and below by a foraminated plate, like that of the "interstice" on the surface, through which the innermost cell thus indirectly obtains communication with the exterior. No oral aperture. No canal-system.

Such are the characters of this genus, which is founded on the species, *Gypsina melobesioides*, that I described in 1877 ('Annals,' vol. xx. p. 172); but as the facts leading to it were communicated at intervals, and are now confirmed by specimens of each of the species contained in the genus, from the Gulf of Manaar, I will briefly recapitulate what has been stated.

When I showed, in March 1877 ('Annals,' vol. xix. p. 215 *et seq.*), that *Tinoporus vesicularis*, Carpenter (Introduction, p. 224, pl. xv. figs. 1–3), had "no generic affinity with De Montfort's *T. baculatus*," I was not aware of the existence of the incrusting species to which I gave the name of *Gypsina melobesioides* (*op. et loc. cit.*); but seeing that the structure of the latter was identical with that of Dr. Carpenter's *Tinoporus vesicularis*, I at once realized the necessity of changing the generic name of the latter also to *Gypsina*, thus making it *G. vesicularis*, Carpenter (*ibid.*). Had Dr. Carpenter, instead of applying De Montfort's name of *Tinoporus* (*T. baculatus* being a *Calcarina*), given it a new name, then this might have been used instead of the one I have proposed.

Further, I observe that the Foraminifer to which I gave the name of "*Polytrema planum*" ('Annals,' 1876, vol. xvii. p. 211, pl. xiii. figs. 18, 19), and which came from the south-west coast of Australia, was a specimen of *Gypsina melobesioides*; hence its name also will have to be suppressed, at the same time that another locality is thus added to those already noticed of *G. melobesioides*, viz. the Mauritius, the West Indies, and, lastly, the Gulf of Manaar.

Gypsina melobesioides, sp. 1877.

There are four specimens of this species among the dredgings from the Gulf of Manaar, two of which nearly cover globular nodules of *Melobesia*, respectively half an inch in diameter, with an incrustation about 1-48th inch thick and twelve cells deep. The other two are also on the surface of similar nodules, but not so extensive. The incrustation spreads itself continuously over whatever irregularities may

be in its way, so as to give the whole the appearance of being frosted with sugar like a bridecake; hence it is very likely, without the aid of a microscope, to be confounded with *Melobesia* as well as the white incrustation of some Gorgonias.

Gypsina vesicularis, Carpenter.

Several specimens of this species also occur, in the sessile and free forms respectively. The sessile is hemispheroidal and for the most part the largest, while the free one is spheroidal and much smaller. Frequently the hemispheroidal form is sunk into the flat surface of a Coralline, subtridentate articulation (*Flabellaria opuntia*), where it is covered by a thick sarcodic cuticle; and in this state I have specimens also from the Straits of Carimata, on the west coast of Borneo; while the spheroidal variety, being free, may be found anywhere. The former is well described and illustrated by Dr. Carpenter (Introduction, p. 225 &c., pl. xv. figs. 1–3); and I have illustrated the structure of the latter ('Annals,' 1877, vol. xix. pl. xviii. figs. 18–20).

Testamœbiformia, new group.

Char. Amœbiform, testaceous.

Hitherto almost exclusive attention has been given to the *free* Foraminifera, whose exquisitely varied forms, although in many instances microscopic, have not unnaturally proved as attractive as the frustules of the Diatomaceæ; so that it has become an object of great search among them to find out a new form, although it can hardly be seen by the unassisted eye. This to the specialist is a matter of paramount importance, but to the biologist one of insignificance compared with the less attractive and larger forms, which tend to reveal the life-history and connexions of the class generally.

For some time past I have anticipated the existence of amœbiform Foraminifera, differentiated only by the peculiarity of their respective pseudopodial expansions; but, of course, this cannot be ascertained except by minute and laborious examination of the *living* so-called "*Bathybius*," which probably abounds with them after the manner of freshwater rhizopods, forming a similar slime to that which may often be observed over the bottom of stagnant (*i.e.* still) freshwater pools. I was not, however, prepared to find that some of these ever-changing forms were stereotyped, as it were, by the permanent secretion of a calcareous test, until the Melobesian nodules from the Gulf of Manaar came under my notice, when I observed two well-characterized forms to be very abundant in

them, which I will now describe under the generic names *Holocladina* and *Cysteodictyina* respectively, having already above defined the general characters of the group under the term *Testamœbiformia*.

Holocladina pustulifera, n. sp.
(Pl. XVIII. fig. 4, *a–g*.)

Test radiciform, polychotomous, free towards the centre, fixed by the terminations of the rootlets at the circumference. Consistence hard. Composition calcareous. Colour white (Pl. XVIII. fig. 4). Surface even, pustuliferous, pustuliform eminences of different sizes scattered over the surface irregularly (fig. 4, *e*), plentifully about the centre, sparsely on the branchlets, in the form of smooth, hemispherical projections, varying in diameter under 1-600th inch, terminating in a slight papillary eminence with a punctum in the centre (fig. 4, *b*, *c*), sometimes extended into a short conical spine (fig. 4, *d*); ends of the rootlets subpalmate, terminating in amorphous granular projections (fig. 4, *h*), alternating with conical processes, which appear to be perforated at the extremity respectively; and if so, here would be the oral apertures (fig. 4, *g g*). Surface of the test between the pustuliform eminences bearing the appearance of being so minutely micropunctate as to be hardly distinguishable under a high power. Internally, structure of the test-wall, which varies in thickness under 1-50th inch, composed of extremely minute tubules in juxtaposition, perpendicularly descending from the surface to the interior (fig. 4, *f*), which in its dried state is now hollow and without foreign material, but still presenting the remains of the sarcode in the form of a thin yellow layer adherent to the inner surface of the test. Size of most perfect specimen about a quarter of an inch in its longest diameter.

Hab. Marine, in the crevices of Melobesian nodules.

Loc. Gulf of Manaar.

Obs. It is evident from the form of this test that the living animal possessed an amœboid form; but whether both were developed successively (that is, one part after another like the crust on a stream of lava), or the living animal was fully developed before the test was secreted, there is no evidence now to show, beyond the presumption that the former was most likely the case. The absence of all foreign material in the interior, together with its form, distinctly separates it from the genera *Carpenteria* and *Polytrema*, while it chiefly differs from *Aphrosina* (Journ. Roy. Microscop. Soc. 1879, vol. ii. p. 500, pl. xvii. figs. 5–10) in not being multilocular. No oral apertures were satisfactorily seen; but it may fairly be

inferred, as above stated, that each of the conical projections on the terminal branchlets bears one, through which a pseudopodium issues during the living state, in search of that subtile kind of nourishment which the present emptiness of the test indicates to have been the nature of the aliment.

Cysteodictyina compressa, n. sp.
(Pl. XVIII. fig. 5, *a–e*.)

Test bladder-like, flat, compressed, interrupted in its continuity by holes of different shapes and sizes, which thus give it a reticulated appearance (Pl. XVIII. fig. 5); spreading flatly over the surface of hard bodies, and thus following their irregularities. Consistence firm, but fragile from its thinness. Composition calcareous. Colour white, yellowish, or lilac. Surface even, uniformly punctate; puncta distinct, in juxtaposition; circumference terminating in short radiciform expansions like those of *Holocladina*, viz. in conical points (fig. 5, *d d*), mixed with an amorphous structure here and there like calcareous sand-grains (fig. 5, *e e*). Internally, test almost too thin for measurement, traversed vertically by tubules in juxtaposition extending inwards from the surface, terminating on the inner side in the midst of their prismatic divisions respectively (fig. 5, *b*). Cavity of the test without foreign material, continuous, and presenting the same kind of dried sarcodic lining as that of *Holocladina*. Size of most perfect specimen about half an inch in its longest diameter, by about a quarter of an inch wide and about 1-160th inch thick. Wall, as before stated, almost too thin for measurement.

Hab. Marine, on the surface of hard bodies and in their crevices.

Loc. Gulf of Manaar.

Obs. This species differs from *Holocladina* in not being branched, but membraniform and lobate, in the greater thinness of the test-wall, the absence of pustuliform eminences on the surface, and the larger size of the pore-tubulation. In other respects the same observations apply to it as to *Holocladina*. The amorphous sand-like development here and there on the processes of the circumference reminds one of the amorphous structure at the ends of some tendrils in the vegetable kingdom, and may serve a similar purpose.

CERATESTINA, n. gen.

Gen. char. Test horny; colour dark amber, translucent.

The composition of the test here brings us one degree nearer than that of the Testamœbiformia to the absolutely

naked Foraminifer, to whose conjectured existence I have before alluded; but lest it might be thought that it is merely the chitine without the calcareous material which characterizes this genus, it should be mentioned that, if a specimen of *Ceratestina* and an ordinary calcareous test of a Foraminifer together be exposed to the influence of an acid solution (*ex. gr.* dilute nitric acid), the latter will be dissolved and leave scarcely any residue, while the former remains unaffected, proving that the horny substance of the *Ceratestina* is something more than the chitine which may support the calcareous material; indeed the best way of extricating a *Ceratestina* is to put the calcareous substance containing the specimen into a strong solution of nitric acid, which, all know, is instant destruction to a calcareous test. This kind of Foraminifer, besides occurring in the cavities excavated by lithodomous sponges in the Melobesian nodules of the Gulf of Manaar, is often observed on the *surface* of old coral. In *some* cases the foraminiferal test is composed in one part of the ordinary calcareous material, and in the other of the horny substance only, which condition is so usually seen in one species that it would appear to be rather natural than accidental. I allude to a species which I have figured and described, conjecturally, as the "embryonic form" of *Carpenteria monticularis* ('Annals,' 1877, vol. xix. p. 213, pl. xiii. fig. 11), but which now, finding it to be a distinct species, I would name "*Carpenteria microscopica*." The chambers of *Carpenteria utricularis* and also the cells of *Polytrema miniaceum* are often lined by a stiff horny layer of considerable thickness; but under what circumstances, I am ignorant, as it does not occur always; this, however, is secondary and must not be confounded with *Ceratestina*, in which the horny structure is primary and permanent.

Ceratestina globularis, n. sp.
(Pl. XIX. fig. 6, *a–g*.)

Test composed of four or more subglobular chambers developed one after another from a primary or embryonic cell, which is subspheroidal and presents the first bud of the stolonic siphon. Composition horny. Colour dark amber (Pl. XIX. fig. 6). Chambers increasing in size as they are successively developed upon the stolonic siphon (fig. 6, *c*) proceeding from the embryonic cell, which is the smallest (fig. 6, *a*); arranged more or less spirally, fitting upon each other, as they are successively developed, by the convex surface of the preceding being received into a lunate one of the following chamber (fig. 6, *c*), and all tied together on the inner side of

the spire by the stolonic siphon mentioned (fig. 6, *c*). Surface of the chamber smooth, indistinctly microspinate and micropunctate (fig. 6, *e*). Size of the group about 1-36th inch in diameter.

Hab. Marine, in minute cavities of the Melobesian nodules, which have been excavated by lithodomous sponges.

Loc. Gulf of Manaar.

Obs. Besides the specimens which come from the cavities above mentioned *in* the Melobesian nodules, I possess pieces of old *Stylaster sanguineus* from the South Pacific Ocean bearing several specimens on the *surface* (fig. 6, *f*). Like the last chamber in the figured specimen from the Gulf of Manaar, which has put forth two stolonic knotted tubular filaments and was in the act of putting forth more (fig. 6, *d d*), some of those on the surface of the *Stylaster* coral are connected with a similar filament. How far the chambers of those from the Gulf of Manaar were originally arranged together in juxtaposition and spirally I am not able to state, further than that their forms indicate it, since to see them satisfactorily it was necessary to dissolve them out of the Melobesian substance with acid and mount them in Canada balsam, during which the chambers became separated.

Ceratestina tessellata, n. sp.
(Pl. XIX. fig. 7, *a–h*.)

Test lobular, adenoid, connected with a crooked, knotted, stolonic filamentous tube. Consistence horny. Colour dark amber (Pl. XIX. fig. 7, *a*, *b*). Developed upon a stolonic tubular filament in a globular form (fig. 7, *c*), which, becoming multiplied as the mass increases in size, passes into a lobulated group whose walls are traversed by straight unbranched lines of fibre intersecting each other at various angles, and thus giving the surface a meridionated or tessellated appearance (fig. 7, *d*), not rising above the level of the outer surface, but sending inwards processes which in the living state may have supported delicate partitions, and thus have rendered the interior multilocular (fig. 7, *f*). External surface of the wall smooth, with the exception of microscopic points which are sparsely scattered over it (fig. 7, *h*). Stolonic tubular filaments, which are often knotted (that is, bearing several successive dilatations and here and there conical processes indicative of budding development), hollow, and characterized throughout by the tessellated fibrous structure above described, only in a less visible degree (fig. 7, *g*). Size of largest group or specimen 1-25th by 1-45th inch in its greatest dimensions.

Hab. Marine, in cavities of the Melobesian nodules, which have been excavated by lithodomous sponges.

Loc. Gulf of Manaar.

Obs. In composition, colour, and position, together with the micropointed surface and its connexion with the crooked, knotted, filamentous, stolonic tubulation, this organism resembles *Ceratestina globularis* more than any thing else that I know of; but there is no visible appearance of punctures in the wall. The knotted form of the stolonic tubulation reminds one of the successive moniliform chambers in the so-called Placopsiline Lituolida—equally so in form, although not in consistence, of the creeping tubulation of the Saprolegnieæ and Myxomycetic fungi, to which in nature the Foraminifera very nearly approach. In consistence, however, they are more like the penetrating developments of the kerataceous sponges, but in structure totally different; for the fibre in the latter is not only infinitely branched, but, in all instances that I am aware of, cactiform—that is, puckered up into little monticules on the surface, which is thus rendered most uneven.

One cannot help here associating the amber colour of *Ceratestina* with the bright brown, or red cinnamon colour of most of the Lituolida, which appears to be thus modified by admixture of the chitine in the latter with the white mineral substance of which the test is otherwise composed.

Subsessile Species of Foraminifera.

Genus Rotalia, D'Orbigny.

The genus *Rotalia*, sometimes parasitic, but, according to Williamson, "usually free," is under the former condition characterized by being flat on one side, by which it adheres to the object on which it may be fixed, and convex on the other; but although many of the latter may be easily detached without injury, still there is one in particular, viz. *Rotalia spiculotesta* ('Annals,' 1877, vol. xx. p. 470, pl. xvi. figs. 1–3), which is so thin and delicate, and so firmly fixed to the object on which it may be growing, that it may be fairly inferred that it remains in this position for the whole period of its existence. As I have found several specimens of this species on the Melobesian nodules of the Gulf of Manaar, and hitherto have only had one to describe from, viz. that to which I have alluded (*op. et loc. cit.*), although Mr. H. B. Brady has obtained three from the Red Sea, whereby he has been able to ascertain that the composition of the spiculiform bodies in the test is calcareous, still it is desirable that I should state, by way of confirmation, what

the Manaar specimens have revealed respecting this beautiful little organism.

Rotalia spiculotesta, sp. 1877.

To the description of this species given in the 'Annals' of 1877 (*l. c.*), and the intimation of Mr. H. B. Brady that he had obtained three specimens out of "dredgings" from the Red Sea, whereby he had been able to ascertain that the spiculiform bodies of the test were calcareous, I have little to add. In the first place, then, it is evident that the number of specimens about the small amount of material from the Gulf of Manaar indicates that it is very plentiful there; they (six) are all about the same size as that which I originally described; and if any difference exists between the two, it is simply that the spiculiform bodies in the Gulf-of-Manaar specimens are more quadrangular or oblong than elliptical, while they are the reverse in that to which I have alluded, viz. that which came from the South Pacific Ocean; they are respectively fixed upon the surface of the Melobesian nodules; and, with so much material, I have been able to mount a fragment of the test in Canada balsam for examination of the spicules under a higher power, whereupon they seem to me to be solid and the granular matter between them to consist of microscopic bodies of the same form, although of different sizes. I have also been able to confirm Mr. Brady's observation that they are calcareous, inasmuch as they dissolve entirely, with effervescence, in dilute nitric acid.

Although all the specimens to which I have alluded appear to contain nothing but the spiculiform bodies in their tests, I have met with some smaller (? young) specimens of the same Foraminifer about the Melobesian nodules, which, when mounted in balsam, show that their tests are at this period composed of a heterogeneous assemblage of microscopic bodies (? calcareous sand), in the midst of which one or more of the genuine spicular ones form prominent features, from their large size and isolated condition. Thus it may be that sometimes the test is composed of foreign material as well as bodies produced by the animal itself—a condition among the testaceous freshwater Rhizopoda to which Dr. G. C. Wallich has alluded in his valuable paper "on Structural Variation among the Difflugian Rhizopods" ('Annals,' 1864, vol. xiii. p. 233 &c.).

Free Species of Foraminifera.

As it is not my object to give a list of all the free forms of Foraminifera that occur about the Melobesian nodules, it will

be restricted to those only whose size renders them most conspicuous, none of which sensibly exceed an eighth of an inch in diameter; and these belong to D'Orbigny's genus *Amphistegina*, for a more intimate acquaintance with which I must refer the reader to Profs. Parker and Jones's account (*apud* Carpenter, 'Introduction,' p. 242).

AMPHISTEGINA, D'Orbigny.

On the borders of the Indian Ocean there are several species of these nummuline forms; and although they may vary slightly in their structural features here and there, for some of the "borders" are very wide apart (*ex. gr.* the Gulf of Aden and the south-west corner of Australia), still the genus extends to all of them; and therefore the Gulf of Manaar is not without its representatives, among which is the well-known *A. mammillata* of D'Orbigny. There is also another compressed globose form, unless it be the thick part of a *Heterostegina* worn down to this, with the same kind of structure as *Heterostegina*, and a third, which is the largest of all, wherein the chambers are extremely numerous and regular, closely approximated, awl-shaped, and much recurved, with a thick nummuline marginal cord between the whorls.

Calcarina calcar, var. *hispida*, n. var.

The same remarks respecting the varietal differences apply to *Calcarina calcar*, which is found in the Red Sea, at the Mauritius, and, under the form of *Trioporus baculatus*, in Polynesia, while it is also abundant in the Gulf of Manaar, but here under the hispid form mentioned. This hispid state bears the same relation to *Calcarina calcar* as the hispid form of *Calcarina Spengleri* bears to the latter species in Polynesia, well shown in Dr. Carpenter's representation ('Introduction,' pl. xiv. fig. 6). All, not averaging more than 1-24th inch in diameter, are much smaller than *C. Spengleri*, while it is not unusual to find the hispid form of the latter, like that of the former, sunk into the flat surface of an articulation of *Flabellaria opuntia* side by side with *Gypsina vesicularis*.

Alveolina sinuosa, n. sp. seu var.

The genus *Alveolina* also occurs on the borders of the Indian Ocean generally; but whether that from the south-west coast of Australia has been named or not I cannot say. Suffice it to state, then, that if so, *A. sinuosa* must be considered a variety; for I can see very little difference between it and that which occurs on the coast of Australia, as well as the

others that I have found about the Melobesian nodules of the Gulf of Manaar, beyond its larger size and sinuous form, it being a quarter of an inch long by 1-24th inch in its greatest transverse diameter.

Hydroid Zoophyte.

Family **Hydractiniidæ**, Hincks.

Hydradendrium, n. gen.

Gen. char. Polypary dendriform; stem solid, with the exception of a small medullary canal, thickly spined.

Hydradendrium spinosum, n. sp.
(Pl. XIX. fig. 8, *a–g*.)

Polypary dendriform, slender; stem erect, branched; branches alternate, about 1-24th inch apart, irregular in length and disposition around the stem, extending upwards and outwards from the fixed to the free end, becoming shorter towards the latter; sometimes subdivided, but generally giving off on each side a regular series of branchlets, arranged alternately and plumosely, from which again spring sparsely a third set, chiefly on one side. Consistence horny. Colour dark amber, translucent (Pl. XIX. fig. 8). Stem and branches smooth, except where interrupted by the presence of spines; the latter also smooth and directed upwards and outwards, in longitudinal lines, wherein they are arranged alternately in adjoining rows, the rows increasing in number with the size of the stem; spine round, conical, slightly curved upwards, varying in size from a slight indication at the growing ends of the branches respectively to 1-200th inch in length where fully developed (fig. 8, *b–f*). Stem solid, with the exception of an axial canal which traverses continuously every part of the structure, and contains the sarcode upon which the whole has been developed; hence at the extremities of the branches the latter is thicker in proportion to the horny material than at any other part (fig. 8, *c*, *d*), composed of concentric layers through which branches radiate from the axial canal to the branches themselves and to the spines respectively (fig. 8, *c*), terminating in the latter a little distance from the point, which is therefore imperforate and itself formed by concentric layers on the branch of sarcode first emanating from the medullary or axial canal (fig. 8, *e*). Diameter of largest fragment of stem found 1-90th inch, that of the axial canal in the same 1-600th inch. Cœnosarc covering the surface of the skeleton, but not now elementarily distinguishable, on account of the specimen having been dried. Spine often bifid, but where

developed from the cœnosarc extending over foreign substances enlarged, dichotomously branched one or more times, and thus rendered dendriform (fig. 8, *a*, *g*). Largest and most perfect specimen, which is that figured, about 2 inches long and $1\frac{3}{4}$ inch in its broadest part; stem of the same at the lower end, which has been broken off, 1-60th inch in diameter.

Hab. Marine, growing on hard objects.

Loc. Gulf of Manaar, in 65 fathoms, N. lat. 7° 18′. Western coast of Ceylon.

Obs. It may seem premature to some to establish a new genus of Hydractiniidæ on the mere skeleton of a Hydroid Zoophyte; but the characters of the family are so peculiar that, to those acquainted with the species which have been described, there is little risk of error in this respect. The generic distinction, however, is founded on the solidity of the structure, which in all other instances hitherto noticed is formed of reticulated fibre, like that of *Hydractinia echinata*. From the number of fragments of *Hydradendrium spinosum* among the Manaar dredgings, it would appear to be very plentiful in this locality. Under the microscope, when fully divested of the cœnosarc, the regularity of the spination and clear amber-colour of the whole stem, make it a beautiful object. In development, of course, the skeleton is formed upon the embryonic sarcode, which thus becomes separated from the cœnosarc of the exterior, although it is probable that subsequently the latter, which must have sprung from the former too, in the first instance, adds the greater portion of the horny material in layers, like the sarcode of the sponges to their structures both horny and siliceous. That the cœnosarc can do this is proved by the forest of dendriform spines which it develops from its surface when extending from the stem to other bodies, as shown in the illustrations (fig. 8, *a* & *g*).

EXPLANATION OF THE PLATES.

Plate XVIII.

Fig. 1. *Polytrema cylindricum*, n. sp., *in situ*, showing the sponge-spicules projecting from the apertures in the ends of the branches respectively: *a*, horizontal section, to show the cortical and medullary cell-structure (magnified 2 diameters); *b*, form of cell about the ends of the branches, broken open; *c*, aperture with sponge-spicules on their way to the interior; *d*, the same in the interior; *e*, portion of surface of pillar, to show the arrangement of pores &c.; *f*, fragment of outer wall of cortical cell, cut horizontally to show the sunken pore-tubules; *g g*, tubules. (All on scale of 1-48th to 1-1800th inch.)

Fig. 2. *Tubipora reptans*, n. sp., *in situ*, showing the calycles and their

stolon (magnified 2 diameters). *a*, calycle, with portion of stolon cut off to show the vertically compressed form of the latter and cavity respectively; *b*, vertical section of stolon; *c*, compressed cavity; *d*, lateral view of tentaculated head when restored to position (ideal); *e*, end view of same sunk into the calycle: all relatively magnified on the scale of 1-144th to 1-1800th inch. *f*, form of young spicule; *g*, matured form (diagrams). *h*, fragment of the corallum, to show pore-openings between the calcareous tubipora-spicules, now otherwise consolidated; *i*, fragment of siliceous sponge-spicule imbedded in the same: scale 1-48th to 1-1800th inch. *k*, sponge-spicules imbedded in the corallum at the bottom of the calycle, as seen on looking down through the end of the latter (diagram).

Fig. 3. *Polytrema mesentericum*, n. sp., nat. size of specimen. *a*, portion of mesenteriform lamina, to show—*b*, pore-surface on the sides and, *c*, cortical and medullary cell-structure in the horizontal section: magnified 2 diameters. *d*, horizontal section of fragment, more magnified, to show—*e e*, pore-tubules, *f f*, cortical cells, and *g*, medullary cell-structure; *h*, fragment of surface, to show pore-openings (diagrams).

Fig. 4. *Holocladina pustulifera*, n. sp., suspended across a crevice in the Melobesian nodule, into which the ends of the branches are for the most part inserted, therefore represented as cut off (magnified about 16 diameters). *a*, average natural size. *b*, end view of large pustuliform eminence; *c*, the same, lateral view; *d*, the same, with summit extended into a spinous form: scale 1-24th to 1-1800th inch. *e*, end of branchlet, much magnified, to show the distribution and unequal size of the pustuliform eminences, also *f*, the structure and thickness of the test, *g g*, the conical, and *h*, the amorphous terminations respectively (diagrams).

Fig. 5. *Cysteodictyina compressa*, n. sp., in contact with the surface of the Melobesian nodule, represented as cut off at each end where the continuation of the circumference was not seen (magnified about 16 diameters). *a*, average natural size; *b*, fragment of surface, much magnified, to show the prismatic structure of the pore-tubulation; *c*, end of circumferential lobule, much magnified, to show thinness of test and punctate surface, also *d d*, conical, and *e e*, amorphous terminations respectively (diagrams).

Plate XIX.

Fig. 6. *Ceratestina globularis*, n. sp. *a*, embryonic or primary cell; *b*, terminal cell or chamber; *c*, connecting stolon; *d d*, crooked and knotted stolonic tubulations put forth by the last chamber; *e*, microspinous processes on the surface of the chamber; *f*, groups of *Ceratestina* on the *surface* of old *Stylaster sanguineus* from the S. Pacific Ocean; *g*, aperture of terminal cell: scale 1-24th to 1-1800th inch.

Fig. 7. *Ceratestina tessellata*, n. sp. *a*, globuliferous or adenoid portion; *b*, stolonic tubes: magnified about 16 diameters. *c*, commencement of the growth of a globuliferous portion on a stolonic tube; *d*, globuliferous portion, much magnified, to show meridionate or crossing lines of fibre in the horny wall, producing the tessellated appearance; *e*, stolonic portion; *f*, internal processes; *g*, end of stolon, more magnified, to show that it also

presents the tessellated appearance; *h*, tesseral division, much magnified, to show microspinous processes (diagrams).

Fig. 8. *Hydradendrium spinosum*, n. gen. et sp., natural size of specimen. *a*, growth of dendriform spines (see *g*); *b*, portion of stem, much magnified, to show rows of spines, viewed laterally; *c*, horizontal section of stem and spines, to show that the stem is composed of concentric laminæ developed on *d*, the axial canal, from which *pari passu* are developed the spines: scale 1-48th to 1-1800th inch. *e*, spine, much more magnified, to show that it also is composed of concentric laminæ, but solid and imperforate towards the free end; *f*, end of branch, to show commencement of spinal development on the medullary sarcode: scale 1-24th to 1-1800th inch. *g*, dendriform growth of spines produced by the cœnosarc (see *a*): scale 1-48th to 1-1800th inch.

[To be continued]

XLI.—*On a Collection of Crustacea from the Malaysian Region.*—Part IV. Penæidea, *Stomatopoda*, *Isopoda*, *Suctoria*, *and Xiphosura.* By Edward J. Miers, F.L.S., F.Z.S.

[Plate XV.]

[Concluded from p. 384.]

Penæidea.

Penæus avirostris, Dana.

W. Borneo.

I refer to this species two female specimens of *Penæus* in the collection. They agree with Dana's description in the form of the rostrum, fifth ambulatory legs, &c. In both the rostrum is prolonged backward into a somewhat indistinct median dorsal carina, which, however, is obsolete near the posterior margin. The rostrum, in the only perfect specimen, is 7-toothed above.

This species was not represented in the Museum collection when I wrote my analytical table of the species of *Penæus* (P. Z. S. 1878, p. 306); and the examination of the foregoing examples shows that it should be classed (in that synopsis) in the neighbourhood of *P. monoceros* and *P. Dobsoni*, on account of the distinct dorsal ridge of the carapace.

Penæus sculptilis, Heller.

W. Borneo (a female).

This specimen agrees very well with the description and figure of Heller, based on examples from Java. Like the

nule-like, round, smooth scales, not imbricate;" while *C. marmoreus* is again placed in the genus *Tonicia* of Gray, which is described as having the "mantle simple, horny, naked, smooth, or glabrous." *C. mediterraneus*, Gray (probably meant for *C. siculus*, Gray, = *C. olivaceus*, Spengler), is placed in both the genera *Lepidopleurus* of Risso and *Leptochiton*. *C. Hanleyi*, Bean, = *C. mendicarius*, Mighels, has the same kind of sculpture as *C. scabridus*, and belongs to the genus *Chætopleura* of Shuttleworth.

I may mention that *C. cancellatus* was sent me by the late Professor Sars as his *C. alveolus*; but the latter, as since described and figured by his no less eminent son, is a different species.

VIII.—*Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Capt. W. H. Cawne Warren.* By H. J. Carter, F.R.S. &c.

[Continued from vol. v. p. 457.]

[Plates IV.–VI.]

SPONGIDA.

The descriptions of the Spongida found in and about the Melobesian nodules from the Gulf of Manaar will, so far as they go, be arranged after the classification proposed in my "Notes," &c. ('Annals,' 1875, vol. xvi. p. 128 *et seq.*); so to this I must refer the reader for the characters of the orders &c. respectively.

In the measurement of the spicules it should be remembered that their form is of much more consequence than their dimensions, as the latter may vary:—1st, in different specimens; 2nd, in the same specimens (as they present themselves under all degrees of development); and 3rd, in the same species, where the average largest vary in proportion to their stoutness, the stoutest being the shortest, and *vice versâ*. My measurements are taken from the average largest of the specimens, as *these* may be assumed to represent the ultimate size, and will be given in parts of an inch, for the purpose of conveying an idea of the *relative* rather than the *real* size of the spicules; while, to avoid repetition, it may be stated here, once for all, that, unless otherwise mentioned, they will refer to the *greatest diameters* of the object. It should not be forgotten that all the specimens are *dry*.

Ceratina.

Aplysina purpurea, n. sp.

Form irregular, membranous, hollow, cactiform on the surface. Colour black-purple. Fibre weakly developed, so that, when elementarily examined, nothing can be distinguished beyond a laminated condensation of the membranous structure densely charged with purple pigment-cells like that of *Ianthella flabelliformis*, Gray (Proc. Zool. Soc. Jan. 1869, p. 50), extending among the Melobesian nodules and detritus of the sea-bottom, so as to form an agglomeration in which the contrast of the dark pigment-cells and the purple stain that accompanies them with the whiteness of the fragments over which the sponge may be spreading is very striking, even to the naked eye. In this respect it is very like *A. nævus* ('Annals,' 1876, vol. xviii. p. 229, pl. xii. fig. 2).

I also possess a large specimen of a similar sponge from Trincomalee, on the N.E. coast of the island of Ceylon, in which the purple colour is not so dark, but the fibrous structure is almost entirely absent, although the surface is cactiform and drawn up into puckered monticules; so the latter is not always dependent on the presence of fibre. It is pyramidal in shape, compressed, and 5 inches high, with a base also 5 inches long and 2 inches thick.

Aplysina fusca, n. sp.

Massive, digitate, hollow, cactiform on the surface. Colour dark brown. Growing like the last. Fibre well developed, of a light brownish colour, opaque, hollow in its dry state, with the axial cavity largely developed in proportion to its horny investment.

Psammonemata.

Hircinia arundinacea, n. sp. (provisional).

This imperfect specimen, which is in long stalks about 1-6th inch in diameter and of a light yellow colour, has had its sarcodic parts replaced by the parasite which usually attacks the *Hirciniæ* in all parts of the world, viz. *Spongiophaga communis*.

Hircinia fusca, n. sp. (provisional).

Massive, digitate, branched lobate, cactiform on the surface. Colour dark brown. Growing like the species of *Aplysina* above described, but solid and charged with fibre covered with foreign material.

Rhaphidonemata.

The Chalinida are only represented by a mere amorphous fragment not more than an inch in diameter, in which the fibre is resilient as usual, and charged with small acerate spicules only.

Desmacidon Jeffreysii, Bk.

This species, described by Dr. Bowerbank, under the name above given, in his Mon. Brit. Spong. (vol. ii. p. 347, and figured in vol. iii. pl. lxii.), also by the Rev. A. M. Norman under the generic name of *Oceanapia* (Brit. Assoc. Report, 1868, p. 334), is, with a slightly varied form, found in the Gulf of Manaar, where the body portions (for there are two specimens) are not more than an inch in diameter respectively, although the tubular extensions are much branched and upwards of 6 inches in length, covered with an overgrowth of other organisms, together with sea-bottom detritus which nearly obscures the surface both of body and tubes. Internally, however, it is essentially the same as *Desmacidon Jeffreysii*, but with the exception that it contains no flesh-spicules—that is, minute bihamates (*fibulæ*),—thus resembling that from the south coast of Australia, where it also occurs, but more under the British form, viz. turnip-like; while the British form *does* contain the bihamates, as mentioned by Mr. Norman (*l. c.*), and found by myself in the identical specimen figured by Dr. Bowerbank (*l. c.*), although the latter has neither figured nor mentioned them in his description or illustrations (B. S. vol. iii.).

In classification, I feel inclined to place this sponge among the Cavochalinida, on account of its fibrous structure charged with simple acerate spicules, and its hollow tubular extensions; but it should, I think, be considered the type of a distinct group.

Echinonemata.

Dictyocylindrus manaarensis, n. sp.

(Pl. IV. fig. 1, *a–g*.)

Stalk-like, erect, cylindrical, branched dichotomously; branches round, obtusely pointed (Pl. IV. fig. 1). Consistence firm. Colour now dark brown. Surface slightly hispid. Structurally consisting of spicules in juxtaposition, arranged in tufts perpendicularly round a condensed axis of a like nature. Spicules of six forms, viz.:—1, long, smooth, curved, acuate, 45 by $1\frac{1}{2}$-1800th (fig. 1, *a*); 2, shorter, smooth, curved, acuate, proportionately stouter, with inflated

microspined round head, 27 by $1\frac{1}{2}$-1800th (fig. 1, *b*); 3, hair-like, smooth, acuate, about 17-1800ths long (fig. 1, *d*); 4, thick, fusiform, slightly curved, shaft with inflated round and microspined extremities, 17-1800ths long (fig. 1, *c*); 5, flesh-spicule, smooth, tricurvate, 12-6000ths long (fig. 1, *e*, *g*); 6, flesh-spicule, equianchorate, naviculiform, 4-6000ths long (fig. 1, *f*, *g*). Nos. 1–4 form, in plurality, the tuft, of which 3 is the most numerous, and all have their long axis respectively outwards; 5 and 6 are plentifully distributed about the base of the tuft. Size of specimen (which is imperfect) about $1\frac{3}{4}$ inch long, stem 1-10th inch in diameter.

Hab. Marine. Growing on hard objects.

Loc. Gulf of Manaar.

Obs. This well accords with the genus *Dictyocylindrus* as established by Dr. Bowerbank. The thick short spicule with inflated and microspined extremities (no. 4) may be considered the echinating form.

Dictyocylindrus sessilis, n. sp. (Pl. IV. fig. 2, *a–d*.)

Massive, convex, sessile, spreading, becoming subhemispherical (Pl. IV. fig. 2). Consistence hard, rigid. Colour light brown. Surface uniformly uneven. Structurally composed of tongue-shaped columns radiating and branching from the base to the circumference, where they are more or less divided, and thus altogether, when dry, present the appearance of a cauliflower, consisting of tufts of spicules densely packed together, and rendered almost inseparable without fracture by their tough sarcodic union. Spicules of three forms, viz.:—1, large, stout, smooth, acuate, curved chiefly towards the blunt end, which is slightly larger than the shaft, 45 by 2-1800ths (fig. 2, *a*); 2, thin, hair-like, smooth, acuate, about 20-1800ths long (fig. 2, *b*); 3, flesh- or echinating spicule, shaped like no. 1, but spined throughout, sparsely towards the large end, 35 by 2-6000ths (fig. 2, *c*, *d*). The large acuates are surrounded by bundles of the hair-like ones, having the echinating spicule at their base, to form, all together, the "tuft." Size of specimen about 6-12ths inch high in the centre by $1\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. Growing on hard objects.

Loc. Gulf of Manaar.

Obs. In this, as in many other species of the Echinonemata, the tufts, when dissected out, will be found to be almost identical in form with those of *Microciona atrosanguinea*, Bk., showing not only an alliance between the two genera, but that *Dictyocylindrus* is only a more complicated structure of *Microciona*.

Microcionina.

I intended this family to include Dr. Bowerbank's genera *Microciona* and *Hymerhaphia* (Brit. Spong. vol. i. pp. 188, 189), chiefly because they are all thin, flat, incrusting and laminiform species, containing respectively a *setaceous* form of spicule, and another more or less allied to the echinating one of the Echinonemata.

The distinguishing character between these two genera, according to Dr. Bowerbank, is that the spicules of *Microciona* are arranged in tufts or "columns" (ex. gr. *M. atrosanguinea* = *Scopalina*, Sdt.), and those of *Hymerhaphia* are not. But the spiculation is more persistent than the "columns" in many instances, whereby the diagnosis would break down, as the *Microciona* thus becomes a *Hymerhaphia*. Taking an opposite view of the case, *Hymerhaphia vermiculata*, Bk., of course contains no "columns;" but *H. vermiculata*, var. *erecta* ('Annals,' 1876, vol. xviii. p. 307, pl. xii. fig. 4 &c.), does (that is, "fasciculi"), with identical spiculation; so here the diagnosis of *Hymerhaphia* breaks down. Again, Dr. Bowerbank's *Microciona carnosa* of 1866 is made identical with *Halichondria plumosa*, Johnston, 1870 (B. S. vol. iii. p. 61), and renamed *Microciona plumosa*. Now, considering that *Halichondria plumosa* grows up into an erect massive form, it must, according to Dr. Bowerbank's diagnosis, be a *Microciona* at one time, viz. when flat and incrusting, and at another not—that is, when it is erect and massive; hence I have proposed a group "Plumohalichondrina" for this and similar species, the most remarkable of which that I have seen comes from Port Elizabeth, South Africa, where it appears to be very abundant; it is large, branched, and compressed, like an elk's horn; and they all possess the *angulated* (Bk.) equianchorate, not the naviculiform spicule of *Microciona*.

Nor is it uncommon to find an Echinonematous sponge beginning in the flat form of a *Microciona* and then becoming erect, as appears to be the case with *Halichondria plumosa* just mentioned. But while this shows that the "columns" in *Microciona* are not of much generic value, it also points out that genera formed upon the characters of indigenous species are very likely to break down when applied to world-wide collections; yet the same may be said of the latter until *all* the species of a class are known.

There is still another of Dr. Bowerbank's genera which, both in spiculation and growth, is very nearly allied to these thin, flat, incrusting laminiform sponges, viz. *Hymedesmia*; but here, again, his chief distinguishing character, viz. the

"recumbent" or horizontal position of the linear spicules, seems to me to be by no means constant and often dependent on circumstances. Even in his description of *Hymedesmia stellata* (B. S. vol. ii. p. 150) he uses the term "hispid;" and in the species *Hymedesmia spinatostellifera*, to be hereafter described, I was obliged to seek for an illustration of the entire skeleton-spicule among *erect* or projecting ones in the more protected parts.

Dr. Bowerbank admits that all these three genera, which are given one after another in his 'British Spongiadæ,' are very nearly allied; and I now feel much inclined to place them *all* in my group Microcionina, although the Hymedesmina in my classification stand as the ninth group of my Holorhaphidota; but then the species which illustrate it (p. 197), viz. *Hymedesmia Johnsoni*, Bk., and *Desmacidon titubans*, have not the long, setaceous, acuate, or spinulate spicule which characterizes Dr. Bowerbank's original species (viz. *H. radiata* and *H. stellata*, described in 1866, B. S. vol. ii. pp. 149 and 150, and illustrated in 1870, vol. iii. pl. xxviii.), and which, together with its accompaniments, is characteristic of the kind of *Hymedesmia* that I should place in my group Microcionina. *Hymedesmia Johnsoni* and *Desmacidon titubans* would be much better placed alongside with Esperina, where they now are in my classification.

There are, however, species which have not this kind of spiculation, viz. the setaceous acuate, &c., ex. gr. *Rhaphidhistia spectabilis* ('Annals,' 1879, vol. iii. p. 300, pl. xxvi. figs. 13, 14 *a*); and there are specimens which may be so circumstanced as never to get beyond a thin lamina, although under other conditions they might grow up into erect forms: such is perhaps *Hymedesmia zetlandica*, Bk., judging from its spiculation *in the type specimen* now in the British Museum, which I should be inclined to regard as allied to *Halichondria plumosa*, in which case it would come under my Plumohalichondrina.

Having premised these remarks it will be understood that although hereafter I shall describe the species of *Hymedesmia* found on the Melobesian nodules among the Holorhaphidota, yet I am of opinion that *they* ought to be under the Echinonemata, in the group Microcionina, together with the following ones of *Microciona* and *Hymerhaphia*.

Microciona atrosanguinea, Bk., and *M. armata*, Bk.

Both these species occur on the Melobesian nodules, now of a red-cinnamon colour, but were probably "blood-red," like the British specimens of the same sponges when alive. Both

are characterized by the large, setaceous acuate, accompanied by a thin one, together with a small clavate-spined spicule (the echinating form), a smooth tricurvate and a naviculiform, small, equianchorate (flesh-spicules), all arranged in tufts with the flesh-spicules about their base; but the tufts or "columns" are much more developed in the former than in any other species of the kind, whence it was called "*Scopalina*" by Schmidt in 1862. In *M. armata* the tufts are not so strongly developed, but the tricurvate spicule is unusually so, and in some instances so spread out as to resemble a long, thin, straight acerate with a short abrupt curvature in the centre.

Microciona affinis, n. sp. (Pl. IV. fig. 15.)

This species is very like the type species, *Microciona atrosanguinea*, in spiculation, but is extremely thin, has no tufts ("columns"), and the colour now is whitish yellow. Its chief specific difference, however, lies in the form of the equianchorate, which being extremely abundant and thicker (but not longer), from a greater projection of the central tongue-shaped arm, presents the appearance of being barbed on the inner side of the point, so that when viewed laterally this has much the appearance of a fish-hook (Pl. IV. fig. 15).

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This is one of the species to which I have above alluded, in which the spiculation is essentially like that of the type specimen of Dr. Bowerbank's genus *Microciona*, viz. *M. atrosanguinea*, although it possesses no "columns." The "fish-hook"-like appearance at the end of the central arm of the equianchorate, when viewed laterally, may be owing to a deficiency or hole in the upper part of the falcate septum which ordinarily unites this arm to the shaft, and a corresponding thickening of the septum at this part, which in some instances appears to extend to the shaft itself; but the object is too small for me to state, with any certainty, more than that it presents the "fish-hook appearance" mentioned.

Microciona bulboretorta, n. sp. (Pl. IV. fig. 3, *a–e*.)

Laminiform, extremely thin, hirsute, spreading. Colour, when dry, whitish yellow. Spicules of four forms, viz.:—1, long, setaceous, smooth, acuate, with inflated blunt end turned to one side, 175 by 2-1800ths (Pl. IV. fig. 3, *a*); 2, the same, but short, and spined halfway up from the blunt end, 30 by $1\frac{1}{2}$-1800th (fig. 3, *b*); 3, the same, about half the length of the last (fig. 3, *d*, *e*); 4, thin, smooth, acuate, 40-1800ths long (fig. 3, *c*). All the spiculation is erect, and no. 4 in tufts

around no. 1. Size variable; that of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The large inflation of the fixed end, which is turned to one side, occurs in all the spicules except no. 4. There are no anchorates and no tricurvates; so that the spiculation is something like that of *Hymerhaphia clavata*, Bk.; but, as above stated, all the spicules are erect like those of a *Microciona*, whereas in Dr. Bowerbank's illustration of that species (B. S. vol. iii. pl. xxvi. fig. 4) part, at least, are reclined confusedly; but then, as I have also said before, this may have been occasioned by circumstances, viz. protection or exposure respectively during growth.

Microciona quadriradiata, n. sp.
(Pl. IV. fig. 4, *a–d*.)

Laminiform, extremely thin, hirsute, spreading. Colour, when dry, dark brown. Spicules of three forms, viz.:—1, large, setaceous, smooth, acuate, curved chiefly towards the blunt end, which is globular and rather less in diameter than the shaft, from which it is separated by a slight constriction, 75 by 3-1800ths (Pl. IV. fig. 4, *a*); 2, thin, smooth, acuate, frequently more or less crooked, 25-1800ths long (fig. 4, *b*); 3, quadriradiate, consisting of three arms radiating at equal angles from a common central point, which, raised and tripod-like, supports the fourth arm in an erect position; all densely and uniformly microspined, $5\frac{1}{2}$ by 6-1800ths (fig. 4, *c*, *d*). No. 1, together with tufts of no. 2, projects vertically out of the lamina, which is densely charged with no. 3, whose erect arm thus becomes the *echinating* spicule. Size variable; that of specimen about $\frac{1}{4}$ inch in diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The quadriradiate spicule of this species is almost identical in form with that of *Dictyocylindrus Vickersii* ('Annals,' 1879, vol. iii. p. 292, pl. xxvii. figs. 5–8), where the vertical arm in like manner becomes the *echinating* element or spicule; and the crooked form of the thin acerate is also similar; but the skeleton- or setaceous spicule is different. In the species, however, to which Mr. Thomas Higgin has called attention, and which also grew on a *Melobesia* ("Nullipore"), both the quadriradiate and setaceous spicule are essentially identical; therefore this is a specimen of *Microciona quadriradiata* from the West Indies ('Annals,' 1877, vol. xix. p. 296, pl. xiv. fig. 9).

Microciona quinqueradiata, n. sp.
(Pl. IV. fig. 5, *a–e*.)

Laminiform, extremely thin, hirsute, spreading. Cream-colour. Spicules of four forms, viz.:—1, long, setaceous, curved, simple, acuate, 125 by 1-1800th (Pl. IV. fig. 5, *a*); 2, short, thick, acuate, curved generally, with blunt end round and a little less in diameter than the shaft, from which it is differentiated by a slight constriction, 33 by 2-1800ths (fig. 5, *b*); 3, thin, slender, simple, acuate, 30-1800ths long (fig. 5, *c*); 4, qradriradiate, consisting of four *smooth* pointed arms radiating opposite each other from a common centre that is raised so as to form a four-legged base to the fifth arm, which is erect, longer than the rest, gradually pointed, thickly spined throughout and the spines recurved, 6 by 5-1800ths (fig. 5, *d*, *e*). Nos. 1–3 are erect, and the latter in greater plurality than the others, while the long, spined arm of the quadriradiate, which is very numerous, forms the echinating part. Size variable; that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This species is in growth, colour, and spiculation very like the foregoing one; but while the quadriradiate or echinating spicule in *M. quadriradriata* is most like that of *Dictyocylindrus Vickersii* (*l. c.*), it is the setaceous and thick, short, acuate spicules respectively here which most resemble the spiculation of that sponge.

Microciona curvispiculifera, n. sp.
(Pl. IV. fig. 6, *a–d*.)

Laminiform, extremely thin, hirsute, spreading. Cream-colour. Spicules of three forms, viz.:—1, long, setaceous, smooth, acuate, curved chiefly towards the blunt end, which is smooth and not differentiated from the shaft, 100 by 1-1800th (fig. 6, *a*); 2, the same, but much shorter, although proportionately stouter, 15 by 1-1800th (fig. 6, *b*); 3, cylindrical, bent in the centre, round at the extremities, smooth at first, becoming when fully formed spiniferous throughout, 15 by $\frac{2}{3}$-1800th (fig. 6, *c*, *d*). Nos. 1 and 2 are erect and fixed in a layer of the bent spiniferous spicules, which project outwards so that half of their length, lying parallel with the other spicules, becomes the echinating part. Size variable; that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This species is well-characterized by the bent spicules, many of which present different degrees of smoothness in proportion to the amount of development, which ends in their becoming thickly spinous throughout.

Microciona fascispiculifera, n. sp.
(Pl. IV. fig. 7, *a–g*.)

Laminiform, extremely thin, hirsute, spreading, covered with little bundles of spicules of different lengths respectively (Pl. IV. fig. 7, *g*). Cream-colour. Spicules of four forms, viz.:—1, long, setaceous, smooth, acuate, curved chiefly towards the blunt end, which is not differentiated from the shaft, 70 by $1\frac{3}{4}$-1800th (fig. 7, *a*); 2, acerate, *hair-like*, in bundles, of different lengths below 20-1800ths (fig. 7, *c*, *d*); 3, spined acuate, 5-1800ths long (fig. 7, *b* and *e*); 4, minute, simple, bihamate, 2-6000ths (fig. 7, *f*). Nos. 1 and 3 project from a layer formed of nos. 2 and 4, the former in sheaf-shaped bundles of various dimensions lying on the surface. Size variable; that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This species is also well characterized, viz. by the fasciculi of hair-like spicules, which respectively vary from 1-3000th to 1-90th inch in length, and by reflected light under the microscope look very much like minute white sawdust, for which, at first, I mistook them, partly on account of the specimens having been packed in this material that had more or less adhered to them. It is not the first time that I have found a hair-like spiculation of this kind in *Microciona*, as may be seen by a reference to the illustration of *M. minutula* ('Annals,' 1876, vol. xviii. p. 239, *mendose script.* "*pusilla*," pl. xvi. fig. 51, &c.).—N.B. Never pack sponges in cotton wool or sawdust, but place them at once in spirit and water in a jar or keg, with a *vellum* label on them written in *black-lead pencil*.

The presence of sheaf-shaped fasciculi of hair-like spicules looking, as just stated, like minute sawdust by reflected light Pl. IV. fig. 7, *g*) is a very common feature in different species of *Esperia*, where they often appear to replace the tricurvates. I delineated them first in 1871 ('Annals,' vol. vii. pl. iv. fig. 22), in *Stelletta lactea*, and again in *Esperia socialis* (ib. ib. pl. xvii. fig. 7, *d*, p. 277). Finally in 1874 ('Annals,' vol. xiv. p. 104) I conjectured not only that they were produced in cells like tricurvates similarly developed (ib. ib. pl. x. figs. 3–8), but

that, in some instances, they were identical with the latter; and now they have presented themselves in *Microciona fasci-spiculifera*, which seems to be a very common species in the Gulf of Manaar, as there are many specimens of it on the Melobesian nodules. This, however, is not the only instance in which the flesh-spicules may be developed together in groups, as we see by the rosettes of inequianchorates, also another common feature of *Esperia*; and I have little doubt that bihamates may be produced in the same way, particularly after considering the illustration of *Hymedesmia zetlandica*, Bk. (Brit. Sponges, vol. iii. pl. xxix.), in which the bihamates are not single, as is usually the case, but in groups like the tricurvates &c. It should, however, be remembered that these spicules are often developed *singly* as well as in groups in their cells ('Annals,' *l. c.* pl. x. figs. 11 and 12). We must view the sheaf-shaped bundles, then, I think, as "flesh-spicules" closely allied to, if not identical with, tricurvates; and therefore they may occur in any kind of spiculiferous sponge; hence it is not strange that we should find them in a *Microciona*, where the tricurvate is such a common flesh-spicule.

Mr. Sollas has proposed for them the name of "trichites" ('Annals,' 1880, vol. v. p. 133), which it would be as well henceforth to adopt, as they are evidently not peculiar to one kind of sponge, and may occur in a great number; so that they should, for convenience of description, have a fixed designation, although, as I have above stated, they seem to me to be but another form of the tricurvate.

Hymerhaphia unispiculum, n. sp.
(Pl. IV. fig. 8.)

Laminiform, extremely thin, hirsute, spreading. Cream-colour. Spicules of one form only viz. large, setaceous, smooth, acuate, curved chiefly towards the blunt end, which is hemispherical and a little more in diameter than the shaft, from which it is differentiated by a slight constriction, 70 by $1\frac{3}{4}$-1800th (Pl. IV. fig. 8). Size variable; that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. Hymerhaphia unispiculum is not so remarkable for the form of its spicule, which is common to many species, as for there being no other, in which respect it resembles *Hymedesmia simplicissima*, Bk. (Brit. Sponges, vol. iii. pl. lxxx. fig. 1). It seems to me questionable, however, if this is not

accidental, and that the other spicules, which often accompany a similar form, are, from some cause or another, absent here; the record, therefore, is only made *provisionally*.

Hymerhaphia vermiculata, var. *erecta*.

This, which is but an erect form of *Hymerhaphia vermiculata*, Bk., I found plentifully among the dredgings of the 'Porcupine' from the bed of the Atlantic Ocean between the north of Scotland and the Faroe Islands ('Annals,' 1876, vol. xviii. p. 307, pl. xii. fig. 4, &c.); and it seems to be equally plentiful in the Gulf of Manaar, with this difference only, that the acuate spicules are not so large or so setaceous as those in the specimens from the Atlantic sea-bed.

Hymerhaphia clavata, Bk.

Laminiform, extremely thin, hirsute, spreading. Cream-colour. Spicules of four forms, viz.:—1, large, smooth, acuate like that of *H. unispiculum*, 100 by 3-1800ths; 2, clavate, nearly straight, with the blunt end differentiated from the shaft by being one third more in diameter, spined throughout, 14 by $2\frac{1}{2}$-1800ths; 3, the same, but not more than half the size; 4, thin, smooth, acuate, 30-1800ths long. All these spicules are erect; and no. 1, which is rather sparse and very large and long, is surrounded by a great number of the fine acuates no. 4. Size variable; that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This is so nearly allied in spiculation to *Hymerhaphia clavata*, Bk., that I think it must be a specimen of the same species; but lest it should not be, I have given the description, merely adding that if it differs from *Microciona* in the absence of the "columns," it certainly comes so near it in the elements and arrangement of its spiculation that it is almost questionable whether it should not be called a *Microciona*.

Hymerhaphia eruca, n. sp. (Pl. IV. fig. 9, *a–c*.)

Laminiform, extremely thin, hirsute, spreading. Colour light brown. Spicules of three forms, viz.:—1, large, smooth, setaceous, acuate, chiefly curved towards the blunt end, which is slightly inflated hemispherically, and slightly differentiated from the shaft by constriction, 70 by $1\frac{3}{4}$-1800th (Pl. IV. fig. 9, *a*); 2, vermiculate, acerate, annulated at more or less equal distances by projecting ridges, which here and there are broken or imperfect, 25 by $1\frac{1}{2}$-1800th (fig. 9, *b*); 3,

the same, but smaller and smooth, in an earlier stage of development (fig. 9, *c*). No. 1 projects from a bed of no. 2. Size variable; that of the specimens about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. This sponge, in spiculation and arrangement of the spicules, is very like *Hymerhaphia vermiculata*, Bk.; indeed the early form of the caterpillar-like spicule (that is, before the annulations are developed) is precisely like the contort spicule of *H. vermiculata* (fig. 9, *c*).

Baculifera.

This group was established for receiving a great number of different forms of a sponge both suberitic in its consistence and in the form of its spicules, but Echinonematous in their arrangement, wherefore it was placed in the order Echinonemata. So far as I have had an opportunity of examining these forms they have all had only one and the same form of spicule, which is pin-like, with the head elongated at right angles to the shaft, like that of a crutch, but so peculiar that there is no mistaking it anywhere when once known. The specimens which I have seen chiefly come from the south-west coast of Australia; and the first described were named *Caulospongia verticillaris* and *C. plicata*, by Mr. Saville Kent (Proc. Zool. Soc. 1871), of which the former is in the Liverpool Free Museum, and the latter in the British Museum. I found a small fragment of this group of a light brown, which is the usual colour, in two places on the Melobesian nodules.

Holorhaphidota.

Renierida.

Much information is yet needed to make the species in the groups of this family clear; for the acerate form of spicule is so common among them that, unless accompanied by a flesh-spicule, which is seldom the case, the descriptions only of a great number of fully developed specimens can establish the species. Thus in the British Museum there are two species on a large, branched, stony coral from Madeira, both massive and amorphous, one yellow, the other white or colourless; both belong to my group "*Crassa*," from the large size of their spicules. The yellow one has a cylindrical spicule with obtuse ends (sausage-shaped); the white one, a still larger spicule, which is long, thick, fusiform, acerate, more like

that of *Halichondria panicea*—that is, gradually pointed. Now just the same kind of sponges appear on the Melobesian nodules; but although the spicule of the colourless or white species is almost identical with that on the Madeira coral, that of the yellow one, instead of being cylindrical and sausage-shaped, is acerate and sharp-pointed; while there is a third species about the Melobesian nodules, which is dark brown, that *has* a cylindrical obtusely-ended spicule. Under these circumstances all that I can do is briefly to describe them respectively by the terms *yellow*, *white*, and *dark brown*, provisionally—that is, until the species to which they respectively belong shall have been satisfactorily defined.

Reniera, yellow. (Pl. V. fig. 17.)

Massive, lobate. Consistence firm. Colour ochre-yellow. Surface even. Spicule of one form only, viz. smooth, acerate, fusiform, curved, abruptly sharp-pointed, 17 by $1\frac{1}{2}$-1800th (Pl. V. fig. 17). Colour variable—some specimens being greyish yellow, and others almost white. Size of largest specimen about $2\frac{1}{2}$ inches in its longest diameter.

Reniera, white. (Pl. V. fig. 16.)

Massive, lobate, rising into short tubular processes. Consistence firm. Colour white. Surface even. Spicule of one form only, viz. smooth, acerate, fusiform, curved, gradually pointed, 60 by $2\frac{1}{2}$-1800ths (Pl. V. fig. 16). Size of largest specimen about 3 inches in diameter.

Reniera, dark brown. (Pl. V. fig. 18.)

Amorphous, growing in small portions here and there in the depressions of the Melobesian nodules. Consistence firm. Colour dark brown. Spicule of one form only, viz. smooth, cylindrical, curved, rounded at the extremities, 23 by 1-1800th (Pl. V. fig. 18). Size of largest specimen about an inch in horizontal diameter.

Reniera fibulifera, Sdt.

This sponge, which seems to be world-wide in its distribution, was represented by a small growth, about 1-16th inch in horizontal diameter, which was identified at the time, but overlooked afterwards, so that there is no slide or mounted specimen of it.

Halichondria albescens, Johnston.

Here and there on the nodules.

Halichondrina.

Halichondria aceratospiculum, n. sp.
(Pl. V. fig. 19, *a*–*d*.)

There was only a minute trace of this, but sufficient for mounting and for the following description of its spicules, which consist of four forms, viz.:—1, acerate, fusiform, curved, sharp-pointed, thickly spined throughout, 25 by $1\frac{1}{2}$-6000th (Pl. V. fig. 19, *a*); 2, smooth, acerate, fusiform, curved, slightly inflated in the centre, and gradually pointed, 35 by 1-6000th (fig. 19, *b*); 3, bihamate, simple, 8-6000ths long (fig. 19, *c*); 4, equianchorate, shaft slightly curved, arms linear in appearance, and distinct when viewed laterally, $3\frac{1}{2}$-6000ths long (fig. 19, *d*).

Obs. This is evidently the spiculation of a variety of *Halichondria incrustans*, in which the flesh-spicules, viz. nos. 3 and 4, are in form identical, while the acerate forms of the larger spicules respectively lead to the designation.

Esperina.

Esperia tunicata, Sdt.

This consists of a thin fragment, about $\frac{1}{2}$ an inch in horizontal diameter, abounding with the usual Esperian rosettes, composed of the inequianchorate of the species, accompanied by a great number of nondescript forms, which appear to be half-developed inequianchorates that have respectively been generated in separate cells.

Esperia serratohamata, n. sp. (Pl. V. fig. 20, *a*–*d*.)

Of this sponge, which I have long wished to find, viz. since I published a representation of the peculiar form of the bihamate found among the spicules in one of the chambers of a specimen of *Carpenteria balaniformis* ('Annals,' 1876, vol. xvii. pl. xiii. fig. 10), a minute portion has grown on one of the Melobesian nodules, which has yielded sufficient for mounting and retaining in the dried state respectively. It possesses four forms of spicules, viz.:—1, the usual Esperian skeleton-spicule, smooth, fusiform, sub-pinlike, with oval inflation at the blunt end, 43 by $1\frac{1}{4}$-6000th (Pl. V. fig. 20, *a*); 2, large, bihamate, serrated on the outside towards each extremity, with the teeth directed backwards, 24 by $1\frac{1}{4}$-6000th (fig. 20, *b*); 3, tricurvate, simple, hair-like, dispersed and in groups, 12-6000ths long (fig. 20, *c*); 4, inequianchorate, small, with the head nearly two thirds of the entire length, 4 by $2\frac{1}{2}$-6000ths (fig. 20, *d*), dispersed

singly and combined in the form of rosettes respectively. Size of specimen about 1-6th inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The remarkable form of the bihamate, together with the short thick inequianchorate, is distinctly characteristic of this *Esperia*, which is not the case with many other species, in which the spiculation is so much alike that much confusion still exists respecting them.

Hymedesmina.

Hymedesmia stellivarians, n. sp.
(Pl. IV. fig. 10, *a–e*.)

Laminiform, extremely thin, spreading, smooth or hirsute. Colour yellow. Spicules of two forms, viz.:—1, pin-like, smooth, fusiform, with oval head, 32 by 1-1800th (Pl. IV. fig. 10, *a*); 2, globostellate, rays short and conical, or short and capitate, or long and pointed, respectively; hence the designation (fig. 10, *b* and *c*, *d*, *e*). Pin-like spicule incorporated with the bed of stellates where the parts are exposed, more or less erect where protected. Size variable; that of specimen about an inch in horizontal diameter.

Hab. Marine. On *Hircinia fusca*.

Loc. Gulf of Manaar.

Obs. I am inclined to think that the real colour of this species is white, and that its yellow tint has been derived from the brown colouring-matter of the *Hircinia* on which it has grown. It is chiefly distinguished from the following sponge, whose stellate is very similar, by the form and smallness of the linear pin-like spicule.

Hymedesmia Moorei, n. sp. (Pl. IV. fig. 11, *a–c*.)

Laminiform, extremely thin, spreading, smooth or hirsute. Colour glistening white. Spicules of two forms, viz.:—1, pin-like, smooth, fusiform, chiefly curved towards the blunt end, which is spherical, varying to simple uninflated acuate, 62 by 2-1800ths (Pl. IV. fig. 11, *a*); 2, globostellate, rays at first long and pointed, with body proportionally small, then short, thick, and conical, with proportionally enlarged body, finally mitre-shaped and microspined, 5-6000ths (fig. 11, *b* and *c*). Where exposed the linear spicule is incorporated with the layer of stellates horizontally, but where protected it is erect. Size variable; that of specimen about an inch in horizontal diameter.

Hab. Marine. On hard objects.
Loc. Gulf of Manaar.
Obs. Like the last species but for the form of the skeleton-spicule no. 1. Named after Mr. T. J. Moore, the assiduous Conservator of the Liverpool Free Museum.

Hymedesmia spinatostellifera, n. sp.
(Pl. IV. fig. 13, *a–d.*)

Laminiform, extremely thin, spreading, smooth or hirsute. Salmon-colour. Spicules of two forms, viz.:—1, pin-like, very long and slender, smooth, curved, head at first round and smooth, then elongated transversely by a convex addition to both sides, and, finally, by similar growths all over so as to become tuberose, shaft 130 by 1-1800th, head much larger than the shaft (Pl. IV. fig. 13, *a* and *b*); 2, stellate, multiradiate, rays conocylindrical, spined in annular rows towards the extremity, fixed on a body which is about one third of the diameter of the whole stellate, 10-6000ths in diameter (fig. 13, *c* and *d*). Linear spicules, where exposed, imbedded among the stellates, but erect and projecting where protected. Size variable; that of specimen extending over the whole of a Melobesian nodule upwards of an inch in diameter.

Hab. Marine. On hard objects.
Loc. Gulf of Manaar.
Obs. This species is characterized by its pink or salmon-colour, the peculiar tuberose form of the head of the linear spicule when fully developed, the large size of the stellate, and the peculiar form and microspination of its rays.

Hymedesmia capitatostellifera, n. sp.
(Pl. IV. fig. 12, *a–c.*)

Laminiform, extremely thin, spreading, sparsely hirsute. Colour snow-white. Spicules of two forms, viz.:—1, pin-like, curved, smooth, long, setaceous, head oval and wider in diameter than the shaft, which is 80 by 1-1800th (Pl. IV. fig. 12, *a*); 2, stellate, with large globular body, multiradiate, rays terminating in a globular, inflated, and spined head with constricted neck, 12-6000ths in diameter (fig. 12, *b* and *c*). Pin-like spicule fixed by its head in the sarcodic layer of the sponge, which is densely charged with the stellates. Size variable, that of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.
Loc. Gulf of Manaar.

Obs. This species is characterized by its brilliant snow-white colour, the large size of its stellates, and the peculiar capitation of their rays.

Hymedesmia trigonostellata, n. sp.
(Pl. IV. fig. 14, *a–d*).

Laminiform, extremely thin, spreading, smooth or hirsute. Colour snow-white, glistening. Spicules of three forms, viz.:—1, acuate, long, thin, smooth, 50 by $\frac{1}{2}$-1800th (Pl. IV. fig. 14, *a*); 2, pin-like, ensiform, smooth, with inflated fusiform shaft, long neck, and small round head not more than one third of the diameter of the shaft, 25 by 1-1800th (fig. 14, *b*); 3, stellate, quadriradiate, in which three of the rays form a kind of tripod to the fourth, that is erect, thus presenting a triangular appearance; each ray expanded at the extremity by a multifid spinous division, 3-6000ths in diameter (fig. 14, *c*, *d*). No. 1, sparsely scattered, projects beyond no. 2, which is parquetted in among no. 3 in great abundance, so as to present a smooth glistening surface. Size variable; that of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The peculiar sword-like form of the pin-like spicule no. 2, together with that of the stellate, characterizes this species unmistakably; while the latter, which always resembles that of *Axos Cliftoni* in the multifid spine-like division of the extremities of its rays, is often rendered still more like it by being sexradiate.

Suberitida.

Suberites vestigium, n. sp. (Pl. V. fig. 21.)

Laminiform, extremely thin, spreading. Colour glistening white, asbestus-like. Spicule of one form only, viz. pin-like, shaft slightly curved and slightly fusiform, head spherical, a little less than the shaft in diameter, 27 by 1-1800th (Pl. V. fig. 21). Spicules confusedly arranged, among which many project irregularly. Size variable, that of the specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine, on hard objects.

Loc. Gulf of Manaar.

Obs. This species, although very like a *Hymedesmia* in growth and appearance, is also very different in spiculation. As may have been observed, there is no long setaceous spicule here markedly projecting from a layer of smaller ones of a

different form, but the whole composed of one only, viz. pin-like, and that, too, not characterized by any one in particular being longer than the rest. It often presents a bluish-green tint (now dry) like that of a similar species on the rocks here (Budleigh-Salterton); but the head of the latter is different in form, viz. globoconical followed by an inflated ring like that of *Suberites* (*Halichondria*, Johnston) *carnosa*. It may be remembered that the colour of the British species (which, when fresh, is cobalt-blue) is owing to the presence of a minute parasitic Oscillatoria, for which I have proposed the name of "*Hypheothrix cærulea*" ('Annals,' 1878, vol. ii. p. 164). How far this, as well as the British species, may be that which, under other circumstances, grows into a larger and distinct form of Suberite, I am not able to state; all that I can say is that both are frequently found under the conditions above mentioned.

Suberites fistulatus, n. sp. (Pl. V. fig. 22, *a*, *b*.)

Irregularly globular, elongate, sessile, appendiculate, the appendages consisting of long tubular extensions of different sizes, irregularly scattered over the surface, which is otherwise even. Colour now pinkish brown. Internally cavernous, densely charged with two forms of spicules, viz.:—1, linear, fusiform, slightly curved, and inflated at both ends, which are microspined, 23 by $\frac{1}{2}$-1800th (Pl. V. fig. 22, *a*); 2, equianchorate (flesh-spicule), naviculiform, 8-6000ths long, comparatively large and numerous (fig. 22, *b*). The tubular appendages are prolonged from large vents, which are in connexion with the cavernous structure of the body. Size of specimen 3 inches long, 3 broad, and $2\frac{1}{2}$ high.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar, and Freemantle, S.W. Australia.

Obs. Having found a minute portion of this sponge on one of the Melobesian nodules of the Gulf of Manaar, I at once recognized in it the spiculation of the sponge above described, which is in the general collection of Dr. Bowerbank's sponges purchased by the British Museum. The cavernous and cork-like consistence claims for it a place among the Suberitida.

Placospongia melobesioides, Gray (Proc. Zool. Soc. Jan. 1867, p. 127, woodcut, fig. 1).

General character largely and irregularly placophorous, hard, petrous, *Geodia*-like, dichotomously branched; branches angulated irregularly and therefore variable in diameter.

Colour white or brown. Surface even, divided into irregular, polygonal, placoid spaces varying in size, under half an inch in diameter, slightly concave towards the centre, raised at the margin, where they meet each other, but do not join. No pores and no vents visible over the placoid spaces themselves, but a line of separation between them where in apposition, through which communication with the interior is obtained. Plates or placoid portions crust-like, composed of siliceous globules, like those of *Geodia*, united together by exceedingly tough fibrous sarcode; subjacent to which is another layer composed of areolar sarcode charged with pin-like spicules, whose points project slightly beyond and between the marginal appositions of the plates respectively; within which, again, is a solid thick axis, *entirely* composed of the same kind of siliceous globules as the plates. Spicules of four forms, viz. :—1, large, pin-like, straight, smooth, shaft subconical and abruptly pointed, head globular, as wide as the thickest part of the shaft, 65 by 1-1800th; 2, siliceous globule, more or less elliptical, compressed slightly in the direction of a hilous depression, which is on one side; surface uniformly consisting of minute stelliform points, more or less multifid and in juxtaposition, being the ends of the radiated crystalline structure of which the interior is composed, 17 by 13-6000ths; 3, a much smaller siliceous globule, which is spherical and covered with minute conical points in juxtaposition, that give it a multiangular appearance, 3-6000ths; 4, smooth, microscopic, siliceous globules, which appear to be originally developed in cells, about 3-6000ths in diameter. No. 2 (siliceous globule), with which no. 3 is sparsely mixed, forms the staple spicule of the hard axis and mail-like plates respectively; while no. 1, the pin-like spicule, is confined to the areolar sarcodic layer between the two, where it is arranged in glistening tufts, whose points, as before stated, project through the line of separation between the plates. The microscopic globules appear to be chiefly situated in the dermal layer. Size of largest specimen (for there are two) about $1\frac{1}{2}$ inch long, 8-12ths inch broad, and 4-12ths thick.

Hab. Marine. Attached to hard objects.

Loc. Gulf of Manaar.

Obs. I have partly described this species from the specimens in the British Museum, one of which was well figured by Dr. Gray (*l. c.*); but the description not being detailed with that minuteness which this remarkable sponge deserves, has led to my making the above additional statements. It will have been observed that the siliceous globule is identical with

that of a *Geodia*, but the rest of the structure so totally different that, wherever located among the Holorhaphidota, it must form a distinct group. The sponge not only grows independently, as above stated, but also parasitically (that is, laminiform over hard objects), yet always presenting the placophorous or mail-plated surface, which is already evident in the smallest of the Manaar specimens, although it is extremely thin and only 1-12th inch in horizontal diameter, with a correspondingly diminutive form of the spiculation, indicating not only that it is a very young specimen, but that the *separation* of the plates from the commencement favours its subsequent enlargement, and thus explains the mode of growth.

Besides this there is a species, or, rather, variety, in which a spinispirular flesh-spicule is added to the foregoing spiculation, consisting of a slightly sigmoid microspined shaft like the flesh-spicule of *Cliona corallinoides*, whose spines afterwards may become elongated, and sometimes multifid at the extremity, so as to present the appearance shown by Dr. Bowerbank (Proc. Zool. Soc. 1874, pl. xlvi. fig. 4). The British-Museum specimen, of which I made a mounting in Canada balsam some years ago, came from "Puntas Arenas" in "Central America," and has been in the collection (as learnt from the registration) since 1850. In my "Notes" I see that it came "off a *Gorgonia*," while that described and called by Dr. Bowerbank "*Geodia carinata*" (*l. c.* fig. 1), now also in the British Museum, is on the same kind of black horny *Gorgonia*-stem from the "South Sea;" hence it is not impossible that both may have come from the tropics; but, be that as it may, these are the only two specimens that I have seen in which the spinispirula is present. It seems, however, to afford corroborative evidence of this sponge being allied to the Suberitida rather than to the Geodina; for when the pin-like spicules and the spinispirulas are seen together, in addition to the structure generally, there is only one link left which causes *Placospongia* to resemble the Geodina; and that is the siliceous ball; so that the characters are far more in favour of the Suberitida than the Geodina. Hence, as before stated, the group of which *Placospongia* may be considered typical should be placed among the Suberitida. I might here mention that in the hilous depression of the siliceous globules of my mounted preparations there is a plug of sarcode, showing the way in which the former are connected with the latter.

Eccœlonida.

(Excavating Sponges.)

In the 'Journal of the Royal Microscopical Society' (1879, vol. ii. p. 496) I proposed the name of "Eccœlonida" for this family, enumerating thereunder three genera, viz. *Cliona*, *Thoosa*, and *Alectona*, and stating that the skeleton-spicule of *Thoosa* had not been determined. Previously ('Annals,' 1879, vol. iii. p. 352) I had indicated that, judging from the figures which he has given, Hancock had probably based this genus on spicules of some kind of *Samus*. I further added, in the 'Microscopical Journal' (*l. c.* p. 497), that it was not impossible that *Samus anonymus* would ultimately have to come in as a fourth genus of the Eccœlonida. All this is now ascertained by the undoubted excavating habit of *Samus anonymus* in some of the Manaar nodules, and the existence of *Thoosa* in others, where no spicule of *Samus*, or any thing like Hancock's figures, is present. New species of *Samus* have also been determined, as well as more Eccœlonida, including a new genus—which will now be successively described.

Thoosa socialis, n. sp. (Pl. V. fig. 23, *a–c*.)

General form (when dry and contracted) a minute sarcodic mass densely charged with the spicules of the species, in which no particular figure or structure can be distinguished. Colour yellowish. Spicules of two forms, viz.:—1, short, thick, nodose, consisting of a central shaft upon which are developed ten globular microspined projections that finally obscure it from their enlargement and approximation, so arranged that one occupies each extremity and the eight others two circular rows respectively in the centre of the shaft, all touching each other when the spicule is fully developed, 8 by 5-6000ths (Pl. V. fig. 23, *a*); 2, circular, compressed, rough or irregularly microspined and wrinkled, 5 by 4-6000ths (fig. 23, *b*, *c*); the latter sparsely mixed among the former. Size of largest specimen about 1-16th inch in diameter.

Hab. Marine. In excavated cavities of the Melobesian nodules, alone or in company with other sponges which have made or have occupied them after they have been made.

Loc. Gulf of Manaar.

Obs. Whether this is the sponge to which Hancock alludes (*l. c.*) or not, he has omitted to mention its accompanying spicule, viz. the cake-like one no. 2; while the presence of the species not only by itself, but together with different other sponges now occupying some of the previously ex-

cavated cavities of the Melobesian nodules, has led me to designate it "*socialis*." The specimen of *Samus anonymus*, to which I have alluded I first found, *together* with a *Cliona*, in an excavated cavity; and knowing of no other sponge but a *Cliona* that made such cavities, I viewed the *Samus* as an intruder; but now that, in the Melobesian nodules, I have found *Samus anonymus* filling the excavations *alone*, I am constrained to admit it as a new genus of the Eccœlonida. If such shall be found to be the case with *Thoosa*, then also there will be no doubt of its excavating power; but the specimens of it that I have seen have been so minute and so mixed up with other sponges, that at present I consider this only a provisional determination. Had I obtained it as I did the following species, which is equally minute, viz. by solution of the piece of *Melobesia* containing it in nitric acid, I might have seen the sarcode holding the spicules; but in the dried state in which I found it I could only infer its existence from the contracted appearance of the little mass. On account of its presence in specimens of many other sponges from the excavations of the Melobesian nodules that I have mounted in Canada balsam, it seems to me to be very plentiful, but in very minute portions. The larger spicule, no. 1, also exists in the neighbourhood of the Seychelle Islands, as represented in the 'Annals' of last year (vol. iii. pl. xxix. fig. 21).

Dotona pulchella, n. gen. et sp.
(Pl. V. fig. 24, *a–d*.)

General form (when dry and contracted) a minute sarcodic mass densely charged with the spicules of the species. Colour white. Spicules of three forms, viz.:—1, a cylindrical curved shaft, round at the ends, which are microspined, interrupted throughout by apparently annular lines at equal distances from each other, but which, by alteration of the focus, are found to be parts of a spiral ridge formed of microscopic points, united longitudinally and respectively by striæ, which thus extend throughout the spicule, 12 by $1\frac{1}{2}$-6000th (Pl. V. fig. 24, *a*, *d*); 2, acuate, simple, smooth, hair-like, very fine, 20-6000ths long (fig. 24, *b*); 3, flesh-spicule, minute, consisting of a straight shaft spined over both ends divergingly, and in a ring round the centre, 2 by $\frac{1}{2}$-6000th (fig. 24, *c*). Spicules mixed together generally; very variable in size and in various stages of development; the flesh-spicules very minute and sparse. Size of specimen about 1-8th inch in diameter.

Hab. Marine. In excavated cavities of the Melobesian

nodules, sometimes in company with other sponges, and sometimes alone.

Loc. Gulf of Manaar.

Obs. The extreme beauty of the large spicule of this species so attracted my attention while it made its appearance in more or less plurality among the fragments of other sponges which I had mounted, that I determined to look for it *in situ*, feeling almost convinced that it was one of the Eccœlonida, but which, like *Thoosa socialis*, could, from its minuteness, be only sought successfully with the microscope. This was accomplished at last, but not until I had often relinquished the search as hopeless; and then the fragment was observed to consist of several dilated globular portions of transparent sarcodic membrane united together isthmically, and densely charged with the spicules of the species on their inner surface, so that when contracted in the dried state they gave the little massive appearance above mentioned. It was also in company with a minute fragment of *Thoosa socialis*; but from its form and approach towards the surface-apertures of the excavation in which it existed by little digital processes densely charged with the spicules of the species at their extremities, like those of *Alectona Millari*, there can be no doubt that this is a truly excavating sponge, for whose genus I have proposed the name of "*Dotona*," after another of the sea-nymphs, and "*pulchella*," from its great beauty. The annulation, when examined by alteration of the focus, so that both sides of the spicule may be examined, is found to be formed, as above stated, of a *spiral* ridge whose coils are so close together that at first they resemble annulations (fig. 24, *d*).

Alectona Higgini, n. sp.
(Pl. V. fig. 25, *a–c*.)

Lining excavated cavities in a Melobesian nodule, in the form of a sarcodic membrane charged on the inner side with the spicules of the species. Colour now that of dried sarcode—that is, yellowish. Spicules of three forms, viz.:—1, subcylindrical, slightly curved, round at the ends, sausage-like, divided irregularly throughout the body into a number of annular depressions and inflations, the latter of which are microspined, and very variable in form and length, the shortest being the thickest, 5 to 20 by $1\frac{1}{2}$ to $2\frac{1}{2}$-6000ths (Pl. V. fig. 25, *a*); 2, fine, hair-like, acerate, tending to the form of a tricurvate, 12-6000ths long (fig. 25, *b*); 3, flesh-spicule, consisting of a straight shaft interrupted towards the centre by eight or more faintly capitate rays radiating circularly from separate points a little nearer to each other than to the extremities of

the shaft; rays equal in length to the distance between the points of radiation and the end of the shaft on each side; all parts of the spicule about the same thinness, which is almost immeasurable; all microspined and all respectively terminated by a globular inflation, 5 by 4-6000ths long (fig. 25, *c*). Size of largest specimen that of the Melobesian nodule which it infests, viz. $1\frac{1}{4}$ inch in diameter.

Hab. Marine. Excavating nodules formed of the layers of *Melobesia*.

Loc. Gulf of Manaar.

Obs. Like *Alectona Millari*, this is essentially an excavating sponge; for the whole nodule is honeycombed by it; and the largest cavity exposed is one sixth of an inch in diameter, fenestrated towards the surface and in the direction of the other cavities which surround it, so that there can be no doubt of its nature any more than of that of the foregoing species. Then the spiculation being something like that of *Alectona Millari*, and especially the flesh-spicule, I have named it after my friend Mr. Thomas H. Higgin, F.L.S., of Liverpool, who has made such important additions to our knowledge of the Spongida.

Samus anonymus, Gray.

This species, which is common in excavations of the Melobesian nodules, I described and figured in the 'Annals' (1879, vol. iii. p. 350, pl. xxix. figs. 1–4), afterwards stating (Journ. Roy. Microscop. Soc. *l. c.*) that it would probably have to be placed as a new genus among the excavating sponges. The form and frequency with which it occurs in the Melobesian nodules of the Gulf of Manaar has now (as before stated) placed this beyond doubt; therefore I will at once give its generic characters under the name "*Samus*," which was established by Dr. Gray (Proc. Zool. Soc. 1867, p. 526) upon the spicule of an unknown sponge, first figured by Dr. Bowerbank (B. S. vol. i. pl. ii. figs. 41, 42).

Samus, nov. gen.

Gen. char.—Sarcode charged with large, coarse, multifid spicules, whose prongs are more or less subdivided according to the species; filling excavated cavities in calcareous structures when fresh, and when dry contracted into masses, through which the prongs of the spicules project in a thorn-like manner; connected with filamentous processes of the same, which occupied the channels of extension; generally accompanied by a flesh-spicule.

Samus simplex, n. sp. (Pl. V. fig. 26, *a–c*.)

Occurring as just mentioned. Colour that of dried sarcode. Spicules of two forms, viz. :—1, a short shaft with trifid head once divided (trifurcate), the whole expanded at right angles to the shaft, 15 by 3-1800ths (Pl. V. fig. 26, *a*, *b*) ; 2, minute or flesh-spicule, consisting of a straight shaft spined throughout irregularly, spines most prominent towards the ends, 3-6000ths long (fig. 26, *c*). Size of specimen variable, concurrent with that of the excavated cavity, which may be 1-6th inch in diameter.

Hab. Marine. In excavations of the Melobesian nodules, towards the surface.

Loc. Gulf of Manaar.

Obs. This is the simplest form of *Samus*-spicule that I have met with; hence the designation of the sponge to which it belongs.

Samus (*Pachastrella*) *parasiticus*.
(' Annals,' 1876, vol. xviii. p. 410, pl. xvi. fig. 50 &c.)

This species, which I formerly called "*Pachastrella parasitica*" (*l. c.*), occurs abundantly in excavations of the Melobesian nodules, accompanied by both forms of its flesh-spicules, viz. the spined bacillar form, fig. 50, *d* (*l. c.*), and the spinispirula, fig. 50, *f* (*l. c.*). Originally I did not know the habitat of *Samus parasiticus* ; but seeing that it so much resembled *Dercitus niger*, Gray, in spiculation, and finding the latter in company with a *Cliona* (to which I have before alluded) in excavations of marine calcareous structure (old coral) from the island of Cuba, I at once thought that *Samus parasiticus* must be closely allied to it, and hence gave it the generic name of "*Pachastrella*," which now should be abandoned for "*Samus*." At the same time I would here observe that the presence of the spicules of *Dercitus niger* (*Hymeniacidon Bucklandi*, latterly *Battersbya Bucklandi*, Bk., 1870) with *Cliona* either shows that *Dercitus niger* is an intruder of this kind occasionally, or that this is part of the habitat of this great, massive, liver-like black sponge so common on our shore-rocks. Be this as it may, there is so much relationship between the *Pachastrellæ* (Schmidt's name for the deep-sea species of *Dercitus*, viz. *P. abyssi*) and *Samus*, that hereafter I expect it will be thought desirable to at least make them one group. Hence it also becomes questionable whether my *Pachastrella intexta* (' Annals,' *l. c.* p. 409, pl. xv. fig. 41 &c.) does not belong to the same category.

Samus complicatus, n. sp.
(Pl. V. fig. 27.)

I would propose this name for the spicule of a sponge of another species of *Samus*, of which there are several specimens in my mountings of the dust from the root-bunch of *Euplectella cucumer* found in the deep sea about the Seychelle Islands, on account of its extremely complicated form, presenting under the microscope one of the most beautiful objects of the kind that I have ever seen. It consists of four arms, three of which form a kind of tripod to the fourth, which is erect, and all thrice divided again to their extremities (there is no shaft); so that it defies all attempts at delineation, from the complicated state of the branches and the impossibility, from the dimensions of the object, of getting the whole into focus at the same time; hence the illustration (Pl. V. fig. 27) must be regarded as a diagram. There is no doubt of its belonging to a *Samus*, of which there are probably many more species yet to be discovered; indeed the representations given by Dr. Bowerbank, which appear to be similarly quadriradiate (B. S. vol. i. pl. x. figs. 235, 236), also seem to be those of spicules belonging to species of the same genus.

Here I would add that, however much *Samus* and *Pachastrella* may be allied to each other in spiculation, their habitats may be totally different; and when we come to add *Cliona* to the Eccœlonida, we get a heterogeneous mixture of sponges in kind, whatever may be their alliances otherwise; for *Cliona celata* itself, which infests the oyster-shell, may become, when it has destroyed the latter, the free massive Suberite to which Dr. Bowerbank has given the name of *Rhaphyrus Griffithsii*.

[To be continued.]

IX.—*Descriptions of new Species of Asiatic Lepidoptera Heterocera.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

Tribe Bombycites.

Saturniidæ.

1. *Antheræa lœpoides*, sp. n.

Primaries above with the basal third dull lake-red, traversed by two irregular saffron-yellow stripes, and with very irregular external edge; central area occupied by a very irregular gamboge-yellow band enclosing the ocellus, which is dull

dorsal dots and the sides of the abdomen snow-white; antennæ with ferruginous pectinations. Wings below pale emerald-green, with an indistinct discal series of sap-green spots; primaries also with a straight postmedian stripe of the same colour; veins white; fringe sap-green tipped with white: body white, yellowish in front. Expanse of wings 2 inches 5 lines.

N.E. Himalayas (*Lidderdale*). Type B. M.

37. *Geometra grata*, sp. n.

Emerald-green; wings sparsely striated with golden orange: primaries with the costal margin pinky whitish, crossed by dark brown striæ and dots; two widely separated, inarched, subparallel golden-orange lines, the inner one distinctly irregular, the outer one very slightly so; fringe tipped with white: secondaries with the costal border, abdominal margin, and the outer half of the fringe upon the outer margin snow-white; a transverse, diffused, golden-orange stripe just before the middle: palpi, antennæ, and front of collar pinky white; abdomen creamy white, greenish at base. Under surface sericeous white, the wings showing a tint of green owing to the transparency of their texture; costal border creamy; the numerous striæ of the upper surface indistinctly visible; a curved greyish line just beyond the middle; minute blackish discocellular dots: pectus green in front. Expanse of wings 1 inch 10 lines.

Darjiling (*Lidderdale*). Type B. M.

Nearest to *G. dentisignata* of Moore.

[To be continued.]

XVI.—*Report on Specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Capt. W. H. Cawne Warren.* By H. J. Carter, F.R.S. &c.

[Continued from p. 61.]

[Plates VII., VIII.]

Geodina.

To facilitate an understanding of the complicated spiculation of a typical *Geodia*, and thereby to save repetition in description hereafter, the following definitions are premised, viz.:—

1. The "zone-spicule." This is generally the largest of all and trifid at its external extremity, where the arms, either

simple or subdivided, are for the most part spread out among and support a layer of siliceous balls or globules on the surface, called the "cortex" or petrous crust; while the shaft is directed perpendicularly inwards; and thus, in juxtaposition, it forms in combination around the *Geodia* a more or less distinct zone, whence its name.

2. "Body-spicule." This, which is acerate, fusiform, smooth, and curved, is generally the next in size to the zone-spicule, but by far the most numerous, as it is not only the staple spicule of the body, but, when associated with the zone-spicules, lies parallel with them, projects into the cortex, and thus adds to the strength of the zone generally, as well as the cortex.

3. "Forks" and "anchors." These are essentially anchoring-spicules, and, from the embryo upwards, are, as a matter of course, projected beyond the surface. They are trifid; but whereas in the "fork" the arms or prongs are produced, they are recurved in the "anchor," while the shaft in both, which is very long, depends for its length upon the distance the heads are beyond the *Geodia*. From their great delicacy and brittleness, they are for the most part broken off, especially the anchor-heads; their presence among the zone-spicules preparatory to their exsertion is thus frequently the only evidence, of their existence; and here they appear to be for any purpose but that of "anchoring" or fixing the *Geodia*. Hence their office is often overlooked.

4. "Siliceous globule." This is developed in the interior, where it may be seen in all stages of growth till fully formed, when it appears to be transferred to the surface, where, in combination, it forms the cortex or petrous crust, in which there are no *young* forms. In its earliest stage of development, or when it is but just visible, it appears to be stelliform; the rays then become multiplied, extended, and hair-like; after which, as they grow outwards, they become united into a crystalline mass, which finally assumes a more or less compressed, spheroidal, or elliptical form; meanwhile a hilous depression becomes apparent on one side; and finally the rest of the surface is covered by little stelliform bodies in juxtaposition, which are respectively supported by the rays, now undistinguishably consolidated into a crystalline mass.

5. "Stellates." There are always two forms of stellates, both of which are very minute—but one much smaller than the other; and this is chiefly confined to the surface, where it densely charges and thus strengthens the pore-bearing dermal sarcode. The other or larger form is chiefly confined to the sarcode of the interior (for they are both flesh-spicules), where

it presents itself much less plentifully; but, from its much larger size, the less number of its rays and their greater length, together with their irregular disposition around the centre, it is for the most part easily distinguished from the smaller ones, although they may also be, in greater or less number, present in the neighbourhood; still it seems to me to be but an enlargement of the latter.

6. "Dermal acerate" or "acuate." In addition to the dermal stellate there is frequently a minute linear spicule on the surface, which may be acerate or acuate in form according to the species, and whose use, as it projects beyond the dermal sarcode, may be, as in other instances, through elevation and depression, to exert some influence over the functions of the pore.

Geodia perarmata, Bk. (Pl. VI. figs. 32, *a–d*, 33, *a–f*, 34, *a–c*, and 35, *a–d*.)

General form spheroidal. Colour grey. Surface uniformly wrinkled (now dry) and cribriform (Pl. VI. fig. 32). Pores minute and numerous in the dermal sarcode, giving to the surface its cribriform structure (fig. 34). Vents small, scattered singly or grouped here and there. Spicules of seven forms, viz.:—1, the zone-spicule, whose head consists of three arms, each of which is furcated, and all expanded at right angles to the shaft after the division of the arms, which at first are slightly inclined forwards, shaft 280 by 6-1800ths, head 50-1800ths in diameter (figs. 33, *a*, and 34, *a*); 2, body-spicule, smooth, fusiform, acerate, curved, 200 by 4-1800ths (fig. 33, *b*); 3 and 4, fork and anchor, arms or prongs respectively about 5-1800ths long (fig. 33, *c*); 5, siliceous globule, 7-1800ths in diameter (fig. 33, *d*); 6 and 7, external and internal stellates respectively, the former 2-6000ths and the latter 6-6000ths in diameter, the rays in both radiating from a small body or central nucleus (fig. 33, *e*, *f*). Zone-spicules projecting beyond the petrous crust (fig. 35, *c*, *d*), and so supporting the dermal sarcode charged with its stellates (fig. 35, *a*) as to leave an interval of 1-30th inch between it and the former, thus traversed by the shafts of the zone-spicules (fig. 35, *b*, *d*, and 32, *a–c*). Petrous crust 1-60th thick (fig. 32, *c*). The other spicules arranged as before mentioned. Size of largest specimen 1 inch in diameter.

Hab. Marine. Free or attached to hard objects.

Loc. Gulf of Manaar.

Obs. The distance between the dermal layer and the petrous crust in this species is both remarkable and instructive. It is remarkable because it is so unusual—and instructive be-

cause it points out the relation and function of this layer, which, in most specimens, is so absorbed into the petrous crust as to be undistinguishable from it; while the futility of attempting to circumscribe the uses of any thing in the Spongida is also shown by the head of the zone-spicule, generally considered to be for supporting the petrous crust, here passing beyond it so as to support alone the dermal sarcode. Of course, all that passes in through the pores must go into this subdermal interval or chamber previous to passing into the body of the sponge; moreover there are the same hourglass-shaped holes in the petrous crust as those which I so minutely described and illustrated several years ago in *Pachymatisma Johnstonia*, Bk. ('Annals,' 1869, vol. iv. p. 12, pl. ii. figs. 11, 12). It is not my object here to trace the progress of this material in through the petrous crust; but I cannot help thinking that the larger holes or vents in the dermal layer are, in all probability, the openings of the terminal canals of the excretory system, which *pass through the chamber entire*, so that their contents may not be mixed with the incoming ones through the pores.

This kind of dermal layer I described and figured many years ago in *Spongilla* under the name of "investing membrane" ('Annals,' 1857, vol. xx. p. 24, pl. i. fig. 1, *b b b*), showing that it is the seat of the dermal pores, while it is supported on the ends of spicules which, projecting from the parenchyma of the sponge, form a hollow space between it and the latter, into which the water and its contents are received before passing further into the interior. Moreover it is shown that the terminal canal of the excretory system *is* continued *through* this space or chamber *entire*, so that its contents may not mix with those of the chamber (*ib. ib.* fig. 1, *g*), which I have assumed to be the case in *Geodia perarmata*. And lately, again, I have represented it in a marine sponge, viz. *Halichondria simulans* ('Annals,' 1874, vol. xiv. pl. xxii. fig. 34, *e e*); while Dr. J. Millar has called attention to its existence over the Hexactinellida, where it is supported in a similar way, strengthened by a square lattice-work of hexagonal flesh-spicules, just as in *Geodia perarmata* it is supported on the heads of the zone-spicules and strengthened by the addition of stellate flesh-spicules.

Although these parts are not all illustrated in Dr. Bowerbank's description and illustrations of his *Geodia perarmata* (Proc. Zool. Soc. Jan. 7, 1873, p. 8, pl. ii. figs. 1 &c.), still the spiculation there given is so like that of the Manaar specimens that, taking into consideration his statement (p. 9), that the heads of the zone-spicules are "projected

through the stratum of siliceous ovaria (globules)," I think that, although the locality, being not known, may be different, there can be no doubt that the Manaar specimens are identical with it in species; and therefore I have used Dr. Bowerbank's name. The minute acerate dermal spicule to which he alludes I have not seen.

Geodia areolata, n. sp. (Pl. VI. figs. 36, *a–g*, and 37.)

General form globular. Colour now light cinnamon externally. Surface more or less regularly areolated by lines of minute echinating acerates fixed by one end in the dermal sarcode, otherwise charged with minute stellates and closely applied to the subjacent petrous crust, one of whose holes may frequently be seen in the centre of the areolar interstice (Pl. VI. fig. 37). Pores minute and numerous in the dermal sarcode, giving it a cribriform structure. Vents in groups, or scattered here and there singly. Internal structure consisting of the usual kind of spiculation distributed throughout an areolar sarcode, more confused and compact towards the centre, but presenting no defined nucleus. Spicules of eight forms, viz.:—1, the zone-spicule, with trifid head expanded at nearly right angles to the shaft, 200 by 5-1800ths, head 40-1800ths in diameter (fig. 36, *a*); 2, large, smooth, fusiform, acerate, curved, 150 by 3-1800ths (fig. 36, *b*); 3 and 4, fork and anchor, arms respectively about 5-1800ths long (fig. 36, *e*); 5, siliceous globule, 21 by 16-6000ths (fig. 36, *d*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 4-6000ths in diameter (fig. 36, *e*,*f*), in form much the same as in the last species; 8, minute dermal acerate, 60-6000ths long (fig. 36, *g*). Spicules arranged in the usual way, viz. the heads of the zone-spicules spread out in the inner part of the petrous crust, which is 1-35th inch in thickness. Size of largest specimen about an inch in diameter.

Hab. Marine. Free or attached to hard objects.

Loc. Gulf of Manaar.

Obs. This chiefly differs from the last species in the areolated form of the dermal layer, arising from the presence of reticulated lines of minute echinating acerates, its contact with the petrous crust, the form and position of the heads of the zone-spicules, and the cinnamon colour externally.

Geodia ramodigitata, n. sp. (Pl. V. fig. 31, *a–f*.)

General form cylindrical, digital, occasionally branched (Pl. V. fig. 31). Colour grey. Surface (which is much worn)

covered here and there by the remains of a cribriform dermal membrane charged with minute stellates. Pores producing the cribriform structure of the dermal layer. Vents in groups or scattered singly here and there. Internal structure the same as that last mentioned, thickening towards the axis of the cylinder. Spicules of seven forms, viz.:—1, zone-spicule, with trifid arms expanded at right angles to the shaft, which measures 160 by 4-1800ths, and head 24-1800ths in diameter (fig. 31, *a*); 2, body-spicule, acerate, curved, smooth, fusiform, 126 by 4-1800ths (fig. 31, *b*); 3 and 4, fork and anchor, arms respectively about 4-1800ths long (fig. 31, *c*); 5, siliceous globule, 10 by 8-1800ths long (fig. 31, *d*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 8-6000ths in diameter (fig. 31, *e* and *f*). The zone-spicules have their heads in the petrous crust, which is 1-16th inch in diameter. Size of largest specimen about 5 inches long, largest part of cylinder $\frac{1}{3}$ inch in diameter.

Hab. Marine. Free or attached.

Loc. Gulf of Manaar.

Obs. This species, besides differing from the rest in shape, has larger siliceous globules and larger internal stellates. It is more or less covered by detritus (bits of shells &c.) and small calcareous organisms, which have become attached to and grown upon it, respectively, during the time it has been carried about by currents at the bottom of the sea.

Geodia globostellifera, n. sp. (Pl. VI. fig. 38, *a–f*.)

Globular. Colour grey. Surface more or less covered with detritus as in the last species. Spicules of seven forms, viz.:—1, the zone-spicule, with trifid thin arms expanded laterally at right angles to the shaft, which is 122 by $1\frac{1}{2}$-1800ths, and head 36-1800ths in diameter (Pl. VI. fig. 38, *a*); 2, body-spicule, acerate, curved, smooth, fusiform, 170 by $1\frac{1}{2}$-1800ths (fig. 38, *b*); 3, fork (no anchor could be found), arms 8-1800ths long (fig. 38, *c*); 4, siliceous globule, spheroidal and oval respectively, about 5-1800ths in diameter (fig. 38, *d*); 5, *globostellate*, consisting of a spherical body covered with short conical points or rays, $1\frac{1}{2}$-1800th in diameter (fig. 38, *e* and *g*); 6 and 7, external and internal stellates respectively, the former 1-6000th and the latter 8-6000ths in diameter (fig. 38, *f* and *h*). Spicules arranged as in the foregoing, and the globostellate mixed up with the siliceous globules of the petrous crust. Size of specimen about $\frac{3}{4}$ inch in diameter.

Hab. Marine. Free or attached.

Loc. Gulf of Manaar.

Obs. The spiculation of this is very much like that of the last species, viz. *G. ramodigitata*; but the addition of the globostellate (no. 5), which is also present in an embryonic specimen of the same species, with an entire absence of pin-like spicules in both instances, whose presence would immediately claim for it a Hymedesmid origin, seems to indicate that it is produced by the *Geodia* itself, and thus distinguishes the latter from all other species that I have yet encountered. This form of globostellate, however, is so unusual in *Geodia*, and so common about the Manaar specimens with one or more Hymedesmids, of which it forms the basal layer (ex. gr. *H. stellivarians* &c.), that I can hardly suppose it would be present in *Geodia* under any other circumstances. Still, from what has been stated, and my inability to find *any traces* of a pin-like spicule in the midst of the petrous crust where these globostellates are present, I am unable to regard it otherwise than as a product of the *Geodia*, where it may be an enlarged form of the dermal stellate. Another character of this species is the great number of "fork" spicules that project through its surface, among which I have not been able to discover a single "anchor-head."

Stelletta euastrum, Sdt. (Pl. VII. fig. 41, *a–l.*)

Laminiform, thin; growing parasitically over groups of *Siliquaria anguina*, and therefore presenting no definite form. Colour greyish white (Pl. VII. fig. 41). Surface even. Pores minute in the dermal sarcode. Vents in groups or scattered singly here and there. Spicules of five forms, viz.:—1, the zone-spicule, with simple trifid head or with the arms more or less divided (that is, the prongs of the furcation more or less lengthened), the whole expanded laterally at right angles to the shaft, which is from 20 to 40 by 4-1800ths, head 27-1800ths in diameter, both shaft and head being very variable in form and size (fig. 41, *b*); 2, body-spicule, acerate, smooth, curved, fusiform, 60 by 2-1800ths (fig. 41, *c*); 3, siliceous globule, discoid, irregularly elliptical, very thin, the hilous depression hardly discernible, and the stellate ends of the radiated structure scattered thickly but *separately* over the surface, about 17 by 9-1800ths and about 3-1800ths thick (fig. 41, *d, g, k, l*); 4, acerate (flesh-spicule), curved, microspined, more or less inflated in the centre (fig. 41, *e, g, h*); 5, stellate, 2-1800ths in diameter (fig. 41, *e, g, i*). Siliceous disks gathered together in a thin layer on the surface, but the rest of the spicules mixed together apparently indiscriminately and confusedly throughout the body; the zone-spicule

in form, size, and position the most irregular of all. Size of largest specimen, of which there are several, that of the group of *Siliquaria*, about $2\frac{1}{2}$ inches in its long diameter, compressed.

Hab. Marine. Parasitic on *Siliquaria*.

Loc. Gulf of Manaar.

Obs. This species was first named by Schmidt, who obtained the specimen from Lacaze-Duthiers, who, again, got it from La Calle, on the north coast of Africa, near Algiers (Schmidt, Spong. Küste v. Algier, 1868, p. 20); no description of it, however, is given beyond the spiculation, of which I examined a mounted type specimen in the British Museum.

The disk is, *mutatis mutandis*, identical with the siliceous globule in development, structure, and location, while the imperfectly formed zone-spicule and its irregular location puts one in mind of *Pachymatisma Johnstonia* (so abundant on our coasts); still it appears to me to be more nearly allied to *Geodia* than to *Stelletta*; and therefore I have placed it, like *Pachymatisma*, among my Geodina. Schmidt, as above stated, has given it the generic name of "*Stelletta*," adding, by way of designation, "*euastrum*," from the large and beautiful form which some of the stellates attain in the specimen from La Calle, but which do not occur in that of the Gulf of Manaar—although they will be seen to do so in the Australian form (fig. 42, *c*), which I will now describe, as it gives us more of the internal structure than is to be found on the laminiform growth over the group of *Siliquaria* (fig. 41).

Stelletta euastrum, Sdt., S.W. Australian specimen, Freemantle. (Pl. VII. fig. 42, *a*–*c*.)

Ovular, now wrinkled from being dry; 3 inches long by $1\frac{1}{2}$ inch in diameter. Colour white externally—that is, the colour of the petrous crust,—pale yellow internally, which is the colour of the sarcode (Pl. VII. fig. 42). Surface even, dimpled, poriferous throughout (fig. 42, *b b*). Vents of different sizes scattered here and there (fig. 42, *a a a*). Dermal layer composed of the disks before mentioned, mixed with both forms of the flesh-spicule, about 1-360th inch thick, surrounding a pale yellow widely areolated body-structure charged with the spicules of the species and, if anywhere, less condensed in the centre than towards the circumference; thus, in the absence of any zonular arrangement and central condensation like that of a typical *Geodia*, this species is identical with *Pachymatisma Johnstonia*, Bk. Possessing much the same kind of spiculation as the Manaar specimen, it has, in addition, the large and beautiful stellate (fig. 42, *c*)

"*euastrum rota*," Sdt., which seems to be always quadriradiate with rays of equal length, viz. 12-6000ths, spined over the outer half, and parting at the same angle from the centre of union, where there is no body. But this spicule is confined to the parenchymatous structure, of which there being none or very little in the Manaar specimen from its thin, parasitic, laminiform growth, may account for its absence there; while the same kind of smaller and more radiated stellates, about half the size in both specimens, are equally abundant, in the dermal layer especially.

Besides *Stelletta euastrum* there are two other species with discoid siliceous globules in the Adriatic, which Schmidt has named respectively *S. discophora* and *S. mamillaris* (Spong. Adriat. Meeres, 1862, pp. 47, 48, Taf. iv. fig. 5, and Taf. v. fig. 1, respectively), of which there is a specimen (for they both appear to me to be the same species) in the British Museum, obtained by Mr. Saville Kent from the coast of Portugal; and from this, together with Schmidt's illustrations, it is evident that the same kind of discophorous layer on the surface, the absence of the zonular arrangement of the spiculation and that of the "forks and anchors," so characteristic of *Geodia*, exists in all, with a badly-developed condition of the zone-spicule (which, as above stated, varies in the form of its head from trifid to trifurcate, and in that of its shaft from long to short, pointed and obtuse), scattered here and there amongst the rest of the spicules without any apparent regularity whatever. In short, the structure is as different from that of a *Geodia* as it is specifically characteristic of *Pachymatisma Johnstonia* and *Caminus vulcan*, Sdt. (*op. et loc. cit.*). All of these, therefore, although belonging to the Geodina, should constitute a different group from *Geodia* proper.

Stellettina.

The chief difference between the Stellettina and Geodina is the total absence of the "siliceous globule" in the former, whether spheroid or discoid, leaving nothing but the "dermal stellates" to rest upon the zone-spicules &c., which are for the most part similarly arranged to those of *Geodia*, although seldom with such characteristic regularity.

Stelletta tethyopsis, n. sp.
(Pl. VI. fig. 39 and 40 *a–f*.)

General form subhemispherical and sessile, or spheroidal and free (Pl. VI. fig. 39). Colour grey. Surface uniformly hispid from the projection of the forks and anchors, beneath

which may be seen the heads of the zone-spicules supporting the dermal sarcode charged with its stellates. Pores in the dermal layer. Vents not seen, probably owing to contraction and dryness. Internal structure very compact on account of all the spicules lying close and nearly parallel to each other as they uninterruptedly converge from the circumference to a point in the centre, where there is no nucleus (fig. 39). Spicules of five forms, viz. :—1, the zone-spicule, consisting of an extremely long, smooth, slightly curved shaft and trifid head trifurcated, of which the three arms advance obliquely forwards at an angle of 45° with the shaft, and the rest turn off at right angles to it, shaft 625 by 5-1800ths, head about 30-1800ths in diameter (fig. 40, *a a*) ; 2, body-spicule, also extremely long, acerate, smooth, slightly curved fusiform, 625 by 4-1800ths (fig. 40, *b b*) ; 3, forks and anchors largely developed, of which the arms respectively are about 10-1800ths long (fig. 40, *c*) ; 4 and 5, external and internal stellates, the former about 1- and the latter 4-6000ths in diameter (fig. 40, *e*, *f*), both multiradiate and without central nucleus or body—that is, their rays radiate from a central point which is not differentiated,—the internal stellate, as is usual in *Stelletta*, very faintly developed, and the rays fewer and longer than those of the external one. Largest specimen sessile, about two inches in horizontal diameter at the base and $\frac{3}{4}$ inch high, somewhat umbonate; but a considerable portion appears to have been left on the rock where it grew.

Hab. Marine. Free or fixed.

Loc. Gulf of Manaar.

Obs. This is a very beautiful species, from the compactness and regularity of its structure internally, which also causes it to closely resemble *Tethya cranium* (the type of my Tethyina), hence its designation ; but its spiculation is that of a *Stelletta*. The head of the zone-spicule is subject to great variety in form, sometimes assuming that of the "fork" greatly enlarged (fig. 40, *d*). It is stated above that a considerable part of the base was probably left on the rock where it grew, since I know by experience, on the S.E. coast of Arabia, that a sponge possessing this kind of structure contracts so forcibly when alive and fixed on the rock where it may be growing, that it can only be got off in portions with hammer and chisel!

Tisiphonia nana, n. sp. (Pl. VII. fig. 43, *a–e*.)

Laminiform, thin, or filling up the depression in the Melobesian nodule where it may be growing. Colour white. Surface even. Spicules of four forms, viz. :—1, large trifur-

cate with very short conical shaft, 6 by 3-1800ths, head 50-1800ths in diameter (Pl. VII. fig. 43, *a*, *b*) ; 2, acerate, smooth, fusiform, curved, 27 by 1-1800ths (fig. 43, *c*) ; 3, acerate flesh-spicule, smooth, fusiform, curved, inflated in the centre, 4-1800ths long (fig. 43, *d*, *e*) ; 4, stellate flesh-spicule 4–6-rayed, rays microspined, 3-6000ths (fig. 43, *d*, *e*). The large trifurcate spicule is parquetted in amongst the rest so as to form a smooth even surface over an areolar structure, whose thickness varies with the subjacent depressions of the Melobesian nodule over which the sponge is growing. Size about one third of an inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. Dwarfed as this variety is, one can see by its spiculation, although modified by its habitat on the surface of the Melobesian nodule, that it belongs to the Stellettina. The trifurcate head, although necessarily with an extremely short shaft, indeed hardly more than a short cone (fig. 43, *b*), and the acerate spicule no. 2, are equivalent to the zone- and body-spicule in *Geodia* respectively; while the central inflation of the acerate flesh-spicule, although not microspined, and the tendency in the stellate to assume a spinispirulate form, ally it to the *Tethea muricata* of Bowerbank, the synonymy of which I have already published ('Annals,' 1878, vol. ii. p. 174) ; but I find that, in this article, I have omitted to mention that my dear old friend, Dr. J. E. Gray, in a note to me, dated 3rd January, 1871, foreshadowed what I have therein chiefly stated, viz. that "Bowerbank's figures of the spicules of his *Tethea muricata* (B. S. vol. i. figs. 304, 305) are probably those of *Tisiphonia, Wyvillethomsonia* and *Dorvillia* respectively," which is now proved to be the case by Dr. Bowerbank's own words and his illustrated description of *Tethea muricata* (Proc. Zool. Soc. 1872, p. 115, pl. v. figs. 1–6).

The first mention of the name *Tisiphonia* for a sponge occurs in Sir Wyville Thomson's paper on *Holtenia Carpenteri* (Phil. Trans. vol. 159, p. 712), read before the Royal Society on the "17th June, 1869," where, without more than the letters "n. g." after it, he gives it as one of the genera illustrating his "suborder Leptophlea." Subsequently we have the name "*Wyvillethomsonia*" proposed as a generic appellation for the same species by Dr. P. Wright in January 1870 ; and then comes Schmidt's of "*Stelletta*" in the month of May following, ending with that of "*Dorvillia*" by Mr. Saville Kent in Dec. 1870.

Now it is evident that no one but Dr. Gray had seen that

this was a form of Dr. Bowerbank's *Tethea muricata* up to the date above mentioned; or if so, no one ever noticed it publicly. Still it is equally evident that *Tisiphonia*=*Dorvillia* is sufficiently different from *Tethea muricata* to require specific distinction; at the same time that *Tethea muricata* is not a species of *Tethea*, but one of *Stelletta*, as Schmidt has made it from his examination of the Florida specimen.

Furthermore, we find Dr. Bowerbank multiplying the varieties of this sponge under the names *Ecionemia compressa*, *Hymeniacidon placentula*, and *Normania crassa* respectively (B. S. 1874, vol. iii.), all of which specimens (now in the British Museum) I have had the opportunity of examining. Hence, when we find the species (varieties) of a sponge so numerous, it becomes necessary to make a group of them under a specific name; and as Sir Wyville Thomson's use of "*Tisiphonia*" claims priority in this respect, I have applied it generically to the species above described, and shall apply it *provisionally* to the two following ones, merely observing that, while I consider them all varieties, the human mind can never remember them without specific distinction. Nature does not require this aid.

Tisiphonia annulata, n. sp. (provisional).
(Pl. V. fig. 28, *a-d*.)

Massive, charged with the spicules of the species, without apparent regularity. Colour white. Spicules of three forms, viz.:—1, quadriradiate, arms equal in size, radiating at equal angles from a common centre, annulated throughout with alternate inflations and depressions, the former microspined and sometimes broken or incomplete in the annulation, arm 17 by 1½-1800ths (Pl. V. fig. 28, *a* and *d*); 2, acerate, smooth, fusiform, curved, 63 by 1½-1800ths (fig. 28, *b*); 3, spini-spirulate flesh-spicule, 3-6000ths long (fig. 28, *c*). Spicules arranged confusedly in an areolated sarcode; nos. 1 and 3 in great abundance and of various sizes, the former below and the latter above their stated measurements respectively. Size of specimen about 1-12th inch in diamenter.

Hab. Marine. Growing on hard objects, in the present instance among the minute detritus attached to the specimen of *Stelletta euastrum* (Pl. VII. fig. 42).

Loc. Gulf of Manaar.

Obs. This sponge was found growing in the place just mentioned. The facies of the spiculation appears to me to be that of a variety of *Tisiphonia*; and if so, the quadriradiate spicule is, with the exception of the annulation, like that given by Dr. Bowerbank of *Normania crassa* (B. S. vol. iii. pl. lxxxi.

fig. 5); but the characteristic acerate flesh-spicule (viz. microspined and centrally inflated) is absent, although the spinispirula is not, but abundantly present.

The chief interest, however, of this specimen is in the annulated quadriradiate form, on account of its resemblance to the fossil spicule from the Upper Greensand of Haldon Hill, near Exeter, which I represented in 1874 ('Annals,' vol. vii. pl. ix. figs. 44, 45), as it may not only throw some light on the nature of the sponge which bore this, but also on the other moniliform spicules so common in the cavities of the chalk-flints of Oxfordshire and perhaps elsewhere, but first represented from some Irish specimens by Mr. Joseph Wright, F.G.S., in the Belfast Nat. Hist. Field-Club Report for 1873-74 (pl. ii. figs. 4, 5).

Tisiphonia penetrans, n. sp. (provisional).
(Pl. VII. fig. 44, *a–d*.)

Amorphous, taking the form of the excavation of the Melobesian nodule in which it may be growing. Colour white. Spicules of three forms, viz.:—1, acerate, curved, smooth, fusiform, 27 by 1-1800ths (Pl. VII. fig. 44, *a*); 2, the same form, but much smaller, 6-1800ths long (fig. 44, *b*); 3, stellate flesh-spicule, variable in the number and position of its rays, often quadriradiate, rays microspined, 4-6000ths in diameter (fig. 44, *c*, *d*). Size varying with that of the excavated cavity in which it may be growing.

Hab. Marine. In excavations previously made by lithodomous sponges.

Loc. Gulf of Manaar.

Obs. There is still less in this to identify directly with the spiculation of *Tisiphonia* than in the foregoing species; but the *facies* here also strikes me as being allied to this genus. Although found in the excavated cavities of the Melobesian nodule, I doubt if it made the cavities itself; for they often contain a heterogeneous mixture of different forms of spicules which come from as many different kinds of sponges that in my examinations I have never met with, some of which are extremely beautiful and not less remarkable, *ex. gr.* figs. 29, 30 (Pl. V.). They are generally, too, enclosed in a transparent membranous investment, which must be the remains of the living organism that not only gathered them together and enclosed them, but dragged them into some of the minutest channels of the excavation in the nodule. What was the nature of that organism, Foraminiferal or Spongious, future observation may determine.

Lithistina.

In describing the Lithistids it is absolutely necessary to have specimens which possess the last-formed dermal layers in addition to a portion of the fully formed internal structure, because these are the parts which are most characteristic of the species; hence, although we may not possess the fully developed *entire* form, the thinnest layer, provided it contains the parts mentioned, will be sufficient to determine the species; for these will ever be the same, although the adult form of the sponge itself may be different. So that, while the specimens on the Melobesian nodules of the Gulf of Manaar are so small that, comparatively, they hardly amount to much more than traces of structure which may attain a large and definite form in the deeper sea, still, so far as they go, they will enable us to predict what they may attain in that situation.

For the most part, they have grown over the layers of *Melobesia* from which the nodules have been chiefly formed, while in many instances they themselves have been overgrown by one of the Microcionina that have been described; but, whether overgrown or not, as the spiculation of a Lithistid, for the most part, is so locked together that even boiling in pure nitric acid does not separate its parts, so in this way it has been easy to free the Lithistid not only from the calcareous *Melobesia* on which it rests, but from the *Microciona* covering it, to such an extent as to cause it to come out under this treatment in a clean, perfect, and beautiful form. I have stated "for the most part," because it may be easily conceived that the elements of which a Lithistid is composed are not inextricably locked together until they have undergone a certain amount of development, and therefore, being more or less united by sarcode until this occurs, they are, up to this time, *separable* by boiling in nitric acid. Such is more particularly the case with the Lithistids whose structure commences in disks (viz. the *Discodermiæ*), which disks we shall hereafter find to be gradually transformed into their branched and complicated spiculation. But even here, under the boiling in nitric acid, all the separated parts can be easily retained, and, when mounted in Canada balsam, present, when *thus separate*, a much better view of their gradationary development than when *in situ*, where they lie more or less obscured in layers one over another as they are formed. The term "interlock" is here used advisedly; for whereas in the vitreous Hexactinellida the spicules are cemented together by the addition of glassy fibre, no such thing occurs in the Lithistida, whose spicules are united by *mere apposition* of the expanded ends of their filigreed branches (Pl. VIII.

fig. 51, *i*), or by an *interlocking*, *inseparable* without fracture, of the filigree of one branch with that of another (Pl. VIII. fig. 48, *k k k* and *l*). At least I have not yet seen *direct union* between the parts of one spicule with those of another in a Lithistid.

Although most of these Melobesian nodules present one or more growths of Lithistida upon them respectively, yet it is only in one or two instances out of the seven species that I have found that two different ones have been observed on the same nodule; while so abundant are they that it is hardly possible to mount a fragment of any other sponge on the nodule without finding in it spicules of a Lithistid.

Of the "seven species" three may be termed "*Corallistes*," because they do not appear to commence their growth in discoid elements; while the opposite is the case with the other four, which will be termed "*Discodermia*." Of course, in describing and illustrating them, my observations will be confined to their structure, since they must be regarded as only little growths or traces, as before stated, of the entire sponges; while the illustrations, on the other hand, must be considered as diagrams after nature, for such is the intricacy of Lithistid structure that it is almost hopeless to attempt any thing beyond catching the specific character and representing this as near to nature as possible. Having premised these remarks, we will begin with the *Corallistes*.

Corallistes.

Corallistes aculeata, n. sp. (Pl. VII. fig. 45, *a*, *b*.)

Surface characterized by the presence of erect spike-like processes (Pl. VII. fig. 45), which, when the structure is torn to pieces, are respectively found to be supported on three arms, which are tubercled and repeatedly subdivided into branches until they end in a filigree consisting of minute *angular* processes, which interlock with those of the neighbouring spicules (fig. 45, *a*). Spike conical, elongated, subsinuous, 1-333rd long by 1-120th inch in diameter at the base, more or less cononodose, tubercles more or less in cirlar lines round the lower two thirds of the spike (fig. 45, *a*, *b*). Internal structure composed of spicules of the usual Lithistid form, consisting of four arms, each of which is repeatedly divided and subdivided into branches until they end in the way above mentioned. Size of largest specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The spike supported on three arms diadem-like and uniformly distributed over the surface is the characteristic feature of this species. There is a small specimen of it in the British Museum, about 6-12ths inch in diameter, which came from the neighbourhood of Kendrick Island, south of Japan (lat. 24° 13′ N., and long. 136° 13′ E.), presented by Dr. J. Gwyn Jeffreys.

Corallistes verrucosa, n. sp.
(Pl. VII. fig. 46, *a*, *b*.)

Surface characterized by the presence of short, tuberose cones (Pl. VII. fig. 46), which, when the structure is torn to pieces, are respectively found to be supported on three arms tubercled and repeatedly subdivided into branches until they end in a filigree consisting of minute *angular* processes which interlock with those of the neighbouring spicules (fig. 46, *a*). Cone consisting of a pyramidal heap of tubercles about 1-666th inch high and 1-750th inch in diameter at the base (fig. 46, *a*), which is triangular and, for the most part, composed of three tubercles larger than the rest, triangularly placed and situated respectively opposite the *reentering* angles *between* the arms (fig. 46, *b*). Internal structure composed of spicules of the usual lithistid form consisting of four arms, each of which is repeatedly divided and subdivided into branches until they end like the one above mentioned. Size of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. There is nothing particular about this species beyond the form of the surface-processes, which, at the same time that they present a distinguishing feature, afford the only remarkable difference between it and *C. aculeata*.

Corallistes elegantissima, n. sp.
(Pl. VII. fig. 47.)

The spicules of this species (if it is a distinct one) were only found in microscopic groups in two places on the same nodule as *Discodermia papillata* (which will presently be described), where they were chiefly in the midst of, and thus protected by, the acerate spicules of a species of *Reniera* that had overgrown them. To describe a Lithistid spicule where there is no particular character is, from its intricateness, almost impossible; therefore I must refer the reader to the illustration, which is a careful drawing to measurement of one of these elegantly beautiful objects, merely adding that

the terminations are not round like those of most *Discodermiæ*, but pointed, prong-like, and angular, as they are delineated (Pl. VII. fig. 47).

Discodermida.

Finding that the Discodermida grow by the transformation of a simple disk on the surface to the complicated structure of the interior, I have endeavoured to illustrate this in a series of figures which are taken from a portion that was boiled to pieces in nitric acid and the residue mounted in Canada balsam (Pl. VIII. fig. 48, *d*, &c.). Indeed all the species have been studied in this way, when the gradationary forms of the disk thus separated render it very easy, as before stated, to see and follow the changes of form which it undergoes; besides which, this may be corroborated by looking at the specimen *in situ* in its natural state through a microscope (Pl. VIII. fig. 48, *a*, *b*, *c*). In addition to the disks the Discodermida appear to be always characterized by one or more forms of minute flesh-spicules in great abundance, of which a curved acerate, or straight bacillar one, microspined, is perhaps the most prevalent (fig. 48, *h*, and 49, *c*, *d*); but these are not confined to the dermal sarcode in which the disks are developed and imbedded, although apparently most abundant there (fig. 48, *a*, &c.), but almost as plentifully distributed throughout the whole structure. Again, the filigreed ends of the branches of the full-formed spicule are *not angular*, but *more or less spherical*, like bunches of grapes interlocked with one another, after the manner of the clasping of hands (fig. 48, *l*). At the same time, however, I am not able to explain the fact that in *Kaliapsis cidaris*, Bk. (Proc. Zool. Soc. 1869, pl. xxv. fig. 2, &c.), of which I possess some good specimens *in situ*, and which is a genuine *Discodermia*, a "diadem-like" form of spicule similar in this respect to that of *Corallistes aculeata*, exists *under* the discophorous layer. I do not pretend to follow this transformation of the disk, which is succeeded, as usual, by the fully formed Lithistid spicule of the interior, but now only to announce the circumstance. In specimens of *Corallistes aculeata*, *in situ*, the spikes may be seen without any disks whatever, even when the surface is overgrown and thus protected by a *Microciona*; nor in the mounted residue after boiling in nitric acid of specimens of this species is there a trace of a disk under any kind of form to be observed; while in most specimens of *Discodermiæ* the *Microciona* grows *upon the disks themselves*.

In describing the structure of the different species of Discodermida, I shall commence with the disks, as these are the

first-formed parts, and follow the structure on by description and illustration to the full development of the spicule, finally giving a magnified view of the form of the filigreed termination characteristic of each species.

Discodermia papillata, n. sp.
(Pl. VIII. fig. 48, *a–l*.)

Surface even, discophorous, disks horizontal; structure papillated throughout, accompanied by a bacillar microspined flesh-spicule (Pl. VIII. fig. 48, *a*, *b*, *c*). Colour yellow internally. Outer layer of last-formed disks more or less circular, micropapillated in the upper, and bearing the rudiment of a spine (the shaft) in the centre of the lower surface, the smallest disk observed being circular, and about 1-300th inch in diameter (fig. 48, *b* and *d*); the next layer larger and more indented on the margin; after this the disk becomes branched, the spine or shaft fully formed (fig. 48, *e*), and the papillæ enlarged and extended over the branches (fig. 48, *f*); finally the staple spicule of the interior is produced (fig. 48, *i*), where the shaft may be observed to be trifidly divided and subdivided until it ends in the filigree, with which it interlocks with its neighbours (fig. 48, *k k k*) on all sides by botryoidal or grape-like terminations (fig. 48, *l*)—the original papillæ, now still more enlarged and extended over the shaft and branches, presenting over the former a wart-like appearance (fig. 48, *i*), probably influencing this character of the development throughout,—a similar development taking place at the inner end of the shaft, by which, both on the outer and inner side, the filigree is interlocked with corresponding portions of similar spicules; and thus the structure presents internally an increase of bulk by successive layers, as the breaking-up of a piece of fully-formed Lithistid testifies. Papillæ at first microscopic, finally becoming conical (fig. 48, *g*). Bacillar spicule elliptical, elongated, microspined throughout, about 3-6000ths long (fig. 48, *h*). Largest specimen about an inch in horizontal diameter, filling up the depressions of the Melobesian nodule over which it grows, and extending into the crevices and cavities made by excavating sponges that may be underneath.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. I have thus summarily described the development of this discodermid sponge, so that it will not be necessary to repeat it in the other species more than the occasion demands; at the same time it should be remembered that the varieties in the structure of the elementary parts of a Lithistid are practi-

cally unlimited. Again, it frequently happens that the discophorous layer has disappeared from some cause or other, and that the surface is *then* formed by that condition of development where the disk has passed into a branched state, in which the branches, curving over each other, leave interspaces charged with the bacillar flesh-spicule (Pl. VIII. fig. 48, *a*, and 50 *a*, &c), which causes it to assume the appearance given byDr. Bowerbank of his *Dactylocalyx Prattii* (Proc. Zool. Soc. 1869, pl. v. figs. 6–11), and the same in *Theonella Swinhoei*, Gray (*ib.* 1868, p. 565), both of which specimens, now in the British Museum, I have examined and find the *discophorous layer absent*. Nor is this to be wondered at, from what I have stated of the instability of this layer until the disks have become transformed into the interlocking spicules; still there are no papillæ on the spicules of *Dactylocalyx Prattii* or of *Theonella Swinhoei*, which distinguishes them from *Discodermia papillata*; but although the flesh-spicule is elliptical elongate in *Dactylocalyx Prattii*, and bent in the middle in *Theonella Swinhoei*, this is not sufficient for specific distinction between them; nor is the flesh-spicule generally to be depended on in this respect; so, with this difference only, I think, as Dr. Bowerbank has concluded (*op. et l. cit.*), that *Dactylocalyx Prattii* and *Theonella Swinhoei* must be considered the same species. Yet there is a large, vase-like specimen to which I have before alluded, and which comes from the seas about the Philippine Islands, in which the flesh-spicules (for there are two forms) may be considered of some specific value, since here the usual acerate curved microspined and centrally inflated flesh-spicule is accompanied by another equally plentiful, viz. a short thick ellipsoidal form also microspined, not unlike the same kind of flesh-spicule in *Pachastrella abyssi*, Sdt.

Discodermia aspera, n. sp.
(Pl. VIII. fig. 49, *a–i*.)

Surface even, discophorous, disks horizontal (Pl. VIII. fig. 49, *a*, *b*). Structure asperous, spinous, accompanied by an acerate microspined flesh-spicule (Pl. VIII. fig. 49, *a*, *b*). Colour grey. Discophorous structure and transformation much the same as in the last-described species, only that the margin of the disk soon becomes denticulated (fig. 49, *c*), and the papillæ pass into spines, as indicated by the four gradationary diagrams (fig. 49, *g*); and in the transformed disk (fig. 49, *f*) the irregularly lobed and denticulated margin, together with the spines on the surface, give that asperous appearance which more or less influ-

ences the subsequent development of the fully formed spicules of this Lithistid even to the end (fig. 49, *h*), in which the filigreed terminations are not grape-like as in the foregoing species, but subangular (fig. 49, *i*). Papillæ at first microscopic, then enlarged, after which they become united by intervening straight linear ridges, then elevated and compressed, and finally divided into spine-like processes (fig. 49, *g*), which more or less characterize the fully formed spicules (fig. 49, *h*). Flesh-spicule acerate, curved, microspined, about 5-6000ths long (fig. 49, *e*), plentifully distributed over the disks (fig. 49, *a*) and throughout the structure. Size about 1 inch in horizontal diameter, filling up the depressions on one side of a Melobesian nodule about this size.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The asperous character of the spiculation of this species, arising from a transformation of the original papillæ of the disk into spinous processes, as above mentioned and illustrated (fig. 49, *g*, &c.), chiefly distinguishes it. As the specimen for the most part is very much worn, I should, but for the boiling in nitric acid of a portion which had been protected by having been overgrown by a *Reniera*, have been entirely ignorant of its discophorous character and the peculiar spinous transformation of the papillæ of the disks to which I have alluded, which seems to continue its influence on to the fully formed structure.

Discodermia spinispirulifera, n. sp.
(Pl. VIII. fig. 50, *a–h*.)

Surface even, discophorous; disks horizontal; structure loose, accompanied by *two* forms of flesh-spicule, viz. an acerate and a spinispirula (Pl. VIII. fig. 50, *a*, *b*, *c*, and *e*, *f*). Colour white. Discophorous structure and transformation much the same as in the foregoing species, only that, instead of papillæ, the disk presents *faint* circular concentric lines (fig. 50, *d*), and, previously to passing into the branched form, show an irregularly lacerated margin in which the foreshadowed divisions of the full-formed spicule assume the most whimsical proportions and appearances (fig. 50, *i*), finally producing a branched spicule repeatedly subdivided as before until the ends become filigreed into subglobular processes (fig. 50, *g*). Flesh-spicule of two forms, viz.:—1, comparatively large, acerate, curved fusiform, microspined, about 20-6000ths inch long (fig. 50, *e*); and the other, 2, a minute spinispirula, consisting of a sinuous shaft covered with thin spines about the same length as itself, arranged over it in an echinating, spiral

manner, 3-6000ths of an inch long (fig. 50, *f*),—the former plentifully distributed over the disks, as before mentioned, and but little less so throughout the rest of the structure, while the latter sparsely accompanies it. Size of largest specimen about $\frac{1}{4}$ inch in horizontal diameter, and the thickness of the depression on the nodule where it may have grown, often extending into the cavities formed by excavating sponges.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. The remarkably shreddy character of the advanced form of disk (fig. 50, *i*) and the presence of the spinispirular flesh-spicule, together with the comparatively large size of its companion the acerate flesh-spicule, distinctly separate this from the other species of *Discodermia*. It may be remembered that the flesh-spicule of *Dactylocalyx Masoni*, Bk., is a spinispirula (Proc. Zool. Soc. 1869, pl. vi. fig. 4).

Discodermia lævidiscus, n. sp.
(Pl. VIII. fig. 51, *a–i*.)

Surface even, discophorous, disks horizontal, structure areolar, accompanied by an acerate flesh-spicule (Pl. VIII. fig. 51). Colour yellow internally. The disks here, which also present a great number of faint lines, like those of the foregoing species, are depressed in the centre (fig. 51, *b*, *c*). They undergo similar transformation to those of the foregoing species (fig. 51, *e*), passing at last into the fully formed spicule of the interior (fig. 51, *h h*), whose terminations appear to be more in expanded, irregular surfaces, for the sake of union by apposition with their neighbours, than in filigree processes interlocking (fig. 51, *i*). Flesh-spicule acerate, curved, fusiform, microspined, about 8-6000ths long (fig. 51, *f*, *g*), plentifully distributed over the disks (fig. 51, *a*) and throughout the interior, as in the foregoing species. Size of specimen about $\frac{1}{4}$ inch in horizontal diameter.

Hab. Marine. On hard objects.

Loc. Gulf of Manaar.

Obs. When viewed *in situ* (fig. 51) the depressions in the centres of the disks, which are rather less in diameter than those of the other species, together with the concentric lines, added to the comparative absence of filigree terminations in the fully formed spicule, and the yellow colour of the interior, are sufficient to distinguish it from the other species; while the absence of papillæ on the disks causes it to

differ from *D. papillata* and *D. aspera*; the absence of the shred-like transformation of the disk (although in both instances there are no papillæ on it), together with the presence of the spinispirular flesh-spicule, causes it to differ equally from *D. spinispirulifera*.

The following is a list of organisms in and about the Melobesian nodules from the Gulf of Manaar above mentioned :—

ALGÆ (calcareous).

Melobesia (?) polymorpha, laminiform.
—— polymorpha, nulliporiform.
Melobesia, quadrangular-celled, laminiform, ? sp.
Flabellaria opuntia.

FORAMINIFERA.

Sessile.

Polytrema miniaceum.
—— cylindricum.
—— mesentericum, n. sp. *Loc.* unknown, not Gulf of Manaar.
Carpenteria utricularis.
Carpenteria monticularis.
Gypsina melobesioides.
—— vesicularis.
—— ——, var. spheroidalis.

Subsessile.

Rotalia spiculotesta.
Orbitolites marginalis.

Free.

Calcarina calcar, var. hispida, n. var.
Alveolina sinuosa, n. sp.
Amphistegina.
Holocladina pustulifera, nov. gen. et sp.
Cysteodictyina compressa, nov. gen. et sp.
Ceratestina globularis, nov. gen. et sp.
—— tessellata, n. sp.

SPONGIDA.

Ord. ii. Ceratina.

Aplysina purpurea, n. sp.
Aplysina fusca, n. sp.

Ord. iii. Psammonemata.

Hircinia arundinacea, n. sp.
Hircinia fusca, n. sp.

Ord. iv. Rhaphidonemata.

Chalina ? sp. (young).
Desmacidon Jeffreysii, *Bk.*

Ord. v. Echinonemata.

Pluriformia.

Dictyocylindrus manaarensis, n. sp.
Dictyocylindrus sessilis, n. sp.

Microcionina.

Microciona atrosanguinea, *Bk.*
—— armata, *Bk.*
—— affinis, n. sp.
—— bulboretorta, n. sp.
—— quadriradiata, n. sp.
—— fascispiculifera, n. sp.
Microciona curvispiculifera, n. sp.
Hymerhaphia vermiculata, var. erecta.
—— unispiculum, n. sp.
—— clavata, n. sp.
—— eruca, n. sp.

Baculifera.

Caulospongia, *Kent*, ? sp.

Ord. vi. Holorhaphidota.

Thalyosa.

Reniera ? sp. Brown and white.

Crassa.

Reniera ? sp. Yellow and yellowish grey.
Reniera ? sp. White.
—— ? sp. Dark brown.

Fibulifera.

Reniera fibulifera, *Schmidt.*

Halichondrina.

Halichondria aceratospiculum, n. sp.
Halichondria albescens, *Johnston.*

Esperina.

Esperia tunicata, *Schmidt.*
Esperia serratohamata, n. sp.

Hymedesmina.

Hymedesmia stellivarians, n. sp.
—— Moorei, n. sp.
—— capitatostellifera, n. sp.
Hymedesmia spinatostellifera, n. sp.
—— trigonostellata, n. sp.

Suberitida.

Suberites vestigium, n. sp.
—— fistulatus, n. sp.
Suberites angulatus, *Carter.*

Placospongida.

Placospongia melobesioides, *Gray.*

Eccœlonida.

Thoosa socialis, n. sp.
Dotona pulchella, n. sp.
Alectona Higgini, n. sp.
Samus anonymus, *Gray.*
—— simplex, n. sp.
Samus (Pachastrella) parasiticus, *Crtr.*
—— complicatus, n. sp. Seychelles.

Geodina.

Geodia perarmata, *Bk.*
—— areolata, n. sp.
—— ramodigitata, n. sp.
Geodia globostellifera, n. sp.
Stelletta euastrum, *Schmidt.*

Stellettina.

Stelletta tethyopsis, n. sp.
Tisiphonia nana, n. sp.
Tisiphonia (prov.) annulata, n. sp.
—— (prov.) penetrans, n. sp.

Lithistina.

Corallistes aculeata, n. sp.
—— verrucosa, n. sp.
—— elegantissima, n. sp.
Discodermia papillata, n. sp.
Discodermia aspera, n. sp.
—— spinispirulifera, n. sp.
—— lævidiscus, n. sp.

Ord. viii. Calcarea.

Gen. Leucortis indica, *Häckel.* Imperfect.

Spicules of unknown Sponges.

HYDROIDA.

Hydradendrium spinosum, nov. gen. et sp.

ACTINOZOA.

Alcyonaria.

Rhizoxenia, *Ehr.*, ? sp.
Spongodes, *Lesson*, ? sp.
Tubipora reptans, n. sp.

POLYZOA.

A great variety of species undetermined.

TUNICATA.

Synascidiæ, Giard.

Tribe i. *Didemnidæ* (with spicules).

Leptoclinum, *Milne-Edwards.* White, incrusting.

GASTEROPODA.

Siliquaria anguina.

Type specimens of all the above organisms, dry and mounted in Canada balsam respectively, may be found in the Liverpool Free Museum, under the designation of "Manaar Collection of 1879, presented by Captain H. Cawne Warren."

EXPLANATION OF THE PLATES.

N.B. To avoid repetition, the measurements are to be considered parts of an inch throughout.

If the *scale* is not given in figures, the following indications should be remembered:—

"Sc. A" means 1-24th to 1-1800th inch.
"Sc. B" means 1-24th to 1-6000th.
"Sc. C" means 1-12th to 1-6000th.
"Sc, D" means 1-48th to 1-1800th.

Where the spicule is fusiform and perhaps curved, a trapezoidal figure has often been given to it for convenience in delineation, although the proportions are maintained; the detail otherwise must be sought for in the letterpress.

Dotted lines and dots are generally intended to represent spination.

Plate IV.

Fig. 1. *Dictyocylindrus manaarensis*, n. sp., nat. size: *a*, *b*, *c*, *d*, linear spicules; *e*, tricurvate; *f*, equianchorate (Sc. A); *g*, more magnified view of *e* and *f*.

Fig. 2. *D. sessilis*, n. sp., nat. size: *a*, *b*, *c*, linear spicules (Sc. A); *d*, more magnified view of *c*.

Fig. 3. *Microciona bulboretorta*, n. sp., spiculation of: *a*, *b*, *c*, *d*, linear spicules (Sc. A); *e*, more magnified view of *d*.

Fig. 4. *M. quadriradiata*, n. sp., spiculation of: *a*, *b*, linear spicules; *c*, quadriradiate (Sc. A); *d*, more magnified view of *c*.

Fig. 5. *M. quinqueradiata*, n. sp., spiculation of: *a*, *b*, *c*, linear spicules; *d*, quinqueradiate (Sc. A); *e*, more magnified view of *d*.

Fig. 6. *M. curvispiculifera*, n. sp., spiculation of: *a*, *b*, linear spicules; *c*, curvilinear spicule (Sc. A); *d*, more magnified view of *c*.

Fig. 7. *M. fascispiculifera*, n. sp., spiculation of: *a*, *b*, *c*, linear spicules; *d* is *c* fasciculated (Sc. A); *e*, more magnified view of *b*; *f*, bihamate (Sc. B); *g*, large spicules and fasciculi of *c*, *in situ* (diagram).

Fig. 8. *Hymerhaphia unispiculum*, n. sp.: one form of spicule only (Sc. A).

Fig. 9. *H. eruca*, n. sp., spiculation of: *a*, erect linear spicule; *b*, caterpillar-like spicule; *c*, the same, but early stage, resembling the contort spicule of *Hymerhaphia vermiculata*, Bk. (Sc. A).

Fig. 10. *Hymedesmia stellivarians*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *c*, *d*, *e*, various forms of ray, more magnified (diagram).

Fig. 11. *H. Moorei*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *a*, ray, more magnified.

Fig. 12. *H. capitatostellifera*, n. sp., spiculation of: *a*, linear spicule (Sc. A); *b*, stellate (Sc. B); *c*, ray more magnified.

Fig. 13. *H. spinatostellifera*, n. sp., spiculation of: *a*, linear spicule; *b*, different forms of head (Sc. A); *c*, stellate (Sc. B); *d*, ray, more magnified.

Fig. 14. *H. trigonostellata*, n. sp., spiculation of: *a*, *b*, linear spicules (sc. 1-12th to 1-1800th); *c*, *d*, stellates (Sc. C).

Fig. 15. *Microciona affinis*, n. sp.: equianchorate, to show hook-like appearance of central arm (Sc. C).

Plate V.

Fig. 16. *Reniera* ? sp., white, spicule of (Sc. A).

Fig. 17. *Reniera* ? sp., yellow, spicule of (Sc. A).

Fig. 18. *Reniera* ? sp., dark brown, spicule of (Sc. A).

Fig. 19. *Halichondria aceratospiculum*, n. sp., spiculation of: *a*, linear, acerate, spined; *b*, linear, acerate, smooth, inflated in the centre; *c*, bihamate; *d*, equianchorate (Sc. B).

Fig. 20. *Esperia serratohamata*, n. sp., spiculation of: *a*, linear spicule; *b*, serrated hamate; *c*, tricurvate; *d*, inequianchorate (Sc. B).

Fig. 21. *Suberites vestigium*, n. sp., spicule of (sc. 1-12th to 1-1800th).

Fig. 22. *S. fistulatus*, n. sp., spiculation of: *a*, linear spicule (sc. 1-12th to 1-1800th); *b*, equianchorate, lateral and front views (Sc. B).

Fig. 23. *Thoosa socialis*, n. sp., spiculation of: *a*, sceptrelliform spicule; *b*, compressed globular spicule (Sc. C).

Fig. 24. *Dotona pulchella*, n. sp., spiculation of: *a*, chief spicule; *b*, fine hair-like acuate; *c*, flesh-spicule (Sc. C); *d*, portion of *a*, more magnified, to show by the dotted faint line on the opposite side that the apparent annulations form part of a *spire*.

Fig. 25. *Alectona Higgini*, n. sp., spiculation of: *a*, chief spicule; *b*, fine hair-like acerate, subtricurvate; *c*, flesh-spicule (Sc. C).

Fig. 26. *Samus simplex*, n. sp., spiculation of: *a*, lateral view of main spicule; *b*, horizontal view of head (Sc. A); *c*, flesh-spicule (Sc. C).

Fig. 27. *S. complicatus*, n. sp.: main spicule, horizontal view, upperside (Sc. A).

Fig. 28. *Tisiphonia annulata*, n. sp., spiculation of: *a*, annulated quadriradiate; *b*, linear acerate (Sc. A); *c*, flesh-spicule spinispirulate (Sc. C); *d*, portion of *a*, more magnified.

Fig. 29. Verticillately spined cylindrical spicule of unknown sponge abundant in excavated cavities of the Melobesian nodules (Sc. B).

Fig. 30. Pin-like spicule with spinated extremities and head turned to one side, of unknown sponge found in similar cavities of the Melobesian nodules (Sc. A).

Fig. 31. *Geodia ramodigitata*, n. sp., nat. size: *a*, zone-spicule; *b*, body-spicule; *c*, fork and anchor; *d*, siliceous globules, round and oval respectively; *e*, stellates of both localities, viz. external and internal (Sc. D); *f*, stellates, more magnified.

Plate VI.

Fig. 32. *G. perarmata*, Bk. Section through the centre, nat. size: *a*, dermal layer; *b*, interval between the dermal layer and petrous crust; *c*, petrous crust; *d*, body or interior.

Fig. 33. The same, spiculation of: *a*, zone-spicule; *b*, body-spicule; *c*, fork and anchor; *d*, siliceous globules, round and oval; *e*, external and internal stellates (Sc. D); *f*, more magnified views of *e*, respectively.

Fig. 34. The same. Dermal layer viewed from within: *a*, head of zone-spicule; *b*, pores in dermal layer, with stellates in the lower half; the latter represented by the dots(diagram).

Fig. 35. The same. Vertical section of dermal layer, subdermal chamber, and adjoining part of petrous crust: *a*, dermal layer charged with stellates; *b*, subdermal chamber or interval; *c*, part of petrous crust; *d d*, heads and adjoining shafts of zone-spicules (diagram).

Fig. 36. *G. areolata*, n. sp., spiculation of: *a*, zone-spicule; *b*, body-spicule; *c*, fork and anchor; *d*, siliceous globules, round and oval; *e*, external and internal stellates; *g*, dermal acerate (Sc. D); *f*, stellates, more magnified.

Fig. 37. The same, portion of surface, more magnified, to show areolation and position of dermal acerates (diagram).

Fig. 38. *G. globostellata*, n. sp., spiculation of: *a*, zone-spicule; *b*, body-spicule; *c*, fork (no anchor seen); *d*, siliceous globules, round and oval; *e*, globostellate; *f*, external and internal stellates (Sc. D); *g*, more magnified view of *e*; *h*, more magnified views of *f*.

Fig. 39. *Stelletta tethyopsis*, n. sp., torn off from the base (nat. size).

Fig. 40. The same, spiculation of: *a a*, zone-spicule; *b b*, body-spicule;

c, fork and anchor; *d*, occasional form of zone-spicule; *e*, external stellate; *f*, internal stellate (Sc. D). The dotted lines at the bottom of *a a* and *b b*, respectively, are to show that they are continuations of the same spicules, which, upon this scale, are too long for the Plate.

Plate VII.

Fig. 41. *Stelletta cuastrum*, Sdt., parasitic on a group of *Siliquaria anguina*: *a a*, mouths of the *Siliquariæ* (nat. size); *b*, zone-spicule; *c*, body-spicule; *d*, siliceous disk; *e*, minute acerate flesh-spicule; *f*, minute stellate flesh-spicule (Sc. D); *g*, more magnified views of *d*, *e*, and *f*, respectively (sc. 1-48th to 1-6000th); *h*, still more magnified view of acerate flesh-spicule, to show that it is microspined and inflated in the centre; *i*, more magnified view of ray of stellate, to show that it is microspined; *k*, more magnified view of portion of disk, to show form and position of stelliform points on surface; *l*, still more magnified views of point, lateral and direct, respectively.

Fig. 42. The same, Australian specimen: *a a a*, vents; *b b*, pores in the crust (nat. size); *c*, spined stellate (quadriradiate) (Sc. B).

Fig. 43. *Tisiphonia nana*, n. sp.: *a*, zone-spicule, viewed from above, as seen *in situ*; *b*, the same, lateral view (observe the extremely short shaft); *c*, body-spicule; *d*, acerate flesh-spicule and stellate (Sc. D); *e*, more magnified view of the same.

Fig. 44. *T. penetrans*, n. sp.: *a*, body-spicule; *b*, acerate flesh-spicule and stellate (Sc. A); *c*, more magnified view of stellate (Sc. C); *d*, still more magnified view of ray of same.

Fig. 45. *Corallistes aculeata*, n. sp. Oblique view of surface, showing spikes (Sc. about A): *a*, spike-spicule, lateral view; *b*, base of the spike, broken off, viewed from above (Sc. B). (Diagrams.)

Fig. 46. *C. verrucosa*, n. sp. Oblique view of surface, showing verrucous cones (Sc. about A): *a*, verrucous cone-spicule, lateral view; *b*, base of the cone, viewed from above (Sc. B). (Diagrams.)

Fig. 47. *C. elegantissima*, n. sp., spicule of (sc. 1-48th to 1-6000th).

Plate VIII.

Fig. 48. *Discodermia papillata*, n. sp. Portion of surface viewed from above: *a*, disks covered with minute, fusiform, bacillar flesh-spicules; *b*, the same without the flesh-spicule; *c*, subjacent spiculation (Sc. about D); *d*, five figures to show the transformation into the surface-spiculation seen at *c*; *e*, shaft of disk; *f*, papillæ on disk; *g*, fully formed papillæ, more magnified; *h*, fusiform bacillar flesh-spicule, much magnified; *i*, ultimate form of spicule of the interior; *k k k*, interlocking of the ends of the branches with those of neighbouring spicules; *l*, characteristic form of "interlocking," much magnified. (Diagrams.)

Fig. 49. *D. aspera*, n. sp. Portion of surface viewed from above: *a*, disks covered with minute, acerate, curved, fusiform flesh-spicules; *b*, the same without the flesh-spicule (Sc. about D); *c*, more magnified view of disk, showing denticulated margin and papillæ; *d*, acerate flesh-spicule (Sc. D); *e*, the same, more magnified; *f*, more advanced form of disk, in which the papillæ are transformed into spines, more or less divided; *g*, four diagrams, showing the transformation of the papillæ into the spinous condition; *h*, ultimate form of spicule of the interior;

i, characteristic form of the interlocking end of the branch, much magnified. (Diagrams.)

Fig. 50. *D. spinispirulifera*, n. sp. Portion of surface viewed from above: *a*, disks covered with acerate, curved, fusiform, and spinispirulate flesh-spicules; *b*, the same without the flesh-spicules; *c*, subsurface spiculation (Sc. A); *d*, four figures showing the gradual transformation of the disk into the subsurface spiculation *c*; *e*, magnified view of the acerate flesh-spicule; *f*, the same of the spinispirula; *g*, ultimate form of spicule of the interior; *h*, characteristic form of interlocking extremity of branch, much magnified. (Diagrams.)

Fig. 51. *D. lævidiscus*, n. sp. Portion of surface viewed from above: *a*, disks covered with the acerate, curved, fusiform flesh-spicule; *b*, the same without the flesh-spicule (Sc. about D); *c*, upper surface of disk, more magnified, to show its smoothness, faint, concentric, circular lines and depression; *d*, under surface of the same, to show spine or shaft; *e*, more advanced form of same, showing subdenticulated border; *f*, acerate flesh-spicule (Sc. D); *g*, the same, more magnified; *h h*, ultimate form of spicule of interior; *i*, union of branches by simple apposition.

XVII.—*Note on the Genus* Heteropora.

By Arthur Wm. Waters, F.G.S.

I have noticed lately in several reviews an error with regard to *Heteropora* to which it seems advisable to call attention lest it creep into the literature of the subject. The confusion is perhaps the most glaring in a review of Nicholson's 'Tabulate Corals,' in 'Nature' (March 25th)—a review which has a certain family likeness to a notice of the same book which appeared in the 'Academy' some time before, signed by Mr. Moseley, where the same mistake occurs.

In the notice in 'Nature' the reviewer says, "Some, as *Heteropora*, are, according to the late researches of Mr. Busk, of Bryozoan affinity." This shows that the points raised by Mr. Busk have not been appreciated; for the genus *Heteropora* was created by Blainville for some cretaceous fossil Bryozoa, and the genus, as palæontologists are well aware, was very abundant in the Jurassic, Cretaceous, and Tertiary periods, occurring frequently in the English Crag; but no living forms had been described until I drew attention to two living species, from Japan and Australia, in a paper with plate, "On the Occurrence of Recent *Heteropora*," in the Journ. of the Roy. Micro. Soc., May 14, 1879, in which I alluded to the minute perforations of the calcareous walls. This is of interest as being a somewhat similar structure to that of some of the so-called tabulate corals, but is not, as some seem to

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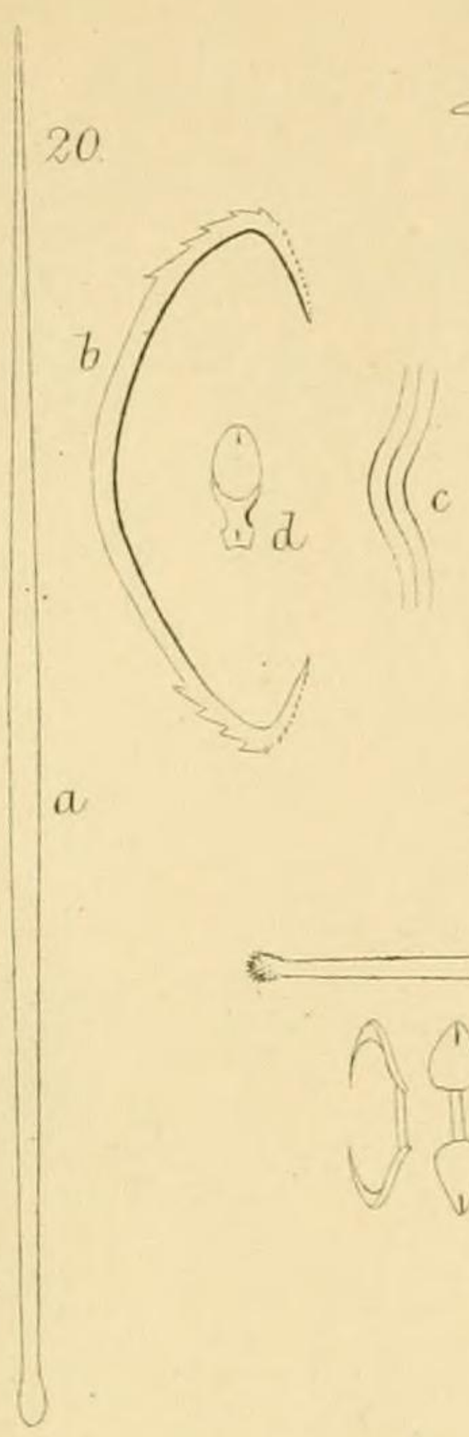
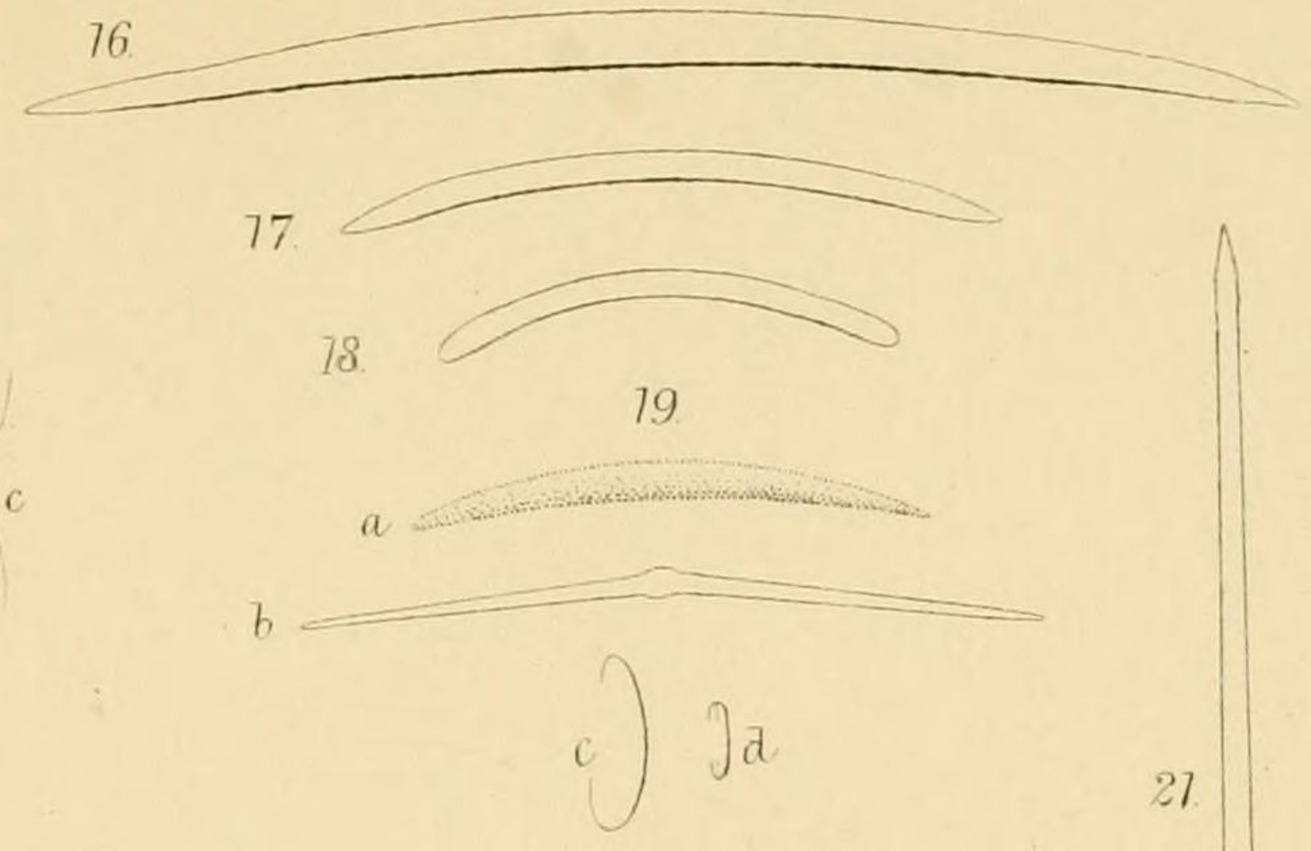
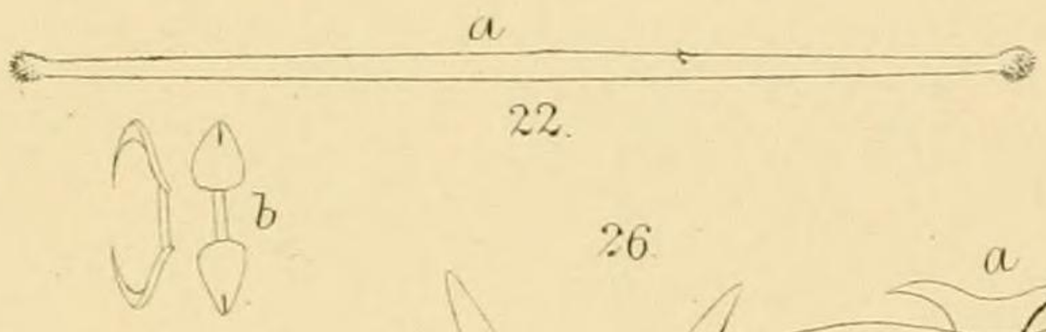
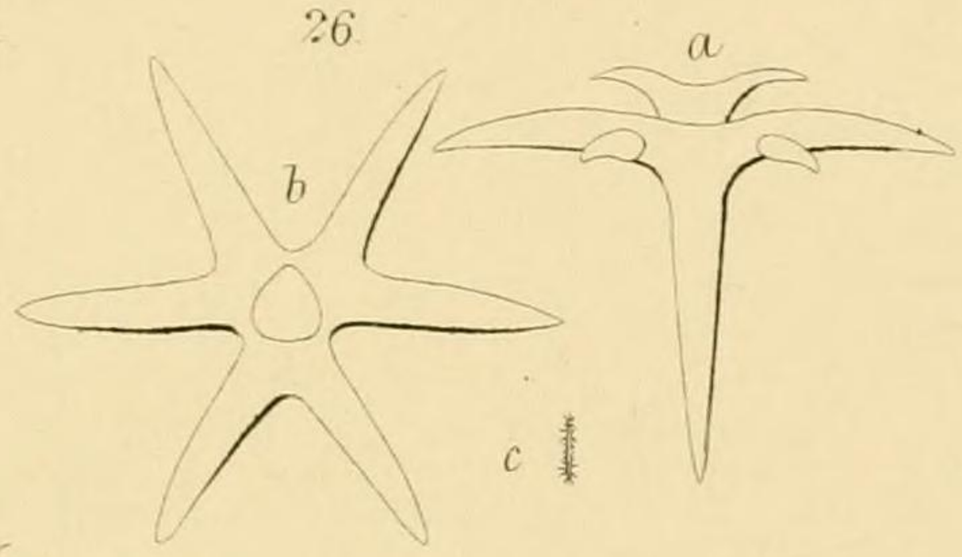
H.I.C. del.

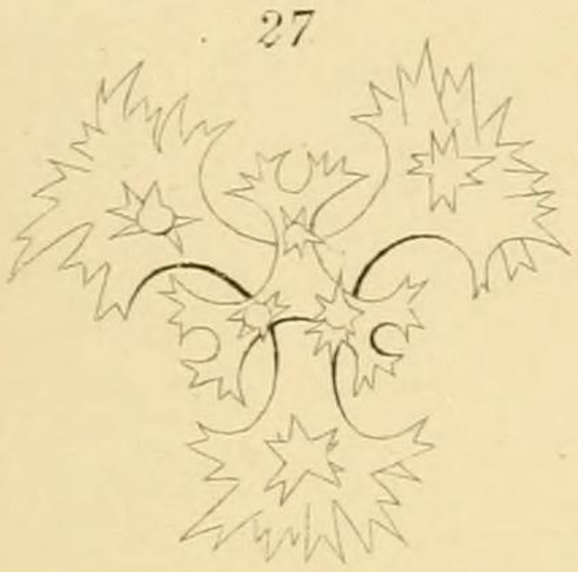
Mintern Bros lith.

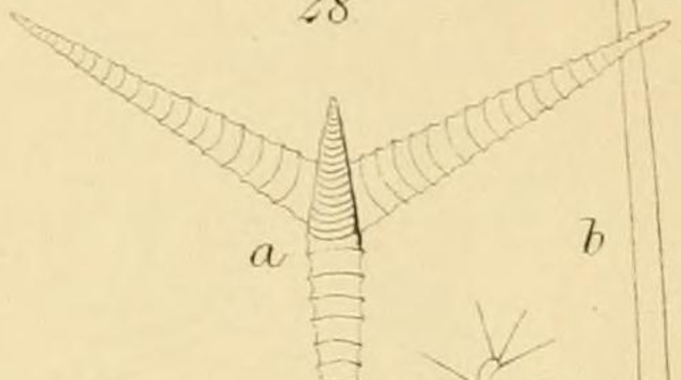


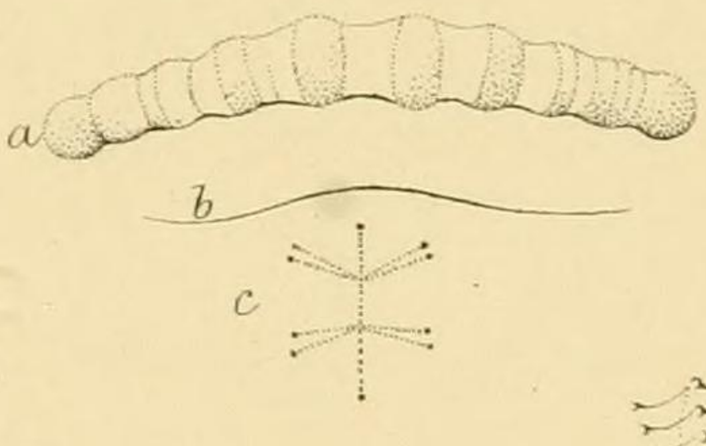


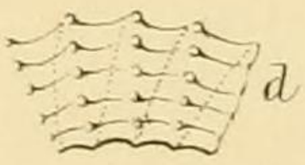


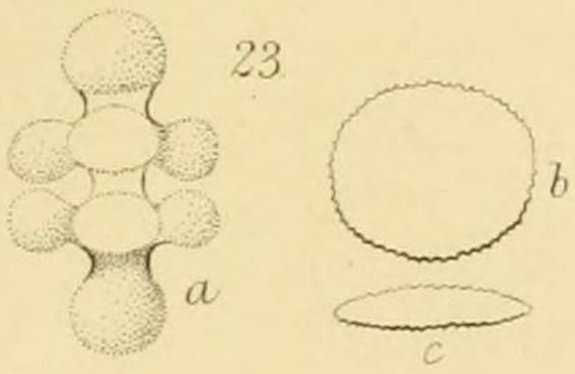


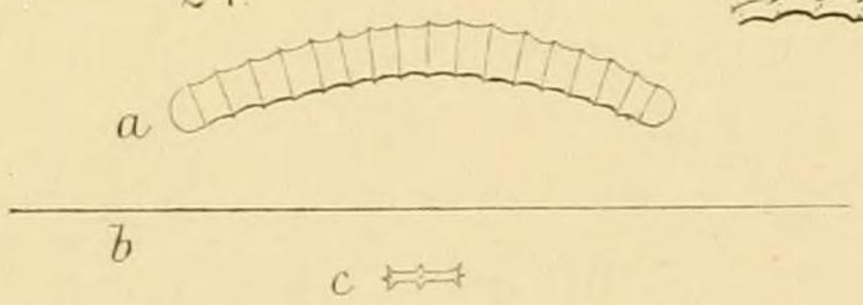


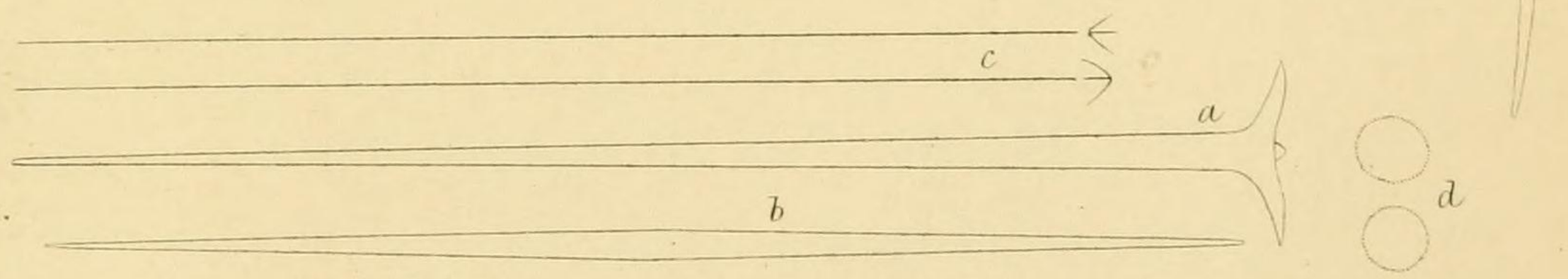


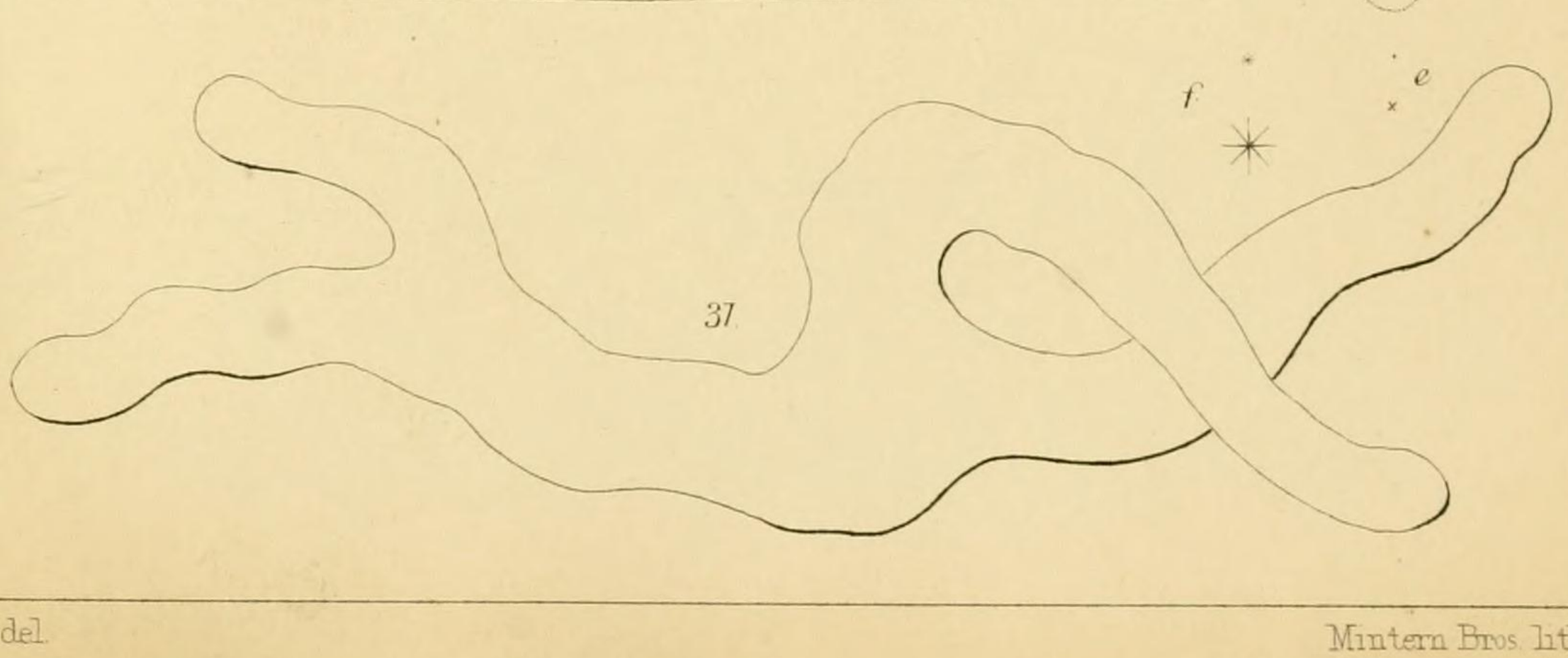












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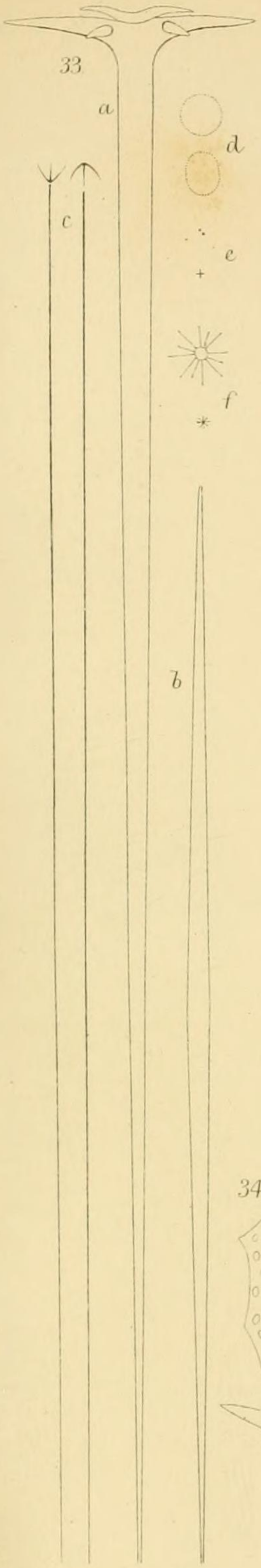

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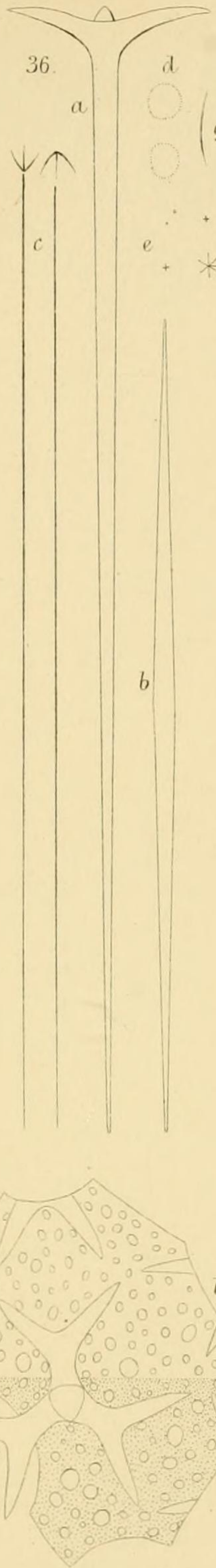

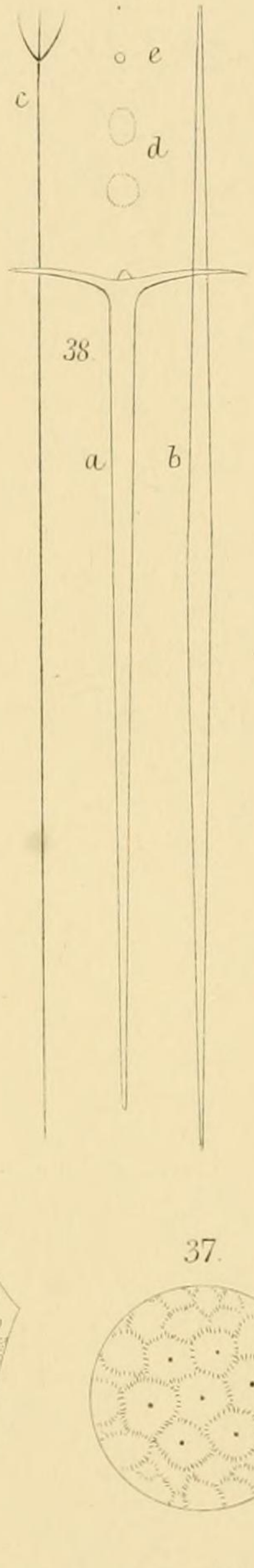

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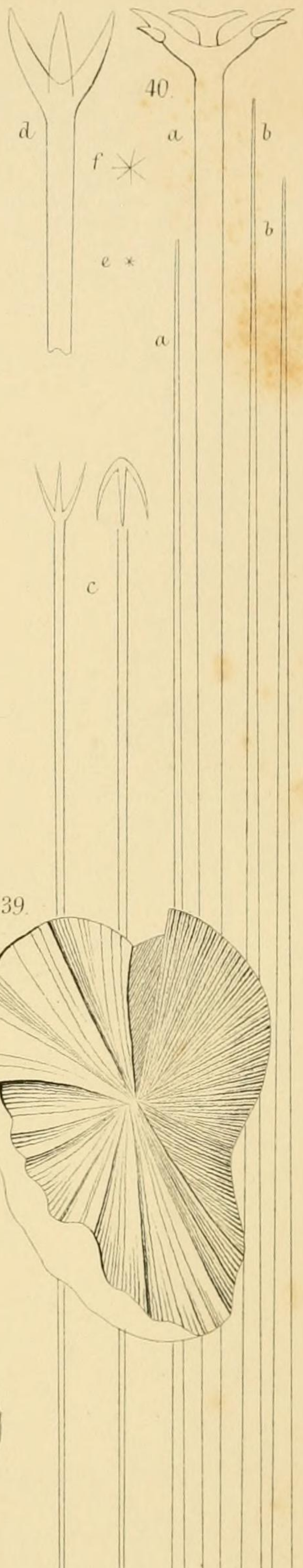

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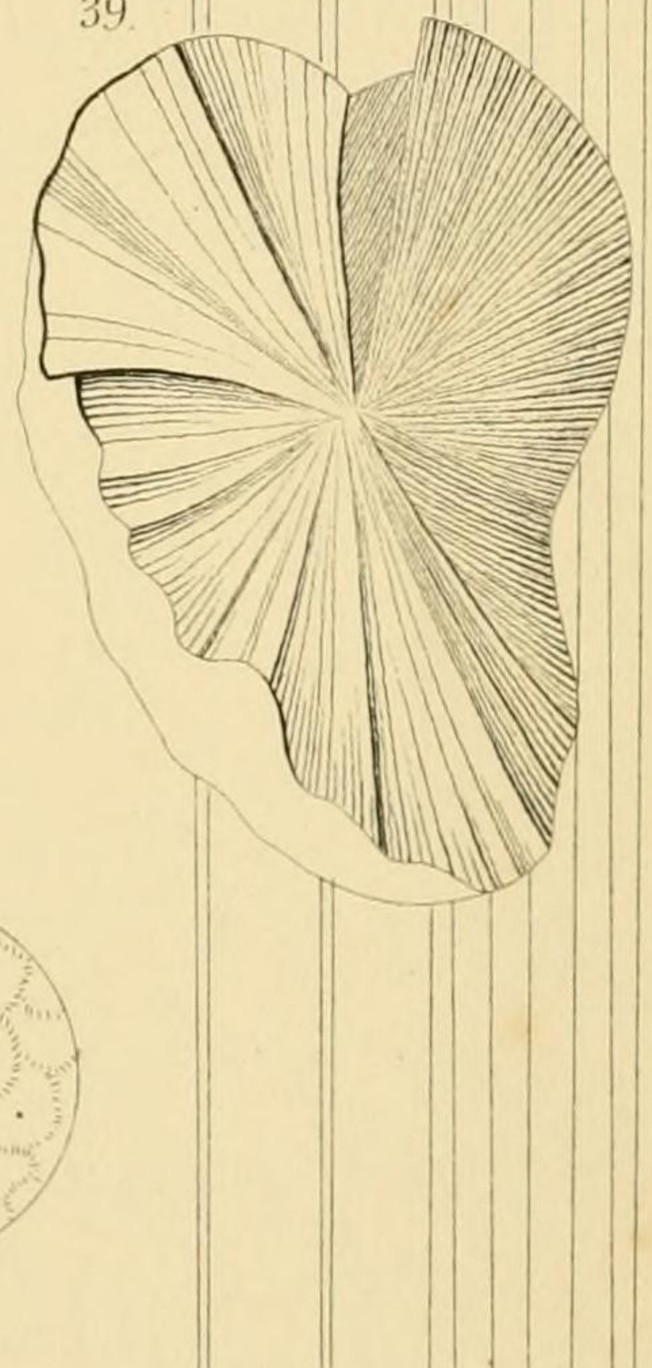

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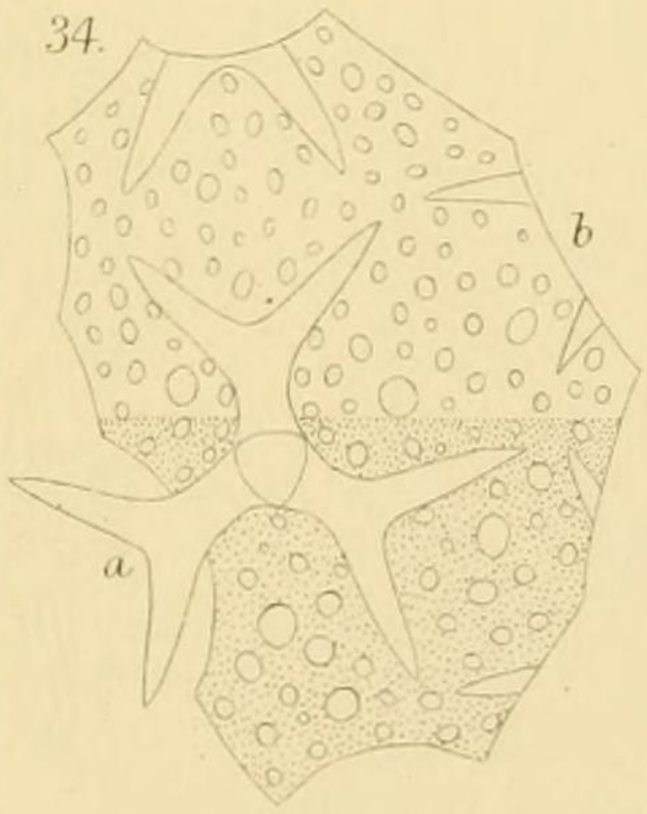

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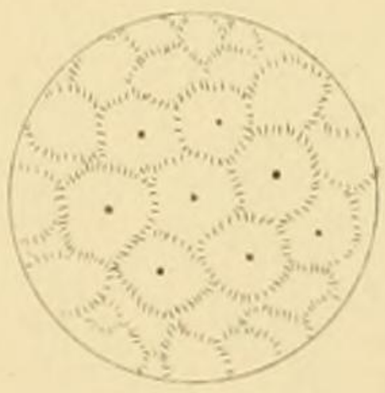

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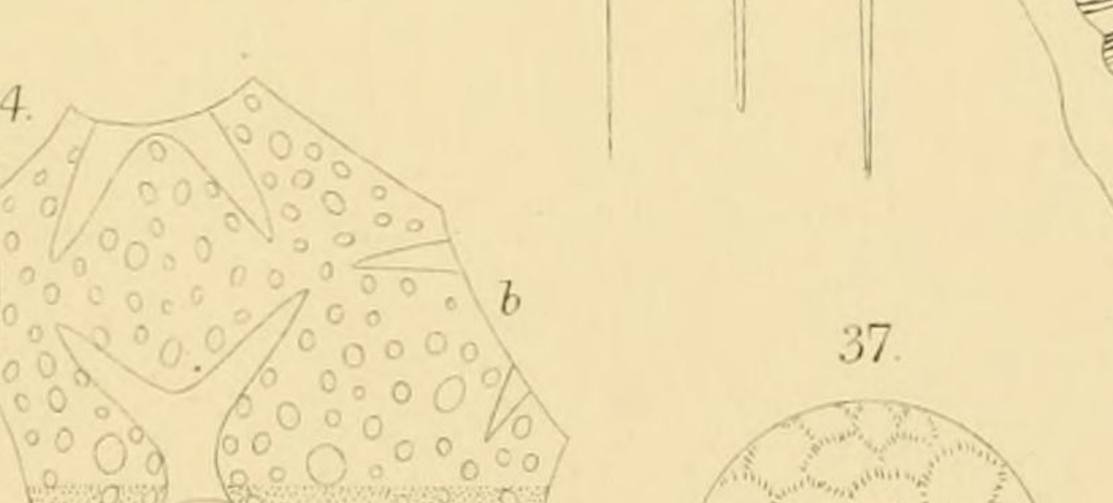

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H. I. C. del.

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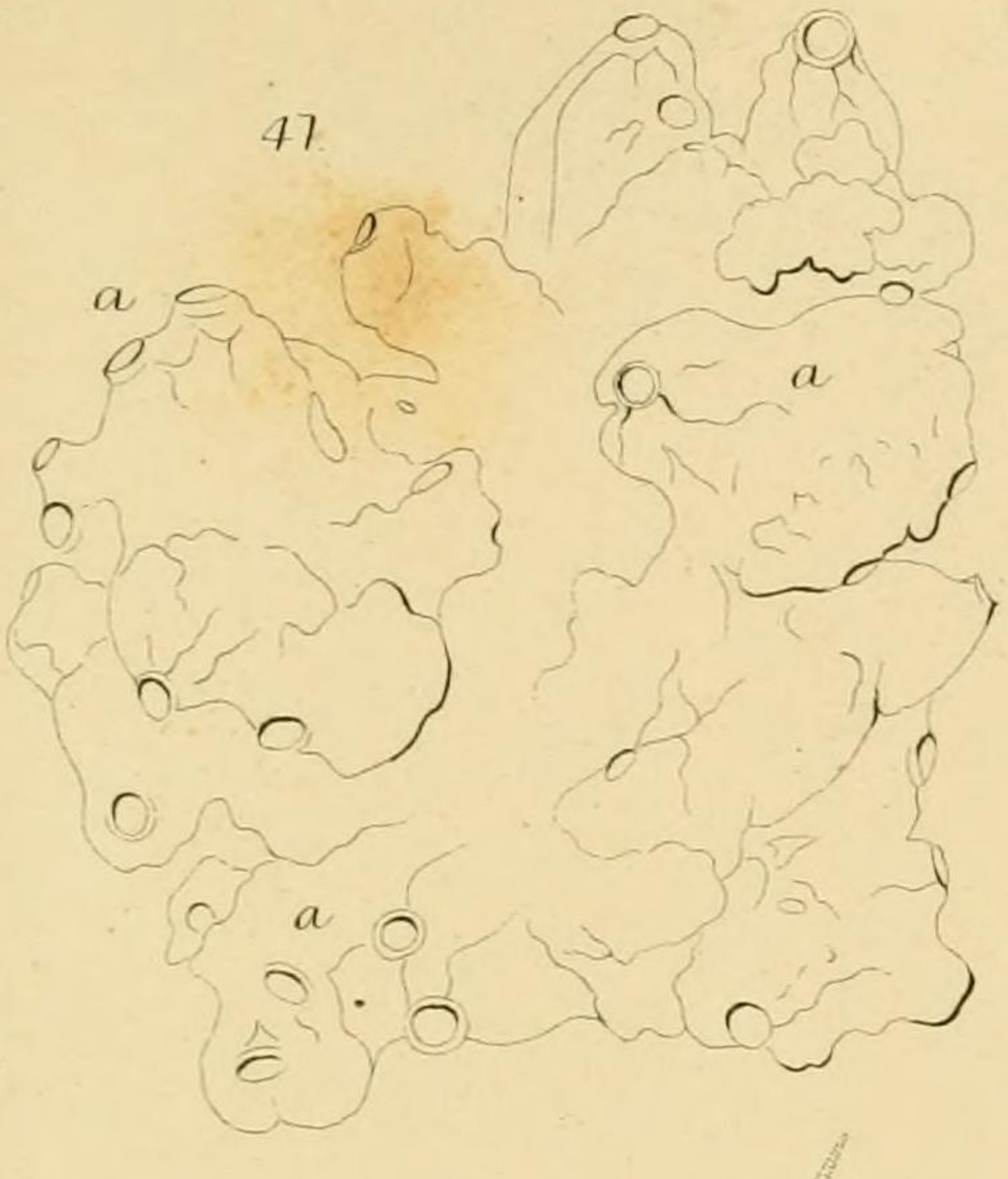

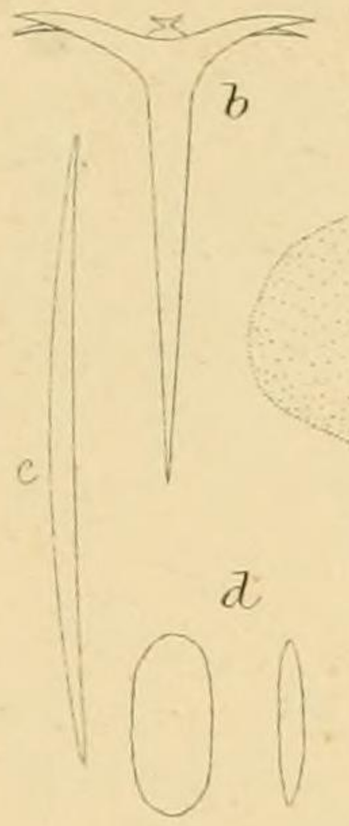

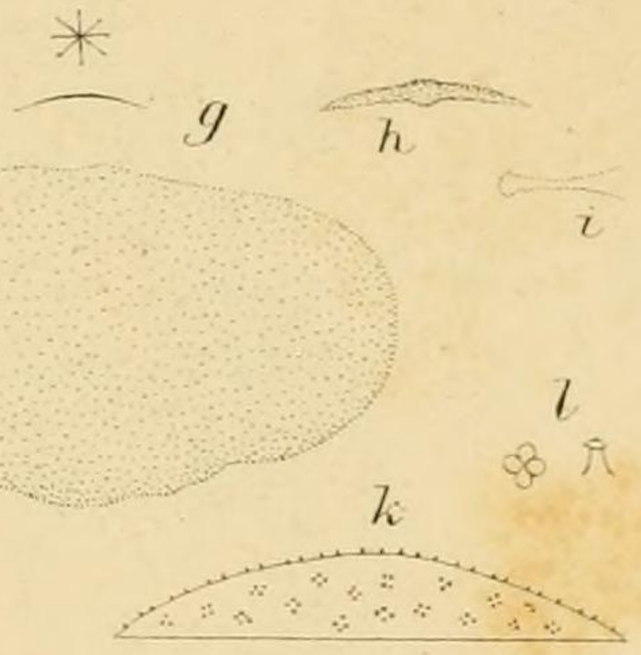

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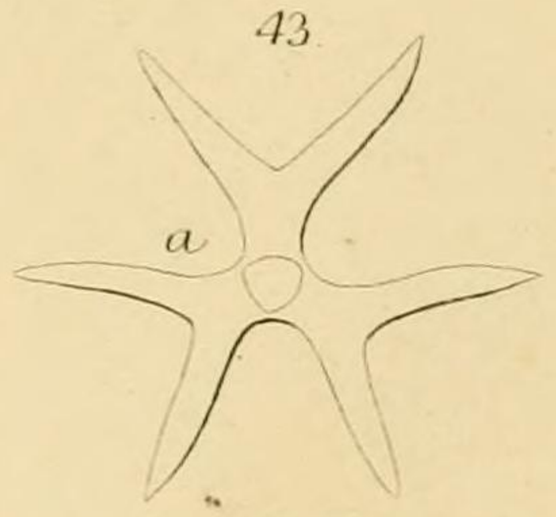

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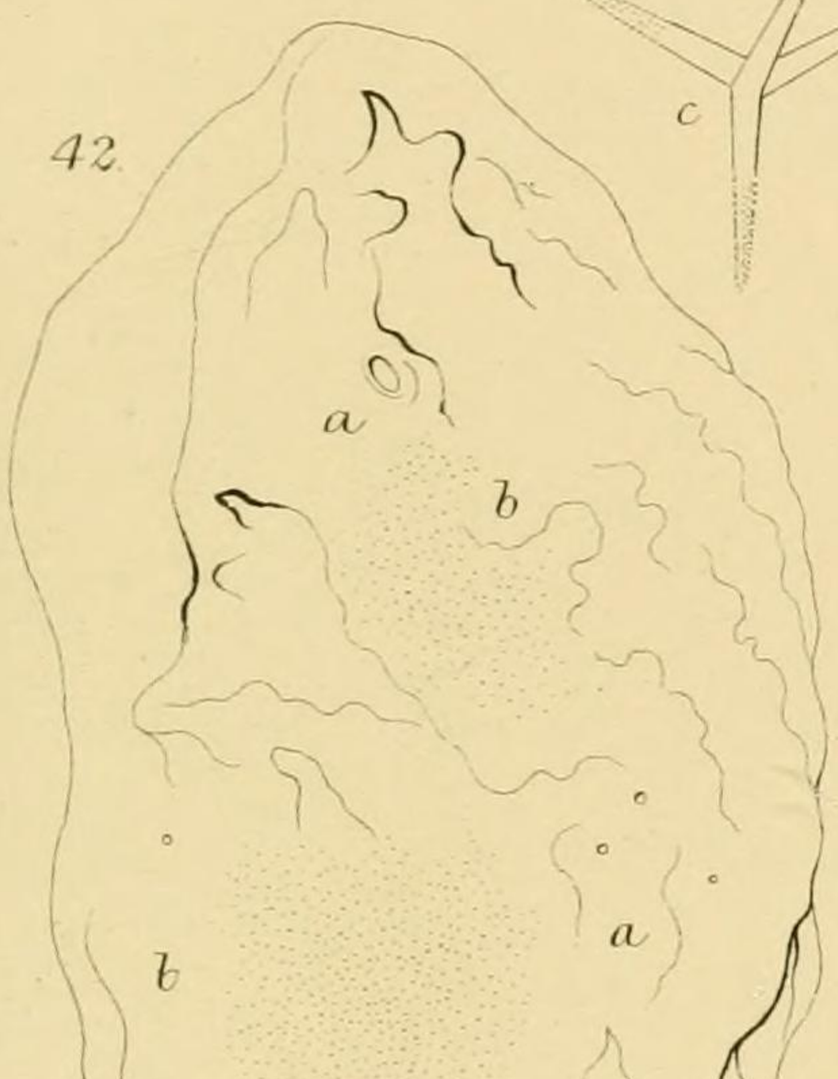

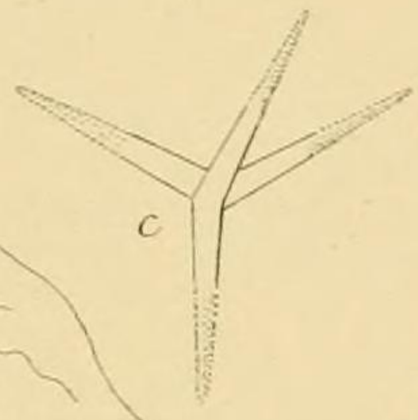

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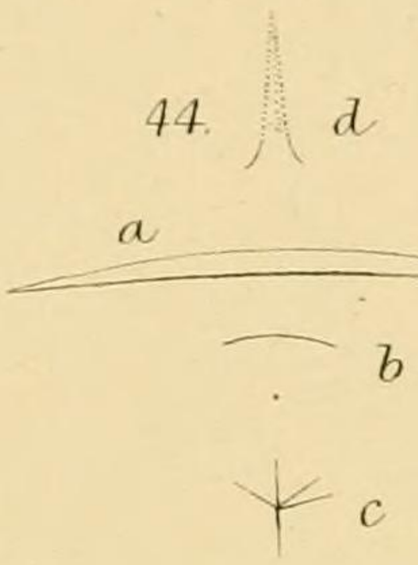

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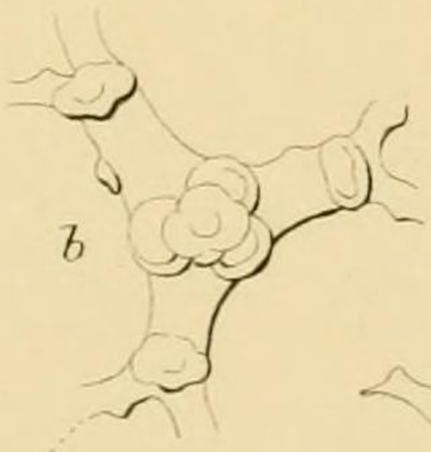

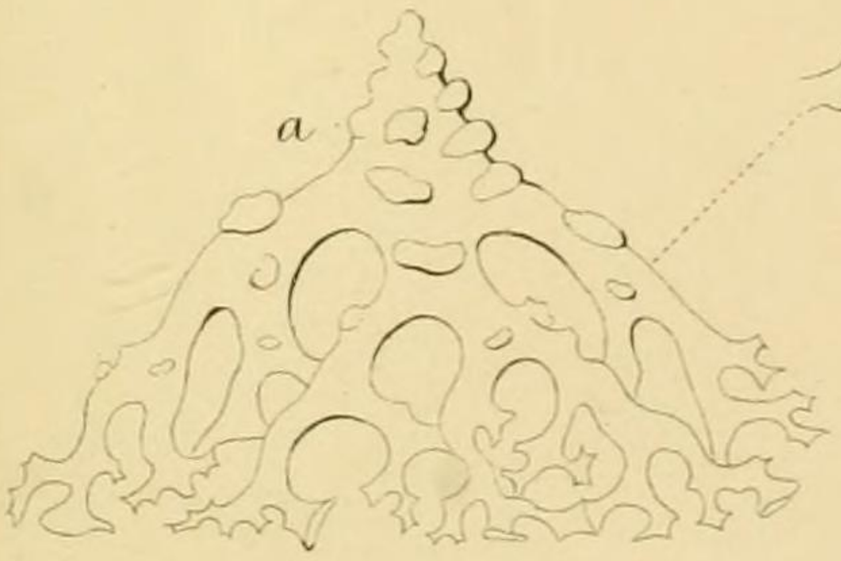

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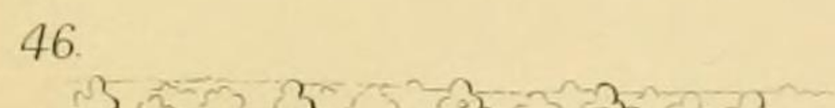

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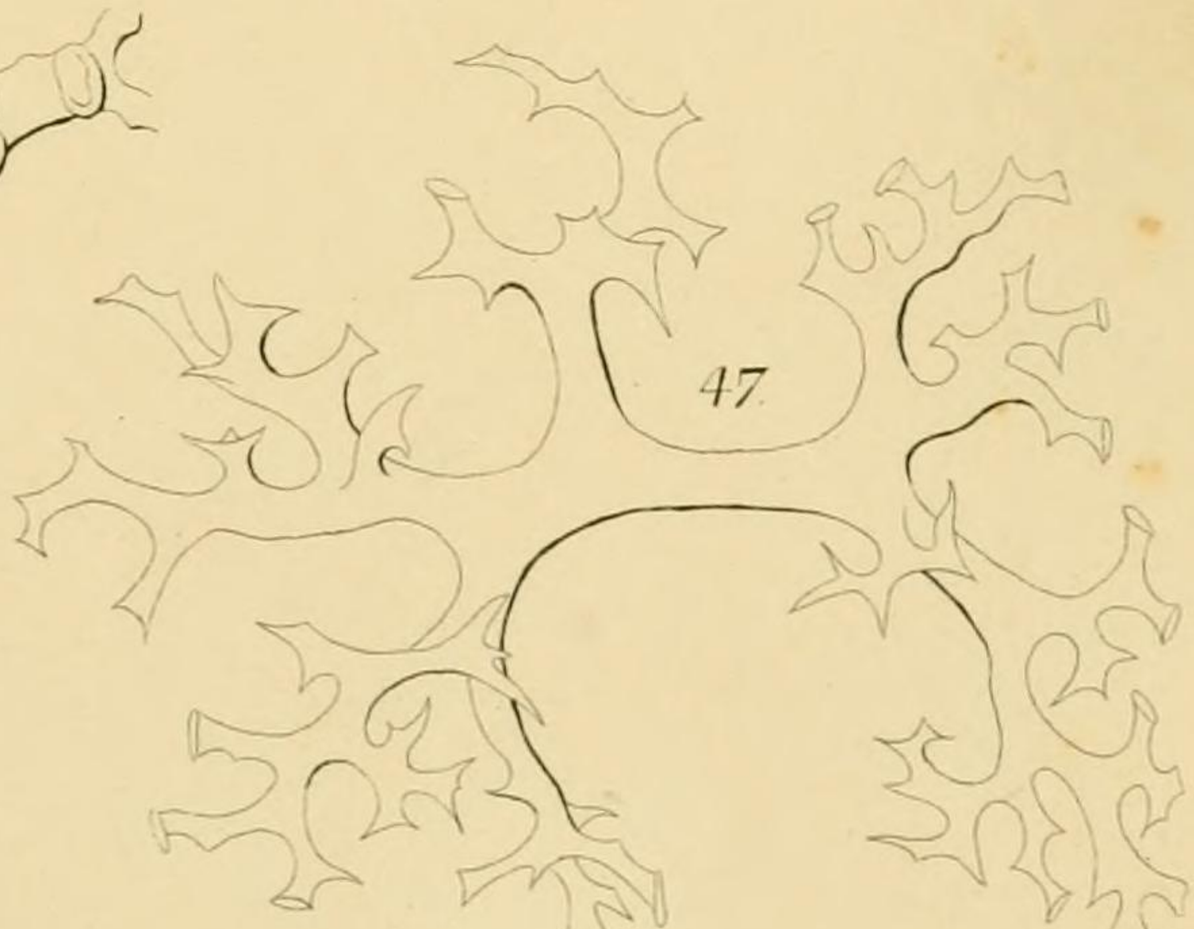

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H.I. C. del.

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