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XV.—Mr. James Thomson's fossil sponges from the Carboniferous system of the South-west of Scotland

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Fig. 6. *Lycosa proxima*, C. Koch, ♂, p. 125: *a*, spider, enlarged; *b*, digital joint and palpal organs, highly magnified; *c*, genital aperture of ♀; *d*, natural length of ♂.

XV.—*Mr. James Thomson's Fossil Sponges from the Carboniferous System of the South-west of Scotland.* By H. J. CARTER, F.R.S. &c.

[Plates IX. & X.]

OF these fossils I have given a preliminary notice in the 'Annals and Magazine of Natural History' for September

iaet (vol. xx. p. 176), since which Prof. J. Young and Mr. J. Young have conjointly published an account of the sarcohexactinellid sponge to which I have therein alluded, under the name of "*Hyalonema Smithii*" ('Annals,' vol. xx. p. 425, pls. xiv., xv.). Their right of priority is undisputed; at the same time my promise to Mr. Thomson, F.G.S., to describe his fossils must now be fulfilled.

It is not, however, necessary for me to do this at length with *Hyalonema Smithii*, as this has already been done (*l. c.*); hence what I have to state will be chiefly confirmatory of what has gone before, having from the commencement, viz. Sept. 1876, been plentifully supplied with fragmentary remains of its accompanying spicules by Dr. J. Millar, who obtained them from Mr. J. Armstrong of Glasgow, in addition to the specimens subsequently sent me by Mr. J. Thomson of the same city. Mr. Armstrong obtained these fragmentary remains, which in many instances are nearly perfect spicules, in great numbers from the rotten detritus with which the crevices of the limestone where *Hyalonema Smithii* abounds are filled; hence my figures must be regarded as partly restored.

Besides *Hyalonema Smithii*, Mr. Thomson has sent me specimens of other fossil sponges from the same system, viz. :—one for which I propose the name of "*Pulvillus Thomsonii*," from Arbigland; and two others, which will be named respectively "*Dysidea antiqua*" and "*Rhaphidhistia vermiculata*," from the same beds as the *Hyalonema*. These will now be described and illustrated successively.

Hyalonema Smithii, Y. & Y.

Of this sponge the separate spicules which I possess were furnished, as before stated, by Dr. Millar; and those which appear to belong to *Hyalonema Smithii* have been identified *in situ* through specimens supplied by Mr. Thomson; while there are others which appear to have belonged to other species of the Sarcohexactinellida, as will be seen hereafter.

Of the cord or stem three fragmentary specimens have been sent to me by Mr. Thomson, two of which are about the same size and also close together in the same piece of limestone. The largest is five inches long and about one inch wide by one sixth of an inch thick, composed of spicules, once long and continuous, but now much fractured transversely, indeed minutely in some parts; varying in diameter from one twenty-fourth of an inch downwards and presenting distinct although slight undulation (Pl. IX. fig. 1). Moreover the cord is compressed so that in the end view from which the proximal or upper portion has been broken off, and it has thus become ex-

posed by the fracture of the limestone in which it lies imbedded, it does not exceed in the thickest part more than one sixth of an inch, as before stated (fig. 2).

In the smallest of the three specimens, which is not more than an inch long and in which the spicules are much reduced in size and spread out, indicative of the free end of such a cord, is an instance of the terminal or anchoring extremity *in situ*, presenting the same inflated, club-like form we shall find hereafter to be so common among the separate fragments, but with the shaft at its junction with the anchor-like end only 1-120th inch in diameter (fig. 4, *a*).

It is not uncommon, as we shall presently see, to find the cord-spicule grooved longitudinally, in one part singly, or generally and in great plurality throughout its circumference (fig. 13, *b, d, e*), which has been attributed by the Messrs. Young to pressure from the "adjacent rods" (*l. c.* p. 427); but on examining the end of one of Mr. Thomson's specimens with the microscope, two rather large spicules may be seen close together with a single groove in each, and the material between them and the neighbouring spicules entirely composed of the white granular calcite which fills up the intervals between these spicules, and thus, in the transverse section, contrasts strongly with the dark end of the transparent material of which the spicule is formed, without the presence of any small spicules whatever (fig. 13, *aa*); so that this grooving would appear to be original and not produced by "adjacent rods." Besides, where there are small spicules in distinct contact with larger ones, there is no groove at all observed in the latter, which therefore may be natural although of casual occurrence.

The fragments of the surface of the body of a sarcohexactinellid sponge, attributed to *Hyalonema Smithii*, were also sent to me by Mr. Thomson, in which the characteristic spiculation of the surface in this species is obvious together with the lattice-like structure formed by the intercrossing of the spicules in the Sarcohexactinellida generally. The largest of these pieces is about half an inch long by a quarter of an inch broad (fig. 7), in which there is one of the circular fenestral spaces (now a hole) forming the interstices of the lattice-like structure, also characteristic of the recent Sarcohexactinellida, together with remains of others on the circumference (fig. 7, *bb*), and the peculiar "nail-like" spicules described by Dr. Young (*l. c.* p. 426) of all sizes below 1-6th of an inch in diameter across the head, which is possessed by the few that chiefly bind down the rest with sloping outspread arms, after the manner of this kind of spicules generally (fig. 7, *aa*).

So much for Mr. Thomson's interesting specimens of *Hyalonema Smithii*. Let us now see what the supply of separate spicules by Dr. J. Millar affords.

1. *Fragments of the spicules of the cord*.—These vary in size from half an inch in length downwards, and the largest of the smooth ones 1-24th of an inch in diameter, while the largest of those grooved all round the circumference are 1-24½th of an inch thick. There is nothing remarkable in the smooth form; but the longitudinal lineation of the grooved one may be single or in variable plurality, as before stated—that is, confined to one part only (fig. 13, *b*), or spread more or less equally round the whole circumference of the spicule to the number of thirty-two in a spicule possessing a diameter of the thirty-second part of an inch (fig. 13, *d, e*), or may not exceed four at unequal distances from each other in a circumference double this size (fig. 13, *c*). Although I have seen the single groove chiefly in the smaller spicules, I have only seen the entire circumference grooved in the larger ones, with the intervals *convex* like the *fascis* of a Roman *lictor*, not fluted or *concave* like an Ionic column. Whether, however, this grooving, in its extreme degree, belongs to the spicules of *Hyalonema Smithii* or not, the more simple one does, as Mr. Thomson's specimen demonstrates *in situ*; and reasons have already been assigned for its seeming to be original, and not produced by the pressure of surrounding smaller spicules, whose absence is evident where the groove is equally present. Again, although the largest spicules I have seen were grooved throughout the circumference, it does not follow that the grooved spicules are always the largest, as has already been shown.

2. *Fragments with four-armed anchor-like ends*.—These are of two kinds, viz. :—the larger, with inflated or rounded extremity and moderately recurved thick short arms (fig. 5); and the smaller, with pointed extremity and much recurved, longer, and less stout arms (fig. 6). Both kinds have four arms opposite. In the former the shaft is slightly reduced in size to the point where it expands into the arms (fig. 3), or it may be constricted just before this termination, while the arms, which in the normal or more regularly formed ones are thick conical spines of nearly equal length, and nearly crucial or opposite in position, are somewhat recurved (fig. 3, *a, b*); but they may vary in length and obtuseness, in the angle at which they separate, and in their degree of recurvation, still always parting from an obtuse or rounded club-like extremity. This is the character of the anchor end *in situ* (fig. 4, *a*), to which I have before alluded; so that we may fairly assign it

to *Hyalonema Smithii*. How far the other form, which, in its largest examples, is not much smaller than the club-shaped end, belonged also to *H. Smithii*, I am not prepared to state; but although some of its largest examples may surpass in size the smallest club-shaped ones, the smallest of the former that has come under my observation does not exceed the 1-360th part of an inch in diameter, and is therefore microscopic, while the largest club-shaped anchoring end reaches 1-16th of an inch, and the smallest that I have seen is still visible to the unassisted eye. Where the shaft is constricted close to the end, the arms are also constricted respectively, so that there is no club-like or rounded extremity, so far as my observation extends, but in its place a crucial depression; hence this is either a variety of the club-shaped anchor end or the anchoring end of a spicule which belonged to another hexactinellid sponge.

3. *Fragments of the "nail-like" spicule.*—One of these, viz. the "nail-like" spicule of (?) *Hyalonema Smithii*, is smooth throughout and consists normally of a shaft with four arms, more or less opposite each other, surmounted by a round head (figs. 8, 9). In size the largest measure about 4-12ths inch across the arms, each arm, which is sharp-pointed, being about 2-12ths inch long, with a thickness at the base of about 1-48th inch; the shaft is about the same, or perhaps a little less, and the round or globular head, which represents a continuation of the shaft, about 1-36th inch in diameter. But all these measurements, as well as the spicules themselves, are subject to great variety, inasmuch as the arms, individually or collectively, may be more or less inclined towards the shaft, and thus not all at the same angle; or they may depart from the shaft at different angles laterally and thus be not opposite; while, in form, one or more may vary from an obtuse point to a short round knob like the head, or be constricted where they join the shaft (fig. 9); while the shaft, which is in a line with the head, varies very little in shape (like the globular head), being for the most part straight and pointed, although sometimes both head and shaft, individually or collectively, like the arms, may be more or less constricted at the base. The position of these spicules in the sponge is illustrated by Mr. Thomson's fragment (fig. 7, *a a*), where the shaft is directed inwards, the head or knob externally, and the arms spreading out laterally slope inwardly, so as in the largest forms to bind down the rest of the structure as in the *Sarcohexactinellida* generally, all of which, even to the minutest spicule observable on the surface, present the same characteristic head and figure as that above described with its modifications.

Besides the "nail-like" spicule of *Hyalonema Smithii*, small sexradiates with straight, simple, smooth arms, more or less varying from a right angle in their departure from the centre, are observed; but as yet I have not seen any *in situ* (fig. 12).

Add to this spicules with stelliform heads of two kinds, viz. smooth (fig. 10, *a*) and tubercled (fig. 10, *b*), the former of which are much the smallest of the two. All appear to me to have had from six to eight arms or rays spread umbrella-like over a central shaft, while seven seems to be the most constant number. The ray of the smooth stelliform spicule in its largest forms that I have seen does not exceed 1-12th inch in length, thus giving 1-6th of an inch for the whole diameter of the head; while that of the tubercled stelliform spicule is double that length, with a diameter at the base of 1-48th of an inch, thus giving a total diameter for the head of 1-3rd of an inch in the largest forms, which is that of the largest "nail-like" spicules of *Hyalonema Smithii*; while each ray is covered with a number of minute tubercles on its convex or outer side (fig. 10, *b*), which, increasing in size from near the point inwardly, become more prominent as they pass into the continuous area formed by the union of the rays with each other towards the centre (Dr. Young's nos. 19, 27, 29). The rays, which are not straight like those of the "nail-like" spicule, but, as before stated, are incurved like the ribs of an umbrella when open, often vary in length in the same spicule, and depart from the centre at different angles in both the smooth and tubercled forms, so that, instead of all being of the same length and equidistant, as in the normal or more regularly formed spicule, some rays are often shorter than others, and more closely approximated, while the shaft is always straight, smooth, and pointed.

Lastly, another form has been pointed out to me by Dr. Millar, like a double star back to back (fig. 11, *a, b*). This consists of a shaft with five smooth, straight arms or rays surmounted by a short, pointed continuation of the shaft in front, which may be minutely tubercled, and five still shorter ones surrounding it, one or more of which may be bifid or trifid (fig. 11, *c, c*). Both sets of rays are inclined towards the shaft or central axis, but in opposite directions, the latter, upper and shorter ones (outer *in situ* probably), most so. Here also the arms appear to be subject to the same variety as those of the foregoing spicules, and the spicules themselves to vary equally in size, the largest seen possessing a straight shaft about 3-48ths inch long with a thickness of 1-48th inch at the base.

Thus the largest of all these three kinds of "nail-like" spicules appear to have been about the same size, and the three different forms to have belonged to three different sarcohexactinellids respectively, while the first only has been seen *in situ*; so that each of these three kinds may have been the nail-like body-spicule of a particular species. At the same time it should be remembered that, although the "nail-like" spicule first described has been found *in situ* in the body-structure of the sarcohexactinellid to which it belonged, this body-structure has not as yet been found in *direct* connexion with the cord, and therefore has only been assumed to have been part of *Hyalonema Smithii* from its association with the fossil cords; while the only instance of an anchoring termination like that assigned to *H. Smithii* that has been found in *direct* connexion with the fragment of a cord is that above mentioned. Again, according to the Messrs. Young's statement (*l. c.* p. 428), the cords are so abundant that it may be fairly inferred that they did not *all* belong to the same species of hexactinellid.

The double sagittate form of anchor end, also above mentioned (Pl. IX. fig. 6), may have belonged to one of the species in particular; while the four arms opposite with their varieties, in the cord as well as in the nail-like body-spicule, seem to indicate an alliance with the genus *Rossella* rather than with *Hyalonema* ('Ann.' 1872, vol. ix. pl. xxi.). At the same time the Messrs. Young's statement that "the rods are of unknown length, the largest fragments at Trearne being 12 inches, and of various thicknesses, from 1-40th inch to nearly a line in diameter," shows that they far exceed in dimensions those of the largest specimens of any *Hyalonema* that I have seen, and dwarfs to almost insignificance the longest of *Rossella*, which are only 6 inches with a corresponding thinness ('Ann.' 1875, vol. xv. p. 19, pl. x.), while the anchoring ends of the cord-spicules in the largest recent *Hyalonemata* can hardly be seen with the unassisted eye, being not more than 1-140th inch in diameter.

Replacement of siliceous by calcareous material during fossilization.

Connected with the fossilized spicules of *Hyalonema Smithii* is the fact that many of the fragmentary spicules sent to Dr. Millar by Mr. Armstrong, and obtained, as before stated, from the "rotten material" or decomposed limestone, respectively present all degrees of transition from the siliceous material of which they were originally composed to calcespar (fig. 14, *a, b, c*); and this may be seen by

the rhombohedral excavations, which may appear singly in some, increased to a plurality in others, which not only has caused them to lose their original outline, but to become fretted into shapes which are chiefly characterized by the angular cavities caused by the encroachment of the calcspar upon the siliceous material (fig. 14, c), so that a little more and the whole of the siliceous spicule would have given place to calcareous material. The calcspar has become redissolved; and the rhombohedral cavities which it occupied are thus left to prove the interesting fact first pointed out by Mr. W. J. Sollas, viz. that calcareous material, *i. e.* phosphate of lime, might replace siliceous material in the "vitreo-hexactinellid sponge *Eubrochus clausus* during fossilization" ('Geol. Mag.,' Sept. 1876). This, which is one of the most important discoveries in modern palæontology, on account of the few organisms which possess siliceous skeletons, and the consequent rarity of the occurrence, while the reverse is so commonly the case with calcareous organisms that are replaced by siliceous, was subsequently put forth by Mr. Sollas in a more extended form in his paper on "*Pharetrosporgia Strahani*," read at the Geological Society on the 20th Dec. 1876, and published in May 1877 ('Quart. Journ. Geol. Soc.' p. 242), which is supplemented by a "Note," dated "26th April," in which (p. 254) Mr. Sollas, on account of the objections made to his view in the discussion of his paper, states:—"I need here only remark that while *Siphonia* exhibits the structure of a Lithistid (siliceous) sponge, *Stauronema* of a Hexactinellid (siliceous) sponge, and *Pharetrosporgia* of a Thalyosian (siliceous) sponge, yet the fossil skeletons of all three frequently occur now in a calcareous state."

About the same time (remarkable facts are frequently noticed simultaneously by different observers independent of, and at a distance from, each other) Prof. K. A. Zittel of Munich must have come to a similar conclusion, as we learn from the "Note" to his paper on the Hexactinellida, entitled "Studien über fossile Spongien," dated 15th Feb. 1877, wherein it is stated that at the general meeting of the German Geological Society, held at Jena in August 1876, he discussed the conversion of the originally siliceous skeleton [of the Hexactinellida] into calcspar, at which time, in the course of conversation, many objections were made to this chemical substitution (transl. 'Ann.' 1877, vol. xx. p. 516). The report of this meeting was subsequently published in the Zeitschr. d. deutschen geolog. Ges. xxviii. p. 631; after which the paper above mentioned was read on the 13th Jan. 1877, in the Mathem.-Physical Class, and finally published in

the Abhandlungen, der k.-bayer. Akademie der Wiss., II. Cl., xiii. Bd. 1877, wherein (transl. *l. c.* pp. 264-6) Prof. Zittel goes into the question at considerable length, noticing in one part ('Ann.' *l. c.* p. 264) the occurrence of a Hexactinellid sponge from the White Jura of Streitberg, "half calcified, half siliceous."

The objections met with by Prof. Zittel at Jena were not less encountered by Mr. Sollas at the Geological Society of London, where it appears, from the discussion that followed the reading of his paper, that the President "thought it was more probable that the sponge described was one of the Calci-spongiæ" (*l. c.* p. 255).

But putting aside the fact that a siliceous spicule may become converted during fossilization into a calcareous one, there can be no harm in showing how improbable it is that *Pharetrospongia* should have been a calcareous sponge, even if the latter ever become fossilized.

In the first place, as regards size, the Calci-spongiæ of the present day are not only all very small, but for the most part absolutely diminutive. Secondly, with the exception of half a dozen species (all that appear to be known), none are without the tri- or quadriradiate spicule; while the acerate spicule *in all* is straight, although sometimes undulating in its course, and more or less spined—never, to my knowledge, simply curved in the form of an arc, as in the siliceous spicules of the Reni-erida, of which *Pharetrospongia* was one. Thirdly, the Calci-spongiæ are so perishable that, although growing exuberantly when alive for the most part on the rocks of the sea-shore, where they are incessantly exposed to the action of the waves, they here become as *diffluent* as Infusoria immediately after death—that is, at once become disintegrated, from the want of that horny fibre and siliceous element which makes the other sponges so lasting. Fourthly, and lastly, their spicules, whether mounted in balsam or drawn in among the foreign bodies forming the core of the horny fibre in the Psammone-mata, break up rapidly, and in a very short time, passing into aqueous globules, leave not "a trace behind." Hence I now never mount a specimen of a calcareous sponge for preservation in any thing but a dry and simple cell.

Thus size of sponge, form of spicule, perishable nature both of entire sponge and individual spicule make it almost impossible that *Pharetrospongia* and the like could ever have been Calci-spongiæ, even if we had not the proofs above stated that a siliceous spicule may during fossilization become a calcareous one.

I have premised a short account of the discovery of this

fact, as the following description of a fossil sponge from the Lower Limestone of the Carboniferous system of S.W. Scotland, sent to me by Mr. Thomson, affords another instance of a Renierid sponge, in form of spicule somewhat like *Pharetrospongia Strahani*, having passed from the siliceous into the calcareous state.

Pulvillus Thomsonii, n. sp. (Pl. X. figs. 1-6.)

Calcareous fossil. Pulvinate, circular, depressed towards the centre on both sides, contracted towards the circumference, which is round or angular, elevated between (Pl. X. fig. 1). Surface uniformly granular, interrupted by a central circular excavation on each side, one of which is much larger than the other (fig. 1, *a*), and the smallest filled with a stem-like fragment (fig. 3, *a, b*). Internal structure granular throughout (fig. 2); granules subround, variable in size, below 1-8th inch in diameter, composed of crystalline calcite, which in the thin vertical section is semitransparent, of a light brown colour and sometimes white (fig. 2, *d d*); imbedded in dark material composed of a heterogeneous mixture of minute particles of sand and organic fragments, often giving place to white semi-crystalline calcite (fig. 2, *e, e, e*); the whole, in a vertical or horizontal section, presenting the appearance of a granular, minutely veined conglomeration, wherein the veins, especially towards the large excavation (fig. 2, *a*), are much wider than the rest, into which they afterwards appear to become subdivided. Granules largest on the side which is most excavated (fig. 2, *a*), and surrounded generally by a thin proper layer, which may be of a dark lead- or ochraceous yellow colour, according to the specimen; presenting, in a vertical section, bundles of smooth, slightly curved, acerate, white, opaque or clear transparent spicules, cut across more or less longitudinally into variable lengths by the plane of the section (fig. 4, *a, b*), which, when passing through the granules horizontally, fails, except here and there, to show more than the crystalline calcite. Broken ends of the spicules abundant in, and projecting from, the surface of the large excavation, where, from their transparent, crystalline nature, they appear, for the most part, in the form of dark, circular, transverse sections of various sizes, in the midst of each of which is a punctum representing the axial canal (fig. 6, *a, b*). Spicule smooth, acerate, fusiform, curved, and gradually attenuated to a point at each end; variable in size, about 1-25th by 1-600th inch in its largest dimensions, the only perfect one seen being smaller, viz. 1-45th by 1-900th inch in its largest dimensions (fig. 5). Size of largest specimen of entire fossil about 5 inches in

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horizontal diameter, and 2 inches in vertical diameter between the circumference and the centre, where it is thickest (fig. 1).

Hab. Marine, associated probably, according to Mr. Thomson, with "reef-building corals."

Loc. Arbigland, 14 miles south of Dumfries, on the Solway Firth, Scotland, S.W. In dark grey shale interstratified with thin bands of limestone characterizing the upper part of the Lower Limestone series of the Carboniferous system.

Obs. On account of the presence of the spicules above described, presenting themselves throughout the fossil *sidewise* in the *vertical* section and *endwise* in the large excavation, which would be tantamount to a *horizontal* section, there can be no doubt that this is a fossil sponge, and, on account of the spicules being of one form only and of different sizes, as above mentioned, that the sponge belonged to my order Holorhaphidota and family Renierida, where it would, according to its spiculation, come in well with the first group, viz. Amorphina, and the species *Halichondria panicea*, whose spicules in the deep-sea form &c. ('Ann.' 1876, vol. xviii. p. 470), where they are larger than in the shore one so common on our coasts, are almost identical. It may also be inferred from the spicules appearing abundantly and longitudinally in the vertical, while they are seldom seen in the horizontal section, together with the broken ends themselves in the large excavation, that the direction of the spiculation was more or less vertical. This would have been more satisfactorily confirmed could the transverse section of the bundles have been seen in the horizontal section, as they thus appear in *Pharetrospongia Strahani*, Soll.; but the opaque crystallization of the calcareous material in the "granules" seems to obscure this, since the transverse sections of the scattered spicules in the large excavation, where the crystallization is transparent, are plain enough, with a common lens of two inches focus: and under a magnifying-power of 100 diameters, their axial canal respectively is distinctly seen, which does not exist in the spicules of the Calcispongiæ, except in Hæckel's fertile imagination.

For the deep-sea variety of *Halichondria panicea* I have proposed the specific name of "*cancellosa*" (*l. c.*), from its areolar structure; and it may be that the "granules" of *Pulvillus Thomsonii* represent such spaces (fig. 2).

Of course the pores of this sponge have disappeared, from their minuteness and situation in the dermal sarcode; while the excretory canal-system seems to be indicated by the venation between the granules, which in its widest and most dilated parts may, in the section, be observed to be filled with heterogeneous material composed of sand and the remains of organic

bodies such as fragments of shells &c. (fig. 2, *eee*), while the remote parts, as above mentioned, are occupied by opaque white crystalline calcite alone. The widest parts, too, being on the side of the large central excavation, and particularly leading into the excavation itself (fig. 2, *a*), would seem to show that this was the excretory side, and that the principal outlet was at this excavation; while the smaller venation being on the opposite side of the fossil, seems to point out that this was more particularly the "pore-surface," which, if the sponge grew from the roof of a submarine rocky cavern pendent from the stem-like portion in the smaller excavation (fig. 2, *b, c*), would indicate its upper part, and *vice versâ* if it grew from the upper surface of the rock or material on which it was originally fixed; for it has every appearance of having once been pedunculated.

The specimens (of which there are three) are not all exactly alike in their general shape: two, growing from a flat circular base, have risen into a depressed truncated conical form; another has a smooth unequal or undulating subconical side, with three large holes almost equidistant from each other and from the circumference, which, together with the central excavation, look very much like the remains of large vents.

The former (fig. 1) appears to be the prevailing form; but independently of an original difference in this respect, something must be allowed for subsequent alteration during the time the sponge was loose on the sea-bottom before fossilization, and something afterwards; hence it would be absurd to expect that all the specimens should be alike in general form any more than those of recent sponges.

All the spicules with the rest of the fossil are calcareous; at the same time it is worthy of remark that when dilute nitric acid is applied to the surface of a polished vertical section where the spicules may be observed to lie horizontally, and the part then subjected to gentle edulcoration with water, more or less of the spicules is left in relief on the surface, which, although in a friable state, as in *Pharetrospongia Strahani* when treated in a similar manner, seems to indicate a lingering remnant of their original siliceous composition.

Dysidea antiqua, n. sp. (Pl. X. figs. 7-9.)

Siliceous fossil. Small, massive, globular, sessile, reticulate (fig. 7). Surface uniformly reticulate (fig. 7, *a*), being a continuation of the internal structure, which is composed of massive reticulation (fig. 8). Fibre of reticulation about 1-96th inch in diameter; interstices about 3-48ths inch wide; com-

posed of a heterogeneous assemblage of sand and fragments of various sponge-spicules, together with what appears to be the siliceous globules of a *Geodia* and the branches of a lithistid sponge-spicule (figs. 8, *d*, and 9, *b*) ; but as the former is sometimes evidently botryoidal chalcedony, and the latter, from its frequency, may be a fibrous form of the same mineral, it is not safe to assume that these two forms were ever organic. Size of largest and best-formed specimen about half an inch in diameter (fig. 7).

Hab. Marine, in company with *Hyalonema Smithii*.

Loc. Upper thin beds of Lower Carboniferous Limestone, Cunningham Baidland, Dalry, Ayrshire, S.W. Scotland.

Obs. From the structure and composition of the reticulated fibre of which this fossil is composed, it may fairly be inferred to have been a sponge belonging to my order Psammonemata, probably of the family Hircinida and 16th group, viz. Arenosa ; even now, from its appearance, it might almost be mistaken for a living *Dysidea* if on the rocks where the latter grows. There are several specimens, of which the largest and most perfect is that above described. Having directed a stream of water over it for some time, the material thus washed off was mounted in balsam, which presents, on microscopic examination, fragments of a variety of spicules, together with grains of quartzose sand, from which a few of the former have been figured *to scale* for illustration (fig. 9, *a*).

Rhaphidhistia vermiculata, n. sp. (Pl. IX. figs. 15-19.)

Siliceous fossil. Laminiiform, parasitic on a species of (?) *Hydractinia* (fig. 15). Composed of acerate, vermicular spicules lying confusedly together on the surface of the fossil *Hydractinia* (fig. 16, *a*), which consists of a convex, subcircular, depressed mass of more or less erect, conical, columnar processes, sometimes unequally bifurcate at the apex, rising from a reticulate structure of the like nature (fig. 16), based on a continuous membranous attachment now lapidified (fig. 16, *c c*), about half an inch in horizontal diameter, which is the size of the superincumbent mass. Processes about 1-12th inch high by about 3-48ths inch wide at the base, composed of chalcedony with a saccharine crystallization on the surface (fig. 17) and a central axial hollow closed at the summit (fig. 16, *e, b*), covered in some instances with the layer of vermiculate spicules above mentioned, one end *alone* of each of which is visible on account of the other being hidden beneath its neighbours (fig. 18). Spicule smooth, apparently acerate, fusiform, vermiform, and abruptly pointed at each end (fig. 19) ; about 1-900th inch in diameter and about 1-90th

inch long, which is that of the longest *exposed* portion. Thickness of the layer inappreciable, extent depending on the quantity of the *Hydractinia* covered by it.

Hab. Marine, in company with *Hyalonema Smithii*.

Loc. Upper thin beds of Lower Carboniferous Limestone, Cunningham Baidland, Dalry, Ayrshire, S.W. Scotland.

Obs. From the general form and reticulate structure of this fossil (fig. 16) it appears to be more like a species of *Hydractinia* than any thing else, subsequently overgrown by the layer of vermiform spicules mentioned. If the whole belonged to the sponge, then it was wholly one, and not parasitically overgrown by the layer of sponge-spicules, which now form, on the columns covered by them, a continuation of the subjacent material (chalcedony). But, out of several specimens, as there are as many without as with this covering, while the columns are hollow and not solid, it seems very likely that *Rhaphidhistia vermiculata* was a parasitic laminiform sponge very much like *Hymeraphia vermiculata*, Bk.; but the large erect pin-like spicules of the latter do not appear to be present. There are many minute recent sponges, however, that are laminiform without the large erect pin-like spicule which characterizes Dr. Bowerbank's suborder *Hymeraphia*, some of which I may hereafter have to describe under the generic name *Rhaphidhistia*.

If this was a *Hydractinia* parasitically covered by the sponge, then it was probably a calcareous one which subsequently became chalcedonized and finally encroached upon by calcite; for many of the conical processes are as much eroded by rhombohedral excavation as the spicules of *Hyalonema Smithii* already mentioned; while this is also the case with many of the minute chalcedonized *shells* which Dr. Millar sent me from the disintegrated or "rotten" limestone, wherein there can be no doubt that the shell was calcareous in the first instance. Hence there is yet much in palæontology that requires elucidation by the chemist.

EXPLANATION OF THE PLATES.

PLATE IX.

Fig. 1. *Hyalonema Smithii*, Y. & Y. Fragment of cord imbedded in Encrinital Limestone, natural size. *a*, upper; *b*, lower end.

Fig. 2. The same. Transverse section of the upper end, nat. size.

Fig. 3. The same. Fragment of anchoring end of cord-spicule; lateral view. *a*, view of free end; *b*, view of shaft side. $\times 2$.

Fig. 4. The same. Magnified, *in situ*. *a*, fragment of anchoring end.

Fig. 5. The same. More magnified lateral view, to contrast with the following form.

Fig. 6. ? The same. Anchoring end of cord-spicule, with four arms opposite and much recurved; double sagittate.

- Fig. 7.* The same. Fragment of surface of body, showing, *a a*, "nail-like" spicules *in situ*, and, *b b*, fenestral openings. $\times 2$. [N.B. In this figure the arms, which appear to have been broken off or absent, have sunk beneath the surface.]
- Fig. 8.* The same. "Nail-like" spicule of the most regular form. $\times 3$.
- Fig. 9.* The same. Lateral view of nail-like spicule, showing the constriction at the fixed ends of the arms respectively. $\times 3$.
- Fig. 10.* ? The same. Stelliform nail-like spicule with smooth and tubercled arms respectively. *a*, smooth or small form; *b*, large, matured, or tubercled form. $\times 3$.
- Fig. 11.* ? The same. Double stelliform nail-like spicule. *a*, small form; *b*, large or matured form; *c c*, stelliform head in *a* and *b* respectively; *d d*, arms respectively: $\times 3$. *e*, more magnified view of head, showing trifurcation of a lateral spine of stelliform head and tubercles over central one.
- Fig. 12.* ? The same. Simple sexradiate spicule.
- Fig. 13.* The same, to show grooving. Magnified view of a few of the cord-spicules *in situ*. Transverse section. *a a*, two single-grooved spicules together, the largest about 3-48ths inch in diameter; *b*, more magnified view of a transverse section of a single-grooved cord-spicule; *c*, the same of a four-grooved spicule; *d*, the same of a thirty-two-grooved spicule; *e*, lateral view of a fragment of the latter. All $\times 16$.
- Fig. 14.* The same. Fragments of the siliceous spicule encroached upon by calcite subsequently redissolved and leaving excavations. *a*, lateral view of a fragment of a cord-spicule presenting a few excavations; *b*, end view of a fragment presenting many excavations, extending to the centre; *c*, lateral view of a fragment rendered shapeless by being fretted out by general excavation.
- Fig. 15.* *Rhaphidhistia vermiculata*, n. sp. ? On a species of *Hydractinia*. Upper view. $\times 2$.
- Fig. 16.* The same. Fragment of the *Hydractinia*, much magnified, to show:—*a*, layer of *Rhaphidhistia* on, *b b*, conoid columns and reticulate structure of *Hydractinia*, based on, *c c*, membranous expansion, now lapidified; *d*, truncated fibre of *Hydractinia*; *e*, truncated column, showing axial cavity; *fff*, interstices of fibre.
- Fig. 17.* The same. Conoid column incipiently bifurcated, much magnified, to show the absence of the layer of spicules.
- Fig. 18.* The same. Conoid column, much magnified, to show presence of the layer of spicules.
- Fig. 19.* The same. Probable form of entire spicule.
- N.B. The above are all *siliceous* fossils.

PLATE X.

- Fig. 1.* *Pulvillus Thomsonii*, n. sp. (Calcareous.) Upper view. *a*, central excavation, presenting the broken ends or transverse sections respectively of the spicules (fig. 6). Half the natural size.
- Fig. 2.* The same. Vertical section through the centre, showing:—*a*, upper or large excavation; *b*, lower or smaller excavation; *c*, ? stem or pedicle in smaller excavation; *d d*, granules of whitish-brown calcite, of which the fossil is chiefly composed, presenting more or less longitudinal sections of the bundles of spicules, all tending to a vertical direction; *e e e*, heterogeneous sandy material, vein-like between the granules in the upper, replaced by white

calcite in the lower part, widening towards the upper part, indicative of their having formed portions of the excretory canal-system. Half the natural size.

Fig. 3. The same. Portion of the lower surface, including the smaller excavation and stem-like process. *a*, excavation; *b*, stem-like process. Half the natural size.

Fig. 4. The same. Separate granule of calcite, much magnified, to show more or less longitudinal sections of spicules in it. Diagram. Spicules on the scale of 1-48th to 1-1800th inch. *a*, calcite; *b*, spicules, variable in length and transverse diameter.

Fig. 5. The same. Example of the staple form of a perfect spicule found in the heterogeneous sandy material filling the interstices between the "granules" near the surface. Scale 1-48th to 1-1800th inch.

Fig. 6. The same. Portion of the surface of the larger excavation, showing the broken ends or transverse sections of the spicules (*fig. 1, a*). *a*, ends on a level with the surface; *b*, ends protruding. Scale of spicules 1-48th to 1-1800th inch.

Fig. 7. *Dysidea antiqua*, n. sp. (Siliceous.) Showing general form of most perfect specimen, and portion of reticulated surface. $\times 2$. *a*, portion of reticulated surface.

Fig. 8. The same. Portion of the reticulated structure, much magnified, showing:—*a a*, the fibre composed of heterogeneous material; *b b*, the interstices; *c*, fragments of cylindrical spicules in the fibre; *d*, fragments of lithistid-like fibre. Diagram.

Fig. 9. The same. A few of the fragmentary spicules washed off the fibre and mounted in balsam, to show that the fibre is heterogeneously composed. *a*, smallest four-armed anchoring-spicule seen; *b*, (?) branch of lithistid sponge-spicule. Scale 1-96th to 1-6100th inch.

Budleigh-Salterton,
28th November, 1877.

XVI.—*Notes on new and little-known Mantidæ.* By Prof. J. WOOD-MASON, Deputy Superintendent, Indian Museum, Calcutta.

1. *Euchomena thoracica*.

Mantis (Thespis) thoracica, De Haan, Orthopt. Orient. p. 94, ♀.

Phasmomantis? thoracica, Saussure, Mélanges Orthopt. i. 3^e fasc. p. 192 (44); *ibid.* p. 403 (279).

Fischeria thoracica, Saussure, *op. cit.* ii. 4^e fasc. p. 58.

Euchomena? macrops, Saussure, *op. cit.* i. 3^e fasc. p. 196 (48), ♂.

“*Femina*. Alis abbreviatis, hypothoracem non superantibus, immaculatis; prothorace longissimo, integro; femoribus anticis intus pallidis, fasciis tribus fuscis; pedibus posticis nigro marmoratis; cercis analibus cylindricis. Long. proth. 2"; abdom. 15"; elytr. 6". *Hab.*?”

Hab. A specimen of the female was captured several years ago by my native collector in Johore, Malay peninsula; and



