the last-named subgenus one known and three new species, pointing out that these agreed together in having the last dorsal abdominal segment longitudinally grooved, and mentioning, in the description of each species, the presence, in the posterior border of this segment, of an emargination filled by a well-developed supraanal plate, which is invariably to be found in the females of all species of *Lonchodes*. I have long felt convinced that the insect of which a description is appended was the male of my *Bacillus* (*Baculum*) *insignis*, but have thought it better to wait for evidence confirmatory of the fact. This has at length reached me from Ceylon, thanks to Mr. Hugh Nevill, C.C.C., who has been kind enough to send me, amongst other species of great interest and value, the two sexes of an insect agreeing admirably with M. de Saussure's * description of *L. pseudoporus*, Westw.

The discovery of the male of *B. insignis* will obviously also necessitate the transference of the following species to the genus *Lonchodes*:—*Bacillus eunicularis* et *hyphereon*, West.; *B. patellifer* et *scytale*, Bates; *B. ramosus*, Sauss., *B. Penthesilea* et *furcillatus*, Wood-Mas.: and I strongly suspect that *B. Woodwardi* et *scabriusculus* will eventually have to follow them to the same genus.

Lonchodes insignis.

♀. *Bacillus* (*Baculum*) *insignis*, Wood-Mason, Journ. A. S. B. vol. xlii. 1873, pp. 51 & 52, pl. v. figs. 1 & 2.

♂. Body of excessive tenuity. Antennæ perfectly filiform, 24-jointed, reaching nearly to the apex of the anterior femora. The head is almost a complete miniature of that of the female, and, in the specimen from which the dimensions given below are taken, has two minute tubercles between the eyes, representing the well-developed horns of the opposite sex. Three dark dorsal streaks, one median and two lateral, pass along the whole length of the body from the head to the end of the sixth abdominal segment. Both meso- and metathorax are dilated at either end, but especially at the insertion of the legs, and have each a raised median dorsal carina. The six basal abdominal segments are slightly expanded at each end, as in spirit specimens of the female; the seventh and eighth are shorter than the preceding, subequal, and gradually widen, the former from the base to the apex, the latter from the apex to the base; the last is scarcely longer than these, and cleft for rather more than a third of its length, but the sides of the cleft are so closely approximated that no hiatus is visible as in many other species; seen from the side, this segment terminates in an obtuse, scarcely deflexed tip. The legs are devoid of all traces of the foliaceous lobes so conspicuous in the female, but present the same general structure; the intermediate femora are just perceptibly curved; and the four posterior tibiæ have a few inconspicuous spinules towards the apical end.

Total length 4 in. 7½ lin., ant. 15½, head 2, proth. 1¾, mesoth. 12, metath. 11, abd. 24+6=30 lin., ant. legs 19+22+6½=4 in., inter. legs 12+12+5=2 in. 5 lin., post. legs 15+16+4½=3 in.

Hab. Samagooting, Naga Hills, with the female. Collected by Captain Butler.—*Proceedings of the Asiatic Society of Bengal*, July 1873.

* *Op. cit.* pp. 120 & 121.

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XLIV.—*On the* Hexactinellidæ *and* Lithistidæ *generally, and particularly on the* Aphrocallistidæ, Aulodictyon, *and* Farreæ, *together with Facts elicited from their Deciduous Structures, and Descriptions respectively of Three New Species.* By H. J. Carter, F.R.S. &c.

[Plates XIII.–XVII.]

This paper was commenced with observations on some deciduous specimens of the Hexactinellidæ from the deep sea, in which the influence of an absorbing process (to be mentioned hereafter) had rendered the sexradiate spicules, on which the vitreous fibre had originally been deposited, again recognizable. It was then found necessary to study the Hexactinellidæ and Lithistidæ (that is, Dr. J. E. Gray's Coralliospongia *ex parte*) generally for a better understanding of this process, and particularly the *Aphrocallistidæ*, *Aulodictyon*, and the *Farreæ*, as it was in the deciduous fibre of such sponges that the facts desired were, if possible, to be ascertained. During this study much information hitherto unknown has been obtained, and three new species of vitreous sponges discovered.

I shall first, therefore, give the results of my investigations of Dr. Gray's Coralliospongia &c., under the heads respectively of "Hexactinellidæ" and "Lithistidæ"—afterwards an account of the specimens respectively to which I shall have to refer when the spicules of the *Aphrocallistidæ*, *Aulodictyon*, and the *Farreæ* in the *living state* have been described and I come to the identifying of them in the *deciduous* structures—and, lastly, a short summary of what these structures have

revealed, together with a description of a new species of *Farrea* and a new genus of vitreous sponges.

I must here premise that whatever value the contents of this paper may possess is all due to the unceasing exertions of my friend Dr. J. E. Gray to place before me all the opportunities in his power, and afterwards to urge me to publish my observations.

In 1867, Dr. J. E. Gray proposed the term "Coralliospongia" for a certain group of sponges ("Notes on the Arrangement of Sponges," Proc. Zool. Soc. Lond. 1867, p. 505), as follows :—

"Order I. CORALLIOSPONGIA.

"Sponge hard, coral-like. Skeleton entirely formed of siliceous spicules anchylosed together by siliceous matter, forming a netted mass covered with sarcode."

Nothing can be more appropriate, both in name and definition, than this diagnosis. Dr. Gray had before him in particular the great, stony, shallow, expanded, stalked, dish-shaped masses of *Dactylocalyx pumiceus*, Stutchbury (P. Z. S. 1841, p. 86), and that of *MacAndrewia azorica* described by himself (P. Z. S. 1859, p. 438, pl. xv.), both in the British Museum, and each more than a foot in diameter.

In 1869, Dr. Bowerbank published his "Monograph of the Siliceous Sponges" (P. Z. S. May and June 1869, parts i. & ii. pls. xxi.–xxv. & pls. iii.–vi.), in which we find details of the same specimens, appearing respectively under the names of "*Dactylocalyx pumiceus*" and "*Dactylocalyx MacAndrewii*."

So far as the term "Coralliospongia" goes, Dr. Gray was right; but the details of Lens Aldous's figures in Dr. Bowerbank's monograph show that *MacAndrewia azorica* might be a family of that order, but could not be a species of *Dactylocalyx*—that is to say, that the elements of *Dactylocalyx pumiceus* are those of a sexradiate sponge, while those of *MacAndrewia azorica* belong to a quadriradiate system. (I call the "quadriradiate system" that in which the shaft of the spicule divides into *three* branches, as in the Geodinidæ, more typically shown in the four-armed spicule of *Pachastrella*, where, the arms being nearly equal in length, that which might be termed the "shaft" is often hardly distinguishable from the rest.) Yet Dr. Bowerbank has changed the name of "*MacAndrewia azorica*" to "*Dactylocalyx MacAndrewii*," thus erring both in grouping and nomenclature.

At the same time Dr. Bowerbank has distinctly shown in his figures, although he has not recognized the fact in his descriptions, that there are two systems, and that while sexradiate spicules characterize one, a trifid branching of the shaft or quadriradiate form characterizes the other system.

In 1868, Prof. Wyville Thomson's classification of these sponges appeared under the name of "Vitrea," to which Prof. Thomson added what Dr. Gray had excluded from his Coralliospongia, viz. the sarcospiculous Hexactinellidæ (*ex. gr. Hyalonema* &c.)—that is, the Hexactinellidæ which are not vitreous (Annals, vol. i. p. 119, Feb. 1868).

But in his fifth genus Prof. Thomson also includes the two species mentioned under the head of "*Dactylocalyx*," viz. "*Dactylocalyx pumicea* [*pumiceus* ?], Stutchbury, and *Dactylocalyx azorica*, Gray," = *MacAndrewia azorica*, Gray. (See also Prof. Wyville Thomson's "genus 4," Phil. Trans. 1869, pt. ii. p. 713.)

At length, in 1870, the results of Schmidt's examination of the deep-sea sponges sent to him from America were published ('Grundzüge einer Spongienfauna des atlantischen Gebietes'), in which the two systems are respectively recognized under the heads of "Hexactinellidæ" and "Lithistidæ"—the former for the sexradiate, and the latter for the triradiate type, our quadriradiate system. The result of this examination shows plainly how much more Schmidt would have done with these systems with more time and more material at his disposal.

I had noticed *this* distinction before seeing Schmidt's work, in my "Fossil Spicules of the Greensand" (Annals, vol. vii. pp. 117, 118, Feb. 1871), where, instead of the term "triradiate," I had proposed "ternate" &c.; but without reference to this in particular, it will be easily seen that if we are to call those sponges *hex*actinellid whose central canal at one point consists of six arms, the other group, whose central canal at one point consists of four arms (viz. that of the shaft and its three branches together), should be termed "*quadri*radiate" to be consistent. The term "triradiate" does not suffice for the latter, which must be either "quadriradiate" or, as I had before proposed, "ternate" or "trifid."

Then, again, if we adopt "ternate" or "trifid," to be consistent we must change "hexactinellid" to "quinate" or "quinquefid;" for in the larger-headed spicules of the Hexactinellidæ the shaft is often so marked that we have to describe it under this term, while the minute sexradiate spicules being for the most part *equi*armed, no other term can be used for them than "sexradiate."

I have endeavoured to show that in the development of a sponge-spicule which is not equiradiate, the primary form is a straight line, from whose central canal branches are *subsequently* given off to form the rest of the spicule. *proper*

(Annals, vol. ix. p. 430, pl. xxii. fig. 16, June 1872). The ornamental parts, such as spines &c., although no doubt in the original design, are not attended by any alteration in the central canal, and therefore do not belong to the "spicule *proper*." I call the "spicule proper" that fundamental form which is marked out by the central canal and its branches; and these do not run into the ornamental portions.

But whatever may be the terms finally adopted for the spicular systems of the Hexactinellidæ and Lithistidæ respectively, it is perfectly evident that in the grouping of these sponges we cannot include the sarcospiculous Hexactinellidæ, viz. *Hyalonema* &c., under either of the terms "Corallio-spongia" or "Vitrea;" while the name "Hexactinellidæ" refers rather to the elements than to the general character of these sponges.

All sponges begin their development from the ovum in the form of a sarcodic embryo; after which come the spicules, and lastly the fibre, which converts the skeleton-spicules into an axis, whether this fibre be vitreous or horny. Hence, as the sarcodic precedes the vitreous state, the latter would rank as a superior development to that of the sarcospiculous Hexactinellidæ, in which the sarcode never passes into either horny or vitreous fibre, but remains simply hardened and amorphous.

So it seems to me desirable that we should discard this "order" altogether, and distribute the groups of the Hexactinellidæ among the divisions of the Spongiadæ in accordance with what I have proposed in the footnote to my paper on the points of distinction between the Spongiadæ and Foraminifera (Annals, vol. xi. pp. 355–356, May 1873).

To understand this suggestion, however, it is necessary to premise that the vitreous fibre of the Hexactinellidæ is merely horny fibre silicified, and that the spicules of the species are imbedded in this, after the same manner respectively as they are imbedded in the fibre of sponges generally. This being the fact, we might expect to find certain Hexactinellidæ with their spicules all confined to the interior of the silicified fibre, as the spicules in the horny fibre of my third division, viz. the "Chalinidæ"—then that the fibre in another group of the Hexactinellidæ is more or less echinated with spicules in addition to those contained in the interior, as in my fourth division, viz. the "Armatæ"—or the spicules supported by amorphous sarcode alone, as in the fifth division, viz. the "Renierinæ," wherein, too, would come our quadriradiate system, or Schmidt's "Lithistidæ," in which I think the filigreed terminations of the arms interlocking with each other, rather than the presence of vitreous fibre, chiefly bind the whole structure together; for, indeed, if divested of this filigreed development, as is the case with the surface-spicules of *Dactylocalyx Bowerbankii*, Johnson (which are simply trifid-headed shafts with the shaft projecting internally and the trifid heads horizontally), they would be reduced to the state of similar spicules in the Geodinidæ and in *Pachastrella* (that is, held together only by the amorphous sarcode of the dermis), and would thus form a group in my fifth division.

We shall see by-and-by that, while the glassy skeleton of the Hexactinellidæ is formed by a vitrification of the sarcode or horny fibre, that of the Lithistidæ is formed by a vitrified extension of the spicule.

Assuming this, I shall for the present give lists respectively of the Hexactinellidæ and Lithistidæ which have already been described, grouping them, according to the best of my judgment, as their characters seem to indicate, and following each by a short commentary. After which I shall take the branched tube-net sponges (that is, the Aphrocallistidæ, in which we must include *Farrea* and *Aulodictyon*) for the special subject of this paper, returning to the other groups for more detailed description at a future time when it may be more convenient. I shall also, for the present, use the terms "sex-radiate" for the Hexactinellidæ, and "quadriradiate" for the Lithistidæ.

As the spicule of the Hexactinellidæ and Lithistidæ is, like that of all other sponges, developed from a single point or minute cell, which, by linear extension, becomes the central canal on which the vitreous layers of the spicule are subsequently built, we find that in the Hexactinellidæ the spicules are produced by a more or less uniform *radiation* from the central cell *immediately*; while in the Lithistidæ the spicules are formed by a more or less uniform *triradiation subsequently*, or from one extremity of the primary cell *after* it has undergone linear extension,—that is, that this *half* of the shaft is transformed into three arms, and that, too, probably commencing a little *beyond* the central cell, as an inflation of the shaft, often just below the head, leaving a kind of neck or more constricted portion, would seem to indicate. (See especially the large trifid spicules of the Geodinidæ &c.)

With reference to the Hexactinellidæ, it is also necessary to premise that there are here, as in most of the Spongiadæ, large spicules which are only concerned in the formation of the supporting structure or skeleton, which we shall term "skeleton-spicules," and minute spicules which belong entirely to the sarcode, which will be termed "flesh-spicules"—also that the latter here often afford a valuable character in conjunction with

others for specific distinction; but while the former remain under all circumstances in the dried specimen, the latter, unless accidentally included in the material which binds together the large spicules (a very rare occurrence), will, if the sarcode has passed into dissolution before the specimen is taken up for preservation, inevitably fall through the reticulated structure of the skeleton, as small pebbles through the meshes of a fishing-net. Hence the distinguishing character furnished by the minute or flesh-spicules will be lost or retained as the case may be; while, as some sponges have no minute spicule, its absence then must be determined by the presence of the sarcode, since if the sarcode be preserved the minute spicule will be in it if there be one, and if not the contrary. Thus it should be remembered that a sponge possessing the flesh-spicule in the natural state may not have it in the dried one, and that this remark applies to the Spongiadæ generally.

So far, all the Hexactinellidæ that have been made known possess a minute or flesh-spicule in the form of a "rosette," which may be defined to be an equiarmed, sexradiate spicule, from the ends of whose arms respectively proceed a certain number of rays which, although the same on each arm of the specimen, may vary in form, number, and arrangement with the species, but always project from the ends of the arms, which corresponding to the six sides of a cube, the whole, when the spicule is perfect, forms a more or less spherical rosette.

The term "rosette" first appears in Dr. Bowerbank's 'British Spongiadæ' (vol. ii. p. 189 &c.), as indirectly applied to a globular group of inequianchorate spicules well delineated in his plate xviii. fig. 297 (vol. i., *op. cit.*) as illustrations of an *Esperia* (*Hymeniacidon lingua*, B.). These are also flesh-spicules. Then Prof. Thomson, in describing *Askonema* ('Depths of the Sea,' p. 428), directly applies the term to the flesh-spicules of this sexradiate sponge. I now intend to apply it *generally* to the flesh-spicules of the Hexactinellidæ which possess this form, designating it according to its differences in a way which I hope will be found less oppressive to the memory, and therefore more practicable, than Dr. Bowerbank's "Terminology."

As before stated, we find in most sponges two distinct classes of spicules, viz. those which belong to the skeleton (skeleton-spicules) and those which belong to the sarcode (flesh-spicules). The skeleton-spicules sooner or later are all involved in the formation of this structure, while an enclosure of the latter is an exception so rare that the flesh-spicule may be said never to become united to the skeleton-structure. However remarkable it may be that the flesh-spicules should be intimately mixed up with the skeleton-spicules of the sponge without ever being taken into the structure of the latter, such is the case.

Among the vitreous Hexactinellidæ, however, there is a sexradiate spicule of the skeleton-structure so minute and so plentiful that it might easily pass for a "rosette," were it not for the following differences, viz. that it never goes beyond the *simple* or *first sexradiate* division (that is, where the distinguishing form of the rosette, viz. the rays, commence), and is always more or less involved in or cemented to the vitreous skeleton (Pl. XIII. fig. 1). Thus it often appears in *Aphrocallistes Bocagei* and in the *Farreæ*, as will hereafter be seen, where, although essentially a skeleton-spicule, it is so much smaller than that which formed the basis of the original fibre that I cannot help viewing it as an "afterformation." Be this as it may, it is so mixed up with the rosette in *Farrea infundibuliformis*, one of the "new species" to be described hereafter, that it is desirable to notice the existence of such a spicule in order that it may not be confounded with the rosettes in any sexradiate sponge, besides those mentioned, in which it may be found to occur (Pl. XVII. figs. 2–4).

From this we pass to a consideration of the "rosette" itself (in connexion with our illustrations), which is essentially a flesh-spicule of the kind above mentioned, but of course subject to modifications.

The simplest form appears to be that in which the six arms are *long* and respectively terminated by two divergent pointed rays (Pl. XIII. fig. 2); or the arms may be *short* with dual rays (fig. 3); or the arms short with a variable plurality of the same kind of rays (fig. 4).

(Here it should be noticed that, for the sake of perspicuity, the fifth and sixth arms (fig. 2, *c c*)—that is, the third axis—will not be introduced in the illustrations after fig. 2.)

Then the dual ray may be straight and capitate, when we get the form fig. 5, where the spines of the head are *few* and *long* (fig. 5, *a*, *b*, *c*); or the arms, still short, may have straight capitate rays in variable plurality (fig. 6), where the spines of the head are short and *numerous* (fig. 6, *a*, *b*); or the arms may be *long* with the same kind of rays (fig. 7); or the arms variable in length in different rosettes, and furnished with a multitude of straight capitate rays of unequal length in the same group (figs. 8 & 16):—the pappiform variety. Here the ends of the *arms* also are conically inflated and provided with tubercles, each of which supports a ray.

Or the rays may be sigmoid, capitate, and arranged *en fleur-de-lis* expanded generally (fig. 9); or the same *en fleur-de-*

lis contracted below and only expanded above (fig. 10); or sigmoid, clavate, capitate, and toothed outwardly, with the lower third or inward curve of the ray diminished to almost nothing, arranged *en fleur-de-lis* (fig. 11, *a*, *b*); or sigmoid and without head, subulate, with flexed extremity diminishing to almost nothing in the lower third or inward curve, also arranged *en fleur-de-lis* (figs. 12 & 15):—the pappiform rosette with flexed ray. Here, too, the ends of the *arms* are conically inflated and tubercled for the support of the rays generally, ending on the summit in a straight coarse spine (fig. 15, *c*). The lowest portion of the ray being stouter than that which follows it, is frequently left attached to the end of the arm both here and in the foregoing form, as shown in fig. 15, *d*.

Then there is the rosette with *elongated* axis, shaft-like and straight spines or rays, sometimes pointed, sometimes capitate (figs. 17 & 18), sparsely associated with the globular forms (figs. 6 & 7) which characterize *Aphrocallistes Bocagei*, and which, with fig. 19 from *Aphrocallistes beatrix*, whose spines are also sometimes capitate, appear to be the transitional forms between the globular rosette on the one hand and the large spined shaft (fig. 20) peculiar to *Aphrocallistes beatrix* on the other, the globular form being altogether absent in the latter.

Also the birotulate spicule (fig. 21), consisting of a straight subspined shaft with eight separate recurved blades, which is the flesh-spicule of *Hyalonema* &c., but not unfrequently assumes the sexradiate form (fig. 22), when it becomes a "rosette." There is also a four-armed variety, so that the birotulate spicule may be said to be two-, and occasionally four- or six-headed; while three similar forms occur in *Hyalonema* on which there are no heads, but where the ends (and sometimes the whole surface) are covered with thick short vertical spines. (See Dr. Bowerbank's Brit. Spongiadæ, vol. i. pl. vi. figs. 153–157.)

Lastly, as regards varieties of the "globular rosette," the rays are sometimes once-branched (fig. 13); sometimes the head of the ray is echinated generally with spines (fig. 13, *a*); in others the *arms* alone have become enveloped by a globular vitreous mass (figs. 23 & 24), which seems to be the transitional state to the stellate and siliceous ball of the Geodinidæ &c., also flesh-spicules. There are, again, many slight modifications of the illustrations themselves, but fundamentally no more distinct forms in the Hexactinellidæ that have as yet been brought to notice than those above described and delineated.

As regards size, there is of course not only a difference between the young and the fully developed rosette in the same species, but the size differs with the form of the rosette and in different specimens. The largest I have met with are in a fragment of *Euplectella aspergillum* dredged up on board H.M.S. 'Porcupine.' Here the form represented in fig. 11 is 26-6000ths inch in diameter, while in the specimens from the Philippine Islands it hardly exceeds 20-6000ths. The pappiform rosette with straight capitate rays (fig. 8) is the smallest form; and this averages in its largest size about 8-6000ths.

Subject to such differences in size, it would of course have been impossible for me to draw all the illustrations which I have given upon the same scale; and therefore, to represent their respective peculiarities, they are for the most part all drawn of the same size.

Let us now proceed to a *list* of the Hexactinellidæ; and as it would be confusing to add to each species the place where it has originally been described and illustrated in the list itself, this will be given in a "footnote," to which the reader may refer if necessary. Also, for the same reason, the short commentary on the species contained in the list will be given subsequently.

Hexactinellidæ *.

General character. Spicules developed upon a sexradiate division of the central canal, held together by silicified fibre or amorphous sarcode, forming a reticulated structure whose interspaces are more or less polyhedral.

Spicules held together by silicified fibre.

Species massive, excavated, shallow.

Rosette or flesh-spicule many-rayed; rays of equal length, straight, capitate, sometimes only pointed (Pl. XIII. figs. 4 & 6).

Dactylocalyx pumiceus, Stutchbury. Barbadoes. (1)
—— *pumicea*, Gray. Malacca. (2)
Iphiteon panicea, Valenciennes. Porto Rico. (3)

* *Abbreviations.* P. Z. S., 'Proceedings of the Zoological Society of London.' Annals, 'Annals and Magazine of Natural History.' M. M. J., 'Monthly Microscopic Journal.' B.M., British Museum. Atlantisch. Spongienf., 'Grundzüge einer Spongienfauna des atlantischen Gebietes.'

1. B.M. 1841, P. Z. S. p. 86; and 1869, p. 77, pl. iii. fig. 1, Bk.
2. B.M. 1867, P. Z. S. p. 506, pl. xxvii. fig. 2, =*Iphiteon Ingalli*, Bk., P. Z. S. 1869, p. 331, pl. xxiii. figs. 1–3.
3. Mus. Jardin des Plantes, Paris. P. Z. S. 1869, p. 324, pl. xxii. fig. 1.

Rosette many-rayed: rays of equal length, straight, capitate (figs. 6 & 7), or with multitudinous rays of unequal length, straight, and capitate, "pappiform" (figs. 8 & 16); or occasionally of the first kind once-branched (fig. 13); or occasionally with echinated heads (fig. 13, *a*).

Dactylocalyx subglobosa, Gray. Malacca. (4)

Rosette many-rayed: rays of equal length, capitate, flexed, and grouped *en fleur-de-lis* (fig. 10); or occasionally with straight and capitate rays.

Myliusia callocyathes, Gray. West Indies. (5)

4. B.M. 1867, P. Z. S. p. 506, pl. xxvii. fig. 1, = *Iphiteon subglobosa*, Bk. P. Z. S. 1869, p. 329, pl. xxii. figs. 10–12.
5. B.M. 1859, P. Z. S. p. 439, (Radiata) pl. xvi., = *Iphiteon callocyathes*, Bk. P. Z. S. 1869, p. 333, pl. xxiii. figs. 4–7.
6. B.M. 1869, P. Z. S. p. 335, pl. xxv. fig. 1.
7. Trans. Zool. Soc. vol. iii. p. 203, pl. xiii.
8. B.M. 1858, P. Z. S. p. 114, (Radiata) pl. xi.; Annals, 1868, vol. i. p. 123, Wyville Thomson, = *Iphiteon beatrix*, Bk. P. Z. S. 1869, p. 325, pl. xxi. figs. 2–4.
9. B.M. Quart. Journ. Microscop. Sc. vol. x. n. s. (No. xxxvii.), p. 4, pl. i. (1870); Schmidt, Atlantisch. Spongienf. 1870, p. 17, pl. ii. figs. 1, 11, 12; Kent, M. M. J. 1870, Nov., p. 248, pl. lxv. figs. 8–15.
10. Atlantisch. Spongienf. 1870, p. 13, pl. ii. figs. 1–3; Kent, M. M. J. 1870, Nov., p. 247, pl. lxv. figs. 2–7.
11. B.M. M. M. J. 1870, Nov. p. 249, pl. lxiv. figs. 18–25.
12. P. Z. S. 1869, p. 339, pl. xxiv. figs. 1–7; Owen, Trans. Linn. Soc. vol. xxii. p. 121, pl. xxi. figs. 8 & 9.
13. Atlantisch. Spongienf. 1870, p. 16, pl. i. figs. 13–20, & pl. ii. fig. 10.
14. B.M. 1873. *Vide posteà.*
15. Atlantisch. Spongienf. 1870, p. 15, pl. i. figs. 7–12.
16. M. M. J. 1870, Nov. p. 245, pl. lxiv. figs. 1–9; Wyville Thomson, 'Depths of the Sea,' 1873, p. 429.
17. B.M. Annals, 1872, vol. x. p. 112.
18. Atlantisch. Spongienf. 1870, p. 14, pl. i. figs. 1–6.
19. B.M. Annals, 1872, vol. ix. p. 414, pl. xxi.
20. B.M. Annals, 1872, vol. x. p. 137.
21. 'Depths of the Sea,' Wyville Thomson, 1873, p. 419.
22. Quoy et Gaimard, 'Voyage de l'Astrolabe,' 1833, p. 302, Atlas (Zoophytes) pl. xxvi. fig. 3, = *id.* Gray, P. Z. S. 1867, pl. xxviii. fig. 1; Wyville Thomson, Annals, 1868, vol. i. p. 131, pl. iv. fig. 2, &c.
23. Gray, P. Z. S. 1867, pl. xxviii. fig. 2; Wyville Thomson, Annals, 1868, p. 129, pl. iv. fig. 1.
24. B.M. P. Z. S. 1835, p. 65, = *H. mirabilis*, 1857, p. 279.
25. B.M. P. Z. S. 1864, p. 265, pl. xxii.
26. Phil. Trans. 1869, p. 701, pls. lxvii.–lxxi.
27. M. M. J. 1869, June, vol. i. p. 367. American Naturalist, 1871, vol. iv. p. 17.
28. B.M. M. M. J. 1870, Nov., p. 243, pl. lxiii. figs. 2–14.
29. B.M. Annals, 1872, vol. x. p. 110.
30. B.M. Annals, 1873, vol. xi. p. 275.
31. Trans. Linn. Soc. 1857, vol. xxii. p. 117, pl. xxi. figs. 1–7.

Rosette many-rayed; rays of equal length, straight, capitate (fig. 6).

Myliusia Grayi, Bowerbank. St. Vincent. (6)

Species tubular, unbranched, closed at the extremity.

Rosette many-rayed: rays of equal length, sigmoid, clavate, and dentate outwards, claw-shaped, flexed and grouped *en fleur-de-lis* (fig. 11, *a*, *b*); or with rays of equal length, straight and pointed (fig. 4); or occasionally with straight rays, few, and terminated by three or more spines at the free ends laterally (fig. 14).

Provided with long anchoring-spicules of two kinds, viz. smooth and spiniferous; the latter terminating in an inflated head with several recurved spines arranged uniformly all round (Pl. XIV. fig. 5), or on one side of the head only (fig. 4); termination of the smooth spicule unknown.

Euplectella aspergillum, Owen. Philippines. (7)

Species tubular, branched; branches closed at their free extremities; wall thick, formed of polyhedrally reticulated fibre. Possessing a scopuline shaft.

Rosette (*small*) with *elongated* shaft-like axis, many-rayed: rays straight, pointed or capitate, thorn-like, chiefly situated in the middle and at the terminations of the shaft, arranged more or less verticillately (fig. 19); or (*large*) with microspined rays slightly curved and *not* capitate (fig. 20).

Scopuline shaft headed with four rays of equal length, slightly everted, microspined, and terminating in small globular heads (Pl. XV. fig. 2).

Aphrocallistes beatrix, Gray. Malacca. (8)

Rosette many-rayed: rays of equal length, straight, capitate (figs. 6 & 7); or with long shaft-like axis, like that of the "*small*" form in *A. beatrix*, with or without heads (figs. 17 & 18).

Scopuline shaft headed with four rays of equal length, flexed outwards *en fleur-de-lis*, microspined, and each terminating in a large conical end (Pl. XV. fig. 1).

Aphrocallistes Bocagei, Wright. Portugal. (9)

?Equal in the young form to *Lanuginella pupa*, Schmidt. (10)

Species tubular, branched; branches closed (?) *at the free extremities; wall thin, formed of a single layer of subrectangular lattice-like fibre. Possessing a spino-capitate or umbrella-like headed shaft.*

Rosette many-rayed; rays of equal length, sigmoid, capitate,

slightly flexed outwards, and grouped *en fleur-de-lis* (figs. 9 & 10).

Umbrella-like headed shaft of two kinds, viz. one with large head and many small circumferential spines (Pl. XV. fig. 4), and the other with small head and few long spines; the latter microspined on the inner aspect (fig. 5); each form flatly convex, or umbonate, and both passing into each other by gradational varieties.

Aulodictyon Woodwardii, Kent. Portugal. (11)

Species tubular, branched; branches open and slightly expanded at the free extremities; wall very thin, only one layer thick.

Farrea occa, Bowerbank. Seychelles, &c. (12)

Note. All that is known of this species is that its skeleton is thin, tubular, branched, and composed of subrectangular lattice-like fibre, only one layer thick. Deciduous skeletons alone have as yet been found. (See an account, with illustrations, of what spicules have been discovered in the deciduous fragments, further on.)

The same: possessing both a scopuline and an umbrella-like headed shaft.

Rosette many-rayed: rays of equal length, sigmoid, capitate, flexed *en fleur-de-lis* (Atlantisch. Spongienf. Taf. i. fig. 19).

Scopuline shaft headed with several attenuated pointed rays, slightly divergent, brush-like (*ib.* Taf. i. fig. 18).

Umbrella-like headed spino-capitate spicule consisting of a straight shaft with convex head spined at the circumference (*ib.* Taf. i. fig. 20).

Farrea fecunda, Schmidt. Florida, Cuba. (13)

Species infundibuliform; wall compounded of subrectangular lattice-like, overrun by dendritic, branched, anastomosing fibre. Possessing the rosette only.

Rosette many-rayed; rays of equal length, sigmoid, capitate, expanded and arranged *en fleur-de-lis* (Pl. XIII. fig. 9, & Pl. XVII. fig. 4).

Farrea infundibularis, Carter, n. sp. Caribbean Sea. (14)

Species stalked, dichotomously branching; branches terminating in oviform heads, each with a terminal aperture.

Rosette many-rayed: rays of equal length, straight, capitate (fig. 6); or rays multitudinous, of unequal length, without heads, flexed outwards and arranged *en fleur-de-lis*; pappiform (figs. 12 & 15).

Sympagella nux, Schmidt. Florida. (15)

SPICULES HELD TOGETHER BY AMORPHOUS SARCODE.

Species sessile, vasiform, deeply excavated, possessing a rosette.

Rosette many-rayed; rays of unequal length, straight, capitate (fig. 6).

Askonema setubalense, Kent. Portugal. (16)

Species stalked, goblet-shaped.

Rosette few- or many-rayed: rays few, of equal length, straight and pointed (fig. 2); or multitudinous, of unequal length, straight and capitate: pappiform (figs. 8 & 16).

Crateromorpha Meyeri, Gray. Cebu, Philippines. (17)

Species sessile, sac-shaped.

Rosette many-rayed; rays multitudinous, of unequal length, straight, and capitate; pappiform (Atlantisch. Spongienf. Taf. i. fig. 6).

Holtenia Pourtalesii, Schmidt. Florida. (18)

Species oblong, excavated, provided with anchoring-spicules.

Rosette few- or many-rayed: rays few, of equal length, straight, and pointed (fig. 3), or spino-capitate (fig. 5); or multitudinous, of unequal length, without heads, flexed outwards and arranged *en fleur-de-lis*; pappiform (figs. 12 & 15): or sometimes many-rayed with rays straight and capitate (fig. 6).

Anchoring-spicules all smooth, stout, and terminating respectively in heads formed of *four* equally stout recurved spines or hooks ('Annals,' 1872, vol. ix. pl. xxi. fig. 7, &c.).

Rossella antarctica, Carter. Antarctic Sea. (19)
—— *philippinensis*, Gray. Philippines. (20)
—— *vulata*, Wy. Thomson. South side of Färoe Islands. (21)

Species tubular, unbranched, closed at the extremity.

Rosette the same as in *Euplectella aspergillum*.

Habrodictyon speciosum, Wy. Thomson. Moluccas. (22)
—— *corbicula*, Wy. Thomson. ——? (23)

Species solid, not excavated, provided with anchoring-spicules and a flesh-spicule, which is birotulate.

Birotulate spicule consisting of a straight subspined shaft terminated at each end by eight separate recurved blades (fig. 21); or sometimes four- and six-armed, with as many heads, thus assuming the form of a rosette (fig. 22); or without heads, and covered throughout or at the extremities with a number of short vertical spines.

Anchoring-spicules of two kinds, viz. smooth and spiniferous, twisted into the form of a cord which runs through the head. Free terminations of the spicules unknown.

Hyalonema Sieboldii, Gray. Japan. (24)
—— *lusitanicum*, Bocage. Portugal. (25)

Species more or less globular, excavated, provided with anchoring-spicules, and characterized by the birotulate flesh-spicule above mentioned.

Anchoring-spicules of two kinds, viz. smooth and spiniferous, the latter terminating at its free extremity in a recurved double hook; termination of the former unknown.

Holtenia Carpenteri, Wy. Thomson. Sea south of Färoe Islands. (26)
Pheronema Annæ, Leidy. Santa Cruz. (27)
—— *Grayi*, Kent. Portugal. (28)
Meyerina claviformis, Gray. Cebu, Philippines. (29)

Species possessing the birotulate flesh-spicule in which the terminations of both kinds of anchoring-spicules are known.

Free termination of spiniferous anchoring-spicule much the same as that above mentioned; termination of the smooth anchoring-spicule consisting of a double hook or arm, opposite, compressed, slightly recurved, and twice the size of the head of the spiniferous form (Pl. XIV. fig. 2).

Labaria hemisphærica, Gray. Cebu, Philippines. (30)

SPICULES HELD TOGETHER IN ONE PART BY VITRIFIED FIBRE AND IN THE OTHER BY AMORPHOUS SARCODE.

Species tubular, unbranched, closed at the extremity.

Body sarcospiculous; lid vitreous. Provided with two kinds of anchoring-spicules and two forms of rosettes, the same as those of *Euplectella aspergillum*.

Euplectella cucumer, Owen. Seychelles. (31)

Short Commentary on the Hexactinellidæ.

As considerable difference exists between the older and youngest portions of the vitreous Hexactinellidæ, it is necessary for specific distinction that fragments from both should be examined—first in their natural state, and then after boiling for a few moments in nitric acid or liquor potassæ; while the minute spicules of the sarcode, viz. the rosettes &c., which come off in the boiling, should, with any minute fragments of the skeleton that may remain, be well washed, dried, and mounted in Canada balsam for examination with a higher power.

The chief difference in structure between *Dactylocalyx pumiceus*, Stutchbury, and the following specimen, viz. *D. pumicea*, Gray, is that the latter is charged, especially towards the surface, with long linear spicules (slender, fusiform, slightly inflated and spined for some distance at each end), while there are none to be seen in *D. pumiceus*.

I say "none" advisedly, because I have repeatedly sought for them in the type specimen of *D. pumiceus* without success. Boiling in nitric acid completely frees *D. pumiceus* and *D. pumicea* from the rosette, because the rosette belongs entirely to the sarcode; but the long acerate spicule, although it also appears to be isolated, is retained in the latter by its bent position in the vitreous structure, thus fixing it there by its elasticity; so that, if these spicules had been equally common in *D. pumiceus*, S., each fragment should contain portions of them, as in *D. pumicea*, G. Had not Dr. Bowerbank figured the central (and thus unmeaning) portion of one in his illustrations of the type specimen of *D. pumiceus* (*l. c.*) without the most distant allusion to such spicules in his description, I should not have thought it necessary to write so much about it: as it is, I am compelled to the conclusion not only that such a spicule does not exist in *D. pumiceus*, but that Dr. Bowerbank has, as in other instances, introduced it as part of the illustrations of this species by mistake (to wit, the surface-spicule of *MacAndrewia azorica* with his illustration of *Myliusia callocyathes*, P. Z. S. 1869, pl. xxiii. fig. 6).

Independently, however, of this difference (and the rosette, which, although alike in other respects, is a little more robust in *D. pumicea* than in *D. pumiceus*), I find it so impossible, either in the general form of the specimens of these two sponges or in their reticulated structure respectively, to see the self-evident facts which should determine a specific distinction, that I can hardly consider them varieties, much less different species, as Dr. Bowerbank has made them.

With reference to Dr. Bowerbank's fancied differences, on which he states (P. Z. S. 1869, p. 333) that Dr. Gray "is in error" in identifying *Dactylocalyx pumiceus* with *D. pumicea* =*Iphiteon Ingalli*, Bk., because "none of the singular and beautiful forms of spicula which I have obtained from the type specimen of *D. pumiceus*, and have figured in plate iii., part i., are to be found in the tissues of the type specimen of *I. Ingalli*," it unfortunately happens that figs. 9 & 10 of these "singular and beautiful forms" belong to quite a different order of sponges, viz. to *Pachastrella abyssi*, Sdt.; fig. 11 probably to a sponge of the same kind; fig. 16 to a *Gummina*, Sdt.; and fig. 6, *a* & *b*, to sponges which are certainly not of the sexradiate system. Thus, with the exception of fig. 3, which (as before stated) appears to have been introduced by mistake, we have nothing left here by way of illustration but figures 2, 4, and 5, which are equally common to both *D. pumiceus* and *D. pumicea*.

With *Dactylocalyx subglobosa*, however, it is different; for although two of its rosette-forms are the same as those of *D. pumiceus* and *D. pumicea*, and there is a long acerate spicule present similar to that in the latter species, the large tubercles with flat muricate summits respectively on the joints of the reticulated structure in *D. subglobosa*, together with the third form of rosette (viz. the pappus-like or pappiform, with straight capitate rays), so far only observed in one other species (viz. *Crateromorpha Meyeri*), at once furnish the specific distinctions.

Here we may shortly revert with advantage to the long, linear, acerate, fusiform spicule with spined extremities, which, although not seen in *Dactylocalyx pumiceus*, forms such a prominent feature in *D. pumicea* and *D. subglobosa*, that particular mention of it is desirable. It pierces the reticulated structure of each of the two last-named sponges generally, forming by its free end on their surfaces respectively a fringe which, on account of the superior size of this spicule, is also most noticeable in *D. subglobosa*; but although it is microspined towards the ends and frequently throughout, it presents no circumscribed central inflation, no "cross" on the central canal, nor is it ever included with the rest of the spicules *in* the vitrified fibre, which it much exceeds in size; so that were it not so interwoven with the skeleton generally, its isolated condition and want of sexradiate character would lead to the conclusion that its presence was accidental. But what is equally worthy of notice is that a similar spicule pervades in a similar manner the structure of at least one of the Lithistidæ (viz. *Azorica Pfeifferæ*, n. sp.), as will be seen hereafter.

At first I thought, from the presence of these long fusiform spicules in great abundance and of large size in *D. subglobosa*, that the latter must be identical with *D. pumicea*; but the general globular cup-like form of *D. subglobosa*, together with the muricated summits of the tubercles on the joints and the pappiform rosette with straight capitate rays, all cause it so far to differ from *D. pumiceus* and *D. pumicea*.

Myliusia callocyathes differs from the foregoing in the thorny appearance of its fibre—that is, in the minute blunt spines which are scattered over the fibre of the foregoing species being much enlarged, elongated, and pointed,—also in the rays of the rosettes in most instances being sigmoid instead of straight, and arranged *en fleur-de-lis*, and in the absence of the linear fusiform spicules. Dr. Bowerbank's figure of its structure would be perfect were it not combined with a surface-spicule of *MacAndrewia azorica*, as before stated (fig. 6, *l. c.*), which of course is an oversight, the latter belonging to quite a different system of sponges, viz. the Lithistidæ.

Myliusia Grayi, both in general form and structure, has many distinguishing characters, especially that which consists in an octahedral lantern-like appearance of the joints, produced by the vitreous fibre stopping short of the joint and proceeding thence directly on from one arm of the sexradiate spicule to the other, so as to leave the centre intact and visible through the interstices. This is best seen in the younger portions of the fibre, as the older ones, by thickening, render the cross in the centre obscure. Schmidt's figure from a fossil species (Taf. ii. fig. 16, *op. cit.*) would illustrate this well, were it not for the absence of the sexradiate cross in the centre, which may have become absorbed in the deciduous specimen previously to fossilization, after the manner to be hereafter explained.

The spicules of *Euplectella aspergillum* are enveloped in ladder-like silicified fibre, such as is seen in some of the horny-fibred sponges; and the characteristic rosette for the most part has its rays arranged *en fleur-de-lis*, while the rays themselves present the peculiarity of being clavate with claw-shaped spines on the outer side of the head. The latter is repeated in *Habrodictyon speciosum* and *H. corbicula*, where the sarcode is not vitrified. It is also present in *Euplectella cucumer*, which appears to be a mixed species in point of structure; that is, while the general structure in the figure looks as if unaccompanied by vitreous fibre, the lid not only appears to be consolidated by it, but in the index to the plate is stated to be "soldered," the only time that this word is used in the whole paper. Thus, a fragment of a *Euplectella* of this nature, presented to the British Museum by "Admiral Sir W. Belcher,"

leads me to the conclusion that it must have belonged to a specimen of *Euplectella cucumer*. That described by Professor Owen and Dr. Farre I have never seen; but no one can have compared the specimens of *Euplectella aspergillum*, which are very common now, with the figures of *Euplectella cucumer* drawn on stone by that accurate artist Mr. G. B. Sowerby (*l. c.*), and those taken from photographs of *Habrodictyon speciosum* and *H. corbicula* obtained by Prof. Wyville Thomson (*l. c.*), without being convinced that *E. aspergillum*, *E. cucumer*, and *Habrodictyon*, if not distinct species, are very different forms of the same type.

Since writing the above I have carefully examined the specimen of *Euplectella cucumer* described by Prof. Owen, still in the possession of Dr. A. Farre, F.R.S., whose kindness on the occasion can only be exceeded by his continued desire for the further elucidation of this beautiful species. I have also examined the figure of *Alcyoncellum speciosum* (*Habrodictyon*, Wy. Thomson) given by Quoy and Gaimard in the Atlas to their Natural History of the Voyage of the 'Astrolabe' in 1826–29 (pl. xxvi. fig. 3, Zoophytes, 1833); and, through the kindness of my friend Dr. J. E. Gray, I am in possession of excellent photographs of this and *A. corbicula*, Val., of the natural size; so that, with specimens of my own of *Euplectella aspergillum*, I am altogether now able to state with certainty the principal differences that exist between these species.

1st. *Euplectella aspergillum* has its spicular basketwork, both of the body and lid, throughout cemented together by an envelope of vitreous ladder-like fibre, which "ladder-like fibre" in a *horny state* is also a peculiarity of some of the keratacеous sponges. The main lines of spicules are longitudinal and transverse, so that, cutting each other at right angles and at nearly equal distances, they leave a number of squarish areas in the intervals, occupied alternately by round holes and matted basketwork. Through this arrangement, the squares with holes and basketwork respectively form diagonal lines again crossing each other, but now obliquely and somewhat spirally round the body; while a number of compressed ridges or frills about a quarter of an inch high, and formed of the same kind of vitreous spicular structure as the rest of the sponge, run along in more or less continuous spiral lines obliquely through the squares of matted basketwork, leaving those with holes free between them, finally terminating above in one which encircles the lid-like end where the latter is joined to the body. The lower end, on the other hand, which is also closed but of a conical form, similar to the

end of a conical sac, is enveloped in a bunch of white horse-hair-like, long, anchoring-spicules, respectively smooth and spiniferous, with hooks at the free extremity of the latter.

2nd. *Euplectella cucumer* has the spicular basketwork of the *lid alone* cemented together by an envelope of vitreous ladder-like fibre, while all the spicules of the basketwork of the *body* below are cemented together by *sarcode only*. The main lines of spicules &c. are the same as in *E. aspergillum*; but there are no ridges or frills, their place being supplied by robust vertical spines one eighth of an inch long, respectively situated in the centre of each square of the matted basketwork, so that the spiral lines of holes are between rows of spines, which thus replace the ridges in *E. aspergillum* (Pl. XIV. fig. 10, *a a a*). Indeed there is a special form of sexradiate spicule produced for this purpose, in which the projecting spine or ray is far more robust than any of the rest, the opposite continuation or internal arm being more or less aborted, and the four horizontal ones extended diagonally along the squares of basketwork to meet the corresponding arms of their neighbours. This spicule is delineated in the original description of the sponge by Prof. Owen (Trans. Linn. Soc. 1857, vol. xxii. pl. xxi. fig. 5), and its position pointed out in the explanation of the plate, but does not appear in the figure of the sponge itself. In other respects *E. cucumer* is generally like *E. aspergillum*, but possesses a number of minor differences, which it is not requisite to mention now.

3rd. *Alcyoncellum speciosum* and *A. corbicula* (*Habrodictyon*, Wy. Thomson) have no vitrified fibre in their composition. The spicules of which their basket-like structure is composed are stated by Prof. Thomson, who examined the specimens, to be *cemented* together by a "small quantity of mucilaginous sarcode" only ('Annals,' 1868, vol. i. p. 126); and it is evident from the photograph that the main spicules present no regularity in their arrangement like those of *Euplectella aspergillum* and *E. cucumer*—that is, that they do not for the most part cross each other at right angles, in consequence of which neither the holes nor the interspaces are regular either in size or direction, while the interspaces present neither "ridges" nor "spines." Neither does either of these specimens possess any anchoring-spicules; while, as evidence of their sessile growth, *Alcyoncellum speciosum* still retains at its base a portion of the rock to which it was attached. On this difference, however, I do not wish to lay any particular stress, because I have a specimen of *Euplectella aspergillum* (fragment of the base) in the same condition—that is, sessile, on a fragment of *Lophohelia prolifera* dredged up on board H.M.S. 'Porcupine' on this side

of the Atlantic Ocean, probably somewhere between the west coast of Ireland and the Färoe Islands; so that it seems reasonable to infer that when there is a tuft of long anchoring-spicules present it is indicative that the *Euplectella* has grown in mud—and when absent, that it has grown upon some hard object.

Alcyoncellum speciosum and *A. corbicula* appear to me to belong to one and the same species; and when we find Prof. Thomson, who examined them carefully and got photographs made of them, stating respecting their differences, "I am not quite satisfied on this point even now" ('Annals,' *l. c.* p. 129), one wonders that he made any difference in their designation.

As regards size, *E. aspergillum*, *E. cucumer*, and *Habrodictyon* are almost all equal: hence it cannot be assumed that either is a young form of the other; and while it may reasonably be inferred that the two specimens of *Alcyoncellum* might reproduce each other, it by no means appears likely that either of the three species above differentiated could do this.

Hence, although in general form all three are alike and all possess the characteristic rosettes of *Euplectella* (Pl. XIII. figs. 4 & 11, *a*, *b*), yet between these two extremes there are the differences above mentioned, together with many other minor ones, which indicate that they are three distinct species.

Here I would take the opportunity of mentioning that Mr. Kitton, of Norwich, informs me that he possesses a specimen of *Euplectella aspergillum* in which there is a netted diaphragm —which is so far interesting as it still more nearly allies the structure of this sponge to that of the Aphrocallistidæ, where the diaphragm is a normal and constant occurrence.

As *Aphrocallistes*, *Farrea*, and *Aulodictyon* will be particularly described in the after part of this paper I shall say nothing more of them here.

In *Sympagella nux*, Sdt., there is the same ladder-like vitrified fibre as in *Euplectella*, but not the form of the rosette peculiar to the latter. Of the two forms of rosette, one is the common one (Pl. XIII. fig. 6), and the other the pappus-like or pappiform rosette with flexed rays, no heads, and arranged *en fleur-de-lis* (figs. 12 & 15), noticed in one other genus only, viz. *Rossella*. The ladder-like fibre is well illustrated by Schmidt (Atlantisch. Spongienf. Taf. i. figs. 9–12).

We come now to the *sarcospiculous* Hexactinellidæ, or those whose spicules are held together by *un*vitrified sarcode, of which the first is *Askonema setubalense*.

Of this sponge, as I have had nothing for examination but a fragment brought from Lisbon to the British Museum by

Mr. S. Kent, I can only state that microscopical observation of portions of it shows that, although *Askonema* possesses small sexradiate spicules, whose arms are covered with short spines, it does not possess that with one arm spined feather-like, which abounds in the *Aphrocallistidæ* &c.; and thus, as will hereafter appear, I have been able to distinguish the minute young sponge of the former from the latter, which otherwise might have been almost impossible, the rosette being of the same form in both.

In *Askonema* the small sexradiate spicules with short-spined arms (of which the vertical one on one side is often deficient) and found together in groups recall to mind the same kind of spicules (which form a rectangularly reticular network) on the surface of *Crateromorpha Meyeri* and *Rossella velata*. Indeed, so far as this goes, *Askonema* might be considered a sessile, vase-like representative on the coast of Portugal of the cup-like head of *Crateromorpha* found about the Philippines only. While the latter is about $2\frac{3}{4}$ inches high and $3\frac{1}{2}$ inches broad, the specimen of *Askonema* dredged up on board H.M.S. 'Porcupine' on the coast of Portugal, off Cape St. Vincent, was 2 feet high and 3 feet broad at the top ('Depths of the Sea,' Wyville Thomson, p. 428). In short, like most things in the west, if the Hexactinellidæ do not surpass in beauty, they do in size, for the most part, those of the east.

For the further description and illustration of *A. setubalense*, I must refer the reader to Mr. Kent's description and figures of this remarkable sponge in the 'Monthly Microscopical Journal' (*l. c.*), merely adding that the spicules represented in his figures 10 and 11 do not belong to the sexradiate system, but appear to me to have come from a species of *Pachastrella*, viz. *P. abyssi*, Sdt. That this should be the case is not extraordinary, seeing that the *Pachastrellæ* are great wanderers, and seem to grow wherever they can find any thing to rest upon, especially in the deep sea. I possess a portion of coral-detritus from the island of Cuba, which has been burrowed through by a *Cliona*, associated with which, in the burrow, is a *Pachastrella* possessing spicules, as my mounted specimen shows, exactly like those of our British species *Dercitus niger*, Gray, = *Hymeniacidon Bucklandi*, Bk.

The long-stemmed goblet-like form of *Crateromorpha Meyeri* would be sufficient in itself to distinguish this sponge from all other species, had it not also the peculiarity of possessing a complicated, tubuliferous, felt-like structure of the stem, sheathed by a layer of shortish, robust, smooth, fusiform spicules, in the central canal of which the "cross" may always be seen, although there may be no corresponding inflation outside. The cup, too, is covered by a rectangular lattice-like structure or

veil formed of the overlapping arms of a small spiniferous sexradiate spicule, whose outer vertical arm being undeveloped renders it nail-like by the corresponding one projecting inward like those just mentioned in *Askonema*. It is charged also with rosettes of two kinds, one of which is the pappus-like or pappiform one with straight capitate rays, as yet only noticed in two other species, viz. *Dactylocalyx subglobosa* and *Holtenia Pourtalesii*, Sdt.

The details figured by Schmidt of *Holtenia Pourtalesii* (*l. c.*) seem to me to ally it much more nearly to *Rossella* than to *Holtenia Carpenteri*, the type species of the *Holtenieæ*, since the former has not the birotulate spicule which is characteristic of *Holtenia* and its associates. The pappus-like rosette last mentioned is also characteristic of *Holtenia Pourtalesii*; but there is no rosette (at all events of this kind) in *Holtenia Carpenteri*, &c. Again the large nail-like spicule of the surface (*l. c.* Taf. i. fig. 4) is spined like that of *Rossella antarctica*. Lastly, if the pappiform rosette with straight capitate rays be equally characteristic of *Crateromorpha*, the latter also has many points of resemblance in its structure to *Rossella* with the rectangular lattice-like dermal veil &c., well seen in *Rossella velata*, Wy. Thomson.

Then the distinguishing character of *Rossella* is, that *all* its anchoring-spicules are *smooth*, and all armed with *four* robust recurved spines opposite ('Annals,' *l. c.*). It is also covered (that is, *R. velata* and *R. philippinensis*) with the rectangular lattice-like veil mentioned; and besides the common forms of rosette, it is charged with the pappus-like or pappiform one with multitudinous flexed rays of unequal length without heads, and arranged *en fleur-de-lis*, seen only in one other species, viz. *Sympagella nux*.

The arms of the large nail-like spicules of *Rossella antarctica* are covered by a layer of microspines, with here and there large curved spines, inclined outwards ('Annals,' *l. c.*).

Habrodictyon speciosum and *H. corbicula*=*Alcyoncellum speciosum* and *A. corbicula* have been noticed under *Euplectella aspergillum*. They are inserted here on account of their spicular structure being enveloped in amorphous sarcode instead of vitreous fibre. If the glassy fibre be considered of no specific value, then they can be removed back to *Euplectella aspergillum* at any time.

Hyalonema, from its twisted cord-like stem, composed of long anchoring-spicules, passing *through* the head (*Carteria*, Gray) so as to appear in a conical projection on the summit of the latter, whereby the central portion of the sponge, which thus hangs upon it, is rendered solid (instead of hollow, like

that of the rest of the species characterized by the birotulate spicule before mentioned), thus stands apart from all the other sarcospiculous forms of Hexactinellidæ possessing this spicule.

Here I take the opportunity, in connexion with illustrations, of correcting a mistake which I made respecting the anchoring-spicules of *Hyalonema* ('Annals,' vol. xi. p. 280, 1873), viz. that the specimen "half an inch long," which I took to be *Hyalonema*, I now find to be hollow, and, therefore, that it cannot be one of *Hyalonema*, but is probably one of *Holtenia Carpenteri*. Hence, I *still* have not yet seen the free termination of either the spiniferous or smooth anchoring-spicule of *Hyalonema*; while those described (*l. c.*) in the young *Holtenia* supposed to be *Hyalonema* show, as illustrated by Prof. Thomson (*l. c.*), that the terminations of its spiniferous anchoring-spicules are of two kinds, viz. one (the common form) in which the flukes are double and opposite, and the other in which they are double or treble and all on one side, somewhat resembling the laterally spined one of *Euplectella* (Pl. XIV. fig. 4).

Then, again (at p. 284, *l. c.*), I might have added what Dr. Gray had sketched for me in a note long ago, viz. that the broken spiral "bracket-like" line round the rough anchoring-spicules of *Hyalonema* was crowned with short spines before the latter became rubbed off (Pl. XIV. fig. 9); while they are of the same nature as the spines on the shafts of the long anchoring-spicules of *Euplectella*, *Holtenia*, and *Meyerina*, in which species, as their spiral continuation disappears, the spines become larger and more isolated.

The spines on the anchoring-spicules of *Hyalonema* are so small and so easily detached (fig. 9, *f*) that we do not wonder at their being for the most part absent on the exposed portions of these spicules; but on examining (this time) an undoubted specimen of *Hyalonema* about 1½ inch long in the body, through which the cord passed, I found the spiral lines on those parts of the spicules which were within the body all fringed with the spines, and immediately mounted some in Canada balsam for more deliberate examination, the result of which went to show that the attenuated end of the spicule in the conical part of the twisted cord which projects above the sponge is smooth and nearly straight—that the spicule then becomes undulated, and upon each bend appears a group of minute points—that these, on descending, soon pass into short spines, and that these become more prominent and supported respectively on the bracket-like processes (Pl. XIV. fig. 9), which, as before stated, form a broken spiral line, here and there more or less continuous round the spicule (fig. 9, *d*)—till at last

the spicule disappears under the parasitic polype (*Palithoa fatua*) which afterwards, for some distance down, covers the cord like a bark. Finally, the spicules again make their appearance, but now with the spines gone and the bracket-like processes alone remaining in the form of a rough more or less continuous spiral line round the spicule, which, together with the free extremities of the smooth anchoring-one, also are always broken off, so that their free terminations are gone: this is the state in which these spicules appear for the most part in the trade specimens.

I have now described the anchoring-spicules of the specimen of *Hyalonema* above mentioned, whose body is about 1½ inch long; and throughout the spicule, all the spines and blunt ends of the bracket-like processes both within and without the body are directed upwards—that is, towards the sponge at the summit of the cord.

Had I not been misled by the observations of others to regard the mounted specimen of the young *Holtenia Carpenteri* "half an inch long" in the first place as a young *Hyalonema*, the mistake to which I have above alluded would not have occurred. But finding it out, and having therefore had to examine more particularly these anchoring-spicules in an undoubted specimen of *Hyalonema*, I am enabled not only to correct the error, but to add more authentic information on the subject than was previously possessed, as well as to point out decisive marks for distinguishing between young *Holtenia* and young *Hyalonemata* another time.

The transition from the sparsely spined anchoring-spicule of *Holtenia Carpenteri* through that of *Meyerina claviformis* to that of *Hyalonema* is represented in Pl. XIV. figs. 7, 8, & 9, where also a comparative view of the heads or free terminations of the anchoring-spicules of *Labaria hemisphærica* (figs. 1 & 2), *Meyerina claviformis* (fig. 3), *Euplectella* (figs. 4 & 5), and *Holtenia Carpenteri* (fig. 6) is also given, to which I have alluded in the "Observations" appended to my description of *Labaria* ('Annals,' vol. xi. p. 280, &c., 1873).

Holtenia Carpenteri, *Pheronema Annæ*, *P. Grayi*, and *Meyerina claviformis* all probably possess the same kind of birotulate spicule as *Hyalonema* (Pl. XIII. fig. 21). I say "probably" with reference only to Prof. Leidy's hasty description of this sponge, in which this spicule appears to have been overlooked. As in *Hyalonema*, so also probably in all the other Hexactinellidæ characterized by the birotulate flesh-spicule, this is not unfrequently found in a sexradiate form, which at once identifies it with the rosette (fig. 22); that is, it may consist of three birotulates joined together in the centre, and thus present six

heads; or it may consist of two birotulates joined together in the form of a cross, and thus present four heads. All the sponges just mentioned, too, possess anchoring-spicules of two kinds, viz. spiniferous and smooth, of which the free or anchoring end of the former terminates in two recurved spines or hooks opposite. But these spicules in all are free, and flow from all parts of the base, not twisted into a compact cord like those of *Hyalonema*, which also traverses the body of the latter, as before stated, in the same form, rendering it solid in the centre, which solidity is replaced, in all the other sponges above mentioned, by a central excavation more or less cylindrical, large, and deep.

In *Pheronema Annæ*, however, this cavity is not wide as in *Holtenia*, but narrow as in *Meyerina claviformis*, and in like manner branches off at the bottom, which is some distance above the base of the sponge. Prof. Leidy describes it as a "canal," whose orifice is only four lines in diameter, descending in the axis of the sponge for "almost half its depth," when it appears to divide into several branches. This is very like the cavity in *Meyerina claviformis*. (For a description and figure of *Pheronema Annæ*, see 'Month. Microscop. Journ.' June 1, 1869, vol. i. p. 36; and 'American Naturalist,' 1871, vol. iv. p. 17.)

Labaria hemisphærica, although possessing the birotulate spicule, is, in addition to the bird's-nest form of its body, distinguished from all the rest by the terminations respectively of its spiniferous and smooth anchoring-spicules, especially the latter (Pl. XIV. figs. 1 & 2). While that of the former consists of a tumid head armed with two round recurved spines opposite like the flukes of an anchor (fig. 1), that of the smooth spicule consists of a compressed head and two compressed spines or arms expanded in the form of a crescent or leather-cutter's knife to double the breadth of the spines on the head of the spiniferous spicule (fig. 2). *Labaria* is the only sponge possessing the two kinds of anchoring-spicules in which I have seen the termination of the *smooth* form.

Euplectella cucumer, which finishes my list, has already been noticed in connexion with *E. aspergillum* and *Habrodictyon*.

[To be continued.]

XLV.—*On three new Species of Birds from Chefoo (North China)*. By Robert Swinhoe, H.B.M. Consul at Chefoo.

1. *Golden-sided Grey Thrush.*

This thrush was shot on the 14th May, on Lighthouse Is-

short perianths and very long stamens—in a word, flowers in which the pollen is completely exposed.

Some plants which seem at the first glance to form an exception to the general rules above laid down, when attentively examined really serve to confirm them. The *Ericæ*, for example, present the anomalous combination of a pulverulent pollen with a coloured perianth producing nectar. But here, just as in plants with coherent pollen, fecundation is impossible without the intervention of insects. In fact the anthers only open by two pores placed laterally at the apex of each cell; at the moment of flowering they are applied to each other by their lateral surfaces so as to close all issue for the pollen. To enable the latter to issue it is necessary that an insect entering the flower should produce a shock upon one stamen, which separates from its neighbours, lets fall a few grains of pollen upon the visitor, and then resumes its place. Some little appendages which are developed at the base of the anthers, and bar the passage of the insect, are exactly destined to produce the required movement.

Analogous peculiarities occur in some Borragineæ of the genera *Cerinthe* and *Onosma*.

Certain *Salices*, of which the pollen, although more or less coherent, is not at all protected, remedy this by producing an enormous quantity of pollen, and by prolonging their flowering for a very long time (a circumstance which recurs with the same signification in many Umbelliferæ, Cruciferæ, and Saxifragaceæ). Sometimes, also, parts of the inflorescence which are already withered become a protection for those which are about to open.

We may remark also among heterostylous plants, such as the *Primulæ*, *Pulmonariæ*, &c., a marked tendency to dimorphism of the perianth. It is more amply developed in the form with long exserted anthers, where the protection of the pollen is more difficult.

M. Kerner concludes his interesting memoir by some considerations on the probable origin of the species with coherent pollen, in which we shall not follow him: they do not appear to us to be necessarily connected with the preceding; and the ideas of the author merit a discussion of which space will not permit the introduction here. These pages suffice to show the object and utility of the infinite variety of form of the floral organs.

LIV.—*On the* Hexactinellidæ *and* Lithistidæ *generally, and particularly on the* Aphrocallistidæ, Aulodictyon, *and* Farreæ, *together with Facts elicited from their Deciduous Structures, and Descriptions respectively of Three New Species.* By H. J. Carter, F.R.S. &c.

[Concluded from p. 373.]

Let us now turn our attention to the Lithistidæ, of which the following is a similar list of those also that have been brought to notice.

Lithistidæ*.

General character. Spicules developed upon a quadriradiate division of the central canal, held together by amorphous sarcode and an interlocking of their filigreed arms, forming a reticulated glassy structure, whose interspaces are more or less irregular and curvilinear. Composed of two kinds of "skeleton-spicules," viz. those which form a layer on the surface and are accompanied by minute or "flesh-spicules" characterizing the species, and those forming the body, which are more or less alike in all the species and accompanied by fewer flesh-spicules. The skeleton-spicules of the surface, which, for the most part, are provided with a smooth, pointed, vertical shaft, directed inwards, and a horizontal head of different shapes according to the species, will be termed "surface-;" and the spicules of the body, which interlock with their neighbours through a filigreed development of all the arms, will be termed "body-spicules."

Species in which the surface-spicule consists of a shaft and three straight bifurcated arms all smooth and pointed.

Minute spicules of two kinds, viz. one acerate, fusiform, slightly curved and microspined; the other subspiral, sinuous, tuberculo-spined.

Dactylocalyx Bowerbankii, Johnson. Azores. (1)
—— *Masoni*, Bowerbank. Madeira. (2)
Coraliistes typus, Schmidt. Florida. (3)

* Abbreviations the same as in footnote, p. 357.

1. B.M. P. Z. S. 1863, p. 259, = P. Z. S. 1869, p. 94, pl. vi. figs. 6, 7, & 8, = *MacAndrewia azorica*, Gray, P. Z. S. 1867, p. 507.
2. P. Z. S. 1869, p. 91, pl. vi. figs. 1–4.
3. Atlantisch. Spongienf. pl. iii. f. 3.
4. B.M. P. Z. S. 1868, p. 565, fig. 1.
5. P. Z. S. 1869, p. 89, pl. v. figs. 6–11.

Species in which the surface-spicule consists of a shaft and three sinuous arms branched.

Minute spicules of two kinds, viz. one long, fusiform, subspinulate, smooth; the other short, more or less bent or horse-shoe-shaped and microspined.

Theonella Swinhoei, Gray. Formosa. (4)
Dactylocalyx Prattii, Bk. East Indies. (5)

Species in which the surface-spicule consists of a shaft and three sinuous arms compressed vertically; branched and dentate or curvilinear on the margins.

Minute spicule acerate, fusiform, curved, microspined.

MacAndrewia azorica, Gray. Azores. (6)
= *Corallistes clavatella*, Schmidt. Florida. (7)
Kaliapsis cidaris, Bowerbank. South Seas. (8)

Species in which the surface-spicule consists of a short shaft and subcircular discoid head, deeply and irregularly fissured.

Minute spicule acerate, fusiform, curved, blunt-pointed, microspined.

Corallistes polydiscus, Schmidt. Portugal, Florida, Cuba. (9)

Species in which the surface-spicule consists of a short shaft and subcircular discoid head.

Minute spicule acerate, fusiform, curved, microspined.

Dactylocalyx polydiscus, Bowerbank. St. Vincent, Portugal. (10)

6. B.M. P. Z. S. 1859, p. 438, pl. xv. *Dactylocalyx McAndrewii*, Bk. P. Z. S. 1869, p. 86, pl. iv. fig. 5.
7. Atlantisch. Spongienf. pl. iii. f. 7.
8. P. Z. S. 1869, p. 338, pl. xxv. figs. 2 & 5.
9. Atlantisch. Spongienf. 1870, p. 24, pl. iii. figs. 8 & 9.
10. B.M. P. Z. S. 1869, p. 96, pl. vi. figs. 10–14. *Discodermia polydiscus*, Bocage, 1869, Journ. des Sc. Math. Phys. et Nat. Lisbonne, No. iv. pl. xi. fig. 1, &c.
11. B.M. See p. 442.
12. See p. 443.
13. Atlantisch. Spongienf. p. 23, pl. iii. fig. 6, &c.
14. *Ib.* p. 23, pl. iii. fig. 4.
15. *Ib.* p. 23, pl. iii. fig. 5.
16. *Ib.* p. 22, pl. iii. fig. 1.
17. *Ib.* p. 21, pl. iii. fig. 2.
18. See p. 443.

Species in which the surface-spicule consists of a shaft and three arms. Arms sinuous, branched, curvilinear, tubercled on the upper or outer aspect, and filigreed at the extremities; shaft filigreed also at it's extremity.

Minute spicule long, slender, fusiform, subspinulate, smooth, most numerous on the margin, where it forms a fringe.

Azorica Pfeifferæ, Carter. Azores. (11)

Species in which the surface-spicule is much the same as the last, but with others like those of Dactylocalyx Bowerbankii *and* D. polydiscus *among the body-spicules.*

No minute spicule observed.

Corallistes borealis, Carter. Färoe Islands. (12)

Species in which the surface-spicule consists of a long shaft and three arms, bifurcated and more or less tubercled on the outer or upper aspect.

Minute spicule (in the slide at the British Museum) straight or slightly curved, smooth, fusiform, acerate.

Corallistes noli tangere, Schmidt. Portugal, St. Jago. (13)

Species in which the surface-spicule (according to the slide in the British Museum) is like that of Dactylocalyx Masoni, *with the branches of the body-spicules in like manner glomerato-tubercled.*

Minute spicules in the slide of two kinds, viz. one acerate, fusiform, curved, smooth; and the other with sinuous shaft, spirally covered with fine spines like that of *D. Masoni*.

Corallistes microtuberculatus, Schmidt. St. Jago, Cape-Verde Isl. (14)

Species inwhich the surface-spicule (according to the slide in the British Museum) is like that of Dactylocalyx Bowerbankii; *the rest with large filigreed head and long sinuous shaft filigreed at the extremity, as in the figure* (Atlantisch. Spongienf. Taf. iii. f. 5).

Corallistes elegantior, Schmidt. Portugal. (15)

Species with curly filigreed spicules (according to the slide).

Leiodermatium ramosum, Schmidt. Florida. (16)
—— *lynceus*, Schmidt. Portugal. (17)

Fossil species in which the surface-spicule is not known, but in which the body-spicule has the common branched filigreed form.

Minute spicule not observed.

Lithospongitis Kittonii, Carter. Carrow, hamlet adjoining Norwich. (18)

Short Commentary on the Lithistidæ.

The remarks regarding the microscopical examination of the Hexactinellidæ (see p. 363) apply to the Lithistidæ; but while the two large specimens respectively of *Dactylocalyx pumiceus*, Stutchbury, and *MacAndrewia azorica*, Gray, in the British Museum, are very much alike in their dish-shaped, wide, circular heads, each of which is supported by a thick short stem, and their minute structure has the same vitrified glassy appearance, it should be remembered that they form representatives of two totally different systems of sponges, the former being built upon a sexradiate division of the spicule, and the latter upon a quadriradiate one; that is, while the Hexactinellidæ have six ends to their spicule, the Lithistidæ have only four, and the lowest system of spicules in which the linear form prevails, of course, only two. Hence the spicule of the Hexactinellidæ has, as it were, three shafts joined together in the centre, thus giving six ends; the next, or quadriradiate system, has, as it were, two shafts joined together in the form of a cross, thus presenting four ends; while the simplest system of all has only one shaft, and consequently only two ends. Thus modified, forms of all the three systems may be found in the Hexactinellidæ; but only those of the third system with the Lithistidæ—that is, no sexradiate spicules. Of course I allude to the staple spicules here, and not to the monstrosities which may occur in either system; and perhaps, too, I should restrict these observations to the spicules of the skeleton-system, or skeleton-spicules, since, when we come to the minute or flesh-spicules, we find the multifid form of the sexradiate spicule, viz. that of the rosettes, passing, as before stated, into the stellates and globular siliceous balls of the Geodinidæ &c., and of course *vice versâ*.

But, be this as it may, there seems to be very little doubt that the system of the Lithistidæ is that of *Pachastrella*, *Geodia*, and *Stelletta*, and never that of the Hexactinellidæ: that is, a sexradiate spicule, as just stated, is never found in the Lithistidæ.

In *Dactylocalyx Bowerbankii* and *D. Masoni* the surface-spicules are nail-like, having the spike or shaft directed inwards and the three arms of the head bifurcated and spread out horizontally, so as to meet those of the other surface-spicules, while the interspaces are occupied by the sarcode charged with the flesh-spicules, in the midst of which are the pores; and thus the dermal aspect is completed. In *D. Masoni* the subspiral shaft of the minute or flesh-spicule is covered

with fine, pointed, long spines, while in *D. Bowerbankii* they are short, blunt, and slightly inflated at the ends; again, the acerate spicule in the former is not figured (Bk. Monogr.), while the fine-spined subspiral spicule of *D. Masoni* seems to be only a variety of the more coarsely formed one in *D. Bowerbankii*; and the acerate spicule, being also very sparse in the latter, may have been entirely overlooked in the former. Thus, at the utmost, *D. Masoni* can only be considered a variety of *D. Bowerbankii*. The secondarily furcate extremities of the arms of the surface-spicule in Dr. Bowerbank's fig. 7 of *D. Bowerbankii* (*l. c.*) at once allies it to similar forms of the spicule in *Pachastrella abyssi*, Sdt., and points out the commencement of the filigree which becomes so elaborately developed as the surface-spicules gradually sink into the general structure of the body. Schmidt's *Corallistes typus* would, therefore, come in here.

In *Theonella Swinhoei* and *Dactylocalyx Prattii*, the arms of the surface-spicules are not straight but sinuous, and, thus overlapping each other, leave circular interspaces which are filled up with sarcode charged with the flesh-spicules, in the midst of which are the pores. The minute, cylindrical, microspined spicule varies much in form, from an elongated ellipse to that of a horseshoe-shaped, cylindrical, linear spicule, being also sometimes contracted in the centre and enlarged towards the extremities.

In *MacAndrewia azorica* and *Kaliapsis cidaris* the arms of the surface-spicule, besides being sinuously branched, are also flattened, and possess a dentate curvilinear margin on both sides, while the branches overlapping each other, as before stated, leave interspaces that are filled with sarcode charged with the rough, microspined, acerate spicule mentioned, in the midst of which are the pores. These minute linear spicules, often slightly inflated in the centre, are arranged around the pores in a radiated manner, so that the pore can be opened or closed by their being raised or the reverse. The structure is well represented by Schmidt in *Corallistes clavatella* (*op. cit.* pl. iii. fig. 7, *b*), which appears to be equal to *MacAndrewia azorica*. I possess fragment-specimens of *MacAndrewia azorica* which were dredged up on board H.M.S. 'Porcupine' between the Färoe Islands and the north coast of Scotland. Unfortunately the specimen of *Kaliapsis cidaris* which Dr. Bowerbank found on a portion of *Oculina rosea* from the South Seas was so small that it was "all" absorbed in the mounting and examination.

In *Corallistes polydiscus*—better designated "*asteroides*" by Schmidt on the slide which he sent to the British Museum,

seeing that this, as well as his figure (*op. cit.* pl. iii. fig. 8), has a discoidal head so deeply fissured as to merit the term mentioned—we seem to have in the surface-spicule a transitional form from the three- flat armed head of that in *MacAndrewia azorica* to that of the subcircular form in the following species, viz. *Dactylocalyx polydiscus*, where the discoid head is so little fissured as to merit this designation. How far these forms may run into each other in the same species I am ignorant, as I have only examined *D. polydiscus*, in which *all* the heads are subcircular.

Here I should notice that, in a small rolled fragment of *Corallistes borealis* which I sent to Mr. F. Kitton, of Norwich, to compare with the fossil species to be presently mentioned, he detected some spicules with subcircular discoid heads, like those of *Dactylocalyx polydiscus*, which he kindly mounted and sent to me; and on them I observe two or three of the minute flesh-spicules common to *D. polydiscus*, but reduced by the process of absorption which takes place in the deciduous vitreous structures of sponges, to be described hereafter, to irregular stick-like forms. Now it so happens that with Schmidt's fig. 8 of the surface-spicule of *Corallistes polydiscus* there are also two of these irregular stick-like forms represented, which I never could understand until Mr. Kitton sent me the mounted specimen mentioned. Hence it seems to me, from their imperfect form, that Schmidt's minute or flesh-spicules at least belonged to a deciduous skeleton.

As just stated, the heads of the surface-spicules in *Dactylocalyx polydiscus* are discoid and subcircular. The shaft is short, smooth, and pointed; and where it joins the disk a triradiate line is seen, which results from the division of the central canal of the shaft into three branches. The discoid heads as usual overlap each other; and the dermal sarcode is charged with the minute flesh-spicule already mentioned; while in the interspaces between the heads are the pores. The triradiate line is often seen in this kind of spicule in the Lithistidæ, where also the minute, acerate, fusiform, microspined flesh-spicule is also very common.

In *Azorica Pfeifferæ*, n. sp. (two specimens, called after Madame Ida Pfeiffer, who obtained them at Madeira and presented them to the British Museum), the surface-spicule is like that of the interior, viz. with the sinuously branched arms and shaft all terminating in filigreed structure, that of the shaft interlocking with that of the heads of the next layer inside it. There is no very minute flesh-spicule, but a great number of long, subspinulated, fusiform, linear ones, which abound

especially upon the growing edge or margins of the specimen. The specimens are covered with dried sarcode, evidencing that they were taken alive and may so far be considered perfect. Hence there is no doubt about their possessing no characteristic surface-spicule; for I searched for this in many parts. Still I think it just possible that this may be explained by assuming that the surface-spicule had passed into the form of the body-spicule before the new layer of surface-spicules had been developed.

Be this as it may, the specimens are magnificent and magnificently perfect; not, perhaps, from any particular care having been bestowed on their preservation, but because, contrary to what one would infer from their glassy structure, they are so tough that it is difficult to get a piece off them. One is 14 inches in diameter and 11 inches high, and the other not quite so large. They are flattish, cabbage-like, infoliated, with branched sinuous laminæ $\frac{2}{12}$ to $\frac{3}{12}$ inch thick, vertical, widely separated, and proliferous. The vents are a little raised on papillary eminences, and scattered over the *inner* aspect of the fronds or laminæ; while the pores are *outside*, as in *MacAndrewia azorica*, to which it bears a strong general resemblance. My reason for stating all these characters is because these specimens have hitherto not been described.

Corallistes borealis is the name which I have given to deciduous fragments of a Lithistid dredged up on board H.M.S. 'Porcupine' between the Färoe Islands and the north coast of Scotland. They have no characteristic surface-spicule; and in their body-structure are confusedly mingled both the simple form of surface-spicule characterizing *Dactylocalyx Bowerbankii* and that of *D. polydiscus* respectively. Various other sponges have built their structures upon them, among which is that possessing the snake-like form of large acerate spicule figured by Schmidt in connexion with his representation of *Corallistes typus* (*op. cit.* pl. iii. fig. 3 *c*), which of course is also parasitic. How to account for the surface-spicules before mentioned occurring among the body-structure of *Corallistes borealis* I know not.

For the structure and form of the remaining Lithistidæ and their spicules, I must refer the reader to Schmidt's work on the Atlantic sponge-fauna, already mentioned, where they are respectively described and figured.

I would, however, for a moment more here revert to the fossil species *Lithospongitis Kittonii*, which Mr. F. Kitton, of Norwich, found in a flint of the Upper Greensand taken from an artesian well at Carrow, close to Norwich, to observe

that we have here *en masse* what my illustrations of the fossil spicules of the same geological formation on Haldon Hill, near Exeter, show in individual spicules (Annals, 1871, vol. vii. pls. vii. & viii.). Thus the existence of such sponges in the Upper Greensand had been predetermined.

Observations.

The above arrangements of the Hexactinellidæ and Lithistidæ, together with the short commentaries which follow them respectively, must be regarded only as preliminary to more detailed descriptions which I hope to offer on some future occasion. They are chiefly intended as an introduction to what will hereafter be stated of the *Aphrocallistidæ*, *Farreæ*, and *Aulodictyon*, concerning which I had, as before stated, gathered many facts for publication hitherto unnoticed, when I found it necessary to make myself acquainted with all the Hexactinellidæ and Lithistidæ that had been made known before I could satisfactorily acquit myself of the task.

This involved much time and much research, combined with opportunities which may not readily occur again. Hence I thought it desirable to record at once the most important part of my observations, although this is not the place to give the whole, which would entail long descriptions.

Object.

We now come to the primary object of this paper, which was to show that the tubular lines which appear in the vitreous fibre of the Hexactinellidæ arise from the absorption of the spicules on which it was originally deposited—that if this has not gone too far, the exact forms of these spicules can be recognized; so that, although nothing else but the deciduous fibre remains, the species of the sponge to which it belonged can thus be determined if previously known in the living state—and if not previously known in the living state, then also the kind of spicules it must have possessed in this condition. The deciduous specimens of Hexactinellidæ which will come before us for this purpose belong to *Aphrocallistes Bocagei* and *Farrea occa*, of which the living state of the former is well known, but the deciduous skeleton *only* of the latter. Meanwhile, for the sake of reference, it will be necessary to premise a short account of each of the specimens from which my observations have been derived; then a description of each of the spicules of the species of Hexactinellidæ with which we are now chiefly concerned that have been found in a living state, viz. the *Aphrocallistidæ*, *Aulodictyon*, and the *Farreæ*; and,

lastly, a description of the deciduous skeleton of *Farrea occa*, and the destructive changes which take place in the sponge-spicule generally, followed by the absorbing process in the vitreous fibre of the deciduous Hexactinellidæ to which I have often above alluded.

Short Descriptions of Specimens that will presently come under reference.

The first of the specimens that came under my observation in this respect was one of the so-called *Farrea occa*, which, having grown upon a branched coral (*Lophohelia prolifera*), subsequently became overgrown, both sponge and coral, by a *Gummina* (*Corticium abyssi*), so as to form a solid mass, through whose smooth surface here and there projected portions of both sponge and coral. This specimen, I learn from the label on the glass jar containing it, was dredged up on board H.M.S. 'Porcupine,' in lat. 43° 31′ N., and long. 10° 3′ W. (that is, in the so-called "*chops*" of the English Channel), in 500 fathoms. It is now an oblong portion, in size about $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$ inch, which originally must have been larger, as there are many fragments of it in the same jar. The specimen is figured in the 'Annals' for July 1873, pl. i. figs. 1 & 2, of the natural size; and to this specimen or figure I shall often have to allude as "No. 3 *a*," which heads the label on the jar. All this may seem unnecessarily particular; but as the specimens of Spongiadæ dredged up on board H.M.S. 'Porcupine' have been handed over to me by Prof. Wyville Thomson for description, every thing that tends to point out their history should be recorded.

By the term "so-called *Farrea occa*," I mean that this name was given to a simple fragment of vitrified network, found in great abundance in the detrital mass on which Dr. Farre's specimen of *Euplectella cucumer* had grown. "Simple," because the fragments are those of dead sponges, and therefore without sarcode, while the minute spicules which accompanied them, and are figured by Dr. Bowerbank as the "retentive spicules" of *Farrea occa* (*l. c.*), are not those of a sexradiate sponge, which the fragments are, but of an undescribed species of *Gummina*. How far the form and structure of this sponge, to which the fragment figured by Dr. Bowerbank (fig. 7, *l. c.*) belonged, has been subsequently discovered, the sequel of this paper will show. Suffice it now to state that we shall take as the characteristic feature of Dr. Bowerbank's *Farrea occa* the rectangular latticed "harrow-like" structure of his illustrations (*l. c.* pl. xxiv. fig. 7, 1869), first represented by Prof. Owen in connexion with *Euplectella cucumer* (Trans. Linn. Soc. 1857,

vol. xxii. pl. xxi. fig. 9 & 9 *a*), and not Dr. Bowerbank's figure 1, which we shall hereafter find to belong to *another* species of *Farrea*, also illustrated by Prof. Owen (*op. cit.* fig. 8). In short, a cursory inspection of the two figures in Dr. Bowerbank's plate will show that they belong to two different structures, one of which (viz. fig. 7) has smooth, and the other(fig. 1) spiniferous fibre. The former we shall call "*Farrea occa*," and the latter "*Farrea densa*."

At the time Dr. Bowerbank described *Farrea occa* (P. Z. S. p. 339, 1869), the only thing known of it was the fragment mentioned; hence it is not surprising that his description should, to say the least of it, be very different from reality. We now know that this smooth rectangular fibre belonged to a branched, tubular skeleton, only one layer thick, and the branches patulous at the ends, which, up to this time, appears to have been found only in a deciduous state; so that we do not know even now what were the forms of the spicules on which the fibre was originally deposited, except through the means already stated, viz. the absorption of these spicules, which takes place only in the deciduous skeleton, reducing their forms to mere moulds, which, however, represent their true forms inside the fibre. Can we find, then, sufficient of these forms enveloped in the deciduous fibre to tell us what the living species possessed? will be the question by-and-by, when we come to consider *Farrea occa* more particularly.

The next specimen which I have had for observation is that of a dead *Aphrocallistes Bocagei* in a jar without label; but finding only one place where this sponge is mentioned in the "Preliminary Report of H.M.S.'Porcupine,'" published in the Royal Society's 'Proceedings' (No. 121, p. 424, 1869), where it is stated that a "tolerably perfect though dead specimen of *Aphrocallistes Bocagei* had been dredged up at Station 36 in 725 fathoms with a bottom of muddy sand," I presume that it is the one in question, which consists of a hollow cylindrical tube, composed of vitreous network, closed at the free end by the same structure in a convex form, and terminated at the other by a flat disk, which adhered to the object on which it grew, covered with buds or shorter tubes of a like kind, whose cavities respectively are continuous with that of the main tube or stem, the whole specimen being about two inches long and one in diameter. This "Station," I see by the table, was in lat. 48° 50′ N., and long. 11° 9′ W.; so that it was dredged up close to the specimen of *Farrea occa* just mentioned. We will designate it by the "Station," viz. "No. 36."

From the deep-sea specimens of H.M.S. 'Porcupine,' let us go to those in the British Museum dredged up on board

Mr. Marshall Hall's yacht 'Norna' in 1870, on the N.W. coast of Spain and Portugal, by Mr. Saville Kent; and here we shall find a dead specimen of *Aphrocallistes Bocagei* now broken into pieces, but when entire a little larger and of the same kind as that last described,—also a dead specimen of *Farrea occa*, consisting of a bunch of short tubes slightly trumpet-shaped and open at their free ends, branching off from a main axis (Month. Microscop. Journ., Nov. 1870, pl. lxiv. fig. 12), both dredged up from a muddy bottom, and both filled with the mud.

Further, on a bunch of dead *Lophohelia prolifera*, there is another small but living specimen of *Aphrocallistes Bocagei*, together with several young or embryonic specimens here and there on the branches of the former, some of which are not more than $\frac{1}{24}$ of an inch in diameter, which, on microscopical examination, present the spicules of *Aphrocallistes Bocagei*, that at the same time are identical with those figured by Schmidt (*l. c.*) as illustrative of his *Lanuginella pupa*, which, as may be observed by his figure of *Aphrocallistes Bocagei* (*op. cit.* pl. ii. fig. 1), grew in great numbers on this specimen.

Lastly, on one of the branches of the same bunch of *Lophohelia prolifera* may be observed the unique specimen of *Aulodictyon Woodwardii*, discovered, described, and figured by Mr. Kent (*op. et l. cit.*). It also, like *Farrea occa*, is a tubular structure of rectangular lattice-like vitreous fibre, but otherwise appears to have been branched and closed at the extremities like *Aphrocallistes Bocagei*; still the specimen is so small, being not more than half an inch long, and the ends of the branches are so broken off, that, with the exception of its growing from a branch of the *Lophohelia* like *Farrea occa* (that is, spread out and not attached by a disk-like end like *Aphrocallistes Bocagei*), nothing more can be said of its general form.

Lastly, I have to notice a deciduous specimen of *Farrea occa*, about the same size and form as that last-mentioned, which was dredged up from the Caribbean Sea in about "lat. 14° 2′ N., and long. 77° 42′ W., in 1500 fathoms," and submitted by Mr. Gassiot (to whom the vessel belonged whose captain obtained it) to Dr. Gray, and by the latter to myself for examination. It is also much broken, but measures an inch long by about the same in transverse diameter. Also, from the same locality, a little stick-like fragment about $1\frac{1}{2}$ inch long and $\frac{1}{4}$ inch broad, composed of vitreous fibre like that of *Farrea*, but solid, bleached, and rounded in its contour, which is rendered very irregular by a dissolving action that has been going on in the fibre both inside and out for some time; and three specimens of a new species of *Farrea*, which was funnel-

shaped, to the solid stem of which stick-like fragment the foregoing specimen appears to have considerable resemblance.

As the latter constitutes the type of a new species of *Farrea*, some specimens of which were taken in the living as well as in the deciduous state, it is necessary, for future reference, to give a particular description of it at once, which will now follow under the designation of "*infundibuliformis*."

Farrea infundibuliformis, Carter, n. sp. Pl. XVII. figs. 1–4.

Vitreo-hexactinellid. Infundibuliform, consisting of a head (fig. 1, *a*) and stem (fig. 1, *b*). Stem subround, solid, composed of interlacing, branched, mixed with rectangular lattice-like fibre. Head funnel-shaped, formed of an expansion of the stem composed of a layer of rectangular lattice-like fibre in the centre (fig. 2, *b b*), covered on each side by one of branched vitreous fibre, whose branches diminish in size as they increase in number towards the circumference (fig. 1, *c*, 2, *a a*); reticulated and anastomosing obliquely throughout. Rectangular fibre strongly spined and formed of an extension of vitrified sarcode over a regular rectangular arrangement of large sexradiate spicules. Branched fibre minutely spined (fig. 2, *c c*), and more or less charged with minute sexradiate spicules, smooth and pointed or spined along the arms and at the ends, confusedly arranged (fig. 1, *d d*, & fig. 3), some of which are only partially enveloped, and others only cemented by one end (fig. 3, *a*) to the fibre. Interstices lined with sarcode charged with rosettes. Rosette many-rayed; rays sigmoid, capitate, expanded and arranged *en fleur-de-lis* (fig. 4); head of ray convex, spined round the margin. *Size*: diameter of funnel-shaped head about an inch, depth about $\frac{4}{12}$; thickness of wall at the margin, which is broken, $\frac{1}{40}$ inch; length of the portion of stem remaining $\frac{4}{12}$; diameter of the same close below the head $\frac{2}{12}$ inch.

Hab. Marine.

Loc. Caribbean Sea.

Obs. There are three specimens of the vitreous skeleton of this sponge in the British Museum, all about the same size and shape, but all more or less imperfect on the margin of the funnel-shaped expansion, which, being very thin, has no doubt been broken away by the dredge or "tangle" in which the specimens were taken. The stem in each also appears to have been broken off at the end, where it was just branching into three or more divisions, as if these divisions had terminated in the roots by which the sponge had been attached to some submarine object, and from which the specimens respectively had been broken off by the dredge or tangle.

Besides the specimens mentioned, there are two other thin flat portions, each of which is about an inch square and $\frac{1}{24}$ inch thick, which, presenting no visible curvature, may have belonged to infundibuliform heads of much larger dimensions than those above given. It is not improbable too, from the extreme thinness of the margin of the expansion of the more perfect specimens, that, if the heads in them respectively had been entire, their diameter would also have been greater. The flat portions must have been broken off from living specimens, as they are covered with dry sarcode abundantly charged with the form of rosette above mentioned.

This differs from *Farrea occa*:—1st, in the addition to the single lattice-like layer of which *Farrea occa* is composed, of a much larger, obliquely anastomosing, branched, vitreous fibre, apparently originating, both outside and in, from the bottom of the funnel-shaped expansion where it is thickest; 2nd, in this fibre being charged with the *minute* sexradiate spicules of the species, *confusedly* imbedded, entirely or partially (that is, in various degrees), within its substance; 3rd, in these sexradiates being much smaller than those singly and *regularly* arranged in what appears to be the basework or original lattice-like fibre of a *Farrea occa*. In short, the branched anastomosing fibre charged with the minute sexradiate spicules appears to be a secondary formation, which has run over a rectangular fibre vertically, so that it cuts the transverse bars of the latter, although amalgamating with them here and there at right angles.

Spicules of the *Aphrocallistidæ*, *Aulodictyon*, and *Farrea facunda*.

We now come to the description of the spicules respectively of the *Aphrocallistidæ* and *Aulodictyon Woodwardii* in their living state, together with a species of *Farrea* described by Schmidt as *F. facunda* (*fecunda*?), with all of which it will be found necessary that we should become acquainted before we can make out any thing of those in the deciduous skeletons.

Aphrocallistidæ.

Aphrocallistes beatrix, Gray, and *A. Bocagei*, Wright.

These two sponges have been excellently described and illustrated by the naturalists respectively who named and brought them into notice. But only generally. The detail of their spicules has not been sufficiently given; and as it is necessary that this should be minutely done, in connexion with illustrations, before their histories respectively can be considered

complete, as well as for the purpose of identification just mentioned, we will direct our attention for a few moments to this part of the subject.

Aphrocallistes Bocagei.

Taking *Aphrocallistes Bocagei* first, as this is the simplest form, it will be found that, besides the common large sexradiate spicule on which the vitreous structure is based, there are seven other kinds attendant upon it, all of which are more or less free and unimplicated in the vitreous sarcode, viz. :—

1. The staple, *linear*, fusiform spicule with inflated centre and extremities, in which the former presents 2–4 tubercles more or less developed opposite corresponding branches of the sexradiate central canal; extremities more or less pointed and spined.

2. A more delicate, *linear*, fusiform spicule, spined throughout. The spines long and slender, supported on projections of the shaft resembling the bracket-steps of a flagstaff; more or less closely inclined towards the shaft, and *all* in the *same direction*—that is, not half one way and half the other, beginning from the centre of the shaft and proceeding in opposite directions, but from one end towards the other throughout. As this is a very common form in the Hexactinellidæ, and the other kind also exists occasionally, viz. that in which the spines are inclined towards either point beginning from the centre, it is necessary to note the difference and give particular attention to the form chiefly under consideration (Pl. XV. fig. 8).

3. A sexradiate spicule whose arms are more or less unequal in length—five being smooth at the commencement and conically inflated and spined at the termination, and the sixth spined, feather-like all round, the spines increasing in length from the fixed to the free end. Sometimes, in an abnormal state, more than one of the arms is thus spined (fig. 9).

4. A scopuline spicule, consisting of a long shaft and four rays. The rays more or less divergent, arising from a corresponding number of tubercles at the end of the shaft, and terminating in conical heads surrounded with recurved spines. The rays are microspined and the end of the shaft also. Frequently the shaft presents a quadriform inflation just below the giving off of the rays; and sometimes the little tubercle in the centre of the four rays, which is the end of the shaft, is prolonged into a fifth ray (figs. 1 & 1 *d*).

5. A rosette with five-rayed arms, each ray straight or slightly sigmoid, and all divergent and capitate, except the central one, which is in a line with the arm; head of the ray convex and spined round the margin more or less deeply

(fig. 11, *d*). An abnormal form of the rosette is to have the arms continued respectively into one large ray.

6. The same, but with the axis stretched out linearly, shaft-like, and the rays arranged round it more or less spirally; rays long, spine-like, capitate, most numerous at the ends, where they are more or less divergent (Pl. XIII. fig. 17).

7. The same, with the rays of the shaft more confined to its centre, and all simple (that is, *not* capitate, but pointed).

N.B. The last two forms are not near so abundant as the globular rosette (Pl. XV. fig. 11, *d*).

Aphrocallistes beatrix.

We now come to *Aphrocallistes beatrix*, in which it will be also found that, besides the common large sexradiate spicule on which the vitreous structure is based, there are six other kinds, viz. :—

1. Similar to no. 1 of *A. Bocagei*, but a shorter, coarser, and more robust form, spined throughout.

2. The same as no. 2 in *A. Bocagei*.

3. A sexradiate spicule whose pointed arms are sparsely and irregularly covered throughout with smooth spines curved outwards, and longest about the union of the middle with the inner third, diminishing towards the extremities of the arms (Pl. XV. fig. 10). This appears to be the analogue of no. 3 in *A. Bocagei*, since I have never seen the sexradiate spicule with feather-like spined arm in *A. beatrix*, nor has Mr. Kent, who also states this, and that the one figured in his illustration of this sponge is taken from Dr. Bowerbank's (P. Z. S. 1869, pl. xxii. fig. 3). If, however, Dr. Bowerbank has been more fortunate in this respect, his figure shows, by the abortive condition of the spines on the feathered arm of this spicule in *A. beatrix* compared with that in *A. Bocagei*, that this spicule is very poorly, and therefore perhaps very sparsely, represented in *A. beatrix*.

4. A scopuline spicule, consisting of a long shaft and four rays; the rays quadrangularly based on a hand-like expansion of the end of the shaft; for the most part proceeding for some distance almost parallel to each other, when they end by becoming slightly divergent, terminating respectively in small, smooth, round heads, surrounded by recurved spines. The rays and the end of the shaft also microspined throughout (Pl. XV. fig. 2).

5. A straight large shaft more or less beset with long, thorn-like spines, most numerous towards the centre, where they are vertical, and at the extremities, where they are divergent; each slightly curved and microspined (Pl. XIII. fig. 20).

6. A smaller kind, in which the rays are straight, smooth, and capitate (Pl. XIII. fig. 19). This, which has also been figured by Mr. Kent (Month. Microscop. Journ. 1870, no. 33, pl. lxv. fig. 20), is analogous to no. 6 in *A. Bocagei*, and thus becomes a transitionary form of the rosette in the latter to the large, spined shaft no. 5 (just described) peculiar to *A. beatrix*, in which sponge there is no rosette; that is, the globular rosette in *A. Bocagei* first presents itself in that sponge with elongated shaft-like axis and pointed or capitate spines, which form is again found, *without* the globular rosette, in *A. beatrix* apparently leading to the large spined shaft that is as characteristic of this species as the globular rosette is of *A. Bocagei*.

Obs. About the bunch of dead *Lophohelia prolifera* dredged up by Mr. Kent there are, as before stated, in addition to the larger specimens of *Aphrocallistes Bocagei* and *Aulodictyon Woodwardii*, several embryo sponges; and two of these (viz. one $\frac{1}{24}$ and the other about $\frac{2}{12}$ of an inch in diameter) I mounted in Canada balsam, when it was observed that they both belonged to *Aphrocallistes Bocagei*; but while the vitrified fibre had not begun to appear in the former, it had in the latter, where several sexradiate and linear spicules had become cemented together, involving also some of the sexradiates of *Aphrocallistes Bocagei* with feather-like spined arm (Pl. XV. figs. 9 & 11, *a*, *b*, *c*). At first I took these embryos for *Askonema*; but the sexradiate spicule with feather-like spined arm, together with the vitrification (both of which are absent in *Askonema*), decided this point. Then I remembered that the feather-like spined arm-spicule abounded also in *Sympagella nux*; but the ladder-like forms of the vitreous fibre here, together with the presence of the pappiform rosette with flexed rays, presented a decided difference. Lastly, it was observed that their spicules accorded with those of *Lanuginella pupa*, Schmidt. But when it is remembered that Schmidt's specimen of *Aphrocallistes Bocagei* bore on its surface many specimens of his *Lanuginella* in an embryo state, that their spicules are identical with those of the embryos of *Aphrocallistes Bocagei* on the specimen of *Lophohelia* mentioned, in company also with a fully developed living specimen of *A. Bocagei*, there seems to be very good reason for assuming that *Lanuginella pupa* is neither more nor less than *A. Bocagei* in an embryonic condition.

Aulodictyon Woodwardii, Kent.

In the tube net of *Aulodictyon*, like that of *Aphrocallistes*, there are several other spicules besides the staple sexradiate which forms the basis of the vitreous fibre; and these are also more or less enclosed together with the sexradiates. According to Mr. Kent (who, as before stated, has the merit of having discovered, described, and illustrated this unique specimen), confirmed by my own observations, they amount to seven, viz.:—

1 and 2. The same as in *Aphrocallistes Bocagei*.

3. An umbrella-like spino-capitate shaft of two forms, one of which has a *large*, flat, convex head, plain or umbonate, with a fringe of minute spines (Pl. XV. fig. 4), and the other a *small* convex head, also plain or umbonate, with a few long recurved spines, microspined on the inner aspect (fig. 5); while between these two extremes this spicule assumes several intermediate forms, in all of which the shaft is pointed, more or less microspined, and of whip-like fineness towards the free extremity.

N.B. This spicule, which appears to be analogous to the scopuline form in the Aphrocallistidæ and that of Schmidt's *Farrea facunda*, from lying parallel with the arms of the large sexradiate skeleton-spicule, often becomes enveloped with them in the vitreous fibre (Pl. XV. figs. 6 & 7).

4. A rosette whose arms are five-rayed; the rays sigmoid, capitate, and somewhat expanded or divergent *en fleur-de-lis*, with the head of the ray round and spined on the margin (like fig. 10, Pl. XIII.).

5. A sexradiate spicule with one arm smooth and inflated, the rest smooth, and terminated respectively by spiniferous points (see Mr. Kent's figure 23, Month. Microscop. Journ. 1870, pl. lxiv.).

6. A sexradiate spicule with one arm spined feather-like, and the rest terminated respectively by spiniferous points (like fig. 9, Pl. XV.).

Nos. 5 and 6 appear to be alternating forms of each other, and analogous to the sexradiate spicule with one arm spined feather-like in *Aphrocallistes Bocagei* &c., but apparently more sparse and less fully developed.

7. A simple minute sexradiate, whose arms may be smooth or spined, attached by one arm to, or more or less enveloped in, the vitrified fibre, as in Pl. XIII. fig. 1.

Obs. These spicules all appear to be analogous to those in *Aphrocallistes Bocagei*; while the umbrella-like ones, lying parallel and close to the arms of the large sexradiate (which forms the basis of the vitrified skeleton), are often, as before stated, enveloped with it (Pl. XV. figs. 6 & 7, *b*). In short, as the sexradiate spicule with feather-like spined arm is seen in the embryo *Aphrocallistes Bocagei* to be becoming enclosed in the vitreous fibre of that species, so the umbrella-like spicules of *Aulodictyon Woodwardii* may be observed on

their way to become enclosed in its vitreous fibre (fig. 7, *b*). Hence may we not infer that the unique specimen of the latter (which is only half an inch in lengh) is a very young specimen also?

Farrea facunda, Schmidt (*fecunda*?).

For a more detailed description of this species, with illustrations, I must refer the reader to Schmidt's 'Atlantisch. Spongienfauna' (1870), merely observing here, for the sake of comparison, that his figure 10, pl. ii., which represents the skeleton of *Farrea facunda* of its natural size, is almost identical in size and form with that figured by Mr. Kent as *Farrea occa* (*l. c.*), with that in my possession from the dredgings of the 'Porcupine' (No. 3*a*, *anteà*), and with that which was obtained by Mr. Gassiot from the Caribbean Sea, which I examined microscopically and of which I made an accurate drawing. The detail of the skeleton in *F. facunda*, represented in Schmidt's pl. i. figs. 13–17, also corresponds with that of the specimens mentioned; while the scopuline form (fig. 18) is often found modified in *Aphrocallistes Bocagei* (see our Pl. XV. fig. 3); and his rosette (fig. 19), with the exception of its arms and rays being microspined, together with the spino-capitate spicule (fig. 20), have their analogues in the rosette and umbrella-like spicules respectively of *Aulodictyon Woodwardii*.

Farrea occa, Bowerbank. Pl. XVI. fig. 4.

We now come to *Farrea occa*, which, as before stated, was so called from a fragment of lattice-like vitreous fibre that Prof. Owen found among the detrital mass on which Dr. A. Farre's specimen of *Euplectella cucumer* (obtained from the Seychelles) had grown. The structure of this fragment Prof. Owen figured (Trans. Linn. Soc. 1857, p. 121), and likened to a "harrow." Subsequently Dr. Bowerbank took a portion from the same detrital mass, and, having subjected it to a higher magnifying-power, thought that he had discovered in it a new kind of vitreous fibre, which was designated "fistulose siliceous," applying the name of "*Farrea*" to the sponge from which it was supposed to have come (Phil. Trans. 1862, p. 758, pl. xxviii. fig. 11). This was repeated in his 'British Spongiadæ,' where it was called "simple fistulose siliceous fibre spinulated, from *Farrea occa*" (vol. i. p. 274, 1864): *occa*, a harrow. Finally, in 1869 (P. Z. S. pl. xxiv. fig. 1) a different representation was given, in addition to the foregoing spinulated form, which was also now accompanied by certain minute spicules termed "attenuate stellate retentive spicula" of *Farrea occa* (*op. cit.* p. 341). These two representations,

viz. figs. 1 & 7, we shall find by-and-by to belong to two different species of *Farrea*, both figured previously and separately by Prof. Owen (*op. et loc. cit.* figs. 8 & 9 respectively); while Dr. Bowerbank's figure 7 alone represents *Farrea occa*, and the "retentive spicula" belong to quite another and very different system of sponges.

Now, considering that Dr. Bowerbank viewed fig. 7 as the "harrow-like tissue of the dermis" of some unknown sponge (instead of a part of the skeleton itself, which we now know to be the case)—that is, a portion of the wall itself of the tube of which *Farrea occa* is formed—considering that the term "fistulose" for the fibre, as being analogous to "simple keratose fibre" (B. S. vol. i. p. 80), ex. gr. *Luffaria*, is misapplied, inasmuch as it will presently be shown that the fistulous appearance in the siliceous fibre arises from the presence of sexradiate spicules, while in the keratose fibre it is a *bonâ fide* continuous canal—and considering that the "attenuate stellate retentive spicula" are not of the sexradiate type, but probably belong to an undescribed species of *Gummina* (see 'Annals,' 1873, vol. xii. p. 22), we have absolutely nothing left but the fragment of rectangular, vitreous, lattice-like fibre of this sponge, first represented by Prof. Owen's figures 9 & 9*a* (*op. cit.*), and repeated in Dr. Bowerbank's figure 7 (P. Z. S. *l. c.*).

That, however, this rectangular lattice-like vitreous fibre has been identified with that forming the skeleton of a sponge to which Mr. Kent has applied the name of *Farrea occa* in his figures (*l. c.*), confirmed by my own observation, his delineations will show, and the specimen itself (now, Mr. Kent informs me, in the British Museum) will demonstrate. But there was nothing but the skeleton left, which, as before stated, was dredged up on the coast of Portugal filled with mud. Mr. Gassiot's specimen, of which I made an accurate drawing and microscopical examination, was in the same condition, and the specimen in "No. 3*a*," dredged up on board H.M.S. 'Porcupine,' also the same; while Schmidt's figure of the specimen from Florida, which he examined (*op. et loc. cit.*), does not differ from either, and appears to have been also nothing but a deciduous skeleton, although it was accompanied by the spicules mentioned, and Schmidt has made a new species of it under the name of "*Farrea facunda*."

Since the above was written, I have (as before stated) examined Dr. A. Farre's specimen of *Euplectella cucumer*, entangled in the beard-like mass of which at the base (viz. the long anchoring-spicules) are many large fragments of *Farrea occa* (Pl. XVI. fig. 4), among which is a small portion of the

tubular general form, quite sufficient to identify with the specimens just mentioned,—also large fragments of the other or spiniferous species, represented by Dr. Bowerbank in his figure 1 (P. Z. S. *l. c.*), which will be described under the name of "*Farrea densa*" by-and-by.

Up to the present time, then, this is all we know of *Farrea occa*; but as there have been several specimens of its deciduous skeleton brought to notice, as well as many of *Aphrocallistes Bocagei*, with the so-called "fistulose" character in the fibre of all, it was not safe to state that all did not belong to the same genus, viz. *Farrea*. Under these circumstances there would be no hope of solving the problem, had it not been found that, although in the fresh and living state of the sponge hardly any trace of the spicules in the vitreous fibre can be seen, yet after death a process of absorption takes place in the interior of the fibre, whereby, if it has not gone too far, the whole of the forms of these spicules may be recognized. Hence, if any peculiarly characteristic spicules should happen to be present in this fibre, the species of the sponge to which it belonged can be determined, as in the case of the Aphrocallistidæ; while in *Farrea occa*, where we have never had any thing but the bare deciduous skeleton, the spicules which it possessed in the *living state* might, under the same circumstances, be also discovered. It is to this process of absorption and its effects in the sponge-spicule as well as the vitreous fibre that we shall now more particularly direct our attention.

Taking first the siliceous sponge-spicule by itself, we find that it is subject to two kinds of wasting or decay, viz. one which takes place in the interior or wall of the central canal, and the other on the surface—the former frequently occurring in the living sponge, and the latter in the substance of the spicule after death.

The wasting which takes place in the wall of the central canal is recognized by its increasing size, which in some cases goes on until the spicule is reduced to a mere shell; or it may take place only at the ends of the spicule, when the central canal at these points presents a funnel-shaped cavity diminishing inwards or towards the centre of the spicule. In either case the cause is not apparent. As this occurs in the living state it is just possible that the central canal of the spicule, which begins in a simple cell, may sometimes become so dilated as to assume the form of a full-grown spicule, with little if any vitrification, and thus appear as the mere shell. To this may be added a general absorption of the proper spicule, which frequently takes place within the horny fibre of

the keratose sponges to such an extent as often to render it very difficult to determine what was its original form.

On the other hand, the destruction which takes place on the surface of the spicule and extends into its substance presents itself under three different phases (Pl. XVI. fig. 8): viz., first, it consists of a simple superficial circular concavity, which may increase in size and depth (fig. 8, *a*); second, of a simple, straight, uniform blind tube extended vertically into the substance of the spicule (fig. 8, *b*); and, third, of a smaller tube of the same kind ending in a globular dilatation (fig. 8, *c*). In each instance it seems to be produced by the eroding action of an organized cell; that is, in specimens of the two latter, mounted in Canada balsam, a granuliferous cell may be observed to occupy the inner extremities respectively (fig. 9, *a*, *b*, *c*), recalling strongly to mind the appearance of the saprolegneous cell *Pythium* when working its way through the cell-wall of *Spirogyra*. Kölliker gives good figures of the first and second forms of this, merely observing that it is a "peculiar degeneration" ('Icones Histologicæ,' der feinere Bau, p. 83, pl. viii. fig. 10).

It is the dimpled superficial kind of this destruction which, attacking the deciduous spicule, seems not only to destroy the ornamental parts but in many instances to reduce the spicule to a mere ragged stick-like state, in which its original form is no longer recognizable: hence the condition of a great number of the fossil spicules in the Upper Greensand deposit of Haldon Hill near Exeter (Annals, 1871, vol. vii. p. 113, pls. vii., viii., & ix.).

I may here also notice that the calcareous sponge-spicules are also subject to two kinds of destruction, viz.:—one which takes place in the living sponge, where the extremities of the acerate long spicules are rendered funnel-shaped, as before mentioned in the siliceous ones; and the other, in which there is a general breakdown of the whole fabric, which gradually becomes resolved into a group of aqueous-looking globules of different sizes, among which there is not a trace of the original structure to be seen. Were this change confined to those calcareous spicules which I have mounted in Canada balsam, I should have inferred that it was caused by the balsam; but I find that the same change accompanies these spicules where they may have been taken in by the kerataceous sponges to form an axis for their horny fibre; and it is worthy of remark that the spicules of the Echinodermata, which may lie side by side with them, do not appear to be similarly affected. Of what nature the origin of this disorganization may be I am ignorant; it is a chemical question; but the destruction takes

place so rapidly in many instances that I have for some time past ceased to mount any more calcareous spicules, and now preserve a record of them by immediate sketches.

Lastly, we come to the peculiar kind of destruction to which I have so often before alluded, which takes place in the centre of the vitrified fibre of the Hexactinellidæ apparently *only* after the death of the sponge. This also, as before stated, consists in an absorption of the spicules over which the vitreous fibre was originally deposited, together with a certain amount of the fibre itself, leaving nothing but their moulds, which, if the absorption has not gone too far, will present exact representations of the spicules respectively. It is analogous to that which takes place in the spicules of the keratose sponges above mentioned.

We have here then an explanation of Dr. Bowerbank's "fistulose siliceous fibre," also a proof that the siliceous fibre of the Hexactinellidæ is based upon the spicules of the sponge, and, finally, means of detecting what the isolated spicules of the sponge were, although nothing may be left but the vitreous fibre in a deciduous state. It is thus that specimens of *Aphrocallistes Bocagei* have been identified, and some of those possessed by *Farrea occa* in its living condition recognized—facts which first drew my attention to the subject, originated this contribution, and will now be severally described.

The first specimen that attracted my notice in this way was the bunch of *Aphrocallistes* in the British Museum, already stated to have been dredged up by Mr. Kent on the coast of Portugal; but possessing the feature which had led Dr. Bowerbank to the idea that there existed "fistulose siliceous fibre" as well as "fistulose kerataceous fibre," and that this was an especial characteristic of his *Farrea occa*, I at once concluded that this was not an *Aphrocallistes*, but a *Farrea* (Pl. XVI. fig. 1).

Soon, however, it became evident that this "fistulose" appearance arose from the presence of sexradiate spicules originally enveloped in the vitrified fibre (fig. 1, *b b*); and chancing to meet with a fragment in which the characteristic scopuline shaft of *Aphrocallistes Bocagei* was present (fig. 2, *b*), the origin of the fistulose appearance was explained, and the specimen, which otherwise bore the character of *Aphrocallistes*, shown to be not *Farrea*, but *Aphrocallistes Bocagei* with the same fistulose appearance as the fibre of *Farrea* (fig. 4). Hence the necessity, to which I have alluded, of a minute and accurate description of all the spicules of these sponges.

Subsequently the specimen dredged up on board H.M.S. 'Porcupine' at station "No. 36" (*vide anteà*) came before

me; and being exactly like Mr. Kent's, there was no difficulty in recognizing its specific nature; but on boiling a portion of it in *liquor potassæ*, it was also found to possess the characteristic scopuline shaft (Pl. XV. fig. 1) together with a rosette (fig. 11, *d*), both in great abundance in the mud with which the tubular branches of the sponge were still filled, especially towards their free closed extremities. It was then observed in the mounted specimen that there were also a few rosettes with elongated shaft-like axes, on which the rays were sometimes capitate and sometimes pointed, the latter bearing a strong resemblance to the spined shafts peculiar to *Aphrocallistes beatrix* (Pl. XIII. figs. 17 & 18). The presence of the rosette in these two forms being new to me, I turned to the examination of the type specimen of *Aphrocallistes Bocagei* in the British Museum, described and figured by Dr. Wright (*l.c.*), and found that it also contained the same kind of rosettes. Lastly, I examined *Aphrocallistes beatrix* in the British Museum, described and figured by Dr. Gray (*l. c.*), and found that, although this did not contain the globular rosette with *short* axis so abundant in *A. Bocagei*, it contained that form with elongated shaft-like axis in which the rays are occasionally capitate (Pl. XIII. fig. 19), thus so far retaining this character of *Aphrocallistes Bocagei*. Hence, again, the necessity of studying minutely all the spicules of these sponges, which led me to write the descriptions of them above given. It will now be observed that, in order to arrive at an accurate knowledge of the Spongiadæ structurally, they must be studied elementarily in this way, and upon the amount of this knowledge will depend the accuracy of our classification.

I next took some minute portions from the fragment which Mr. Kent sent me of his *Farrea occa*, and also from Mr. Gassiot's before mentioned, but was not correspondingly fortunate here. However, on returning to the deep-sea specimen dredged up on board H.M.S. 'Porcupine' (No. 3 *a*), which had grown on a *Lophohelia* and had subsequently been enveloped in a Gummina (*Corticium abyssi*), I found in one fragment, as the illustration will show (Pl. XVI. fig. 5), a spicule of the form no. 2 (Pl. XV. fig. 8) previously described under *Aphrocallistes Bocagei*. This spicule, as I have before stated, is not confined to *A. Bocagei*, but is found in *Aulodictyon Woodwardii*, *Hyalonema*, and all the sarcospiculous Hexactinellidæ possessing the "birotulate spicule." Possibly it might be considered an accidental instance, and therefore might not originally have belonged to *Farrea occa*; but in three or four instances it was found thus imbedded.

In each of two other fragments from this specimen of

Farrea occa a scopuline spicule with pointed rays was found, like that figured by Schmidt in his *Farrea facunda* (*l. c.*). These specimens were also mounted in Canada balsam and delineated, as the illustrations will show (Pl. XVI. figs. 6, *b*, & 7, *b*).

Lastly, in many instances in the fibre of *Farrea occa* the capitate end of a largish spicule was observed (fig. 7, *c*), which I see appears in one of Schmidt's *fossil* illustrations (*op. cit.* pl. ii. fig. 18) as an arm of a sexradiate spicule. Of this form I can state, as I know, nothing further.

I had hoped, by finding this specimen of *Farrea* enveloped in the Gummina, that I might also find some of its isolated spicules within the tube; but, with the exception of four sexradiates of the form no. 3 under *Aphrocallistes Bocagei*, viz. that with the feather-like spined arm (Pl. XV. fig. 9), I could not, even after repeated searching, see any thing of the kind.

Whether or not these spicules did belong to *Farrea occa* I am unable to state, since together with the *Farrea* were included in the Gummina some fragments of *Aphrocallistes Bocagei*, one of which, as will be seen by the illustration, bears a mould of the sexradiate spicule with feather-like arm just mentioned. That such spicules are involved in the vitreous skeleton of this sponge has been already shown by the embryonic specimen mentioned at p. 452.

In the "stick-like" fragment among Mr. Gassiot's specimens, also above noticed, which looks like the solid stem of *Farrea infundibuliformis*, the absorbing process has gone on to such an extent internally as to destroy all forms of the sexradiate spicules on which the vitreous fibre of which it is composed was built, and externally to such a degree as to round off and diminish in size every spine and original projection of this fibre; so that it now presents the white appearance and form of a substance that is disappearing under the dissolving influence of water. Such is another instance of the way in which the fibre of the hexactinellid sponges may pass into dissolution.

We learn from the foregoing, then :—

1st. That the vitreous structure of the Hexactinellidæ is built upon a network of their spicules, as proved by the examination of the embryonic forms of *Aphrocallistes Bocagei*, in one of which (viz. that $\frac{1}{24}$ of an inch in diameter) the process of vitrification has not commenced, while in the other ($\frac{2}{12}$ of an inch in diameter), although incomplete, it has already made considerable progress; that after the spicules have become enveloped in the vitrification their forms disappear; and that, finally, after the fully developed fibre has become deciduous, their forms reappear in the state of moulds caused by a process of absorption of the spicule not yet explained.

2nd. That by the reappearance of the forms of the spicules we are enabled to determine the species if previously known in a living state, although nothing but the bare deciduous vitrified structure may remain; and therefore, where no living specimen of the species has been found, to determine what kind of spicules it originally possessed.

3rd. That there are no grounds for stating that a hexactinellid sponge exists in which the fibre is fistulous—that is, pervaded by a continuous central canal, as in the keratose sponge *Luffaria* (D. et M.); but, on the contrary, that the vitreous fibre is always based on an axis of sexradiate spicules.

With the deciduous specimens of *Aphrocallistes Bocagei* there has been no difficulty in determination, because we know what the characteristic spicules of this sponge are in its living state.

But the case is not so satisfactory with *Farrea occa*, of which nothing but deciduous specimens have yet been found. However, here it is evident that, besides the common sexradiate spicules of the skeleton (Pl. XVI. fig. 4, *b b b*), there was the spined one described as no. 2 under *Aphrocallistes Bocagei* (fig. 5, *b*), and the scopuline shaft like that figured by Schmidt in his *Farrea occa* (figs. 6, *b* & 7, *b*), to which I have before alluded.

Lastly, it might be stated respecting *Farrea occa* that, although we know that, in addition to the common sexradiates, it possessed the spined spicule no. 2 of *Aphrocallistes Bocagei* and another like the scopuline spicule of *Farrea facunda*, while the latter spicule is by no means identical with that figured by Schmidt (neither have we seen the spino-capitate spicule nor the rosette which are also figured by the same author as characteristic of *F. facunda*), yet the field from which we have obtained the facts above mentioned respecting *F. occa* is very limited; so that by-and-by, if a living specimen is not found of *F. occa*, but still more deciduous ones, more of the spicules it originally possessed may be made known after a like manner. At the same time, it should be remembered that the *general* figure (Taf. ii. fig. 10), as well as the detail of its skeleton which Schmidt has given of his *F. facunda*, are so identical with Mr. Kent's, Mr. Gassiot's, and the deep-sea ones of *F. occa* before mentioned that without a certain knowledge of all the isolated spicules of the latter it would be very hazardous to state that *F. occa* and *F. facunda* were not one

and the same species. Should this turn out to be the case, which name is to be suppressed?

That Schmidt's specimen of *F. facunda* was a deciduous one is proved (if I am right in considering that the reappearance of the sexradiate spicules (Pl. XVII. fig. 4) *only* takes place after death) by his description and delineations, wherein he both states and shows that the vitreous fibre was built upon sexradiate spicules, and also shows that the specimen which was submitted to him for examination was accompanied by the isolated forms of spicules peculiar to the species, which he has also represented; so was the deciduous specimen of *Aphrocallistes Bocagei* "No. 36" dredged up on board H.M.S. 'Porcupine,' although not that dredged up on board the 'Norna' by Mr. Kent, of which nothing was left but the vitreous structure.

It will be remembered that at p. 446 I have stated that Dr. Bowerbank had confounded two species of *Farrea* in his illustrations of *F. occa* (P. Z. S. 1869, pl. xxiv. figs. 1 & 7); also that both had been previously noticed and illustrated by Prof. Owen in 1857 (Trans. Linn. Soc. *l. c.*); further that the "retentive spicules" figured by Dr. Bowerbank as characteristic of *Farrea occa* do not belong to the sexradiate system of sponges, but probably to some undescribed species of *Gummina*.

In order that I might fully satisfy myself of these points I (at the kind suggestion of Dr. Farre) took for deliberate examination fragments of these two species of *Farrea*, which abound, in a deciduous state, in the mass of detrital material in which the anchoring-spicules of his specimen of *Euplectella cucumer* are imbedded. These, which altogether would not fill a cubic space of $\frac{2}{12}$ inch, were boiled in nitric acid; and the larger fragments having been taken out, the rest was well washed, dried, and mounted in Canada balsam. To a short description of the latter I shall return presently; in the mean time let us turn our attention to the specimens of the two *Farreæ*; and as already *F. occa* has been described, we have now only left the new species which stands in Prof. Owen's and Dr. Bowerbank's illustrations respectively under the figures "8" and "1." To this species I intend to apply the term "*densa*," on account of its massive reticular structure, which is just the opposite to that of *Farrea occa*, whose general form is tubular, branched, and only one layer thick. While, however, nothing remains of this sponge also but its deciduous skeleton, still the general character of this and the peculiar character of the fibre of which it is composed appear to me, although necessitating a very short description, to be quite sufficient to show that it is a distinct species.

Farrea densa, n. sp. (Pl. XVII. figs. 5 & 6.)

Skeleton composed of lattice-like, subrectangular, thickly spined, vitreous fibre, varying in size with its age, anastomosing freely in all directions, so as to form a densely reticulate massive structure. Fibre originally based on sexradiate spicules, whose forms have become more or less recognizable by the process of absorption above mentioned; thickly spiniferous, each spine conical and divided at the summit into several spinules, which are expanded (fig. 6, *b b b*).

Hab. Marine.

Loc. Seychelles.

Obs. There are many large detrital fragments of the deciduous skeleton of this sponge mixed up with those of *Farrea occa*, and a host of other matters, all entangled in the tuft of anchoring-spicules at the base of Dr. A. Farre's specimen of *Euplectella cucumer*; but none appear to indicate the general form of the sponge to which they belonged, while they are accompanied by such a variety of minute spicules of all kinds that it is impossible to state which, if any of them, formed part of their original structure.

Among the spicules boiled off from these minute fragments and mounted in balsam, as before stated, may be observed:—a new form of equianchorate, very large, with both ends of the shaft winged or spread out laterally by a thin expansion like that on the shaft of the anchorate in the deep-sea sponge called by the late Dr. M. Sars "*Cladorhiza abyssicola*" ('Remarkable Forms of Animal Life from the Great Deeps on the Norwegian Coast,' by the late Dr. M. Sars, edited by his son, p. 65, pl. vi. f. 32: Christiana, 1872); several kinds of bihamate spicules, among which is one sparsely spined on the body and measuring 23 1800ths of an inch long by one 1800th of an inch in its thickest part (this is the largest known, being more than twice the size of that in the deep-sea sponge just mentioned, viz. *Cladorhiza abyssicola*, which with another similar sponge, viz. *Chondrocladia virgata*, Wy. Thomson, were abundantly dredged up on board H.M.S. 'Porcupine'); three distinct forms of siliceous globules, indicating as many species of *Geodia*; one discoid from *Stelletta mammillaris*, Sdt. (?); the scopuline shaft of *Aphrocallistes beatrix* in great abundance; spicules of undescribed species of Gummineæ, especially that figured by Dr. Bowerbank (P. Z. S. 1869, pl. iii. figs. 6 *a* & 16) as belonging to "*Dactylocalyx pumiceus*, Stutchbury"! the surface-spicule of two different kinds of Lithistidæ, and frag-

ments of a new species which I am about to describe under the name of *Arabescula parasitica*, together with exquisite skeletons of many Polycystinæ and circular frustules of Diatomaceæ, &c. In short, I should think that a careful examination of this mass of detritus, after the manner mentioned, would, if furnishing an amount of deciduous remains proportional in number and variety to that which came from the minute fragments of the *Farrea* that I boiled in nitric acid, yield sufficient not only to copiously illustrate a book with most exquisite figures, but to afford no mean catalogue of the sponge-fauna, Polycystinæ, and marine Diatomaceæ of that part of the Seychelles from which this specimen of *Euplectella cucumer* was obtained.

Lastly, I have to describe the structure of a new genus of sponges, apparently allied to the Lithistidæ, which was first observed on some fragments of the deciduous skeletons of *Aphrocallistes Bocagei* and *Farrea occa* respectively, from the specimen No. 3 *a* dredged up by H.M.S. 'Porcupine,' and subsequently seen among the minute spicules &c. just mentioned which were boiled off the fragments of the two *Farreæ* from the root-mass of *Euplectella cucumer*. The resemblance of this structure, which lies flat and parasitic on the deciduous glassy fibre mentioned, to that kind of sculptured "open work" used by the Mohammedans for their architectural windows before glass was made for this purpose, suggests the generic name of "*Arabescula*"—and the manner in which it has grown over the deciduous fibre mentioned, the specific "*parasitica*;" under which appellation it will now, so far as the bare skeleton permits, be described:—

ARABESCULA, nov. gen., Carter.

Arabescula parasitica, n. sp., Carter. (Pl. XVII. figs. 7–9.)

Skeleton corticiform, vitreous, thin, spreading, composed of frond-like spicules, each of which is formed of a sinuous, vermicular body, tortuously branched in all directions on the same plane (fig. 8, *a*); branches ending in filigreed terminations, which, interlocking with those of adjoining fronds, constitute a membrane-like expansion (fig. 7, *b*). Body smooth externally, provided with sparsely scattered, short, truncated cylindrical projections (fig. 8, *b*) on the inner side, which, being situated on the body and larger branches, rested on the vitreous fibre over which the sponge might be growing.

Hab. Marine, growing over deciduous fibre of *Aphrocallistes Bocagei* and *Farrea occa*.

Loc. Western entrance of the English Channel; and the sea about the Seychelles.

Obs. This exquisite little arabesque structure (Pl. XVII. fig. 7, *b*), from its vitreous appearance, and from not dissolving when boiled in nitric acid, together with the form of its frond-like branched and filigreed spicules (fig. 8, *a a*), seems to belong to the Lithistidæ; but, like the preceding species of *Farrea densa* as well as *F. occa*, it has yet to be found in a living state for this identification, and for the remaining part of its description. While some portions are found on the vitreous fibre of the sponge mentioned, others are observed to be separated from it (fig. 9), as if the extent to which the structure had grown round the spicule and had formed by union a continuous sheath had determined this. It appears to be the product of a creeping sarcode, like that of the Spongiadæ; and therefore I assume for the present that it is the structure of a sponge.

EXPLANATION OF THE PLATES.

PLATE XIII.

HEXACTINELLIDÆ.

Skeleton-spicule.

Fig. 1. Three small skeleton-spicules, showing the way in which they are united to the main fibre and to each other to form the skeleton-structure: *a*, fragment of main fibre; *b*, small skeleton-spicule united by one arm to the fibre; *c c*, skeleton-spicules united by one arm to the spicule *b*. From *Aphrocallistes Bocagei*.

Flesh-spicules.

Fig. 2. Rosette with long arms and short, straight, pointed, dual rays: *a a a a a a*, arms; *b b b b b b*, rays. From *Crateromorpha Meyeri*, Gray.

N.B. After this the fifth and sixth arms (*c c*), or third axis, will, for the sake of perspicuity, be omitted.

Fig. 3. Rosette with short arms and long, straight, pointed rays. *Euplectella aspergillum.*

Fig. 4. Rosette with three-rayed arm. *Euplectellidæ.*

Fig. 5. Rosette with two-rayed arm; rays straight, capitate, few- and long-spined: *a*, caput or head; *b*, head, more magnified, to show spines, end view; *c*, the same, lateral view. *Rossella velata*, Wy. Thomson.

Fig. 6. Rosette with *short* arms and many straight capitate rays: *a*, many-spined head, end view; *b*, the same, lateral view. *Dactylocalyx subglobosa*, Gray.

N.B. This is the usual form of head, although the spines may not always be distinguishable except with a very high power.

Fig. 7. Rosette with *long* arms and many straight capitate rays. *Dactylocalyx subglobosa*, Gray.

Fig. 8. Rosette with multitudinous straight rays of unequal length, capitate. *Crateromorpha Meyeri.*
This is the rosette to which I have applied the term "pappiform," with straight capitate rays.

Fig. 9. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis*, expanded. *Farrea infundibuliformis.*

Fig. 10. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis*, contracted below only. *Myliusia callocyathes.*

Fig. 11. Rosette with many sigmoid capitate rays arranged *en fleur-de-lis.* Ray clavate; head expanded laterally and dentate outwardly, claw-shaped; diminished to extreme fineness just before it terminates in the lower fourth, which again becoming thicker joins the end of the arm of the rosette: *a*, upper portion of ray, more magnified, dorsal view; *b*, the same, lateral view. *Euplectellidæ.*

Fig. 12. Rosette with multitudinous sigmoid rays of unequal length, without heads, arranged *en fleur-de-lis.* Ray linear, subulate; upper portion thick and bent downwards and outwards at the end; diminishing below into extreme fineness just before it terminates in the lower fourth, which again becoming thicker joins the end of the arm of the rosette. *Rossella velata*, Wy. Thomson.
N.B. The extreme fineness to which the ray is reduced at the point mentioned often leads to its being broken off in the two rosettes last described, whereby it is seen lying about the "field" in the forms of 11 *b* and 15 *a* respectively, while the lower extremities still remain attached to the arm of the rosette, as at 15 *d*.

Fig. 13. Rosette with rays once branched, capitate. An occasional form. *Dactylocalyx subglobosa. a*, echinated head of ray; an occasional form of the head in fig. 6, from the same sponge.

Fig. 14. Rosette with straight capitate rays spined laterally. *Euplectella aspergillum* (fragment dredged up by H.M.S. 'Porcupine').

Fig. 15. Rosette; more magnified view of one arm of fig. 12: *a*, detached ray, broken off at the fine portion; *b*, conically inflated and tubercled end of arm; *c*, apical straight spine of the same; *d*, end of arm, showing the way in which the lower extremities of the rays still remain attached to the tubercles on the inflation after the upper portions (*a*) have been broken off.

Fig. 16. Rosette; more magnified view of one arm of fig. 8: *a*, rays, of unequal length; *b*, conically inflated and tubercled end of arm; *c*, end of arm, showing the way in which the straight rays are respectively based on a tubercle.

Fig. 17. Rosette with elongated shaft-like axis and straight capitate rays. *Aphrocallistes Bocagei.*

Fig. 18. Rosette with elongated axis and pointed rays. *Aphrocallistes Bocagei.*
N.B. The last two forms are rather sparsely mixed up with the globular forms figs. 6 & 7 in *Aphrocallistes Bocagei.*

Fig. 19. Rosette with elongated axis and straight pointed rays, often capitate. *Aphrocallistes beatrix.*

Fig. 20. Long-spined shaft peculiar to *Aphrocallistes beatrix.*
This and the foregoing form are mixed up together in *A. beatrix* without the forms 6 & 7, which are only found in *A. Bocagei.* They bear the relation in size represented in the figures (19 & 20); but 20 is much more plentiful than 19. Thus, while the forms 6 & 7 appear to pass into 17 & 18 in *A. Bocagei*, fig. 19 (which is identical with the latter) appears to be a transitionary form to fig. 20, which is the long-spined spicule peculiar to *A. beatrix.*
N.B. The dotted lines indicate that the spines themselves are microspined. Figs. 18–20 are all on the scale of 1-12th to 1-6000th of an inch.

Flesh-spicules of Hyalonema, &c.

Fig. 21. Birotulate, consisting of a sparsely spined straight shaft, terminated at each end by eight separate blades, which are recurved, dome-shaped towards the centre. *Hyalonema Sieboldii*, Gray, &c.

Fig. 22. Birotulate in a sexradiate form, showing its analogy to the "rosette." *Hyalonema Sieboldii.* Sparse.
N.B. The birotulate may have two, four, or six heads, according with the development of the elementary cell of the spicule into two, four, or six arms—that is, a simple shaft, a cross, or sexradiate.
In like manner, the rotulate heads may be absent, and the shafts thickened and covered with short, conical, vertical spines either at the extremities only or throughout (see Bowerbank's Brit. Spong. vol. i. pl. vi. figs. 153–157).

Fig. 23. Rosette with straight pointed rays, in which the arms have become enveloped by vitrified sarcode so as to form a spherical centre. *Euplectella cucumer.*

Fig. 24. Rosette with straight capitate rays, in which the same thing has taken place, but the vitrified mass has gone beyond the arms of the rosette: *a*, main fibre; *b*, portion uniting rosette to main fibre. *Dactylocalyx pumiceus.*
N.B. The last two forms point out the transition of the rosette to the siliceous globules and stellates (which are also "flesh-spicules") in the Geodinidæ, &c.; while the junction of this rosette with the main fibre is the *only* instance in which I have met with a flesh-spicule involved in the skeleton-structure.

Plate XIV.

Anchoring-spicules.

Fig. 1. Spiniferous anchoring-spicule of *Labaria hemisphærica*, Gray, showing form of head or free end: *a*, head; *b*, undulating line on head, which has its projecting curves prolonged into spines in *Euplectella* (see figs. 4 & 5); *c*, portion of shaft, whose upper or fixed end is smooth and attenuated; *d*, spines on shaft; *e*, position of cross on central canal.

Fig. 2. *Smooth* anchoring-spicule of *Labaria hemisphærica*, showing form of head or free end: *a*, position of cross; *b*, usual inflation of shaft just before expansion into head (here there is no undulating line on the head, which is more or less compressed); *c*, portion of the smooth shaft.
N.B. These two forms in *Labaria* are relatively magnified and taken from the larger specimens of their kind. The upper or fixed end of the shaft is not figured, neither is the intervening portion between it and that given; but the former is the same in all the anchoring-spicules, viz. smooth, attenuated, and firmly fixed in the sarcode of the body; while the latter or intervening

portion is spiniferous in the spined and smooth in the smooth anchoring-spicules.

Fig. 3. Spiniferous anchoring-spicule of *Meyerina claviformis*, Gray, showing form of head or free end: *a*, position of the cross; *b*, undulating line.

The only difference between this and the spiniferous anchoring-spicule of *Labaria* consists in the prominence and number of the undulations of the line on the head, too slight for specific distinction, although showing still more strongly that these undulations are prolonged into spines in *Euplectella*. Figs. 1–3 are all on the scale of 1-24th to 1-1800th of an inch.

Fig. 4. Spiniferous anchoring-spicule of *Euplectella aspergillum*, showing form of head or free end, where the spines or arms are lateral and much recurved: *a*, undulating line; *b*, end of central canal terminating in a lash of branches; *c*, position of the cross on central canal.

Fig. 5. The same, in which there are eight spines or arms uniformly arranged round the head, and based respectively upon the projections of *a*, the undulating line; *b*, position of the cross on the central canal.

Figs. 4 and 5 are on the scale of 1-12th to 1-1800th of an inch.

Fig. 6. Spiniferous anchoring-spicule of *Holtenia Carpenteri*, showing form of head or free end: *a*, position of the cross on the central canal. Here there is no undulating line, on account of the thinness of the head. Scale 1-24th to 1-1800th of an inch.

Fig. 7. Portion of the shaft of a spiniferous anchoring-spicule of *Holtenia Carpenteri*, showing the distant but still spiral arrangement of the spines: *a*, proximal end; *b*, spines; *c c c*, spines, made a little lighter to represent their being on the *opposite* side of the shaft.

Fig. 8. Portion of the shaft of a spiniferous anchoring-spicule of *Meyerina claviformis*, showing a more crowded, but still spiral, arrangement of the spines: *a*, proximal end; *b*, spines; *c c c*, spines on the opposite side of the shaft.

Fig. 9. Portion of the shaft of a spiniferous anchoring-spicule of *Hyalonema Sieboldii*, Gray, showing a still more crowded condition of the spines, which are here grouped into lines arranged round the shaft more or less in a continuous spire; also that they are supported on bracket-like projections of the shaft: *a*, proximal end; *b*, spines; *c c c c*, spines on the opposite side of the shaft; *d*, groups in continuous spiral; *e*, minute tubercles or aborted spines; *f*, spines broken off.

N.B. The specimen of *Hyalonema* from which this drawing was made was dredged up on board H.M.S. 'Porcupine' in the Atlantic Ocean, somewhere off the coasts of Great Britain and Ireland. The body is just 1½ inch long, and the thickness of the spicule of course very small compared with that of an adult form, which, if relatively magnified, would exceed the whole width of the plate. Moreover the portion selected for mounting and drawing was taken *out of* the *body* and not from the stem, where the spines soon get rubbed off, although they may be afterwards frequently found lying on the shaft, as at *f*. The minute tubercles *e*, often accompanying the groups of spines, are the remains of such as never went beyond this stage of development, as the whole group of spines and tubercles commences in this way in the upper part of the anchoring-spicule

(viz. that enclosed within the body), diminishing upwards into nothing, and gradually passing into fully developed spines below.

Figs. 7–9 are on the scale of 1-12th to 1-1800th of an inch.

Fig. 10. Fragment of *Euplectella cucumer*, to show robust vertical spine of sexradiate spicule in the intervals between the circular openings: *a a a*, spines; *b b*, circular openings; *c*, lines of main spicules crossing each other. Diagrammatic.

Plate XV.

Sub-skeleton spicules of the Aphrocallistidæ *and* Aulodictyon. (By "sub-skeleton" are meant the subordinate, not the staple, skeleton-spicules.)

Fig 1. Scopuline spicule of *Aphrocallistes Bocagei*: *a*, head; *b*, shaft; *c*, sexradiate tubercle-inflation of neck; *d*, variety in which the shaft is somewhat extended beyond the inflation.

Fig. 2. Scopuline spicule of *Aphrocallistes beatrix*.

Fig. 3. Scopuline spicule of *Aphrocallistes Bocagei*. Occasional variety. Like the one in Schmidt's *Farrea facunda* (*l. c.*).

N.B. The dotted lines indicate that the parts are microspined. Such is the case also with the ends of the shafts, which are here represented with smooth lines.

Fig. 4. Spino-capitate shaft or spicule of *Aulodictyon Woodwardii*; head umbonate, many- and small-spined. *a*, the same, with head plano-convex or plain, not umbonate.

Fig. 5. Spino-capitate shaft or spicule of *Aulodictyon Woodwardii*; head umbonate, spines few, and microspined on the inner aspect. *a*, the same, with plano-convex head.

N.B. These two forms appear to be the extremes of the same spicule, which are united by a variety of transitionary ones. Figs. 1–5 are on the scale of 1-12th to 1-6000th of an inch.

Fig. 6. Nail-like skeleton-spicule of *Aulodictyon Woodwardii*, to show the way in which the four arms are accompanied by the spino-capitate spicules, with which they become included in the vitreous fibre (as shown in the following figure): *a*, shaft of nail-like spicule; *b*, arms; *c*, spino-capitate spicules. Diagrammatic.

Fig. 7. Portion of the vitrified fibre of *Aulodictyon Woodwardii*, showing that the spino-capitate spicules are included with the arms of the nail-like spicules in the vitrified skeleton: *a*, vitrified fibre; *b*, head of spino-capitate spicule, whose shaft is enclosed in the fibre; *c*, end of arm of nail-like spicule not enclosed. Scale 1-12th to 1-6000th of an inch.

Fig. 8. Fusiform spiniferous spicule, in which all the spines incline the same way. Common to the Aphrocallistidæ, *Aulodictyon*, and *Farrea occa* (see Pl. XVI. fig. 5); also to all the Hexactinellidæ possessing the birotulate spicule.

Fig. 9. Sexradiate spicule with one arm spined, feather-like. Common to the Aphrocallistidæ, *Aulodictyon*, *Sympagella nux*, and the Hexactinellidæ which possess the birotulate spicule. Scale 1-24th to 1-6000th of an inch.

Fig. 10. Sexradiate spicule in which each arm is more or less uniformly beset with long curved spines. *Aphrocallistes beatrix*, Euplectellidæ, and the Hexactinellidæ possessing the birotulate spicule.

The figure represents an unusually perfect form, as regards the

uniformity of spines, from *Aphrocallistes beatrix*. Scale 1-24th to 1-6000th of an inch. In general, it is a very ragged-looking half-developed spicule.

Fig. 11. Portion of the commencing vitrification of the skeleton in a young *Aphrocallistes Bocagei*, not more than two twelfths of an inch in diameter, showing the enclosure of the sexradiate with spined feather-like arm among the other spicules; also the characteristic rosette: *a a*, spicules with feather-like arm; *b b*, other spicules; *c c*, vitrified sarcode spreading over the same; *d*, form of rosette. Scale 1-24th to 1-6000th of an inch.

N.B. This appears to be Schmidt's *Lanuginella pupa*. It is found growing on a branch of *Lophohelia prolifera* close to a living *Aphrocallistes Bocagei*, just as Schmidt has represented it growing in abundance on *Aphrocallistes Bocagei* itself (Atlantisch. Spongienf. pl. ii. fig. 1). It can only be confounded with the structure of *Sympagella nux*, Sdt., whose characteristic ladder-like vitreous fibre and the pappiform rosette, however, point out the distinction.

Plate XVI.

Deciduous vitrified fibre.

Fig. 1. *Aphrocallistes Bocagei*. Fragment of dead specimen dredged up from muddy bottom at the western entrance to the English Channel, in 725 fathoms, by H.M.S. 'Porcupine,' showing that the fibre is based on sexradiate spicules whose presence is rendered evident, after the fibre has become deciduous, by a process of absorption which, if not gone too far, leaves a perfect mould of the imbedded spicule. *a a*, spiniferous vitreous fibre; *b b*, moulds of spicules; *c c*, puncta indicating spines on the surface of the fibre.

This specimen, or the portions which were still filled with mud having been boiled in liquor potassæ, yielded an abundance of the rosette and scopuline spicule peculiar to *Aphrocallistes Bocagei*.

Fig. 2. *Aphrocallistes Bocagei*. Fragment of dead specimen dredged up from muddy bottom on the north-west coast of Spain, on board the yacht 'Norna' (depth not mentioned), showing an enclosure of the scopuline spicule in the vitreous skeleton (Pl. XV. fig. 1): *a*, spiniferous vitreous fibre or skeleton; *b*, scopuline spicule.

Although this specimen was treated with liquor potassæ in the way above mentioned, it yielded neither rosette nor scopuline spicule. Thus, but for the presence of the latter involved in the skeleton, there might have been (and indeed was) a doubt as to the species. Figs. 1 and 2 are on the scale of 1-12th to 1-1800th of an inch. The difference in size is owing to the difference in the size of the fibre in the two specimens figured.

Fig. 3. *Aphrocallistes Bocagei*. Fragment involved in the Gummina (*Corticium abyssi*) enveloping *Farrea occa*, which had grown on a dead *Lophohelia prolifera* dredged up from muddy bottom at the western entrance of the English Channel, on board H.M.S. 'Porcupine,' in 500 fathoms (see sketches of specimen, 'Annals,' 1873, vol. xii. pl. i. figs. 1 & 2), showing an enclosure of the sexradiate spicule with feather-like arm in the vitreous skeleton (Pl. XV. fig. 9): *a a*, spiniferous vitrified skeleton; *b*, sexradiate spicule with feather-like arm. Scale 1-12th to 1-1800th of an inch.

Fig. 4. *Farrea occa*. Fragment of deciduous skeleton from the last-named specimen showing that the smooth, lattice-like, subrectangular fibre is based on sexradiate spicules, as above mentioned: *a a a a*, lattice-like fibre, smooth; *b b b*, moulds of sexradiate spicules; *c c c*, short conical spiniferous extensions of the fibre, corresponding to the two arms of the sexradiate spicule, which projected vertically both inside and outside of the lattice-like structure. Scale 1-24th to 1-1800th of an inch.

Fig. 5. *Farrea occa*, fragment of, from the same specimen, showing an enclosure of part of a fusiform spined spicule in the vitreous fibre (Pl. XV. fig. 8): *a a*, smooth vitrified fibre; *b*, *un*imbedded half of fusiform spined spicule; *c*, imbedded half of the same. Scale 1-24th to 1-1800th of an inch.

This spicule is common in the Aphrocallistidæ, *Aulodictyon*, &c.

Fig. 6. *Farrea occa*, fragment of, from the same specimen, showing the enclosure of a scopuline spicule with pointed rays, like that figured by Schmidt as occurring in his *F. facunda*: *a a*, smooth vitrified fibre; *b*, mould of scopuline spicule (see a similar form found occasionally in *Aphrocallistes Bocagei*, Pl. XV. fig. 3).

Fig. 7. *Farrea occa*, fragment of, from the same specimen, showing the enclosure of another form of scopuline spicule with pointed rays; also a capitate spicule of a larger kind, often observed: *a*, smooth vitrified fibre; *b*, scopuline spicule; *c*, capitate spicule, in which the head seems in some instances to be flattened; the latter is introduced by Schmidt as an arm of a *fossilized* sexradiate spicule (tab. ii. f. 18, *op. cit.*).

Figs. 6 and 7 are on the scale of 1-24th to 1-6000th of an inch.

Fig. 8. Fragment of a large deciduous linear spicule (from *Geodia*?), to show the different forms caused by some eroding organism: *a*, simple circular depression; *b*, straight tubular form; *c*, the same, expanding into a globular termination in the substance of the spicule. Diagrammatic.

Fig. 9. The same, more magnified, to show that each of the forms is attended by a granuliferous cell something like the saprolegneous one (*Pythium entophytum*) which bores its way through the cell-wall of *Spirogyra*, &c. *a a a*, granuliferous cell.

Appears to be of general occurrence, as I have specimens from the Agulhas Shoal at the Cape of Good Hope, dredged up by Dr. Wallich, from the dredgings of H.M.S. 'Porcupine' off the north coast of Scotland, and from the Seychelles, among the detrital mass of the specimen of *Euplectella cucumer* in the possession of Dr. A. Farre, &c. &c.

Plate XVII.

New Species of Hexactinellidæ, &c.

Fig. 1. *Farrea infundibuliformis*, sp. n. *a*, funnel-shaped expansion; *b*, stem; *c*, reticulating lines of large, branching, vitreous fibre imbedding minute sexradiate spicules confusedly, fibre microspined; *d*, distinct or accessory portion of small vitreous fibre imbedding the same regularly; *e*, dotted line indicative of original expansion. Natural size.

Fig. 2. The same, portion of inner surface of funnel-shaped expansion,

more magnified, to show:—*a a a*, reticulating lines of large vitreous fibre imbedding *minute* sexradiates confusedly, running over and covering in part *b b*, spinous lattice-like fibre imbedding *large* sexradiates regularly; *c c*, puncta indicating microspines on large vitreous fibre; *d d*, minute sexradiates. Diagrammatic.

Fig. 3. The same, minute sexradiate, more magnified, showing that one end is united to the vitreous fibre: *a*, minute sexradiate; *b*, vitreous fibre.

Fig. 4. The same. Rosette or flesh-spicule, also more magnified. Figs. 3 and 4 are upon the scale of 1-48th to 1-6000th of an inch.

Fig. 5. *Farrea densa*, sp. n. Fragment magnified on scale of 1-48th to 1-1800th of an inch. From deciduous portions, upwards of an inch in diameter, in the detrital mass enveloped by the anchoring-spicules of *Euplectella cucumer* from the Seychelles.

Fig. 6. The same. Portion of vitreous fibre of, more magnified, to show that the summit of the spines is mucronate: *a a*, fibre; *b b b*, mucronate spines; *c c*, mould of sexradiate spicule. Scale 1-12th to 1-6000th of an inch.

Fig. 7. *Arabescula parasitica*, sp. n., parasitic on vitreous fibre of *Aphrocallistes Bocagei*: *a a*, fibre; *b*, portion of *Arabescula*. From the specimen dredged up on board H.M.S. 'Porcupine' in 500 fathoms, above mentioned; also from the detrital mass of *Euplectella cucumer* on the fibre of the foregoing species. Scale about 1-32nd to 1-6000th of an inch.

Fig. 8. The same. *Internal* view, showing that there are distinct fronds, *a a*, with projections, *b*, on the body and main branches here and there, which appear to have been based upon the fibre on which the *Arabescula* was parasitic.

Fig. 9. The same. Portion much less magnified, which appears to have become separated from the fibre on which it had been parasitic. Natural size about 1-18th of an inch long by 1-180th of an inch in widest part.

LV.—*Descriptions of New Genera and Species of* Heteromera, *chiefly from New Zealand and New Caledonia, together with a Revision of the Genus* Hypaulax *and a Description of an allied New Genus from Colombia.* By Frederick Bates.

As there is considerable activity just now displayed in the publication of papers descriptive of the coleopterous fauna of New Zealand, I have thought it might be acceptable to give descriptions of all the species of New-Zealand *Heteromera* contained in my collection that appear to be new to science.

I have therewith incorporated a revision, together with descriptions of new species, of my genus *Hypaulax* and another, allied, new genus (*Astathmetus*) from Colombia.

Of the genus *Cilibe* (peculiar to New Zealand) I have established twelve species (ten of which are new, the *phosphugoides*, White, = *elongata*, Brême) and two supposed varieties.

The *Titæna Erichsoni*, White, proving upon examination to be generically distinct from *Titæna*, has caused me to notice the species of that genus (which are peculiar to Australia), and to describe some that are new; the New-Zealand group of three species forms a new genus (*Artystona*), the characters of which are fully stated in the body of the paper. I have also thought it interesting to describe the cognate group of species found in New Caledonia which constitute my genus *Callismilax*, some of the species of which have already been described by Montrouzier as belonging to the genus *Strongylium*.

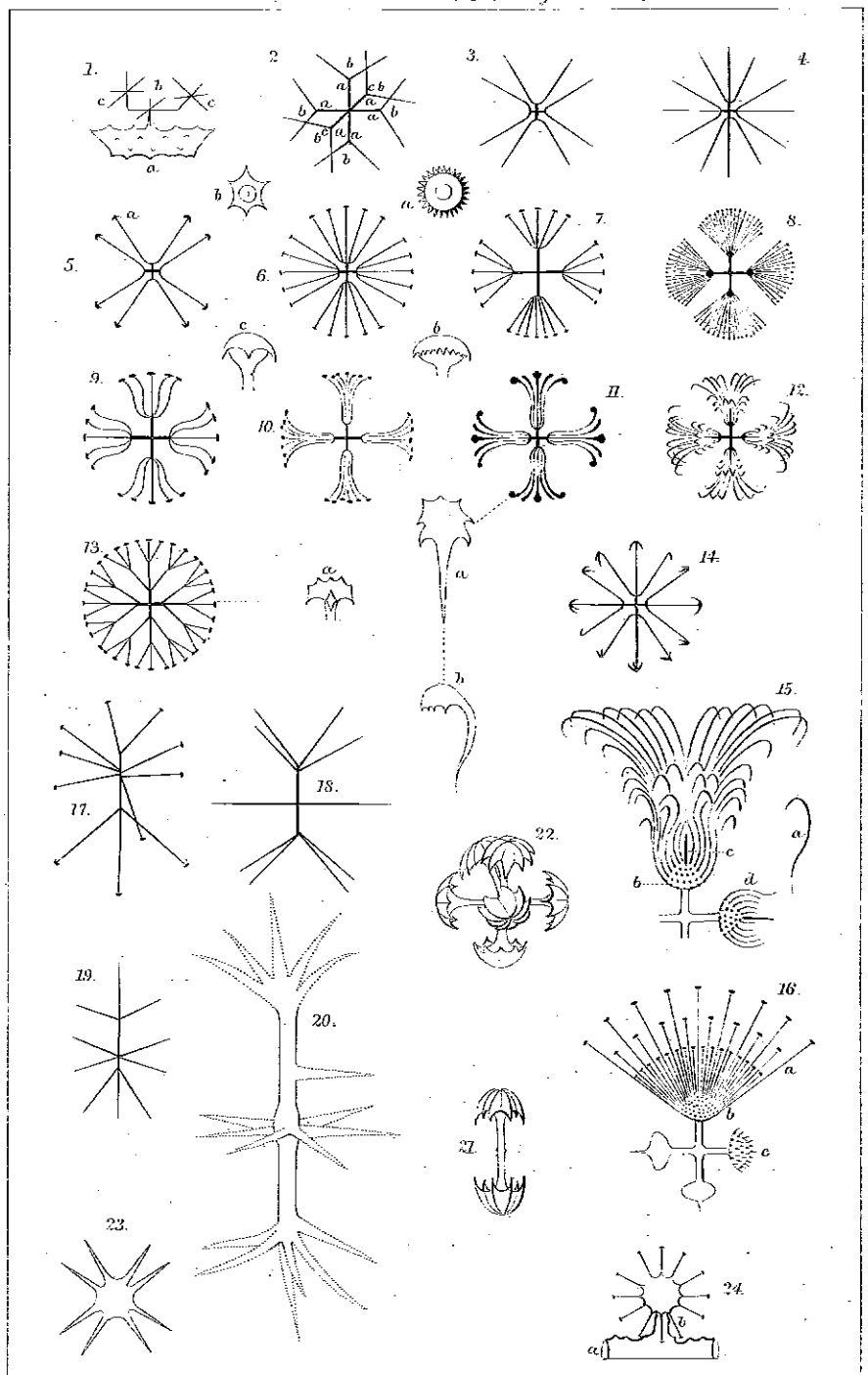
The *Opatrinus convexus*, Fairmaire, described from examples coming from Wallis Island, occurs also in New Zealand; it will form the type of a new genus, totally removed from *Opatrinus*, and must be placed not far from *Scotoderus*, Perroud *.

The *Opatrum tuberculicostatum*, White, evidently does not belong to that genus; as M. Miedel, of Liége, is at present engaged upon a monograph of the *Opatrides*, I leave this in his hands.

I have not as yet been able to consult the work by Blanchard containing the description of his *Bolitophagus angulifer* (from New Zealand); I, however, strongly suspect it to be identical with a species I have in my collection, and which I refer to the genus *Bradymerus*, Perroud: this genus is placed by its author with the *Bolitophagides*; to me it seems more natural to place it with the *true Tenebrionides*.

I have received from Mr. Pascoe examples of the *Selenopalpus cyaneus*, Fab.; these appear to me to be specifically identical with the type specimens (in my possession) of *S. chalybeus*, White. The characters of this genus lie rather in the form of the hind femora and tibiæ in the male (of which

* The description of *Scotoderus cancellatus*, Perroud, very accurately applies to examples of *Iphthimus cancellatus*, Montrouz., obtained from the collection of Doué. *Dechius*, Pascoe, is but another name for *Scotoderus*; and Perroud's, having priority, must stand. The mesocoxal cavities being widely open externally, revealing the trochantins, at once removes this genus from the position where Perroud has placed it, viz. in the vicinity of *Antimachus* (a genus of *Ulomides*); as I have previously stated (Trans. Ent. Soc. 1868, p. 265), its true position appears to me to be near to *Bius*. The *Scotoderus cancellatus* is very near to *aphodioides* (*Dechius*), Pascoe, but may at once be separated from the latter by its smaller size, more finely punctured prothorax, the more distinctly crenated striæ of the elytra (especially those by the suture), with the intervals distinctly punctulate. *Scissicollis* (*Dechius*), mihi, may instantly be distinguished from both by its sparsely punctured and not at all rugose head, the very strong (and punctured) groove down the middle of its prothorax, the remainder of the surface of this part being almost impunctate.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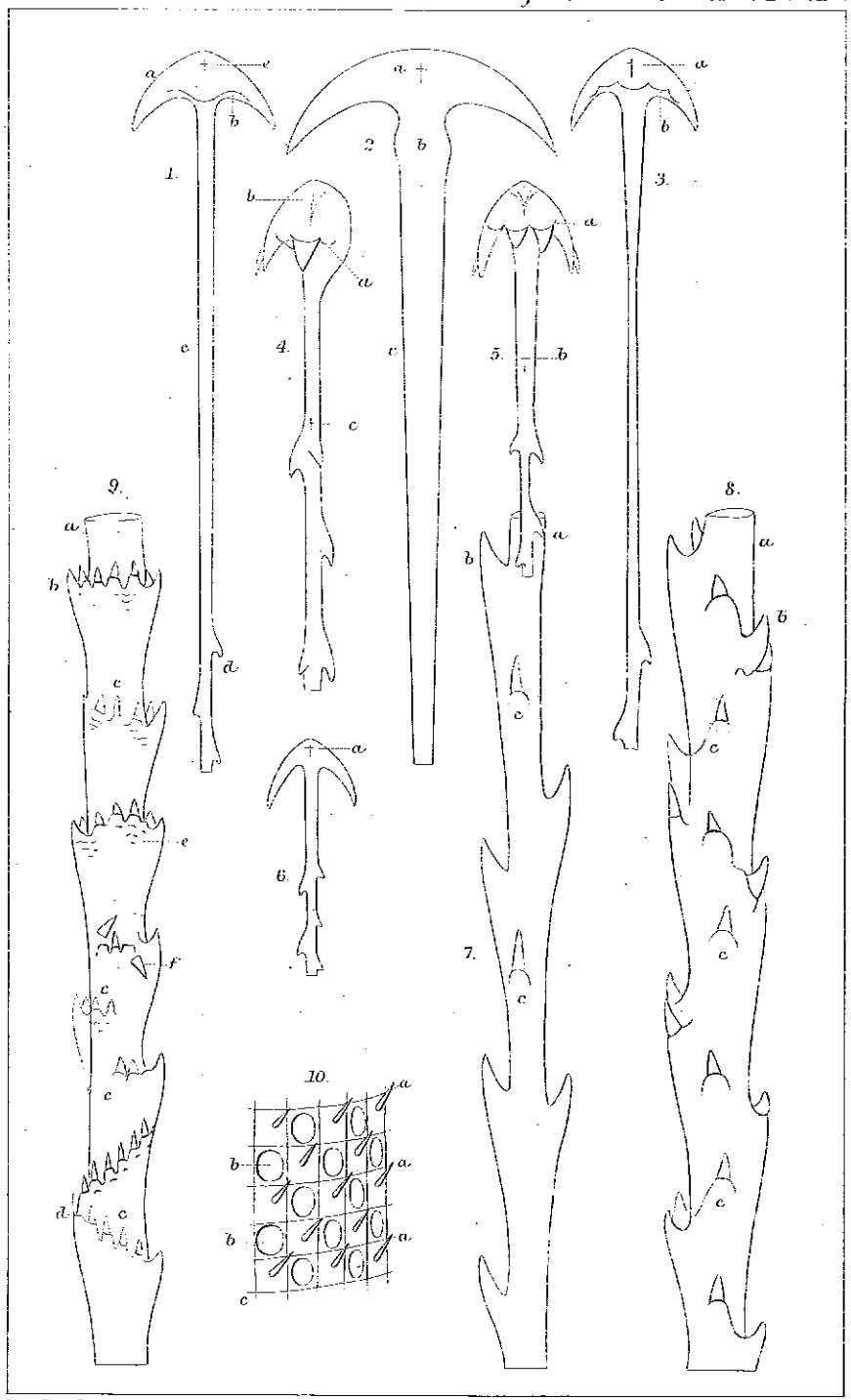

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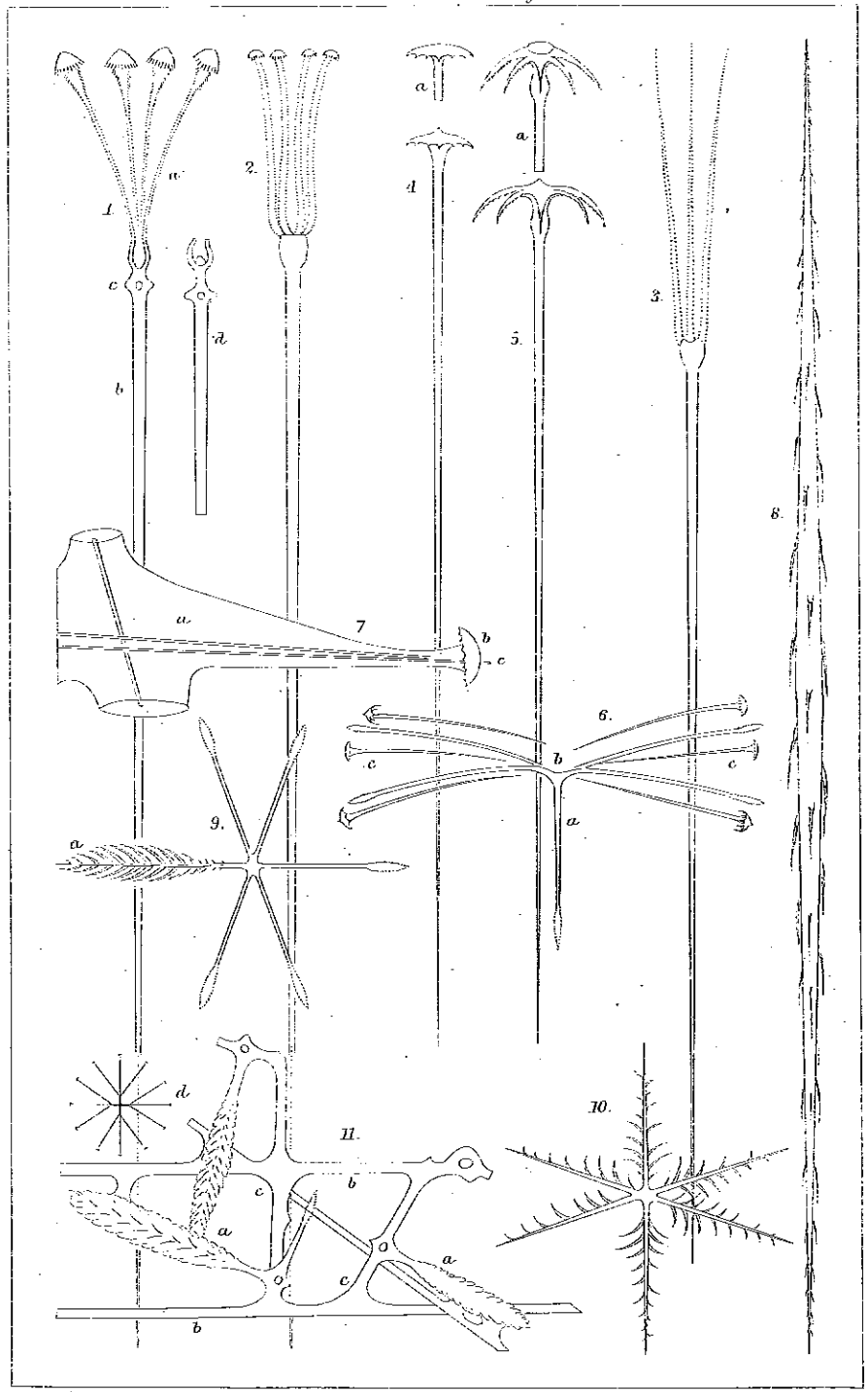
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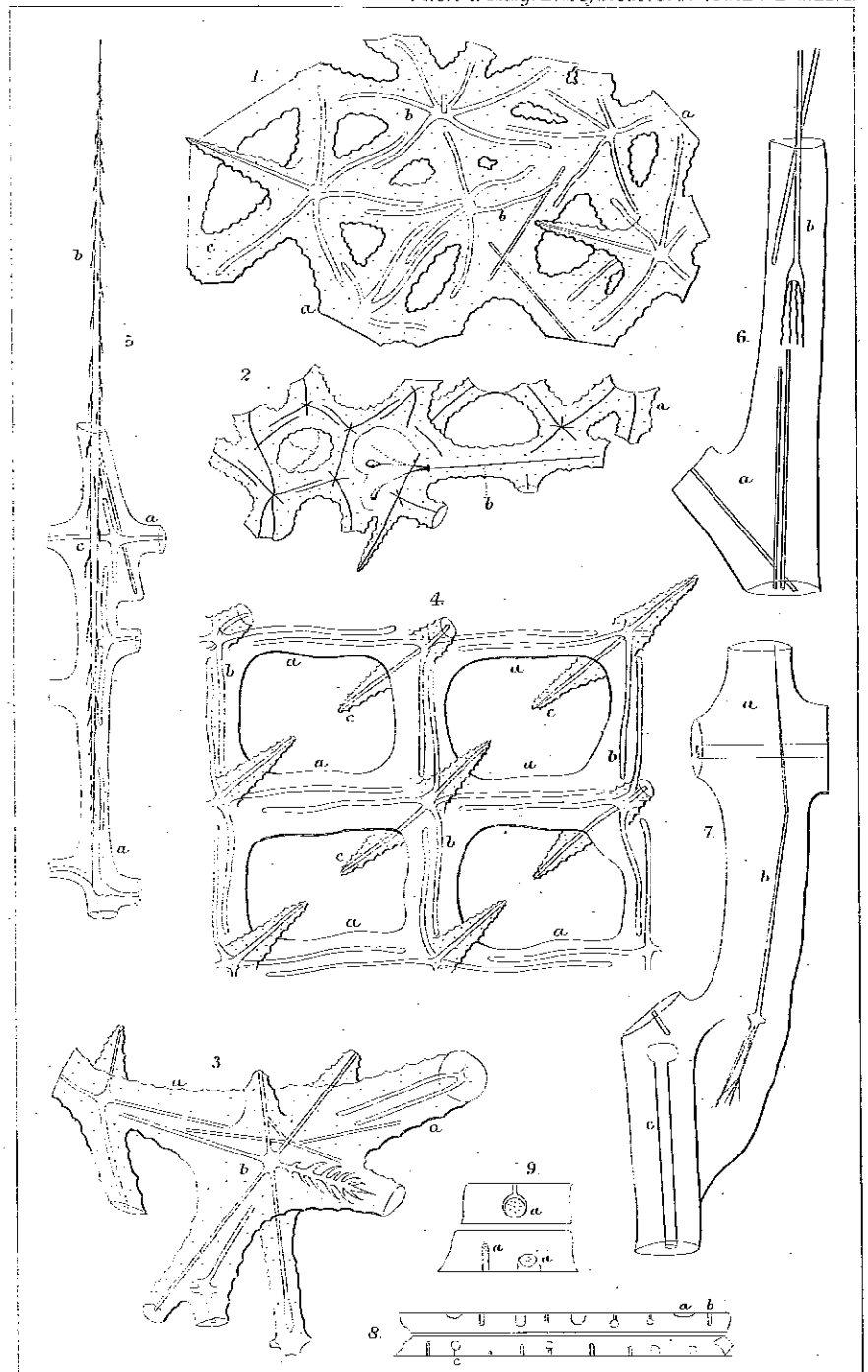
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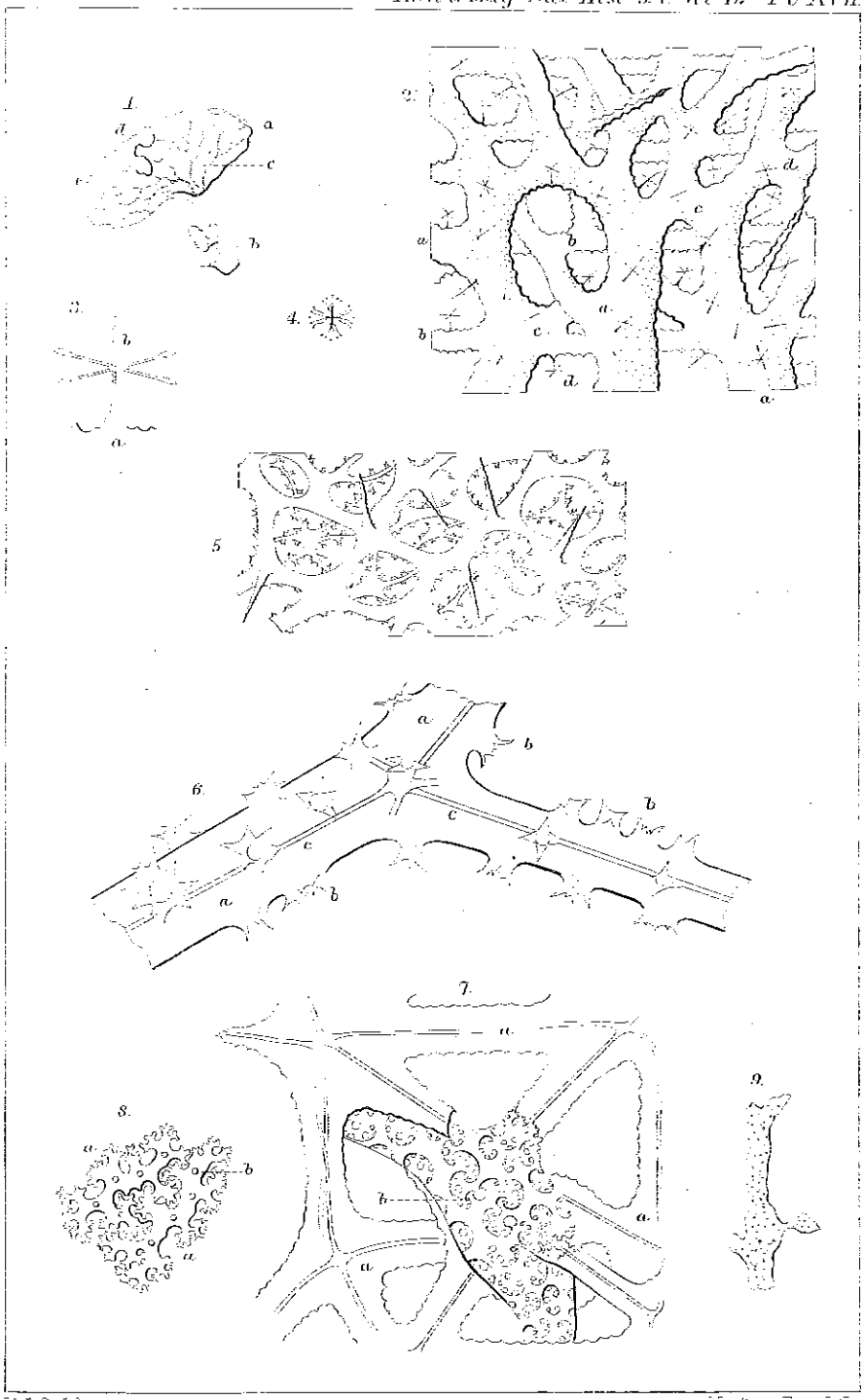
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