VI. *Description of a new Species of* Euplectella (Euplectella Cucumer, *O.*).

By Professor Owen, *F.R.S.*, *V.P.L.S.*

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In 1841 I communicated to the Zoological Society of London a description of a new generic form of reticulate Alcyonoid Sponge, represented by one of the most singular and beautiful, as well as the rarest, of the marine productions with which the researches of Mr. Hugh Cuming in the Philippine Islands had enabled him to enrich his famous Natural-History collection*. For this genus the name *Euplectella*† was proposed, indicative of the exquisite regularity and complexity of the interweaving of its component threads.

The characters of the genus are:—a cylindroid hollow form of body, closed at the wider end by an irregular network, and at the narrower end by the terminal tuft of finer filaments into which the parietal fibres are there resolved.

The parietal fibres, or those that constitute the wall of the cylinder, are regularly disposed, and intersect each other at definite and nearly equal distances throughout its extent. They consist of longitudinal (Pl. XXI. fig. 1, *c*, *d*, *e*), transverse (*t*), and oblique fibres, the latter being of two kinds (*o*, *o'*), winding spirally round the cylinder, but in opposite directions: (see magnified view of part of the parietes, Pl. XXI. fig. 4). The longitudinal and transverse fibres are the thickest: they are arranged at intervals of from one to two lines, averaging one line and a half apart, and divide the cylinder-wall into square spaces (*a*) of about the latter diameter. The longitudinal fibres (fig. 4, *b*) are external to the transverse ones (*t*), to which they are bound by the oblique or spiral fibres; these are, some external, some internal, to the others, and they close by their decusastion alternate quadrate intervals (*k*) between the longitudinal and transverse fibres. The angles of the alternate open squares are intersected by finer and less regular oblique fibres, which reduce their area more or less to a circular form (fig. 4, *a*).

It appeared, in the first-described species, that the fine silky filaments into which the parietal fibres were resolved at the small end of the cylindroid, had been torn, or detached by violence from some other body. The subject of the present description, which has been liberally confided to me for that purpose by my friend Dr. Arthur Farre, F.R.S., has been fortunately preserved, along with the foreign body to which it was attached by the terminal filaments: such mode of attachment may now, therefore, be added to the generic characters of *Euplectella* as above defined.

The first-described species of this rare genus was founded on a specimen eight inches in length, of a slightly conical form, two inches across the base, and gradually and progressively decreasing in diameter to the truncated apex, which is one inch and a quarter in longest diameter‡.

* Transactions of the Zoological Society of London, vol. iii. p. 205.

† Gr. εὖ, well, πλέκω, I weave.

‡ Trans. Zool. Soc. vol. iii. pl. 13.

The present species (Pl. XXI. fig. 1) is six inches in length, two inches across the base, whence the cylindroid body gradually expands to near the middle of its length, where it presents a diameter of two inches seven lines, and then decreases to the truncated apex, which is about one inch and a quarter in diameter; but part of this appears to have been torn away. Thus the form of the body is ventricose, not regularly conical as in *Euplectella Aspergillum*; it more resembles a cucumber than the shell after which the first species was named, whence the present species may be named *Euplectella Cucumer*.

The next difference which strikes the eye is the absence of the oblique and wavy crests or ridges which project from the network of the cone, and especially the absence of that marginal plate which divides the reticulate terminal cap or lid from the wall of the cylinder, standing out like a ruff or frill in *Euplectella Aspergillum*.

The convex reticulate lid or cap in *Euplectella Cucumer* (Pl. XXI. fig. 3) is bounded simply by the marginal ridge (figs. 1 & 3, *r*), which represents the last or lowest* of the transverse fibres, but which is thickened by an accession of the constituent fibrils, especially from the oblique series, so as to project slightly like a rim or 'bead' in carpentry. Some slightly projecting fibrils from the track of the oblique series of fibres, chiefly multiradiate, and of the kind figured in Pl. XXI. fig. 5, and which scarcely catch the eye, except when in relief at the border of the cylindroid, as at *p*, *p*, fig. 1, alone feebly represent the parietal and reticulate crests which so peculiarly distinguish the *Euplectella Aspergillum*. In this species the gradual diminution of the cylinder is produced by the convergence and confluence of two contiguous longitudinal fibres at certain parts of the circumference. The like convergence and final interblending of contiguous longitudinal fibres, as they pass from the free towards the fixed end of the body, is also manifested, though in a minor degree, in *Euplectella Cucumer*, as at *c* and *e*, fig. 1. But the gradual expansion of the cylindroid is made compatible with this diminution in the number of the longitudinal fibres by the divergence of many of the longitudinal fibres as they proceed from the marginal ridge, as at *d*, fig. 1, towards the widest part of the cylindroid, where their intervals are greater than in the corresponding part of *Euplectella Aspergillum*. Very few instances of confluence of longitudinal fibres take place before they reach the widest part of *Euplectella Cucumer*: the majority occur beyond it, as at *e*, *e*, fig. 1; and besides the diminution in number of the longitudinal fibres, they all converge as they approach the smaller and attached end of the cylindroid. Here the resolution of the several series of fibres into their constituent fibrils seems to take place, at least on one side, viz. that shown in Pl. XXI. fig. 1, more abruptly than in *Euplectella Aspergillum*: on the opposite side, as in fig. 2, the fibres in *Euplectella Cucumer* begin to be resolved into the fibrils or filaments sooner than in *Euplectella Aspergillum*. The considerably greater length of these fibres appears to offer another marked distinction between the two species: but as the specimen of *Euplectella Aspergillum* was torn by violence and brought up by the fish-hook from its place of attachment, no safe inference can be drawn as to their original length in that specimen. In the present example of *Euplectella Cucumer* the delicate separated silky filaments penetrate, and, as it were, permeate, the substance of a mass made

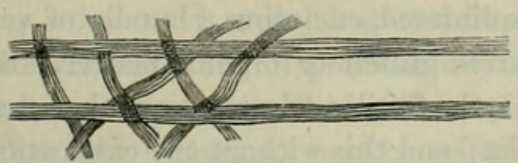
* On the supposition that the *Euplectella* hangs dependent from its filamentous attachment.

up chiefly of portions of a coarse irregular siliceous sponge, which appears to be foreign to the proper body of the *Euplectella*, and includes some shells and other marine calcareous bodies. Some of the fine long fibrils, emerging from the mass, converge, as they are reflected back (fig. 2), and, after a few graceful bendings, again diverge into separate wavy locks of the most delicate hairs, having a silken or silvery lustre (*h*, *h*, figs. 1 & 2). The whole of this beautiful elongated filamentous medium of attachment of the *Euplectella* may be compared to a lock or tuft of the hair which Poets feign to have adorned the head of the Syren or Mermaid.

The number of the longitudinal fibres at the base of the cone in *Euplectella Aspergillum* is sixty, in *Euplectella Cucumer* it is fifty-three: their number at the apex in *Euplectella Aspergillum* is thirty, in *Euplectella Cucumer* it is thirty-five. I would not, however, be understood as confiding in these particular numbers being constant and characteristic of the species. The fibres of the reticulate cap consist of converging and of connecting or transverse kinds: many of the former are continued from the confluence of two of the longitudinal fibres of the cylindroid, where they become bent at nearly right angles after leaving the connecting marginal band to form the cap: such fibres show a thickness proportionate to the additional material entering into their composition. The degree of irregularity in the converging and connecting fibres forming the reticulate cap is like that in *Euplectella Aspergillum**. The superficial fine oblique series of fibres, with the superadded multiradiate spicula, terminate abruptly at the marginal rim in *Euplectella Cucumer*, just as the ridges of the cylinder terminate in *Euplectella Aspergillum*.

Dr. A. Farre notes, as the result of his study of the structure of the *Euplectella Cucumer*, that "the oblique lines are not formed out of one continuous line of fibre for each side, wound round and round, which is the idea of a spiral, but they consist of a double series of ellipses, placed at definite distances, which intersect each other at right angles, or nearly so. These form perfect ellipses only towards the centre of the specimen, for at either end they are necessarily interrupted. In these oblique fibres there occur the same confluence of two contiguous lines, in some places, and divergence or bifurcation of simple ones in others, as happen in the longitudinal series, and evidently with the same object of adapting their arrangement to the increasing or diminishing diameter of the cylinder. With regard to the relative positions of the longitudinal, transverse and oblique fibres, I find that these lie in several alternate series. First a bundle of about half-a-dozen longitudinal close-lying fibres. These run straight from end to end of the cylinder,

except where they bifurcate or combine. Then the looser bundles of oblique fibres decussate with the longitudinal ones, the fibres separating to pass over, under, and between them, and at the same time intersecting the fibres of the opposite oblique series in a similar way,



* Compare Pl. 13, Trans. Zool. Soc. vol. iii. fig. 2, with fig. 2 in Pl. XXI.

not with strict regularity, but in a sufficiently marked manner, and forming a rough pattern of those wicker-baskets in which the cross fibres are interwoven among the longitudinal ribs. Lastly, the transverse fibres lie below these, and are, on that account, the least easily distinguished. Then the same series of longitudinal, oblique and transverse lines is repeated, but more irregularly, until the walls of the cylinder acquire a depth of 2‴ at their thickest part, which occurs at about $\frac{2}{5}$ths of the entire length of the specimen from its operculated end."—(A. F.)

The average diameter of the longitudinal fibres of the cylindroid in *Euplectella Cucumer* is one-thirtieth of an inch: that of the transverse fibres is about one-fortieth of an inch: these oblique fibres present much smaller and more varying diameters. All these fibres consist of much finer fibrils, and these are composed of a delicate siliceous sheath enclosing still more minute fibrillules. The component fibrils of *Euplectella Cucumer*, as in *Euplectella Aspergillum*, are of two kinds; one smooth, the other barbed at pretty regular distances like the hair of certain caterpillars (Pl. XXI. fig. 6): and some fibrils show both characters, and the gradual transition of the barbed to the smooth part (fig. 7). In some of the barbed fibrils, which most abound in the resolved tuft of attachment, Dr. A. Farre discovered a terminal convex disk, with a border divided into four or five retroverted spines, simulating a small anchor: one of these is represented in fig. 6. The same experienced microscopist found that he could frequently detach, with a fine pair of forceps, from the exterior of the point of decussation of the oblique fibres, in the body of the cylindroid, minute multiradiate aciculi, like the one represented at fig. 5,—one ray representing the axis, from which four other rays would diverge at right angles and equal distances on the same plane. These "multiradiate spicula invariably consist of six rays, viz. a perpendicular spine, which projects above the surface of the cylinder, a small spiculum opposite to it which lies buried in the mass, for the purpose apparently of fixing the upper spiculum, and four basal rays (one very generally longer than the rest), which take a direction always exactly corresponding with the lines of intersection of the oblique fibres, with which they become blended."—(A. F.) These detached bodies may have been the commencement of the new-forming oblique fibres in the gelatinous substance of the living *Euplectella*.

On applying the test of fire, by subjecting the fibrils of the *Euplectella Cucumer* to the flame of a candle, they generally splintered, and minute iridescent portions flew off in all directions. Some of these particles, being caught on slides of glass, showed under the microscope that they were parts of a delicate sheath of silex: their iridescent hue seemed to be due to the partially disintegrated constituent layers of siliceous matter entering into the constitution of the sheath. Portions of fibrils, submitted in a test-tube to the flame of a candle, were observed to splinter, sometimes with a slight bend; and, on being submitted to a half-inch objective in the compound microscope, showed the siliceous sheath variously cracked or splintered, enclosing a bundle of very minute fibrillules, with here and there a trace of charred gluten or organic matter. Submitted to the action of dilute muriatic, or nitric, acid, the fibrils underwent no other change than that of becoming rather more clear or less opake; and this without the extrication of bubbles, as from carbonate of lime, and with not more evidence of any liberated gas than might be accounted

for by the solution of the gluten, to which act, perhaps, the greater transparency of the soaked fibril might be due. No diminution of diameter or other change of the fibril could be detected whilst it was under the action of the mineral acid.

The fibrils of the *Euplectella Aspergillum* contain a greater proportion of organic matter, but have, as described in my original memoir, the same siliceous basis as in the present species. In consequence, however, of the different proportion of the glutinous and siliceous principles, they do not behave exactly like the fibrils of *Euplectella Cucumer* under the tests of heat and acid. In general, when subject to fire, they do not splinter, but merely bend; and when afterwards microscopically examined, show more trace of charring, and sometimes present increased opacity with the appearance of dead or frosted silver. Yet some show clearly their constitution of a siliceous sheath, including fine iridescent filaments or fibrillules.

It sometimes happened, in the case of fibrils of the *Euplectella Cucumer* submitted to the acid test, that a small amorphous mass would be adherent to part of a fibril; and such mass was quickly dissolved with the extrication of abundant gas-bubbles: the inference from this was, that some fragment of a foreign body of carbonate of lime had become accidentally entangled in the meshwork of the *Euplectella*.

In the amorphous portions of sponge to which the *Euplectella Cucumer* was connected by its long filaments, two modifications of reticulate structure were discovered by Dr. A. Farre. One, represented in Pl. XXI. fig. 8, is an irregular network, more or less bent, with subquadrate meshes, sometimes crossed by oblique threads. A second and more beautiful structure is represented in fig. 9. The meshes of this network are on nearly the same plane, and of a more regular square form, with a short pointed spiculum projecting from one side of each decussation of the threads, like the teeth of a harrow. Both figs. 8 & 9 give magnified views of the above structures, with the part magnified of the natural size. Fig. 9*a* gives a more magnified view of one of the squares, with its spines, of the 'harrow' structure.

To the question put by almost every one to whom the *Euplectella* is shown, as to how the threads could have been so regularly yet intricately interwoven, I have sometimes replied, that there has been no such thing as interweaving in the case; that no thread, as such, was ever laid across another in the construction of the *Euplectella*; that the analogy of human textile fabrics does not apply to this beautiful natural object. In artificial lacework the several stages of a complex result must be taken in the succession indicated by painful and exact calculation: in organic lacework different stages are done at once. Thus it is that the Divine works surpass those of man's utmost ingenuity. The threads of the *Euplectella* were not first spun and then interwoven, but were formed as interwoven, the two processes going on simultaneously, or '*pari passu*.' Just as in the cancellous texture of bone, the plates of bone are not first formed and then fitted to one another, as in building a house of cards; but the forming and the fitting go on together in the course of molecular growth. I presume also, that in the beautiful object which we call the *Euplectella*, we have but its skeleton; and that, in the living state, the exquisite structure of the flinty framework may be veiled by the delicate gelatinous enveloping organic tissue.

The specimen of the *Euplectella Cucumer* here described, Dr. Farre writes, "was given, together with other presents, by the King of the Seychelle Islands to Captain Etheridge, R.N., in acknowledgment of some friendly services, and with an intimation that this was one of the rarest products of those regions. From Captain Etheridge it passed into the hands of Dr. Richard Payne Cotton, of Clarges Street, by whom it was recently presented to me."—(A. F.)

With regard to the first-described species, *Euplectella Aspergillum*, Mr. Hugh Cuming writes to me:—"The *Euplectella* brought home by me from the Philippines was taken by a fisherman, in ten fathoms, rocky ground, off the island of Bohol, one of the southern islands of the Philippine group. The fisherman was employed in catching a species of cod which abounds in those islands, and finding, after some time, the fish did not take his bait, he drew it up, when to his surprise he found the above specimen attached to his hook, near the orifice; and fearing to injure it by disentangling the hook from such a fragile substance, he cut out that portion to which the hook was attached. On his arrival on shore at St. Nicholas di Zebu, he made a present of it to the governor of the town. On my arrival a few days after, I was introduced to the governor, who, upon knowing the object of my visit to the island, presented me with it as the greatest curiosity he had to offer me, as he had never seen the like before. On my showing it to the bishop of that city, and the principal inhabitants, they confirmed the opinion of its rarity expressed by the governor."—(H. C.)

In conclusion, I beg to state, that although this paper is communicated to the Society as from one author, it is properly the work of two: many of the observations were originally made by Dr. Arthur Farre, which afterwards were confirmed by my own eyes; and every recorded observation of my own has been repeated by, and received the sanction of my friend. In returning these acknowledgments for the considerate call which he pressed upon the describer of the original species to bring the second before the notice of naturalists, and for his generous relegation of this pleasing task to me, I desire, at the same time, to offer my best thanks to Mr. Cuming, who, with his own hands, transported his frail and unique specimen of *Euplectella Aspergillum* to the residence of Dr. A. Farre, in order to afford every facility of comparing the two species: and I have again to express, as at the close of my former memoir, my obligations to Mr. G. B. Sowerby, for his zealous devotion of much time and peculiar artistic skill to a faithful representation of this second species of the rare genus *Euplectella*.

DESCRIPTION OF THE PLATE.

TAB. XXI.

Fig. 1. *Euplectella Cucumer*, nat. size; with the foreign sponge and other bodies to which it is attached:—A. wall of the cylindroid, or parietal portion; B. terminal grating or lid; *a.* parietal orifices; *c.* confluence of longitudinal fibres; *d. ibid.* prior to forming the network of the lid; *e. ibid.* as the cylindroid contracts towards its attached end; *h.* resolved filaments, reflected from the attached body; *o*, *o'*. oblique fibres; *p.* prominent lines from the oblique fibres, chiefly due to the multiradiate accessory spicula; *r.* rim or thickened transverse line at the attached border of the lid; *t.* transverse fibres.

Fig. 2. The opposite side of the attached end of the *Euplectella Cucumer*, with the substance to which it adheres:—*h.* the free ends of the resolved filaments: nat. size.

Fig. 3. The reticulate grating or soldered lid of the *Euplectella Cucumer*: nat. size.

Fig. 4. A closed and an open interspace of the meshwork, magnified four diameters:—*a.* the open space; *b.* longitudinal fibres; *t.* transverse fibres; *k.* superficial oblique fibres closing an interspace; *o.* deep-seated fibres; *o'*. intermediate fibres.

Fig. 5. A multiradiate spiculum, from the place of intersection of the superficial oblique fibres, magnified eight diameters.

Fig. 6. Portion of a barbed filament with its terminal anchor, magnified twenty diameters.

Fig. 7. Transition of the barbed to the smooth structure in one of the filaments, similarly magnified.

Fig. 8. A portion of a sponge from the mass to which the *Euplectella* adheres; natural size, and magnified ten diameters.

Fig. 9. Another portion of sponge from the same mass; natural size, and magnified ten diameters:—9*a*. one of the squares of the harrow-like structure, magnified twenty diameters.