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XV.—*Observations on the Thalassicollidæ.*

By G. C. WALLICH, M.D., F.L.S.

THE true value and significance of characters derived from the degree of development of the sarcode-body of the Rhizopods, as distinguished from those which are derived from their mineral shells or skeletons, is perhaps nowhere more clearly exemplified than amongst the families which I have associated together in my second Order, namely the Protodermata, which are characterized by the presence of a definite nucleus, but are still not sufficiently differentiated to exhibit the contractile vesicle which appears, for the first time, amongst the Actinophryan and Amœban Rhizopods of the third Order, namely the Proteina*. Thus, viewing their siliceous portions apart from the animal body to which they afford support, it would be difficult to point out structures exhibiting a smaller amount of apparent resemblance; and hence it is hardly a matter for surprise that important differences of opinion should have arisen concerning the true morphological relations of the Polycystina, Thalassicollidæ, and Acanthometrina, which constitute the Rhizopoda Radiolaria of Müller's system. But I hope to be enabled to show that, however widely the mineral framework may differ in the four groups constituting the Protodermata, the uniform development and mode of disposition of the sarcode-mass places their affinity beyond a doubt.

The first accurate series of observations on the Thalassicollidæ was made by Huxley, and formed the subject of an admirable paper contributed to the 'Annals and Magazine of Natural History' in 1851 (2nd ser. vol. viii. p. 433 *et seqq.*). With one or two unimportant exceptions, the

* See a paper "On the Structure and Affinities of the Polycystina," read before the Microscopical Society in May 1865, and published in the August number of the 'Quarterly Journal of Microscopical Science.'

views therein published are those from which our knowledge of the true physiological relations of that family may be said to have been almost exclusively derived. But it is asserting too much to say that the Thalassicollidæ were previously unknown, inasmuch as they are not only amongst the most constant but the most numerous inhabitants of the surface-waters of both tropical and subtropical seas. Every voyager who has traversed such seas must have become familiar with their appearance, as I confess myself to have been for twenty years and more. But so far from detracting from the credit due to Professor Huxley's researches, this fact serves only to increase it. In short it was the difficulty of resolving the nature and relations of the organisms under notice that caused them to be entirely neglected, although they must have been constantly met with by other naturalists.

If we discard as untenable the separation of the isolated forms of *Thalassicolla* from those which are grouped together in a common gelatinous matrix, "like an animal *Palmella*"*, the soft body may be described as a mass of granular protoplasm, presenting a well-defined nucleus and contained within a membranous capsule, the latter being in turn protected by a more or less thick gelatinous exudation, whilst numerous sarcoblasts of varying size occur scattered through the endosarc, and occasionally a few may be seen suspended within the external gelatinous stratum. Again, if we compare those forms in which the siliceous framework is composite (that is to say, in which a number of spicular masses afford the required support by being crowded together, as they do in a Sponge or *Holothuria*) with those in which it is simple and consists of a delicate foraminated shell, we shall find that the relative positions of the hard and soft structures are nevertheless the same, and that the former, when present, invariably occur externally to the membranous capsule, and within the gelatinous investing layer.

Owing to the peculiar configuration of the Thalassicollidæ, and the facilities afforded by the composite forms for comparing a number of individuals under precisely similar conditions, they are admirably adapted for showing whatever changes take place in the protoplasmic substance as the age of the organism increases; for although it is very unusual to find any important difference in the degree of development attained by the various members forming one of the composite Thalassicollidæ, and there is every reason to believe that their growth is uniform, the constant recurrence of certain characters in conjunction with the evidence of immaturity derivable from small size

* Huxley on *Thalassicolla*, l. c. p. 434.

enables us to distinguish such characters as are normal from those that are accidental or occasional. In this manner we discern that the degree of granularity of the endosarc, the number and situation of the sarcoblasts, the colour of the nuclear body, the density of the membranous ectosarc, and (in *Collosphæra*) the degree of consolidation of the spherical "shell" are one and all subject to a wide range of modification; and hence it follows that any attempt to establish species on distinctions arising out of these characters, unless we could assure ourselves of their having arrived at the same stage in their life-history (a thing which is manifestly impossible), must inevitably lead to misconception.

Thus in specimens of *Sphærozoum punctatum** in which, owing to the small size of the individuals, it is reasonable to infer that mature growth has as yet not been attained, the contents of the membranous capsule appear like a viscid and semitransparent yellow fluid, almost devoid of granular particles. The same is observable in young *Acanthometræ*, and, as I have elsewhere shown, in the last-formed chambers of the Foraminifera and Polycystina. In like manner the ectosarc is more hyaline, and the shafts of the siliceous spicules (*acanthostypes*), although of their full dimensions as to length, are much more slender than in the adult specimens; whilst in specimens of *Collosphæra* of nearly full size, but in which the appearances just described lead to the inference that they are nevertheless immature, the spherical shell becomes corrugated under pressure, instead of being broken up into fragments, thus rendering it highly probable that many of the spinous and tubular growths met with in the shells of that genus may also be dependent on the age of the individual, or varying conditions in the supply of the siliceous material.

These facts appear to me to be of great importance, inasmuch as they are suggestive of the generic unity of *Sphærozoum* and *Collosphæra*, which has already been so strongly indicated by the similarity in the composition and disposition

* The name "*Sphærozoum*" was given by Meyen in 1834 to "a form of agastric animal which he describes as a spherical muco-gelatinous mass, constituted internally of globules, which, again, consist of vesicles" (Quarterly Journal of Microscopical Science, vol. iv. p. 73). Assuming the organism thus portrayed to be identical with the *Thalassicolla punctata* of Huxley, Müller retained the name on the plea of *priority*. The extreme vagueness of Meyen's description, however, renders it equally applicable to *Thalassicolla* and numberless "spherical muco-gelatinous masses" to be met with in abundance in the ocean, but which are certainly not members of the Rhizopodal group. The extension of the law of priority to such cases ought, therefore, to be rigidly *denied*, as holding out a premium to inaccuracy and slovenly investigation.

of the soft parts. Professor Huxley, who regarded them only as "varieties" one of the other, says, with reference to *Thalassicolla punctata*, "It is the connecting-link between the Sponges and the Foraminifera. Allied to the former by its texture, and by the peculiar spicula scattered through the substance of some of its varieties, it is equally connected with the latter by the perforated shell of the other kinds. If it be supposed that a *Thalassicolla* becomes flattened out, and that a deposit takes place not only round the cells, but between the partitions of the central 'vacuole,' it becomes essentially an *Orbitoides*;" whilst in a note from Dr. Carpenter, appended to the above observations, it is stated that "the cullender-like skeleton of certain Foraminifera is extremely like in its appearance to a fragment of the shell of an *Echinus*, or to the plates contained in the integument of a *Holothuria*; and we know that these begin with a network of spicules" *.

Accordingly, though unprepared to allow that the real connecting-link between the Foraminifera and the Sponges is to be found in *Thalassicolla*, or that the modification in form or the superaddition of a deposit as described would render it conformable to the type of any of the Foraminifera—in the first instance, because the mode of siliceous deposit characteristic of the Sponges is not met with in the *Thalassicollidæ*, but in the *Dictyochidæ*, as has already been shown by me elsewhere†, and, in the second, because the presence of a nucleus, and the much more highly differentiated condition of the rest of the sarcode-substance, attests the existence of a more advanced type in *Thalassicolla* than in the Foraminifera—there appears to me to be no sufficient reason for the generic separation of the two forms in question.

With reference to the distinction into the simple and composite forms of *Thalassicollidæ*, suggested by Müller but repudiated by other writers on analogical grounds only, I may mention that isolated free-floating individuals of the *Sphaerozoum* and *Collosphaera* type are constantly to be met with; and it is quite evident that these are in a normal condition, and have not been separated from the parent matrix by violence during capture, inasmuch as they are to be found not only as free-floating organisms when the composite masses are apparently altogether absent at the surface of the ocean, but also within

* Huxley on *Thalassicolla*, *Annals and Magazine of Natural History*, ser. 2. vol. viii. p. 429.

† See my observations "On the Process of Mineral Deposit in the Rhizopods and Sponges," in the *Annals and Magazine of Natural History* for January 1864.

the digestive cavities of Hydrozoa of far too minute size to have been able to swallow them in the aggregated state*.

The most remarkable feature in *Thalassicolla nucleata* (Huxley) consists in the presence of the "delicate flattened branching fibrils," which are described as being "beset with exceedingly minute dark granules like elementary molecules, which are in active motion as if circulating *along* the fibrils, but without any definite direction"—and likewise in the occurrence of the "yellow cells" (sarcoblasts) amongst the deeper-seated vacuoles†. If we regard the "fibrils" here alluded to as pseudopodial filaments (and it is difficult to regard them in any other light, if the organism belongs at all to the Rhizopodal group), it is manifest that the cyclosis cannot be dependent on a contractile power resident in those portions of the structure of the typical forms that exhibit a similar phenomenon, but must be the result of a contractile power inherent in the gelatinous matrix by which the "fibrils" are surrounded, as stated by M. de Quatrefages to be the case in *Noctiluca miliaris*‡. On the other hand, according to Huxley, it would seem highly probable that the cyclosis, together with the division and inoculation of the fibrils in *Noctiluca*, are "abnormal states, and that in the natural and perfectly unaltered condition the fibres and fibrils are perfectly quiescent, and present nothing to be compared to the Protean movements of the *Amœbæ*"§, the conclusion he arrives at being that *Noctiluca* "is no Rhizopod, but must be promoted from the lowest ranks of the Protozoa to the highest." If the latter view be correct, the true position of *Thalassicolla nucleata* must still remain somewhat doubtful; for it is obvious that the granular circulation and the presence of the fibrils are in reality the principal characters upon which the Rhizopodal character of that organism can be assumed.

Although I have had ample opportunity of examining *Thalassicolla nucleata* in the tropical and subtropical seas on both sides of Africa, I have never been able to satisfy myself

* Specimens of composite Thalassicollidæ when preserved in spirits usually break up, and accordingly yield no reliable evidence, one way or the other, as regards the question under discussion. In spirit-specimens, and also in such as have been preserved on slides, I have now and then detected what appeared to be the spherical-shelled and the spicular forms within the same gelatinous envelope; but I regard the chances of misinterpretation as too great in such a case to admit of my stating that their juxtaposition is normal, however probable this may be.

† Huxley on *Thalassicolla*, *loc. cit.* p. 435.

‡ See observations by this distinguished French naturalist in Huxley's paper on *Noctiluca*, 'Quarterly Journal of Microscopical Science,' vol. iii. p. 51.

§ *Loc. cit.* p. 51.

of its true nature, the only approach to a transitional state being suggested, rather than proved, by the occasional detection of a specimen in which the central mass with its investing capsule appeared to have escaped through an irregular orifice in the external gelatinous matrix. According to my notes written at the time of observation, these empty matrices showed the fibrillated structure, but no vacuoles or cyclosis of granules. Hence, notwithstanding their occurrence amongst the perfect forms, and their uniformity as to external appearance and dimensions, it is possible, although hardly probable, that they may have formed part of other organisms.

Lastly, as bearing on the identity in nature of *T. nucleata* with *Noctiluca**, I may mention that, according to my experience, there are no examples of phosphorescence amongst living animals holding so low a position in type of organization as the Rhizopods. As a negative character this absence of phosphorescence is of some value for the following reason. Both amongst the minute luminous Crustaceans proper, Entomostraca, and Ascidians of the open sea, I have found it easy, by means of a fine paint-brush, to detach a portion of a phosphorescent fluid from the living animal, and to communicate a luminous streak to any object by passing the brush so charged over it. It would seem, therefore, to be a true specialized secretion, and would furnish an explanation why creatures of such simple organization as the Rhizopods do not exhibit the phenomenon in question.

XVI.—*Notulæ Lichenologicæ*. No. XXVI.

By the Rev. W. A. LEIGHTON, B.A., F.L.S.

On the Change of the Gonidia of Lichens into Zoospores.

By MM. A. Famintzin and J. Boranetzky†.

IN a thin vertical section of a Lichen the gonidia occupy the middle layer of the thallus, and are partly attached to the medullary filaments and partly free and scattered. When the section is placed in water, the gonidia readily detach themselves in abundance, and present a perfect resemblance to a unicellular Alga.

M. Sperschneider, in 1853, placed thin slices of the thallus of *Physcia ciliaris*, DC., on pieces of decomposing wood in a confined humid atmosphere. At the end of two months the filaments of the thallus became decomposed, but the gonidia

* See paper on *Thalassicolla*, ut suprâ, pp. 441, 442.

† Translated from 'Ann. Sc. Nat.' ser. 5. vol. viii. p. 137.