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IX.—*Notes on Species of Ascodictyon and Rhopalonaria from the Wenlock Shales.* By GEORGE ROBERT VINE.

IN the 'Annals and Magazine of Natural History' for June 1877, Prof. H. Alleyne Nicholson and Robert Etheridge, jun., published their joint paper on "*Ascodictyon*, a new Provisional and Anomalous Genus of Palæozoic Fossils." In that paper (pp. 463–468) the authors describe forms from the Devonian (Middle, of Ontario) and Carboniferous strata (of Scotland). In a paper read before the Geological Society and ultimately published in their journal ("*Notes on the Polyzoa of Wenlock Shales*," Feb. 1882), I placed upon record (p. 54) the name *Ascodictyon filiforme*, Vine, as a provisional one. Since the publication of that paper I have been closely engaged on the study of Silurian and Carboniferous *Ascodictya*, and I find that the forms that I originally placed under the above name may conveniently remain. The organism, however, is such a peculiar one, and my opportunities of studying its varied aspects so singularly fortunate from the possession of a large series of specimens, that I make no apology for adding further details of the species to the brief notice already referred to.

The genus *Ascodictyon* is Palæozoic, though not peculiarly
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so. In examining a series of Cretaceous Polyzoa in the possession of Miss E. C. Jelly, one specimen appeared to me to belong to the genus.

In describing an American Silurian form—in some respects similar to forms found in the Wenlock Shales—Mr. E. O. Ulrich (Journ. of Cincinnati Soc. Nat. Hist. April 1879, pp. 18, 19) has established a genus under the name of *Rhopalonaria*. The species of the genus, *R. venosa*, Ulr., the author places with the Crisiidæ, remarking, “that the form has only been observed incrusting *Streptelasma corniculum*. On account of the great delicacy of the fossil, the fronds themselves are rarely found; but instead we find a series of impressions on the exterior coat of the *Streptelasma*, which very well represents the fronds and cells of the same.” A specimen of the species described by Mr. Ulrich is before me. It is from the same Cincinnati rocks; as I shall have to refer to the genus again, I have thought that it might be more satisfactory to make reference to an actual specimen than to the mere description of the same.

ASCODICTYON, Nicholson & Etheridge, Jun.

Ascodictyon, Nich. & Eth. jun., Ann. & Mag. Nat. Hist., June 1877, pl. xix.; “Notes on Polyzoa of the Wenlock Shales,” Vine, Quart. Journ. Geol. Soc. Feb. 1882, pp. 52, 53.

1. *Ascodictyon filiforme*, Vine.

Ascodictyon filiforme, Vine, “Notes on Polyzoa of the Wenlock Shales,” *op. cit.* pp. 54, 55 (merely referred to in the above).

Organism filamentous, forming linear, contorted or clustered threads, adherent to shells, stems of crinoids, fragments of trilobites, but rarely to corals. *Filamentous* threads hollow, but surrounded by delicate calcareous walls; the hollows filled with a dark brown granular mass. *Lagena*-like divergences developed on the sides of the thread, sometimes as single vesicles, otherwise as groups of vesicles. Peculiarly clustered stellate fibres are also formed at unequal distances.

Locality. Buildwas beds, generally distributed throughout the whole of the washings, but more abundant in nos. 36 and 38.

This curious organism begins its existence as a mere speck upon stone or shale or stem, which forms the nucleus of a colony. From this delicate filaments are developed (fig. I. 1 *a*, *a'*), sometimes in two or three, at other times in four different directions; these vary in thickness, but the average size, both in breadth and depth, may be taken as measuring between $\frac{1}{130}$ and $\frac{1}{200}$ inch. The threads are sometimes, but rarely, white, more generally of a dark brown tint. Viewed as

opaque objects on shell-fragments they appear like fine hairs laid in lines across the surface, or contorted, crossing each other at different angles, or running in parallel lines; but it would be useless to direct attention to any special feature in their modes of growth, for they vary considerably; but one

Fig. I.

1. *Ascodictyon filiforme*, Vine, $\frac{1}{180}$ inch thick. Two filiform threads running almost parallel. The point of origination is a^1 ; the portion marked a is nearly similar, but wanting the nucleus; a^2 single vesicle.
2. *A. radiforme*, Vine, $\frac{1}{180}$ inch thick. One of the filiform contracted threads, placed here for comparison.
3. Thread of *A. filiforme*, drawn from a transparent specimen, showing dark brown pulp.

feature which appears to me to have something to do with the development of the colony must not be lost sight of. Occasionally some of the filaments bifurcate, and before bifurcation takes place the organism contracts at intervals, and out of this contracted portion a new thread originates. It must not be supposed, however, that this simple explanation is, on the whole, a plainly satisfactory one. The two different sorts of threads, though apparently allied, give rise to two distinctly separable colonial growths in the after stages of their existence. Yet in the earliest, or initial stages, it is not easy to distinguish the difference between them. It will be better, however, to keep the two forms distinct.

In a few cases I have been able to reduce the thickness of the shell to which a typical *A. filiforme* is attached, and have mounted the specimen in balsam on glass. It is then seen that the filament is hollow, and the central parts filled with a dark brown granular matter. This granular matter, which I

shall call the pulp, is sometimes continuous, at other times slightly separated from the adjoining mass, when the grains appear like a row of beads dotting the centre of the threads (figs. I. & II. 3 to 5). Surrounding the pulp are delicate and transparent walls, which are distinct and clearly defined. In a few cases the filament bifurcates and the pulp in the undivided portion separates at the node and passes into the divisions thus formed. Real development takes place at irregular intervals. On the sides of the thread there is a slight protuberance of the wall, which increases in size until a roundish knob or a lagena-like vesicle is formed. Into these vesicles, which may be either single or in groups, the pulpy mass passes; but to what extent the colony increases beyond the *A. siluriense* stage, I am unable to say; although I believe we may safely regard this species, at least, as the ultimate outcome of the colonial development of *A. filiforme*, Vine.

Fig. II.

- 4, 5. *Ascodictyon filiforme* (transparent and semitransparent), showing vesicles and pulp.
 6. Ditto, showing clusters of vesicles, passing into
 7. *A. siluriense*, Vine.

At this stage of inquiry it may be well to ask, whether the name *A. siluriense*, Vine (Wenlock Polyzoa, *op. cit.* p. 52), should be suppressed. If the Silurian name is suppressed the Devonian name (*A. stellatum*, Nich. & Eth.) must be suppressed also, unless the one name may be allowed to embrace both the type and the varieties. In opposition to this view, I think the wiser course would be to allow the forms to retain their present names as given below, for the simple reason that it would be perhaps impossible, or almost impossible, to make another collection similar to my own unless the

shales were searched with the same minute care that I have bestowed upon those furnished to me by Mr. George Maw. Then, again, *A. siluriense* and *A. radiforme* were the firstfruits of my labours; and *A. filiforme* was the result of closer examination. As with me so with others, because the matured forms will, I fancy so at least, be considered by the student of micropalæontology as by far the most important as initial stages in an inquiry like the present one. Another consideration is with me of much greater weight than any previously given. It may be, after all the care that I have exercised in thus tracing the origin and development of a colonial growth, that some few facts or fossil illustrations may have been overlooked, and it may be necessary at some future time to limit the type now characterized as *A. filiforme*. If this should happen, the suppressed names would have to be restored.

In his observations on *A. stellatum* Prof. Nicholson remarks (*op. cit.* p. 465), that in its youngest stage the organism "presents itself simply in the form of scattered oviform or pyriform calcareous vesicles attached to the exterior of foreign bodies. When mature it consists of similar vesicles combined into clusters." I do not doubt the accuracy of Prof. Nicholson's observations, though I cannot, on the whole, endorse them from my own labours: all the vesicles are united to the filiform thread, though in a few isolated instances "apparently" they are not so. I have examined a large series of *A. filiforme* for the purpose of putting the observations of Prof. Nicholson to the test, and I am consequently unable to confirm his views. In his description of fig. 6, pl. xix. (*op. cit.*), the author says, "Four young vesicles (?) of the same (*A. stellatum*) &c.;" the vesicles are not foraminated, as in the other figures (2 to 5, pl. xix.), and in this special feature the Ontario vesicles are allied to, though not identical with, those shown in fig. II. of the present paper as gradational stages in the development of *A. filiforme*, Vine.

2. *Ascodictyon stellatum*, Nich. & Eth., jun.,
var. *siluriense*, Vine.

= *Ascodictyon stellatum*, Vine, Quart. Journ. Geol. Soc. Nov. 1881,
p. 618.

= *Ascodictyon stellatum*, var. *siluriense*, Vine, Q. J. G. Soc. Feb. 1882,
p. 52.

The details of this species have been given in the works referred to above.

3. *Ascodictyon radicumforme*, Vine.

= *Ascodictyon radicans*?, Vine, Quart. Journ. Geol. Soc. Nov. 1881, p. 619.

= *Ascodictyon radicumforme*, Vine, Q. J. Geol. Soc. Feb. 1882, p. 53.

When I wrote the details already given in the papers referred to above I did not possess the fine suite of specimens which has enabled me to extend my remarks on the origin, growth, and apparently final (?) development of this peculiar group of organisms, found as yet only adherent to other organisms in the Wenlock shales.

In speaking of *A. filiforme*, I incidentally referred to a single form apparently related to the species, but which I said it would be best to keep separate. I have now to consider the relationship of that form, but which, not being the earliest in the development of the species, I will defer till later on.

In fig. III. 5 I have sketched the fragment of a crinoid stem, magnified about 2 diameters, on which one of the finest of my colonies of the earliest stages of this species (*A. radicumforme*) is attached. I do not, however, found the whole of the evidence which I am about to bring forward on a single specimen. I have corrected both the positive and the negative evidence by appeals to between sixty and seventy other specimens; but as this one affords me evidence of continuous growth, I have built up my description mainly on it. And here I must be allowed to say that, contrary to my general plan in drawing, the whole of my sketches are drawn by the eye, and not by the aid of the *camera lucida*; but every figure is a faithful delineation of the original.

In fig. III. 1, 2, and 3 I have drawn a fibre which is continuous on the fragment of crinoid stem already referred to. At 2, *a* and *a'*, we have two nuclei, either of which may be referred to as the originating nucleus of the colony; but it will be best to speak of them separately. In fig. III. 2, *a*, a kind of false stellate cluster is formed; but this I regard as only an offshoot; the true nucleus is at *a'*, and at this the central part only. It appears to me that the central nucleus originates by the combination of minute spores, which up to the present have escaped my observation; but immediately after the combination, delicate prolongations of the central mass or radii are sent off which do not in every case produce fibrous threads. At *a'* one of these minute combinations is formed, but only one of the rays is apparently developmental*.

* It will be understood by the palaeontologist that in restricting myself thus I only take the evidence presented to me. I have not the least doubt but that what I say of one might be said of all the rays; but I have only the one evidence to rely upon—the positive.

This extends for a short distance, when another, or pseudo-combination, takes place, the result of which is shown, so far as I am able to trace it; but in that portion which recedes towards a'' the fibre is slightly contracted at certain distances.

Fig. III.

1 to 6. Varied forms of *Ascodictyon radiciforme*, Vine (already described in text).

In fig. III. 1 the fibre is white, undoubtedly hollow, with here and there a broken surface, showing the dark brown pulp (or matrix) below. In fig. III. 3, which is a continuation of fig. III. 2, at a'' we find the continuation of the contracted fibre and

other features which it may be well for the reader to refer to, the stellate cluster being a continuation of the fibre at 3*. In following the above remarks it will be easily understood that I attach very great importance to the method of formation and the character of the tongue-like vesicles which form the radii of this anomalous species, *A. radiceforme*. Sometimes after single vesicles are formed, at other times after a combination of vesicles, the organic matter of the thread or fibre undergoes other changes, to which reference has not been made. A group of vesicles combined as in fig. III. 3*, some of the cells, and occasionally the whole of them, will contract towards the centre or separate from the nucleus, forming club-like cells. In nearly all the instances where I have seen this mode of contraction the cells have a very delicate covering of calcareous matter, and are foraminated either in a single line along the centre or indifferently over the whole surface; the latter, however, is a very rare occurrence. I have given figures of the club-like cells (fig. III. 4 *a*, 4 *b*), showing the direction and positions of the foraminated surfaces; but in fig. III. 4 I have shown the basal attachment of one of the fibres, which shows that the under surface was more densely foraminated than the upper. The irregular fibre shown in fig. III. 6, though not strictly speaking a portion of a stellate cluster, is likewise foraminated.

In the 'Journal of the Cincinnati Society of Natural History,' 1879, vol. ii. pl. vii. figs. 24 and 24 *a*, Mr. E. O. Ulrich describes and figures a very peculiar fossil adherent to the exterior coat of *Streptelasma corniculum*. For the species a new genus is founded—*Rhopalonaria*, from *rhopalon*, a club—which Mr. Ulrich places in the family Crisiidae; and he says that "the genus is related to *Hippothoa*, but in the form and arrangement of the cells they differ widely." There is not, however, any relationship to *Hippothoa* in the species described; but as the cells are somewhat club-shaped, it may be well to accept the genus if more fully defined.

In the species, *R. venosa*, Ulr., the "cells are uniserial, long, acutely elliptical, and joined together at their contracted ends. . . . Cell-mouths not clearly determined, *but appear to be situated near the middle of the cell*" †. In my own specimens of this species I cannot detect any cell-mouths, but the other characters are well defined by the author.

In the Ludlow rocks and also in the Wenlock shales there are several fossils that might have been conveniently placed in this genus if my specimens did not throw some little light

† Italics mine.

upon their origin and development. In fig. IV. I have given sketches of four distinct types of very common forms found in the shales. In fig. IV. 1 we have the rarest of these, showing elongated cells very similar to some of the cells of *Stomatopora elongata*, Vine (fig. IV. 2), only that the cells are in an opposite direction to what (apparently?) is the case in *S. elongata*. I cannot, however, detect any orifices in these cells such as we have in *S. elongata*.

Another form, very common indeed, is shown in fig. IV. 3. Only that the cells are not club-shaped, I suggested for this type *R. botellus*, as descriptive of its peculiar sausage-like character. But even of this type better evidence is afforded by

Fig. IV.

1, 3, 4, 5. *Rhopalonaria*, Ulrich; species described in text.
2. *Stomatopora elongata*, Vine.

fig. IV. 4, in which both the *botelloid* and the *rhopaloid* characters are shown in one colony. Some of the cells in the last figure have, one would suppose at first sight, cell-mouths. This is not so: those cells that are shown thus are a little more calcareous than the others; the walls are broken at this part, and the dark brown matter is shown below. I have some few specimens of the last two types, and the whole of the walls or outer covering is destroyed, and the *botella*-like matrix is still adherent to the fragments to which the original organism was fixed. In fig. IV. 5 we have a fourth and

last type, which is similar in some respects to *R. venosa*, Ulrich*.

In addition to my own observations I have the evidence of a most careful observer as to the existence of *Rhopalonaria* in the Ludlow rocks. In 1881, J. D. Longe, Esq., of Cheltenham, sent me a series of sketches (fig. V.), with the

Fig. V.

Rhopalonaria, Ulrich, from the Ludlow rocks. Figures supplied by J. D. Longe, F.G.S., Cheltenham.

following remarks:—"I also enclose a sketch of a very abundant, encrusting, creeping 'stoloniferous' form, which I have on shells (*Spirifer*) from some Upper Silurian bed . . . probably Ludlow." These beautiful forms are different from any known to me in the Wenlock shales, and their publica-

* Not similar to his figures, but similar to some cells seen on the specimen of Ulrich's species in my own cabinet.

tion with the above details may be the means of helping others in their researches among the micaceous and other shales of the Ludlow series of rocks. My labours are entirely confined to the Wenlock series and some only of the shales over the Wenlock Limestone.

I do not think it necessary to speak more fully now of the genera *Ascodictyon* and *Rhopalonaria*. It is important, however, in vindication of my remarks, to make some reference to the various opinions on the organisms which Prof. Nicholson gives in the section of his paper entitled "Systematic Position and Affinities" (*l. c.* p. 466). He says, in the first place, that Dr. Stretchill Wright (to whom Scotch specimens of *A. radians*, Nich. & Eth., were submitted for examination) "was unable to throw any light upon their nature." Prof. Huxley, to whom the same specimens were submitted, after considerable hesitation, suggested that they might be Protozoa. Mr. H. B. Brady, after a protracted examination of both the Scotch and the American forms, has arrived at the conclusion that they cannot be referred to the Foraminifera. Some of the American specimens (*A. fusiforme*, N. & E., and *A. stellatum*, N. & E.) were kindly submitted by Mr. H. B. Brady to the Rev. Thomas Hincks, who suggested that they were possibly allied to the recent *Anguinaria*. Neither Prof. Nicholson nor Mr. Etheridge expresses any positive opinion as to their systematic position or affinity. The difficulties encountered by these various authorities when speaking of this remarkable group are valuable so far in helping to establish the uniqueness of the types submitted to them; but none of the suggestions help to throw light upon their nature and affinity. Yet I have respected the whole of the remarks, and have compared specimens of the fossil species with specimens of every known living type suggested as "probable" by these authors, but without any definite results. Perhaps it would be wise to pause here, for it is not for me to suggest possible affinities when so many experts have failed. Yet I cannot allow the paper to pass out of my hands without making a suggestion, which may possibly share the same fate as the others.

There are not, so far as I am aware, any Cyclostomatous Polyzoa which may be considered as truly stoloniferous. Some of the Hydrozoa are; but I know of none whose stolons are adherent to stone or shell, such as are found in these ancient rocks, neither am I aware that the stoloniferous Ctenostomatous Polyzoa are adherent to stone and shell, like *Ascodictyon* or *Rhopalonaria*. Yet it seems to me that we have, in *Ascodictyon filiforme* at least, primitive representatives

of the stoloniferous Vesiculariidae, such as *Vesicularia* and *Bowerbankia*, or, possibly, some member of the more humble race of the Entoprocta. Barrois has already, in his paper "On the Embryogeny of the Cyclostomatous Polyzoa" (Ann. & Mag. Nat. Hist. Nov. 1882, p. 402), spoken of a pro-Bryozoan race, composed of "free swimming organisms." May *Ascodictyon* be the attached, or larval form, of some of the as yet unknown pre-Upper-Silurian types of organic life, polyzoan or otherwise?

There is, however, another suggestion which may help to throw some little light on the development of *A. radiceforme*, Vine, though we cannot hope by the comparison to explain away all the difficulties which surround the subject. I refer now especially to some remarks contained in a paper by Mr. George Busk, F.R.S., entitled "Notes on a peculiar Form of Polyzoa closely allied to *Bugula*, = *Kinetoskias*, Kor. & Daniels^{se} 1" (Quart. Journ. Microsc. Soc. vol. xxi. new ser.). After speaking of the development of the various species of *Kinetoskias*, Mr. Busk says, "I have yet scarcely adverted to the most remarkable feature of *Kinetoskias*, viz. the peduncle or stem, which appears to exist in all species. . . . The mode of formation of this part of the zoarium, which is undoubtedly the homologue of the bundle of separate radical tubes so commonly met with among the Polyzoa, is extremely curious and interesting, and, at the same time, in some points as yet more or less obscure, as, in fact, *may be said respecting the mode of formation and development of the more ordinary form of radical tubes* *.

"In the more common forms they are cylindrical, jointed, chitinous tubes, with rather thick walls and with very scanty contents, beyond a few granular particles and irregular threads, representing, as it would seem, the remains of an endosarc, with which, in order that their progressive increase in length, and occasionally complicated branching &c., may be effected, we must suppose the tube to be furnished. In fact it is otherwise impossible, without assuming the presence of a germinal material, to account for the fact that even after the tubes have attained a considerable length the extremity, or a considerable part of the tube, may undergo great changes in form, as is seen in the production of hooks and other means of ensuring adhesion to foreign bodies, changes showing a most extraordinary adaptability to circumstances. Not the least remarkable of these adaptations is the division of the extremity of the tube into a multitude of very minute tubular

* Italics mine.

filaments, each of which may be traced into independent connexion with small foreign bodies." Had Mr. Busk been writing of *Ascodictyon* instead of species of *Kinetoskias*, he could not have given more faithful descriptions of some of the specimens found in the Palæozoic rocks. The suggestive inference to be drawn from these remarks, and others that might have been given, is that the dark brown masses (pulp &c.) in the various species of *Ascodictyon* are probably the remains of endosarc in these once living filaments and semi-tubular and bulbous tubes.

There is just one other point in Mr. Busk's paper to which I will direct attention in conclusion, because it will help us to understand and appreciate at its proper value *Ascodictyon* and the abortive or "blind cells" of *Rhopalonaria*:—"That the radical and connecting tubes, like the avicularia and vibacula, represent modified zooids, is, I believe, generally admitted; nor can it be denied in this case (*Bugula* &c.) that each successive joint or internode is a distinct zooid." And in a note the author says, "In *Bicellaria* and in *Notamia* it may almost be said that the inhabited part of the zoecia is simply a dilatation at one part of the internode of a radical tube, which is continued to the ultimate extremity of the branch."

X.—*Descriptions of two new Species of Walckenaëra, Blackw.*
By the Rev. O. P. CAMBRIDGE, M.A., C.M.Z.S., &c.

[Plate IV.]

AMONG a large number of Spiders sent to me for identification, during the last three or four years, by Major-General A. W. M. van Hasselt, from Holland, are two of the curious genus *Walckenaëra*, Bl., which I believe to be undescribed. Their discoverer having kindly permitted me to do so, I now sub-join descriptions and figures of these novelties.

Family Theridiidæ.

Genus WALCKENAËRA, Bl.

Walckenaëra Hasseltii, sp. n.

Adult male, length $\frac{1}{20}$ of an inch, or $\frac{3}{8}$ of a line.

Cephalothorax rich black-brown.

Legs yellow, tinged with orange-brown. Perhaps in some examples they would be bright orange-yellow.