screen ten inches distant, and a 1-12th objective should magnify 120 times. If the eye-piece is equivalent to 1-10th single lens, it again enlarges the object 100 times, and the total power will be 12,000 diameters. The magnifying power of a microscope whose objective has a focal length f and eye-piece e; will be conveniently expressed by—

$$M = \frac{10}{f} \times \frac{10}{e} = \frac{100}{ef}$$

I have several times tested this formula against the camera lucida, and have found it extremely accurate for a standard of ten inches' distance of the eye-lens from the objective.

Examples.—With a C eye-piece, Powell and Lealand's 1-8th objective magnifies 800 times, and its focal length is one inch. The 1-12th, with the same eye-piece, gives 1200 diameters, and the 1-50th 5000 diameters. The formula produces identical results, precisely expressing their printed tables:

(1) $\frac{1}{8}$th. $e = 1$, $f = \frac{1}{8}$.

$$M = \frac{100}{1 \times \frac{1}{8}} = 800.$$

(2) $\frac{1}{12}$th. $e = 1$, $f = \frac{1}{12}$.

$$M = \frac{100}{1 \times \frac{1}{12}} = 1200.$$

(3) $\frac{1}{50}$th objective. $e = 1$, $f = \frac{1}{50}$.

$$M = \frac{100}{1 \times \frac{1}{50}} = 5000.$$

If the draw-tube be used to increase the distance by the 1-5th or 1-6th the magnifying power will, for high objectives, increase proportionately. Thus, if the draw-tube give twelve inches instead of ten, and an eye-piece similar to Browning's G achromatic of ·1000 focal length, and a 1-12th objective—

$$M = \frac{100}{\cdot 1000 \times \frac{1}{12}} \times \frac{12}{10} = \frac{100 \times 12 \times 12 \times 10}{10} = 14{,}400.$$

By the formulæ the focal length of double D eye-piece would, if the 1-12th gives 12,000 diameters with twelve inches of tubing instead of ten, be given by the equation—

$$M = 12{,}000 = \frac{100}{e \times \frac{1}{12}} \times \frac{12}{10};$$

$$\text{Therefore, } e \text{ or DD eye-piece} = \frac{100 \times 12}{12000 \times \frac{1}{12} \times 10} = \frac{3}{25},$$

or rather less than the 8th of an inch, or eight times deeper

than Powell and Lealand's third eye-piece C, which is generally preferred to all higher powers for accurate definition.

When objectives are pressed to this extreme amplification the jewelled brilliance of the translucent and radiant beading vanishes; they take a grey and sombre hue, and all intervening structure is lost in an indefinable haze of exaggerated aberration. The spherical beads of diatoms are brilliantly transparent (being formed of pure silica?), and they behave themselves in almost every respect as spherical lenses, showing crescentic shadows, blending and mingling with each other in endless variety, according as the inter-spherical refractions develop single or multiple shadows. I cannot refrain from expressing my convictions that all diatoms of this character possess a double set of beading, set in different planes.

On some Freshwater Rhizopoda, New *or* Little-Known.

By William Archer.

(*Continued from vol.* ix, *N.S., p.* 397.)

Pleurophrys spherica (Clap. et Lachm.)? *Pl. ? amphitremoides* (sp. nov.), and *Pl. ? fulva* (sp. nov.)

Having endeavoured in the foregoing to give some account of the remarkable form, *Diaphoropodon mobile*, I pass on to the three others, which in the present series seem next related thereto, figured on Pl. XX, figs. 1, 2, 3 (vol. ix), and which I would (provisionally at least) identify as above. I regret, however, that I have it in my power, at present at least, to do but very little more than refer to the figures and the accompanying explanation of the plate.

It will be seen by the appended notes of interrogation that it is not without some amount of uncertainty as yet that I refer these forms to Claparède and Lachmann's genus, which is thus characterised:—"Body covered by a test furnished with a single opening, and formed of foreign substances agglutinated by means of an organic cement," to which diagnosis is prefixed the remark that this genus is to the Actinophryans as the Difflugiæ are to the Amœbæ.[1]

From this we are to understand that in Pleurophrys the sarcode body emits slender linear, unbranched pseudopodia, through the single aperture of a test formed of agglutinated foreign particles. Nor must the figure given[2] be misunder-

[1] Claparède et Lachmann, 'Les Infusoires et les Rhizopodes,' p. 454.
[2] Op. cit., pl. xxii, fig. 3.

stood, because the pseudopodia are depicted as radiating all around, for, as the explanation of the plate states, the figure is drawn as seen from above, and hence the opening, whence emanates the pencil of pseudopodia, must be below, and these, seen from that point of view, naturally appear to project in all directions.

Three circumstances seem to render the identity of the form of which I have tried to convey an idea by fig. 1 with *Pl. spherica* somewhat doubtful. The first is that this latter form is depicted as possessing linear pseudopodia quite *unbranched*, whereas our form shows its pseudopodia very distinctly, but not indeed very copiously, branched. The second point is that the outer covering is represented by Claparède and Lachmann as formed of irregular arenaceous-looking particles, whereas in our form the test appears to be formed of certain problematic linear or bacillar bodies, along with minute indescribable granules agglutinated in a single stratum by an intervening, indeed seemingly organic, cement into a more or less flexible test. The third point is that our animal appears to be notably larger than Claparède and Lachmann's. That those observers are silent as to the presence of a nucleus may not bear upon the immediate question, because it may have been present in their form, though concealed by the opacity of the outer covering.

But it might almost become a further question if any of the three forms I figure belong rightly to the genus Pleurophrys by reason of the decidedly branched character of the pseudopodia; for though no absolutely strict distinction can be drawn from pseudopodia in this regard, still, as is well known, these, in many forms, maintain a great amount of constancy in their individual character. For instance, compare the pseudopodia of the two forms I have designated in this paper as *Cystophrys Haeckeliana* and *C. oculea* (Pl. XVII, figs. 1 and 3), as well as of others.

The test not being membranous, but formed of foreign and miscellaneous particles, excludes my three forms from Gromia (Duj.), not to speak of the nature of the pseudopodia, which seems to me to be very distinct from those characteristic of that genus. Admitting that their linear but branched character would be compatible with the genus Pleurophrys, they appear to be quite different from the pseudopodia in a Gromia by their comparatively rigid nature, and clear, non-granular, and tufted shrub-like appearance, without any evident current or reticulated arrangement. They are long, and comparatively straight, clear, and silvery, so to say, in appearance, the branches given off more or less dichotomously at an acute

angle, and do not again appear to inosculate with their neighbours. They alter in appearance, or position, or ramification but slowly—the change which, indeed, is speediest of accomplishment is that of retraction, leaving the oval body a brown, inert, not then readily recognisable mass. All this is quite unlike the behaviour of a Gromia which, when quiet some time upon a slide, pours forth an overflow of a clouded, fluid sarcode, which gives off at all points irregularly branched prolongations, copiously anastomosing and carrying a vigorous flow of granules in a current almost like a system of vessels. It need not be remarked that the pseudopodia in our form are quite a distinct sort of thing from the finger-like, ever fitful pseudopodia of a Difflugian. That these forms, apart from the tests, are quite distinct in themselves from Difflugia on the one hand and from Gromia on the other, I could have little doubt; whether they rightly fall under Pleurophrys, as I have indicated, may be a question. For some time I imagined, as I now believe erroneously, that these forms might fall under the genus propounded by Schlumberger[1]—Pseudodifflugia,—but that type is described as having a membranous test, which, so far as I can see, would exclude the present forms. I would be disposed to suggest that Pseudodifflugia (Schlumb.) might really come nearer such a form as the so-called *Gromia Dujardinii* (Schultze).

Further, it appears to me that these differ in character quite from the pseudopodia of Euglypha or Cyphoderia, not to speak of the quite distinct kind of test. In these genera and their allies the pseudopodia are few, unbranched, extremely slender and very lively, thrown out comparatively rapidly, sometimes waved with no little vigour, drawn in hurriedly, often showing a knob-like expansion or clavate end during the act—all quite unlike the inert, comparatively persistent, shrub-like tuft of thicker pseudopodia shown by our forms. I think those who may be inclined to consider the importance here attributed to the kind of pseudopodia, and their appearance and behaviour, as too overdrawn, would be at least obliged to admit, on looking over these forms in a living state upon a slide for a length of time, that they possess at least remarkable idiosyncrasies.

The form shown in Pl. XX, fig. 1, is, I think, not uncommon; but it is easy to pass it over, though, as will be seen, by no means minute, as it may be taken almost for a pellet of some kind of excrementitious matter, and, moreover, it is shy of protruding its pseudopodia. The test, as mentioned, formed of a number of elongate and granular

[1] 'Annales des Sciences Naturelles,' 3rd ser., tom. iii, p. 256.

particles agglutinated by an intervening brownish substance, sometimes presents itself of an irregular, or lobed, or distorted shape, though a broad elliptic figure seems to be more usual; in so far as this goes it is further against its presumed identity with *Pleurophrys spherica*. The body of the creature is suspended within this test, from which it mostly stands off a notable distance, and it is granular. I have not noticed a vacuole, but a large orbicular nucleus is often readily to be perceived, which by some management can be extruded intact.

The form represented by fig. 2 (*Pl. ? amphitremoides*) is much smaller, and prone to cover itself with various diatomaceous frustules, and in the specimens I have met with contained numerous chlorophyll granules, but I could not see a nucleus. The ramifications of the pseudopodia seem more copious as compared with the preceding, hence the tuft appears more shrub-like. A smaller and nearly orbicular form, seemingly the same, is met with without diatomaceous frustules, but covered by large arenaceous particles, this perhaps, after all, equally likely to be the same as *Pl. spherica* (Clap. et Lachm.)

The third form, which I have named from its colour *Pleurophrys fulva*, is far smaller than either the preceding, and is characterised by its tawny hue and the pellucid character of its rough test, owing to its use of clear quartzose granules. These must be impacted on a basis of that colour which gives it the tawny hue. I have not seen a nucleus. This is the only one of these forms I have seen "conjugated," in which position pairs are not unfrequently met.

The character of the pseudopodia in these forms is very like that of the pseudopodia of *Diaphoropodon mobile*. I do not mean the long, extravagantly drawn-out ones, but the tufted ones at the sides or after the retraction of the very long ones. The nucleus seen in Fig. 1, too, is very like that of fig. 6, and hence the consideration of the three forms just drawn attention to naturally follows after the latter.

Amphitrema Wrightianum (gen. et. sp. nov.)

The two drawings presented (fig. 4 and 5), taken along with the explanation of the plate already given, convey, I might say, all I am able to offer upon this curious little form. This rhizopod possesses an elliptic compressed test, bearing impacted thereon a number of granular foreign particles, each face being comparatively free from these, which are most crowded along the margins and edges. At each opposite end there exists a rounded aperture, through which emanates a

dense shrub-like tuft of more or less branched, linear, pseudopodia of quite the same character as that of those belonging to the forms drawn attention to above in the preceding section. One of these tufts is always notably larger and more drawn out than the other. It sometimes happens that one of the apertures becomes stuffed up by foreign granular particles clustered in a heap, so much so as seemingly to prevent the emission of any pseudopodia at all, or only a few straggling ones make their way out from amongst the particles. Indeed, it is quite rare to get examples in which the short neck-like margin of the aperture can be seen in either, not to speak of both ends, for the same kind of foreign particles which abound at the margin have a tendency to be retained around the aperture, obscuring its margin, and rendering it hard to be proven that a neck-like border exists. The body assumes generally a narrower form than the test, thus usually leaving a space at each side, though it sometimes appears to completely fill the test. It is always densely loaded with chlorophyll granules, along with which occur other brownish coloured particles. I have not seen a nucleus, nor have I seen crude food in its interior.

This seems a sufficiently remarkable form, inasmuch as I do not know of the existence of another rhizopod of its affinity with a single chamber, and with two large apertures for the emission of pseudopodia, if we except *Diplophrys Archeri* (Barker).[1] To the seeming distinctions of these two forms in a generic point of view I shall allude below; in an individual or specific point of view no two forms could be more distinct, though the descriptions of each to a certain extent, no doubt, coincide.

Having thus, in the foregoing sections of this communication, passed in review the various new Rhizopoda figured on the present occasion (with the exception of *Difflugia carinata*), the account of the forms described must naturally conclude with their short diagnostic, generic, and specific characters.

However, as regards locating them first in their due position in higher, more comprehensive groups, it does not appear to me that the known forms of Rhizopoda inhabiting the freshwaters are yet sufficiently numerous or sufficiently understood to enable us to classify them otherwise than approxi-

[1] 'Quart. Jour. Mic. Sci.,' vol. xvi, p. 123, in "Proceedings of Dublin Microscopical Club," 19th December, 1867.

mately or provisionally under received Orders or Families. Thus the three Pleurophrys (?) shown in Plate XX, figs. 1, 2, 3, and Amphitrema (figs. 4, 5), and Diaphoropodon (fig. 6), would come under the Order Proteina, as adopted by Claparède and Lachmann, but would seem possibly to make a Family intermediate in character between Amœbina and Actinophryna. *Gromia socialis* (figs. 7—11) surely belongs to Gromida, whilst Acanthocystis and Raphidiophrys would appertain to Echinocystida by reason of having siliceous spicules; but Heterophrys, Pompholyxophrys, and Cystophrys have no spicules, yet are, no doubt, closely related, but yet according to the characters given by Claparède and Lachmann they would require a new Order.

Endeavouring, again, to arrange them after the system laid down by Haeckel in his "Radiolaria,"[1] and acquiescing that the forms here drawn attention to, referable to Pleurophrys (Clap. et Lachm.) do not possess a contractile vacuole, and if it be conceded that the marginal, pulsating vacuole shown by Diaphoropodon is entitled to come under that designation, then the latter genus must be placed near Difflugia and far apart from Pleurophrys, whereas I believe it cannot be doubted but that they are really closely allied. Again, the forms I have comprised under the new genera Raphidiophrys, Heterophrys, Pompholyxophrys, Cystophrys—not one of them, in my own opinion, possesses a central capsule, nor so far as I see even an analogue of that part of the organization of Haeckel's marine forms. *A priori* then they would fall under Haeckel's Order Acyttaria and Family Athalamia, where he would, when he then wrote, place *Actinophrys sol*. But I think there can be but small doubt that they have a far stronger claim to admission into the Order Cytophora, Family Radiolaria, notwithstanding the want of a "central capsule."

Again, on having recourse to the system laid down by Carpenter,[2] the forms referable to the genera Raphidiophrys, Acanthocystis, Heterophrys, Pompholyxophrys, would, of course, fall under his Radiolaria. The new Gromia (*G. socialis*) must be placed to Reticulosa; but then what of the form I have called *Cystophrys Haeckeliana*, with its subarborescent pseudopodia, which often coalesce, more or less, in a reticulose manner, whilst the other form referred to the same genus as yet (*C. oculea*) has linear and non-coalescent pseudopodia, clearly placing *it* under Carpenter's Radiolaria. What too of the forms on Pl. XX referred by me to Pleurophrys (Cl. et Lachm.), Diaphoropodon (mihi) and Amphitrema (mihi)? These almost seem to hover between Carpenter's Radiolaria and Reticulosa.

[1] 'Die Radiolarien,' p. 212.
[2] 'Introduction to the Study of the Foraminifera,' 1862, p. 17.

Again, looking to Wallich's proposed classification,[1] *Pompholyxophrys punicea* and *Heterophrys myriopoda*, with no definite nucleus, and no contractile vesicle, and *no* spicula, (confined by the diagnosis) must come under one division of the Order "Herpnemata," whilst Raphidiophrys, likewise with no definite nucleus and no contractile vesicle, but *with* spicula, would come under another division of the same Order; yet I fancy it could hardly be doubted but that, although none of those named show a "nucleus," these forms come most naturally in alongside of the solid-skeletoned "Protodermata" (Wallich). I never saw a contractile vacuole in the little *Gromia socialis*, but it has a nucleus, thus seemingly with only half a right to a place under Wallich's Order Proteina, where, however, seemingly clearly should come Pleurophrys and Diaphoropodon.

In neither Raphidiophrys, Heterophrys, nor Pompholyxophrys, can I see anything capable of being called a nucleus, such as occur, for instance, in Actinospherium. If we admit the validity of that class, are they then "Monera" (Haeckel[2])? Even some of *those* can secrete siliceous structures during a developmental condition. The nature of the sarcode of the body-mass in the new form here described, which, as we have seen, is far indeed from being "structureless and homogeneous"—a characteristic in the diagnosis of the Class given by Haeckel, placed even before the absence of a "nucleus,"—would in itself, no doubt, place them above the "Monera" in the system. But Haeckel would now claim *Actinophrys sol* as a Moneron, but that form could hardly be placed far from such as *Heterophrys Fockii*, which indeed, like *A. sol*, does not show a nucleus, and they agree in possessing a marginal pulsating vacuole.

It, therefore, seems to me that an attempt to place the forms I have brought forward in this paper in their Classes or Orders is not yet to be accomplished. We must just for the present consider the forms on Plates XVI and XVII as annexing themselves most closely to Radiolaria (Haeck.), forming a Heliozoan subgroup, wanting a central capsule, of which *Actinophrys sol* is the very simplest representative; whilst the forms upon Plate [redacted] even including Diaphoro-

[1] Wallich "On the Structure and Affinities of the Polycystina," in 'Quart. Journ. of Micr. Science,' vol. v, page 57.
[2] 'Monographie der Moneren.' loc. cit.

podon (of course leaving *Difflugia carinata*, fig. 6, out of view), appertain more closely to Gromida.

The foregoing view of the case as regards forms such as those on Plates XVI and XVII, seems to receive a very strong confirmation from certain freshwater Rhizopoda brought forward only a few weeks ago by Greef, in a paper full of close observation and close reasoning founded thereon,[1] some of which forms are identical with mine and certain others very closely related, and which latter do actually seem to possess a true central capsule. I allude to the forms falling under his new genus Astrodisculus (*A. ruber*, *A. flavescens*, *A. flavo-capsulatus*, Greef). This valuable and interesting paper of Greef's opens up some new points, and, as is seen, brings to notice some instructive new forms.

Upon a species appertaining to one of the genera—Acanthocystis (Carter), a valuable paper has likewise previously appeared by Grenacher,[2] with whom, so far as his observations are concerned, Greef seems to coincide. Perhaps it would be of advantage to English readers briefly to allude to the points made out in both.

As, however, some of the species Greef himself either describes or alludes to are actually identical with certain of those described by myself in the preceding sections of this communication, before the appearance of his paper (as well as previously in a cursory manner in the 'Proceedings of the Dublin Microscopical Club'), I shall, perhaps, most fittingly allude to his account of them and of the forms most immediately related in a paragraph following the diagnosis of each of the species themselves under the head of "Affinities and Differences."

Not essaying, then, to place our forms under headings of any of the proposed Classes or Orders, I shall simply attempt to give their generic and specific character, with a view to facilitate their more speedy recognition when encountered by other observers.

But before proceeding to do so, I would draw attention to the circumstance that whilst partaking with other forms of a common "heliozoan" or "actinophryan" nature, there is, moreover, one additional character or point of structure in which the forms located in the three genera now sought

[1] "Ueber Radiolarien und Radiolarien-artige Rhizopoden des süssen Wassers," in Schultze's 'Archiv für mikroskopische Anatomie," Bd. v, Heft 4, Oct. 1869.

[2] 'Zeitschrift für wissensch. Zoologie,' Bd. xix, p. 288, T. 2, fig. 25.

to be constructed by me, Raphidiophrys, Heterophrys, Pompholyxophrys, along with the genus Acanthocystis (as well as, possibly (?), Greef's new genus Astrodisculus), all mutually coincide; I mean, at least, as it appears to my own observation. I think, then, that in the forms included under the genera just named, the body-mass is in all composed of *two distinct regions or strata of sarcode, sharply marked off, one within the other, the outer surrounding the inner as a complete investment.* These two sarcode regions are distinguished by a sharp line of demarcation, and present considerable difference of appearance, colour, and consistency. The outer region appears to me to be the softer, and more plastic and polymorphous, the inner to be more consistent, and in itself (unacted on by outward forces) the less changeable in form. When spicula are characteristic of the species, it is the outer region which bears them—when colouring granules (green, red, or yellow) are characteristic of the species, it is the inner region which contains them. It is the inner region which projects the true pseudopodia, these passing directly through and through the outer investing region; and further, it is the inner region which receives and digests the food in such forms as have shown crude objects incepted. But sharply marked off as may be the inner globular portion from the outer investing stratum, there appears no evidence of a "capsule" including the former; nor does it appear, therefore, that the outer can be regarded as homologous with the "extra-capsular," and the inner as corresponding to the "intra-capsular" region of a true or typical Radiolarian.

It is true that ere now in bringing forward before our Club *Heterophrys Fockii* for the first time, I have suggested a different view,[1] and it is also true that Greef proposed, in his recent paper, the same view which I then suggestively put forward, of the presence in this rhizopod (which I think I see portrayed in his fig. 35), of a "central capsule" represented by the definite outline of the inner globular body. But I do not any longer see the justice of the assumption, when compared with the seemingly *true* "central capsule" of the forms contained in his new genus Astrodisculus and *Acanthocystis spinifera*, for the very same sharp line of demarcation exists in those forms; because they contain *within* the globular central portion a capsule-like structure, it is unnecessary to assume the outer boundary of the inner region as the representative of the "central capsule," and yet the globular inner

[1] "Proc. Dub. Micr. Club," 19th Sept. 1867, in 'Quart. Journ. Micr. Science.'

region seems to me to be in both quite alike in this regard. But it further appears to me to be indisputable that (in *H. Fockii*, or *Pompholyxophrys punicea*, for instance), there is no capsule enclosing the globular central portion—first, because it cannot be seen when crushed or otherwise—secondly, because the margin of the inner globular region sometimes shows pulsating vacuoles (in *H. Fockii*), like those of Actinophrys or Actinosphærium—and thirdly, because crude food is incepted into it—all which could not happen were there a rigid 'capsule' (even though minutely 'perforated' for the passage of pseudopodia) enclosing it.

If this outward boundary of the inner globe in *Heterophrys Fockii* be truly the homologue of the "central capsule," with however delicate a wall, then the same part in Astrodisculus must have a like signification, and in that case must not, surely, the central globe represent rather the "inner vesicle" ("Binnenblase")?

Nor can this outer region, as it seems to me, be supposed to be truly the same thing, that is homologous with, that sarcode-layer, attributed by Wallich to the Polycystina—the "chitonosarc" Wallich—which film of sarcode he supposes to be formed by the universal coalescence of the bases of the pseudopodia themselves.[1] In the forms now described, this layer is not formed by the coalescence of the pseudopodia, for these, taking origin from the inner region, pass out directly through the outer, without the least appearance of any confluence.

The *other* heliozoan genera forming the subject of Greef's and my own communications (along with *Actinophrys sol*) do not present the character of two differentiated portions of the sarcode body. This appears to be similar throughout, but, as the case may be, in the new genera enclosing or surrounded by characteristic structures.

The following, then, may serve as diagnostic characters of the several forms brought forward :—

GENUS, *Acanthocystis* (Carter.)

Generic Characters.—Rhizopod composed of two distinct sarcode regions, the inner dense, hyaline and with or without colouring granules, of a globular and somewhat rigid figure, the outer colourless, soft, and delicate (sometimes difficult to be discerned), bearing a number of more or less elongate siliceous spicula discoid at the base and arranged in close approxima-

[1] Wallich "On the Polycystina," in 'Quart. Journ. of Micr. Science,' vol. v, N. S. page 71.

tion vertically upon the periphery of the inner sarcode body, which gives off, through the outer region, and reaching beyond the radiating spicula, a variable number of very slender, delicate, non-coalescing granuliferous pseudopodia.

It will be seen that, in the generic characters, I have claimed for Acanthocystis, as in some other new genera, two differentiated strata of the sarcode mass; the inner one is, of course, that within the cavity, the outer is not so perceptible, yet I think can be readily seen with close examination as a pale, colourless, granular, rather plastic, investment to the radial spines. It is not, I think, conceivable how these could originate, merely touched to the surface of the inner body-mass; they would not grow like a plant just in contact and no more, or even slightly immersed in the upper surface of the inner body: they must be deposited by sarcode. This outer sarcode region, I believe I readily see in living examples; and though I do not find it insisted on by Grenacher or Greef, I think I see it well depicted in the figures of the latter. I think that in Acanthocystis this differentiated outer sarcode region exists just as truly and as marked as in Raphidiophrys, Heterophrys, or Pompholyxophrys.

It will be further seen that I have left out any allusion in the foregoing characters to the assumed more or less curved tangental spicula, described by Carter as characteristic, inasmuch as I now conceive they are not of any essentially different nature, nor, indeed, even necessarily, present. Even when present, I should now, upon re-examination of the two Irish forms, quite coincide with Grenacher's suggestion that they represent but the discoid bases of certain of the spines, whose shafts have not become developed. If they were truly linear or arcuate, or crescentiform spicula, as Carter represented, and as I had myself long thought, though always puzzled about it, they should naturally be apparent on the upper portion of an example when focussed by an observer, and yet I could not perceive them; they, in fact, only appear linear when seen *edgeways* at the periphery of a specimen. These apparently distinct spicula, that is, the bases of the spines, are, of course, really circular, and appear so when viewed at the near or upper portion of a specimen, but they are very pellucid, and hence hard to be made out, even with accurate focussing, and this seems to me to account for the puzzle that the assumed linear spicula could be seen *only* at and towards the periphery.

So far, then, as I can see, the foregoing diagnosis lays down all that can be as yet absolutely stated as appertaining to the genus of which Carter's *A. turfacea* is the type.

Further accounts of its structure internally are given by Grenacher and by Greef in the papers already alluded to, but they are open to confirmation, and it may, therefore, be here useful as briefly as I can, to presently try to convey their observations.

The form described by Grenacher and called by him *Acanthocystis viridis*, is regarded by him as identical with *Actinophrys viridis* (Ehr.), but as distinct from *A. turfacea* (Carter). Greef, on the other hand, considers he latter and Grenacher's form to be identical, and truly none else but *Actinophrys viridis* (Ehr.). I would myself still venture to hold a different opinion, and regard it as not proven that *Acanthocystis turfacea* (Carter), is actually the same as *Actinophrys viridis* (Ehr.). That form is figured by Ehrenberg as densely fringed by the pseudopodia, which are very short, say not more than one third or one half of the diameter of the body. Even assuming that the radial processes are really siliceous spines (the true pseudopodia overlooked), they are thus so far quite unlike either Grenacher's or Greef's or our Irish form in these respects, for in these the spicula are comparatively fine and long, the longer ones quite equal in length to the diameter of the body (if not, indeed, longer), not to speak of their occurring of two distinct lengths. In fact, Ehrenberg's figure shows the radial processes only about equal in length to the shorter series of spines of *A. turfacea*. In the latter form, too, they are far less numerous and less crowded—could be without much difficulty counted—they do not form the *dense* fringe-like border shown by Ehrenberg. Hence it appears to me to be still a matter of doubt that Ehrenberg's *Actinophrys viridis* is trulythe same as *Acanthocystis turfacea* (Carter), or *A. viridis* (Grenacher), provided the two latter forms are distinct; until it should be proved that they indeed are truly identical, Carter's name should for the present, at least, and unless *A. viridis* (Ehr.) could be proved to be the same thing, maintain its currency.

The observations of Greef on the form *A. turfacea* (Carter), (*A. viridis*, Greef), are, as I shall now briefly try to narrate: The body is of a globular figure, frequently densely filled with green granules, showing apparent vacuoles, not pulsating. From the circumference of this globular body there stand off in a radial manner the closely posed siliceous spicula, these of two lengths. The longer are hollow spines expanded at the base in a discoid manner, and minutely forked at the apex. These are said to be by Greef in length about two thirds of the diameter of the body; I myself think they mostly attain in length as much at least as the full diameter of the

body; and, indeed, Greef's figures so depict them. Amongst these long radial spines there occur a fewer number of others, not attaining half their length (in Irish examples say about one third), still more slender, also discoid at the base, but notably more widely furcate at the apex. The pseudopodia are long, delicate, colourless, and granuliferous, and by both Greef and Grenacher described as possessing an axis like those of Actinophrys. For so far all this is apparent on even a superficial examination, and it accords, too, with Grenacher's description of his form, the main difference being that he represents the bifurcation of the apex of the longer spines as less pronounced and less divergent than in Carter's, and they are said to reach in length only half of the diameter of the body; thus, indeed, more approaching in this regard *Actinophrys viridis* (Ehr.), but still they are far fewer and far less crowded than in Ehrenberg's figure. A new point brought forward by Grenacher is the existence in the centre of the globular sarcode mass, of a little pale body or cavity from which proceed in an everywhere radiant manner, from the very centre numerous pale, delicate threads or lines showing an agreement in appearance with the *axes* of the pseudopodia; and the author assumes, though he could not satisfy himself, that these lines radiating from the common centre were, in truth, carried on directly through and through the body mass, reappearing as the axes of the pseudopodia. Greef confirms the account given by Grenacher, as he was able to extrude by pressure a vesicle containing a solid "nuclear mass" (Kernmasse), which he regards as the common central starting-point from which radiate the fine threads, and he thinks he can recognise in the extruded vesicle with its contained corpuscle, the doubly bounded space which occupies the centre of an uninjured example, but which he could never see of that sharply bounded stellate figure depicted by Grenacher. He (Greef) states he has been able to follow the central radiating lines even to under the surface of the body, where they get lost, and incapable of being directly followed outwards into the pseudopodia.

Greef alludes to two kinds of probable reproductive processes—a direct self-division of the total animal into two, and a resting or "encysted" state. The latter consists in the withdrawal of the sarcode body-mass from the inner boundary formed by the union of the bases of the radial spines, leaving a rather wide empty border, and its becoming invested by a double coat, a firm inner one, when empty dotted, as if perforated, and an outer hyaline one. Of any further development of this state Greef has not seen any indication.

It is difficult to condense his long and interesting account so as to do fair justice to the matter, but the foregoing may, I trust, convey an epitome of his principal observations.

I myself would argue as Greef does in one place that in *Acanthocystis turfacea*, just as little as in *A. Pertyana*, is there anything around the central sarcode body which might be denominated a special membrane. The so-called "lorica"—"biegsamer Panzer"—"verdichtete Rindenschicht"—can be but the expression of the mutually approximated discoid bases of the radial spines being held together with a considerable amount of coherence by means of some intervening bond not readily perceptible. One meets not unfrequently portions of the periphery of a defunct Acanthocystis, perhaps as much as a fourth or fifth of a circle (nay, whole globes sometimes), all the sarcode clean gone and nothing but a greater or less number of radial spines left, and those still cohering by their discoid bases, the shafts radiating in the same manner, just as they would if they stood at the periphery of a still living example. See also Greef's fig. 15 of an "encysted" state of this form, where the peripheral system of spines, still mutually coherent, stand off a distance from the contracted inner sarcode body, the latter now surrounded by its special investments. But Greef's views expressed in his account of this outer boundary (page 488), do not seem to me to coincide with those previously expressed (page 484). The following extract gives the ipsissima verba used by Greef in the latter place referred to:—"Ich meinerseits habe keine bestimmte Anzeichen finden können, die mit Sicherheit eine besonders abgegrenzte und erhärtete Rindenschicht, oder was doch wohl dasselbe sagen will, eine Membran bekunden, wohl aber mehrere die auf die Abwesenheit einer solchen schliessen lassen." And he adduces as evidence of the foregoing view the fact (not unfrequently to be seen), that large finger-like sarcode projections are capable of being extruded through the outer boundary, these withdrawn, and the place of their exit effaced, and the spines again all normally *in situ*. He also refers as additional evidence to the extrusion of green granules by a separation of the spines, and by intervening opening which again disappears. All this is just and according to fact, but I think the foregoing extract does not seem to accord with the following, in alluding, in the encysted state (fig. 15), to the very same outward boundary where the bases of the spines touch and form a hollow globe, now standing off leaving a vacant margin around the encysted body:—"Die Oberfläche dieses Saumes wird vielmehr durch eine zarte und glashelle aber starre und undurchdringliche Kieselhülle gebildet, in oder unter welcher die Fussplättchen der Stacheln festsitzen." It does not appear that they can truly be held imbedded in a rigid pellucid siliceous coat, from the strong reasons previously adduced. The intervening bond of union, whatever it may be, has then no connection with the central sarcode body, for the spines can independently maintain their mutual position, and yet this with greater or less readiness gives way to forces sometimes from within, and most likely sometimes from without, and in the living animal recovering position and coherence, as, for instance, pressing on the covering glass, or the action of the little parasitic rotatorian previously described by me. In addition to the fact of finger-like protrusions of colourless sarcode being projected and withdrawn, one sometimes sees likewise two individuals of *A. turfacea* united by an isthmus ("conjugated"?) (showing that the spines can recede from one another and come back to position) the isthmus gradually stretched, till it becomes a mere connecting thread of sarcode, which eventually snaps, and the two examples pass away from one another, no trace of the place from which the mutual band of sarcode emanated being left. Can such examples represent the state of "fission" (Zweitheilung), adverted to by Greef, as one of the reproductive conditions of *A. turfacea?* Under ordinary circumstances, the circular discoid bases of the spines must leave triangular spaces between, quite large enough to allow of the passage forth of the ordinary pseudopodia through the medium which we must assume causes the mutual coherence of the spines, and this without any displacement of the latter.

In this genus Acanthocystis Greef brings to notice three other forms; two he names as new, and the other he leaves in abeyance. One, which he calls *Acanthocystis pallida*, seems to me to differ in no respect from *A. turfacea* further than in the absence of the green colouring granules, except that he attributes to it the existence of the bacillar or linear spicula said to occur along with the radial spines, and as to which, indeed, he is silent as regards Carter's form. But, as I have mentioned, I now am quite disposed to hold these as very problematical. There remain only then the colourless granules to distinguish this form from *A. turfacea*. Now, quite colourless examples of what I have always thought could be none else than *A. turfacea* often occur here; nay, examples present themselves with a great proportion of the body mass bearing the green (chlorophyll) granules, and the remainder colourless, and these regions marked by a sudden transition. I think the same green granules sometimes become colourless. We see

sometimes Difflugiæ loaded with chlorophyll granules. *Raphidiophrys viridis* sometimes, but it is rarely, shows some colourless granules. I cannot but think, therefore, that *A. pallida* is only a colourless, not at all uncommon state, of *A. turfacea*.

But as regards another form (not named) referred to by Greef I would, indeed, very deferentially think he had far better ground to establish it as a distinct species. I mean the form he gives in Pl. XXVII, fig. 18. This form seems to be distinguished from *A. turfacea* by the want of the shorter series of radial spines—by the longer series, less copiously present, being, according to Greef's account, immersed to a certain extent within the periphery of the inner body—and, further, by the outer sarcode region, here strongly pronounced, being subdivided at the outer margin into a great number of exceedingly delicate, linear, acute processes, the pseudopodia passing, just as in *A. turfacea*, right out through the outer region afar into the water. This fringe-like subdivision of the marginal or circumferential portion of the outer sarcode-region strongly resembles that characteristic of my *Heterophrys myriopoda* (see my Pl. XVII, fig. 4). In that form, however, there are *no* radial spicula like Acanthocystis. Further, judging from Greef's figure his form is of a more olive-coloured green than *A. turfacea*. I do, therefore, venture to think this must really be quite distinct.

Greef, moreover, names a further new form *Acanthocystis spinifera*, of all the described forms, coming nearest to my *A. Pertyana*, but, as will be seen in the remarks following the diagnosis of that species, under the head of Affinities and Differences, seemingly, indeed, quite a different thing therefrom.

The following will, I think, serve as a diagnosis of the new form occurring in this country:—

Acanthocystis Pertyana (Arch.).

(Pl. XVI, fig. 1).

Specific characters.—Radial spicula very short, shaft comparatively thick, tapering, pointed at the apex; pseudopodia very slender, in length about equal to the diameter of the body, bearing minute granules passing up and down; body mostly colourless, but sometimes green when more or less loaded with chlorophyll-granules.

Measurements, variable; diameter of body from $\frac{1}{300}$ to $\frac{1}{600}$, length of spine $\frac{1}{5000}$ to $\frac{1}{3300}$ of an inch.

Localities.—In pools near Carrig mountain, county Wicklow, and in county Westmeath; rare.

Affinities and Differences.—This form is readily and at once distinguishable from *A. turfacea* (Carter) by its considerably smaller size, short tapering and pointed spines, of one kind only (not elongate, hardly tapering, bifurcate, and of two dimensions). It is, likewise, far more usually devoid of chlorophyll-granules than *A. turfacea*, nor are they ever seemingly present in the dense quantity which ordinarily characterises that far more striking species. The pseudopodia do not seem to be so delicate in my form, at least they are usually more readily noticed than in *A. turfacea*.

Its points of difference from Greef's new species *A. spinifera*[1] are not so manifest at first sight, but on closer comparison the two forms seem abundantly distinct. That species seems pretty nearly to agree with the present in dimensions (though apparently averaging a little larger), as well as in the radial spines being slender and pointed, but in it the spines are much longer, far finer, and much more elongate, and more acute. In *A. Pertyana* the spines are in length not more than a fifth or sixth part of the diameter of the body, whilst in *A. spinifera* they seem to be in length about three fourths of the diameter of the body. They agree in having a discoid base (Fussplättchen), as do, so far as we know, indeed all the species referable here. In my form there never appear any colouring granules except green, never yellow bodies ("yellow cells"?) like those often occurring in Greef's. Further, I have never seen in the former any indication of the central vesicular body (representative of "central capsule"?) which forms a distinguishing feature in the latter. I have never, indeed, myself seen Greef's form, but I cannot entertain a doubt as to its complete distinctness from mine.

As regards other described or figured forms I have already (p. 255) referred to its resemblance to *Actinophrys brevicirrhis*[2] (Perty); if, indeed, we conceive for a moment the pseudopodia absent from my figure, and assuming that the rays bordering the figures given by Perty, may be actually spines, not pseudopodia, the resemblance to Perty's is certainly greater than to any other published figure I know of; but the very great uncertainty due to the insufficient account given by him of his animal fully justifies my appropriating to this species a distinct name.

But in contrasting my form with Greef's *A. spinifera*, and on reading over his very interesting account of that species,

[1] Loc. cit., p. 493, t. xxvii, figs. 20—23.
[2] L. c., p. 493, t. xxvii, figs. 20—23.

I am led on to advert to his further suppositions regarding the assumed developmental or transition states thereof drawn by him.[1] Beyond any question Greef's figures 26, 27, and 28 represent nothing else than Barker's *Diplophrys Archeri*,[2] and nearly equally certainly Greef's figure 29 represents my own *Cystophrys oculea*.[3] The nearly orbicular (Fig. 26) or broadly elliptic (Figs. 27 and 28) figure of Diplophrys is there, the large characteristic conspicuous oil-like, amber coloured, refractive body, with the same little granular bodies, are there, and the two pencils of delicate pseudopodia emanating from opposite ends, but set slightly obliquely to one another, are there,—all just as they occur in this very marked little form, as it has presented itself in gatherings made from the east, south, west, and centre of Ireland. But although this wide distribution must be attributed to it, it is always seemingly scanty, and rarely encountered; this may indeed be, in part, due to its great minuteness. Perhaps Greef's otherwise excellent representation of this form would have been improved if he had indicated that sometimes the pseudopodia slightly subdivide dichotomously, and occasionally show more or less of a changeable dilatation at the point of ramification or along the length of a pseudopodium. I myself have never seen anything like Greef's figure 25.

(To be continued.)

On a New Polyzoon, "Victorella pavida," *from the* Victoria Docks. By Wm. S. Kent, F.Z.S., F.R.M.S. of the Geological Department, British Museum. With Plate IV.

In November, 1868, I briefly referred, in the pages of 'Science Gossip,' to a representative of the Ctenostomatous Polyzoa, taken by myself in the brackish waters of the Victoria Docks.

Though at the time possessing strong reasons for premising the species to be new to science, no name was conferred upon it, and it was rather brought forward with the view of attracting attention and possibly of recognition.

Having been fortunate enough this last autumn to secure fresh samples from the same locality, and feeling now convinced that the form represents not only a new species, but moreover, serves as the type of a new genus, and even family,

[1] L. c. t. xxvii, figs. 25, 26, 27, 28, 29.

[2] Proceedings Dublin Microscopical Club, in 'Quart. Journ. Micr. Science,' loc. cit.

[3] Ante in this paper, p. 265.

I proceed to describe it at greater length, and to bestow upon it a name which shall distinguish it from its congeners.

The sub-order of the *Ctenostomata*, in accordance with the system of classification most recently accepted, is subdivided into the two families of the *Alcyonidiadæ* and the *Vesiculariadæ*. The first of these is distinguished by the polypidom being sponge-like, fleshy, and irregular in shape, and in which the cells furnished with a contractile orifice are immersed. In the second the polypidom is plant-like, horny, and tubular, having free deciduous cells, whose extremities are flexible and invertile.[1] The species to which I would now direct attention, though possessing the circlet of setæ characteristic of the order, secretes a polypidom referable to neither of the two forms just indicated.

Its affinities with the *Vesiculariadæ* are the most marked, but, as will be seen on reference to the accompanying plate, the contour of the polypidom is entirely irregular, and wholly wanting in that uniformity and complexity of structure so characteristic of that family, possessing neither the main rachis nor the distinct deciduous cells by which all the members of the *Vesiculariadæ* are so readily distinguishable.

Hence, it appears essential that another family should be specially constructed for its reception, and, taking into consideration the uniform structure of the polypidom, I propose the acceptance of the term *Homodiætidæ* as a family name expressive of that same structure. The diagnosis of this third family may be briefly summed up as follows:

Polypidom horny, tubular; cells not deciduous nor separately distinguishable, but throughout freely communicating, their terminations flexible and invertile. The generic name I propose for this new polyzoon is *Victorella*, a somewhat lame acknowledgment of the great variety of animal life which the locality from whence it was procured has afforded me. The same characters above given serve also for its generic distinction, to which must be added that the animal has no gizzard, and is provided with eight ciliated tentacles.

[1] In Gosse's 'Marine Zoology,' and in the 'Micrographic Dictionary,' the genus *Pedicellina* is admitted as the representative of a third family of the *Ctenostomata*, but the error of such an arrangement becomes apparent on considering that the individual animals in the various species of this genus simply roll up their tentacles when at rest, and are unable to withdraw them within their polypidom; and hence the crown of protective setæ surrounding the orifice of the cell and characteristic of all the true Ctenostomes would be to them a simple superfluity, and the absence of these characteristic setæ, in conjunction with other well-marked structural peculiarities, has furnished ample grounds for setting this genus apart as the type of a separate sub-order known as the *Pedicellineæ*.