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PROFESSOR LEIDY'S "FRESH WATER RHIZOPODS OF NORTH AMERICA."

Dr. Leidy is acknowledged to be the highest authority on the subject treated in his great work, "Fresh Water Rhizopods of North America;" a criticism of the book becomes, therefore, a work of supererogation, and we reserve to ourselves the more pleasing task of pointing out its many beauties and particularly its importance as one of the most valuable contributions to the literature of microscopic forms of life.

Published by the Department of the Interior of the United States Government, and forming volume twelve of the "Report of the United States Geological Survey of the Territories" in charge of Professor F. V. Hayden, it is produced in a sumptuous form which no private publisher would have dared to imitate.

Dr. Leidy's Report covers about three hundred folio pages, illustrated by forty-eight full sized plates, printed in colors in the highest style of lithography.

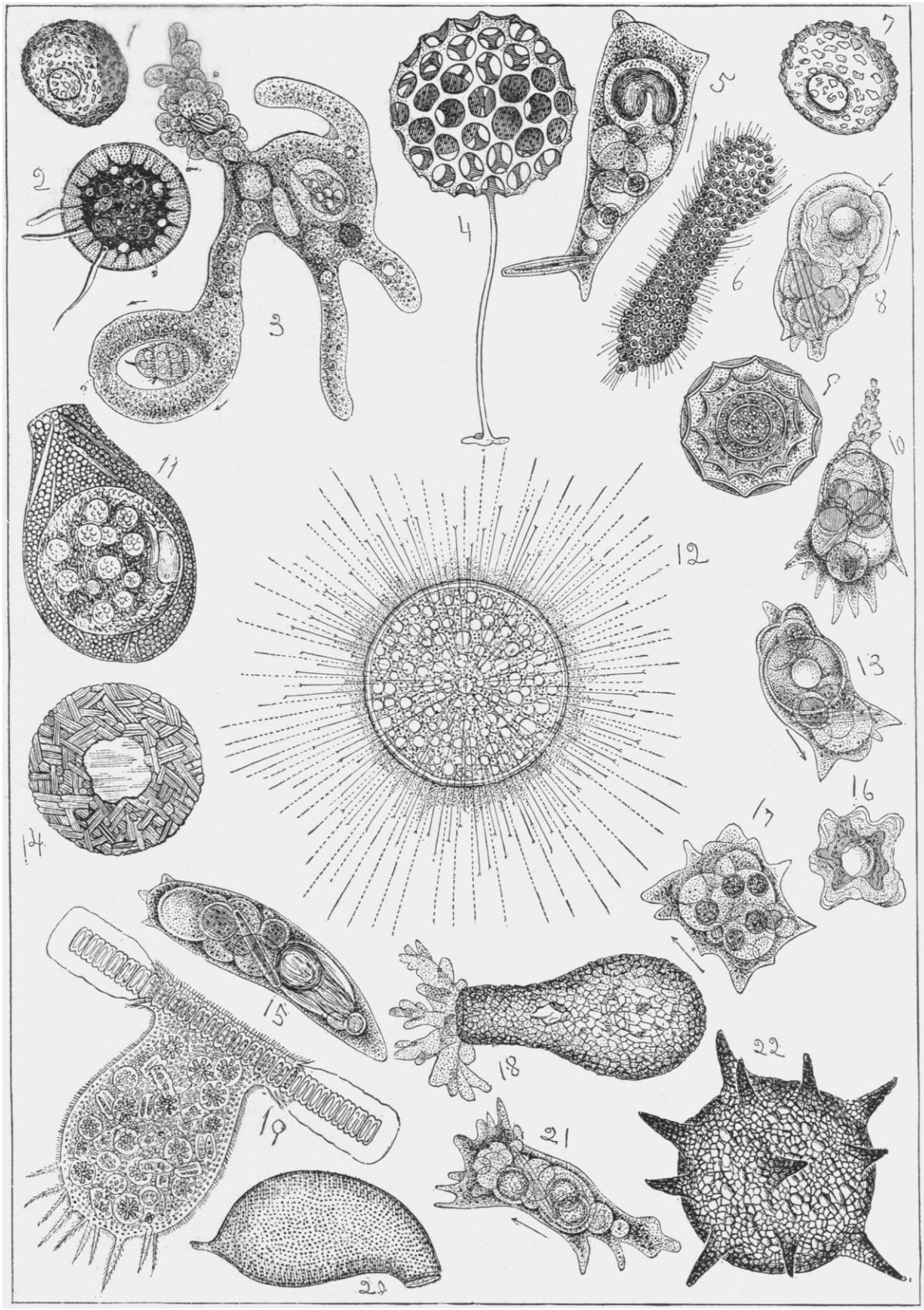
It may be a superfluous question to most of our readers, but as Dr. Leidy himself inquires in the first page of his work, "What are Rhizods?" In reply he says, "Rhizopoda are the simplest and lowest forms of animal life, constituting the first class of the Protozoa. They derive their name from the Greek word *rhiza*, a root, and *pous*, a foot. They are mostly microscopic beings, although sometimes sufficiently large to appear as conspicuous objects." We may add that the essential characters are the gelatinous structureless bodies, and the locomotive organs consisting of variable retractile root like processes (pseudo-poda or false feet).

Their minuteness is compensated for by their multitude and wide-world distribution; essentially aquatic they occur wherever there is moisture; the search for them may be commenced in the crevices of the stones at your door step, and may be continued in every marsh, pool, ditch, pond, lake, sea and ocean, and from the greatest depths of the latter to the snow lines of mountains.

The particular Rhizopods which form the subject of the book now under consideration, are those found in fresh water only, and Dr. Leidy expressly states that his attention, during the four years engaged, was directed more to the discovery and determination of the various forms occurring in the United States, than to the elaboration of details of structure, habits, modes of development, and other matters pertaining to their history.

Although it is professedly an illustrated catalogue of the fresh water Rhizopoda of North America, we find most interesting and valuable contributions to their life history which makes us regret that time and opportunity did not permit Dr. Leidy to extend his observations in this direction, for we know how exhaustive such a treatise would have been from his hands.

Instead of writing a discursive essay upon Dr. Leidy's book, already done by many brillant writers, which, with a work so purely technical, seems the least profitable method of treating the subject, we propose to take our readers through the book, acting the part of a friendly guide, trusting by the aid of twenty-two illustrations we have reproduced for this purpose, not only to do justice to the work in question, but to convey to those who have not



Drawn and Engraved for "Science."

studied the subject, a fair idea of the nature and form of Rhizopods.

In figure (3) we have a representation of the Amœba proteus, the most simple and wonderful of Rhizopodic forms—it is, to all appearance, a structureless gelatinous mass. As the *International Review* states (we fear somewhat rashly) it is without organs; they are certainly not permanently visible, and so far the most intelligent research has not discovered them; but the Amœba has the power of extemporizing such organs as are necessary for its existence, and has the means of reproducing its species. In the drawing, the pseudopoda, or false feet, are seen extended, and the animal is sketched while in the act of capturing an infusorial, by the act of joining the points of two of these pseudopoda.

In the Dinamœba mirabilis, figure (19), we find an advance made in structure, and a more specific form; the interior may be noticed to be full of desmids on which the animal feeds, and its posterior is widely expanded, so as to embrace a cord of Didymoprium.

In figure (18), Difflugia pyriformis, our Rhizopod is now found with a case or shell formed of irregular particles of quartz sand.

The empty shell of another of the same species, D. lobostoma, is shown at figure (14). The shell is composed of rectangular and oval plates, with dotted intervals.

Another of the Difflugia, D. Corona, at figure (22), still with a case formed of the same material, but of a somewhat different form, and having eleven spines; on the reverse side, the mouth would have been seen armed with teeth.

In figures (1) and (7), D. Constricta, we have further examples. In the original drawing they are colored a light redish-brown, whereas the previous examples were colored a blackish tint.

We now approach a beautiful design in form, the Nebela collaris, figure (11), the sarcode being contracted in the shape of a ball.

The design shown in figures (2) and (9), Arcella vulgaris, is still more beautiful and decidedly approaching the delicate patterns seen on the silicious valves of diatoms. The first in the original drawing is colorless, the second a light-brown, the sarcode being encysted.

In figure (20) is seen the empty shell of Cyphoderia ampulla, having a form somewhat similar to the Marine Rhizopods; the spur-like process may be noticed.

Clathrulina elegans, figure (4), is a very beautiful and remarkable form of Rhizopod, having a yellow colored lattice shell, enclosing sarcode in two balls, and supported by a stem of the same color. In other specimens Dr. Leidy shows the sarcode balls emitting numerous rays; this appears to be omitted in the present drawing.

At figure (6), Diplophrys Archeri, is a form of a different class taken from the swamp water on the mountains of Pennsylvania. Dr. Leidy describes them as composed of multitudes of minute globular individuals aggregated in masses, which in their movement causes the whole to undergo a change of shape. The corpuscle seen in each transparent body should be colored a bright cherry-red, to imitate the original drawing.

Acanthocystis chætophora, represented at figure (12), is very similar in form to the Actinophrys sol, or Sun animalcule, of the text books. The body is a finely granular protoplasm, invested with numerous delicate, silicious rays, implanted by minute basal disks; there are also numerous soft rays, like those of the Actinophrys, but distinguished from the silicious rays by the former ending in a simple pointed or furcate extremity.

We have now carried our readers briefly through Dr. Leidy's book, and have shown the beauty and variety of the forms studied. The interest attached to such investigations is obvious, and they are within the reach of every student. Considerable work has still to be done in this direction, and however great may be that done by Dr. Leidy, we feel sure that he would be the first to admit that so far the ground has been but broken.

To our mind it seems most important to concentrate future work on the genus Amœba, for therein lies the nucleus of the most valuable discoveries, which may even be of the highest importance to the human race. What is required in this direction is the constant and continuous observation of a single individual of the species, so as to arrive at its life history. We did hope that Dr. Leidy, in his present work, would have added to our knowledge on this point; but he frankly admits that neither himself nor others profess much knowledge relating to the reproduction of the Amœba.

It is, however, a question with us, if Dr. Leidy has not missed such an opportunity during his recent investigations.

At page 49 of this work on Rhizopods we notice Dr. Leidy describes what he calls an act of cannibalism, when he saw an individual (Amœba proteus) swallow and digest one of another species (Amœba verrucosa). We would ask, was this really an ingestive or a sexual act? Dr. Leidy takes the former view. With great respect for his

experience, we suggest that it may have been the latter, and we do so on the following ground.

In 1873 the Rev. W. H. Dallinger, F. R. M. S.,

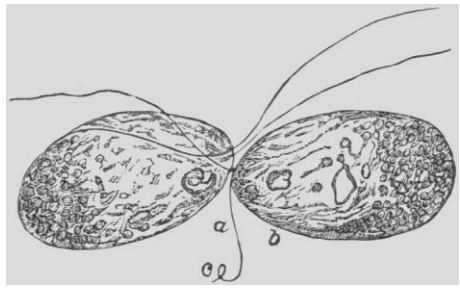


FIG. 1.

undertook, with Dr. J. Drysdale, to make a continuous microscopical investigation into the life history of a certain species of Monas. For this purpose they constructed apparatus which prevented the evaporation of the water, and the conditions were made perfect, to keep the specimen in a living state for a considerable time under the microscope. They then commenced to watch the monads in turns continuously, keeping the object in view without a break in observations for many days. During this close study of these monads, Messrs. Dallinger and Drysdale also observed an act so similar to that noticed by Dr. Leidy, that we will produce both statements for comparison.

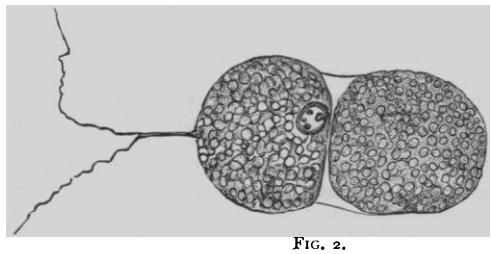


FIG. 2.

Messrs. Dallinger and Drysdale found the modes of re-production with the monads to be equally as varied as that known to exist with the Amœba, but there was one method which particularly attracted their attention.

Two monads at times met and touched their anterior ends, swimming freely together (figure 1), their bodies *then melted into each other*, (figure 2); it then became a single oblong mass, the line of juncture slowly disappearing, when after from six to 24 hours, it became rounded, (figure 3); at length the edges gave way, and myriads of minute points poured out, which were watched until they developed into perfect monads.

In figures Nos. (5, 8, 10, 13, 15, 16, 17, 21)* of our illustrations may be seen in the drawings, from Dr. Leidy's work, of what he observed of the mingling of two Amœbæ; he first speaks of their mutual approach, followed by an "embrace," when the jointed ends of the pseudopods *fused together*, and one sank deep into the body of the other, and eventually assumed the appearance of a sphere; further internal breaking up was then noticed, but later observation was not made. This is to be regretted as it seems quite probable that as "*the melting into each other*" was proved in the case of the monads to be a sexual act, that the *fusion*, when noticed by Dr. Leidy in the Amœba, may have been of the same character.

The necessity for the continuous mode of study

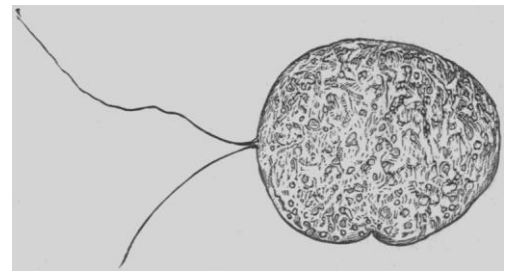


FIG. 3.

of such forms becomes more apparent every day, especially in the case of the Amœba, for in the very next paragraph to that just quoted, Dr. Leidy states "in my studies of Amœba proteus I have not been so fortunate as to trace its history from an early period, nor to discover its modes of reproduction."

There are other points to which we would refer, but having already exceeded our limit of space, we can only conclude by extending our thanks to Dr. Leidy for this his latest and most valuable contribution to SCIENCE, and to those who had the foresight and judgment to direct its publication.

*Figures (5, 8, 10, 13, 15, 16, 17, 21) illustrate the series of changes observed in the swallowing and digestion of an *Amœba verrucosa* by an *A. proteus*. From Bristol Marsh, Pennsylvania, August 27, 1876, 500 diameters. Fig. (16). *Amœba verrucosa*, comparatively quiescent with central contractile vesicle. Figs. (5, 8, 10, 13, 15, 17, 21). Successive changes in shape and relative position of *A. proteus* during the act of swallowing and digesting the former. Fig. (21). *A. proteus* approaching the *A. verrucosa* with anterior short diverging pseudopods. Fig. (8). The *A. proteus* embracing closely the *A. verrucosa* by a pair of digitate pseudopods, the points of contact of which being marked by the left hand arrow. Fig. (13). The *A. verrucosa* swallowed and forming a large sphere within the *A. proteus*. Fig. (10). The *A. verrucosa*, within the latter, has assumed an oval form, and is contained within a vacuole. The central contractile vesicle, which until now had remained persistent, had become less distinct. Fig. (15). The *A. verrucosa* has assumed a pyriform shape within a large elliptical vacuole and its contractile vesicle disappeared. Fig. (5). The *A. proteus* in the act of discharging a diatom, while the *A. verrucosa* has become doubled on itself. Fig. (17). The remains of the *A. verrucosa* seen as five granular balls within the *A. proteus*. Later these balls disappeared and their material appeared to be diffused among the granular contents of the *A. proteus*.