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Introduction

During the last quarter of the nineteenth century, a considerable number of investigators gained fame for their studies of the organisms usually placed in the order Amoebida, class Rhizopodea, subphylum Sarcodina, phylum Protozoa (Jahn, 1949), commonly referred to as the naked amoebas.

Because these scientists were working in a relatively untouched field of investigation—which it still remains—their attempts to classify the organisms they saw and depicted resulted in considerable confusion as to which amoebas were really legitimate species, and which were simply varieties of established species. The inevitable "lumper" and "splitter" appeared amongst these men as they applied their taxonomic techniques, and the confusion was extended to the literature.

The great work of Joseph Leidy (1879) reveals him as one of the "lumpers", as well as an extremely keen observer and draftsman. Having named *Amoeba proteus* Leidy, perhaps in violation yet-to-be clarified by rules of zoological nomenclature (Schaeffer, 1926); he was prone to regard other smaller amoebas which bore it a superficial resemblance as young forms of *proteus*.

During the summer of 1948 the writer had the good fortune to rediscover one of Leidy's "young amoebae *proteus*" which is clearly depicted in Figures 19 & 20, Plate VIII in Leidy's "freshwater Rhizopods of North America" (1879). It was obtained from a culture taken from a stagnant freshwater canal separated by a road fill from Emerson's Bay, West Okoboji Lake, Dickinson County, Iowa, near the site of the Iowa Lakeside Laboratory.

The amoeba was later observed in a culture of fresh rainwater taken from a ditch adjoining the Harshaw Chemical Plant in El Segundo, California, during March 1950, and further observations were made on it and recorded.

A survey of the literature concerned with the taxonomy of amoeboid protozoa failed to indicate that anyone other than Leidy has recorded evidence of having seen the organism, he dismissing it, as aforementioned, as a young *Amoeba proteus*.

Method of Observation

The organism collected in Iowa was observed with a Spencer binocular research type microscope having Italian made lenses of high resolving power on the 4 mm. and 1.8 mm. objectives. Lighting was provided by a 100 watt desk lamp, the light being passed through a 1000 ml. Florence flask filled with distilled water to filter out as much heat as possible.

The organism found in California was observed with a Spencer binocular research type microscope fitted with dark contrast phase objectives and condensor elements for the 4 mm. and 1.8 mm. objectives; and also by means of ordinary 16 mm., 4 mm., and 1.8 mm. Spencer research objectives. Light was provided by a 100 watt Spencer research microscope lamp, filtered through distilled water in a 500 ml. Florence flask.

Description of the Organism

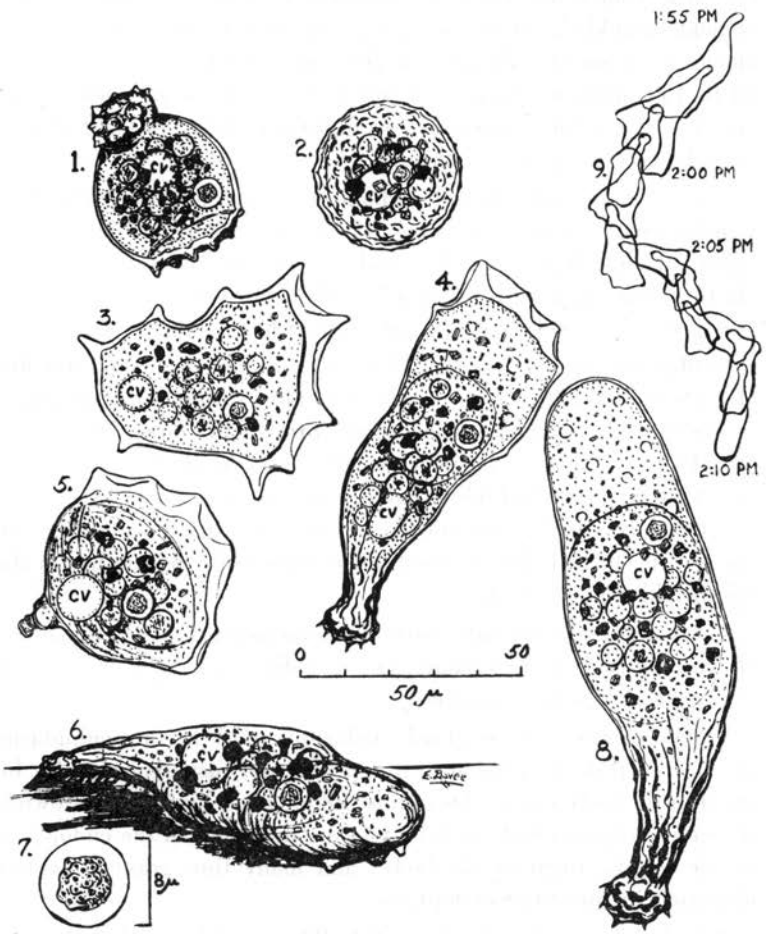
Characteristics

Spherical at rest, 35 to 40 μ in diameter, surface slightly rugous to punctate, with nucleus, contractile vacuole, food vacuoles, food bodies and large crystals clustered centrally. Disturbed, inactive, floating individuals egg-shaped, about 30 by 50 μ, with posterior end a punctate knob, and with short, conical pseudopods at the anterior end, of 2 to 3 μ length, and in varying numbers; several pneumatic gas vacuoles appear centrally amongst the clustered large inclusions (i.e., nucleus, contractile vacuole, food vacuoles, etc.), enabling the organism to float. In slow movement with little locomotion, flattened, 30 to 50 μ broad by 40 to 60 μ long; conical peripheral pseudopods, somewhat flattened, 6 to 10 μ long, 3 to 6 μ broad at the bases, tapering to rounded tip 1.5 to 2 μ in diameter; psuedopods sometimes connected almost to the tips by a clear, protoplasmic wave of ectoplasm; nucleus, vacuoles and granules mostly in the center, contractile vacuole slightly eccentric towards posterior end.

In slow locomotion similar to slowly active form, but slightly longer, with conical pseudopods formed anteriorly, the organism riding forward over them, pseudopods often connected by a clear wave shortly after formation; lateral pseudopods frequently diverted to the sides, remaining as the amoeba passes between them until they collapse, wrinkle and are absorbed by the posterior end. In moderate locomotion 90 to 110 μ long, anterior third flattened, 20 to 30 μ long by 30 to 40 μ wide, forming pairs of pseudopods connected by clear waves anteriorly; middle third egg-shaped 30 to 40 μ long by 20 to 25 μ broad, containing nucleus, contractile and other

vacuoles, globules and crystals, contractile vacuole nearest posterior end; posterior third roughly cylindrical, wrinkled, to nearly conical, with bulbous posterior tip, bearing a uroid of about half a dozen short, conical filaments, 1.5 to 2 μ length. During rapid locomotion, clavate, anterior end rounded, conical pseudopods formed

PLATE I



1. A floating stage of *Mayorella clavella* nov. sp. assumed after the amoeba had been disturbed when in locomotion.
2. An individual in the spherical, resting state.
3. The organism as it appears in movement with but little locomotion.
4. An individual in moderately rapid locomotion.
5. An individual just beginning locomotion from a previously floating stage which has recently descended to the substrate.
6. A reconstructed perspective view of an individual in rapid locomotion.
7. An enlargement of the nucleus, showing detail.
8. The amoeba in rapid locomotion.
9. The typical wavy path of locomotion of the organism followed during a fifteen minute period, showing momentary outlines of body form at various intervals enroute.

CV—the contractile vacuole.

antero-ventrally below rounded anterior end, difficult to see; anterior third a somewhat flattened, slightly tapering tube about 25 μ wide by 30 μ long, filled with clear endoplasm containing only barely visible granules and a few small truncated bipyramidal crystals; middle third egg-shaped, 50 to 60 μ long by 20 to 25 μ wide, containing nucleus, vacuoles, globules, larger crystals, nucleus usually forward, contractile vacuole circulating; posterior third slightly conical, wrinkled, 40 to 50 μ long, tapering from about 20 μ diameter to about 10 μ diameter at the posterior knob, which is about 12 to 15 μ diameter, bearing about half a dozen short conical filaments 1 to 2 μ long, composing an indistinct uroid, no large objects in endoplasm of posterior third.

Nucleus spherical, clear, 8 μ diameter, containing pale bluish to bluish-green, central endosome 4.5 to 5 μ diameter, irregularly spherical and slightly knobby, both nucleus and endosome slightly elastic. Nucleus usually located in central third of body, in locomotion preceding food vacuoles and contractile vacuole.

Contractile vacuole single, 17 to 18 μ diameter, forms and discharges about once per minute during rapid locomotion; circulates in middle third of body, discharging through the dorso-lateral surface like a collapsing balloon, usually just ahead of the wrinkled posterior third of the body; replaced by another which appears, of a size barely visible, in about ten seconds after discharge of the old one, filling to full size in about 40 seconds while circulating in the middle third of the body.

Up to a dozen, sometimes more, food vacuoles, 6 to 12 μ diameter, containing bacteria in various stages of digestion, vacuoles pinkish to orange as digestion progresses.

Irregular, greenish to bluish inclusions exist in the endoplasm, up to several dozen present, 3 to 6 μ diameter, usually centrally located in the body mass. Also up to 100 or more bluish to yellowish, truncated, bipyramidal crystals, 1 to 3 μ diameter, in the endoplasm of the middle third of the body; and many tiny granules widely dispersed in the entire endoplasm.

Speed of locomotion is about 50 to 90 μ per minute along a wavy path in moderately rapid progress; in rapid advance it reaches speeds of up to 130 μ per minute.

Activities

In locomotion this amoeba progresses much as do others as described by Mast (1929, 1934), endoplasmic sol flowing forward against the hyaline ectoplasm at the anterior end where it turns to

gel to form a peripheral tube through which more endoplasmic sol is pushed forward. The posterior third of the body contracts, pushing the sol forward, and new sol is formed by conversion of the gel to sol posteriorly at the same rate that sol is being renewed anteriorly. As the posterior part of the body contracts, ectoplasmic filaments are formed ventrally as the body is lifted above points of adhesion to the substrate, and as the body passes over the points of adhesion the filaments appear briefly as the uroid, until pulled loose and reincorporated with the posterior ectoplasm.

Feeding activities were not fully observed. However, new food vacuoles were seen to appear ventrally as the organism moved over bacteria on the substrate and incorporated them within a vacuole. How the vacuole was formed was not determined insofar as the manner in which the amoeba accomplished its construction. It simply "appeared" as the organism passed over the bacteria.

It is particularly noticeable that the larger inclusions in the body of the amoeba remain aggregated in the middle one third of the body mass at all times, both during rest, and all speeds of locomotion and activity. The larger inclusions circulate somewhat, the nucleus tending to precede the food vacuoles and larger amorphous masses during locomotion, and the contractile vacuole tending to move to the rear, but restricting their movements within the middle third of the body mass. Only smaller crystals and barely visible granules are found in the endoplasm in the somewhat flattened anterior third of the body mass, or in the contracted, wrinkled, tube-like, posterior third of the body.

When disturbed, the organism ceases activity, and contracts peripherally, retaining the pseudopods, and general outline which it had when disturbed, in a contracted form. It usually develops several gas bubbles or vacuoles of diameters up to about 15 μ which enable it to float away from the area where it encountered the disturbance. When returning to activity, the gas bubbles are absorbed, and the amoeba settles to the substrate, reactivating the old pseudopods, or extending new ones as it begins locomotion.

Discussion

This amoeba is quite clearly the same one depicted by Leidy in Figures 19 and 20, Plate VIII in his "Freshwater Rhizopods of North America". He has shown the amoeba in rapid locomotion, and the details of its body form, the shape of the nucleus and its position, the size and position of the contractile vacuole, and the nature of the inclusions as he shows them are easily recognizable in

the living animal. There is no doubt in the mind of the writer that they are the same species.

Since Leidy dismissed it as a "young *Amoeba proteus*", and did not recognize it as the separate species which it undoubtedly is, it is therefore an unnamed species. It superficially resembles the *Amoeba limax* of Penard (1902), but does not form floating stages of the type described by him for that species, and it differs in size. It does not appear to have been previously described and named by any earlier investigator so far as the writer can ascertain on the basis of a survey of available literature at his disposal. It appears that no one has described it previously, and only Leidy has depicted it.

Its place in the taxonomy of the Amoebida is to be determined, then. The most practical classification yet advanced for the amoebas is that of Schaeffer (1926), which employs as many features of the external and internal morphology as possible, adhering to the principal of employing the locomotor organelles for basic determination, as is done for most of the Protozoa which possess them.

Quite clearly, according to Schaeffer's scheme, this amoeba belongs to the family Mayorellidae, which is characterized by the formation of clear, conical, ectoplasmic pseudopods of determinate length. It conforms to the type of conical pseudopod possessed by the genus Mayorella, which develops small, clear, conical pseudopods, having rounded tips, and being produced anteriorly, usually from a clear anterior margin. It never forms waving pseudopods, and thereby meets another of Schaeffer's requirements for the genus Mayorella, from which he excluded all similar amoebas which develop waving pseudopods. In other respects it also agrees with other members of the genus, having a nucleus of the type usually found in the Mayorellas previously described, clear, and with a central endosome; a contractile vacuole which is single and fairly large; truncated, bipyramidal crystals which are often found in the genus; and bacterial feeding, which is also common in the genus.

Its family and genus having thus been determined, its species remains to be established, and it is here proposed that it be named *Mayorella clavella* nov. sp., because of the club-like appearance of the amoeba in rapid locomotion, following the recommendation of Schaeffer (1926) that characteristics of the locomotive form be employed in constructing a species name descriptive of the organism.

Mayorella clavella nov. sp. shows many characteristics similar to some other described Mayorellas, most closely resembling *Mayorella clavabellans* described by Bovee (1950), differing from that or-

ganism by being somewhat larger, and forming fewer visible anterior pseudopods in locomotion, and having a larger nucleus.

Summary

1. An amoeba, found both in Iowa and California, is identified as identical with the unnamed one shown in Figures 19 and 20. Plate VIII, of Leidy's "Freshwater Rhizopods of North America" (1879).

2. The organism is described in detail, and depicted in various stages of activity.

3. The amoeba is identified as belonging to the order Amoebida, family Mayorellidae, genus Mayorella.

4. It is proposed that it be named *Mayorella clavella* nov. sp.

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