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A NEW PROTOZOAN, *PARATRICHOMONAS ULMERI* (MASTIGOPHORA), FROM THE AMERICAN WOODCHUCK, *MARMOTA MONAX* LINNAEUS

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Reexamination of the material from 14 woodchucks used in a previous survey of this host has revealed an additional protozoan symbiote of its lower intestinal tract. The symbiote is a rather rare organism and was found in only one of the 14 hosts examined. Its close similarity to *Paratrichomonas marmotae* (Crouch) Gabel and the sparseness of the population in the host contributed to its being overlooked in the previous survey (Gabel, 1954). The host harboring this protozoan was trapped in the vicinity of Chestnut Hill, Philadelphia, Pennsylvania, and autopsied at the Philadelphia Zoological Gardens in the spring of 1951.

The slides studied had been fixed with Schaudinn's sublimate-alcohol-acetic acid, Hollande's and Bouin's fluids. Staining techniques used were Heidenhain's haematoxylin and Moskowitz's (1950) modification of the Bodian protein silver technique. All drawings were made to the magnification of 4000 with the aid of a camera lucida.

Paratrichomonas **ulmeri** n. sp.

The flagellate has a variable shape, ranging from oval to bean-shaped with the ventral side sometimes flattened. Very often the anterior one-third of the ventral surface appears to have a slight dorsally directed concavity (Figs. 2, 3, 4). The posterior end of the organism may be drawn out along the borders of the protruding axostyle (Figs. 2, 3, 5, 6), but this is not a constant feature for the flagellate is sometimes rounded posteriorly (Figs. 1, 4, 8).

The size of the organism varies slightly depending upon the fixing and staining techniques used. Because of the scarcity of the population, measurements are based on a small number of the organisms. Twenty-five specimens from protein silver preparations gave an average length of 4.96 (4-6) microns, and a width of 2.71 (1-4) microns. The length does not include the protruding tip of the axostyle which has an average extension of 1.53 (1-2) microns. Forty-eight organisms from iron haematoxylin preparations showed a slightly larger size having an average length of 5.78 (4-9) microns, with a width of 3.18 (2-4) microns. The amount of protrusion of the axostyle compares well with protein silver slides, averaging 1.63 (1-3) microns. These figures show that there is about 1 micron (0.91) variation in overall length between specimens prepared by protein silver and iron haematoxylin techniques, indicating that there

is a difference in the amount of shrinkage between the two methods of preparation.

The flagellar structures consist of three anterior flagella of equal diameter but unequal length. Two of these flagella are of body length or slightly longer, while the third is usually shorter than the body. These three anterior flagella are usually united in a short column about 1 micron long from their base in the blepharoplast and the shorter of the three flagella is the first to break away from the other two (Figs. 1, 2, 4, 5, 6). Protein silver preparations reveal a slight bulb at the tip of all flagella (Figs. 5 to 8). There is a trailing flagellum which passes posteriorly, bordering the undulating membrane, and then extending behind the organism as a free flagellum for about two and one-half times the body length. The posterior flagellum becomes a fine fiber abruptly after it leaves the body. The termination of the thickness of this fiber varies from the end of the undulating membrane (Figs. 2, 4, 5) to a point some distance from the body (Figs. 3, 6, 7).

An undulating membrane arises from the blepharoplast and usually has three broad undulations, ranging from one-fourth to one-half the body width. This undulating membrane generally extends the length of the body but some organisms have a shorter one. The latter are often specimens which have a rounded posterior end (Fig. 1). The undulations vary from two to five with three as the average number and the thickness of the outer edge shows that it is bordered by the posteriorly directed flagellum.

The costa, lying beneath the undulating membrane, is a thin, dark-stained rod of uniform thickness, running the whole length of the body. It has the appearance of being round in cross-section for there is no variation in diameter when it is viewed from different angles. Sometimes the costa and the undulating membrane spiral around the body in their course toward the posterior end (Fig. 1). There are no granules specifically associated with the costa.

The flagella structures have their source in a single, large, chromatic blepharoplast situated against the apex of the cell. The small size of the organism makes it difficult to resolve the granular complex of this structure. The costa and the axostyle are connected to the blepharoplast.

The nucleus lies in the anterior one-third of the body with its axis at about a 45° angle from the longitudinal axis of the organism. It is usually oval but may be round or bean-shaped (Figs. 1, 2). Iron haematoxylin preparations show a definite endosome (Figs. 1, 2, 4) and some protein silver preparations give the impression of an endosome being present (Fig. 7). The nucleus stains darker than the surrounding cytoplasm and its membrane is visible as a dark, granular border to the nucleus.

An axostyle passes from the blepharoplast to the posterior end of the protozoan where it protrudes from 1 to 3 microns beyond the body. It tapers to a needle-like point outside the cell. The length of the protrusion of the axostyle varies among the population studied;

however, those organisms which had the axostyle protruding the farthest were usually rounded at the posterior end (Figs. 1, 4, 8). This indicates a shrinkage of the protoplasm away from the axostyle, probably as a result of the fixing and staining techniques. There are no granules associated with the axostyle nor any chromatic ring surrounding it at the posterior end of the body. The anterior end broadens into a capitulum (Figs. 6, 7) similar to that described by Wenrich and Emerson (1933) for *Tritrichomonas foetus* (Riedmuller). The broadening begins about the mid-point of the body and extends almost to the blepharoplast. The axostyle may be hyaline or granular in nature.

A small ovoid to rod-like parabasal body lies between the nucleus and the costa, usually over the anterior half of the nucleus (Fig. 8). It follows the curve of the nuclear membrane against which it lies. It can be seen when the organisms have been treated with the protein silver technique which also shows it to be attached to the blepharoplast by a very fine rhizoplast.

There has been no indication of a pelta in this organism. Many of the protein silver preparations had groups of granules clustered in the anterior end, and detailed study failed to disclose any structure which could be called a pelta.

The cytoplasm appears to be of an almost uniform granular nature in iron haematoxylin preparations, often with a scattering of larger clumps of granules. Protein silver preparations show the cytoplasm as alveolar or vesicular, a condition probably caused by the extremes of the technique. There is no indication of this organism having a cytostome.

Diagnosis

Paratrichomonas ulmeri n. sp.

Host. Marmota monax Linnaeus
Diagnostic description from *M. monax*. Length 5.37 (4-9) microns; width 2.95 (1-4) microns; protruding axostyle 1.58 (1-3) microns; three slender flagella, two body length or longer, the third less than body length; posterior flagellum forms margin of body length undulating membrane, free beyond end of the membrane with sharp decrease in diameter after becoming free flagellum, 4-10 microns long; costa a thin, round rod from blepharoplast to posterior end of the body; clockwise spiral to the costa and undulating membrane; large blepharoplast at anterior end of the body; nucleus in anterior one-third of organism, bean to oval shape, with endosome; axostyle with club-shaped capitulum and sharp, needle-like posterior point; parabasal body rod-like, lies against anterior dorsal surface of nuclear membrane.
Disposition of type material. Slides containing type specimens are in the author's collection.

Discussion

That this protozoan was overlooked in the previous survey is not surprising when only 73 organisms have been observed in the present survey of two dozen slides. The organism is not easily distinguished from *Paratrichomonas marmotae* and was mistaken for a smaller sized population of that species.

The absence of a pelta and the rod-shaped parabasal body are two

features which readily distinguish this organism from *Paratrichomonas marmotae*. Other features are the undulating membrane and costa which extend the full length of the body in *P. ulmeri* whereas in *P. marmotae*, like *Tritrichomonas batrachorum* (Perty), they are three-fourths body length. There seem to be no additional filaments connected with the undulating membrane as are found by Honigberg (1953) in *T. batrachorum*, in *T. foetus* (Riedmuller) by Wenrich and Emerson (1953), by Gabel (1954) in *T. wenrichi* (Crouch), in *Trichomonas wenyoni* Wenrich by Wenrich and Nie (1949), and in *T. microti* Wenrich and Saxe (1950). The variation in the length of the three anterior flagella of *Paratrichomonas ulmeri* separates it from *P. marmotae* which has anterior flagella of equal length. The flagella are always three in number, so far as observed, and the variation in length is limited to one of the anterior three. The lack of any subcostal granules, as described by Gabel (1954) in *P. marmotae*, in *Tritrichomonas muris* Galli-Valerio and Hartmann by Wenrich (1921) and by Kirby and Honigberg (1949), in *T. wenrichi* by Kirby and Honigberg (1949) and Gabel (1954), and in *T. augusta* (Alexeieff) by Chen (1949) and by Buttrey (1954), is another distinctive feature of *Paratrichomonas ulmeri*. The capitulum of the axostyle in *P. marmotae* is spoon-shaped whereas that of *P. ulmeri* is club-shaped like that of *Tritrichomonas foetus* as shown by Wenrich and Emerson (1933). The diminutive size of *Paratrichomonas ulmeri*, similar to *Tritrichomonas minuta* Wenrich (1924), should also be considered as a differentiating characteristic when included along with the other structures. These features are sufficient to distinguish it as a species separate from *Paratrichomonas marmotae*.

It is the desire of the author to give this organism the name designated as a token of gratitude to Mr. Fred Ulmer of the Philadelphia Zoological Gardens, for his assistance in the spring of 1951. Because the new species was found in the groundhog Mr. Ulmer provided at that time, this organism is designated as *Paratrichomonas ulmeri* n. sp.

Summary

A new species of flagellate, *Paratrichomonas ulmeri*, is reported from the caecum of *Marmota monax* Linnaeus. The organism resembles *P. marmotae* but is smaller in size, and has one of the three anterior flagella shorter than the other two. The undulating membrane and costa extend for the length of the body and show no accessory filaments to the undulating membrane nor paracostal granules.

The axostyle is club-like in appearance, varying from hyaline to granular and ends in a sharp posterior point which protrudes from 1 to 5 microns beyond the body. The posterior flagellum borders the undulating membrane as a thick fiber and tapers sharply to a fine filament after becoming free from the undulating membrane.

The nucleus is oval to bean-shaped and has a distinct endosome. A

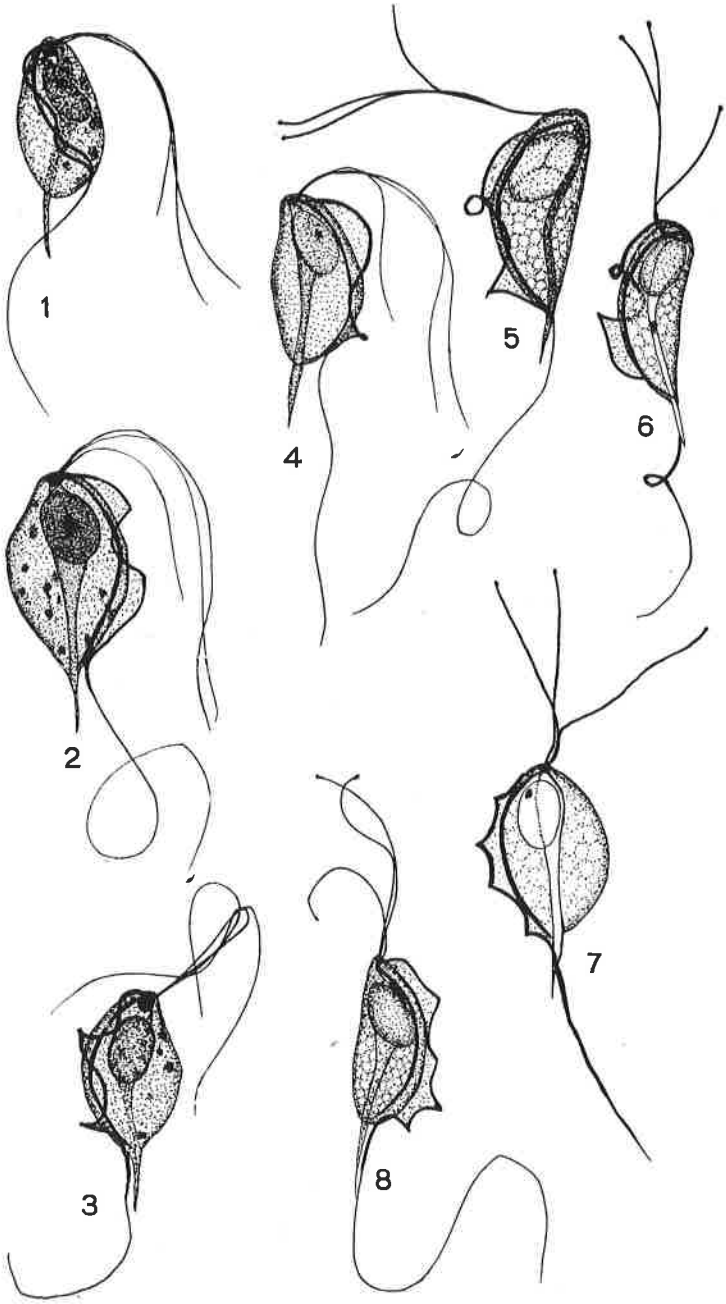

Plate I. All figures are of *Paratrichomonas ulmeri* n. sp.

parabasal body lies against the dorsal surface of the nuclear membrane. Neither pelta nor cytostome were observed.

The new species name, *Paratrichomonas ulmeri,* is given because of the apparent morphological differences from the species already described from the woodchuck.

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Explanation of Plate

Figs. 1-4. Heidenhain's haematoxylin

1. Dorsal view
2. Left lateral view
3. Right lateral view
4. Left lateral view

Figs. 5-8. Protein silver

5. Right lateral view
6. Right lateral view
7. Right lateral view
8. Left lateral view

NEWS OF TENNESSEE SCIENCE

(Continued from page 259)

special care unit, special studies are being made of patients with diseases associated with pregnancy. The Atomic Energy Commission has awarded $17,946 for a study of the effects of radiation on the entire body. The investigation is concerned with changes in body chemistry and function brought about in primates resulting from exposure of the body to high doses of radiation. An $8,694 grant, also from the AEC, will finance a study of the factors which govern the permeability of blood vessels to common elements found in the body, particularly sodium and potassium, which are important to the maintenance of healthy function. On a $6,809 grant from the United States Public Health Service, an investigation is being made of certain drugs which produce an increase in urinary out-put. A $7,300 grant, also from the Public Health Service, will permit a study of the physiological effects of high fever, especially as it affects the heart and blood vessels.

Dr. Aaron Ganz, assistant professor of pharmacology at the University of Tennessee Medical Units, has been awarded a $4,428 research grant by the

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