SCHOOL OF TROPICAL MEDICINE
JAN 26
SAN JUAN, P.R.

THE PUERTO RICO JOURNAL OF PUBLIC HEALTH AND TROPICAL MEDICINE

VOL. 12 DECEMBER, 1936 NO. 2

SOME POLYMASTIGOTE AND HYPERMASTIGOTE FLAGELLATES FROM PUERTO RICAN TERMITES *

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At the invitation of the Director of the School of Tropical Medicine at San Juan, Puerto Rico, I spent the months of February and March, 1935, in studying the Protozoa of San Juan and its environs. The present report is an initial paper on some of the more striking of the symbiotic abdominal flagellates from certain termites of this region.

I gratefully acknowledge the courtesy of Dr. T. E. Snyder, Senior Entomologist of the Forest Insect Investigations, in identifying some of the termites providing the material for this report. He very kindly sent me a list of the termite species which have been reported from Puerto Rico as follows:

Family Kalotermitidae Banks.

1. *Kalotermes snyderi* Light, reported from Río Piedras.
2. *Neotermes castaneus* Burmeister.
3. *Kalotermes castaneus* Burmeister.
4. *Cryptotermes brevis* Walker.
5. *Glyptotermes pubescens* Snyder, from Aibonito in coffee tree.
6. *Glyptotermes corniceps* Snyder.

Family Rhinotermitidae Froggatt.

1. *Heterotermes tenuis* Hagen, from Aibonito by Banks.
2. *Heterotermes convexinotatus* Snyder, from San Juan.

Family Termitidae.

1. *Tenuirostritermes discolor* Banks, from El Yunque.
2. *Tenuirostritermes wolcotti* Snyder.
3. *Microcerotermes arboreus* Emerson.
4. *Nasutitermes moris* Latreille.
5. *Nasutitermes creolina* Banks.
6. *Nasutitermes sanchezi* Holmgren.
7. *Nasutitermes costaricensis* Holmgren.

* Received for publication May 12, 1936.

Termite material from four different sources was examined for Protozoa:

1. From a strong infection in certain doors in the School of Tropical Medicine in San Juan, March 24.

2. From an infected window frame in the same building, March 21. Thinking that this species and the one above mentioned were the same, as they came from the same building at nearly the same time, I sent samples of the more numerous type of March 24 to Dr. Snyder for identification. These were reported as *Cryptotermes brevis*. Later study of the flagellate fauna of this termite and comparison with that of the March 21 termite showed that they were not the same species of termites, the former having almost exclusively polymastigotes and the latter only hypermastigotes.

3. A third type of termite was obtained through the kindness of Dr. del Toro of San Juan. It came in fragments of a pine box in which the insects were found solitary at the blind ends of long tunnels running with the grain. I was able to get only eight or ten specimens and, vainly hoping to get more for identification, I used them all for study of the contained Protozoa. The flagellates were of the same types, although less numerous, as those found in termite No. 2, above. In neither was the species determined, but there is a remote chance that it was *Heterotermes convexinotatus*, which has been found in San Juan and belongs to the same family (Rhinotermitidae) in which the same types of contained flagellates are most abundant.

4. A fourth type of termite was obtained from a large rotting tree part way up the mountain of El Yunque, near San Juan, but its identification is not satisfactory.

The procedure in making preparations was as follows: the flagellates are pressed out of the abdomen into a small drop of 0.4 per cent to 0.6 per cent normal salt solution on a cover glass. The drop is quickly spread out and the cover glass immediately immersed in a Columbia staining jar filled with saturated bichloride of mercury in absolute alcohol. They are left here for about thirty minutes and are then passed through the alcohols to water and stained with iron haematoxylin. After staining for one hour to twenty-four hours, the jet-black material is de-stained with saturated aqueous picric acid or with 2 per cent iron alum. The preparations are thoroughly washed in running water, dehydrated, and mounted in Canada balsam.

Order POLYMASTIGIDA

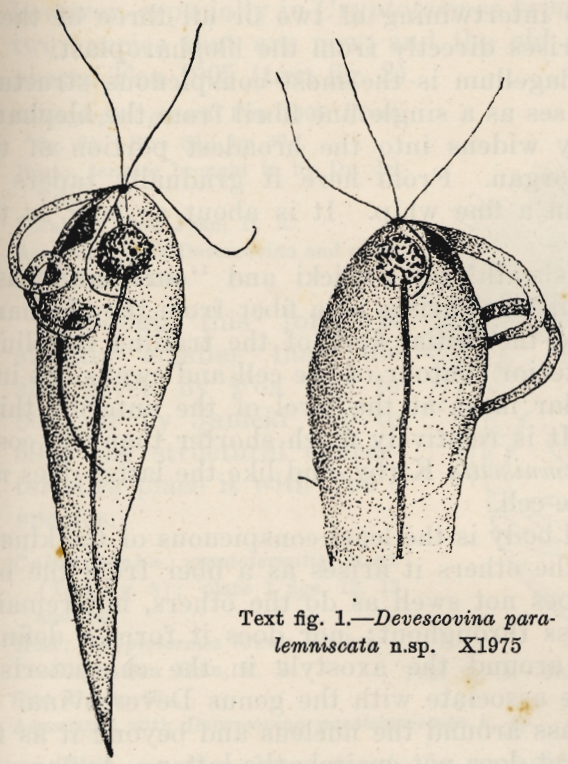
Genus DEVESCOVINA Foa 1905.

Species: *Devescovina paralemniscata* n. sp. Text fig. 1. Size 39μ to 42μ by 11μ to 13μ.

Host termite: *Cryptotermes brevis* Walker.

Locality: San Juan, P. R.

The genus Devescovina is widely distributed amongst termites of the subfamily Kalotermitinae Holmgren of the family Kalotermitidae Banks. Nine species of Devescovina have been reported, four from the termite genus Cryptotermes and four from Kalotermes.



Text fig. 1.—*Devescovina paralemniscata* n.sp. X1975

Individuals of the present species of Devescovina are quite uniform in size and all are elongate - pyriform in shape, widest at the anterior end and tapering posteriorly. They thus resemble Janicki's "slender form" of *D. striata* var. *hawaiensis* in shape but differ in all other points. The pellicle is without striations of any kind, thus resembling Grassi's *D. glabra* or *D. nova,* and Lewis' *D. polyspira.*

The endoplasm in the majority of individuals is clear and homogeneous, but fine wood splinters are present in some. No structure that can be interpreted as a cytostome is found, and there is no evidence of an anterior papilla. The nucleus is spherical and is situated near the anterior end. It contains finely granular chromatin and a small endosome which is only slightly larger than the surrounding chromatin granules (text fig. 1). A fine fibril runs from the nucleus to the blepharoplast.

The blepharoplast at the anterior end of the body is large and conspicuous and contains from one to three deeply-staining granules. As in other species of Devescovina it forms the center of the kinetic elements of the cell. These include anterior flagella, trailing flagellum, costa, parabasal filament and axostyle.

The anterior flagella are delicate and relatively short (about one-third of the body length). They are evidently three in number, although frequently only one or two can be made out, due to intertwining of two or all three of them. Each flagellum arises directly from the blepharoplast.

The trailing flagellum is the most conspicuous structure of the cell; it arises as a single fine fibril from the blepharoplast, but quickly widens into the broadest portion of the flattened motile organ. From here it gradually tapers in width and ends in a fine whip. It is about as long as the body.

The costa ("sheath" of Janicki and "chromatic basal rod" of Kirby) likewise arises as a fiber from the blepharoplast and close to the initial fiber of the trailing flagellum. It follows the anterior contour of the cell and swells out into a plump triangular mass at the level of the anterior third of the nucleus. It is relatively much shorter than the costa of *Devescovina lemniscata* Kirby, and like the latter does not protrude from the cell.

The parabasal body is the least conspicuous of the kinetic elements. Like the others it arises as a fiber from the blepharoplast; it does not swell as do the others, but remains the same thickness throughout; nor does it form a definite element, coiling around the axostyle in the characteristic manner which we associate with the genus Devescovina. It does, however, pass around the nucleus and beyond it as far as the axostyle, but does not encircle the latter. Apparently it is equivalent only to the parabasal or axial thread of the parabasal of other species.

The axostyle arises anterior to the nucleus, does not divide to enclose it, but continues with uniform diameter to about three quarters of the length of the cell where it ends abruptly (fig. 1).

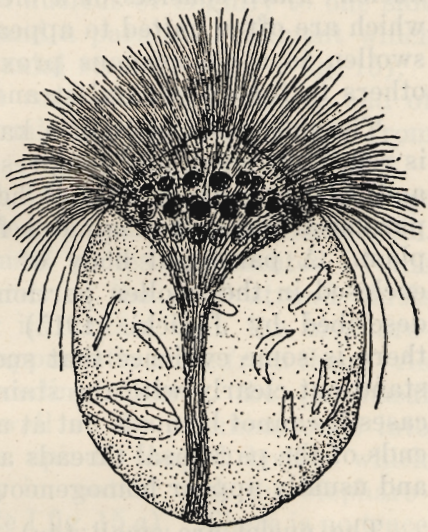
This species resembles *Devescovina lemniscata* Kirby more closely than any other, but differs (1) in larger size; (2) in absence of striations; (3) in delicacy and length of the parabasal; (4) in form and size of the costa and (5) in structure and length of the axostyle.

Species 2: ***Devescovina striata*** **A. Foa. Size from 28μ to 42μ.**
Host: termite brought in by Dr. del Toro.
Locality: San Juan, P. R.
Associated with ***Calonympha grassii*** **and** ***C. irregularis*** **n.sp.**

Genus CALONYMPHA FOA 1905.

There appears to be only one established species of this genus, viz. *Calonympha grassii.* In the Puerto Rican termites however, especially in *Cryptotermes brevis,* there are at least two species that are new, and the old species *Calonympha grassii* Foa 1905 (text fig. 2).

Calonympha grassii Foa 1905 (Text fig. 2). Size 51μ by 30μ.
Host: termite brought in by Dr. del Toro.
Locality: San Juan, P. R.
Associated with Devescovina and other Calonymphidae.

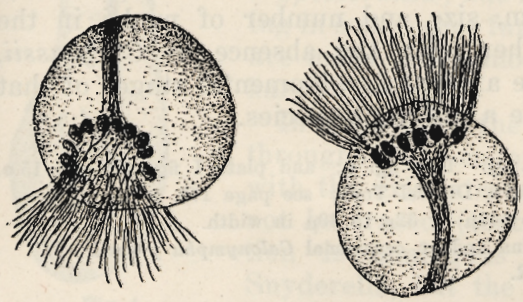


Text fig. 2.—*Calonympha grassii.* X1000

Although this form is slightly smaller than the size given by Foa (up to 90μ) or by Janicki (up to 69μ) the structural characteristics place it with Foa's species.

Calonympha cryptotermitis n. sp. (Text fig. 3); plate 1 figs. 12, 13 and 14.
Host: *Cryptotermes brevis* Walker.
Locality: San Juan, P. R.
Size 27μ to 43μ.
Associated with *Devescovina paralemniscata* n. sp.

This small polymastigote is probably the most common of the intestinal flagellates of *Cryptotermes brevis.* It is usually spherical in shape with a bluntly conical apex and is very slightly, if at all, metabolic. The most characteristic feature is the ring of from 12 to 16 karyomastigonts arranged in one plane near the anterior end and close to the surface. Each nucleus is accompanied by a blepharoplast with three long flagella, a parabasal body with



Text fig. 3.
Calonympha cryptotermitis n.sp. X1000

a parabasal filament which, with others, forms a conspicuous axial strand extending to the posterior end of the body (text fig. 3).

The akaryomastigonts (plate I figs. 12 and 13) which are more than twice as numerous as the karyomastigonts, occupy the apical region and are enclosed posteriorly by the ring of nuclei. Each consists of a blepharoplast with three flagella which are often united to appear as one, a parabasal filament swollen to a conspicuous proximal spindle and joined with others to form the axial strand.

The parabasal body of a karyomastigont (plate I fig. 14) is relatively small and compressed between the blepharoplast and nucleus. It is difficult here to determine whether the parabasal filament originates from it or from the blepharoplast. A parabasal body of the akaryomastigont may be enclosed in the swollen portion of the parabasal filament as described by Janicki (1915) for *Calonympha grassii* and there is some evidence that such is the case, but it does not stand out clearly with the stain used, and in the majority of cases it cannot be made out at all. The spindle-like proximal ends of the parabasal threads are very large and conspicuous and usually appear homogeneous in make-up (plate I fig. 13).

The nuclei are small (4μ), each with a single endosome and finely granular chromatin forming a reticulum. The endoplasm may have numerous small and irregular fragments of wood or may be quite clear.

Janicki mentions a form which he interpreted as a young stage of *Calonympha grassii* with few nuclei (up to 12). The constancy of form, size and number of nuclei in the present species, together with the absence of *C. grassii*, convinces me that these are not developmental stages of that organism but constitute a different species.

Calonympha irregularis n. sp. Text fig. 4; and plate I figs. 15 and 15 *a*.
Host: termite obtained from Dr. del Toro; see page 170.
Size variable from 80μ to 148μ by 32μ to 40μ in width.
Associated with Devescovina and an occasional *Calonympha grassii*.
Locality: San Juan, P. R.

This is a highly metabolic form from which it results that, in fixed material, scarcely any two are alike in shape. In each case, however, there is an elongate body from two to six times its greatest width.

The karyomastigonts vary in number and in arrangement; sometimes there are as few as twenty; again, as many as thirty-six. They may be arranged in two circles, in three circles or irregularly. Each consists of a vesicular nucleus without an endosome, a blepharoplast with three free flagella which usually emerge as one, a spherical parabasal body between the blepharoplast and nucleus or slightly to one side of the line between the two, and a parabasal filament which joins its fellows to form the axial strand (plate I fig. 15).

The axial strand does not reach to the posterior end of the cell but tapers out and terminates at some distance from the posterior end.

The blepharoplasts in both types of mastigonts are large and conspicuous and stain deeply with iron haematoxylin. The parabasal bodies represented by the proximal ends of the axial strand fibrils are closely in contact with the blepharoplasts and apparently arise from them. As in the preceding species, the parabasal filaments swell at the proximal ends into conspicuous spindle-shaped bodies which are directly in contact with the blepharoplasts (plate I fig. 15 *a*). There is no trace of a definite parabasal body in any of these swellings such as Janicki describes for *C. grassii.*

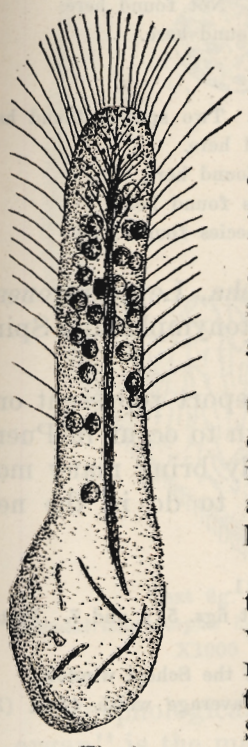


Fig 4.
Calonympha irregularis
X1000

The akaryomastigonts are not restricted to the apical surface as in *C. grassii* or *C. cryptotermitis,* but form a battery extending in some cases far down the body. They are many times more numerous than the karyomastigonts.

In some cases the nuclei are distributed throughout the endoplasm and connections with the axial strand or with flagella cannot be traced (text fig. 4). This condition is analogous to that in Kirby's Snyderella, but the general shape of the organism, the shortness of the axial strand and the resemblance of the nuclei to those of the more usual type are evidences that such cases are merely indicative of the irregularity of this species.

Order HYPERMASTIGIDA

Cleveland, in collaboration with Hall, Sanders and Collier, considerably modified the classification of this Order into families, and re-distributed many of the genera. This procedure is followed here. Six families are recognized as follows:

Family 1. Lophomonadidae. No genera found in Puerto Rican termites.
2. Hoplonymphidae Light. None found here.
3. Staurojoeninidae Grassi. None found here.
4. Trichonymphidae Grassi (one genus only). Not found here.
5. Eucomonymphidae Cleveland *et al.* 1934.

Genus 1. Eucomonympha Cleveland (roach). Not found here.
2. Pseudotrichonympha Grassi and Foa. One species found here.
3. "Pseudotrichonympha" of Cutler 1921. Not found here.
4. Deltotrichonympha Sutherland 1933. Not found here.
5. Mixotricha Sutherland 1933. Not found here.

6. Spirotrichonymphidae Grassi.

1. Spirotrichonympha Grassi and Foa. Two species found here.
2. Spironympha Koidzumi. Not found here.
3. Spirotrichonymphella Grassi. Not found here.
4. Holomastigotes Grassi. Two species found here.
5. Holomastigotoides Grassi. Three species found here.

Four other genera, Macrospironympha, Leptospironema (both parasites of the wood roach), Teratonympha and Spirotrichosoma are not found here.

The four termites recorded in this report represent only a small part of the termite species known to occur in Puerto Rico, and further study will undoubtedly bring many more Hypermastigida to light. This I hope to do in the near future.

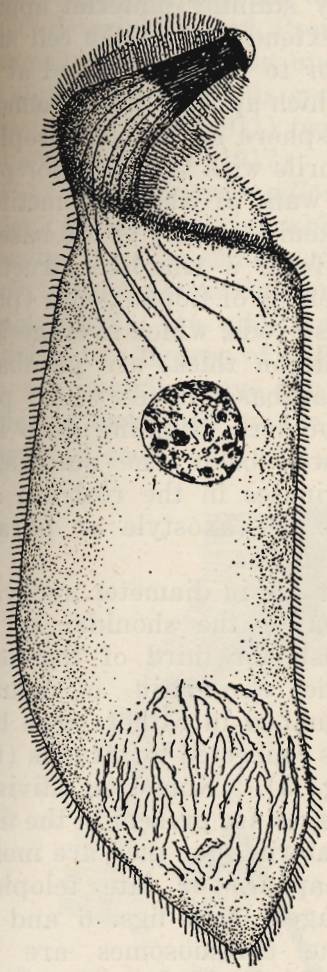
Genus PSEUDOTRICHONYMPHA Grassi and Foa 1911.

Species *Pseudotrichonympha bachmani* n.sp. Text figs. 5, 6 and 7. Plate I fig. 17.

Host: unidentified termites from El Yunque and the School window.

Size: average length 131.7μ (118μ to 175μ); average width 42.4μ (35μ to 51μ).

The most striking characteristic of this form is the active torsion of the anterior end. In the living organism this twists about sometimes to the right, sometimes to the left (fig. 5). Again, it stretches out and remains symmetrical for a time, and then once more begins to twist. The body is obtusely pointed at the anterior and the posterior ends and is covered by fine, short flagella; food taking occurs at the posterior tip and is indicated by the occasional absence of flagella at this point.



Text fig. 5.
Pseudotrichonympha bachmani n. sp.
X1000

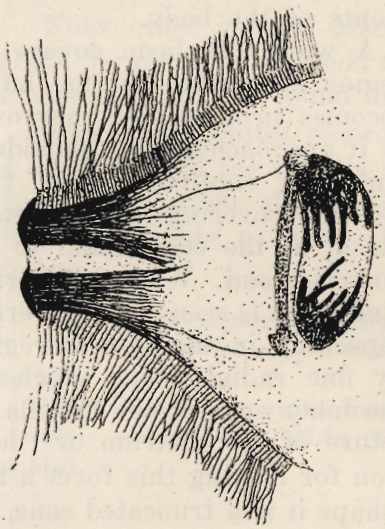
The flagella are slightly longer about the rostrum and at the posterior end, but the difference between these and the remainder of the flagella is scarcely noticeable. They are closely inserted on longitudinal lines down the body, but these lines may be flexed to right or left with movements of the body.

A wide ectoplasm covers the region about the rostrum but it becomes progressively narrower as it approaches the "shoulder" and then continues as a very delicate covering of the endoplasm at the center and to the posterior end. With appropriate staining it is seen to be traversed, especially in the rostral region, by fine radial fibers which are the inner ends of the flagella.

Morphologically, the structure of the rostrum or "head organ" is the main justification for making this form a new species (plate I fig. 17). In shape it is a truncated cone, the base of which spreads out radially to the margin of the body anterior to the shoulder. When properly de-stained it shows

characteristic structures not apparent after ordinary staining. It begins with a cap or hyaline structure in the shape of an inverted saucer. This, in some cases, appears to be perforated, for strands of deeply staining material appear to pass through it and even to extend beyond the cell as a short, stained rod. Just posterior to this saucer and at its center is a homogeneous sphere which appears like a rounded glass stopper of a bottle. This sphere is the blepharoplast which is connected by very fine fibrils with the posterior part of the rostrum, thus forming the walls of what is sometimes called the collar. A rod-like thickening occurs at the base of each fibril and these, together, form a ring-like structure which recalls the ring of blepharoplasts of Lophomonas (plate I fig. 17). It is possible that these rods, which average 5.7μ in length and are one-half a micron thick, are parabasal bodies; they are continued as parabasal fibrils which pass as far down the body as the shoulder. Running deep into the endoplasm, in some cases well below the nucleus, is another set of fibrils which originates in the rostrum and which apparently corresponds to the axostyle or parabasal (?) fibrils described for some forms.

The nucleus is spherical, about 17μ in diameter and variable in position from the region of the shoulder to the posterior third of the body. The chromatin is usually clumped in rather large bodies connected by strands (text fig. 5). Numerous division stages are present in the fixed material, but they are mostly anaphase or late telophase stages (text figs. 6 and 7). The chromosomes are undoubtedly V-shape, but I was unable to get a definite count of their number.

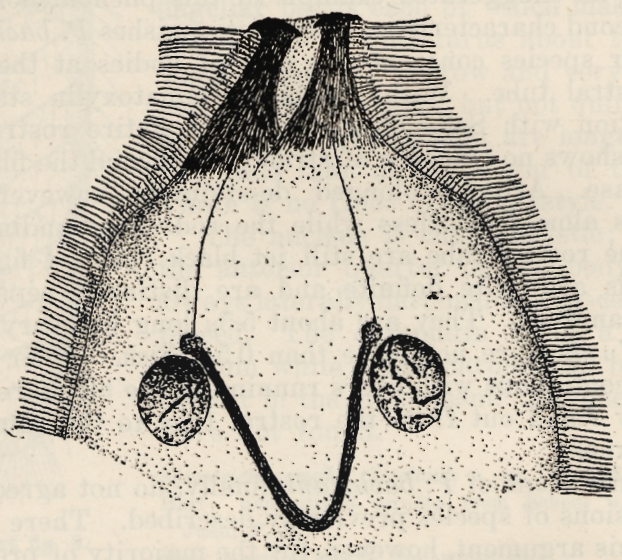


Text fig. 6.
X1000

The mitotic figure of *Pseudotrichonympha grassii* has been well described by Koidzumi and by Cleveland for an unnamed species, and these descriptions apply equally well to the anaphase and telophase stages of *P. bachmani*. The centrioles are very

delicate fibrils which arise from the centrosomes and pass to the rostral complex where they are lost.

Cleveland emphasizes the incomplete nature of the published descriptions of Pseudotrichonympha. Including the unnamed species whose nuclear history he describes, there are eight species of this genus. These are: (1) *P. hertwigi* Grassi and Foa (1911) with two varieties, "major" and "minor" (Grassi 1917); (2) *P. magnipapillosa* Grassi (1917); (3) *P. parvipapillosa* Grassi (1917); (4) *P. pristina* Cutler (1921), a species which does not belong to this genus, according to Cleveland; (5) *P. grassii* Koidzumi (1921); (6) *P. sphaerophora* Dunkerley (1923); (7) *P. introflexibilis* Dogiel (1922). In addition to these species Kirby (1932) publishes two figures of a *Pseudotrichonympha sp.* which he does not describe save for the "parabasal cords". A 9th species is described by the Mello (1920) in a paper which I have not seen.



Text fig. 7.
X1000

In adding one more species to this group I realize I am adding one more inadequately described form. *Pseudotrichonympha bachmani,* however, has two characteristics which are quite new to the published descriptions that I have seen.

These characteristics are so clearly evident that no previous observer could have missed them had he had the species before him. One of these is apparent in the living animal as it moves slowly forward rotating leisurely on its long axis. With the forward progression there is a sidewise movement of the rostrum to the right or left, usually alternating, so that a curious sculling motion is suggested. The animals are sufficiently rigid to be caught and fixed by the killing agent in this twisted condition (fig. 5). The often sharp shoulders which are produced by this torsion recall the "shoulder-like" protrusion described by Kirby for *Trichonympha sphaerica,* but a more exaggerated condition is seen when the rostrum sinks into the body to form a slight concavity. Such movement is not uncommon in animals which have been confined for some time on a slide, and is probably the result of abnormal conditions. The insinking of the rostral region in Dogiel's *P. introflexibilis* is possibly no more than an exaggerated example of this phenomenon.

The second characteristic which distinguishes *P. bachmani* from other species concerns the ring of bodies at the base of the rostral tube. With ordinary heamatoxylin staining after fixation with Schaudinn's fluid, the entire rostrum is black and shows no evidence of structures beyond the fibrillae at the base. After prolonged de-staining, however, the rostrum is almost colorless while the rods surrounding the base of the rostral tube are still jet black (plate I fig. 17). These rods are quite definite and are distinctly separated one from another. They are about 5.5μ long but vary from 5.4μ to 6.7μ and are not more than 0.5μ thick. Their inner faces are continuous with fibers running to the blepharoplast, hence they stand out from the rostral tube to the extent of their thickness.

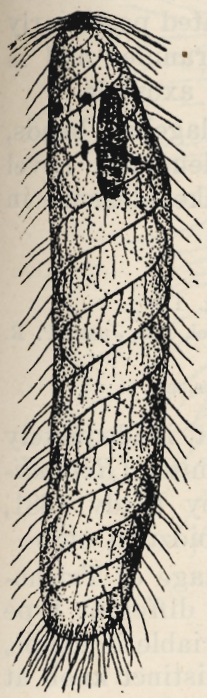
The dimensions of *P. bachmani,* finally, do not agree with the dimensions of species previously described. There is not much in this argument, however, for the majority of previous observers not only fail to give the size in terms which can be accurately translated into microns (as with all of Grassi's species), but even when properly given, there is a wide variation in size in the same species. Hartmann's *P. hertwigi* is considerably larger than the present species (265μ); Koidzumi's *P. grassii* varies from 200 to 300 microns; Dunkerley's *P. sphaerophora* is 230μ; Cleveland's undetermined species varies in length from 153μ to 458μ, etc.

The species is named for Dr. G. W. Bachman whose unfailing interest and delightful hospitality made our visit to Puerto Rico a constant pleasure.

Family Spirotrichonymphidae Grassi.

Genus SPIROTRICHONYMPHA Grassi.
Species *Spirotrichonympha fragilis* n. sp. Fig. 8.
Host: Unidentified termite from window frame of School at San Juan.
Size length 38μ to 84μ, diameter 14μ to 19μ.

In this species the body is ellipsoidal with obtusely rounded ends and slightly wider at the posterior end (text fig. 8). The body is transparent and free from wood splinters; it is covered by a thin and delicate ectoplasm which apparently is easily ruptured, for broken specimens are common. The rostrum is short, conical and gives rise to four flagellar bands each of which makes three and a half to four turns about the body. These bands are narrow and very delicate and approach nearly, but not quite, to the periphery. The flagella are longer at the two ends than at the center of the body. There is no trace of an axostyle.



Text fig. 8. *Spirotrichonympha fragilis* n.sp. X1000

The nucleus is characteristic; it is in the anterior quarter of the body and is always laterally flattened and ex-centrically placed. The chromatin is in a fine reticulum while a few chromatoid bodies lie near it in the endoplasm. Division stages were not found.

Spirotrichonympha clevelandi n. sp. Text fig. 9.
Host: unidentified termite from School window, San Juan, P. R.
Size: average length 68μ, width 24μ.
Occurrence: abundant, with Pseudotrichonympha, Holomastigotoides, etc.

In this species the body is ovoidal with a bluntly rounded posterior end and a more pointed anterior end. The dexiotropic spirally wound flagellar bands are relatively broad and distinct, and unlike the majority of Spirotrichonympha

species, are three in number, each making from four to four and a half turns about the body. At the anterior end there is a pseudo-rostrum with six transverse strands made by two tight coils of each of the three flagellar bands (text fig. 9). These rostral bands are topped by a flat saucer-like blepharoplast which is continuous at the margins with the ectoplasm of the cell. The flagellar bands are deeply inset and bear rows of distinct basal granules from which flagella pass through the ectoplasm to the outside. The flagella are densely grouped around the anterior end and are continued to, and around, the posterior end of the body.

The endoplasm is clear and apparently without wood splinters. The nucleus is club-shaped, attenuated posteriorly and filled with relatively small chromatin granules and is without endosomes. There is no trace of an axostyle.

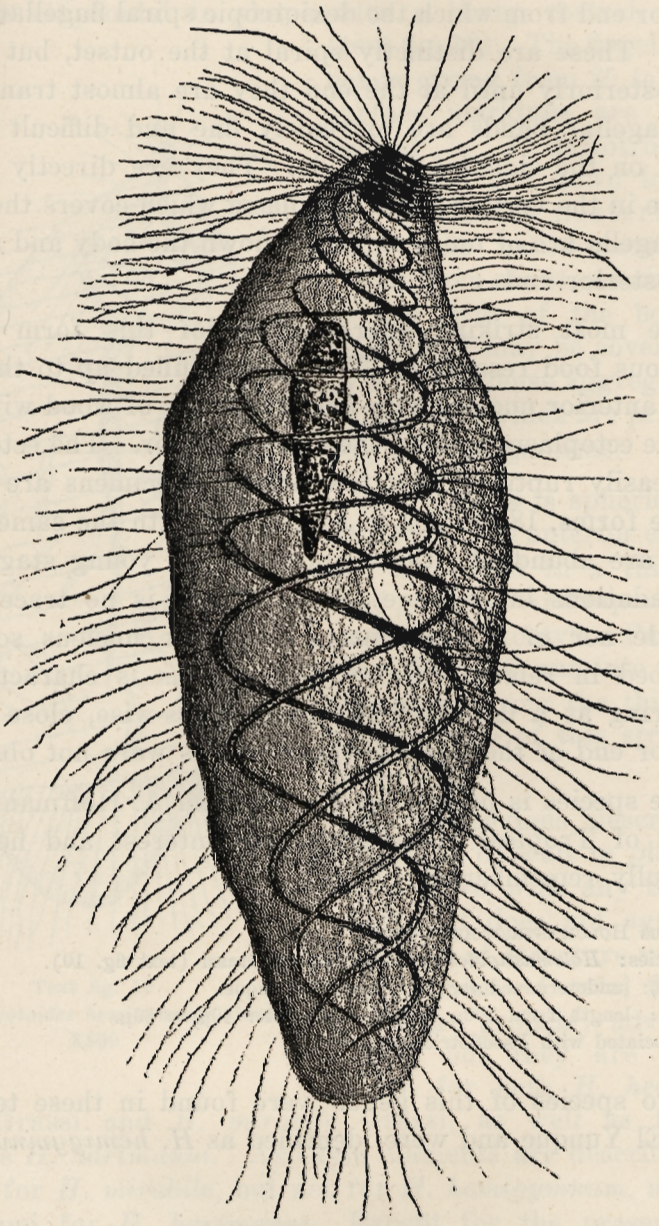
The closely packed rostral coils, three flagellar bands, absence of axostyle and shape of the nucleus are novel features indicating a new species which I take pleasure in naming for Dr. L. R. Cleveland.

Genus HOLOMASTIGOTES Grassi and Sandias.
Species: *Holomastigotes elongatum* Grassi. Plate I fig. 17.
Host: unidentified termite from window frame of School, San Juan, P. R.
Size: length 32μ; greatest diameter 11μ.
Occurrence; with Pseudotrichonympha, Holomastigotoides, etc.

This small form agrees with figured but inadequately described forms from numerous species of termites (*Reticulitermes lucifugus* Grassi; *Termes flavipes* by Leidy 1881, Porter 1897, et al; *Leucotermes speratus* Koidzumi etc.)

Leidy interpreted this form as a young stage of Trichonympha, but Porter placed it as an entirely different type without giving it a name. It is somewhat variable in shape, but is usually club-shaped with a small but distinct knob at the anterior end. There are four dexiotropic spiral flagellar bands on the body surface and the nucleus is anterior. There is no trace of an axostyle nor do I find any evidence of the parabasal bodies described by Duboscq and Grassé.

Species: *Holomastigotes hoffmanni* n. sp. Plate I fig. 18.
Host: unidentified termite from window frame of School, San Juan, P. R.
Size length from 80μ to 90μ; diameter 48μ to 52μ.
Occurrence: with Pseudotrichonympha, Holomastigotoides etc.



Text fig. 9.—*Spirotrichonympha clevelandi* n.sp. X1000

In shape this species is rounded oval with a sharp pointed anterior end from which the dexiotropic spiral flagellar bands begin. These are distinctly spiral at the outset, but flatten out posteriorly until at the end they are almost transverse. The flagellar bands are extremely fine and difficult to see except on the sides of the body. They are directly on the surface in the very delicate ectoplasm which covers the body. The flagella are of uniform length down the body and around the posterior end.

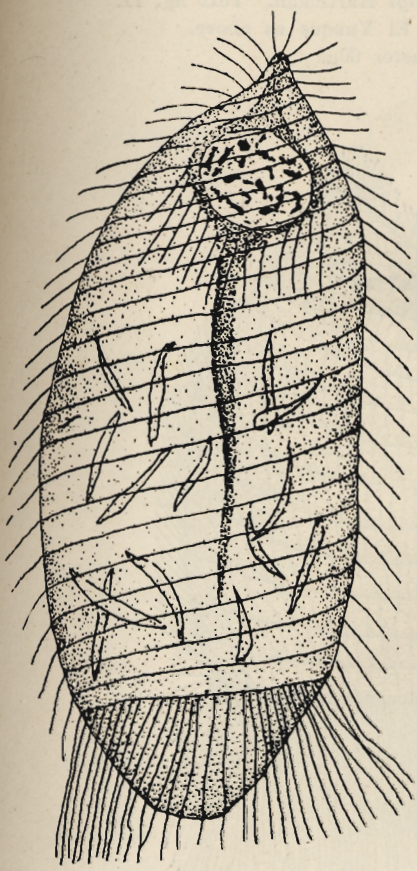
The most striking characteristic of this form is the enormous food reservoir. The body is filled up to the level of the anterior nucleus with fine fragments of wood with only delicate ectoplasm holding the mass together. The ectoplasm is so easily ruptured that few perfect specimens are found. Minute forms, 18μ to 20μ in length, but with the same structures, are abundant; these appear to be young stages, for all gradations in size are found. There is no trace of an axostyle nor of a dense mass about the nucleus so often described in related forms. The nucleus is characteristic, appearing as a flattened disc lying cross-wise, close to the anterior end of the cell. Division stages were not observed.

The species is named for Dr. William A. Hoffman of the School of Tropical Medicine, whose interest and help are gratefully remembered.

Genus HOLOMASTIGOTOIDES Grassi.
Species: ***Holomastigotoides hemigymnum*** Grassi (text fig. 10).
Host: undetermined termite from El Yunque.
Size: length from 100μ to 150μ; diameter 40μ to 60μ.
Associated with Pseudotrichonympha.

Two species of this genus were found in these termites from El Yunque and were identified as *H. hemigymnum* and

H. hertwigi. The one identified as *H. hemigymnum* Grassi is elongate ellipsoidal in shape with a sharp rostral tip (text fig. 10). The flagellar bands giving from 25 to 29 surface markings are arranged in a dexiotropic spiral and run down to a non-flagellated posterior end. This naked portion varies from about one sixth to one fifth of the body length and may be covered by a fairly dense aggregate of filaments which are probably microorganisms.



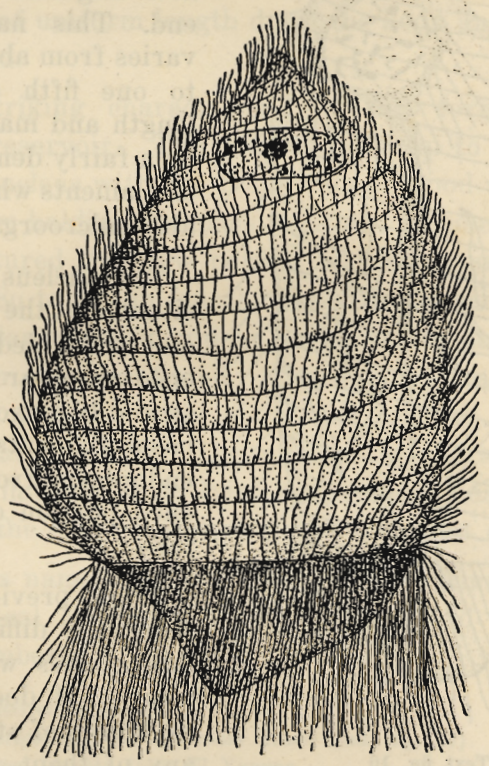
Text fig. 10
Holomastigotoides hemigymnum Grassi.
X890

The nucleus is spherical, situated at the anterior end, and embedded in a thickened granular and tapering strand-like axostyle. Parabasal filaments run into the endoplasm from the thickened portion of this structure.

From previous descriptions it is difficult to place this species with any certainty. It does not agree in details of structure with any of them. Caudal filaments are probably adventitious, but they are recorded for both *H. hemigymnum* Grassi and *H. mirabile* Grassi, as well as for Koidzumi's *H. hartmanni.* Axostyle filaments are described by Grassi for *H. mirabile,* but not for *H. hemigymnum,* and by Koidzumi for *H. hartmanni.* Except for the presence here of parabasal filaments, the present species agrees closely with Mackinnon's *H. hemigymnum,* but she was not at all

certain that her form and Grassi's were the same. I am equally uncertain that mine is the same as hers, but until the genus is monographed, I shall leave it here.

Species: *Holomastigotoides hertwigi* Hartmann. Text fig. 11.
Host: unidentified termite from El Yunque as above.
Size: average length 112μ; diameter 60μ.



Text fig. 11.
Holomastigotoides hertwigi Hartman. X1000

This is another species from the same host as *H. hemygymnum* above. It differs from the latter (1) in the smaller number of flagellar bands (16 to 20 surface striae); (2) in the more swollen form; (3) in the absence of an axostyle and (4) in shape, position, and chromatin content of the nucleus (text fig. 11).

Plate 1

Fig. 12.—*Calonympha cryptotermitis* n.sp. Optical section of the anterior end. X1500

Fig. 13.—Same. Optical section; eight akaryomastigonts and four karyomastigonts. Parabasal filaments forming the axial strand shown with characteristic swollen proximal ends. X2000

Fig. 14.—Same. Four karyomastigonts with blepharoplasts, flagella, and non-swollen parabasal filaments. Optical section. X2000

Fig. 15.—*Calonympha irregularis* n.sp. Optical section with three rings of karyomastigonts and battery of akaryomastigonts. X1000

Fig. 15 *a*.—Same. Optical section of anterior end. Parabasal filaments from akaryomastigonts are short and begin to swell very soon after leaving axial strand. Two rings of karyomastigonts indicated, their parabasal bodies spherical. X2000

Fig. 16.—*Holomastigotes elongatum* Grassi. X1000

Fig. 17.—*Pseudotrichonympha bachmani* n.sp. Details of the rostral region showing cap, blepharoplast, collar and basal rodlets (parabasal bodies?) and parabasal filaments running into the endoplasm. X1000

Fig. 18.—*Holomastigotes hoffmani* n.sp. Characteristic body filled with wood splinters, transversely placed nucleus, delicate flagellar bands and thin ectoplasm. X1000

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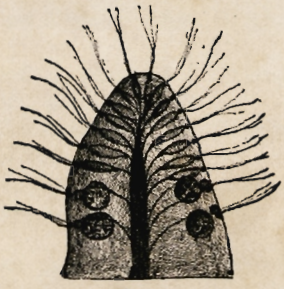

15a

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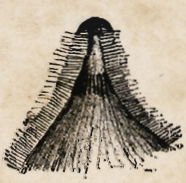

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