Spirotrichosoma magna (n. sp.) from a New Zealand Termite.

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ALTHOUGH a large amount of literature on the Protozoan fauna of termites exists, yet up to the present time there has been no record of the fauna belonging to the New Zealand species. While examining *Stolotermes ruficeps* (Braur), the writer found that the ileum, like that of other termites, possessed a very large protozoan fauna composed of the large flagellate *Spirotrichosoma magna* n.sp., which is described in the present paper. Other protozoa were present also, but to a lesser extent. The genus is new, and was created by Sutherland in 1933, but the original description is very inadequate. This author distinguishes the genus, *Spirotrichosoma,* by the structure of the axial organ or " centroblepharoplast " and its relation to the flagellar bands, but does not enter into a minute description of these structures, nor does this author give their detail when describing the species of this genus. However, the flagellar bands in the flagellate about to be described are two in number, are coiled in a spiral of about one and one-half to two complete turns, and are intimately connected with the " centroblepharoplast " of Sutherland. These two conditions, together with the fact that this flagellate is present in another species of termite belonging to the same genus from which *Spirotrichosoma* was obtained, leave no doubt that the two flagellates are of one and the same genus, but different species.

The following is a description of *Spirotrichosoma magna* n.sp., but some minute detail is omitted because the lenses available did not give good definition at high magnifications.

TECHNIQUE.

Living protozoa were examined in a drop of water, saline solution of 0·75 per cent. concentration, or in modified Ringer's solution under paraffin sealed cover-glasses on ordinary slides. Since the protozoa were of a dark-brown colour due to the presence of wood fragments, termites were fed on filter-paper for a week or ten days in order to render the cytoplasm clear and so enable the internal structures to be seen.

Various intra-vitam stains were used such as Neutral Red, Methyl Green, Methylene Blue, and Janus Green. These were dissolved in absolute alcohol, a drop of which was placed on the slide and allowed to evaporate before the protozoa were transferred to the slide. A solution of iodine in potassium iodide was used to demonstrate the flagella; this solution also rendered visible the surface ridges of the

posterior region of the body. Permanent mounts were made as wet cover-slip smears fixed in the following:—Hot Schaudin's, Bouin's, Carnoy, Petrunkewitsch, and La Cour's solutions (1929), all of which gave excellent results.

Smears were stained with Delafield's, Heidenhein's, and Shortt's Haematoxylin, Acetic-alum-carmine, Borax-carmine, and Picro-carmine; the first three were countered-stained with acid Fuchsin, Eosin, or Erythrosin.

Occurrence and Activities.

The protozoan is found densely packed in the ileum of *Stolotermes ruficeps,* and together with fragments of wood and other smaller protozoa almost completely fills the lumen of the intestine. Kofoid and Swezy (1919) noted that the smaller flagellates occupy the region near the walls, but this has not been verified for this species of termite.

The intestinal fluid is thick and milky, and through this liquid the flagellates move slowly by means of their flagella, using their mobile rostra to push a pathway through the medium. The chief locomotor flagella appear to be the long anterior ones which are directed forwards and sideways. The flagella or cilia covering the posterior region of the body are uniformly distributed and are directed backwards. They have a characteristic wave motion both when the organism is in motion and when it is at rest, the waves passing from the base of each flagellum to the tip. The wave movement of the anterior flagella begins at the top of the rostrum and passes down and around the anterior, flagellar bands, a new wave movement commencing at the top again.

Morphology.

Size and Shape.

Average length ·3 mm.; average breadth ·2 mm. The organism (Fig. 1) is broadly oval with the posterior end bluntly pointed, tapering to the apex, whilst a definite anterior constriction distinguishes a head region from the rest of the body.

The body is divided into three regions:—

(1) An anterior, clear, dome-shaped cap or operculum, which is covered by a very delicate membrane. Its base is slightly concave, whilst its cavity is filled with a perfectly transparent, homogeneous substance. In the base of the cap there is a refractile, hemispherical granule, the blepharoplast, which is visible in the living organism.

(2) The rostrum proper, which together with the cap comprises the head region. From this region the long anterior flagella arise from the two flagellar bands.

(3) A large posterior region increasing in width from before backwards to about half its length, where the broadest part is situated. Posteriorly it tapers to the bluntly-pointed apex. This region is clothed with long, backwardly directed, uniformly distributed flagella. It is composed chiefly of endoplasm, in which are fragments of wood detritus. The endoplasm is invested with a thin sheath of ectoplasm.

Surface-ridges.

The posterior region of the body possesses a large number of low, rounded, transverse surface-ridges with grooves in between.

The Flagella.

The flagella may be divided into three sets:—

(1) Those arising from the rostral tube,

(2) Those arising from the anterior flagellar bands, and

(3) Those clothing the posterior region of the body.

The first two groups form the anterior tuft, are directed forwards and sideways, and their movement is independent of those belonging to the last group.

(1) The flagella belonging to this group penetrate through the ectoplasm, their roots finding attachment to the rostral tube which is formed from the fused basal granules of these flagella.

(2) The flagella of group two penetrate through the ectoplasm and endoplasm of the rostrum to the two spirally twisted, flagellar bands, which have one and one-half to two complete turns that increase in width from before backwards. The roots of the flagella and the nature of these bands are clearly seen when these structures are viewed from above (Fig. 2). As has already been stated, movement of these two groups of flagella commences at the top and progresses down and around the anterior axial organ.

(3) The flagella covering the posterior region of the body emerge from the grooves between the surface-ridges as was found by Kirby (1932). Their basal granules and plates have not been observed.

THE ECTOPLASM.

The ectoplasm is thickest in the rostrum and decreases in thickness posteriorly towards the body, which it invests as a thin layer. The differentiation of the anterior ectoplasm into three layers as found by Kirby (1932) could not be determined owing to poor definition under high magnification, but it appears probable that this region is divided into:—

(1) An outer layer which is traversed by the basal portions of the flagella,

(2) The middle layer likewise traversed by the flagellar roots and probably of a fluid nature, and

(3) The innermost layer which includes the basal granules of the flagella. These latter are intimately fused to form the rostral tube.

BLEPHAROPLAST.

The hemispherical granule in the base of the cap is latterly considered by Franca (1916-18) to be a blepharoplast. Kirby (1932) accepts this term, and, as his reasons for doing so are reasonable, it is accepted in the present paper. As Kirby points out, most workers have either overlooked this structure, or have described it inaccurately. Sutherland (1933) appears to have overlooked it, too, as it is not

figured at all. Presumably this author did not see the deeply staining ring of Kofoid and Swezy (1919), nor does she appear to have seen Kirby's paper, as she adopts the nomenclature of the former, which Kirby has shown needed revising.

In *Spirotrichosoma magna* the blepharoplast is connected to the rostral tube from which the flagella take their origin. This, together with the fact that a rhizoplast has been traced from the nucleus to the base of the rostral tube, also suggests that the granule is of a blepharoplastic nature. It is probable that the rhizoplast passes up the rostral endoplasm to the blepharoplast.

The Rostral Tube.

The rostral tube was termed the " centroblepharoplast " by Kofoid and Swezy (1919). Kirby's term rostral tube is adopted in the present paper, however. It consists of a tube which increases in diameter from before backwards; anteriorly it is joined to the blepharoplast whilst posteriorly it gives off the two deeply stainable, flagellar bands. Its walls are solid and deeply stainable, and since the anterior flagella arise from these it is probable that the walls are composed of the fused basal granules; hence it is not to be differentiated from the rest of the layer of basal granules. With Heidenhein's Haematoxylin (Figs. 2 and 3) it stains an intense black, appearing as a solid rod, with the blepharoplast also deeply stained as a small knob situated at the anterior end. With acetic-alum-carmine it appears as two rods, but in these specimens it is not possible to trace the rhizoplast up the rostral tube to the blepharoplast. In the former, on the other hand, this filament is clearly visible passing from the nucleus to the base of the rostral tube (Fig. 3).

The Flagellar Bands.

There are two bands of deeply stainable material given off from the posterior end of the rostral tube in the form of a double spiral, which has about two complete turns as mentioned before. These turns increase in diameter from before backwards and enclose the nucleus. The bands, when viewed from above (Fig. 2), show minute, deeply staining plates situated on their external borders. These are undoubtedly the basal plates of the flagella, and since the bands are intimately connected to the rostral tube and give rise to the flagella, like this latter, they must be comprised of the fused basal granules of the flagella. That this is the case is also indicated from the fact that the movement of the flagella arising from these bands is co-ordinated with that of the flagella arising from the rostral tube itself.

The Parabasal Apparatus.

A number of filaments (Fig. 1), which stain intensely with Heidenhein and which are scattered throughout the anterior endoplasmic region, are considered to be parabasal apparatus. Sutherland (1933) makes no mention of having observed these structures in the other two species, but it is probable that they possess an apparatus similar to the one herein described. The whole apparatus lies posterior

to the nucleus and is not connected with it. Kirby (1932) states that in what are probably the more primitive species the cords do not come into contact with the nucleus. Again, in some species of *Pseudotrichonympha,* the apparatus, while it lies anterior to the nucleus, does not come into contact with it, so that the dispersed apparatus in the species here described is not an unusual feature.

THE NUCLEUS.

Average length 24 μ; average breadth 15 μ. It is pyriform, with its more pointed end directed forwards, and varies slightly in size according to the individual. It is almost always situated in the anterior end, and is enclosed by the flagellar bands as already described. In two abnormal cases the nucleus has been observed to lie nearer the posterior end. Internally the chromatin is dispersed as irregular separate granules in the nucleoplasm, which is finely granular. From the anterior end, the rhizoplast is given off.

Diagnostic Characters.

Average length of body ·3 mm.; average breadth ·2 mm. It differs from *S. obtusa* and *S. capitata* in its large size and greater breadth in proportion to its size. Body broadly oval, bluntly pointed, and tapering to apex posteriorly; anterior end constricted to form a rostrum from which arise the anterior flagella; entire body posterior to rostrum clothed with long flagella emerging from grooves between surface ridges. Nucleus average length 24 μ; average breadth 15 μ, pyriform, with more pointed end directed forwards. There is an anterior hemispherical granule attached to a more posterior rostral tube, which gives off two flagellar bands posteriorly, the latter of which form a double spiral of one and one-half to two complete turns increasing in diameter from before backwards and encircling the nucleus. The parabasal apparatus is diffuse and lies posterior to nucleus.

SUMMARY.

A new species of Hypermastigote, *Spirotrichosoma magna,* is recorded from the New Zealand termite *Stolotermes ruficeps,* and its occurrence, activities, and morphology are described.

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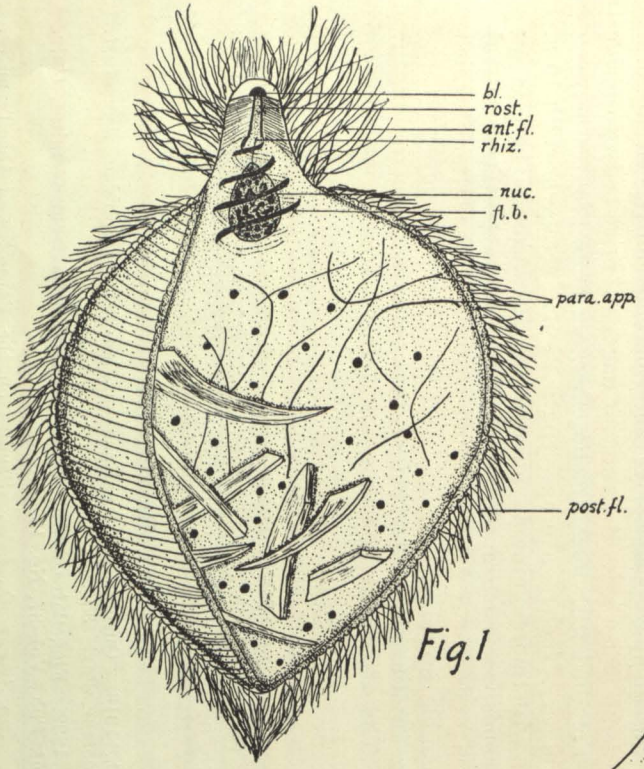

Fig. 1

ant. fl., anterior flagella; bl., blepharoplast; fl. b., flagellar band; nuc., nucleus; para. app., parabasal apparatus; post. fl., posterior flagella; rhiz., rhizoplast; rost., rostrum.

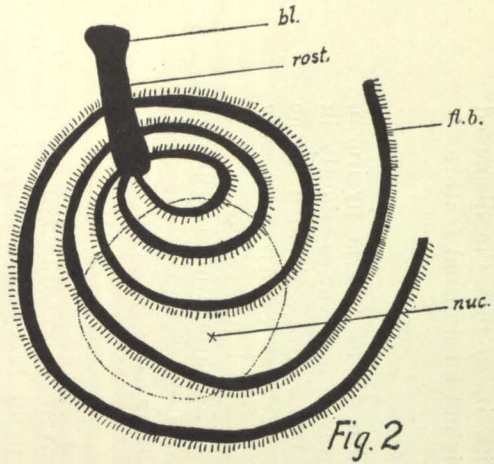

Fig. 2

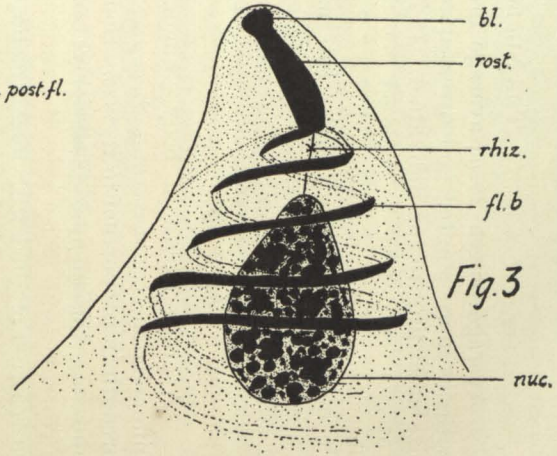

Fig. 3

FIG. 1.—*Spirotrichosoma magna* n. sp. × 450. Composite drawing. FIG. 2.—Blepharoplast, rostral tube, and flagellar bands of *S. magna* stained with Heidenhein and showing basal plates of the flagella. Oc. 5; obj. 1/12. FIG. 3.—Head of *S. magna* showing blepharoplast, rostral tube, flagellar bands, nucleus, and rhizoplast. Oc. 5; obj. 1/12.