On *Balantidium praenucleatum* n. sp., inhabiting the colon of *Blatta orientalis*[1]).

By

R. R. Kudo and **P. A. Meglitsch**
(Urbana, Illinois, U.S.A.).

With 9 figures in the text and plates 6—7.

For a number of years, the authors have recognized from time to time, a species of *Balantidium* in the colon of *Blatta orientalis.* With continued examination of host insects, sufficient amount of information concerning this ciliate has been obtained, which indicates that the organism is different from any of the known species of *Balantidium.* A brief taxonomic and morphological consideration of the protozoan is therefore presented in the following pages.

The host insect, *Blatta orientalis*, was obtained from the University grounds as reported before by the senior author (Kudo, 1926, 1926a, 1936). The *Balantidium* is present in the lumen of the anterior region of the colon in association with several other species of protozoans. Its incidence, however, is far smaller than that of any of the latter. For example, while 90 per cent of 500 host insects examined between June, 1937 and January, 1938 harbored *Nyctotherus ovalis*, only 7.6 per cent contained the *Balantidium* under consideration. Moreover, the number of individuals which occur in a single host insect is smaller in the present ciliate than in the case of *Nyctotherus ovalis.* Not infrequently more than 200 Nyctotherus are observed in a host's colon, but the largest number of the *Balantidium* encountered in a host so far was 59. As a rule, each host insect harbors a far smaller number of *Balantidium.*

---

[1]) Contribution from the Zoological Laboratory of the University of Illinois. No. 519.

The observations have chiefly been made on organisms in life and in permanent smear preparations. Because of its rare occurrence, section preparations were not practical. A few individuals have been found in the host's organ sectioned for the study of other protozoans, but there were not enough of them to carry on a detailed morphological study. The smears were fixed on cover-glasses in CARNOY'S, SCHAUDINN'S, BOUIN'S or ZENKER'S fluid. As stains, HEIDENHAIN'S iron hematoxylin, GIEMSA'S stain and FEULGEN'S nucleal reaction were used.

Living organisms were studied in isotonic saline or LOCKE'S solution, buffered to p_H 7.2 to 7.4 by addition of potassium phosphates. When hanging drop preparations were to be observed for several hours, 0.5—1 per cent albumin was added to the solution, which allowed the organisms to remain alive for 24 hours or longer in seemingly normal condition.

The trophozoite.

When observed in life under slight pressure of a cover-glass or in permanent smear preparations, the organism is most commonly seen in side view, and varies from ovoid to oblong in shape (Text-Figs. A, B). At the tip of the broadly rounded posterior end there is a conspicuous cytopyge. The thickest part of the organism lies usually in the posterior half of the body (Pl. 7 Figs. 10—13). From this region the body tapers toward the anterior end, which is more slender than the posterior end. The anterior extremity may be rounded or obliquely truncate and this results in a diversity of appearance of the organism, coupled with a varied amount of tapering. The dorsal surface is usually more convex than the ventral surface. The aperture of the peristome is located on the ventral surface, very close to the anterior extremity. The macronucleus is situated dorsally to the peristome near the anterior end.

In dorsal or ventral view the body appears to be more slender (Text-Fig. C). In smear preparations, the organisms lying on the ventral or dorsal side are more or less highly flattened so that the body width is much larger than it is in actively moving trophozoites. The posterior end is more or less broadly rounded in this view. The body tapers toward the anterior end and terminates in a knob-like structure. In this view the peristomal region is usually obscured by the macronucleus.

Measurements of 177 typical specimens studied in permanent smear preparations gave the following dimensions: Body length, 42.5—127 μ, average, 65.5 μ; body thickness, 32—102.5 μ, average, 48.5 μ; body width, 25—80 μ, average, 38 μ; length of macronucleus, 16.5—56.5 μ, average, 29.5 μ; thickness of macronucleus, 7—20 μ, average, 10.5 μ; depth of peristome, 4.7—29.5 μ, average, 14.5 μ; ratio of length to thickness of body, 1.1 : 1—1.9 : 1, average, 1.3 : 1: ratio of body length to length of macronucleus, 1.4 : 1—.3 : 1, average, 2.3 : 1; ratio of body length to peristomal depth, 3 : 1—7.8 : 1, average, 5 : 1. It must be mentioned here that since the organisms measured

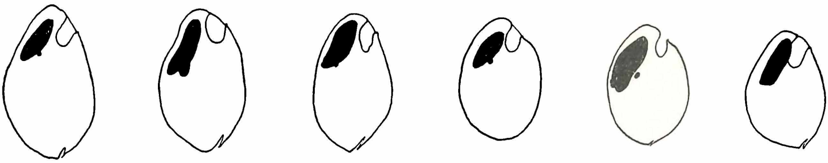


Fig. A.

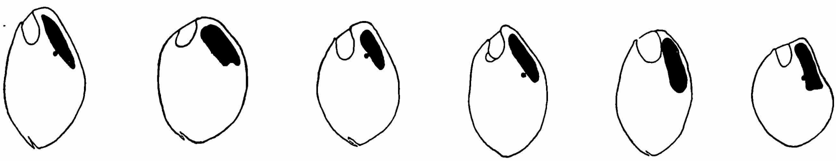


Fig. B.

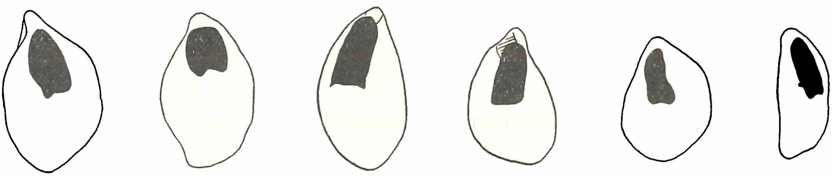


Fig. C.

Figs. A—C. Outline drawings of normal trophozoites of *Balantidium praenucleatum* showing variation among different individuals. A, right side views; B, left side views; C, ventral or dorsal views. All from permanent smear preparations. $\times$ 250.

were specimens present in permanent smear preparations they were somewhat flattened.

The ectoplasm appears to be a clear and hyaline zone in life and stains quite deeply with eosin or light green in whole mounts. The line of demarcation between the pellicle and the ectoplasm is indistinct. The ectoplasm of the anterior and posterior regions is a little thicker than that at the other part of the body which is uniformly about 1 μ thick (Pl. 7 Figs. 10—13).

The ciliary furrows appear as surface striae which can be seen most clearly in disintegrating individuals (Pl. 6 Fig. 2). The ciliary rows are longitudinal, converging anteriorly at the extremity of the body, where the ectoplasm is thickened. In this region the body surface appears to be ridged owing to the proximity of the ciliary furrows. The ridges are less distinct in the posterior portion of the body, since the furrows become arranged further apart.

The endoplasm appears highly alveolar and greyish in color in living organisms, and when stained presents a conspicuously reticulated structure (Pl. 6 Figs. 1—7, Pl. 7 Figs. 10—13). It is filled with refractile bodies and food particles, consisting of yeast cells, spores of *Coelosporidium periplanetae* and detritus occurring in the lumen of the host organ. A few spherical or elliptical bodies similar to the glycogenous inclusions characteristically found in *Nyctotherus ovalis* sometimes occur, although they are never as numerous as in the latter. As seen in life, there is a very slow cyclosis in the endoplasm.

A small flagellate was often noticed in the endoplasm of the ciliate. In morphological detail, it is indistinguishable from the one reported by the senior author from *Nyctotherus ovalis* (KUDO, 1936). When the host protozoans disintegrate, the flagellates are set free and swim about in the observation fluid with a characteristic jerky motion for about fifteen minutes. Then they explode suddenly and both the cytoplasm and the nucleus rapidly disintegrate. Of the three flagella which remain visible longer, two appear to be a little longer than the other. In one case, the longer flagella and shorter one measured 9 μ and 7 μ long respectively.

The peristome is located near the anterior extremity (Pl. 6 Figs. 1—7, Pl. 7 Figs. 10—13). It is a narrow and deep cylinder. Its depth however is considerably less than the length of the macronucleus. The peristome in each individual has been found to be constant in shape as judged by repeated continued observation of living specimens which lead the authors to state that the peristomal motion observed by MCDONALD (1922) in *Balantidium suis* does not occur in the present form. The diversity of form and size of the peristome is due to the size as well as to the angle of insertion in the body. This angle may be very acute or obtuse. In certain individuals the posterior part of the peristomal cavity is curved to one side. The "oral plug" named and described by MCDONALD in *B. suis* is not present in the present form, although in ventral view there is frequently noted a spoon-like termination of the anterior end. However this part did not show the mobility of the "oral plug" as described by MCDONALD in *B. suis*.

Although a ring or spiral of larger adoral cilia appears to encircle the peristomal aperture of certain species of *Balantidium*, such cilia have not been observed in the present form. A thickened layer of ectoplasm forms the lip of the peristome, the posterior margin of which is sometimes distinctly elevated above the body surface (Pl. 7 Figs. 10—12). The ciliation within the cavity seems to be continuous with that of the body surface. The adoral zone of membranellae extends almost the whole length of the cavity. The most anterior membranellae arise just inside the aperture, projecting out of the cavity in a brush form, the characteristic movement of which is in striking contrast with that of the body cilia. The membranellae lie in a longitudinal series on the dorsal left wall of the peristomal cavity, extending to the bottom of the cavity, where the cytosome is located (Pl. 6 Figs. 1, Pl. 7 Figs. 10—13). The membranellae are shortest at the posterior end near the cytostome, and longest in the middle of the peristomal cavity. These strong membranellae beat synchronously so that the entire zone functions as a single membrane. Viewed in either living or stained specimens, each membranella is distinctly separated from those which are adjacent to it. The cytopharynx is not well marked and only rarely can it be seen clearly. It is a short tube, ordinarily directed ventrally.

The trophozoites show two types of movement. The more common type is a rapid rotation of the body in the dorso-ventral plane, without being accompanied by progressive locomotion. The other type is a progressive spiral movement. The first type is apparently produced by a vigorous movement of the adoral zone which is stronger than that of the body cilia. This results in turning the body continuously toward the dorsal surface, and brings about rotation of the body toward that surface, with the posterior extremity acting as an axis. The body cilia of individuals undergoing such a movement are noted not to move in unison. An increase in the coordination of the body cilia increases the amount of forward progression and decreases the relative amount of rotation. As the progressive movement becomes pronounced, the rotation becomes changed to a spiral movement. However, the progressive locomotion does not completely overcome the active movement of the adoral zone, for in all organisms observed, there was always a spiral movement due to this cause. When an individual comes in contact with an obstacle, the activity of the adoral zone becomes increased, which brings about turning of the body toward the dorsal surface until no further resistance to the forward progress is encountered. Reversal of ciliary movement has not been seen even under these circumstances.

Each trophozoite possesses a macronucleus and a micronucleus (Pl. 7 Figs. 10—13). The macronucleus is always situated dorsal to the peristome and can readily be distinguished under a high dry objective in living specimens. It lies as a rule in the anterior half of the body, although when exceptionally large it may extend slightly into the posterior half.

In lateral view the macronucleus varies from oblong to spindle in form (Pl. 6 Figs. 1—4, 6, 7). Viewed from either dorsal or ventral surface the macronucleus presents an entirely different appearance (Textfig. C). It is more or less rectangular in shape with rounded or sometimes somewhat truncate anterior end. It is broader near the posterior end, which is drawn out at both right and left sides and therefore appears concave in outline. The maximum breadth of the macronucleus varies between 15 and 30 μ, averaging about 16.5 μ. The ratio between the body length and the length of the macronucleus is variable as has already been pointed out. In general, the macronucleus is a little less than one-half the body length.

The macronucleus is surrounded by a very thin membrane which is optically homogeneous as seen in living individuals (Pl. 3 Figs. 3, 10, 12). When a trophozoite disintegrates, as a result of mechanical pressure of the coverglass, the whole macronucleus is often compressed out of the body, in which case the membrane is easily noticed. As soon as the nucleus is completely outside the body, it assumes a spherical shape and when the nuclear membrane ruptures, it shrinks, which indicates that the nuclear membrane is highly elastic.

The constancy of the position of the macronucleus in the present ciliate reminded the authors of that of *Nyctotherus ovalis*, in which the macronucleus is suspended and supported by a karyophore, easily recognizable in living specimens. Careful examination of living individuals of the present Balantidium, however, failed to reveal any fibrils which might function as supporting structures. In permanent preparations, on the other hand, several fibrils which connect the macronuclear membrane with the anterior and dorsal body walls were always observed (Pl. 6 Figs. 6, 7, Pl. 7 Figs. 10—13). These fibrils vary somewhat in position and number except those which occur at the anterior and posterior extremities of the macronucleus.

The anterior fibrils connect the anterior end of the macronuclear membrane with the anterior tip of the body (Pl. 6 Figs. 6, 7, Pl. 7 Figs. 10—13). In many individuals several fibrils were seen in groups, or separately (Pl. 6 Fig. 12). The postnuclear fibrils connect the mid-dorsal region of the body wall with the two outer margins of the posterior end of the macronucleus (Pl. 6 Figs. 6, 7, Pl. 7 Figs. 10—13). The characteristically anterior position of the macronucleus in the present form, which has not been observed in other species of *Balantidium*, is undoubtedly maintained by these fibrils which hold the macronucleus in constant position. In certain individuals a number of fibrils appear to produce narrow membranes which connect the antero-lateral margins of the macronucleus with the ectoplasm opposite those points. They may represent a structure somewhat similar to the karyophore so well developed in *Nyctotherus ovalis* (Kudo, 1936).

The macronucleus is made up of refractile spherules suspended in karyochylema (Pl. 6 Fig. 3, Pl. 7 Fig. 10). These spherules vary from less than 1 μ to more than 5 μ in size. In the compressed living specimen, the larger spherules appear often not to be spherical, but when fixed and stained they are always spherical in shape. They give a strong positive response to Feulgen's nucleal reaction much like those of the macronucleus of *Nyctotherus ovalis* as reported by the senior author (Kudo, 1936). However, the alveolation of the spherules which was often noticed in the latter, has not been seen in the present *Balantidium*.

The structure of the macronucleus of various species of *Balantidium* appears to be variable. The majority of observers reported that in the species they studied minute chromatin granules either filled the macronucleus compactly or were distributed over reticulum. A few workers reported the occurrence of large chromatin bodies. Hegner and Holmes (1923) observed five "chromosome-like" bodies in the macronucleus of *Balantidium cunhamunizi* which appeared before division and afterward disintegrated into granules. Bhatia and Gulati (1927) showed a few large chromatin (?) masses in the macronucleus of *B. elongatum*, *B. gracile* and *B. bicavata*, in all of which the greater portion of the chromatin material was present in minute granular form. The same is true with Ghosh's (1929) observation on the macronucleus of *B. rhesum* in which he noted a single chromatin mass which was located centrally. Weil (1929) gives a drawing of *B. ovatum* in which the macronucleus is made up of small granules and several large bodies of various forms some of which show fibrilar processes. Thus the structure of the macronucleus of the present species is distinctly different from that of any of the known species of the genus, and resembles very closely that of *Nyctotherus ovalis* (Kudo, 1936).

The karyochylema is a homogeneous ground substance as viewed in life or in permanent smears. It is apparently normally in gel state, since Brownian movements of spherules begin only after the disintegration of the body. This movement of the spherules continues until the membrane ruptures, when the spherules scatter freely and without order.

The micronucleus is a vesicular body adhering to the macronuclear membrane (Pl. 6 Figs. 2—4, 6, 7, Pl. 7 Figs. 10—13). It lies on the ventral or lateral side and near the middle or in the posterior half of the macronucleus. It is oblong or ovoid with its long axis lying parallel to that of the macronucleus.

In life the micronucleus appears as an optically homogeneous vesicle. In permanent smear preparations, it presents a typical vesicular structure. The micronucleus as seen in permanent smear preparations measures 2.5 to 7 μ in the longest diameter. The chromatin substance is contained in a single large endosome and its response to Feulgen's reaction is less intensive as compared with that of the macronucleus (Pl. 7 Fig. 10). In this respect also, the macronuclei of the present *Balantidium* and of *Nyctotherus ovalis* (Kudo, 1936) resemble each other very closely.

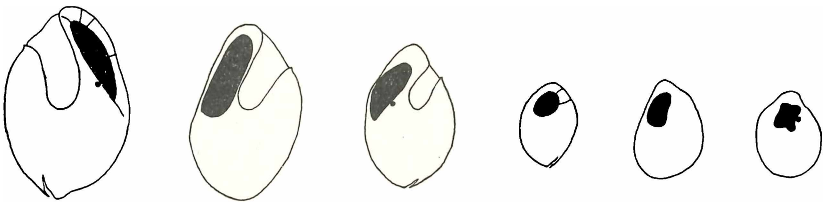
A single contractile vacuole is located near the cytopyge at the posterior end of the body (Pl. 7 Figs. 11, 13). The contractile vacuole is at first made up of small vacuoles which fuse together, gradually growing in size. Just before the contents are expelled, the vacuole is a conspicuous spherical vesicle. In the region of the anal canal and contractile vacuole, an area of specialized cytoplasm appears to be present. It is more homogeneous than the surrounding part, and its alveoli are much smaller and take acid stains more intensely.

The anal canal enters the body ventrally and obliquely from the cytopyge. In cross-section it appears to be wide and flattened. Lining the canal are a few short cilia which are noticeable only at the time of extrusion of solid waste. The solid waste material is expelled by contraction of the walls of the canal and the active movement of the cilia.

The cyst.

A few individuals which appeared to be encysting were observed (Text-Figs. G—I, Pl. 7 Fig. 14). They vary from 30 to 50 μ in length. They are ovoid in general body form and less active compared with normal trophozoites. The macronucleus becomes more or less rounded. The reticulation of the cytoplasm is less distinct and more irregular than that of the active trophozoite.

The cyst is ovoid (Pl. 6 Fig. 8, Pl. 7 Figs. 15, 16). Its membrane appears to be uniform in thickness except at one of the extremities where it is much thickened. The cytoplasm becomes vacuolated and often there is a single layer of small spherules over the entire peripheral portion. The compact rounded macronucleus is located near the center and shows a smaller number of chromatin spherules. The cysts measured from 30 to 40 μ long by 25 to 30 μ broad and thick.



D E F G H I

Figs. D—I. Outline drawings of abnormal and encysting trophozoites of *Balantidium praenucleatum*. D, type A; E, F, type B; G—I, different views of encysting trophozoites. All from permanent smear preparations. $\times$ 250.

Abnormal trophozoites.

While the dimensional and structural variations observed in the normal trophozoites are great between the two extremes, there is always continuity among them. Certain individuals however appeared to be too greatly different from the normal form to be considered as variants. These forms were too rare to permit more than mere mentioning at present, and their taxonomic status depends on future observations.

Type A. A small number of trophozoites were found to possess a very large peristome (Text-Fig. D). It is similar in body form and general morphological characteristics to the normal trophozoite. The macronucleus contains chromatin spherules, and appears arched in side view, since its dorsal surface is more convex than the ventral surface. The peristomal cavity is very large, and usually somewhat curved posteriorly. The dorsal wall of the peristomal cavity carries a row of membranellae. The ectoplasm is thick and distinctly much thicker at the anterior and posterior regions. The endoplasm is alveolar and contains a few food vacuoles. Thus the only characteristic which differs from normal individuals is the relative size of the peristome. The largest peristome found in normal trophozoites was 29.5 μ long possessed by an individual 127 μ in body length. One of the abnormal trophozoites of the present type was 103 μ long with 45 μ long peristome. This group is the most poorly defined of the abnormal forms and may possibly represent the upper limit of peristomal length attained by the organism.

Type B. This form is also characterized by a comparatively large peristome (Text-Figs. E, F). It is elongated and its anterior end is truncate. The peristomal cavity is large and straight. The dorsal wall of the peristome bears a number of rows of very long and strong cilia, but there are apparently no membranellae. The food vacuoles are often filled with rather large objects, and their size alone appears to be sufficient in distinguishing this group from others. The macronucleus is filled with large chromatin spherules. An individual measured 95 μ long by 57.5 μ thick; its macronucleus was 44.5 μ long by 12 μ thick and peristome 33 μ by 19 μ.

Type C. A single specimen showed very much different characteristics (Pl. 6 Fig. 9). The organism was very broad and ovoid. It showed a very large ovoid macronucleus with its long axis placed at right angles to the longitudinal axis of the body. There were seemingly no chromatin spherules in the nucleus. The peristome was extremely small. A short row of membranellae was located in the dorsal wall of the peristomal cavity. A cytopyge was located posteriorly and was connected with a very short anal canal. The ectoplasm formed a thick zone around the animal, which was thicker at both the anterior and posterior regions. The endoplasm was alveolated and food vacuoles were minute in size and small in number. It measured 155 μ long by 118 μ thick and its macronucleus was 82 μ by 59 μ.

Taxonomic consideration.

The genus *Balantidium* which was established by CLAPARÈDE and LACHMANN (1858) was emended by STEIN (1867) who defined it as follows: „Körper kurz ei- bis länglich spindelförmig, meist drehrund und vorn etwas abgestutzt; Peristom ein fast gerader, nach vorn erweiterter und in den Vorderrand auslaufender Längsspalt, der fast in der Mittellinie der Bauchseite und nur ausnahmsweise am rechten Seitenrande liegt und lediglich auf der linken Seite mit adoralen Wimpern besetzt ist; Schlund sehr rudimentär oder fehlend".

Since that time several attempts to divide the genus into two genera were made. BÜTSCHLI (1889) established the genus *Balantidiopsis* for *Balantidium duodeni*, with which SCHAUDINN (1899), BEZZENBERGER (1903), BHATIA and GULATI (1927) and others did not agree. Recently ALEXEIEFF (1931) described in *B. coli* and *B. testudinis* a "sidèrophile" lip which apparently possesses a strong affinity for basic stains. He found that it was not present in *B. entozoon*, *B. elongatum* and *B. suis*. Based upon the presence or absence of a "sidèrophile" lip, ALEXEIEFF established a new genus, *Balantioides*. To the genus *Balantidium* he placed those organisms with an extended peristome and without any "sidèrophile" material and designated *B. entozoon* as the type species. To the genus *Balantioides* he placed those forms which possess a reduced peristome containing a ring or lip of "sidèrophile" material and named *B. coli* as the type species. Since the size of the peristome may be subject to a great deal of variation in organisms which are similar in other regards as can be seen clearly in the present *Balantidium* and since entirely different forms may possess similar peristomes as in the case of *B. elongatum* and *B. littorinae*, it seems that the only difference which distinguishes *Balantidium* and *Balantoides* is the presence or absence of the "sidèrophile" material, which in the present authors' opinion is too inadequate for this purpose.

In the list which follows, are mentioned all the species of *Balantidium* known at present, except those listed in McDONALD (1922).

	Species	Authors	Hosts
1	*B. haughwouti*	DE LEON, 1919	*Ampullaria* sp.
2	*B. granulosum*	GAUTHIER, 1920	*Salvelinus* sp.
3	*B. ranarum*	GHOSH, 1921	*Rana tigrina*
4	*B. depressum*	GHOSH, 1921	*Ampullaria globosa*
5	*B. luciencis*	POISSON, 1921	*Orchestia littorea*
6	*B. suis*	McDONALD, 1922	*Sus scrofa*
7	*B. blattarum*	GHOSH, 1922	*Blatta americana*
8	*B. ovatum*	GHOSH, 1922	"
9	*B.* sp.	HEGNER, 1924	*Ovis aries*
10	*B. knowlesii*	GHOSH, 1925	*Culicoides peregrinus*
11	*B. amygdalli*	BATHIA and GULATI, 1927	*Bufo macrotis*
12	*B. bicavata*	"	*B. melanostictus*
13	*B. aragaoi*	CUNHA and MUNIZ, 1927	*Cebus caraya*
14	*B.* sp.	POPOW, 1928	*Sus scrofa*
15	*B. rhesum*	GHOSH, 1929	*Macacus rhesus*
16	*B. amblystomatis*	JIROVEC, 1930	*Amblystoma tigrinum*
17	*B. simile*	CUNHA and MUNIZ, 1930	*Macacus rhesus*
18	*B. sushilii*	RAY, 1932	*Rana tigrina*
19	*B. philippinensis*	HEGNER, 1934	*Macacus philippinensis*
20	*B. wenrichi*	"	*Ateles geoffroyi*
21	*B. cunhamunizi*	"	*Cebus variegatus*
	= *B.* sp.	HEGNER and HOLMES, 1923	"
22	*B. cameli*	HEGNER, 1934	*Camelus bactrianus*
23	*B. marsupialis*	"	*Didelphis marsupialis etensis*
24	*B. struthionis*	"	*Struthio camelus*

According to BHATIA and GULATI (1927), *B. ovale* is identical with *B. helenae* and *B. hyalinum* is a synonym of *B. duodeni*. It appears therefore that there are 44 species of *Balantidium* reported up to the present time.

A careful comparison of the present *Balantidium* with the descriptions of all of the reported species has failed to reveal any previously described species with which it agrees in morphological detail. It differs entirely from either of the two species which have been observed in the colon of *Blatta americana* in India (Ghosh, 1922, 1922a) and Indochina (Weill, 1929). *Balantidium blattarum* Ghosh has an entirely different form as compared with the form under consideration, while *B. ovatum* Ghosh resembles it somewhat in body form. They show numerous structural differences as compared with the present form, especially in nuclear apparatus. As a matter of fact, the location and the structure of the macronucleus observed in the present species is unique in this genus. Therefore, the authors consider the form under consideration is new to science and propose to name it *Balantidium praenucleatum* n. sp.

Summary.

A new species of *Balantidium*, *Balantidium praenucleatum* n. sp., is described from the lumen of the colon of *Blatta orientalis*. Its distinguishing characteristics may be summarized as follows: Trophozoite ovoid or oblong. Peristome small, close to the anterior end and on the ventral side. Adoral zone of membranellae originates in the dorsal left wall of the peristomal cavity. Macronucleus oblong or spindle-shaped, dorsal and anterior. Chromatin spherules of various sizes. Micronucleus ovoid on the ventral or lateral surface of macronucleus. Macronucleus is suspended from the antero-dorsal region of ectoplasm by fibrils. Cytopyge at the posterior tip with ciliated anal canal. Average dimensions: Body: length, 65.5 μ, thickness, 48.5 μ, width, 38 μ; macronucleus, 29.5 μ long by 10.5 μ thick; peristome, 14.5 μ deep; ratio of body length to body thickness, 1.3 to 1; ratio of body length to length of macronucleus, 2.3 to 1; ratio of body length to peristomal depth, 5 to 1. The ovoid cyst measures 35 μ by 27 μ. Locality: Urbana, Illinois.

Papers cited.

Alexeieff, A. (1931): Sur quelques particularités de structure de Balantioides (nom. nov.) coli (Malmsten). C. r. Soc. Biol. Paris. **107**, 210—211.

Bezzenberger, E. (1903): Über Infusorien aus asiatischen Anuren. Arch. Protistenkde **3**, 138—174.

Bhatia, B. L. and A. N. Gulati (1927): On some parasitic ciliates from Indian frogs, toads, earthworms and cockroaches. Arch. Protistenkde **57**, 85—120.

Bütschli, O. (1887—1889): Infusoria. Bronn's Klass. u. Ordn. Thier-Reichs **1**, H. 3.

CLAPARÈDE, E. and J. LACHMANN (1858): Études sur les infusoires et les rhizopodes **1**.

DA CUNHA, A. M. and J. MUNIZ (1927): Ciliés du genre Balantidium, parasites des singes. C. r. Soc. Biol. Paris **97**, 823—825.

— (1930): On the endomixis phenomenon in ciliata of the genus Balantidium. Observations concerning the encystment of these ciliata and description of a new parasitic species of Macacus rhesus. Mem. Inst. Cruz **23**, 189—235.

DE LEON, W. (1919): Balantidium haughwouti, new species, parasitic in the intestinal tract of Ampullaria species, a morphological study with remarks on the relation between the meganucleus and the micronucleus. Philippine J. Sci. **15**, 389—409.

GAUTHIER, M. (1920): Présence d'un Infusoire parasite dans l'estomac d'un saumon de fontaine. C. r. Soc. Biol. Paris **83**, 1607—1609.

GHOSH, E. N. (1922): On a new ciliate, Balantidium blattarum sp. nov., intestinal parasite in the common cockroach (Blatta americana). Parasitology **14**, 15—16.

— (1922a): On a new ciliate, Balantidium ovatum sp. nov., an intestinal parasite in the common cockroach (Blatta americana). Ibid. **14**, 371.

— (1925): On a new ciliate, Balantidium knowlesii sp. nov., a coelomic parasite in Culicoides peregrinus. Ibid. **17**, 189.

— (1929): A new species of Balantidium from the intestine of the Bengal monkey (Macacus rhesus). J. roy. microsc. Soc. **49**, 14.

HEGNER, R. (1924): Giardia and Chilomastix from monkeys, Giardia from the wild cat and Balantidium from the sheep. J. of Parasitol. **11**, 75—78.

— (1934): Specificity in the genus Balantidium based on size and shape of body and macronucleus, with description of six new species. Amer. J. Hyg. **19**, 38—67.

HEGNER, R. and F. O. HOLMES (1923): Observations on a Balantidium from a Brazilian monkey, Cebus variegatus, E. GEOFFR., with special reference to chromosome-like bodies in the macronuclei. Amer. J. Hyg. **3**, 252—263.

JÍROVEC, O. (1930): Über ein neues Balantidium aus dem Darmtractus von Amblystoma tigrinum. Z. Parasitenkde **3**, 17—21.

KUDO, R. R. (1926): Observations of Endamoeba blattae. Amer. J. Hyg. **6**, 139—152.

— (1926a): Observations on Lophomonas blattarum, a flagellate inhabiting the colon of the cockroach, Blatta orientalis. Arch. Protistenkde **53**, 191—214.

— (1936): Studies on Nyctotherus ovalis LEIDY with special reference to its nuclear structure. Ibid. **87**, 10—42.

MCDONALD, J. D. (1922): On Balantidium coli (MALMSTEN) and Balantidium suis (sp. nov.) with an account of their neuromotor apparatus. Univ. California Publ. Zool. **20**, 243—300.

POISSON, R. (1921): Sur un infusoire du genre Balantidium, parasite du tube digestif d'Orchestia littorea MONT. C. r. Soc. Biol. Paris **84**, 333—335.

RAY, H. (1932): On the morphology of Balantidium sushilii n. sp., from Rana tigrina DAUD. J. roy. microsc. Soc. **52**, 374—382.

JAKOBY, M. and F. SCHAUDINN (1899): Über zwei neue Infusorien im Darm des Menschen. Zbl. Bakter. **25**, 487—494.

STEIN, F. (1867): Der Organismus der Infusionsthiere nach eigenen Forschungen in systematischer Reihenfolge bearbeitet, **2**.

WEILL, R. (1929): Notes protistologique indochinoises. (Première Série.) Archives de Zool. **69**, 12—37 (N. et R.).

Explanation of plates.

Plates 6—7.

Plate 6.

Photomicrographs of Balantidium praenucleatum n. sp., from permanent smear preparations.

Fig. 1. A typical trophozoite, showing the reticulation of the endoplasm. Formaldehyde: HEIDENHAIN. × 700.

Fig. 2. A trophozoite showing the macronucleus and the usual position of the micronucleus. SCHAUDINN, HEIDENHAIN. × 700.

Fig. 3. A smaller trophozoite with the rounded anterior end, showing the chromatin spherules of the macronucleus and lightly stained micronucleus. Mercuric bichloride, GIEMSA. × 700.

Fig. 4. A trophozoite, showing the fibrils which connect the macronucleus and the body wall, the micronucleus and the typically reticulated endoplasm. SCHAUDINN, HEIDENHAIN. × 700.

Fig. 5. Dorsal view of a somewhat flattened trophozoite, showing the macronucleus, peristome and reticulated endoplasm. SCHAUDINN, HEIDENHAIN. × 700.

Fig. 6. A flattened trophozoite, showing the nuclei and the fibrils at both anterior and posterior end of the macronucleus. SCHAUDINN, HEIDENHAIN. × 700.

Fig. 7. Anterior portion of another highly flattened trophozoite, showing the fibrils between the macronucleus and the body wall, and the micronucleus. SCHAUDINN, HEIDENHAIN. × 950.

Fig. 8. A cyst shown in Fig. 16. SCHAUDINN, HEIDENHAIN. × 700.

Fig. 9. An abnormal trophozoite, type C. SCHAUDINN, HEIDENHAIN. × 280.

Plate 7.

Optical section drawings of Balantidium praenucleatum n. sp., from permanent smear preparations. × 950.

Fig. 10. A typical trophozoite. SCHAUDINN, FEULGEN.

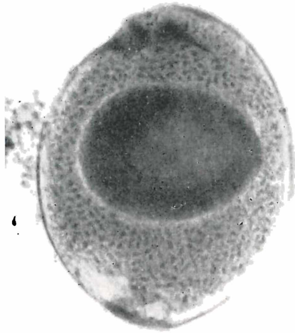
Figs. 11—13. Three trophozoites somewhat different from that shown in Fig. 10. SCHAUDINN, HEIDENHAIN.

Fig. 14. An encysting trophozoite. SCHAUDINN, HEIDENHAIN.

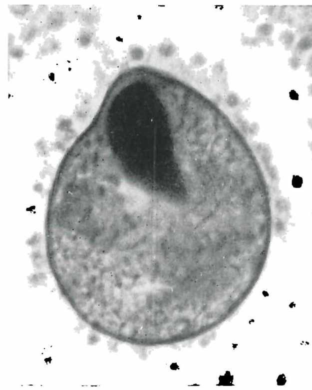
Fig. 15. A young cyst. SCHAUDINN, HEIDENHAIN.

Fig. 16. A more mature cyst shown in Fig. 8. SCHAUDINN, HEIDENHAIN.

1



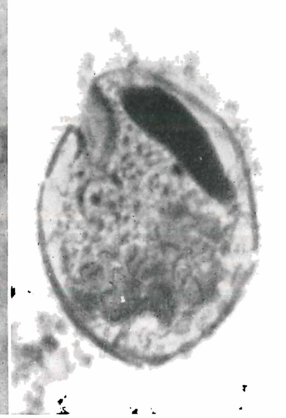
9



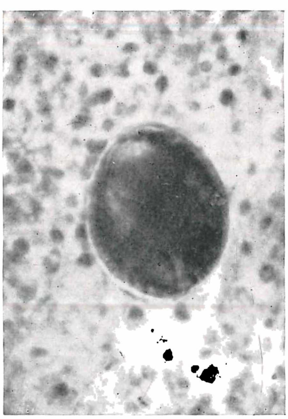
5

6

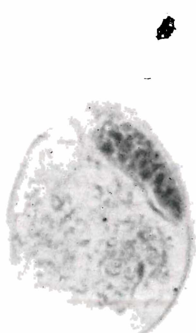
7



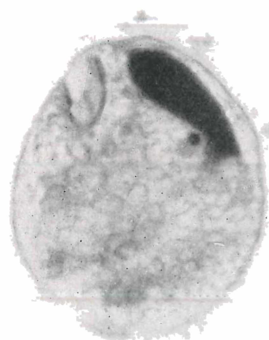
2



8



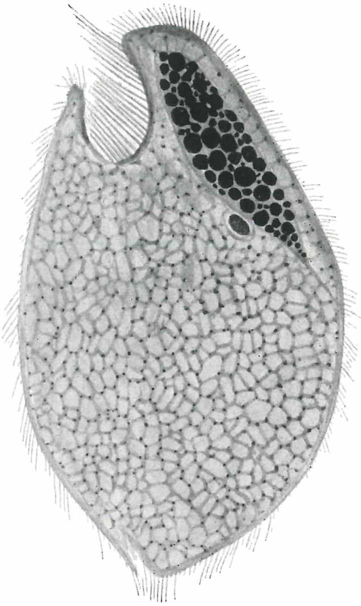
3



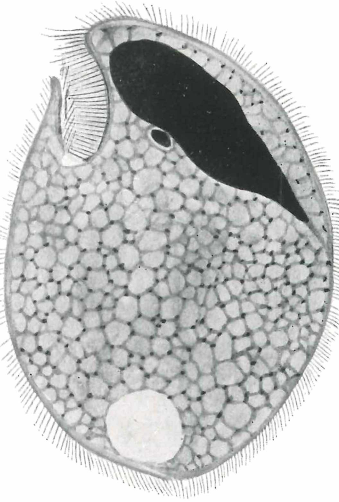
4

Kudo u. Meglitsch.

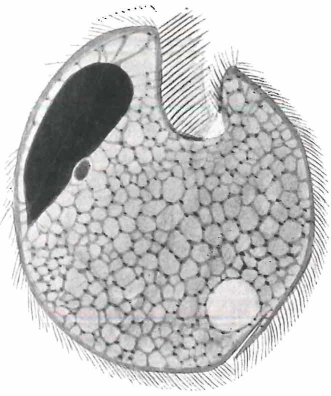
VERLAG VON GUSTAV FISCHER IN JENA



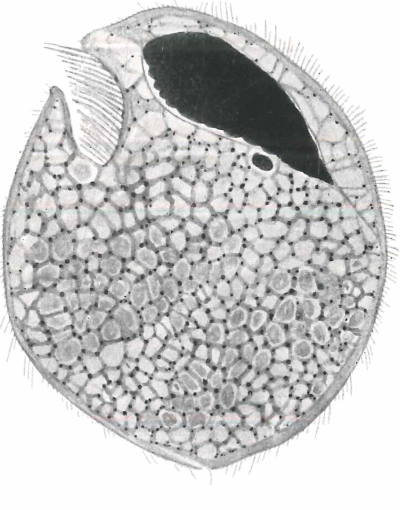
10



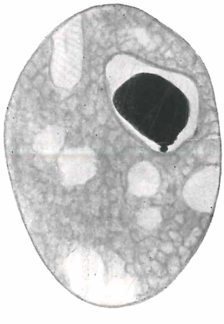
11



13

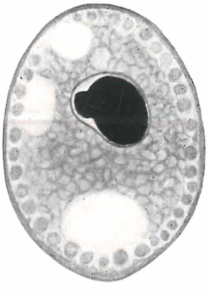


12



14

15



16

Kudo u. Meglitsch.

VERLAG VON GUSTAV FISCHER IN JENA

Zeitschrift/Journal: Archiv für Protistenkunde

Jahr/Year: 1938

Band/Volume: 91_1938

Autor(en)/Author(s): Kudo Richard Roksabro, Meglitsch P.A.

Artikel/Article: On Balantidium praenucleatum n. sp., inhabiting the colon of Blatta orientalis. 111-124