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Records of the Zoological Survey of India

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of Andhra Pradesh**

**C. Kalavati, C. C. Narasimhamurti
And
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Zoological Survey of India

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ANURANS OF ANDHRA PRADESH**

By

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AND
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INTRODUCTION

Anurans harbour a rich endocommensal fauna from Protozoa to Acanthocephala, each having a different grade of host-parasite relationships. Among protozoans, the rectal ciliates outnumber all others and constitute a very interesting heterogenous group of organisms that coexist in one and the same environment to the extent that literature on these forms "is as confusing and confused as is the taxonomy of the ciliates themselves" (Corliss, 1978).

There is much information on different species of endocommensal rectal ciliates of anurans from other parts of the world namely, Brazil (Amaro and Sena, 1967, 1968 ; Albaret, 1967-1975) ; Ohio, U. S. A. (Earl Paul, 1970, 1972, and England (Cox, 1971). In the Indian context our knowledge on these forms remains comparatively scanty. Ghosh (1921) was the first to report *Nyctotherus cordiformis* in *Bufo melanostictus* from Calcutta. Bhatia and Gulati (1927) studied the parasitic ciliates from frogs and toads of Punjab. de Mello (1932) worked on the protozoan endocommensals of Amphibia of Malabar and Nova Goa. Ray (1932) gave a description of *Dilleria* (= *Balantidium*) *sushlii* from *Rana tigrina* from Calcutta. Uttangi (1948-1958) carried out extensive investigations of Anura of Dharwar (Karnataka). Shete (1982, 1984) reported 10 species of *Nyctotheroides* and 8 species of *Balantidium* from amphibians of Aurangabad (Maharashtra).

The present study which was undertaken for a period of two years (1981-1983) was aimed at studying the endocommensal ciliates of anurans of Andhra Pradesh. During the study, besides 6 known species, 18 new species, 2 each of genera namely, *Balantidium*, *Trichodina*, *Metasicuophora* and *Prosicuophora* ; 4 *Nyctotheroides* and 6 *Sicuophora* were encountered, described and their systematic position discussed. The paper contains key to the identification of all Indian species and individual descriptions of those forms found in Andhra Pradesh,

MATERIAL AND METHODS

For examining parasites, frogs of varying sizes collected from different habitats in Andhra Pradesh (India) were brought to the laboratory and maintained in 2' x 1' x 1 1/2' size aquaria tanks. During this period the animals were fed with odonate and other insect larvae. In some cases, frogs were dissected immediately after collection and examined for parasitic ciliates since it was felt that delay in examination could sometimes result in defaunation.

Autopsied individuals showed a large number of ciliates living endocommensally at the junction of the large intestine and upper part of the rectum. Smears were prepared from rectal contents, wet-fixed in Schaudinn's, alcoholic Bouin's or Carnoy's fluid and stained suitably with different histological stains such as Heidenhain's, Delafield's, Ehrlich's or phosphotungstic acid haematoxylin, Azocarmine, Aniline blue, Mallory's triple stain and Feulgen. Histochemical techniques such as Periodic Acid/Schiff (PAS), mercuric bromophenol blue, alcian blue, phloxine and Steedman's alcian blue were used to demonstrate adhesive organelle and dry silver method after Klein (1958) and Silver impregnation technique with ammoniacal silver nitrate for studying ciliary rows and infraciliature. All measurements were given in microns (μ m) and diagrams drawn with the aid of a camera lucida.

ABBREVIATIONS USED

AD.—Adhesive disc without border ; AO.—Adhesive organelle ; AZM.—Adoral zone of membranelle ; CV.—Contractile vacuole ; Cy. Ph.—Cytopharynx ; Cy. Py.—Cytopyge ; Cy. Py. c.—Cytopygeal cilia ; D.—Denticle ; DR.—Denticulate ring ; E.—Ectoplasm ; Endo.—Endoplasm ; Es.—Episarc ; Fi.—Fibrils ; Fi. K.—Fibril of karyophore ; Fi. S.—Fibrillar structures ; GB.—Glycogen bodies ; I.—Infundibulum ; K.—Karyophore ; Ma. N.—Macronucleus ; P.—Peristome ; RB.—Refringent bodies ; S.—Suture ; V.—Vestibule ; Ve.—Velum.

Classified list of endocommusal ciliates of amphibians described so far from India (Classification according to Levine *et al.*, 1980 ; Species arranged chronologically).

Phylum : CILIOPHORA
Class : KINETOFRAGMINOPHOREA
Subclass : VESTIBULIFERIA
Order : TRICHOSTOMATIDA
Suborder : TRICHOSTOMATINA

Family : BALANTIDIIDAE

Genus : **Balantidium** Claparede and Lachmann, 1858

- *1. *B. elongatum* Stein, 1867
- *2. *B. duodeni* Stein, 1867
3. *B. rotundum* Bezenberger, 1904
- *4. *B. gracile* Bezenberger, 1904
5. *B. helenae* Bezenberger, 1904
6. *B. amygdelli* Bhatia and Gulati, 1927
7. *B. bicavata* Bhatia and Gulati, 1927
8. *B. tigrinae* Shete and Krishnamurthy, 1984
9. *B. aurangabadensis* Shete and Krishnamurthy, 1984
10. *B. ranae* Shete and Krishnamurthy, 1984
11. *B. megastomae* Shete and Krishnamurthy, 1984
12. *B. cyanophlycti* Shete and Krishnamurthy, 1984
13. *B. corlissi* Shete and Krishnamurthy, 1984
14. *B. mininucleatum* Shete and Krishnamurthy, 1984
15. *B. ganapatii* Shete and Krishnamurthy, 1984
- *16. *B. rhacophori* n. sp.
- *17. *B. waltirensis* n. sp.

Class : OLIGOHYMENOPHOREA
Subclass : PERITRICHIA
Order : PERITRICHIDA
Suborder : MOBILINA

Family : TRICHODINIDAE

Genus : **Trichodina** Ehrenberg, 1830

1. *T. cyanophlycti* n. sp.
2. *T. waltirensis* n. sp.

Class : POLYHYMENOPHOREA
 Subclass : SPIROTRICHIA
 Order : HETEROTRICHIDA
 Suborder : CLEVELANDELLINA

Family : SICUOPHORIDAE

Genus : **Sicuophora** de puytorac and Grain, 1969

1. *S. kalii* (Uttangi, 1950)
2. *S. macropharyngea* (Bezenberger, 1903)
3. *S. magna* (Bezenberger, 1904)
4. *S. malabarica* n. sp.
5. *S. waltirensis* n. sp.
6. *S. limnochari* n. sp.
7. *S. fragilis* n. sp.
8. *S. puytoraci* n. sp.
9. *S. levinei* n. sp.
10. *S. ranae* n. sp.

Genus : **Metasicuophora** Albaret, 1973

1. *M. cyanophlycti* n. sp.
2. *M. melanosticti* n. sp.

Genus : **Prosicuophora** de Puytorac and Oktem, 1967

1. *P. andhrae* n. sp.
2. *P. hexadactyli* n. sp.

Family : NYCTOTHEROIDAE

Genus : **Nyctotheroides** Grasse, 1928

1. *N. cordiformis* Stein (Ehrenberg, 1938)
2. *N. reniformis* (Bhatia and Gluati, 1927)
3. *N. cochlearis* (Uttangi, 1948)
4. *N. caucopusi* (Uttangi, 1951)
5. *N. systoma* (Uttangi, 1958)
6. *N. limnocharis* (Uttangi, 1958)
7. *N. curtipes* (Uttangi, 1958)
8. *N. breviceps* (Uttangi, 1958)
9. *N. bufonis* (Uttangi, 1958)
10. *N. (Aduncoperistomatus) cyanophlycti* (Shete, 1982)
11. *N. (A.) melanosticti* (Shete, 1982)
12. *N. (A.) aurangabadensis* (Shete, 1982)
13. *N. (A.) marathwadensis* (Shete, 1982)

14. *N. amaro* (Shete, 1982)
15. *N. ratnagirensis* (Shete, 1982)
16. *N. indicum* (Shete, 1982)
16. *N. rhacophori* n. sp.
18. *N. bhatiae* n. sp.
19. *N. foliatus* n. sp.
20. *N. hexadactyli* n. sp.

TAXONOMIC ACCOUNT

Key to the identification of families described during the study (after Corliss, 1978).

Family : BALANTIDIIDAE Reichnow in Doflein
and Reichnow, 1929

Cytostome at the base of vestibulam, anterior in position, somatic ciliation uniform. Parasitic in diverse hosts.

Family : TRICHODINIDAE Claus, 1874

Body cylindrical or barrel-shaped, adoral spiral 180°, 2-3 spirals, buccal ciliature conspicuous, denticles complex, macronucleus sausage to horse-shoe shaped, widely distributed in a variety of hosts.

Family : SICUOPHORIDAE Amaro, 1972

Body ovoid to ellipsoidal, sucker often extensive, present on concave surface of body, reinforced with polysaccharide skeletal elements. Macronucleus compact, kinetal sutures variable. Endocommensal in vertebrate hosts only.

Family : NYCTOTHERIDAE Amaro, 1972

Body ovoid to reniform, buccal ciliature running from near apical to sub-equatorial region forming a 'S' shaped curve, macronucleus compact, karyophore present. Parasites of different hosts.

Genus : **Balantidium** Claparede and Lachmann, 1858

Genus *Balantidium* is established by Claparede and Lachmann in 1858 for a parasite which they observed in the

rectum of frogs. The genus is characterised by the presence of a cytostome situated at the base of an anteriorly located vestibule, a body of uniform ciliation and an oval macronucleus.

Species of genus *Balantidium* are known from a variety of vertebrate hosts such as frogs, toads, snakes, chimpanzees, and even man from all over the world but only 16 of them have been so far reported from the Indian sub-continent. In the present study, 3 species are reported as occurring in new hosts and 2 others new to science.

*Key to the identification of species of genus Balantidium
reported so far from anuran hosts in India*

- I. Vestibule long, reaching middle body
 - (A) Body oval
 - (i) Ma. N. kidney shaped.
One CV ... *B. duodeni*
 - (ii) Ma.N. oval. CV absent ... *B. bicavata*
 - (B) Body cylindrical
 - (i) Ma. N. kidney shaped. Four
CV ... *B. giganteum*
 - (ii) Ma. N. oval. CV absent ... *B. gracile*
- II. Vestibule small less than half the length of body
 - (A) Vestibule slit like
 - (i) Body cylindrical. Ma. N.
oval, in the posterior half
of body. 2 or 3 CV ... *B. elongatum*
 - (ii) Body oval, Ma. N. Kidney
shaped. One CV ... *B. helenae*
 - (iii) Body almond shaped. Ma,N.
oval. One CV ... *B. amygdalli*
 - (iv) Body elliptical or pyriform
Ma. N. lobed. CV absent ... *B. megastomae*
Ma. N. sausage shaped ... *B. corlissi*

- (B) Vestibule funnel or 'V' shaped
- (i) Body elongate
 Ma.N. kidney shaped. Mi.N. embedded on surface of the
 Ma. N. CV absent ... *B. cyanophylcti*
 Ma. N. sausage shaped ... *B. aurangabadensis*
 Ma. N. spherical. CV absent ... *B. mininucleatum*
 Anterior end broad. 2 equal spherical or oval nuclei.
 2 CV ... *B. rhacophori n.sp.*
- (ii) Body typically pyriform.
 Ma. N. oval. CV absent ... *B. ranae*
- (C) Vestibule terminal, asymmetrical, sac-like
- (i) Body elongate
 Ma. N. 'C' shaped. CV absent ... *B. tigrinae*
 Body narrow with pointed ends. Ma. N. oval or elongate ... *B. ganapatii*
- (D) Vestibule triangular, pocket-like with raised lips
- (i) Body flask-shaped. Ma. N. oval. Mi. N. spherical near
 Ma. N. one CV ... *B. waltairensis n.sp.*

1. *Balantidium elongatum* Stein

Host : *Rana breviceps*

Site of infection : Rectum

Locality : Nellore, Andhra Pradesh

Trophozoites elongated, posterior end pointed, anterior end bluntly rounded. Size varying from $80-120 \times 25-56 \mu\text{m}$. Vestibule broad, depressed, anterior and extends about $1/3$ the length of body. Macronucleus oval, measuring $10-15 \times 8-12 \mu\text{m}$, situated generally in posterior half of body. 2 or 3

contractile vacuoles. Cytoplasm granular. Body ciliation uniform. Kineties parallel. 36-42. Posterior cilia longer than body cilia.

Remarks :

This form resembled those described by Bhatia and Gulati (1927) examined from *R. tigrina* in Punjab (Lahore). The present host, *R. breviceps*, is a new host record from Andhra Pradesh for this species.

2. *Balantidium duodeni* Stein

Host : *R. tigrina*

Site of infection : Rectum

Locality : Vizianagaram, Andhra Pradesh

Trophozoites oval or slightly bean-shaped. Size varying from 60-80 × 35-68 μm . Vestibule narrow, tubular, extending up to the middle of body. Macronucleus kidney shaped, measured 10-16 × 5-10 μm . Micronucleus small, spherical, situated near one end of macronucleus. Cytopyge small, cleft-like. Single contractile vacuole. Cytoplasm granular, clearly demarcated into deeply stained ectoplasm and lightly stained endoplasm. Body ciliation uniform. 68-62 kineties.

Remarks :

This form resembled the one described by Bhatia and Gulati (1927) from Punjab in all other characters except that the species is much smaller. The present host is also a new host record from Andhra Pradesh.

3. *Balantidium helena* Bezenberger

Host : *R. limnocharis*

Site of infection : Colon

Locality : Visakhapatnam, Andhra Pradesh

Trophozoites oval, ends broadly rounded, size varying from 110-140 × 60-70 μm . Vestibule broad, extending about 1/5 the length of body. Macronucleus kidney shaped generally situated in posterior region of body measuring 18-20 × 10-16 μm . Micronucleus not observed. Cytoplasm granular with large number of vacuoles.

Body cilia longer in posterior region forming a small tuft.
Kineties discontinuous.

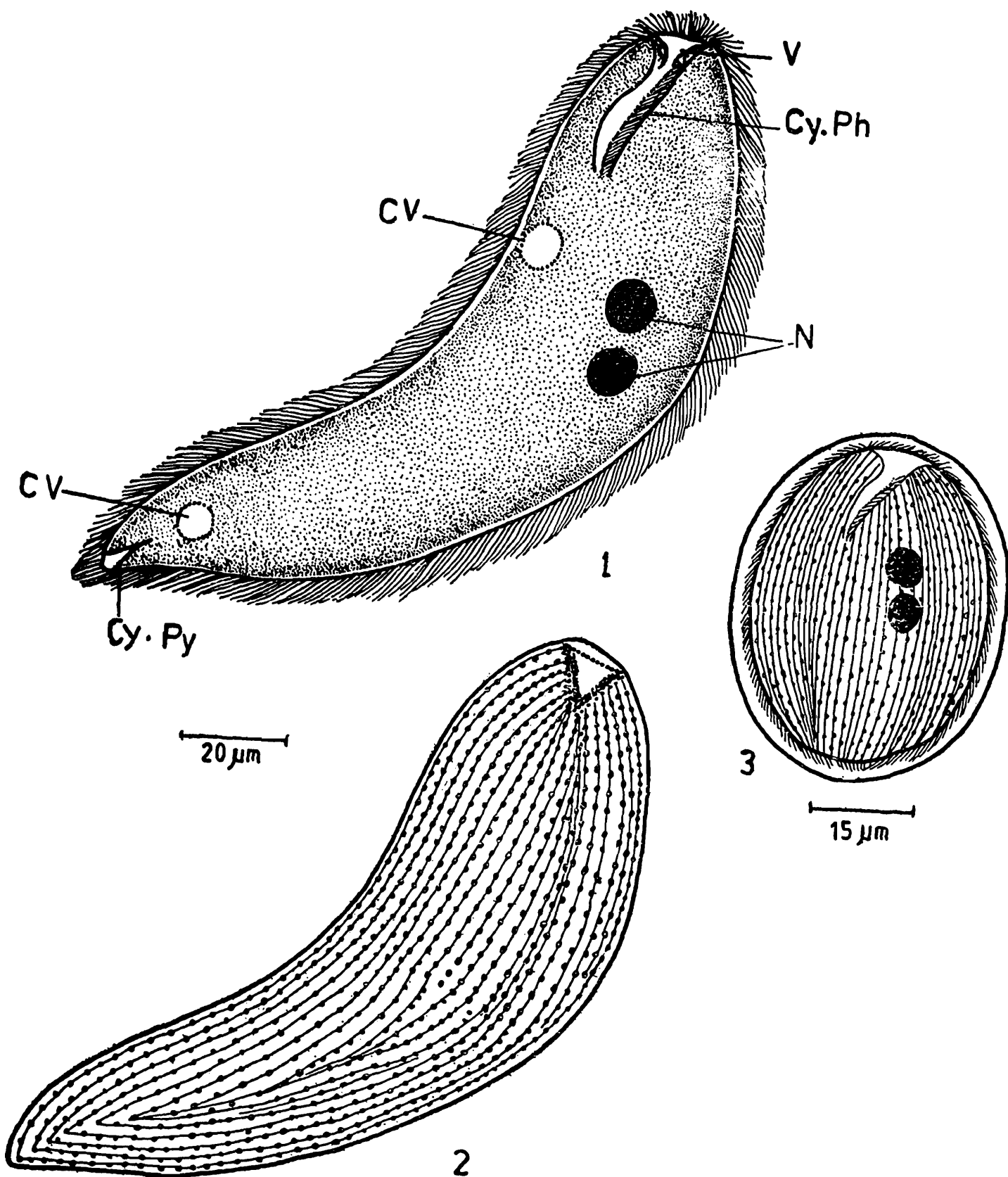


Fig. 1 *Balantidium rhacophori* n. sp.—morphology

Fig. 2 Showing calialy rows

Fig. 3 Cyst

Remarks :

This form resembled those described by Bezenberger (1904) in body size. Though Bhatia and Gulati (1927) reported much smaller individuals, the authors have not encountered such small sized forms. The present species differs from the original form in the presence of a large number of vacuoles in its cytoplasm. Whereas the two earlier records were from *R. tigrina*, its present occurrence in *R. limnocharis* is the species new host record from Andhra Pradesh.

4. *Balantidium rhacophori* n. sp.

Host : *Rhacophorus maculatus* (Gray)

Site of infection : Rectum and colon

Locality : Araku Valley (Visakhapatnam District, Andhra Pradesh)

Incidence : 2/23

Type slides : ZSI pt. 2067 (Holotype)
2068 (Paratype)

Trophozoites elongated with broad anterior and narrow posterior ends. Size varying from $150-1300 \times 30-70 \mu\text{m}$ ($n=50$). Width : length ratio generally 1 : 5.6. Vestibule funnel shaped and located at anterior tip that appears as a depression in fresh preparations. Vestibule opens into a small tubular cytopharynx through a narrow cytostome. Cytopharynx $15-48 \mu\text{m}$ long.

Nuclei spherical or oval, rarely one and more often 2 of equal diameter, located in the anterior half of body measuring $10-15 \times 10-12 \mu\text{m}$ and stained deep. Micronucleus not observed. Two contractile vacuoles, one each in anterior and posterior halves. Cytoplasm granular. Cytopyge small and triangular.

Ciliation uniform. Peristomial cilia longer. Kineties 24-38, parallel, converging near vestibule. Vestibular region with a number of closely arranged basal granules.

Reproduction through binary fission. Observed merely in forms collected from gravid female hosts during January

year 1981-1982. Cysts oval measuring $25-40 \times 50-90 \mu\text{m}$. Cyst wall thin and transparent. Binucleate. Noticed during March-April months.

Remarks :

Altogether 16 species of *Balantidium* have been reported from anuran hosts in India but none from *Rhacophorus*. In comparison, the present species had no resemblance with any of the other known forms in its body size, nature of cytopharynx and nucleus. The species is also considered unique in the presence of 2 identical nuclei in over 90% of the trophozoites examined. Krascheninnkow (1959) reported 'monsters' of *B. coli* with 2 or 3 nuclei occasionally, which could be due to their incomplete division in conjugation.

In view of these distinct characters namely, presence of 2 identical nuclei, a slightly curved cytopharynx, funnel-shaped vestibule and 2 contractile vacuoles and based on its first record in *Rhacophorus*, the species is considered new to science and the name *Balantidium rhacophori* n. sp. after the host is proposed.

5. *Balantidium waltairensis* n. sp. (Figs. 4-5)

Host : *Rana cyanophlyctis*

Site of infection : Rectum

Locality : Visakhapatnam (Andhra Pradesh)

Incidence : 3/158

Type slides : ZSI, pt. 2069

Trophozoites typically flat-shaped. Posterior end broad and rounded, anterior end narrow, and pointed, measuring $110-140 \times 90-105 \mu\text{m}$ ($n=50$). Width : length ratio 3 : 4. Vestibule broad, triangular with pocket-like raised lips with slight curvature. Left lip with a row of peristomial cilia. Cytopharynx tubular, $30-44 \mu\text{m}$ long, extending up to 1/3rd length of body. Macronucleus oval, always on the left side of body, $25-35 \times 15-20 \mu\text{m}$. Micronucleus spherical, $4-8 \mu\text{m}$ in diameter, located in close proximity to macronucleus. Only one contractile vacuole, $35-45 \mu\text{m}$ in diameter in diastole, always on the right side seen. Cytopyge not observed.

Ciliation uniform, ciliary rows parallel starting from a suture at anterior end below vestibule. Kinetosomes appearing

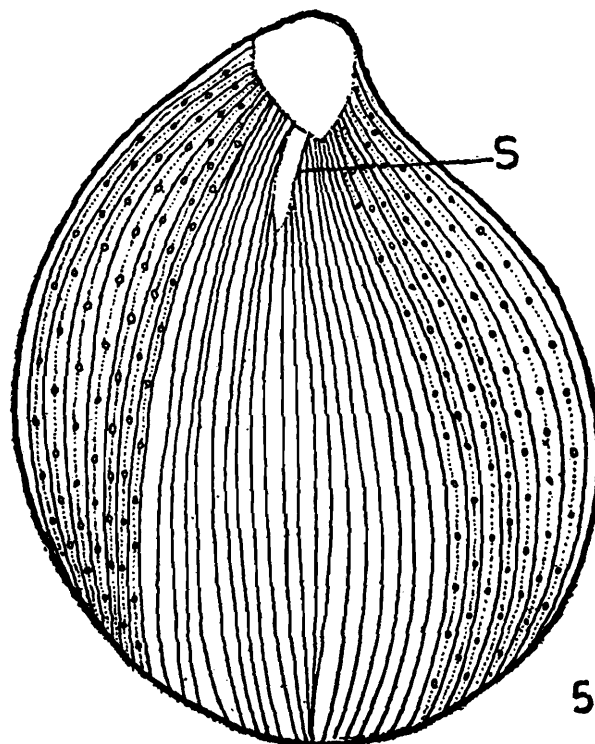
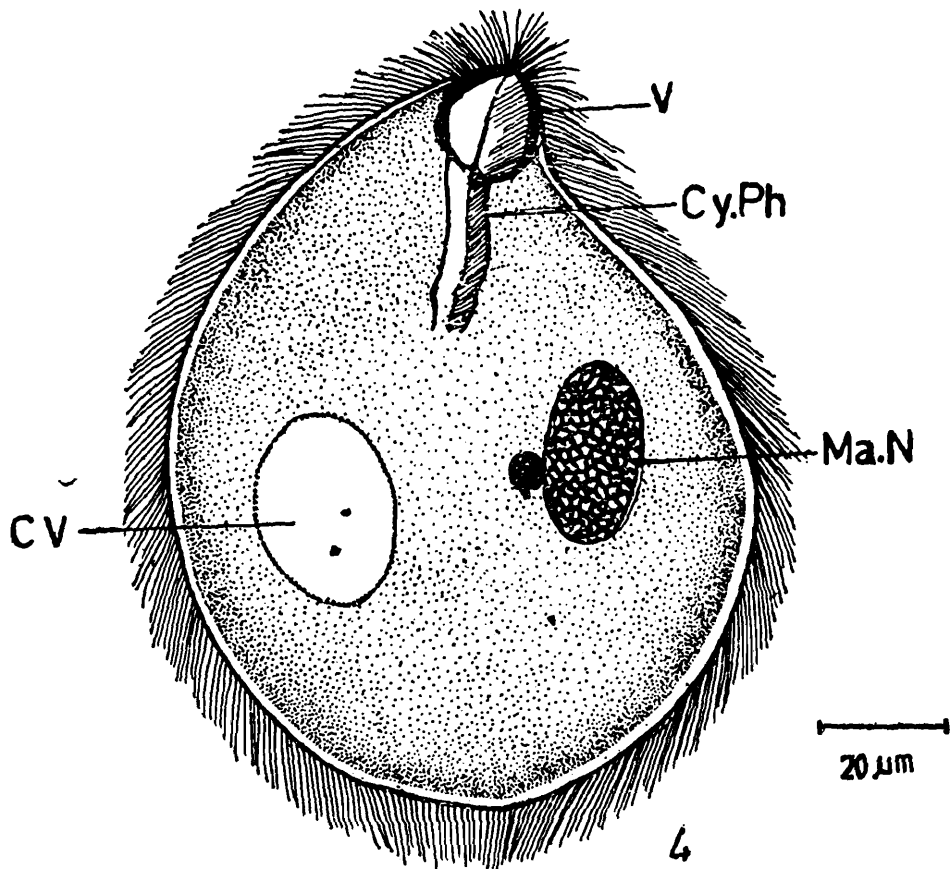


Fig. 4 *Balantidium waltirensis* n. sp.—morphology

Fig. 5 Showing ciliary rows

pale when impregnated with silver. Kineties discontinuous. Stages of binary fission and cysts not observed.

Remarks :

The present form though resembled closely *B. elongatum* Stein, 1857 in body dimensions, 90-142 × 33-62 μm (cf. Bhatia and Gulati, 1927), the species differed considerably in length : width ratios. Similarly while the macronucleus in the present form was found on the left side usually in the middle 1/3 of body, in *B. elongatum* it was seen in posterior region. It is significant that even though the other two species namely, *B. gracilis* and *B. helenae* (Bezenberger, 1904), occurred in anurans such as *R. hexadactyla*, *R. limnocharis* and *R. tigrina*, besides *Rana cyanophlyctis* the present species was encountered merely in *R. cyanophlyctis*. It differed from both *B. gracilis* and *B. helenae* in body size and shape.

In view of the distinct nature of the species stated above it is considered new to science for which *Balantidium waltairensis* n.sp. is proposed.

Genus : Trichodina Ehrenberg, 1830

Several species of *Trichodina* are reported from piscean and amphibian hosts, both as ecto-and endoparasites. While the former are generally non-specific and occur on the body surface of fishes, the latter are more or less specific to frogs and toads living in their urinary bladder. So far, 5 species of *Trichodina* have been reported from frogs and toads and the others among newts all in urinary bladder. Lom (1958) listed trichodinids of amphibians and proposed a scheme for their identification. The present account deals with 2 more new species of *Trichodina*, one from the rectum of *Rana cyanophlyctis* and the other, in the urinary bladder of *R. breviceps* and *R. cyanopelyctis*.

Genus : Trichodina Ehrenberg, 1930

Denticulate ring consists of denticles with two projections- distal blade and proximal ray. Adoral region with an angle of 350-450°, performing 1 to 1 1/2 circles.

*Key to the identification of species of the genus
Trichodina from anuran hosts in India :*

- I. Adoral zone with an angle of 360-420°, performs one complete turn. 28-42 denticles. Ma.N. bean-shaped. Mi.N. spherical. One CV in the median line. Velum incipient. ... *T. cyanophlycti*
n. sp,
- II. Adoral zone with an angle of 390-450°, performs 1 1/2 turns. 48-52 denticles. Ma.N. bent with one long and one short arm. Velum distinct with marginal cilia. ... *T. waltirensis*
n. sp.

1. *Trichodina cyanophlycti* n. sp. (Figs. 6-8)

Host : *R. cyanophlyctis*

Site of infection : Rectum

Locality : Eluru (Andhra Pradesh)

Incidence : 1/120

Type slides : ZSI, pt. 2070

Trophozoites generally free in lumen but occasionally attached to rectal wall. Body oval or rectangular measuring 60-186 × 28-128 μm (n=50). Adoral zone having an angle of 360-420° and performs one complete turn at anterior end of body, parallel to adhesive disc. Adhesive disc 28-100 μm, with an outer thin membrane having a row of cilia and a small depression in the centre on aboral side. Striated membrane reinforced with 4 to 5 radial pins in between two denticles. Denticulate ring 20-68 μm in diameter. Denticles varying from from 28-42 in number, 12-18 μm in size. Inner ray 5-10 μm, distal blade 6-8 μm.

Macronucleus bean-shaped 35-48 × 15-20 μm in size, located at right angles to main axis of body. Micronucleus small, spherical, located close to macronucleus near indentation. Cytoplasm hyaline. Velum not clear. Incipient folding of ectoplasm present, occasionally representing

velum. Contractile vacuole single and in median line of body. No apparent damage to host tissue seen.

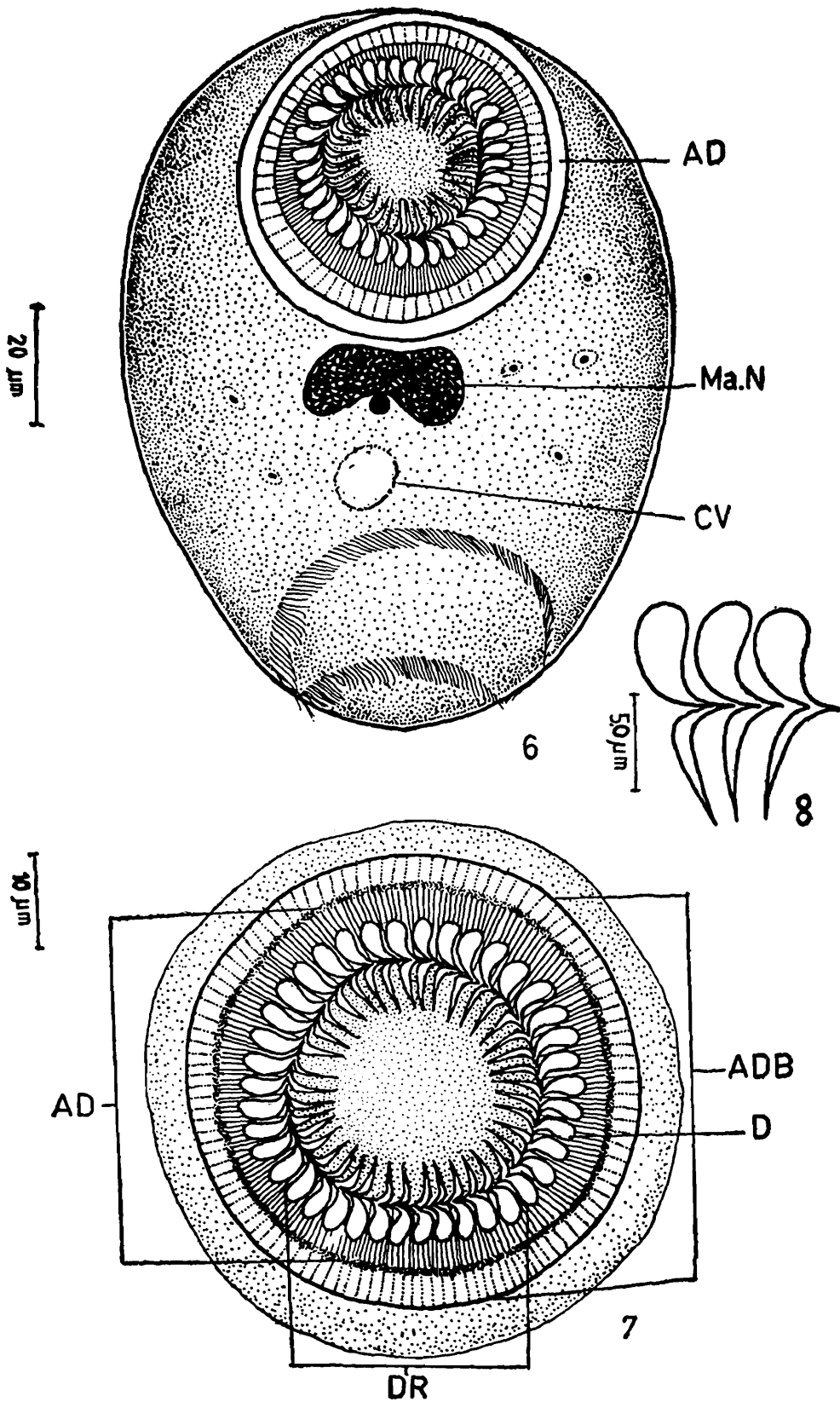


Fig. 6 *Trichodina cyanophlycti* n. sp.—morphology
 Fig. 7 Adhesive disc
 Fig. 8 Denticles

Remarks :

Five species of *Trichodina* have so far been reported from the urinary bladder of frogs and toads. These include *T. urinicola* Fulton, 1923 from *Bufo* sp. (U.S.A.) ; *T. xenopodis* Fantham, 1924, *Xenopus laevis* *T. bufonis* Fantham, 1924, *Bufo regularis* (S. Africa) ; *T. entzii* Bretschneider, 1935, *Rana esculenta* (Europe) ; *T. ranae* da Cunha, 1950, *R. esculenta*, *R. lessonae* and *R. rudibunda* Perezi (Europe). *T. xenopodis* Fantham, 1924 is reported from *Xenopus laevis* (S. Africa). The present form is the largest reported so far being as large as $186 \times 128 \mu\text{m}$. In comparison with other species, *T. entzii* ($60 \times 130 \mu\text{m}$) is perhaps the closest to the present form but differs from it in the presence of a cylindrical body and a 'U' shaped macronucleus. As regards the number of denticles, they are relatively more in the present form. With the exception of *T. xenopodis* (48-64), the maximum number of denticles in all others remained at 36. In *T. urinicola forma bohémica*, the number of denticles, however, is nearly the same as in the present form but it differs in having a bell-shaped conical body.

In view of the above differences and also since it is the first report from the rectum of a frog in India, it is considered new to science and the name *Trichodina cyanophlyctis* n. sp. after the host is proposed.

2. *Trichodina waltairensis* n. sp. (Figs. 9-11)

Host : *Rana breviceps* and *R. cyanophlyctis*

Site of infection : Urinary bladder

Locality : Vizianagaram (Andhra Pradesh)

Incidence : 6/42 *R. breviceps*

2/56 *R. cyanophlyctis*

Type slides : ZSI, Pt. 2071 Holotype

2072 Paratype

Trophozoites cylindrical, $90-150 \times 40-50 \mu\text{m}$. Adoral zone of angle $390-450^\circ$ forming approximately one and half turns around body with a row of cilia. Adhesive disc $56-80 \mu\text{m}$ with an outer striated membrane. Denticulate ring $40-50 \mu\text{m}$

in diameter, denticles 48-52, 8-10 radial pins in between two denticles arranged in pairs. Denticles 10-12 μm long, inner

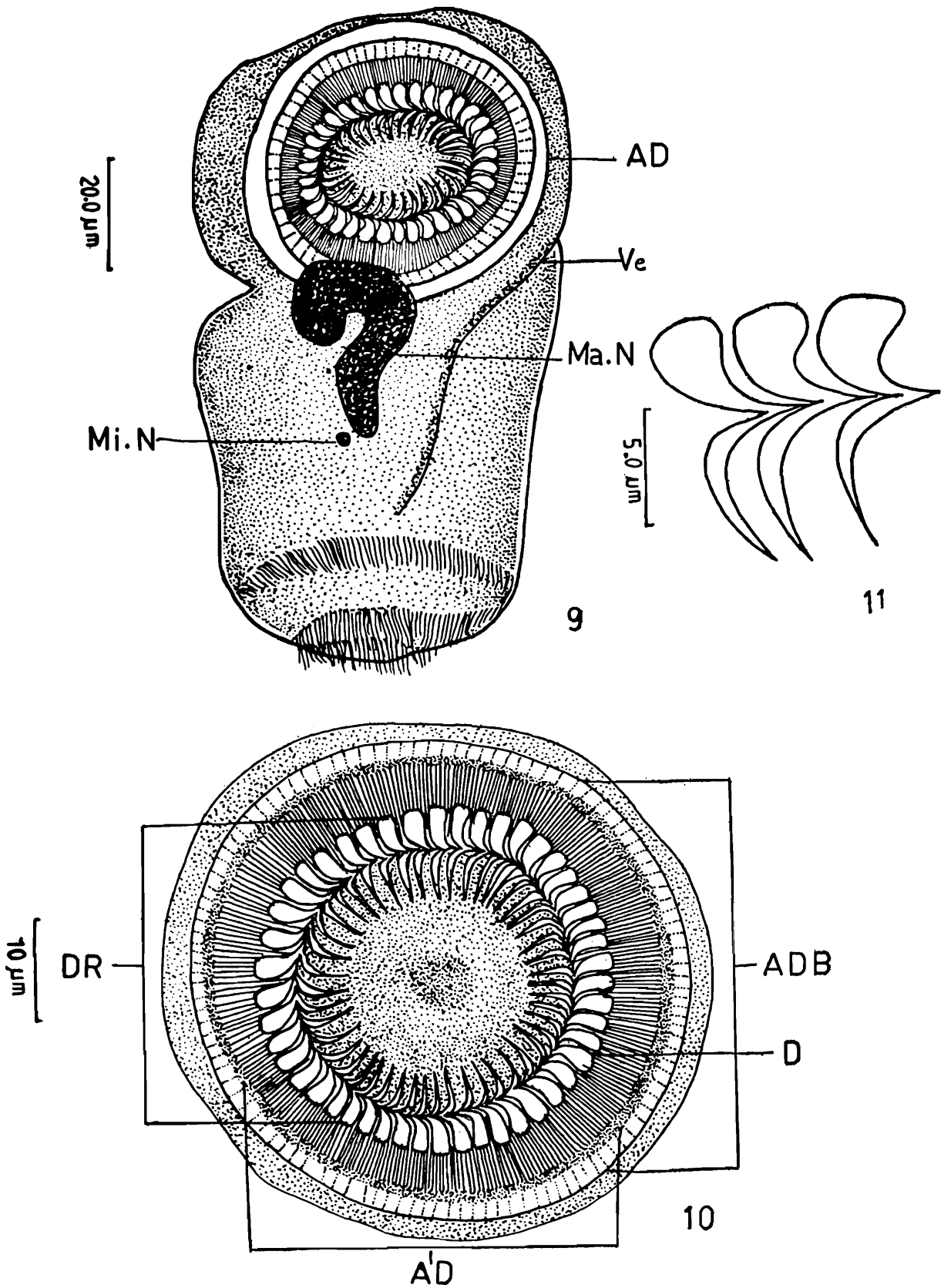


Fig. 9 *Trichonina waltirensis* n. sp.—morphology

Fig. 10 Adhesive disc

Fig. 11 Denticles

ray of 4-5 μm and a distal blade of 6-7 μm . Distal blade has small, spine-like projection. Macronucleus bent with one each of short and long arms, measuring 40-50 \times 4-5 μm . Micronucleus small, spherical situated near long arm of macronucleus. Velum deeply stained without marginal cilia. Cytoplasm hyaline, vacuolated. No contractile vacuole.

Remarks :

This species resembles *T. entzii* in body size and *T. xenopodis* in the number of denticles, but in both cases, the macronucleus is either horse-shoe or 'U' shaped with equal arms, The macronucleus in the present form has one each of short and long arms. The velum, though well developed, is non-ciliated and there is a shift of adoral zone. This species is different from *T. cyanohlycti* n. sp., described earlier, in structure, site of infection, host and locality.

In view of the above, and based on its occurrence, the first of its kind, in the urinary bladder of *R. breviceps*, the species is considered new to science and the name *Trichodina waltirensis* n.sp. is suggested.

Genus : Sicutophora de puytorac and Grain

Genus *Sicutophora* was established by de puytorac and Grain (1968) for a ciliate they collected from the rectum of *Xenopus fraseri*. Genus *Sicutophora* is characterised by the presence of an adhesive organelle on concave side reinforced with polysaccharide skeletal elements and a ciliary system which consists of a well developed pre-oral, right, apical and caudal parts. The macronucleus has generally two dorsal branches, one of which extends along peristome and the other being ventral in position. The oval micronucleus is situated at extremities of macronucleus and embedded on ventral surface. A karyophore is often present.

Altogether seven species namely, *S. macrophaayngea* found in *R. cyanophlyctis* (Bezenberger, 1903), *S. magna*, *R. hexadactyla* (Bezenberger, 1904); *S. cheni*, *R. spinosa* (Witchermann, 1934); *S. kalli*, *R. curtipes* (Uttangi, 1950); *S. malabarica*, *R. tigrina* (Amaro and Sena, 1967); *S. xenopi*, *Xenopus*

frasseri (de puytorac and Grain, 1968) and *S. heimi*, *R. (Dicroglossus) occipitalis* (Albaret, 1970) have so far been reported from different parts of the world and of which four species occur in India. These are *S. macropharyngea* (= *Nyctotherus macropharyngeus* Bhatia and Gulati, 1927) ; *S. magna* (= *N. magnus* Uttangi, 1958) ; *S. malarica* (= *N. magnus* *Var malarica* de Mello, 1932 and *S. Kalii* (= *N. kalii* Uttangi, 1951). All of them originally described as *Nyctotherus*, were subsequently transferred to genus *Sicuophora* by Albaret (1975).

During the present study, six more species of *Sicuophora* have been encountered in different species of *Rana* with the exception of *S. macropharyngea* found in an altogether different host.

Key to the identification of species of *Sicuophora* reported so far from anuran hosts in India.

I. Adhesive organelle covers entire lower surface

(A) Body oval

(i) p-starts beyond anterior apex.

I-with 2 spires. Ma.N. oval.

Karyophore distinct ... *S. macropharyngea*

(ii) Dorsal side convex. p-origina-

tes below anterior apex. I-with

2 spires. Ma. N. triangular.

Karyophore distinct ... *S. puytoraci* n.sp.

(iii) Anterior end broad. I-with

single spire. Ma. N. oval.

Karyophore not described. ... *S. kalli*

(iv) Anterior end pointed. p-origi-

nates away from anterior apex.

I-with single spire. Ma. N.

branched. Karyophore inci-

ipient. ... *S. fragilis* n.sp.

- (B) Body bean or kidney-shaped
- (i) p-starts at the anterior apex. I-with single spire. Ma. N. oval, flattened length wise. Karyophore not described. ... *S. magna*
- II. Anhesive organelle partly covers lower surface
- (A) Body oval
- (i) p-starts beyond anterior apex. I-with single spire. Ma. N. club-shaped with 2 arms. Karyophore distinct. AO extends up to 3/4 of lower surface. ... *S. limnochari* n.sp.
- (ii) p-starts beyond anterior apex. I-with 2 close spires. Ma. N. bifurcated with 2 arms. AO broad, in anterior half. ... *S. ranae* n.sp.
- (B) Body dorsoventrally flattened
- (i) p-starts near anterior apex. I-with 2 spires. Ma. N. triangular, drawn into a branch ventrally. Karyophore distinct. AO extends up to infundibulum. ... *S. waltirensis* n.sp.

1. *Sicuophora macropharyngea* (Bezenberger, 1903)

Hosts : *R. cyanophlyctis*, *R. breviceps*

Site of infection : Colon

Locality : Visakhapatnam (Andhra Pradesh)

The species was previously described from *Rana cyanophlyctis*, *R. hexadactyla* and *R. tigrina*. In the present study, it was encountered in *R. cyanophlyctis* and *R. breviceps*.

Trophozoites bean-shaped, dorsal side convex and ventral side concave, $225 \times 134 \mu\text{m}$ in size. Peristome begins near anterior apex. Infundibulum narrow, small measuring about $95 \mu\text{m}$, with 1-1 1/2 spirals. AZM extends deep into

infundibulum. Macronucleus irregular measuring 55-21 μm , karyophore thin. Micronucleus not observed. Adhesive organelle on concave side measured $200 \times 120 \mu\text{m}$, extending over entire body surface with distinct fibrillar structures. Body uniformly ciliated. Ciliary rows parallel. Cytopygeal canal narrow and cleft-like.

Remarks :

This form resembles *N. macropharyngeus* described by Bhatia and Gulati (1927) in all its morphological features. In 1967, de puytorac and Oktem transferred this species to genus *Prosicuophora*. Albaret (1973) identified the adhesive organelle and included it in genus *Sicuophora*. Our observations clearly showed presence of a broad adhesive organelle on lower side, considered as a diagnostic feature of the genus. *R. breviceps* is also a new host record for this species.

2. *Sicuophora waltirensis* n. sp.

(Figs. 12-15)

Hosts : *R. cyanophlyctis*, *R. breviceps*, *R. limnocharis*

Site of infection : Rectum

Locality : Waltair (Andhra Pradesh)

Incidence : *R. cyanophlyctis* 80/158

R. breviceps 36/138

R. limnocharis 2/28

Type slides : ZSI, pt. 2073

Trophozoites oval, $250-290 \times 140-175 \mu\text{m}$, dorsoventrally flattened, apex rounded. Length : width 1 : 1.8. Peristome long, extending up to anterior apex, $100-125 \mu\text{m}$ in length. Infundibulum narrow, funnel-shaped taking a sharp bend about half the body length making an angle of about 90° . AZM extending deep into infundibulum, $290-305 \mu\text{m}$ in length with 2 spirals, and a short non-ciliated distal portion. Macronucleus triangular, $32-64 \mu\text{m}$, drawn out as a branch on ventral side. Micronucleus adherent to macronucleus at broad end. Karyophore distinct, attached to pellicle by refractile fibrillar structure.

Adhesive organelle on concave side, $196-220 \times 80-124 \mu\text{m}$,

enveloping all organelle extending posteriorly beyond

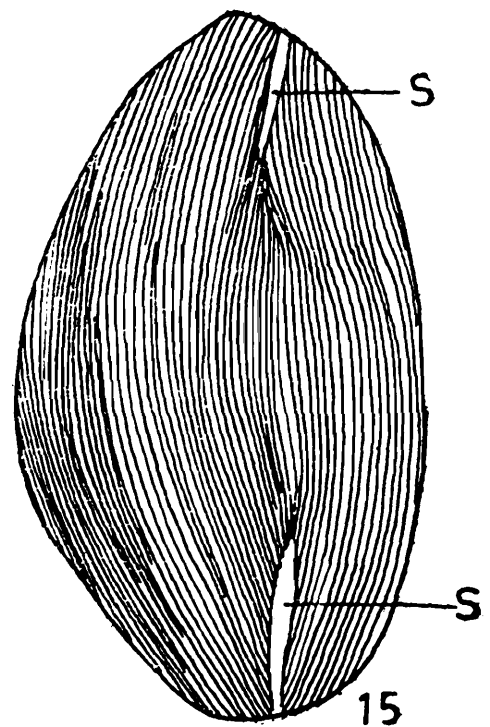
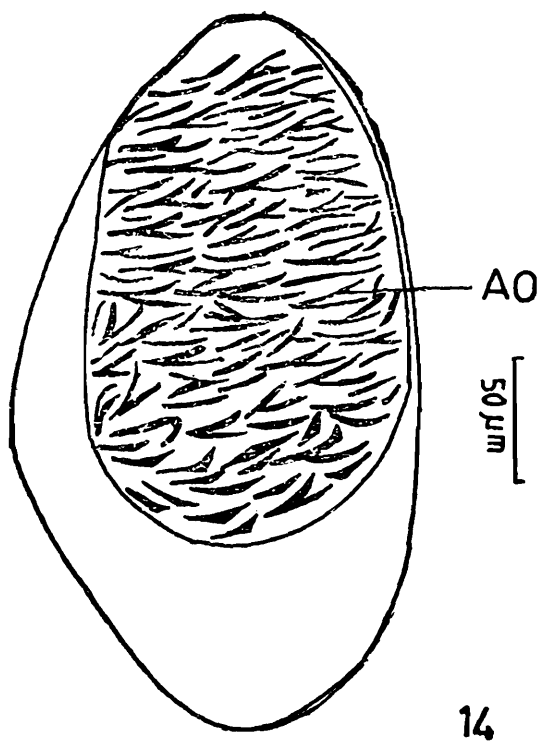
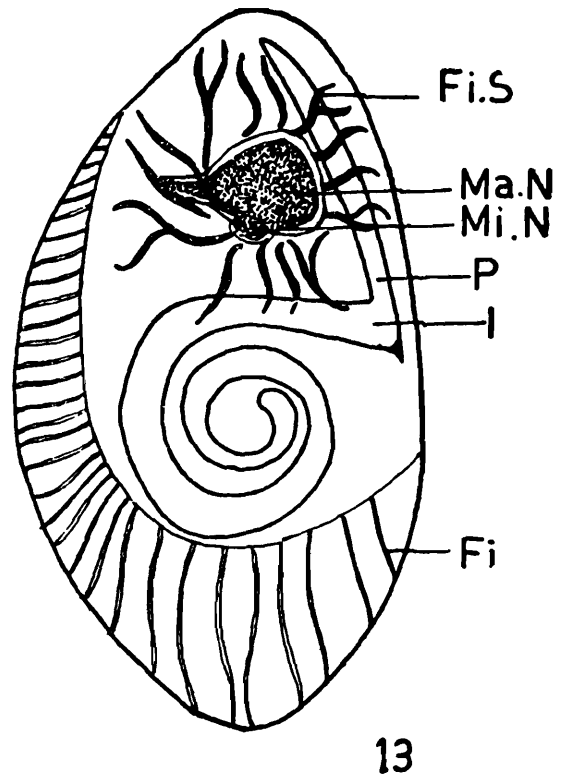
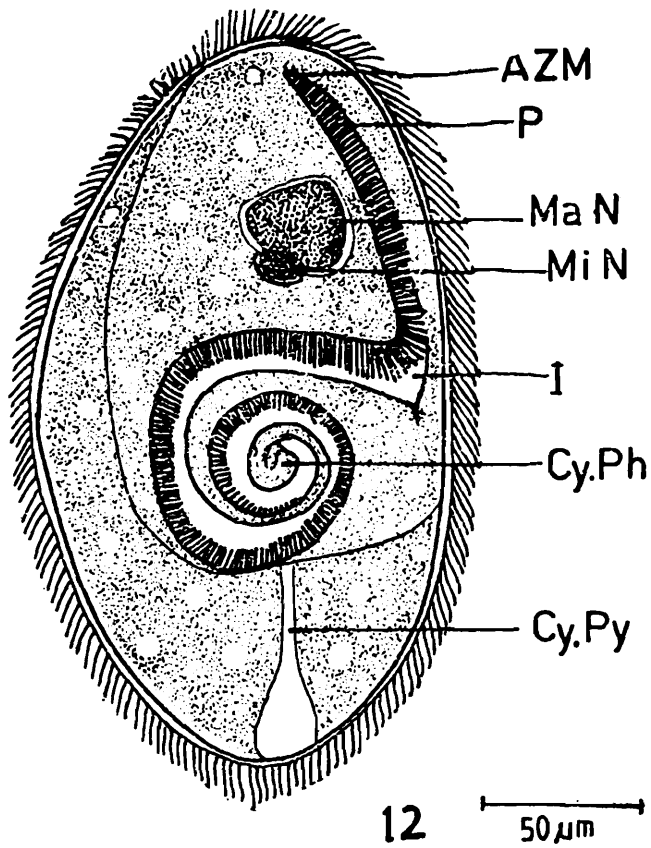


Fig. 12 *Sicuophroa waltirensis* n. sp.—morphology

Fig. 13 Showing fibrillar structures

Fig. 14 Showing adhesive organelle

Fig. 15 Showing ciliary rows

infundibulum. PAS positive, Steedman's alcian blue positive, fibrillar structures present between adhesive organelle and pellicle. They stain yellow with phosphotungstic acid haematoxylin.

Body uniformly ciliated, ciliary rows parallel, sutures two, one at either end. Cytopygeal canal with a bulbous base extending between infundibulum and posterior end. Cysts spherical, 60-75 μm in diameter. Common in summer.

Remarks :

The present form is assigned to genus *Sicuophora* de puytorac and Grain (1968) since it has all the characters of this genus. A comparison of the present species with others described so far showed that it does not resemble any one of them (Table 1), except *S. macropharyngea* (= *N. macropharyngeus* Bhatia and Gulati, 1927) and *S. malabarica* (= *N. magnus malabarica* de Mello, 1932) with which it has some affinity. However, the species differs from the latter form in peristome length, presence of two spires in infundibulum and position of the nucleus. The karyophore, connected to pellicle by branched fibres in the present form, though resembles *S. xenopi*, the species differs from it in other characters such as size and shape of the body, length of peristome and macronucleus. In view of these features, the species is considered new to science and the name *Sicuophora waltirensis* n. sp. after the type locality, is suggested.

**3. *Sicuophora limnochari* n. sp.
(Figs. 16-19)**

Hosts : *Rana limnocharis*, *R. cyanophlyctis*

Site of infection : Rectum

Locality : Vizianagaram (Andhra Pradesh)

Incidence : *R. limnocharis* — 32/46

R. cyanophlyctis — 12/56

Type slides : ZSI, pt. 2074

Trophozoites flat, oval, ends rounded, 290-310 \times 170-200 μm in size. Peristome starts beyond anterior apex and extends to less than middle of body, takes a broad bend making an

TABLE I
Species of *Sicuphora* described so far from different parts of world

Species and author	Synonyms	Body Length × width	Macronucleus	Host and locality
<i>Sicuphora xenopi</i> de puytorac and Grain, 1968	—	150 × 100 μm	Spherical 20 μm in diameter	<i>xenopus fraseri</i> , Gabon and France <i>X. mulleri</i> , Maboka, Central Africa
<i>S. cheni</i> (Wichterman, 1934) de puytorac and Grain, 1968	<i>Nyctotherus cheni</i> wichterman, 1934 <i>wichtermania cheni</i> (wichterman, 1934) Earl, 1972	179 × 125	Quadrilaterangular 49 × 26 Karyophore present	<i>Rana spinsa</i> , China
<i>S. kalli</i> (Uttangi, 1950) de puytorac and Grain, 1968	<i>Nyctotherus kalli</i> (Uttangi, 1950) <i>Nyctotheroides kalli</i> (Uttangi, 1950) Amaro and Sena 1967 <i>Wichtermania kalli</i> Earl, 1972	280 × 223 Body with a flange around	Ovoid, 101 × 30 μm	<i>Rana curtipes</i> , Tad Poles, India

[Contd.]

Species and author	Synonyms	Body Length × width	Macronucleus	Host and locality
<i>S. heimi</i> Albaret, 1970	—	200 × 150 Ovoid μm	50 μm long transverse	<i>Rana (Dicroglossus) Occipatalis</i> Republic of Congo <i>Ptychodena perreti</i> , Republic of Central Africa
<i>S. macropharyngea</i> (Bezzenberger, 1903) Albaret, 1973	<i>Nyctotherus macropharyngeus</i> Bezzenberger, 1903 <i>Nyctotheroides macropharyngeus</i> (Bezzenberger, 1903) Amaro and Sena, 1967 <i>Prosicuphora macropharyngeus</i> (Bezzenberger, 1903) de puytorac and Oktem, 1967	225 × 135 Ovoid μm	Irregular 55 × 21 μm Kar-yophore present	<i>Rana cyanophlyctis</i> <i>R. regularis</i> , <i>R. hexadactyla</i> <i>R. tigrina</i> , Afganisthan, Asia
<i>S. magnr</i> (Bezzenberger, 1904) Albaret, 1975	<i>Nyctotherus magnus</i> Bezzenberger, 1904 <i>Nyctotheroides magnus</i>	290 × 230 μm	Flattened	<i>R. hexadactyla</i> , Asia

[Contd.]

Species and author	Synonyms	Body Length × width	Macronucleus	Host and locality
	(Bezenberger, 1904) Amaro and Sena, 1967 <i>Prosicuophora magnus</i> (Bezenberger, 1904) de puytorac and Oktem, <i>Sicuophora mabokensis</i> Albaret, 1970	Ovoid		<i>R. (Dicroglossus) occipitalis</i> , Central Africa and Republic of Gongo <i>R. cyanophlyctis</i> , Afganis- than
<i>S. malabarica</i> (Amaro and Sena, 1367) Albaret. 1975	<i>Nyctotherus magnus</i> Var. <i>malabarica</i> de Mello, 1932 <i>Nyctotheroides mag-</i> <i>nus malabarica</i> (de Mello, 1932) Amaro and Sena, 1967 <i>Prosicuophora mala-</i> <i>barica</i> Earl. 1972	250 × 140 μm	—	<i>R. malabaricus</i> , India

angle of 100° . AZM continues into infundibulum from

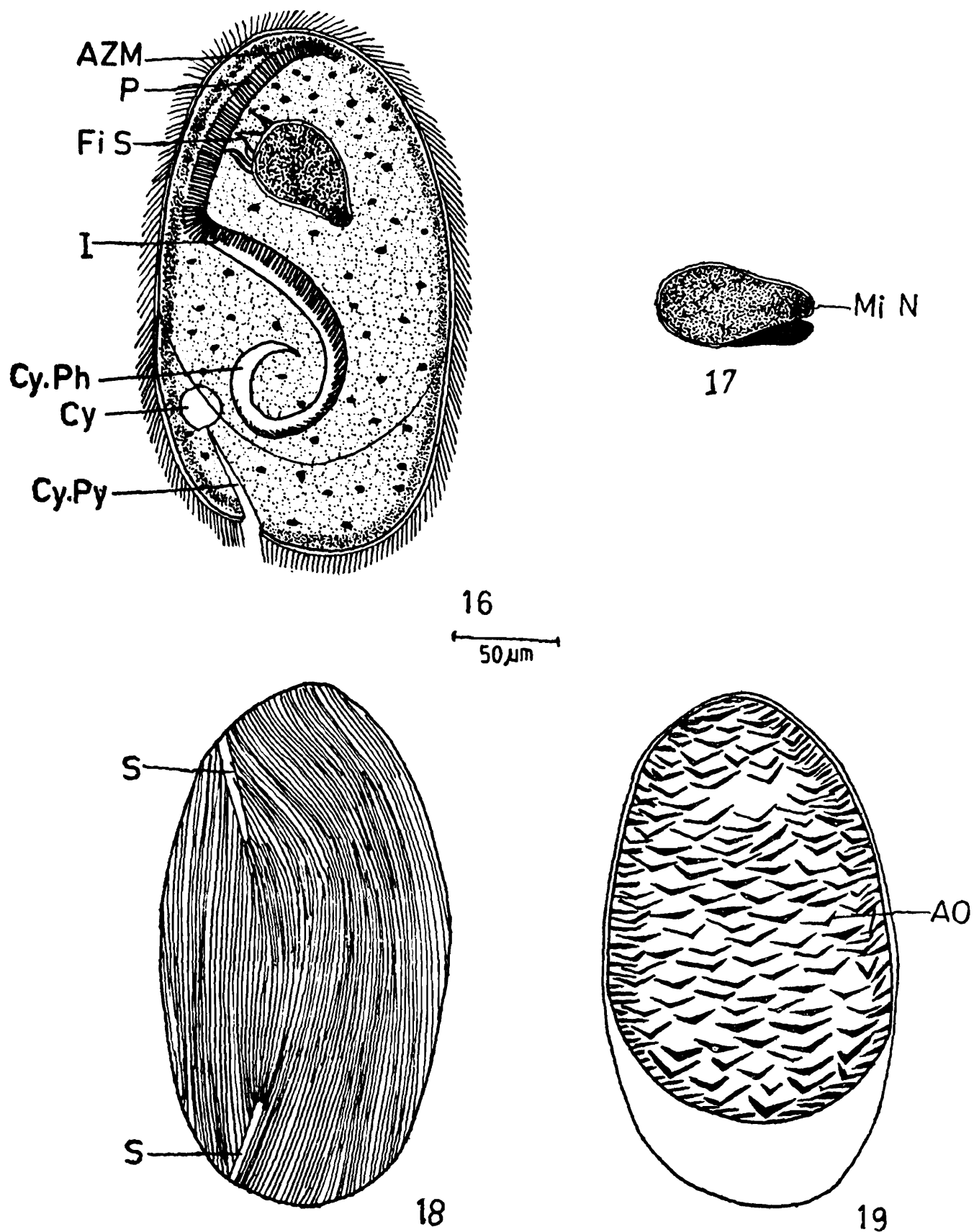


Fig. 16 *Sicuophora limnochari* n. sp.—morphology

Fig. 17 Enlarged view of macronucleus—note the two arms.

Fig. 18 Showing adhesive oaganelle

Fig. 19 Showing ciliary rows

peristome, measures 92-128 μm in length. Infundibulum starts at middle of body, runs obliquely downwards to right, forms a single spire, 120-135 μm in length, ends at a distance of 64-90 μm from posterior end. Macronucleus club-shaped 55-68 \times 40-45 μm , with a dorsal and ventral arm. Micronucleus small, spherical 2-5 μm in diameter, embedded at the end of club-shaped macronucleus. Nuclear complex enclosed in karyophore, attached to peristomial wall by fibrillar structures. Cytopygeal tube 48-60 μm in length with a vacuole at distal end.

Adhesive organelle large, 225-240 \times 152-270 μm . Outer rim with a number of uniformly arranged fibrils and greater concentration of polysaccharide material near periphery. Body ciliation uniform, kineties parallel, converge at sutures. Cilia prominent in the region of adhesive organelle.

Remarks :

Presence of a large, adhesive organelle on concave side qualified the species, inclusion in genus *Sicuophora*. Sizewise (290-310 \times 170-200 μm), this form resembled *S. magna* closely. However, it differed from it in the length of peristome and presence of a single spire in cytopharynx. The macronucleus is also characteristically club-shaped and bifurcated, the adhesive organelle extending to 3/4 length of the body. The species differed from all others described so far, including those found in this study, in body size, shape of cytopharynx, size of macronucleus, peristome and fibrillar structures (Tables I and I). Finally, the present record is also the first account of the species from *R. limnocharis* based on which it is considered new to science for which the name *Sicuophora limnochari* n. sp. after the host is proposed.

4. *Sicuophora fragilis* n. sp.

(Figs. 20-23)

Hosts : *Rana cyanophlyctis*, *R. hexadactyla*

Site of infection : Colon

Locality : Nellore (Andhra Pradesh)

Incidence : *R. cyanophlyctis* 18/33

R. hexadactyla 11/28

Type slides : ZSI, pt. 2075 (Holotype)

2076 (Paratype)

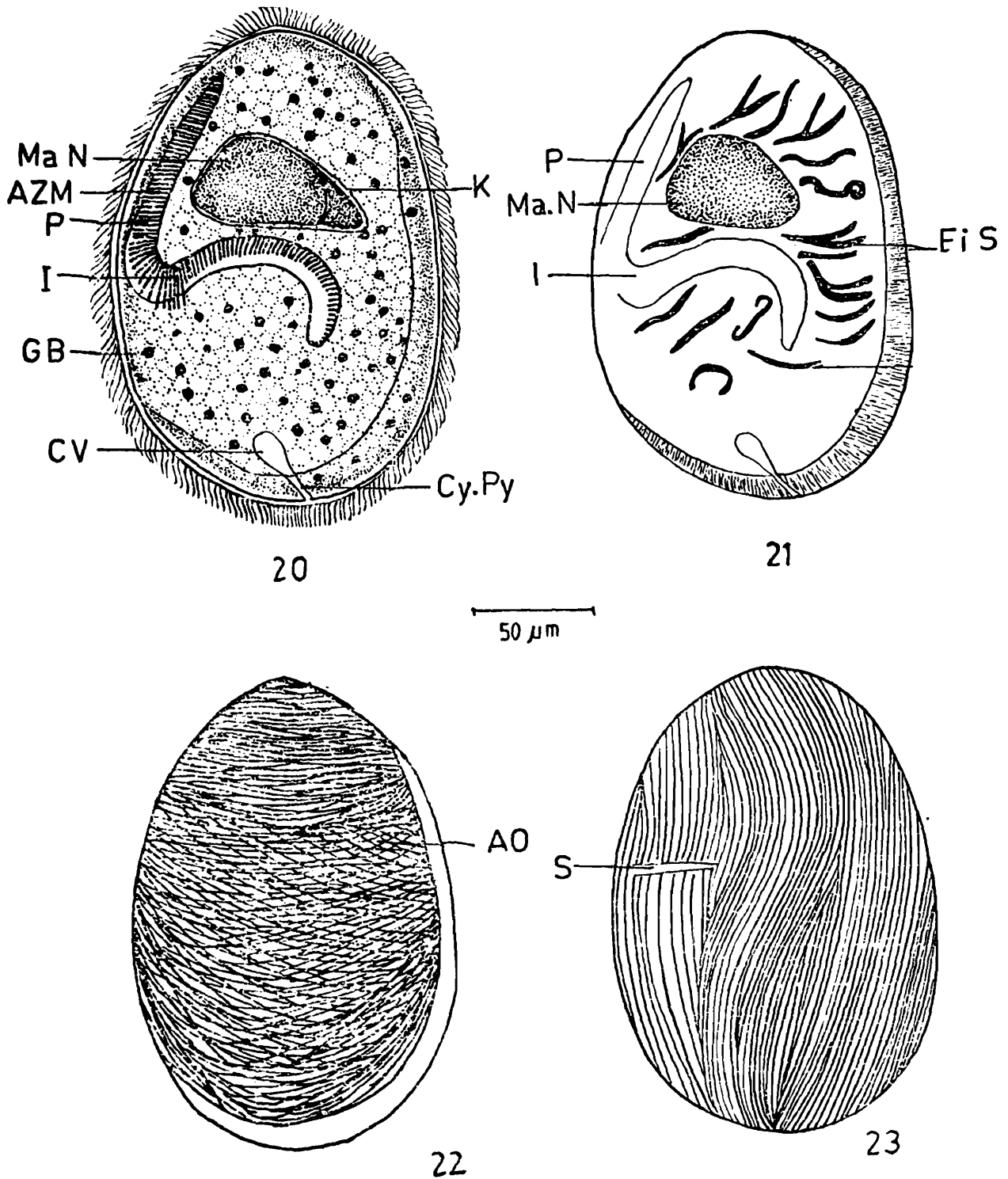


Fig. 20 *Sicuophora fragilis* n. sp.—morphology

Fig. 21 Showing fibrillar structures

Fig. 22 Showing the adhesive organelle

Fig. 23 Showing the ciliary rows

Trophozoites broadly oval, anterior end slightly pointed, posterior broadly rounded, dorso-ventrally flattened, glossy in appearance, transparent, thin greenish yellow in colour, measuring $180-220 \times 132-144 \mu\text{m}$. Peristome $72-96 \mu\text{m}$ long, originating $20-25 \mu\text{m}$ away from anterior apex, joins infundibulum appearing like a deep depression in fresh condition. Infundibulum $96-128 \mu\text{m}$ in length, makes an acute angle of 80° with peristome, runs ventrally forming a small arch in middle region of body. AZM extending deep into infundibulum. Macronucleus massive, measuring $58-80 \mu\text{m}$, tip bifurcated, located in the angle of peristome. Karyophore incipient. Micronucleus not distinct. Cytopygeal tube $35-45 \mu\text{m}$ long with a bulbous tip.

Adhesive organelle large, $172-186 \times 96-132 \mu\text{m}$, occupying most of concave surface. Close knit mucopoly-saccharide fibrils, thick in posterior region than in anterior, attached to pellicle by discontinuous fibres seen. Bifid, refractile hook-like fibrillar structures, staining yellow with phosphotungstic acid haematoxylin, present. Body ciliation uniform. Kinetes obliquely arranged, 'S' shaped. Suture transverse, band-like on right side of infundibulum.

Remarks :

The present species does not resemble any other *Sicuophora* described so far in its features (Tables I and II). However, the form has a close affinity with *S. heimi* in body measurements, except for a long and spiral infundibulum, which in the present form is bent and not like a spiral. Macronucleus in this species fairly massive and appeared distinct in having an incipient karyophore. Similarly, the oblique cytopygeal tube is absent in *S. heimi*. Further, the host of *S. heimi* is different being *R. occipitalis*.

In comparison though the present species is recorded from the same host as *S. waltirensis* n. sp. described earlier, it considerably differs from it in body shape, peristome, cytopharynx and adhesive organelle (Table II). The species appeared unique in having a transparent body with glossy appearance based on which features it is considered as a new

Table II

Comparise of the body measurements of *Sicuphora* species described (n=50)

Characters	<i>S. waltirensis</i> n.sp.		<i>S. limnochari</i> n.sp.		<i>S. fragilis</i> n.sp.		<i>S. puytoraci</i> n.sp.		<i>S. levinei</i> n.sp.		<i>S. ranae</i> n.sp.	
	Range (μ m)	Mean (μ m)	Range (μ m)	Mean (μ m)	Range (μ m)	Mean (μ m)	Range (μ m)	Mean (μ m)	Range (μ m)	Mean (μ m)	Range (μ m)	Mean (μ m)
Length of the body	250-290	270.0	290-310	300.0	180-220	200.0	180-250	215.0	90-108	99.0	130-184	157.0
Width of the body	140-175	157.5	170-200	185.0	132-144	138.0	124-160	142.0	64-78	71.0	112-136	124.0
Width : Length	1 : 1.8	—	—	1:1.6	1 : 1.4	—	1 : 1.5	—	—	1:1.39	—	1:1.2
Length of p	100-125	112.5	92-128	110.0	72-96	84.0	72-104	88.0	30-40	35.0	54-90	77.0
Length of I	290-305	297.5	120-135	227.5	96-128	112.0	300-340	320.0	50-68	59.0	124-158	141.0
Length of Ma.N.	32-64	48.0	55-68	61.5	58-80	69.0	36-50	43.0	18-26	21.5	40-45	42.5
Distance of Ma.N. from the anterior apex	55-64	59.5	45-64	58.5	32-44	38.0	42-56	59.0	18-26	22.0	18-26	22.0
Distance of P from the posterior end	72-96	84.0	64-90	77.0	60-74	67.0	30-35	32.5	20-26	23.0	45-65	55.0
Length of the cytopygeal canal	75-88	82.5	48-60	54.0	35-45	40.0	24-52	38.0	8-12	10.0	20-30	25.0
Length of the adhesive organelle	196-220	208.0	225-240	232.5	172-186	179.5	150-210	180.0	68-82	75.0	72-104	88.0
Width of the adhesive organelle	80-124	102.0	152-170	161.0	96-132	114.0	80-90	85.0	36-48	42.0	86-128	112.0
Host and percentage of infection	<i>R. cyanophlyctis</i> -48%		<i>R. limnocharis</i> -70%		<i>R. cyanophlyctis</i> -54.6%		<i>R. breviceos</i> -70%		<i>R. cyanophlyctis</i> -6%		<i>R. limnocharis</i> -50%	
	<i>R. breviceps</i> -26%		<i>R. cyanophlyctis</i> -24%		<i>R. hexadactyla</i> .39%		Juvenile frogs only		<i>R. hexadactyla</i> -25%		<i>R. cyanophlyctis</i> -6.5%	
	<i>R. limnocharis</i> -7%											
Site of infection	Rectum		Rectum		Colon		Rectum		Rectum		Rectum	
Locality	Visakhapatnam, Andhra pradesh, India		Vizianagaram, Andhra pradesh, India		Nellore, Andhra pradesh, India		Machilipatnam, Andhra prades, India		Visakhapatnam, Andhra pradesh, India		Eluru, Andhra pradesh, India	

species for which the name *Sicuophora fragilis* n. sp. is proposed.

5. *Sicuophora puytoraci* n. sp.

Host : *Rana breviceps*

Site of infection : Rectum

Locality : Machilipatnam (Andhra Pradesh)

Incidence : 29/45

Type slides : ZSI, pt. 2077

Trophozoites oval, anterior end bluntly pointed, posterior end rounded, $180-250 \times 124-160 \mu\text{m}$ in size. Convex dorsally, concave ventrally, showing characteristic wobbling movement anchoring to debris by adhesive organelle. Peristome $72-104 \mu\text{m}$ long, commences below anterior apex. Infundibulum $300-340 \mu\text{m}$, with 2 widely spaced spires, in posterior half of body. AZM well formed and deeply stained. Macronucleus triangular $36-50 \mu\text{m}$, with drawn out corners. Micronucleus adherent to the corner, $3.6-5.0 \times 2.0-2.8 \mu\text{m}$ in size. Karyophore distinct. Fibrillar structures curved radiating from karyophore towards pellicle. Cytopygeal tube $24-52 \mu\text{m}$, runs obliquely towards median line opening into a vacuole below infundibular spiral (Fig. 24). Adhesive organelle oval, measuring $150-210 \times 80-90 \mu\text{m}$, showing numerous irregularly distributed PAS positive rod-like polysaccharide bodies. They stained deeply with alcian blue. Ciliation uniform. Ciliary rows parallel, converging near sutures straight.

Remarks :

The species resembles *S. heimi* and *S. limnochari* n. sp. (this study) (Tables I and II) in size but differs from both in having a longer peristome, infundibulum with 2 spirals and a triangular macronucleus. Adhesive organelle is unique being in middle of concave side unlike in other species where it is adherent to anterior apex. While cytophygeal tube opens into a contractile vacuole in the present species, it is not so in *S. limnochari* n. sp. The additional difference being that

S. limnochari n. sp. has a curved infundibulum absent in the present species. Hostwise, while *S. heimi* was reported from *R. occipitalis* ; *S. limnochari* n. sp. from both *R. hexadactyla*

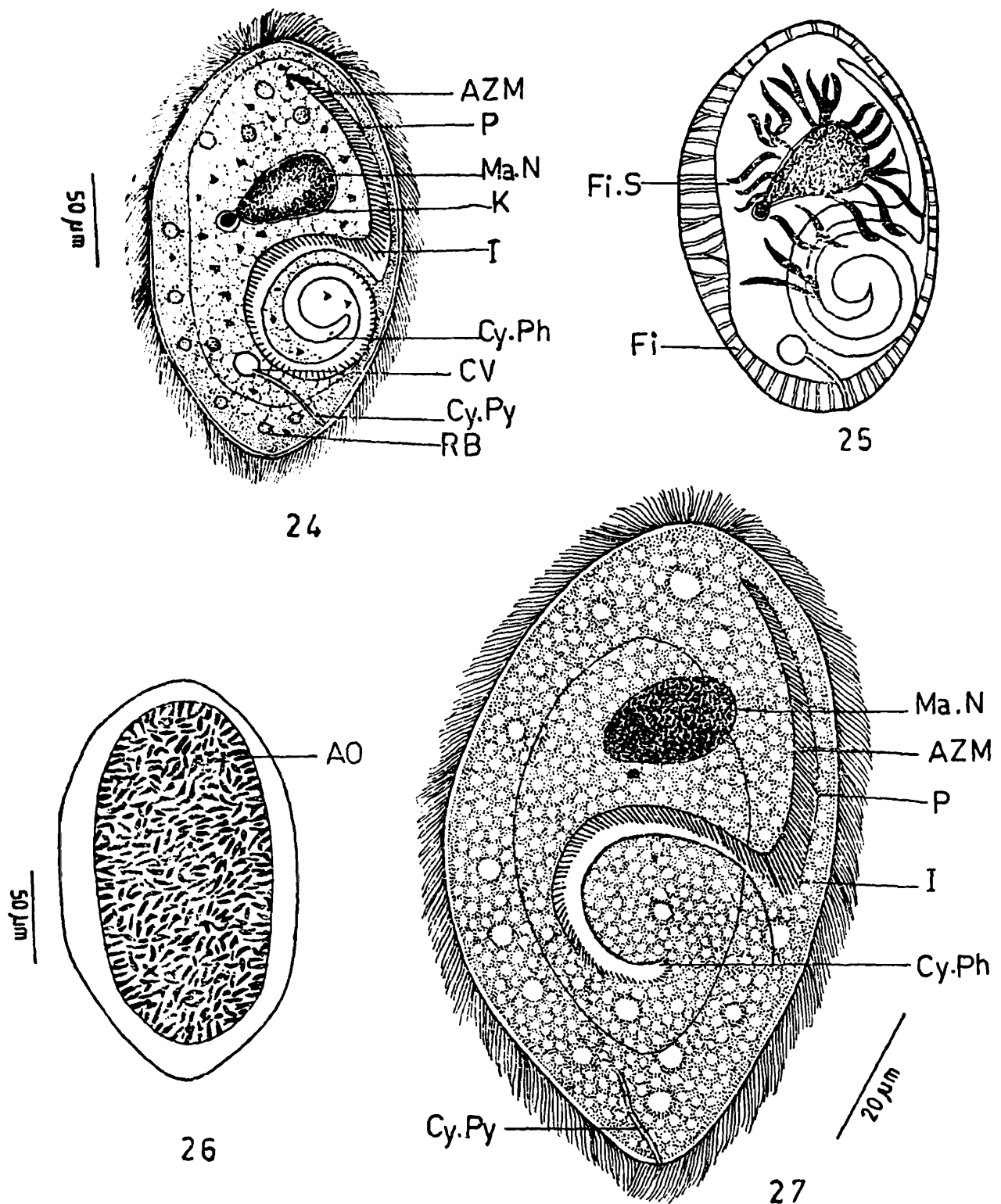


Fig. 24 *Sicuophora puytoraci* n. sp.—morphology
 Fig. 25 Showing fibrillar structures
 Fig. 26 Showing adhesive organelle
 Fig. 27 *Sicuophora levinei* n. sp.—morphology

and *R. cyanophlyctis*, the present form was encountered merely in *R. breviceps*.

In view of these reasons and based on the host specificity and occurrence in a geographical different locality, the species is considered new to science for which the name *Sicuophora puytoraci* n. sp. is proposed.

6. *Sicuophora levinei* n. sp.

Host : *Rana cyanophlyctis*

Site of infection : Rectum

Locality : Visakhapatnam (Andhra Pradesh)

Incidence : 8/158

Type slides : ZSI, pt. 2078 Holotype
9079 Paratype

Occurs merely in juvenile frogs. Body flat, posterior end pointed, 90-108 × 64-78 μm in size. Peristome 30-40 μm originates 5-10 μm away from anterior apex. Infundibulum funnel-shaped 50-68 μm , making a prominent 'C' shaped curve in middle of body. AZM conspicuous. Macronucleus irregular, 18-26 × 12-20 μm , transversely placed, parallel to infundibulum, sometimes with drawnout ends. Cytopyge and cytopygeal tube incipient, faintly seen at posterior end. Fibrillar structures absent (Fig. 27). Adhesive organelle oval, measuring 68-82 × 36-48 μm , placed 15-25 μm away from anterior apex in posterior half of body. It has a net-work of thick and thin fibrils alternating with each other (Fig. 28). Ciliation uniform. Ciliary rows parallel. Two straight sutures.

The present form is unique in having a 'C' shaped infundibulum and differs from all other species in body size being only 99 × 71 μm (mean). The position and nature of fibres in adhesive organelle are also different from other species (Tables I and II) as also the fibrillar structures. Further, the parasite's presence merely in the metamorphosing individuals and late tadpole stages and never in adult frogs even from the same locality constituted an important criterion.

In view of the reasons mentioned above, the present form is considered new to science for which the name *Sicuophora levinei* n. sp. in honour of Professor N. D. Levine, Emeritus Professor, University of Illinois, U. S. A. is proposed.

7. *Sicuophora ranae* n. sp.

(Figs. 29 and 30)

Hosts : *Rana limnocharis*, *R. hexadactyla*,
R. cyanophlyctis

Site of infection : Rectum

Locality : Eluru (Andhra Pradesh)

<i>Incidence</i> ; <i>R. limnocharis</i>	—	12/24
<i>R. hexadactyla</i>	—	4/16
<i>R. cyanophlyctis</i>	—	8/120

Type slides : ZSI, pt. 2080

Found primarily in *R. limnocharis*, occasionally in *R. hexadactyla* and *R. cyanophlyctis*. Trophozoites flat, oval measuring $130-184 \times 112-136 \mu\text{m}$. Peristome measures $64-90 \mu\text{m}$, commences beyond anterior apex, joins infundibulum above median line at an angle of $30-40^\circ$. Infundibulum $124-158 \mu\text{m}$ in length, with two close spires on left side of body. AZM conspicuous. Macronucleus, $40-45 \times 15-25 \mu\text{m}$ with bifurcated arms. Nuclear complex enclosed in a karyophore attached to pellicle by two fine fibrils. Micronucleus not observed. Cytopygeal tube extends as a fine capillary into contractile vacuole (Fig. 29). Adhesive organelle broadly oval, flat $72-104 \times 96-128 \mu\text{m}$ occupying anterior half of body extending from body wall. Network of mucopolysaccharide fibrils with discoid amylopectin bodies seen near periphery. Cytoplasm clearly demarcated into anterior hyaline and posterior granular regions containing several disc-shaped amylopectin bodies (Fig. 30). Ciliary rows parallel. Single slanting suture on right side in the region of peristome seen.

Remarks :

The present form resembles *S. heimi* found in the rectum of *R. occipitalis* in size but differs from it in the size of

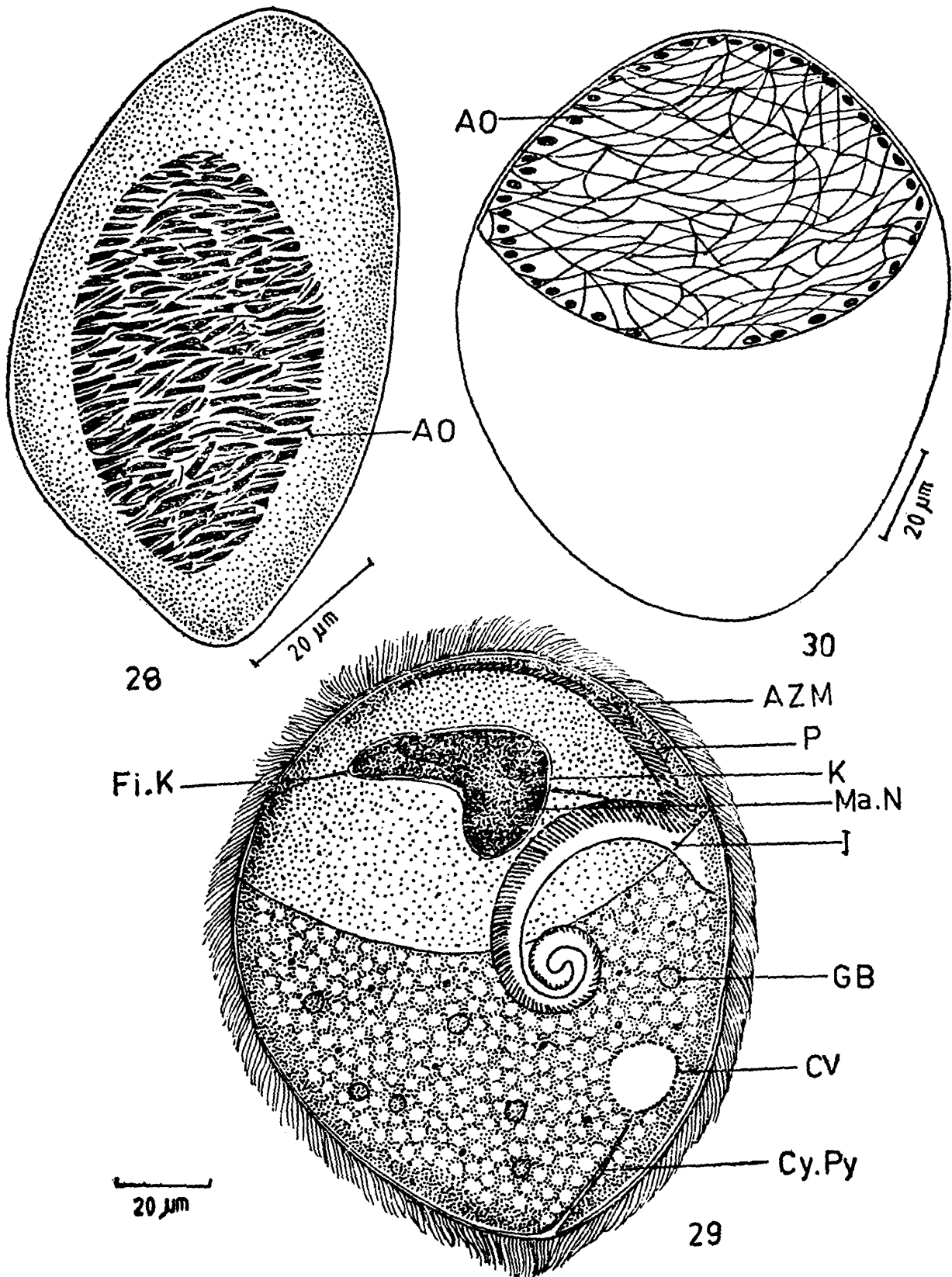


Fig. 28 Showing adhesive organelle

Fig. 29 *Sicuophora range* n. sp.—morphology

Fig. 30 Showing the adhesive organelle

peristome, position and size of infundibulum and the adhesive organelle. The adhesive organelle while in *S. heimi* extends along the entire concave surface of the body, in the present form it is flat, less than half the length of body and not depressed and cup-like as in genus *Prosicuphora*.

The only previous report of a species of *Sicuphora* from *R. limnocharis* is *S. limnochari* n. sp. (this study) which differs considerably from the form under discussion in all characters (Table II) and hence considered as a new species for which the name *Sicuphora ranae* n. sp. is proposed.

Genus : **Metasicuphora**

Albaret (1973) established a new genus *Metasicuphora* for an endocommensal ciliate, *M. petteri* which he found in the rectum of *Xenopus fraseri*. The genus is characterised by the presence of terminal enlargements for marginal plaques of adhesive organelle and well developed skeletal elements of upper surface. So far, genus *Metasicuphora* is solely represented by *M. petteri* until this study when two additional species were encountered in the colon of *Rana cyanophlyctis* and *Bufo melanostictus* collected locally. For reasons discussed elsewhere in the text these species are considered new to science.

Genus : **Metasicuphora** Albaret, 1973

Body oval. Ao with characteristic terminal enlargements for marginal plaques. Skeletal elements well developed.

Key to the identification of species of genus *Metasicuphora* described so far from anuran hosts in India :

- I. Body small, oval. Ectosarc thick.
p-short, commences about 10 μ m
from anterior apex. I-with 2
spires. Ma.N. club-shaped. Mi.N.
small spherical. Ao occupies
entire lower surface. Marginal
plaques broad. ... *M. cyanophlycti*
n.sp.

- II. Body flat, round. Ectosarc thick. p-long, starts beyond anterior apex. I-with one spire. Ma.N. trapezium shaped. Ao broad with double layered marginal plaques with dilated ends. ... *M. melanosticti*
n. sp.

1, *Metasicuophora cyanophlycti* n.sp. (Figs. 31 and 32)

Host : *Rana cyanophlyctis*

Site of infection : Colon

Locality : Repalle, Guntur District (Andhra Pradesh)

Incidence : 2/126

Type slides : ZSI, pt. 2081 Holotype
2082 Paratype

Trophozoites small, oval, flattened $75-95 \times 45-65 \mu\text{m}$. Length : width ratio 3:2. Outer ectosarc $10 \mu\text{m}$, peristome commences about $10 \mu\text{m}$ from apex, $30-45 \mu\text{m}$ long, makes an angle of $40-50^\circ$ with infundibulum forming two spires in equatorial region in posterior half of body leading to non-ciliated cytopharynx. AZM well developed. Macronucleus club-shaped, $15-30 \times 10-20 \mu\text{m}$, placed above infundibulum. Micronucleus small, spherical, situated near macronucleus.

Numerous thick refractile elements seen on upper surface of body. Adhesive organelle occupies entire lower surface, peripheral portion of which shows broad marginal plaques which stain deep with PAS technique and Steedman's alcian blue. Cytopyge small and cleftlike. Contractile vacuoles not observed.

Remarks :

The present form is assigned to genus *Metasicuophora* since it has broad marginal plaques in adhesive organelle and a well developed skeleton in upper surface. It differs from *M. petteri*, the only described species so far, in being much smaller in size (Table III). In *M. petteri*, while the macronucleus is irregular, it is club-shaped in the present form.

In view of these differences concerning its structure and based on its first occurrence in *R. cyanophlyctis* in the Indian

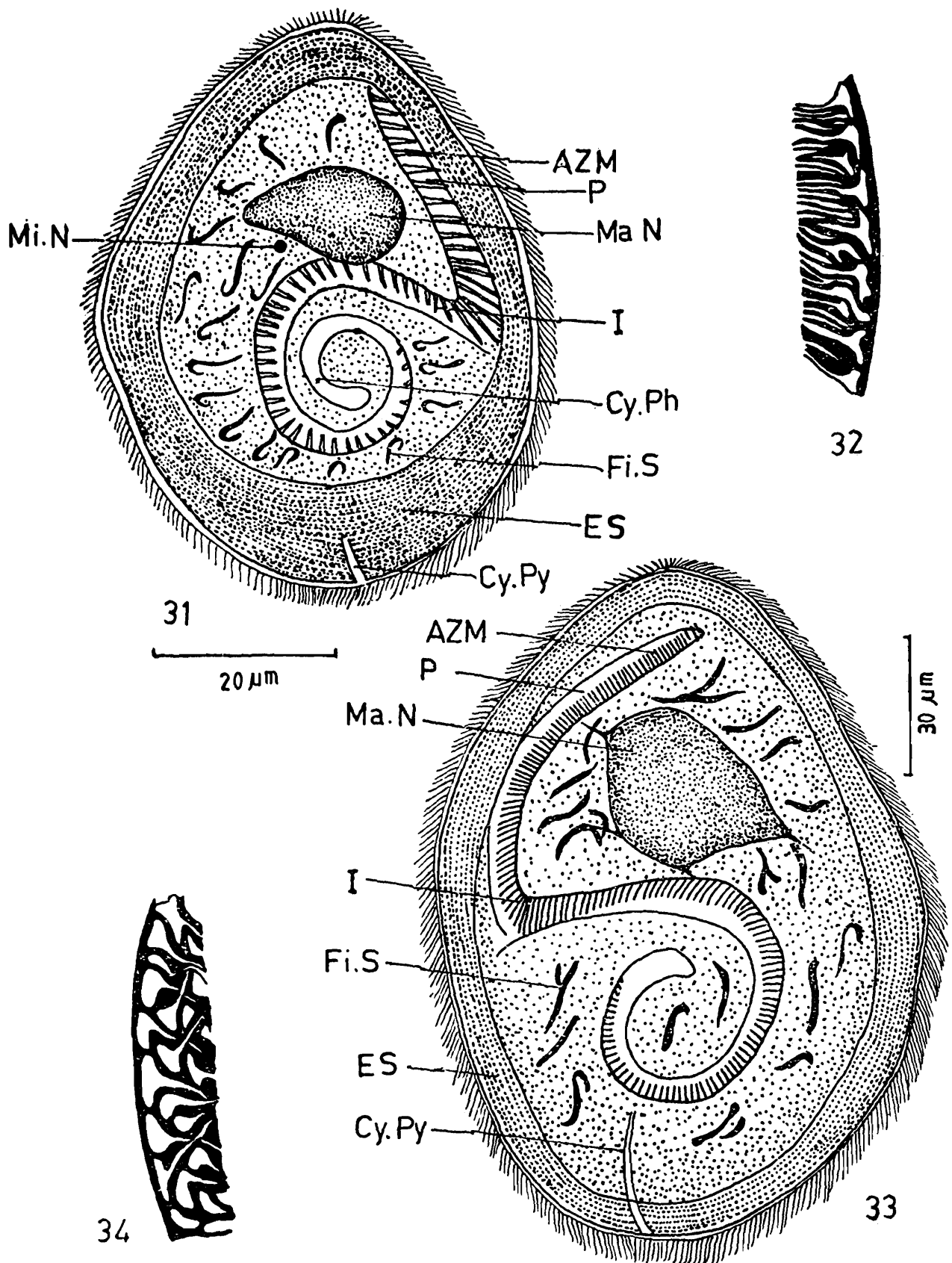


Fig. 31 *Metasicuophora cyanophlycti* n. sp.—morphology
 Fig. 32 An enlarged view of the marginal plaques
 Fig. 33 *Metasicuophora melanosticti* n. sp.—morphology

subcontinent, the species is described as new to science for which the name *Metasicuophora cyanophlycti* n.sp. after the host is proposed.

2. ***Metasicuophora melanosticti* n.sp. (Figs. 33 and 34)**

Host : *Bufo melanostictus*

Site of infection : Intestine and colon

Locality : Machilipatnam (Andhra Pradesh)

Incidence : 4/32

Type slides : ZSI, pt. 2083 Holotype
2084 Paratype

Mainly encountered in toads. Trophozoites flat, round, slightly convex dorsally, concave ventrally, measuring 125-168 \times 100-125 μ m. Ectosarc 10-15 μ m thick. Peristome starts beyond anterior apex, measures 60-75 μ m in length and extends towards median line. Infundibulum placed at right angles forming a single spire. Macronucleus trapezium-shaped 35-42 \times 20-30 μ m with drawn-out corners. Micronucleus not observed. Numerous fibrillar skeletal structures, irregularly distributed on upper surface seen. Adhesive organelle broad with double layered marginal plaques with dilated ends present in lower surface. They stain deep with PAS and Steedman's alcian blue. Cytopygeal tube at posterior end, 26-32 μ m in length. Contractile vacuole not seen.

Remarks :

This species differs from both *M. pctteri* in body size, length of peristome, size and shape of macronucleus (Table III); and *M. cyanophlycti* n.sp. (described earlier in the study). Albaret (1973) noted that among these forms the skeletal structures, made up of polysaccharides, constitute complementary taxonomic criteria with a phylogenetic significance. The present species shows an adhesive organelle with broad marginal plaques arranged in double layers unlike the other two species. Further, the present record is also the first report of the species from *Bufo melanostictus* in India. Based on these findings, the species is considered new to science for which the name *Metasicuophora melanosticti* n.sp. after the host, is proposed,

Genus : **Prosicuphora**

Genus *Prosicuphora* was established by de Puytorac and Oktem in 1967, for a heterotrich ciliate which they encountered in the rectum of *Bufo superciliaris* and *Hylarana albolabris albolabris* from Gabon, France and named its type species as *P. basoglui*. They identified members of the genus as commensals of batrachian anurans-‘Ventose’ occupying anterior region of lower surface, reinforced with armature, lower surface depressed to form a cup-like sucker anteriorly (c. f. Albaret, 1975). Puytorac and Oktem (1967) transferred

TABLE III

Comparison of the characters of the species of *Metasicuphora*
(Measurements in microns)

Character	<i>M. petteri</i>	<i>M. cyanophlycti</i> n. sp.	<i>M. melanosticti</i> n. sp.
Length of body	240-328	75-95	125-168
Width of body	210-290	45-65	100-125
Length of peristome	150	30-45	60-75
Distance from anterior apex	45	10 from the apex	10-15 beyond apex
Length of the infundibulum	200	120-138	65-90
Size of the macronucleus	—	15-30 × 10-20	35-42 × 20-30
Adhesive organelle		Broad marginal plaques 72.5-80	Doubled layered marginal plaques 95-106
Host	<i>Xenopus fraseri</i>	<i>Rana cyanophlyctis</i>	<i>Bufo melanostictus</i>
Site of infection	Rectum	Colon	Intestine and colon
Locality	Latileboke (Republic of Central Africa)	Repalle (Andhra Pradesh, India)	Machilipatnam (Andhra Pradesh, India)

Nyctotherus magnus Bezenberger, 1904 and *Nyctotherus macropharyngeus* Bezenberger, 1903 to genus *Prosicuophora*. Earl Paul (1972), while revising family Plagiotomidae, identified the genus as 'like *Nyctotheroides* except that a straight suture receiving the kineties is seen on the right side interrupted by an anterior lens of kineties, its sucker'. Earl Paul (op. cit) raised *Nyctotherus magnus malabaricus* de Mello, 1932 to the level of a species and transferred it to genus *Prosicuophora* as *P. malabarica* n. sp. Subsequent to this, Albaret (1975) wrote a monograph on the forms and transferred the above three species to genus *Sicuophora* since the sucker in these forms is completely formed unlike in genus *Prosicuophora*. Thereby, the type species, *Prosicuophora basoglui* was left behind.

Genus : **Prosicuophora** Puytorac and Oktem, 1967

Commensals of batrachian anurans. Body oval. AO in anterior region of lower surface, cup-like and depressed. Sutural line straight receiving kineties on right side.

Key to the identification of species of genus *Prosicuophora* reported so far from anuran hosts in India.

- I. Body oval. P-long oblique. I-with single spire Ma.N. with 2 bifurcated arms. Karyophore absent. AO-egg shaped, central ... *P. andhrae* n. sp.
- II. Body pear-shaped. P-straight adherent to AO. Buccal apparatus characteristically '6' shaped. Ma.N. 'V' shaped. Karyophore absent. AO pear shaped with raised margins. ... *P. hexadactyli* n. sp.

1. **Prosicuophora andhrae** n. sp.

(Figs. 35 & 36)

Host : *Rana cyanophlyctis*

Site of infection : Rectum

Locality : Visakhapatnam (Andhra Pradesh)

Incidence : 261/58

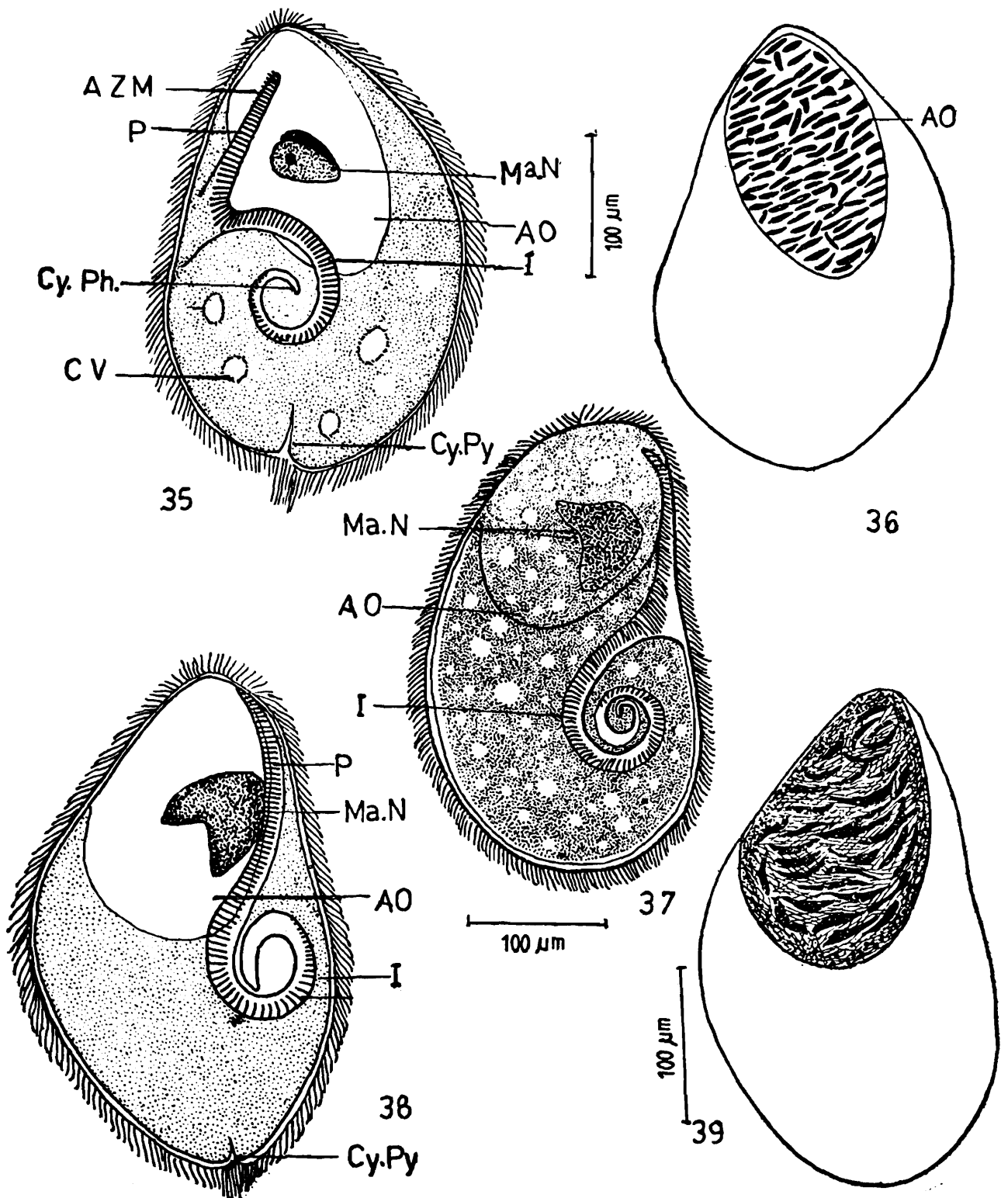


Fig. 34 An enlarged view of the marginal plaques

Fig. 35 *Prosicuophora andhrae* n. sp.—morphology

Fig. 36 Adhesive organelle

Fig. 37 *Prosicuophora hexadactyli* n. sp.—dorsal view

Fig. 38 Ventral view

Fig. 39 Adhesive organelle

Type slides : ZSI, pt. 2085 Holotype
2086 Paratype

Trophozoites oval, $280-350 \times 180-300 \mu\text{m}$ in size, anterior end pointed, posterior rounded. Peristome oblique $50-80 \mu\text{m}$ long, originates approximately $30-40 \mu\text{m}$ from anterior apex, joins funnel-shaped infundibulum in middle region making an angle of $70-80^\circ$. Infundibulum has a single spire. Macronucleus $40-50 \times 20-30 \mu\text{m}$ with two bifurcated arms. No karyophore. Micronucleus small, spherical, adherent to macronucleus on upper surface. Cytopyge cleft-like near posterior end. With long-tuft of cilia. 3-4 contractile vacuoles. Adhesive organelle egg-shaped, $150-180 \times 90-130 \mu\text{m}$, median, in the lower surface of anterior end, appears depressed with raised margins and irregularly distributed PAS positive, rod-like bodies. Ciliary rows slanting and discontinuous. Suture single, straight, seen on left side.

Remarks :

The present form is assigned to genus *Prosicuophora* based on the presence of kineties, single suture and a depressed, cup-like adhesive organelle. It differs from the one form namely, *P. basoglui* in body size, being comparatively smaller (Table IV). In *P. basoglui* while the sucker is pushed to a side, in the present form it is median in position. The transverse fibres and karyophore described in *P. basoglui* have not been observed in the present form.

In view of these features and based on the species first report from *R. cyanophlyctis* in a geographically different region, it is considered new to science for which the name *Prosicuophora andhrae* n. sp. is proposed.

2. *Prosicuophora hexadactyli* n. sp.

(Figs. 37-39)

Host : *Rana hexadactyla*

Site of infection : Rectum

Locality : Visakhapatnam and Chirala (Andhra Pradesh)

Incidence : 3/138 in Visakhapatnam

2/18 in Chirala

Type slides : ZSI, pt. 2087 Holotype
2088 Paratype

Rare endocommensal. Body pear-shaped, $300-380 \times 180-250 \mu\text{m}$ with a narrow pointed anterior end. Peristome $100-120 \mu\text{m}$, adherent to margin of adhesive organelle, joining funnel-shaped infundibulum in midde region making an angle of $140-160^\circ$. Infundibulum with two spires, generally in posterior half of body with small non-ciliated distal portion. AZM well developed. Trophozoites have deep depression in this region in fresh condition. The buccal apparatus has characteristic '6' shaped appearance. Macronucleus 'V' shaped measuring $40-60 \times 35-50 \mu\text{m}$ and has two equal arms. No karyophore. Adhesive organelle pear-shaped $180-250 \times 120-180 \mu\text{m}$, antero-lateral, with central cup-like depression and raised margins, bordered on right side by peristome. It is filled with a network of fibrils bordered by a number of PAS positive granules. Cytopyge small and cleft-like. No cytopygeal tuft of cilia. Contractile vacuole absent. Ciliary rows discontinuous, slanting and do not take silver impregnation uniformly. No vertical suture on right side.

Remarks :

The present form differs considerably from both *P. basoglui* as well as *P. andhrae* n. sp. (this study). It is unique in appearance with a pear-shaped anterolateral sucker (adhesive organelle) the margin of which is bordered by peristome and AZM. Buccal apparatus has characteristic '6' like appearance as shown in figure. The difference in size measurements between the three species is given in Table IV. It may be said that the present form differs from *P. basoglui* and *P. andhrae* n. sp. in several respects including host and locality based on which the species is considered new to science for which the name *Prosicuophora hexadactyli* n. sp. is proposed.

TABLE IV

Genus : *Nyctotheroides* Grasse, 1928
Order : HETEROTRICHIDA
Suborder : CLEVELANDELLINA

Family : NYCTOTHEROIDAE

Genus *Nyctotheroides* Grasse, 1928 is identified by the absence of a karyophore, and a left suture receiving slanting kineties which crosses the apex to continue as anterior right dorsum. Exclusively these are parasites of anurans.

Comparison of the characters of the species of *Prosicuophora*
(Measurements in microns)

Character	<i>P. basoglui</i>	<i>P. andhrae</i> n. sp.	<i>P. hexadactyli</i> n. sp.
Length of body	373	280-350	300-380
Width of body	—	180-300	180-250
Length : Width	—	1 : 1.5	1 : 2.5-3.0
Macronucleus	with two branches	Oval with two arms	'V' shaped
Size	—	40-50 × 20-30	40-60 × 35-50
Karyophore	Present	Absent	Absent
Length of peristome	—	50-80	100-120
Length of infundibulum	—	230-250	300-310
Adhesive organelle	220-230	Egg-shaped 150-180 × 90-130	Pear-shaped 180-250 × 120-180
Position of adhesive organelle	Pushed to a side	On the lower side in the anterior end in the median line	Anterolateral on the lower side
Number of contrac- tile vacuoles	—	3-4	Nil
Host	<i>Bufo regularis</i> <i>B. superciliaris</i> <i>Hylarana albo-</i> <i>laris albolaris</i>	<i>Rana cyanophly-</i> <i>ctis</i>	<i>Rana hexadac-</i> <i>tyla</i>
Locality	Gabon, France	Visakhapat- nam (Andhra and Chirala Pradesh, India)	Visakhapatnam (Andhra Pradesh, India)

Information on *Prosicuoophora basoglui* from Albaret (1975)

As many as 86 species of *Nyctotheroides* have so far been reported from anuran hosts from different parts of the world of which 16 species namely, *N. cordiformis*, *N. reniformis*, *N. cochlearis*, *N. caucopusi*, *N. systoma*, *N. limnocharis*, *N. curtipes*, *N. breviceps*, *N. bufonis*, *N. (Aduncoperistomatus) cyanophlycti*, *N. (A) melanosticti*, *N. (A) aurangabadensis*, *N. (A) marathwadensis*, *N. amaroii*, *N. ratnagirensis* and *N. indicum* have been described from India. Shete (1982a, 1982b) included the parasites under 2 sub-genera, *Aduncoperistomatus* and *Nyctotheroides* following Grasse (1928). Since Earl Paul (1972) united the four sub-genera of *Nyctotheroides* into a single genus, all the species described by Shete (1982a, 1982b) were considered as different species of the genus *Nyctotheroides*.

In the present study, 4 new species of *Nyctotheroides* are described from frogs of Andhra Pradesh along with 2 previously described species namely, *N. cordiformis* and *N. reniformis*.

Key to the identification of species of *Nyctotheroides* reported from anurans in India.

I. Body oval

- | | |
|--|-----------------------|
| (i) Cy. ph. nearly straight Ma. N. kidney shaped p. not described. ... | <i>N. cordiformis</i> |
| (ii) Cy. ph. narrow. Ma.N. massive, oval. p-starts at anterior apex. I-curved. Cy. py. canal small. ... | <i>N. systoma</i> |
| (iii) Ends rounds. Ma.N. massive, sausage shaped. Mi.N. small in Ma.N. depression. p-long, nearly reaching posterior middle I-small. ... | <i>N. curtipes</i> |
| (iv) With ventral indentation. Ma. N. massive, curved. P-small does not extend middle of the body. I-funnel shaped, short, slightly curved. Cy. py. canal angular open into large CV ... | <i>N. limnocharis</i> |

- (v) Anterior end narrow. Ma. N. oval P-confined to anterior region. I-narrow, tubular, oblique. Cy. py, cleft like. One CV ... *N. bufonis*
- (vi) Posterior end with knob-like projection. Ma.N. sausage shaped. P-extends through the length of the body. I-narrow and curved. ... *N. breviceps*
- (vii) Ends bluntly rounded. Ma. N. broadly rounded, narrow ventrally and notched dorsally. Cy. py. Y-shaped ... *N. cyanophlycti*
- (viii) Cy. ph. J-shaped. Ma.N. elongated. P-near middle of the body. Cy. py. wide. ... *N. aurangabadensis*
- (ix) Cy. ph. uniform. Ma.N. elongate, ovoid, irregular. Cy. py. narrow tubular. Opens into CV. ... *N. indicum*
- (x) Ma.N. triangular. Karyophore absent. P-starts below anterior end. I-J-shaped. Cy. py, opens into a CV. ... *N. rhacophori* n.sp.
- (xi) Ma.N. conical. Mi.N. oval adherent to Ma.N. P-starts beyond anterior apex. I-with 2 spires. ... *N. foliatus* n.sp.
- (xii) With deep depression on one side. Ma.N. sausage shaped. P-small. I-slightly curved, C-shaped. ... *N. hexadactyli* n.sp.
- (xiii) Cy. ph. curved. Ma.N. massive, ovoid. Cy.py. extends up to the tip of Cy. ph, ... *N. marathwadensis* n.sp.

- II. Body kidney or bean shaped
- (i) Cy.ph. reaching beyond middle of the body. Ma.N. kidney shaped. ... *N. reniformis*
 - (ii) Cy. ph. st.aight, oblique. Ma.N. club-shaped. Mi-n. large, oval. Cy. py. cleft-like angular ... *N. caucopusi*
- III. Body spoon shaped
- (i) Cy. ph. funnel shaped. Ma.N. long and ellipsoidal. Mi.N. not observed. ... *N. cochlearis*
- (IV) Body elliptical
- (i) Cy.ph. typically J-shaped. Ma.N. triangular and irregular. A loose membrane around Ma.N. present. Cy. py. tubular narrow long and delicate. ... *N. melanosticti*
 - (ii) P-extends to the middle of the body. Ma.N. large, elongated, sausage shaped. Cy.py. absent... *N. amaroii*
 - (iii) Anterior half triangular. P-extends 2/3 length of body. Ma.N. elongated, banana shaped. Cy. py. straight, delicate, narrow one or more CV ... *N. ratnagirensis*
- (V) Body pyramidal or conical
- (i) Anterior end pointed. P-starts from centre of anterior apex. Cy. ph. with globular distal end. Buccal apparatus forms a characteristic S-shaped structure. Ma.N. triangular. Cy.py. opens into CV. ... *N. bhatiae* n. sp.

1. *Nyctotheroides cordiformis* Ehrenberg

Host : *Rana cyanophlyctis*

Site of infection : Rectum

Locality : Vizianagaram (Andhra Pradesh)

Trophozoites oval measuring $80-120 \times 50-85 \mu\text{m}$. Peristome short, starts beyond anterior apex and meets infundibulum at 90° , extending transversely up to middle of body. Macronucleus typically kidney shaped. No karyophore. Micronucleus not observed. Cytoplasm hyaline and ciliation uniform.

Remarks :

Bhatia and Gulati (1927) reported *N. cardiformis* from *Bufo melanostictus* from Punjab ; Stein (1867) from *Rana esculenta* and *R. temoporja* ; de Mello (1932), *R. cyanophlyctis* in Goa and Uttangi (1950), *R. curtipes* and *R. breviceps* in Mysore. The present report is the species' first record from Andhra Pradesh.

2. *Nyctotheroides reniformis* Bhatia and Gulati

Host : *Rana hexadactyla*

Site of infection : Rectum

Locality : Repalle, Guntur District, Andhra Pradesh

Trophozoites kidney-shaped measuring $80-100 \times 40-60 \mu\text{m}$, with a concavity on one side. Peristome starts at anterior apex and extends to middle body. Infundibulum oblique and curved. Adoral zone of membranelles well developed. Macronucleus large and oval. Micronucleus small, spherical and adherent to macronucleus. Cytoplasm hyaline.

Remarks :

Bhatia and Gulati (1927) reported *N. reniformis* from *Bufo macrotis*. *Rana hexadactyla* is the species new host record from Andhra Pradesh.

3. *Nyctotheroides rhacophori* n. sp.

(Fig. 40)

Host : *Rhacophorus maculatus* Gray*Site of infection* : Colon*Locality* : Aruku Valley, Visakhapatnam District
(Andhra Pradesh)

Incidence : 2/23

Type slides : ZSI, Pt. 2089 Holotype
2090 Paratype

Body oval, $80-90 \times 40-50 \mu\text{m}$. Anterior end pointed, posterior rounded. Dorsal side concave, ventral slightly convex. Peristome $20-25 \mu\text{m}$ starting about $10-12 \mu\text{m}$ below anterior apex. Peristome meets infundibulum at an angle of 120° . Infundibulum narrow, 'J' shaped, $40-45 \mu\text{m}$ in length. Cytostome ventral in position. AZM continues from peristome into infundibulum. Cytopharynx narrow, hyaline and non-ciliated.

Macronucleus triangular $20-36 \times 15-25 \mu\text{m}$, situated above infundibulum, about $15 \mu\text{m}$ from anterior apex. Karyophore absent. Micronucleus embedded in macronucleus.

Cytopyge $3-4 \mu\text{m}$, opens into contractile vacuole, visible only in fresh condition. Cytoplasm filled with deeply stained amylopectin granules.

Ciliation uniform. Kineties parallel, extending from anterior to posterior end, slanting, joining left suture at posterior end.

Remarks :

In general, this form resembled *N. bufonis* (Uttangi, 1958) Amaro and Sena (1967) parasitic in the rectum of the toad, *Bufo melanostictus*, but differed in size and structure being much smaller. In *N. bufonis*, the infundibulum takes a characteristic curvature starting from cytostome, running initially dorsally and later bending along whole length its posterior end remaining straight. However, in the present form the infundibulum takes a 'J' shaped bend with a hyaline non-ciliated cytopharynx at the distal end.

The massive macronucleus in *N. bufonis* is oval measuring 40-45 μm while in the present form it is triangular measuring only 20-36 μm .

The present finding is also the species first report from

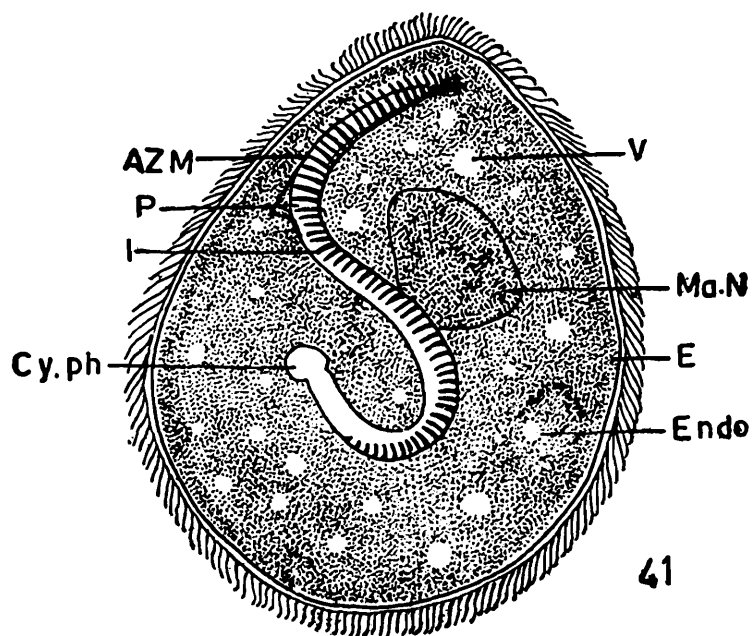
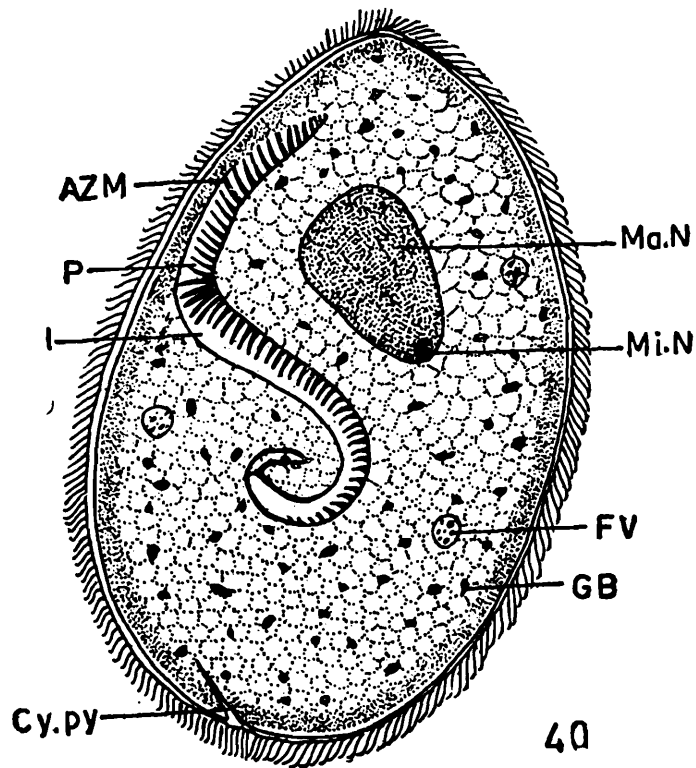


Fig. 40 *Nyctotheroides rhacophori* n. sp.—morphology

Fig. 41 *Nyctotheroides bhatiae* n. sp.—morphology

Rhacophorus maculatus in India. In view of the distinctiveness exhibited by the form, it is considered new to science for which the name *Nyctotheroides rhacophori* n. sp. is proposed.

4. *Nyctotheroides bhatiae* n. sp.

Host : *Rana limnocharis*

Site of infection : Rectum

Locality : Visakhapatnam (Andhra Pradesh)

Incidence : 6/28

Type slides : ZSI, pt. 2091 Holotype

2092 Paratype

Incidence and intensity of infection low. Occurred merely in adult frogs during November-December period (1981 and 1982). Trophozoites generally pyramidal or conical but sometimes spherical. Anterior end pointed, posterior end oval measuring $50-65 \times 40-45 \mu\text{m}$. Transparent and glossy in fresh condition. Peristome $25 \mu\text{m}$ in length, starts from the middle of anterior apex and joins infundibulum. Infundibulum $30-40 \mu\text{m}$, located on dorsal side, making an angle of 90° and extending to middle of the body as non-ciliated cytopharynx. Distal end of cytopharynx globular. Buccal apparatus forming a characteristic 'S' shaped structure. AZM extends through the length of peristome and infundibulum.

Macronucleus triangular, $15 \times 10 \mu\text{m}$, situated about $15 \mu\text{m}$ from the apex, almost adherent to infundibulum. Micronucleus not seen. Cytopyge absent. Cytoplasm hyaline with a number of small vacuoles and without any inclusions.

Kinetics parallel, slanting with 2 sutures, one anterior and the other posterior. Ciliation uniform.

Remarks :

The present form is unique in its pyramidal or conical body shape and presence of 'S' shaped buccal apparatus. It resembles *N. landanae* (Albaret, 1968) in having a cytopharynx with a globular distal end. However, *N. landanae* is typically oval in shape with an elongated macronucleus and a

cytopygeal canal opening into contractile vacuole while in the present form the macronucleus is triangular and the cytopyge is altogether absent.

In view of the differences in shape and structure and considering that the species is from an altogether different host it is contended that the parasite is new to science and herein described as *Nyctotheroides bhatiae* n. sp.

5. *Nyctotheroides foliatus* n. sp.

(Fig. 42)

Host : *Rana breviceps*

Site of infection : Rectum

Locality : Visakhapatnam (Andhra Pradesh)

Incidence : 56/138

Type slides : ZSI, Pt. 2093 Holotype
2094 Paratype

Trophozoites broadly oval, flat, with thin rounded ends, measuring $90-100 \times 60-80 \mu\text{m}$. Generally glides on the slide rather than swim with active ciliary movements.

Peristome $55-65 \mu\text{m}$, originates well beyond anterior apex, and runs parallel to ventral body surface to join the funnel-shaped infundibulum making an angle of $60-70^\circ$. Infundibulum narrows into a tubular part and measures $90-110 \mu\text{m}$. Cytopharynx $40-45 \mu\text{m}$ makes two spiral coils in the middle of the body. AZM extends through peristome and infundibulum.

Macronucleus conical $20-30 \times 7-10 \mu\text{m}$, situated about $15-20 \mu\text{m}$ away from anterior apex in peristomial-infundibular angle. Micronucleus small, oval, adherent to macronucleus.

Cytopyge $6-7 \mu\text{m}$, opens into a big contractile vacuole.

Cytoplasm granular with large number of discoid bodies. Ciliation uniform. Kineties slanting and meet near left suture at anterior apex.

Remarks :

This species resembles *N. reniformis* (Bhatia and Gulati,

1927), Amaro and Sena (1907) and *N. cordiformis* (Stein, 1867) reported from India in size but differs from them in the

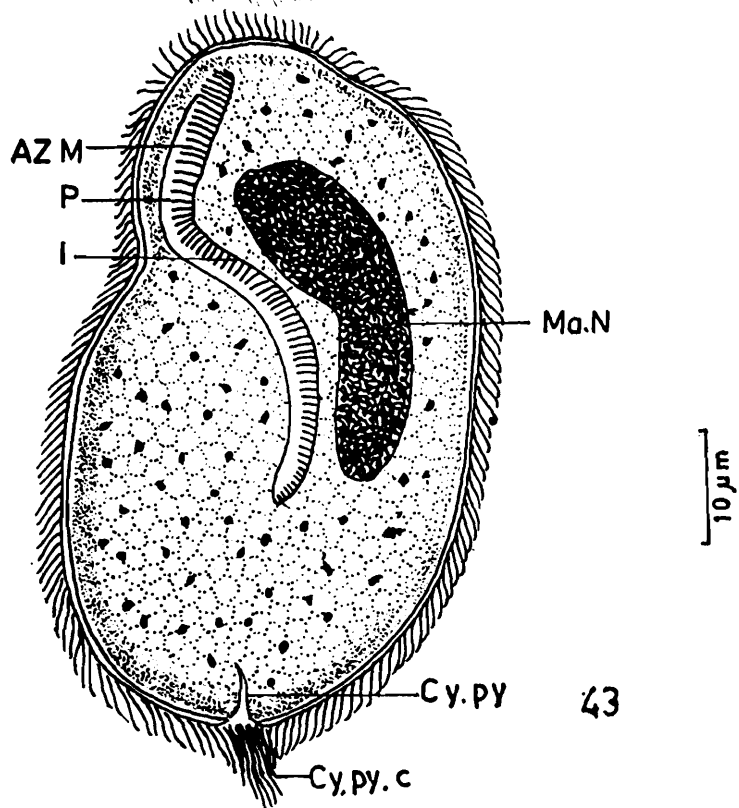
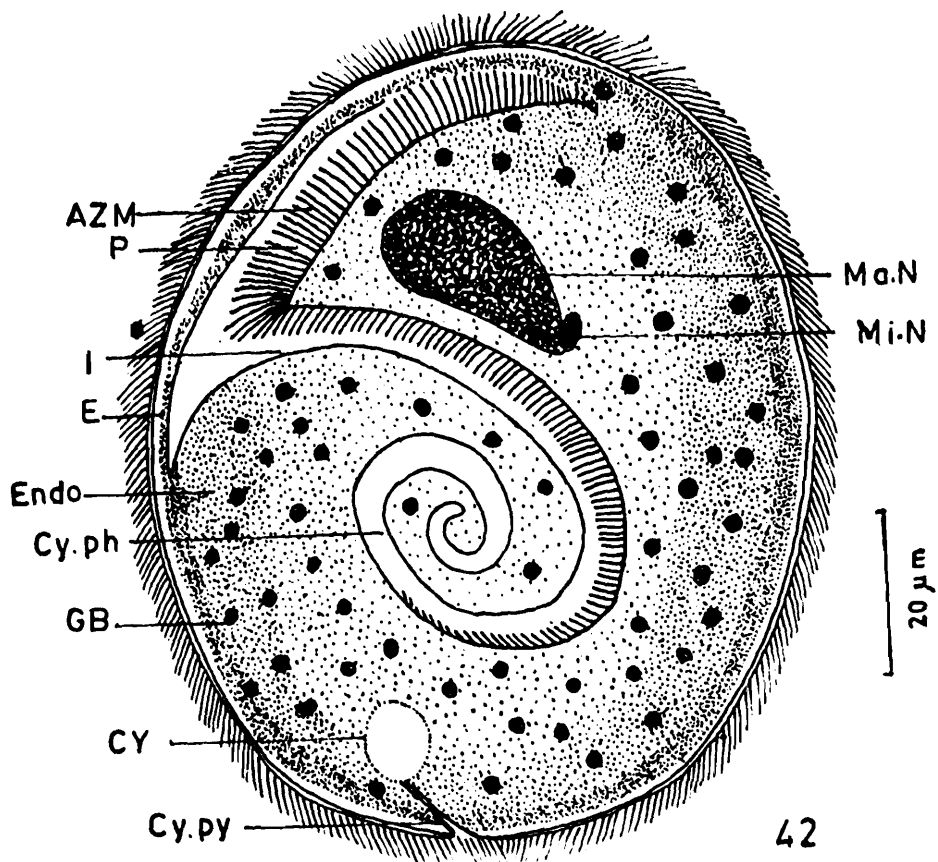


Fig. 42 *Nyctotheroides foliatus* n. sp.—morphology

Fig. 43 *Nyctotheroides hexadactyli* n. sp.—morphology

presence of a flattened, leaf-like body. The cytopharynx in the present form has two spires while it is merely curved both in *N. reniformis* and *N. cordiformis*. The species though resembles *N. spirostomatus* Amaro and Sena (1967) in the shape of the cytopharynx, it differs from it in size and position of the macronucleus. Similarly, while *N. spirostomatus* has the characteristic karyophore the same is absent in the present form. While *N. breviceps*, the only other species reported from *Rana breviceps* (Uttangi, 1958), has a unique knob-like blunt conical projection at the posterior end and a long peristomial groove extending for nearly the entire length, these characters are absent in the present form.

In view of the above and based on the morphological differences with others described so far the species is considered new to science and the name *Nyctotheroides foliatus* n. sp. is proposed.

6. *Nyctotheroides hexadactyli* n.sp. (Fig. 43)

Host : *Rana hexadactyla*

Site of infection : Colon and rectum

Locality : Vizianagaram (Andhra Pradesh)

Incidence : 3/32

Type slides : ZSI, pt. 2095 Hclotype
2096 Paratype

Incidence of infection maximum during February-April, 1981 and 1982. Other than a few *Opalina* spp., no endo-commensal ciliates were observed to coinhabit the rectum.

Trophozoites oval, small $50-68 \times 30-35 \mu\text{m}$. Dorsal side convex. A deep depression in the region of infundibulum on ventral side seen. Peristome small, $16 \mu\text{m}$ in length and begins at anterior apex and joins the tubular infundibulum making an angle of 90° . Infundibulum curved or 'C' shaped, $30-35 \mu\text{m}$ in length. AZM extends through the length of peristome and infundibulum. Cytopharynx not observed. Macronucleus massive, sausageshaped, $25-30 \times 6.10 \mu\text{m}$, generally bent, follows the course of infundibulum. Micronucleus not observed.

Cytopyge cleft-like, 4 μm in length with cytopygeal tuft of cilia. No contractile vacuole. Cytoplasm homogenous and granular.

Ciliation uniform. Kineties parallel and slanting. Suture in peristomial region on ventral side.

Remarks :

This species is relatively small in size and has no structural resemblance with any others described so far. The shape of the body is characteristically peculiar and resembles somewhat the kidney-shaped trophozoites of *N. reniformis* and *N. cordiformis*. However, it differs from both of them in all other characters such as body length, peristome and infundibulum.

A massive sausage-shaped macronucleus of the kind noticed in the present form has been reported earlier in *N. breviceps* (Uttangi, 1958 ; Amaro and Sena, 1967). However, the species differed from *N. breviceps* in the absence of protruberance and long double spiralled cytopharynx. The species also differed from all others described in this study in its morphology.

In view of the above and based on the first report of the species in *R. hexadactyla*, it is considered new to science for which the name *Nyctotheroides hexadactyli* n. sp. is proposed.

SUMMARY

Endocommensal ciliates of anurans of Andhra Pradesh have been studied and 2 new species of the genus *Balantidium* namely, *Balantidium rhacophori* from rectum and colon of *Rhacophorus maculatus* and *B. waltirensis*, rectum of *Rana cyanophlyctis* ; 2 new species of *Trichodina*, *T. cyanophlycti* rectum of *R. cyanophlyctis* ; *T. waltirensis*, urinary bladder of *R. breviceps* and *R. cyanophlyctis* ; 6 new species of *Sicuophora*, *S. waltirensis*, rectum of *R. cyanophlyctis*, *R. breviceps* and *R. limnocharis* ; *S. limnochari*, rectum *R. limnocharis* and *R. cyanophlyctis* ; *S. fragilis*, colon of *R. cyanophlyctis* and *R. hexadactyla* ; *S. puytoraci*, rectum of *R.*

breviceps ; *S. levinei*, rectum of *R. cyanophlyctis* ; *S. ranae*, rectum of *R. limnocharis*, *R. hexadactyla* and *R. cyanophlyctis* ; 2 new species of *Prosicuophora*, *P. andhrae*, rectum of *R. cyanophlyctis* ; *P. hexadachyli* rectum of *R. hexadactyla* ; 2 new species of *Metasicuophora*, *M. cyanophlycti*, colon of *R. cyanophlyctis* ; *M. melanosticti*, intestine and colon of *Bufo melanostictus* and 4 new species of *Nyctotheroides*, *N. rhacophori*, colon of *Rhacophorus maculatus* ; *N. bhatiae*, rectum of *R. limnocharis* ; *N. foliatus*, rectum of *R. breviceps* and *N. hexadactyli*, colon and rectum of *R. hexadactyla* have been encountered, the same described and their systematic position discussed.

Keys to the identification of species of six genera, *Balantidium*, *Trichodina*, *Sicuophora*, *Metasicuophora*, *Prosicuophora* and *Nyctotheroides* described from India also given.

*Details of the endocommensal ciliates of Anura of Andhra Pradesh submitted for deposition
in the Zoological Survey of India, Calcutta*

Slide No. (1)	Name of the species (2)	Name of host (3)	Site of infection (4)	Place of collection (5)	Date of collection (6)
ZSI 1 Pt. 2067	<i>Balantidium rhacophori</i> n. sp. (Holotype)	<i>Rhacophorus maculatus</i>	Rectum & colon	Araku Valley (Visakhapatnam Dt.)	Dec. '83
ZSI 1A Pt. 2068	<i>Balantidium rhacophori</i> n. sp. (Paratype)	<i>Rhacophorus maculatus</i>	Rectum & colon	Araku Valley	Dec. '83
ZSI 2 Pt. 2069	<i>B. waltirensis</i> n. sp. (Holotype and paratype)	<i>Rana cyanophlyctis</i>	Rectum	Visakhapatnam	Feb. '83 (through year)
ZSI 3 Pt. 2070	<i>Trichodina cyanophlycti</i> (Holotype and paratype)	<i>Rana cyanophlyctis</i>	Rectum	Visakhapatnam and Eluru	Aug.-Oct. '83 and '84
ZSI 4 Pt. 2071	<i>T. waltirensis</i> n. sp. (Holotype)	<i>R. breviceps</i> and <i>R. cyanophlyctis</i>	Urinary bladder	Vizianagaram	Feb. & March '84
ZSI 4A Pt. 2072	<i>T. waltirensis</i> n. sp. (Paratype)	<i>R. breviceps</i> and <i>R. cyanophlyctis</i>	Urinary bladder	Vizianagaram	Feb. & March '84
ZSI 5 Pt. 2073	<i>Sicuophora waltirensis</i> n. sp. (Holo and paratypes)	<i>R. cyanophlyctis</i> <i>R. breviceps</i>	Rectum	Visakhapatnam	Jan.-April 1983 & '84
ZSI 6 Pt. 2074	<i>S. limnochari</i> n. sp. (Holotype and paratype)	<i>R. limnocharis</i> <i>R. cyanophlyctis</i>	Rectum	Vizianagaram	June-July '84
ZSI 7 Pt. 2075	<i>S. fragilis</i> n. sp. (Holotype)	<i>R. cyanophlyctis</i> <i>R. hexadactyla</i>	Colon	Nellore	Aug. 1984

[Contd.

(1)	(2)	(3)	(4)	(5)	(6)
ZSI 7A Pt. 2076	<i>S. fragilis</i> n. sp. (Paratype)	<i>R. cyanophlyctis</i> <i>R. hezadactyla</i>	Colon	Nellore	Aug. 1984
ZSI 8 Pt. 2077	<i>S. puytoraci</i> n. sp. (Holotype and paratype)	<i>R. breviceps</i>	Rectum	Machilipatnam	May, 1983
ZSI 9 Pt. 2078	<i>S. levinei</i> n. sps (Holotype)	<i>R. cyanophlyctis</i>	Rectum	Visakhapatnam	July-Aug. '84
ZSI 9A Pt. 2079	<i>S. levinei</i> n. sp. (Paratype)	<i>R. cyanophlyctis</i>	Rectum	Visakhapatnam	July-Aug. '84
ZSI 10 Pt. 2080	<i>S. ranae</i> n. sp. (Holotype and paratype)	<i>R. limnocharis</i> <i>R. hexadactyla</i> <i>R. cyanophlyctis</i>	Rectum	Eluru	Sept. 1984
ZSI 11 Pt. 2080	<i>Metasicuophora cyanophlycti</i> n. sp. (Holotype)	<i>R. cyanophlyctis</i>	Colon	Repalle (Guntur Dt.)	Oct. 1984
ZSI 11A Pt. 2082	<i>Metasicuophora cyanophlycti</i> n. sp. (Paratype)	<i>R. cyanophlyctis</i>	Colon	Repalle (Gunter Dt.)	Oct. 1984
ZSI 12 Pt. 2083	<i>M. melanosticti</i> n. sp. (Holotype)	<i>Bufo melanostictus</i>	Intestine & colon	Machilipatnam	April, 1984
ZSI 12A Pt. 2084	<i>M. melanosticti</i> n. sp. (Paratype)	<i>Bufo melanostictus</i>	Intestine & colon	Machilipatnam	April, 1984
ZSI 13 Pt. 2085	<i>Prosicuophora andhrae</i> n. sp. (Holotype)	<i>Rana cyanophlyctis</i>	Ructum	Visakhapatnam	Sept. 1983

[Contd.

(1)	(2)	(3)	(4)	(5)	(6)
ZSI 13A Pt. 2086	<i>Prosicuoophora andhrae</i> n. sp. (Paratype)	<i>Rana cyanophlyctis</i>	Rectum	Visakhapatnam	Sept. 1983
ZSI 14 Pt. 2087	<i>P. hexadactyli</i> n. sp. (Holotype)	<i>R. hexadactyla</i>	Rectum	Visakhapatnam and Chirala	Apr. 1984 May, 1984
ZSI 14A Pt. 2088	<i>P. hexadactyli</i> n. sp. (Paratype)	<i>R. hexadactyla</i>	Rectum	Visakhapatnam and Chirala	Apr. 1984 May, 1984
ZSI 15 Pt. 2089	<i>Nyctotheroides rhacophori</i> n. sp. (Holotype)	<i>Rhacophorus maculatus</i>	Colon	Araku Valley (Visakhapatnam Dt.)	Dec.-Jan. '83
ZSI 15A Pt. 2090	<i>Nyctotheroides rhacophori</i> n. sp. (Paratype)	<i>Rhacophorus maculatus</i>	Colon	Araku Valley (Visakhapatnam Dt.)	Dec -Jan. '83
ZSI 16 Pt. 2091	<i>N. bhatiae</i> n. sp. (Holotype)	<i>R. limnocharis</i>	Rectum	Visakhapatnam	Nov.-Dec. '84
ZSI 16A Pt. 2092	<i>N. bhatiae</i> n. sp. (Paratype)	<i>R. limnocharis</i>	Rectum	Visakhapatnam	Nov.-Dec. '84
ZSI 17 Pt. 2093	<i>N. foliatus</i> (Holotype)	<i>R. breviceps</i>	Rectum	Visakhapatnam	June, 1983
ZSI 17A Pt. 2094	<i>N. foliatus</i> (Paratype)	<i>R. breviceps</i>	Rectum	Visakhapatnam	June, 1983
ZSI 18 Pt. 2095	<i>N. hexadactyli</i> n. sp. (Holotype)	<i>R. hexadactyla</i>	Colon & Rectum	Vizianagaarm	May, 1983
ZSI 18A Pt. 9096	<i>N. hexadactyli</i> n. sp. (Paratype)	<i>R. hexadactyla</i>	Colon & Rectum	Vizianagaram	May, 1983

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