ON SOME FREE-LIVING CILIATES FROM BANARAS CANTT., U.F

By H. KHAJURIA, *M.Sc., Zoological Survey of India, Indian Museum, Calcutta.*

INTRODUCTION.

On the kind suggestion of Dr. S. L. Hora, Director, Zoological Survey of India, the present work was undertaken in December, 1947 with a view to survey the free-living protozoan fauna of Banaras. Unfortunately, it has not been possible to do full justice to the work, partly because the Head Quarters of the Zoological Survey were shifted from Banaras to Calcutta just after a few months since the work was begun and partly because the work was carried out only during spare time obtained after my official duties. Sixteen species of ciliates, including one new species, have been recorded in the following account. Only new or controversial variations as noted in comparison with original descriptions or with those given by Bhatia (1936) have been elucidated in the case of old species. Observations recorded here were mostly made on the living organisms as facilities for their proper fixation and staining were not available in the Zoological Survey.

MATERIAL AND METHOD.

Samples of water from the Varuna River and the various ponds were brought to the laboratory, centrifuged for about ten minutes in a hand-centrifuge, and examined in a hanging-drop-preparation. To slow down the active movements of the organisms, osmic vapour, Indian ink, a weak solution of iron alum, and that of cocaine hydroxide were used with some success. The actual concentration and the time of reaction of these chemicals is different in different cases and can only be established by trial. The muscilage obtained from the seeds of *ispaghul* (*Plantago ovata*) recommended by Bhatia (1936) for this purpose was not found to be helpful. Indian ink and iron alum solution also help to show the characters of cytostome and cilia or flagella respectively. When the organisms were available in abundance, smears were allowed to dry on the coverslips; and the cilia and the flagella were rendered clearer and clearer as the water dried up probably due to the expansion of these structures as a result of disintegration.

For permanent preparations, a very small drop of water, concentrated with the organisms, was placed on a coverslip coated with a thin film of Mayer's albumen, and the drop spread afterwards into an even film. The coverslips with smears downward and still wet were dropped in alcoholic Bouin's fluid and left there from 10 minutes to ½ an hour. Occasionally, the fixation in Bouin's fluid was preceded by the exposure of the smear to osmic vapour for a few seconds. Sometimes a drop of the fixative was placed on the smear which was allowed to dry along with the fixative. Hot fixative was also used in certain cases to avoid

the washing-away of the material by immediate and effective coagulation of Mayer's albumen. Iron haematoxylin and Delafield haematoxylin were used as stains.

Cultures of *Urotricha, Enchelis, Coleps, Paramecium, Colpidium* and *Stylonychia* were successfully maintained in the laboratory for several days by the simple addition of natural food material and frequent renewal of water.

LIST OF SPECIES WITH THEIR INDIAN DISTRIBUTION.

Family HOLOPHRYDAE

1. *Urotricha bhatiai*, sp. nov.—Banaras, U. P.
2. *Lacrymaria vermicularis* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.
3. *Enchelis arcuata* C. & L.—Lahore, Punjab ; Banaras, U. P.

Family COLEPIDAE

4. *Coleps hirtus* (O. F. Müller).—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P. ; Calcutta, Bengal.

Family AMPHILEPTIDAE

5. *Litonotus fasciola* (Ehrenberg).—Sirinagar, Kashmir ; Lahore, Punjab ; Bombay ; Banaras, U. P.; Calcutta, Bengal.
6. *Litonotus pleurosigma* Stokes.—Lahore, Punjab ; Banaras, U. P.

Family TRACHELIDAE

7. *Dileptus anser* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.

Family NASSULIDAE

8. *Nassula stamphii* (Ehrenberg).—Lahore, Punjab ; Banaras, U.P.

Family PARAMECIIDAE

9. *Paramecium caudatum* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Lucknow, Banaras, U. P. ; Calcutta, Bengal.

Family FRONTONIDAE

10. *Colpidium colpoda* (Ehrenberg).—Lahore, Punjab ; Banaras, U. P.

Family SPIROSTOMIDAE

11. *Spirostomum ambiguum* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Calcutta, Bengal ; Banaras, U. P.

Family STENTORIDAE

12. *Stentorella polymorphus* (O. F. Müller).—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P. ; Calcutta, Bengal.

Family HALTERIIDAE

13. *Halteria grandinella* (O. F. Müller).—Lahore, Punjab ; Banaras, U. P.

Family OXYTRICHIDAE

Subfamily *Pleurotrichinae*

14. *Stylonychia pustulata* Ehrenberg.—Sirinagar, Kashmir ; Lahore, Punjab ; Banaras, U. P.

Family VORTICELLIDAE

15. *Vorticella companula* Ehrenberg.—Lahore, Punjab ; Banaras, U. P.

Family EPISTYLIDAE

16. *Epistylis* sp.—Banaras, U. P.

SYSTEMATIC ACCOUNT.

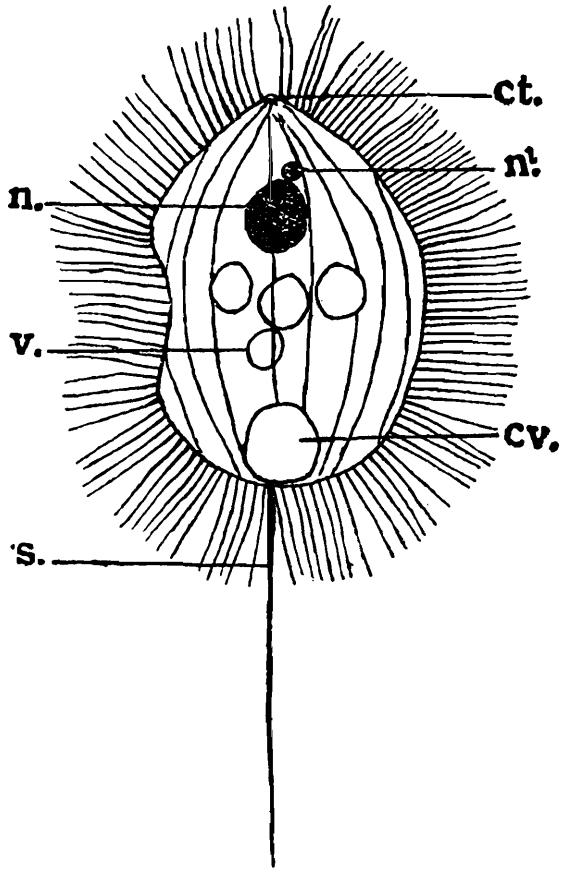
Urotricha bhatiai, sp. nov.

Body form more or less egg-shaped, about two times as long as broad and frequently attenuated towards anterior end ; but rarely globular, globular forms often with wavy uneven contour. One side

either straight or with prominent curvature which rarely appears in fixed preparations. Cilia very long, uniformly covering whole body. A single seta directed straight backwards at posterior end. Mouth anteriorly situated leading into a protrusible cytopharynx. Macronucleus spherical or oblong accompanied by a micronucleus and placed anteriorly. Contractile vacuole placed in median line at extreme posterior end, its posterior margin almost one with that of body. Food vacuoles always fewer (3 to 5) but larger than those of *U. globosa* Schewiakoff. Movements leaping and restless marked by sudden change of direction.

Measurements in microns of Type Specimen.—Body : 27·1 × 14·7 ; macronucleus (diameter), 5·2 ; micronucleus (diameter), 1·2 ; seta, 26·3.

Variations.—In some cultures the organisms underwent an interesting change. Characteristic restless movements changed into slow undulating movements ; body became very much elongated ; ciliary lines so faint



TEXT-FIG. 1.—*Urotricha bhatiai*, sp. nov. ×1400 (approx.). *ct.*, cytostome ; *cv.*, contractile vacuole ; *n*, macronucleus ; *n1*, micronucleus ; *s*, seta ; *v*, food vacuole.

in an ordinary individual almost changed into prominent cuticular creases ; and the contractile vacuole expanded so as to occupy nearly one-half of the body. In short, the organisms appeared to belong to a different species. But there are reasons to believe that the change was environmental, probably due to some basicity in the contents of the culture.

Measurements in microns of 60 individuals.—Body : 35·24 × 20·13 ; mean, 27 × 17 ; macronucleus (mean diameter), 5 ; micronucleus (mean diameter), 1·5 ; seta, 25 (mean).

Habitat.—Pond water and the Varuna River.

KEY TO THE SPECIES OF *Uotricha* WITH ONE SETA.

A. Seta at posterior end directed straight backward. No oblique striations

a. Cilia uniformly distributed all over body .. *U. bhatiai*, sp. nov.

b. Arrangement of cilia otherwise . ..

c. Cilia scantier or absent at posterior end, shorter and finer near mouth *U. globosa* Schew.

d. Cilia longest in anterior region *U. lagenula* Kent.

B. Seta at posterior end directed obliquely to one side. Striations oblique . . **U. farctá* C. & L.

Relationships.—Of all the species of *Urotricha*, *U. bhatiai* is most closely allied to *U. globosa* with which it shares a number of important characters, though, at the same time, clearly distinguishable from it. An analysis of the characters of both species is given in the following table :—

U. bhatiai	*U. globosa*
1. CONTRASTING CHARACTERS.	
1. Cilia uniformly distributed all over the body.	Cilia santier or absent in posterior region, shorter or finer near mouth.
2. One side markedly convex, the other straight or concave.	Both sides equally convex.
3. Food vacuoles fewer (3-5), but larger	Food vacuoles numerous, but smaller.
2. OVERLAPPING CHARACTERS.	
4. Posterior end with one seta	Posterior end with one or two setae.
5. Contractile vacuole always in median line.	Contractile vacuole median or lateral in position.
6. Body form egg-shaped	Body form spherical or egg-shaped.

Characters No. 1 to 3 are of sufficient specific value to distinguish the new species from *U. globosa*. In other characters the two species overlap. It appears that the two species have a closely approximated evolutionary history, and originally two races of one and the same species have now developed important specific characters. It is also clear from the above table that *U. globosa* has got much greater range of variations and is, thus, probably more primitive.

Bhatia (1916) came across a species of *Urotricha* and, though he noted a few points of difference from *U. globosa* (position of the contractile vacuole, presence of the cilia on the posterior part), he ultimately referred the species to *U. globosa*. There are reasons to believe that he might have ment the species under consideration. Partly for this and partly for many a contributions he made to the Indian Protozoa, I name the species after him.

* The characters of *U. farctá* given here are given by Kent (1880-1882). It is rather strange to note that the figure of this species produced by Kudo (1946) shows entirely different characters : there are cilia only in the anterior region ; the springing bristle is not oblique, and there are no oblique striations.

Lacrymaria vermicularis (O. F. Müller).

Body cylindrical, about four times as long as broad. Ciliary girdle at the base of very small apical portion with cilia usually directed forward. Body surface smooth (without cilia). No spiral striations as noted by Kahl (1930-5). Scarce.

Measurements in microns of 6 fully expanded individuals.—Body : 125-100×40-20 ; mean, 112×26.

Habitat.—Pond water kept in a glass tube for a week.

Enchelis arcuata C. & L.

Ciliary coat uniform without longer cilia surrounding oral region as noted by Bhatia (1916). Contractile vacuoles appeared to be seven in number.

Measurements in microns of 20 individuals.—Body : 98-38×36-32 ; mean, 90×36.

Habitat.—Pond water in which some wheat flour was added.

Coleps hirtus (O. F. Müller).

Cilia uniformly distributed and not arising in pairs as shown in the diagram by Noland (1925) ; no attenuation towards the posterior end as shown by him. Probably a new race.

Measurements in microns of 23 individuals.—Body : 46-38×35-20 ; mean, 41×21.

Habitat.—Pond water and stagnant Varuna River water.

Litonotus fasciola (Ehrenberg).

S-shaped curvature well-marked. Cilia situated along the mouth cleft were not sharply marked off from those on rest of body. Forms with sharply pointed posterior end were also found. Contractile vacuole closely approximated towards posterior end. Scarce.

Measurements in microns of 10 individuals.—Body ; 95-86×38-32 ; mean, 90×35.

Habitat—The Varuna River and pond water.

Litonotus plearosigma Stokes.

Cilia on neck region not distinguished from those on rest of body. Posterior end generally obtusely pointed. Number of contractile vacuoles in a row 6 to 8. Scarce.

Measurements in microns of 5 individuals.—Body : 250-200×50-40 ; mean, 220×42.

Habitat.—Pond water and standing Varuna River water.

Dileptus anser (O. F. Müller).

Colour whitish ; posterior end not much pointed ; trichocysts not noticed. No longitudinal striations. Very scarce.

Measurements in microns of 6 individuals.—Body : 260-200×70-45 ; mean, 200×45.

Habitat.—Varuna River.

Nassula stamphii (Ehrenberg).

Anterior flexible prolongation $\frac{1}{3}$ of the whole body. Contractile vacuole almost touching posterior margin of body. Other vacuoles absent or rarely one. Macronucleus oval and central.

Measurements in microns of 20 individuals.—Body : 75-60×48-38 ; mean, 65×40.

Habitat.—Pond water in association with green algae.

Paramecium caudatum Ehrenberg.

Tuft of longer cilia at posterior end absent. No extra contractile vacuoles as noted by Bhatia (1916).

Measurements in microns of 25 individuals.—Body : 280-200×74-50 ; mean, 240×60.

Habitat.—Infusions of leaves prepared from Varuna River and pond water.

Colpidium colpoda (Ehrenberg).

Only central region of body convex. No longer cilia on posterior extremity ; anterior end with longer cilia in addition to normal ones. Contractile vacuole posteriorly situated and on left side of nucleus which is postero-terminal and sublateral. Cytopharynx not noticed. Vacuoles other than contractile one 1 to 3. Subsidiary vacuoles not observed. Ciliary striations only noticeable on margins. Mouth in middle of anterior portion.

Measurements in microns of 35 individuals.—Body : 160-90×90-40 ; mean, 130×60.

Habitat.—Varuna River and pond water.

Spirostomum ambiguum Ehrenberg.

Posterior end rounded. Ratio between length of body and that of peristome 7 : 4. Scarce.

Measurements in microns of one individual.—Body : 3050×300.

Habitat.—Pond water.

Stentorella polymorphus (O. F. Müller).

Colourless and solitary. No strong bristles on body. Macronucleus zigzag Anal aperture not noticed. Radiating canals not clearly seen.

Measurements in microns of 5 individuals.—Body : 1300-1190×88-70 ; mean, 1200×74.

Habitat.—Pond water.

Halteria grandinella (O. F. Müller).

Body rounded, not with posterior rounded point. Macronucleus oval or rounded. Number of larger cilia at anterior end quite numerous and not 6 to 7 as recorded by Bhatia (1920).

Measurements in microns of 15 individuals.—Body : 45-28 (diameter) ; mean, 32.

Habitat.—Varuna River and pond water.

Stylonychia pustulata Ehrenberg.

Four of anal styles projecting backward. Undulating membrane not noticed. Caudal styles short. Two parts of macronucleus not overlapping. Cytoplasm bounded up by a very thin membrane which allows the protoplasm to flow out as soon as the movements stop at the time of death.

Measurements in microns of 15 individuals.—Body : 180-160×85-70 ; mean, 174×75.

Habitat.—Pond water.

Vorticella companula Ehrenberg.

In ordinary expanded position, the maximum width is in the middle, but several phases of contraction and expansion are present. Ciliary wreath forms two spiral convolutions. Pellicular striations not noticed, A few granules in the stalk present.

Measurements in microns of 5 individuals.—Body : 140-80×100-50 ; mean, 105×75.

Habitat.—Pond water. Rarely in Varuna River.

Epistylis sp.

One small colony met with for a short time and detailed observation were not possible. Body globular, cuticular sufrace smooth. Pedicle seemed to be dichotomous, thick, and without longitudinal striations.

Measurements in microns.—Length approximately 80.

Habitat.—Pond water.

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