

ON SOME FRESHWATER CILIATES (PROTOZOA) FROM CALCUTTA AND ITS ENVIRONS

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With 1 Table and 4 Text-figures)

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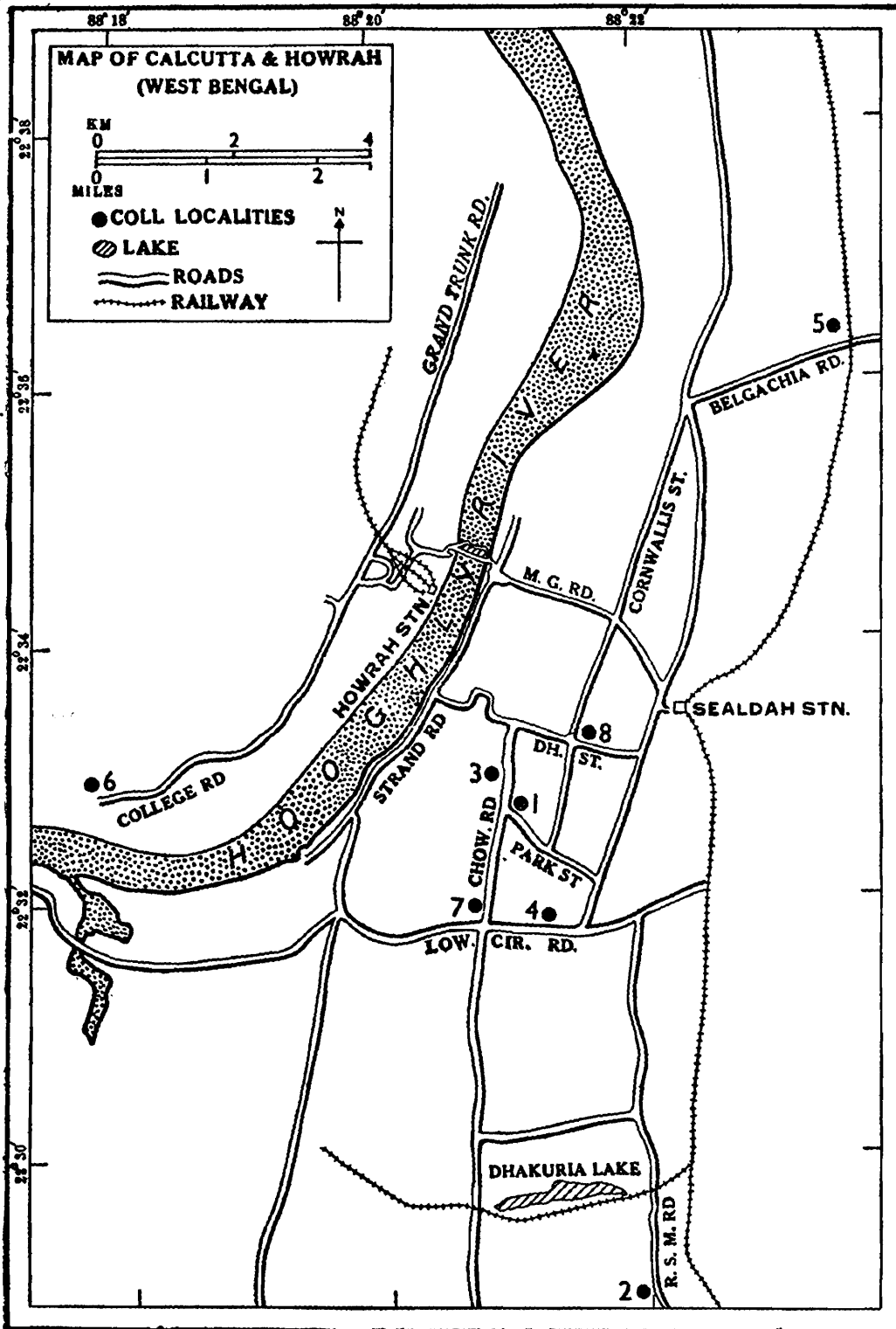
I—INTRODUCTION

(a) *General*

This paper deals with nineteen species and one variety of freshwater ciliates (Protozoa) collected during the faunistic survey of the freshwater

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Protozoa of the perennial and temporary ponds and pools of Calcutta and its vicinity (Sibpur, District Howrah) in West Bengal. (Text-fig.-1)



TEXT-FIG. 1.—Sketch map of Calcutta city and its environs, showing the localities of collection for Protozoa.

1. Indian Museum Tank. 2. Jadavpur (Indian Association for the Cultivation of Science compound). 3. Manohar Das Thadak (Tank). 4. Minto Square Tank. 5. Shahid Colony. 6. Sibpur (Indian Botanic Garden). 7. St. Paul's Cathedral Tank. 8. Wellington Square Park.

CHOW. RD., Chowringhee Road; DH. ST., Dharamtalla Street; H. R. STN., Howrah Railway Station; M. G. RD., Mahatma Gandhi Road; R.S.M. RD., Raja Subodh Mullick Road.

Very little attention has hitherto been devoted to the ciliate fauna of this area. The earliest account is that of Cantor (1842) in which he referred about G. W. Grant (no published work by Grant) as having observed in Calcutta six species of freshwater Protozoa. Among these, only two were ciliates, viz., *Coleps hirtus* Ehrenberg and *Vorticella patellina* Müller. Simmons (1889, 1891) recorded ciliates belonging to 12 genera from Calcutta, without giving any specific identification of the forms. Ghosh (1918-29) recorded 29 species of free-living ciliates from Calcutta and its vicinity. Only 18 species belonging to 11 genera are directly referred as pondwater forms and the rest as either sewer-water or vegetable-infusion forms. Nair (1960) reported one new record of a ciliate from Sibpur (Howrah District).

A survey of the freshwater ciliates of Calcutta was started by the Zoological Survey of India a few years ago and the present paper is a result of that work. Nineteen species (and a new variety) belonging to 14 genera, 11 families and 6 orders are described here. Of these, 18 species are new records from India (as restricted after separation of Pakistan—some having been reported from Lahore, West Pakistan, by Bhatia, (1936), and 4 are new records from Calcutta. The species *Neobursaridium gigas* Balech is reported here for the first time from Asia.

The descriptions are mainly based on observations made on living specimens kept in hanging drops of natural medium, but the number of examples mentioned under 'Material' for each species refers only to those present on prepared slides, and not to the number actually observed in the living condition which was usually about 20-30. 'Methocel' was used for slowing down the fast-moving forms, and Lugol's solution was used as a killing agent and also for detecting the peripheral organellae. Schaudinn's fixative and Carnoy's fluid were used as fixatives. The majority of the specimens were stained with Heidenhain's iron haematoxylin and counterstained with eosin. Some specimens were also stained with Delafields' haematoxylin. Silver impregnation (dry method) was also employed in some cases.

(b) Acknowledgements

Our thanks are due to John O. Corliss, Associate Professor of Zoology, University of Illinois, Illinois, U. S. A., for the identification of our material of *Neobursaridium gigas*. We are highly grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for his helpful suggestions and guidance in the preparation of this paper. Thanks are due to the staff of the Protozoology Section for the help rendered in collecting some of the specimens.

II—LIST OF CALCUTTA CILIATES DEALT WITH

In the following list, the orders, genera and species are given a running number.

Records of the Zoological Survey of India

Class CILIATA Perty

Subclass (A) HOLOTRICHA Stein

Order 1. GYMNOSTOMATIDA Bütschli

Suborder (i) RHABDOPHORINA Faure-Fremiet

Family (a) ENCHELYIDAE Ehrenberg

Genus (1) *Prorodon* Ehrenberg1. *Prorodon edentatus* Claparède & Lachmann2. *Prorodon discolor* (Ehrenberg)3. *Prorodon teres* Ehrenberg

Family (b) LOXODIDAE Bütschli

Genus (2) *Loxodes* Ehrenberg4. *Loxodes magnus* Stokes5. *Loxodes striatus* (Engelmann)

Order 2. TRICHOSTOMATIDA Bütschli

Family (c) COLPODIDAE Ehrenberg

Genus (3) *Colpoda* Müller6. *Colpoda aspera* Kahl

Family (d) PLAGIOPYLIDAE Schewiakoff

Genus (4) *Plagiopyla* Stein7. *Plagiopyla nasuta* Stein

Order 3. HYMENOSTOMATIDA Délage and Hérourid

Suborder (i) TETRAHYMENINA Faure-Fremiet

Family (e) TETRAHYMENIDAE Corliss

Genus (5) *Glaucoma* Ehrenberg8. *Glaucoma pyriformis* (Ehrenberg)

Suborder (ii) PLEURONEMATINA Faure-Fremiet

Family (j) PLEURONEMATIDAE Faure-Fremiet

Genus (6) *Pleuronema* Dujardin9. *Pleuronema crassum* Dujardin

Order 4. PERITRICHIDA Stein

Suborder (i) *SESSILINA* Kahl

Family (g) VAGINICOLIDAE de Fromentel

Genus (7) *Platycola* Kent10. *Platycola decumbens* (Ehrenberg)Genus (8) *Pyxicola* Kent11. *Pyxicola affinis* KentGenus (9) *Vaginicola* Lamarck12. *Vaginicola crystallina* EhrenbergSubclass (B) *SPIROTRICHA* Bütschli

Order 5. HETEROTRICHIDA Stein

Suborder (i) *HETEROTRICHINA* Stein

Family (h) BURSARIIDAE Perty

Genus (10) *Neobursaridium* Balech13. *Neobursaridium gigas* Balech

Family (i) GYROCORYTHIDAE Stein

Genus (11) *Caenomorpha* Perty14. *Caenomorpha medusula* PertyGenus (12) *Metopus* Claparède & Lachmann15. *Metopus es es* Müller15. (a) *Metopus es* Müller var. *minor*16. *Metopus nasutus* Da Cunha17. *Metopus spiralis* Smith

Family (j) SPIROSTOMATIDAE Stein

Genus (13) *Blepharisma* Perty18. *Blepharisma intermedium* Bhandary

Order 6. OLIGOTRICHIDA Bütschli

Family (k) HALTERIIDAE Claparède & Lachmann

Genus (14) *Halteria* Dujardin19. *Halteria grandinella* (Müller)

III—KEY TO SPECIES OF CALCUTTA CILIATES DEALT WITH

- 1 (6). Body housed in a lorica, animal sedentary.
- 2 (3). Animal with an operculum (to close the lorica) and a stalk. *Pyxicola affinis*
- 3 (2). Animal without an operculum and without a stalk.
- 4 (5). Lorica straight, attached by posterior end. *Vaginicola crystallina*
- 5 (4). Lorica decumbent, fixed entirely on one side *Platycola decumbens*
- 6 (1). Body not housed in a lorica, animal free-living.
- 7 (8). Body ciliation restricted to anterior end, body with bristles *Halteria grandinella*
- 8 (7). Body ciliation all over the body, body without bristles.
- 9 (24). Body ciliation uniform, no adoral zone of spirally arranged cilia.
- 10 (15). Cytostome apical, followed by a pharyngeal tube.
- 11 (12). Pharyngeal tube simple, without trichites. *Prorodon edertatus*
- 12 (11). Pharyngeal tube with trichites.
- 13 (14). Posterior end of body narrow *Prorodon discolor*
- 14 (13). Posterior end of body rounded *Prorodon teres*
- 15 (10). Cytostome not apical but on one side at anterior part.

- 16 (17). With denticles above the peristomial region. *Colpoda aspera*
- 17 (16). Without denticles.
- 18 (19). Peristome at right angles to body and without tetrahymenous structures *Plagiopyla nasuta*
- 19 (18). Peristome obliquely placed and with tetrahymenous structures *Glaucoma pyriformis*
- 20 (21). Peristome with a large undulating membrane; body oval *Pleuronema crassum*
- 21 (20). Peristome without any undulating membrane; body leaf-like; peristome sickle-shaped
- 22 (23). with two macronuclei : *Loxodes striatus*
- 23 (22). with more than two macronuclei *Loxodes magnus*
- 24 (9). Body ciliation not uniform; generally buccal ciliation well developed; with adoral zone of membranellae.
- 25 (26). Animal pink coloured *Blepharisma intermedium*
- 26 (25). Animal colourless.
- 27 (28). Body purse-shaped; with two contractile vacuoles having radiating canals *Neobursaridium gigas*
- 28 (27). Body not purse-shaped; with a single contractile vacuole.
- 29 (30). With a caudal projection to the body *Caenomorpha medusula*]
- 30 (29). Without caudal projection.
- 31 (32). With a proboscis-like process at anterior end *Metopus nasutus*
- 32 (31). Without a proboscis-like process at anterior end.
- 33 (34). Body sigmoidal in shape; the macronucleus nearly sausage-shaped and lying below peristome *Metopus es*
- 34 (33). Body more oval; macronucleus spherical and placed above peristome *Metopus spiralis*

IV—SYSTEMATIC ACCOUNT

1. *Prorodon edentatus* Claparède & Lachmann

(Text-fig. 2A)

1858. *Prorodon edentatus* Claparède & Lachmann, *Mém. Inst. Genevois*, Geneve, 6, pp. 320-321, pl. XVIII, fig. 4.
1930. *Prorodon edentatus* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 18, p. 73.
1936. *Prorodon edentatus* : Bhatia, *Faun. Brit. India*, London (Taylor & Francis, Ltd.), Protozoa : Ciliophora, p. 82.

Material.—2 examples : Wellington Square fountain tank, Calcutta, 24. v. 1959.

Diagnosis.—Body ovoid, with green algal fragments in endoplasm ; mouth terminal and eccentric, followed by a long tube-like pharynx extending upto middle of the body diagonally ; macronucleus single and oval, slightly elongate. ; with a single contractile vacuole at the posterior end ; body ciliation uniform ; average size $43 \times 30 \mu$.

Distribution.—*Calcutta* : As above (first-record from India). *Elsewhere* : Lahore, W Pakistan.

Remarks.—Our specimens are very small. Kahl (1930) recorded a length of $100-150 \mu$ and Bhatia (1936) gave the size as $74 \times 24 \mu$. The species is not common, and is observed in water with plenty of *Oscillatoria*.

2. *Prorodon discolor* (Ehrenberg)

(Text-fig. 2B)

1835. *Holophrya discolor* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin [1833], p. 251.
1930. *Prorodon (Holophrya) discolor* Ehrenberg : Kahl, *Urtiere oder Protozoa*, (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 18, p. 76, fig. 8 (4).

Material.—One example : Wellington Square fountain tank, Calcutta, 20. vi. 1959.

Diagnosis.—Body oval, narrower posteriorly; whitish in colour when not full with food vacuoles ; covered with fine cilia arranged in longitudinal rows, ciliary lines converging at the aboral end ; mouth termino-central, followed by an oral basket with trichites which extends for about one-fourth the distance from the anterior end ; macronucleus single, rounded ; contractile vacuole situated at the posterior end ; average size $155 \times 92 \mu$.

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Germany.

Remarks.—Our specimen is longer than those reported by Kahl (1930, length 100-130 μ). It resembles *P. platydon* Blochmann in having the oral basket placed at an angle to the long axis of the body but differs in body-size (length of *P. platydon* ranges between 200-300 μ).

3. *Prorodon teres* Ehrenberg

(Text-fig. 2c)

1838. *Prorodon teres* Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, p. 316, pl. XXXII, fig. 11.
 1930. *Prorodon teres* : Kahl, *Urtiere oder Protozoa*, (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 18, p. 80, fig. 8 (10-13).
 1936. *Prorodon teres* : Bhatia, *Faun. Brit. India*, London (Taylor & Francis, Ltd.), Protozoa : Ciliophora, p. 84, fig. 86.

Material.—2 examples : Wellington Square fountain tank, Calcutta, 5. iv. 1959.

Diagnosis.—Body ovoid ; anterior end rather truncated, posterior end more rounded ; body ciliation uniform, with very fine cilia ; mouth slit-like, opening into an oral basket supported by trichites and extending about one-fourth the length from the anterior end ; contractile vacuole terminal ; macronucleus spherical ; size 115 \times 86 μ .

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Lahore, W. Pakistan.

Remarks.—The specimens resemble *P. discolor* in fixed preparations but can be distinguished from the latter in having a more rounded posterior end and a waist-like depression in the middle portion as observed in locomotion. They are of medium size. Kahl (1930) recorded a length of 130-200 μ and Bhatia (1936) gave the size 63-84 \times 45 μ .

4. *Loxodes magnus* Stokes

(Text-fig. 2E)

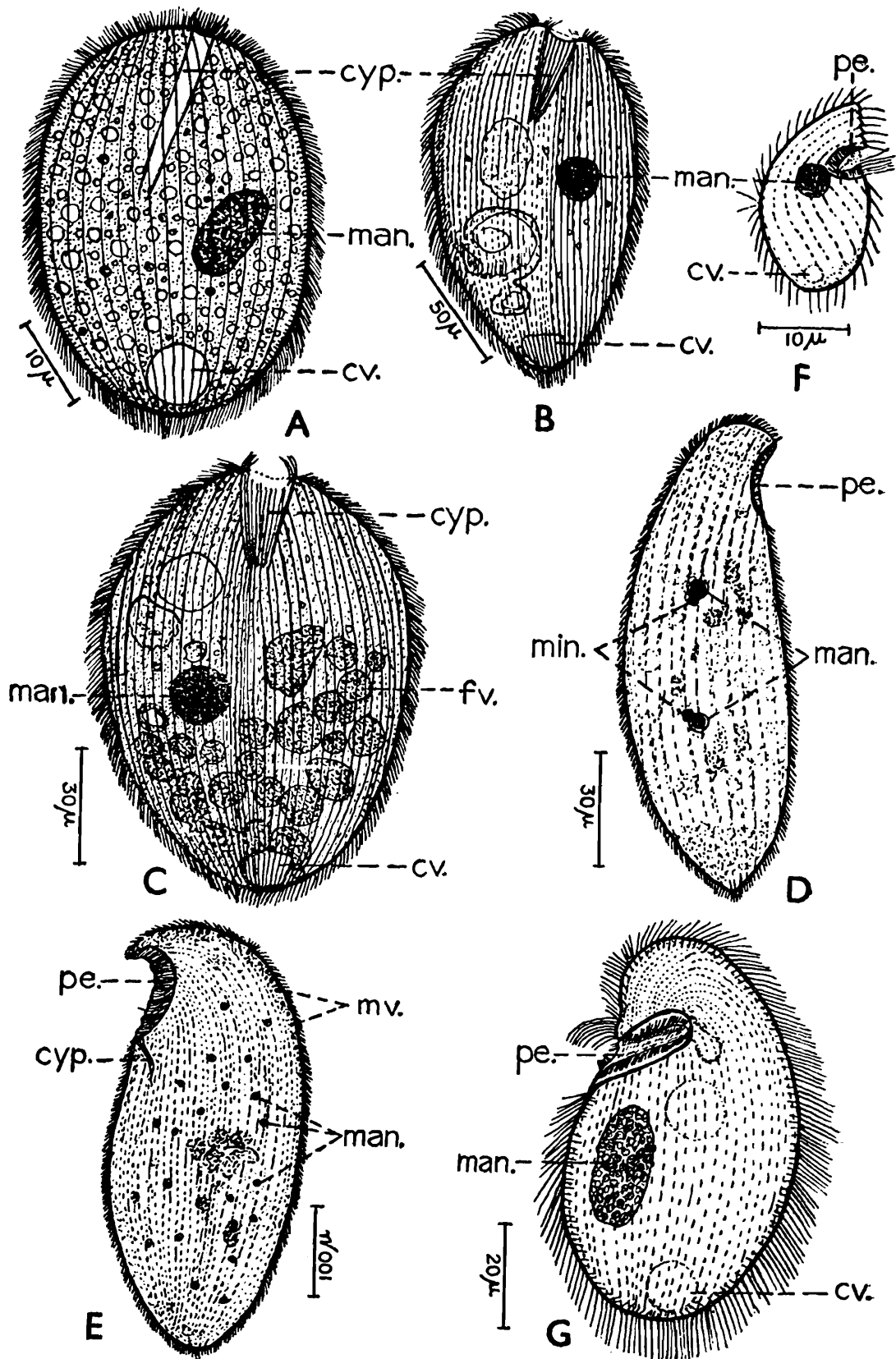
1887. *Loxodes magnus* Stokes, *Ann. Mag. nat. Hist.*, London, 20, pp. 104-114, pl. I.
 1931. *Loxodes magnus* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, p. 215, fig. 35(1).

Material.—3 examples : A Tank in Jadavpur, Calcutta, 30. xi. 1961.

Diagnosis.—Large leaf-like form with a bent beak-like anterior end ; slightly brownish in colour ; covered with very fine small cilia arranged in longitudinal rows ; a few refractile bodies (Müller's vesicles) in a row present at the dorsal margin ; mouth sickle-shaped with a conical tube-like pharynx ; with many macronuclei scattered in the endoplasm ; no contractile vacuole and micronuclei observed, size 368 \times 231 μ .

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : North America.

Remarks.—The length as given by Stokes (1887) is 700μ in extended condition but our specimens average only 368μ . The row of bristle-like cilia shown on the ventral margin by Stokes in his drawings is absent in our specimens.



TEXT-FIG. 2.—Freshwater Ciliates of Calcutta and its environs.

(A) *Prorodon edentatus* Claparède & Lachmann. (B) *Prorodon discolor* (Ehrenberg). (C) *Prorodon teres* Ehrenberg. (D) *Loxodes striatus* (Engelmann). (E) *Loxodes m. agnus* Stokes. (F) *Colpoda aspera* Kahl. (G) *Plagiopyla nasuta* Stein. For lettering of text-figures please see p. 22.

5. *Loxodes striatus* (Engelmann)

(Text-fig. 2D)

1862. *Drepanostoma striatum* Engelmann, *Z. wiss. Zool.*, Leipzig, 11, pp. 382-383, pl. 21, fig. 7.

1917. *Loxodes striatus* (Engelmann) : Penard, *Rev. suisse Zool.*, Genève, 25, pp. 471-476, figs. 5-12.

Material.—(i) 6 examples : A Tank in Jadavpur, Calcutta, 24. xi. 1959; (ii) 2 examples : A Tank in Shahid Colony, Calcutta, 29. xi. 1962.

Diagnosis.—Body flattened and leaf-like, with a beak-like anterior end ; body ciliation uniform, cilia fine and small, cytostome cleft along the curved anterior part and followed by a tube-like pharyngeal tube, with two vesicular macronuclei ; the two micronuclei situated at the posterior pole of the anterior and the anterior pole of the posterior macronucleus ; size $125 \times 43 \mu$.

Distribution.—*Calcutta* : As above. *Elsewhere* : India : Srinagar (Kashmir).

Remarks.—The specimens resemble *Loxodes vorax* Stokes, 1887 in size but differ in having a pointed posterior end and in the disposition of micronuclei. Commonly observed with plenty of ingested algal fragments and diatoms. No Müllers corpuscles and tactile bristles observed. Specimens are small, nearly half of those recorded length by Kahl (length 200μ).

6. *Colpoda aspera* Kahl

(Text-fig. 2F)

1926. *Colpoda aspera* Kahl, *Arch. Protistenk.*, Jena, 55, pp. 322-323, fig. X ($a=c$).

1940. *Colpoda aspera* : Burt, *Trans. Amer. micr. Soc.*, Lancaster, 59 (4) pp. 422-425, figs. 2E ; 3E-G ; 4A-D.

Material.—4 examples : A Tank in Shahid Colony, Calcutta, 18. xii. 1962.

Diagnosis.—Body somewhat bean-shaped, anteriorly more narrowed ; with 5-7 frontal dentations above the cytostome ; cytostome situated at the bottom of a depression located about one-third the length from anterior end ; body ciliation uniform ; contractile vacuole single and posterior ; macronucleus spherical and centrally placed ; size $24 \times 12 \mu$.

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Germany.

Remarks.—The specimens were observed in water samples mixed with hay infusion, kept in the laboratory. These resemble *Colpoda stenii* Maupas in size but differ in not having a long caudal cilia and a

beard. The specimens are of average size. Mackinnon and Hawes (1961) gave the length as 12-42 μ .

7. *Plagiopyla nasuta* Stein

(Text-fig. 2G)

1860. *Plagiopyla nasuta* Stein, *S. B. bohn. Ges Wiss.*, Prague, p. 58.
 1931. *Plagiopyla nasuta* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*, Jena, pt. 21, pp. 264-265, fig. 45 (1)).
 1960. *Plagiopyla nasuta* : Kudo, *Protozoology*, London (Charles C. Thomas), pp. 740-741, fig. 315a.

Material.—6 examples : Minto Square Tank, Calcutta, 5. ii. 1963.

Diagnosis.—Body broadly reniform or ovoid, narrower anteriorly ; with a prominent peristome in the anterior region and a broad ventrally open groove ; cytostome situated near median line at end of the peristome ; cytopharynx long ; body ciliation uniform, cilia in peristome short except in the anterior region where a tuft of longer cilia is present ; contractile vacuole single and terminal, macronucleus rounded ; size 72 \times 45 μ .

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Cosmopolitan.

Remarks.—Rare ; encountered in the bottom debris of pond-water kept in bottles. The striped band described by Kahl (1931) was not observed in these specimens. In certain specimens a secondary contractile vacuole was also observed, lying anterior to the terminal one. Our specimens are smaller than those of Kahl (1931, length 80-180 μ) and Kudo (1960, length 100 μ).

8. *Glaucoma pyriformis* (Ehrenberg)

(Text-fig. 3A)

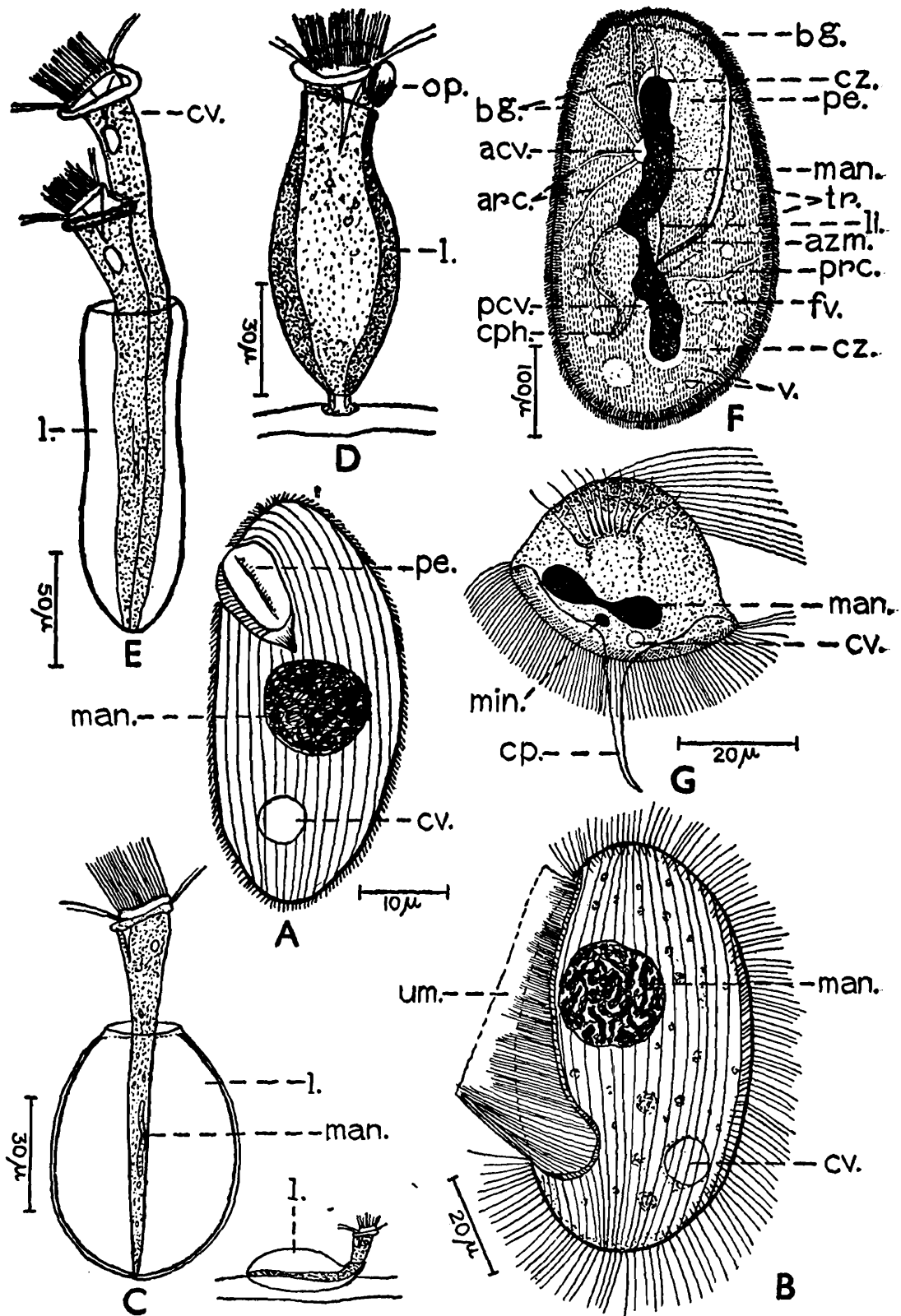
1838. *Leucophys pyriformis* Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, pp. 312-313, pl. XXXII, fig. 4.
 1889. *Glaucoma pyriformis* (Ehrenberg) : Schewiakoff, *Bibl. zool.*, Leipzig, 5, pp. 35-36, pl. IV, figs. 54-55.
 1931. *Glaucoma pyriformis* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*) Jena, pt. 21, pp. 330, fig. 58(13).

Material.—4 examples : A Tank near St. Paul's Cathedral, Calcutta, 11.ix.1963.

Diagnosis.—Body pyriform ; size small to medium, cytostome about one-fourth of the body-length ; situated in anterior third of the body, and placed a little obliquely, with an inconspicuous undulating membrane on right side of peristome and seven postoral ciliary meridians ; body ciliation uniform ; macronucleus rounded and central ; micronucleus small ; contractile vacuole single and lying in posterior one-fourth of the body, slightly towards one side ; size 52 \times 22 μ .

Distribution.—*Calcutta* : As above (first record), *Elsewhere* : India : Srinagar (Kashmir).

Remarks.—Our specimens are medium-sized when compared to those of Kahl (1931, length 38-80 μ).



TEXT-FIG. 3.—Freshwater Ciliates of Calcutta and its environs (*lettering as in Text-fig. 2*).

(A) *Glaucoma pyriformis* (Ehrenberg). (B) *Pleuronema crassum* Dujardin. (C) *Platycola decumbens* (Ehrenberg). (D) *Pyxicola affinis* Kent. (E) *Vaginicola crystallina* Ehrenberg. (F) *Neobrusaridium gigas* Balech. (G) *Caenomorpha medusula* Perty. For lettering of text-figures please see p. 22.

9. *Pleuronema crassum* Dujardin

(Text-fig. 3B)

1841. *Pleuronema crassa* Dujardin, *Histoire nat. des Zoophytes Infusoires*, Paris, pp. 474-475, pl. vi, fig. 1 ; pl. XIV, fig. 2.
 1931. *Pleuronema crassum* : Kahl, *Urtiere oder Protozoa*, (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, pp. 387-388, fig. 65 (23).

Material.—4 examples : Wellington Square fountain Tank, Calcutta, 9. vi. 1960.

Diagnosis.—Body irregularly egg-shaped ; size small to medium ; peristome long and prominent ; with a prominent undulating membrane on the left border of peristome ; body with long cilia, those at the posterior portion longer than the rest ; with a single contractile vacuole in the posterior half of the body ; macronucleus spherical and lying in anterior half of body ; a micronucleus present close to macronucleus ; size $79 \times 49 \mu$.

Distribution.—*Calcutta* : As above. *Elsewhere* : Germany.

Remarks.—Very rare ; found in stagnant water with a little decaying vegetation. The size of our specimens agree with those of Kahl (1931, length 70-120 μ). In one specimen three deeply stained micronuclei-like structures were seen around the macronucleus.

10. *Platycola decumbens* (Ehrenberg)

(Text-fig. 3C)

1830. *Vaginicola decumbens* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 41.
 1881. *Platycola decumbens* (Ehrenberg) : Kent, *A Manual of the Infusoria*, London (David Bogue), p. 731, pl. XL, figs. 33 and 34.
 1935. *Platycola decumbens* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 30, p. 791, fig. 146 (29).

Material.—One example : Manohar Das Thadak (Tank), Calcutta, 16.X.1963.

Diagnosis.—Animalcule *Vorticella*-like ; when fully extended, it projects perpendicular to the attached lorica ; the latter broadly oval, colourless to yellow, decumbent and attached to the substratum entirely on one side. A small collar-like projection ('neck') present at the anterior end of lorica ; size of lorica $105 \times 82 \mu$.

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : England.

Remarks.—Very rare ; found attached to the submerged twigs ; lorica with two animalcules are also reported but are rare. The lorica of our specimen is smaller than those of Kahl (1935, length 90 μ). Simmons (1891) had reported a species of *Platycola* from Calcutta, but it was not identified correctly.

11. *Pyxicola affinis* Kent

(Text-fig. 3D)

1881. *Pyxicola affinis* Kent, *A Manual of the Infusoria*, London (David Bogue), p. 727, pl. XL, figs. 28 and 29.
1935. *Pyxicola affinis* : Kahl, *Urtiere oder Protozoa*, (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 30, p. 787, figs. 146 (1 & 2).

Material.—Several examples : The Indian Museum Tank, Calcutta, 8. x. 1963.

Diagnosis.—Lorica urceolate, slightly curved at anterior end and a little narrowed beneath the aperture end ; lorica colourless to deep brown according to the age ; attached to the substratum by a circular disc formed at the end of short, stumpy stalk which is colourless. Animalcule *Vorticella*-like, single in a lorica ; when fully extended showing a colourless to light brown operculum on the anterolateral surface of a conical protuberance that projects from beneath the peristome border ; size of lorica $76 \times 26\mu$, length of stalk 6-7 μ .

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Cosmopolitan.

Remarks.—The stalk of lorica is small and similar to that of *P. carteri* (Kent), 1880-82 but the even nature of the lorica margin distinguishes it from that species. The stalk of our specimens are smaller than those drawn by earlier authors.

12. *Vaginicola crystallina* Ehrenberg

(Text-fig. 3E)

1830. *Vaginicola crystallina* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 41.
1862. *Vaginicola crystallina* : Mitchell, *Quart. J. Sci.*, (N. S.), London, 2, p. 60.
1874. *Vaginicola crystallina* : Fromentel, *Etudes sur les Microzoaires ou Infusoires Proprement dits*, Paris, p. 248.
1935. *Vaginicola crystallina* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 30, p. 762, fig. 142 (15).

Material.—One example : The Indian Museum Tank, Calcutta, 8.x. 1963.

Diagnosis.—Animalcule elongated and housed in a lorica ; lorica attached to substratum with its posterior end transparent, colourless, vase-like ; lorica with two individuals very common, one of them being invariably shorter ; size of lorica $117 \times 39\mu$.

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Cosmopolitan in freshwater bodies.

Remarks.—Our specimens resemble those drawn by Fromentel (1874). The size is similar to that recorded by Kahl (1935, length 120μ). The animalcules are colourless, no green granules having been observed. Mitchell (1862) reported a species of *Vaginicola* from Bangalore, but he did not determine the species.

13. *Neobursaridium gigas* Balech

(Text-fig. 3F)

1941. *Neobursaridium gigas* Balech, *Physis*, Buenos Aires, 49, pp. 29-35.
 1962. *Neobursaridium gigas* : Nilsson, *J. Protozool.*, New York, 9(3), pp. 273-276, figs. 1-5.

Material.—5 examples : Ponds in Jadavpur, Calcutta, 4. i. 1963.

Diagnosis.—Body large, broadly ovate and purse-shaped ; anterior end truncated, the anterior left side slightly lower and more arched than the right ; ventral surface flattened, dorsal surface convex ; body ciliation uniform and dense with short cilia ; a uniform row of trichocysts present below the ectoplasm ; a layer of oval and spherical brown granules present below the trichocyst layer ; peristome wide and conspicuous, starting from anterior end, then taking a turn to right, there after to the dorsal left, then entering a bulbous portion inside endoplasm and finally ending in a conical "cytopharynx". The conical tube usually pointing straight towards the posterior end but in some cases turning towards one side. Adoral zone of membranelles short and situated on the left side of peristome ; the right side of peristome drawn as a flap ; macronucleus long, dumbbell-shaped, placed in the middle of body parallel to longitudinal axis of body ; anterior half of macronucleus slightly longer than the posterior half ; clear and colourless zone observed around both ends of macronucleus ; micronuclei not observed ; with two contractile vacuoles, each with 6-9 long radiating canals ; the anterior contractile vacuole situated in the anterior one-third of body, the posterior vacuole in the posterior one-third, each vacuole provided with two excretory pores ; body provided with many vacuoles of varied sizes ; bodysize $514 \times 264 \mu$, length of macronucleus 353μ .

Distribution.—*Calcutta* : As above (first record from India and Asia).
Elsewhere : Argentina (S. America) ; and central Africa.

Remarks.—A rare species found only in ponds with plenty of water hyacinth and decaying vegetation. Superficially resembles *Bursaria truncatella* Müller, in size and in having a truncated anterior end. Seen creeping on the sides of bottles containing the culture medium, rarely seen swimming.

14. *Caenomorpha medusula* Perty

(Text-fig. 3G)

1852. *Caenomorpha medusula* Perty, *Zur Kenntnis kleinster Lebenstormen*, Bern, p. 140.
 1932. *Caenomorpha medusula* : Kahl, *Urtiere oder Protozoa* (in : *Dahl's Tierwelt Dtsch.*), Jena, pt. 25, p. 430, fig. 71 (30).

Material.—4 examples : A Tank in Shahid Colony, Calcutta, 5.i.1962.

Diagnosis.—Small, bell-shaped animalcules with a long caudal projection at posterior region. Peristome situated at base of the bell-shaped body ; with long and dense cilia on the posterior margin of the bell-shaped part ; the long cilia in the anterior region in a bunch ; contractile

vacuole single ; macronucleus dumbbell-shaped ; a micronucleus lying just below the connecting strand of the ends of macronucleus ; the animal moving by rotating on its long axis ; size $60 \times 19 \mu$.

Distribution.—*Calcutta* : As above (first record from India). *Elsewhere* : Germany.

Remarks.—These specimens are very similar to *C. medusula* var. *lata* Kahl in shape and disposition of nuclei, but are smaller than Kahl's forms (1932, $150 \times 130 \mu$).

15. *Metopus es* Müller

(Text-fig. 4A)

1786. *Metopus es* Müller, *Animalium Infusoria fluviat. et Marina etc.*, Havniae et Lipsiae, p. 126.

1932. *Metopus es* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, pp. 416-417, figs. 70 (1-2).

Material.—One example : A Tank in Shahid Colony, Calcutta, 17.ii.1962.

Diagnosis.—Body characteristically sigmoidal in shape ; peristome prominent at the anterior half of the body, runs diagonally from left to right on the ventral side ; contractile vacuole prominent and terminal ; body covered by long cilia arranged in longitudinal row, few longer cilia at posterior end ; macronucleus single, sausage shaped and usually just below the peristome ; micronucleus single and close to the macronucleus ; size $92 \times 26 \mu$.

Distribution.—*Calcutta* : As above. *Elsewhere* : In India marine form recorded from Waltair Coast by Ganapati & Rao (1958).

Remarks.—Very rare forms, usually found moving among the decaying vegetation and very sensitive to disturbance.

15a. *Metopus es* Müller n. var. *minor*

(Text-fig. 4B and Table 1)

Material.—3 examples : The Indian Museum Tank, Calcutta, 29 viii.1961.

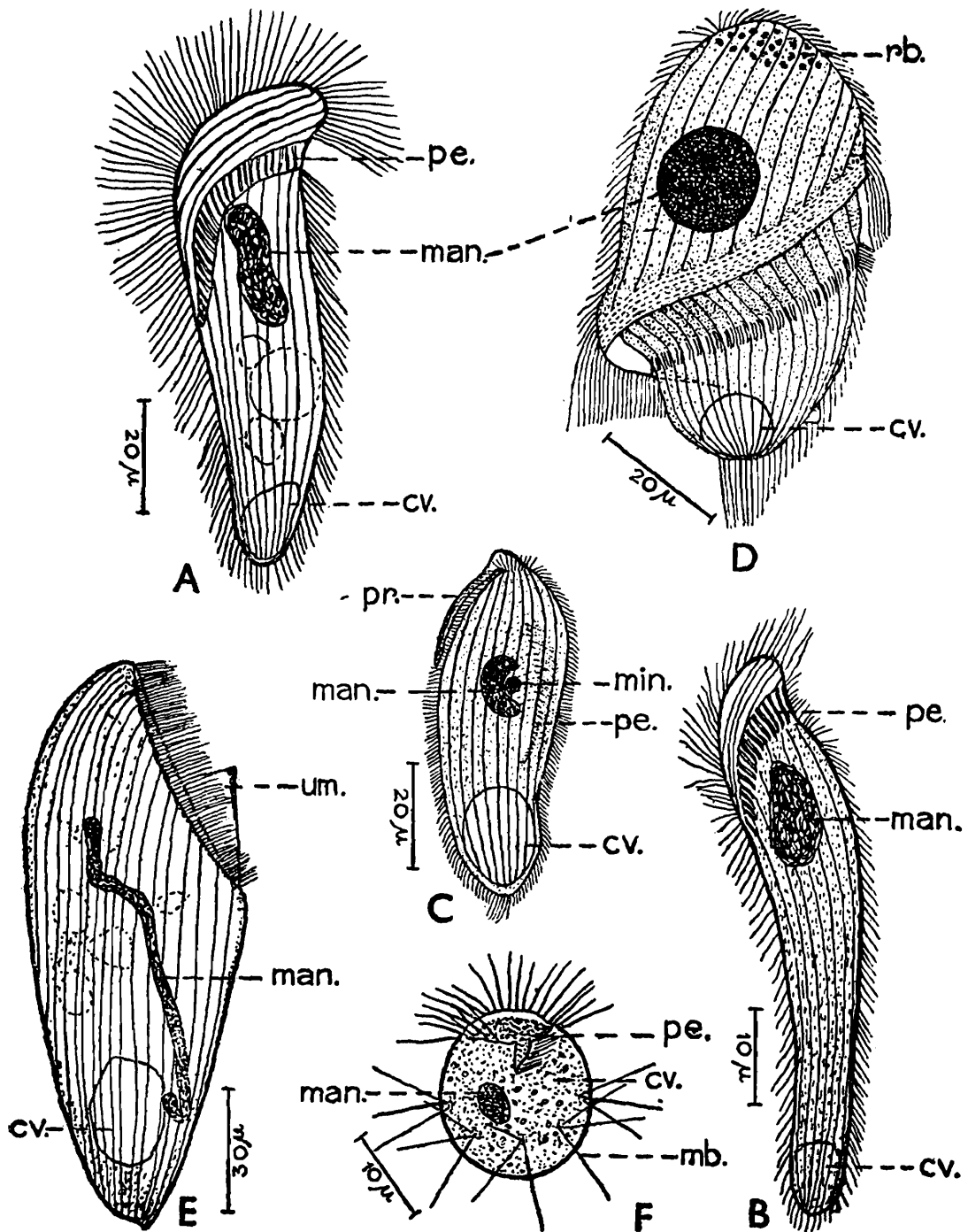
Diagnosis.—Body-shape sigmoidal, four times as long as broad ; narrowing gradually to the posterior end ; body ciliation uniform except at anterior end where a few longer cilia are present ; peristome lying at anterior one-third of body and running diagonally from the left margin to right on ventral side ; macronucleus oval and lying below the peristome ; micronucleus lying close to the macronucleus ; a prominent contractile vacuole present at posterior end ; body size $59 \times 13 \mu$.

Distribution.—*Calcutta* : As above.

Remarks.—This ciliate resembles the nominate form, *Metopus es* Müller, and the two varieties *M. es* var. *rectus* Kahl, (1932) and *M. es* var. *pinguis* Kahl, (1927) in having sigmoidal body-shape, the gradual

narrowing of the body towards the posterior end, and a similar peristomial structure. But it differs from these in the absence of granular bodies in its anterior end, as has also been stated in Table 1.

Type-specimens.—The type slides are deposited in the National Zoological Collections at the Zoological Survey of India, Calcutta, as follows :—*Holotype* : One slide, Z. S. I., Reg. No. Pt. 547 (one example). *Paratypes* : Two slides, Z. S. I., Reg. Nos. Pt. 548 and Pt. 549 (one example on each slide).



TEXT-FIG. 4.—Freshwater Ciliates of Calcutta and its environs (lettering as in Text-fig. 2).

(A). *Metopus es es* Müller. (B). *Metopus es* var. *minor*. (C). *Metopus nasutus* Da Cunha. (D). *Metopus spiralis* Smith. (E). *Blepharisma intermedium* Bhandary. (F). *Halteria grandinella* (Müller). For lettering of text-figures, please see p. 22.

TABLE 1.—*Differentiating characters of Metopus es Müller, and its varieties including minor var. nov.*

Characters	<i>M. es</i> <i>es</i> Müller	<i>M. es.</i> var. <i>rectus</i> Kahl	<i>M. es.</i> var. <i>pinguis</i> Kahl	<i>M. es.</i> , n. var., <i>minor</i>
Body-length	92-160 μ	120 μ	150 μ	59 μ
Granular bodies in anterior end	Present	Present	Present	Absent

16. *Metopus nasutus* Da Cunha

(Text-fig. 4c)

1915. *Metopus nasutus* Da Cunha, *Brazil Med.*, Rio de Janeiro, p. 129.1932. *Metopus nasutus*; Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pp. 407-408, fig. 69(9).*Material.*—One example : A tank in Shahid Colony, Calcutta, 6.ii.1962.*Diagnosis.*—Body somewhat fusiform ; body ciliation uniform with long cilia except at the posterior end where 4-5 longer cilia are found ; peristome running only slightly diagonally, more so towards the posterior end, beyond the middle ; a strong undulating membrane on the right side of peristome present ; a prominent antenna-like extension at the anterior end, hanging on one side ; macronucleus single and crescent-shaped ; micronucleus single and placed in notch of macronucleus ; contractile vacuole at the posterior end ; size $68 \times 22 \mu$.*Distribution.*—*Calcutta* : As above (first record from India). *Elsewhere* : Brazil (S. America).*Remarks.*—Very rare. Our example is much smaller than those of Kahl (1932, length 100-130 μ).17. *Metopus spiralis* Smith

(Text-fig. 4D)

1897. *Metopus spiralis* Smith, *Trans. Amer. micr. Soc.*, Lancaster, 19, p. 62, pl. 1, fig. 13.1932. *Metopus spiralis* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pp. 423-424.1960. *Metopus spiralis* : Nair, *Curr. Sci.*, Bangalore, 29 (11), pp. 435-436, fig. 1.*Material.*—(i) 3 examples : A Tank in Sibpur (Howrah Dist., W. Bengal), 7.viii.1959. (ii) 2 examples : A Tank in Shahid Colony, Calcutta, 11.i.1963.

Diagnosis.—The characteristic feature of this species is the location of the spherical macronucleus in the anterior half of the body above the peristome, unlike the species described earlier in this paper. The specimens from Sibpur measure $48-59 \times 25-36 \mu$ and from Shahid Colony, $80 \times 40 \mu$.

Distribution.—Vicinity of *Calcutta* : Nair (1960) ; and also as above. *Elsewhere* : Louisiana (U.S.A.).

Remarks.—The size of specimens varied to a great extent according to the availability of food-material. The length reported by Kahl (1932) is $80-150 \mu$.

18. *Blepharisma intermedium* Bhandary

(Text-fig. 4E)

1962. *Blepharisma intermedium* Bhandary, *J. Protozool.*, New York, 9 (4), p. 437, figs. 1, la & 7.

Material.—3 examples : A Tank in Jadavpur, Calcutta, 19.ii.1963.

Diagnosis.—Body flattened, ellipsoidal, both ends narrowed and compressed ; pink coloured ; body ciliation uniform, ciliary meridians slightly spiral ; peristome extending from anterior end to one-third of the body-length, slightly curved to the interior in the middle ; undulating membrane in front of the cytostome ; contractile vacuole at the posterior portion ; macronucleus long and cylindrical with the ends slightly swollen ; micronuclei not observed ; size $210-234 \times 92 \mu$.

Distribution.—*Calcutta* : As above. (first record from W Bengal). *Elsewhere* : India : Bangalore.

Remarks.—Our specimens are medium-sized. Bhandary (1962) gave the length as $200-350 \mu$. The pigmentation is light pink only.

19. *Halteria grandinella* (Müller)

(Text-fig. 4F)

1786. *Trichoda grandinella* Müller, *Animat. Infusoria fluviat. et Marina*, Havniae et Lipsiae, p. 160, pl. XXIII, figs. 1-3.

1841. *Halteria grandinella* (Müller) : Dujardin, *Histoire nat. des Zoophytes Infusoires*, Paris, pp. 415-416.

1951. *Halteria grandinella* : Khajuria, *Rec. Indian Mus.*, Delhi, 48 (2), pp. 58-59.

1962. *Halteria grandinella* : Dingfelder, *Arch. Protistenk.*, Jena, 105 (4), pp. 604-605.

Material.—2 examples : A Tank in Jadavpur, Calcutta, 4.xii.1959.

Diagnosis.—Body globular, anterior border with conspicuous frontal and adoral membranellae ; a small membrane present on right edge of peristome ; an equatorial zone of bristle-bearing grooves, each groove with three long bristles (seen in living condition only) ; contractile vacuole in anterior half of body ; macronucleus oval ; animal moves by jerky movements, length 18μ .

Distribution.—*Calcutta* : As above (first record from W. Bengal).
Elsewhere : India : Varanasi (Uttar Pradesh).

Remarks.—Our specimens are smaller than those of Dingfelder (1962, length 25-43 μ).

V—SUMMARY

Nineteen species and one variety of freshwater ciliates collected from the ponds of Calcutta and its vicinity (Districts of Calcutta and Howrah, West Bengal) are dealt with in the present paper. Of these, 13 species are new records from India (some of these were recorded earlier from Lahore, now in West Pakistan), 4 are new records from West Bengal and one variety, *Metopus* *es n.* var. *minor* (Fam. Gyrocorythidae, Ord. Heterotrichida) is new to science.

A Classified list of the species, as per the classification of Corliss (1961), and a key to their identification are provided.

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LETTERING OF TEXT-FIGS: 2-4

Lettering for Text-figs. 2-4: *acv.*, anterior contractile vacuole; *arc.*, anterior radiating canals; *azm.*, adoral zone of membranellae; *bg.*, brown granules; *cp.*, caudal projection; *cv.*, contractile vacuole; *cyp.*, cytopharynx; *cz.*, clear zone; *fv.*, food vacuole; *l.*, lorica; *li.*, lip; *man.*, macronucleus; *mb.*, body bristles; *min.*, micronucleus; *mv.*, Müller's vesicles; *op.*, operculum; *pcv.*, posterior contractile vacuole; *pe.*, peristome; *pr.*, proboscis; *prc.*, posterior radiating canal; *rt.*, refractile bodies; *tr.*, trichocysts; *um.*, undulating membrane; *v.*, vacuoles.