

# FAUNA OF RAJASTHAN, INDIA.

## PART 10. PROTOZOA (NO. 2)

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(With 1 Table and 6 Text-figures)

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### I—INTRODUCTION

#### (a) *General*

This is the second of a series of papers on the free-living protozoan fauna of Rajasthan\*, and is based on the collections made by the author during the period September-December 1963, from the districts of Ajmer Bikaner, Jaipur, Jodhpur, Pali, Udaipur and the vicinity of the Sambhar Salt Lake (Nagaur and Jaipur districts). Field cultures were prepared to obtain examples of the various species, except in the case of the testacean rhizopods, e.g., species of *Diffugia* Leclerc, *Arcella* Ehrenberg, and *Centropyxis* Stein. The material was subjected to appropriate *intra vitam* staining and was also observed under a phase contrast microscope. In some cases, owing to the scarcity of material, these procedures could be followed only for one or two individuals. For the study of the ciliates, silver-line observations were taken as far as possible. The number of examples mentioned under 'Material' under each species relates to the permanent preparations made but several individuals were also observed and studied in the field, and the final conclusions and identifications arrived at were based on both sets of observations.

\* For the first part see Mahajan, *Rec. Zool. Surv. India*, Delhi, 61, (3&4) [1963], 1969, pp. 377—401.

*Rec. Zool. Sugv. India*, 63 (1—4), 1971.

A total of 34 species belonging to 21 genera, 19 families, 9 orders and 3 classes (Mastigophora, Sarcodina and Ciliata) are included in this paper. Of these, the following three taxa (2 species and one variety), all belonging to the class Ciliata, are new to science :

(A) Subclass Holotricha : Order Gymnostomatida :

1. *Coleps devdaniensis* n. sp. (Fam. Colepidae).

2. *Holophrya bengalensis minor* n. subsp. (Fam. Enchelyidae).

(B) Subclass Spirotricha : Order Hypotrichida :

3. *Oxytricha oblongatus* n. sp. (Fam. Oxytrichidae).

The type-specimens of these new taxa have been deposited in the National Zoological Collections at the Zoological Survey of India, Calcutta.

All the 34 species are recorded for the first time from Rajasthan, and the following 25 of them are first records from India :—

### Class MASTIGOPHORA

Order EUGLENOIDINA : 1. *Euglena acus* (probable first record also from India). 2. *Euglena spirogyra minor*. 3. *Entosiphon sulcatum*.

### Class SARCODINA

Order AMOEBINA : 4. *Amoeba radiosa*. 5. *Amoeba vespertilio*.

Order TESTACEA : 6. *Arcella vulgaris* (probable first record also from India). 7. *Diffugia lobostoma*. 8. *Diffugia urceolata*. 9. *Diffugia pyriformis*. 10. *Centropyxis aculeata*.

### Class CILIATA

Order GYMNSTOMATIDA : 11. *Coleps hirtus minor*  
12. *Coleps inermis*. 13. *Coleps devdaniensis* n. sp. 14. *Holophrya bengalensis minor* n. subsp. 15. *Hemiophrys procera*.  
16. *Nassula ornata*.

Order TRICHOSTOMATIDA : 17. *Colpoda inflata*.

Order HYMENOSTOMATIDA : 18. *Frontonia atra*. 19. *Frontonia complanata*.

Order ODONTOSTOMATIDA : 20. *Saprodinium mimeticum*.

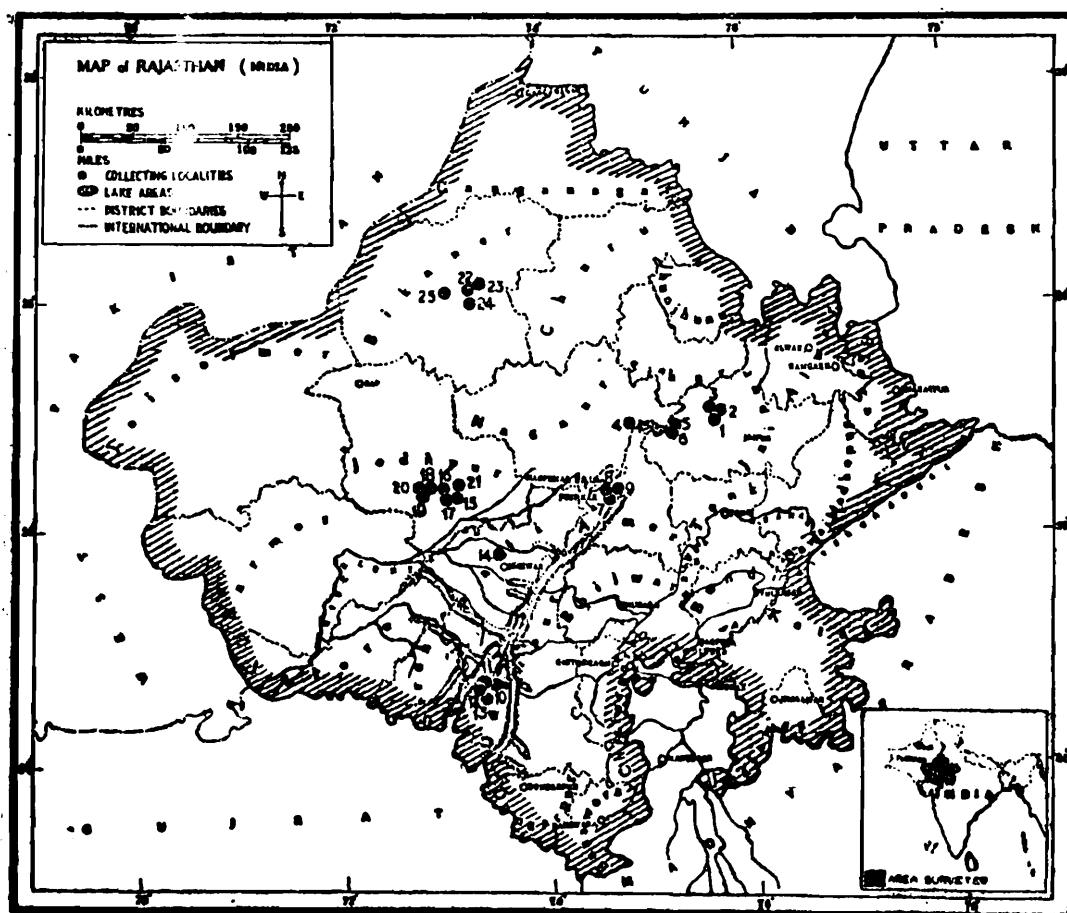
Order HYPOTRICHIDA : 21. *Euplotes plumipes*. 22. *Euplotes inkystans*. 23. *Oxytricha fallax*. 24. *Oxytricha hymenostomata*. 25. *Oxytricha ovalis*. 25. *Oxytricha oblongatus* n. sp.

### (b) Abbreviations used

Dist., District.; Ex., Exs., Example, Examples ; Hom., Homonym ;  
Syns. Svdynvm ; Z. S. I., Zoological Survey of India.

(c) *List of Collecting Stations*

The collecting stations, with their location, etc. are listed in Table 1.



TEXT-FIG. 1.—Map of Rajasthan, showing the collecting localities for freshwater Protozoa. (The number given refers to the serial number of localities in the list of collecting localities in the text).

TABLE 1.—*List of collecting stations for Rajasthan Protozoa dealt with in this paper.*

Collecting Station	Latitude & Longitude (Approximate)	
	Lat. (N)	Long. (E)
<i>(i) Jaipur District</i>		
1. Jaipur . . . . .	26°55'	75°52'
2. Galta (NE. of Jaipur) . . . . .	27°00'	75°52'
3. Mansagar (north of Jaipur) . . . . .	26°58'	75°52'
4. Devdyani (near Sambhar) . . . . .	26°55'	75°13'
5. Phulera (near Sambhar) . . . . .	26°52'	75°16'
6. Sambhar Lake . . . . .	26°54'	75°13'

Collecting Station.	Latitude & Longitude (Approximate)	
	Lat. (N)	Long. (E)
(ii) <i>Ajmer District</i>		
7. Anasagar Lake, Ajmer	26°25'	74°35'
8. Faisagar (ca. 8 Km. NW. of Ajmer)	26°32'	74°37'
9. Pushkar Lake (ca. 15 Km. NW. of Ajmer)	26°32'	74°35'
(iii) <i>Udaipur District</i>		
10. Fatehsagar Lake (near Udaipur)	24°35'	73°35'
11. Sarupsagar (near Udaipur)	24°35'	73°35'
12. & 13. Pichola Lake (near Udaipur)	24°34'	73°40'
(iv) <i>Pali District</i>		
14. Sardar Samand (ca. 55 Km. SE. of Jodhpur)	25°54'	73°25'
(v) <i>Jodhpur District</i>		
15. Jodhpur	26°18'	73°04'
16. Bari Tank (near Jodhpur)	26°60'	72°55'
17. Bijolai (ca. 4 Km., West of Jodhpur)	26°15'	72°50'
18. Lambia & Megulai Nadi (ca. 23 Km., West of Jodhpur)	26°20'	73°00'
19. Khandesar Talab (ca. 35 Km. West of Jodhpur)	26°20'	72°40'
20. Khandia (ca. 35 Km. N. West of Jodhpur)	26°20'	72°40'
21. Nagkund (ca. 10 Km. NE. of Jodhpur)	26°19'	73°02'
(vi) <i>Bikaner District</i>		
22. Bikaner	28°01'	73°22'
23. Devikund (near Bikaner)	27°56'	73°18'
24. Shivbari (ca. 6 Km. SE. of Bikaner)	28°00'	73°23'
25. Gajner (ca. 35 Km. SW. of Bikaner)	27°55'	73°04'

#### (d) Acknowledgements

My thanks are due to the following for the assistance rendered :— To the staff of the Protozoology Section for assistance in the field as well as in the laboratory and the staff of the Desert Regional Station of the Zoological Survey of India at Jodhpur ; to Shri C. L. Mahajan of the Department of Zoology, University of Rajasthan, Jaipur, and to other members of the staff of that department, particularly Dr. P. N. Srivastava, for help and facilities rendered at Jaipur. To the Hindusthan Salt Corporation Ltd., Sambhar Lake, for working facilities afforded from time to time, to Shri Bhim Sen, Principal, M. B. College, Udaipur, for much valuable assistance at Udaipur. I am grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for his valuable suggestions and guidance.

## II—LIST OF FREE-LIVING PROTOZOA KNOWN FROM RAJASTHAN

In the following list the families, genera and species are numbered serially :

- Class I. **MASTIGOPHORA**  
 Order 1. **EUGLENOIDINA**  
 Family (i) **EUGLENIDAE**  
 Genus 1. *Euglena* Ehrenberg
1. *Euglena acus* Ehrenberg
  2. *Euglena spirogyra* var. *minor* Lefèvre
- Family (ii) **ANISONEMIDAE**  
 Genus 2. *Entosiphon* Stein
3. *Entosiphon sulcatum* (Dujardin)
- Class II. **SARCODINA**  
 Order 1. **AMOEBINA**  
 Family (iii) **AMOEBIDAE**  
 Genus 3. *Amoeba* Ehrenberg
4. *Amoeba radiosa* Ehrenberg
  5. *Amoeba vespertilio* Penard
- Order 2. **TESTACEA**  
 Family (iv) **ARCELLIDAE**  
 Genus 4. *Arcella* Ehrenberg
6. *Arcella vulgaris* Ehrenberg
- Family (v) **DIFFLUGIIDAE**  
 Genus 5. *Diffugia* Leclerc
7. *Diffugia lobostoma* Leidy
  8. *Diffugia urceolata* Carter
  9. *Diffugia pyriformis* Perty
- Genus 6. *Centropyxis* Stein
10. *Centropyxis aculeata* (Ehrenberg)
- Class III. **CILIATA**  
 Subclass (A) **HOLOTRICHA**  
 Order 1. **GYMNOSTOMATIDA**  
 Family (vi) **COLEPIDAE**  
 Genus 7. *Coleps* Nitzsch
11. *Coleps hirtus* Müller var. *minor* Kahl
  12. *Coleps inermis* Perty
  13. *Coleps devdaniensis* n. sp.
- Family (vii) **ENCHELYIDAE**  
 Genus 8. *Holophrya* Ehrenberg
14. *Holophrya bengalensis minor* subsp. nov.
  15. *Holophrya simplex* Schewiakoff
- Genus 9. *Lacrymaria* Ehrenberg
16. *Lacrymaria olor* (Müller)
- Family (viii) **TRACHELIIDAE**  
 Genus 10. *Dileptus* Dujardin

17. *Dileptus anser* (Müller)  
Family (ix) AMPHILEPTIDAE  
Genus 11. *Hemiophrys* Wrzesinowsky
18. *Hemiophrys procera* (Penard)  
Family (x) NASSULIDAE  
Genus 12. *Nassula* Ehrenberg
19. *Nassula ornata* Ehrenberg  
Order 2. TRICHOSTOMATIDA  
Family (xi) COLPODIDAE  
Genus 13. *Colpoda* Müller
20. *Colpoda inflata* (Stokes)  
Order 3. HYMENOSTOMATIDA  
Family (xii) PARAMECIIDAE  
Genus 14. *Paramecium* Müller
21. *Paramecium bursaria* (Ehrenberg)  
Family (xiii) UROCENTRIDAE  
Genus 15. *Urocentrum* Nitzsch
22. *Urocentrum turbo* (Müller)  
Family (xiv) FRONTONIIDAE  
Genus 16. *Frontonia* Ehrenberg
23. *Frontonia atra* (Ehrenberg)
24. *Frontonia complanata* (Wetzel)  
Subclass (B) SPIROTRICHA  
Order 4. HETEROTRICHIDA  
Family (xv) STENTORIDAE  
Genus 17. *Stentor* Oken
25. *Stentor coeruleus* Ehrenberg  
Family (xvi) SPIROSTOMATIDAE  
Genus 18. *Spirostomum* Ehrenberg
26. *Spirostomum ambiguum* Ehrenberg  
Order 5. ODONTOSTOMATIDA  
Family (xvii) EPALEXELLIDAE  
Genus 19. *Saprodinium* Lanterborn
27. *Saprodinium mimeticum* (Penard)  
Order 6. HYPOTRICHIDA  
Family (xviii) EUPLOTIDAE  
Genus 20. *Euplotes* Ehrenberg
28. *Euplotes plumipes* Stokes
29. *Euplotes patella* (Müller)
30. *Euplotes inkystans* Chatton  
Family (xix) OXYTRICHIDAE  
Genus 21. *Oxytricha* Bory
31. *Oxytricha fallax* Stein
32. *Oxytricha hymenostomata* Stokes
33. *Oxytricha ovalis* Kahl
34. *Oxytricha oblongatus* n. sp.

III—KEY TO GENERA OF FREE-LIVING PROTOZOA KNOWN  
FROM RAJASTHAN

- 1(7) Permanent locomotory organs (organelle) absent.
- 2(3, 6) Individuals mononucleate ; body in a spherical or flask-shaped monocular shell formed by reinforcement of sand grains 1. *Diffugia*
- 3(2) Individuals in a hemispherical or dome-shaped shell made up of chitinous membrane. 2. *Arcella*
- 4(5) Mouth central 3. *Centropyxis*
- 5(4) Mouth eccentric ; shell with spines .. 4. *Amoeba*
- 6(2) Individuals mononucleate, naked, with characteristic locomotory organs called pseudopodia.
- 7(1) Permanent locomotory organs (organelle) present.
- 8(12) Locomotory organelle long flexible and whip-like (flagella) ; situated anteriorly.
- 9(10, 11) With a single flagellum rooted in a reservoir 5. *Euglena*
- 10(9, 11) With two flagella, both directed forwards 6. *Chilomonas*
- 11(9, 10) With two flagella, one always trails behind during locomotion 7. *Entosiphon*
- 12(8) Locomotory organelle short and generally present all over the body ; sometimes restricted to certain regions.
- 13(50) Individuals free-living (not sessile).
- 14(43) Individuals with no cirri.
- 15(35) Cytostome present on body surface.
- 16(17, 18) Cytostome anterior, at the characteristic apical cone, situated at the tip of a highly contractile neck 8. *Lacrymaria*
- 17(16, 18) Cytostome anterior, lying at tip of an apical cone. Without contractile long neck. Body barrel-shaped, with 2 or 4 characteristic girdles of cilia at various levels . .. 9. *Didinium*
- 18(16, 17) Cytostome anterior, not apical but surrounded by slightly longer cilia. Body barrel-shaped and covered with regularly arranged, perforated cytoplasmic plates .. .. 10. *Coleps*
- 19 Cytostome slit-like and situated on a convex surface of a flattened flask-shaped, laterally compressed body at the base of anterior neck-like projection. Cilia present only on right side of the body.
- 20(21) With only one contractile vacuole, situated at posterior end. Cytostome with trichocysts : 11. *Lionotus*

- 21(22) With contractile vacuoles arranged laterally in rows. Posterior portion also drawn out 12. *Hemiophrys*
- 22(19) Cytostome situated on a flattened ventral surface. Dorsal surface convex. Somatic ciliation restricted to ventral surface 13. *Chilodonella*
- 23(24) Cytostome rounded, situated at base of an anteriorly drawn out finger-like process; body oval, and rounded posteriorly 14. *Trachelius*
- 24(23) Cytostome found and at base of a conspicuous neck-like projection. Body lanceolate and drawn out into a tail-like prolongation 15. *Dileptus*
- 25(26) Cytostome at about  $\frac{1}{4}$  of the body length towards anterior end, with inconspicuous undulating membrane on right and three membranellae on left. Ciliation uniform. One contractile vacuole present and located centrally 16. *Glaucoma*
- 26(25) Cytostome at left of median line, at about one-fourth of body length. Cilia dense, uniform and in rows, short and conical cytopharynx. One contractile vacuole present and located centrally 17. *Monochilum*
- 27(28) Cytostome at right of median line, in posterior half, with a membrane on both edges forming a pocket. With one caudal cilium. Contractile vacuole single and terminal 18. *Cinetochilum*
- 28(27) Individuals ovoid, with a caudal cilium, peristome near the right side, with a membrane on its right edge which forms a pocket around cytostomal groove. On the left of peristome lies the undulating membrane 19. *Cyclidium*
- 29(31) Pharynx absent.
- 30 Cytostome rounded and anterior. Body uniformly ciliated 20. *Holophrya*
- 31(29) Pharynx present.
- 32 Cytostome round and anterior. Pharynx supported by the characteristic rod apparatus 21. *Nassula*
- 33(34) Cytostome with short, curved pharynx, situated in depression on one side of kidney-shaped body 22. *Colpoda*
- 34(33) Cytostome with well developed pharynx. Body more or less dumb-bell-shaped with a characteristic ciliary girdle and ciliary tail 23. *Urocentrum*
- 35(15) Cytostome not present on body surface but situated within peristome.
- 36(37) Body foot-shaped, with a pair of characteristic contractile vacuoles 24. *Paramecium*



- 37(36) Cytostome having no connection with peristome, though situated therein. Body sole-shaped with contractile vacuole having long radiating canals 25. *Frontonia*
- 38 Body cylindrical, somewhat compressed and extremely contractile. Peristome long, extending down the left side of the ventral surface upto or beyond the middle of the body and continues inward as a short funicular cytopharynx. Excretory (contractile) vacuole terminal, large and with a long dorsal canal. Macronucleus chain form 26. *Spirostomum*
- 39(40) Peristome sickle-shaped. Ciliated slit sunk at right angles to body surface. One or two contractile vacuoles having long radiating canals 27. *Ophryoglena*
- 40(39) Peristome not sunk at right angles to body, but starting from anterior end to middle of body ; curved to right. Body spindle-shaped. Peristome with two membranes on right edge 28. *Cohnilembus*
- 41(42) With conspicuous anterior peristome, slightly spirally diagonal, beginning at anterior end and reaching almost to middle of body. A narrow non-ciliated zone on right of adoral zone. One macronucleus 29. *Metopus*
- 42(41) Peristome wide anteriorly, 'V'-shaped and without non-ciliated zone. A large undulating membrane on right edge and adoral zone on left of peristome, present. Macronucleus moniliform. 30. *Condylostoma*
- 43(14) Individuals with cirri.
- 44(45, 46) Body reniform, inflexible, with two oval macronuclei. Five ventral cirri in two rows 31. *Stylonychia*
- 45(44, 46) Body oblongate or oval, flexible, contractile and with two macronuclei. Eight frontal cirri 32. *Oxytricha*
- 46(44, 45) Body ovoid, inflexible, longitudinally ridged. Nine fronto-ventral cirri, not in rows. Macronucleus ribbon-shaped 33. *Euplotes*
- 47 Body carapaced, rounded triangular in shape and laterally compressed. Anterior end pointed towards ventral surface. Posterior end irregularly truncated and with four anal cirri 34. *Saprodinium*
- 48(49) Body loricated, individuals flask-shaped, flexible and free to move inside lorica. Cytostome at base of proboscis 35. *Chaetospora*
- 49(48) Body not loricated. ..
- 50(13) Individuals sessile, trumpet-shaped and highly contractile, with moniliform macronucleus 36. *Stentor*
- 51(52) Individual sessile with non-contractile stalk. Food-procurement and ingestion with the help of tentacles .. 37. *Sphaerophrya*
- 52(51) Individuals with a short contractile stalk. No suctorial tentacles. Individuals with lorica 38. *Cothurnia*

## IV—SYSTEMATIC ACCOUNT

1. *Euglena acus* Ehrenberg

(Text-fig. 2A)

1832. *Euglena acus* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 39.1956. *Euglena acus*: Pringsheim, *Nova Acta Leop.*, Leipzig, 18 (125), pp. 47—50, fig. 2.

*Material*.—2 exs., pond in Megulai Nadi, near Jodhpur (Jodhpur Dist.), 2.xii.63.

*Diagnosis*.—Spindle-shaped with slight torsion, widest in the middle; anterior end truncate; posteriorly narrowing into an almost cylindrical tail-like process devoid of chromatophores. Metaboly weak, limited to general body while the tail portion remaining straight even if bent on one side; canal opening a little towards one side; body striation not pronounced but visible with an immersion system; flagellum about  $\frac{1}{4}$ th of the body-length; nucleus central and cylindrical with hemispherical ends; size  $58.7-75 \times 13\mu$ .

*Distribution*.—RAJASTHAN (first record; probably first record also from India): As above. *Elsewhere*: Universal in stagnant waters.

*Remarks*.—The forms which were designated as type by Pringsheim (1956), possess a flagellum  $\frac{1}{3}$ rd of the body-length (vs.  $\frac{1}{4}$ th in the present ones). Records in the literature show that the flagellum is less than  $\frac{1}{3}$ rd the body-length. Pringsheim gave the size as  $104-109 \times 10-22\mu$ . The present specimens were much contracted during fixation. The size-range from various authors is:  $47-311 \times 4-25\mu$ , but Pringsheim (1956) prefers to regard the general range of *Euglena acus* as  $75-150\mu \times 7-12\mu$ .

In spite of the short flagellum, these animals are lively swimmers; these were not seen to glide. Fixation takes place at the tip of the tail.

2. *Euglena spirogyra* var. *minor* Lefèvre

(Text-fig. 2B)

1932. *Euglena spirogyra* var. *minor* Lefèvre, *Ann. Protis.*, Paris, 3, p. 203.

*Material*.—2 exs., pond in Devikund, Bikaner (Bikaner Dist.), 7.xii.63.

*Diagnosis*.—Elongated, fusiform, a little twisted; anterior end slightly narrowed and rounded; canal opening a little to one side; posterior end conical, with cylindrical, well-defined, colourless tail-piece. Metaboly by increase in twist; followed by bending along whole length of the body except the tail portion which remains straight; flagellum about  $\frac{2}{3}$ rds the body-length; periplast is adorned with quite prominent striation made up of small knobs; size  $42.4-45.6 \times 9.8\mu$ .

*Distribution.*—RAJASTHAN (first record from India) : As above. *Elsewhere* : Universal in stagnant waters.

*Remarks.*—Lefèvre (1932) had recorded somewhat longer specimens— $45-50 \times 7-9 \mu$ .

### 3. *Entosiphon sulcatum* (Dujardin)

(Text-fig. 2C)

1841. *Anisonema sulcata* Dujardin, *Histoire Naturelle des Zoophytes infusoires* Paris, p. 345, pl. 4, fig. 28.

1878. *Entosiphon sulcatum* (Dujardin): Stein, *Der Organismus der Infusionsthier*, Leipzig, 3, pl. 24, fig. 18 (and explanation).

*Material.*—2 exs., Mansagar Jaipur (Jaipur Dist.), 21.ix.63.

*Diagnosis.*—Body oval, flattened, more or less rigid; two flagella both arising from a cytostome, one flagellum trailing; cytopharynx a long conical tubule placed obliquely and covering more than half the body-length; nucleus centro-lateral; size  $11.4 \times 13 \mu$ .

*Distribution.*—RAJASTHAN (first record from India) : As above. *Elsewhere* : Universal in stagnant waters with decaying vegetation.

*Remarks.*—My specimens are small, being nearly half the size of those recorded by earlier authors.

### 4. *Amoeba radiosa* Ehrenberg

(Text-figs. 2D-G)

1832. *Amoeba radiosa* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 39.

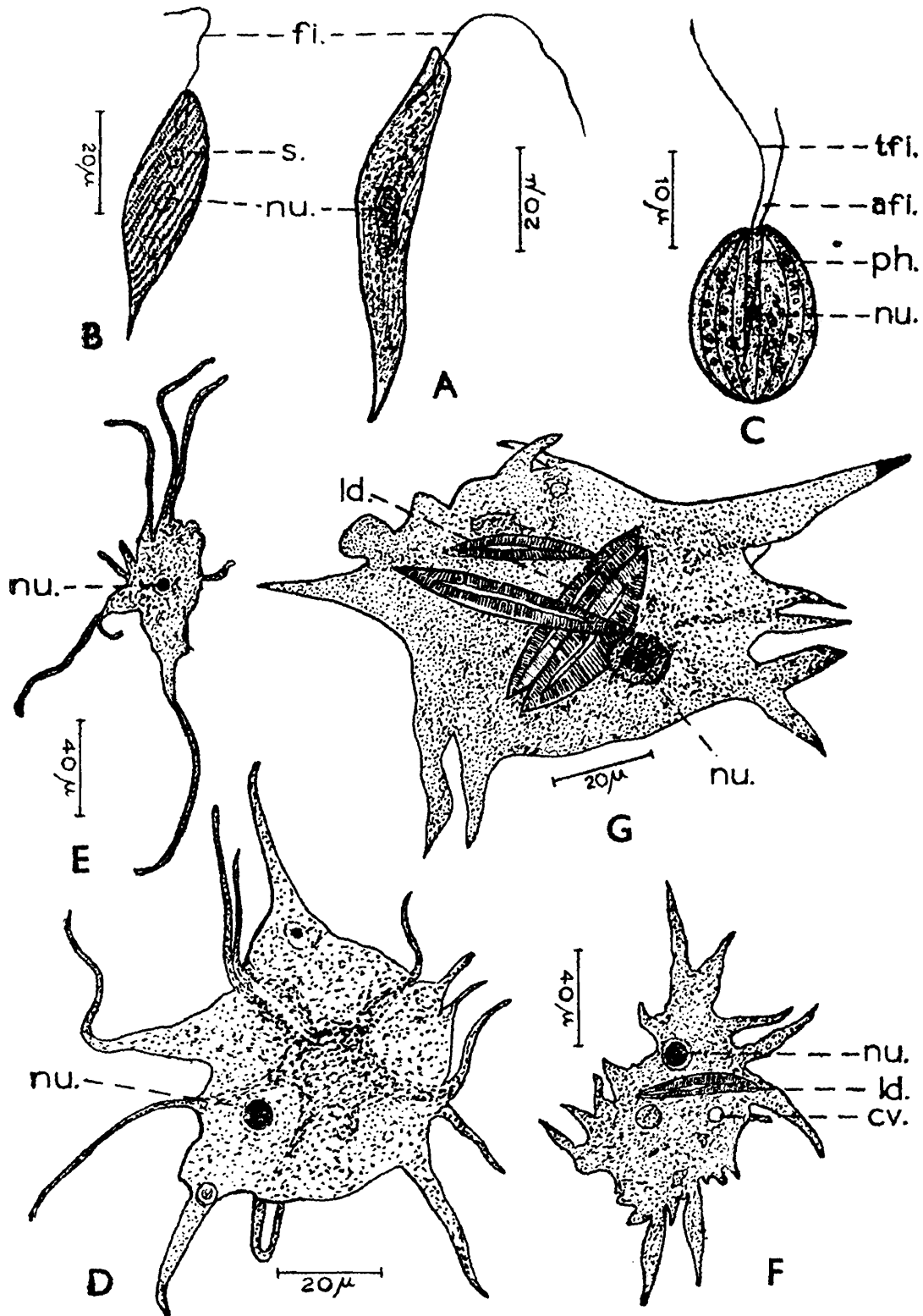
1879. *Amoeba radiosa* : Leidy, *Rep. U. S. geol. Surv.*, Washington, 12, pp. 59—62, pl. 4, figs. 1—18.

*Material.*—(i) 5 exs., Pushkar Lake near Ajmer (Ajmer Dist.), 27.x.63.  
(ii) 2 exs., Sardar Samand (Pali Dist.), 24.xi.63.

*Diagnosis.*—Small, with many long, slender radiating pseudopodia; when inactive, globular or oval in outline; single nucleus; size  $13-45.6 \times 9.7-42 \mu$ ; length of pseudopodia  $42.3 \mu$ .

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

Remarks.—The specimens observed are of average size, the maximum length of the pseudopodia being 42  $\mu$ . Leidy (1879) had recorded 80  $\mu$  long pseudopodia.



TEXT-FIG. 2.—(A) *Euglena acus* Ehrenberg. (B) *Euglena spirogyra* var. *minor* Lefèvre. (C) *Entosiphon sulcatum* (Dujardin). (D-G). *Amoeba radiosa* Ehrenberg.

5. *Amoeba vespertilio* Penard

(Text-fig. 3A)

1902. *Amoeba vespertilio* Penard, *Faune Rhizopodique du Bassin du Letman*, Geneva, 4, p. 92.

*Material*.—3 exs., Pushkar Lake, near Ajmer (Ajmer Dist.), 27.x.63.

*Diagnosis*.—Pseudopodia conical, comparatively short, connected at base by web-like expansions of ectoplasm ; single vesicular nucleus ; contractile vacuoles present ; size  $32-42 \times 22.8-29 \mu$ .

*Distribution*.—RAJASTHAN : As above (first record from India).

*Elsewhere* : Universal in freshwater bodies.

*Remarks*.—My specimens are small, being nearly half the size of the earlier records (60-100  $\mu$ ). It is a rare species.

6. *Arcella vulgaris* Ehrenberg

(Text-fig. 3B)

1832. *Arcella vulgaris* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 90.

1856. *Arcella vulgaris* : Carter, *Ann. Mag. nat. Hist.*, London, (2) 18, p. 247.

*Material*.—4 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 21.x.63.

*Diagnosis*.—Height of the test about  $\frac{1}{2}$  the diameter ; dome of hemispherical test evenly convex ; aperture circular and central ; test yellowish brown ; protoplasmic body conforming with shape of test but never filling the latter ; lobopodia hyaline ; diameter of test  $45.6-92.8 \mu$ .

*Distribution*.—RAJASTHAN : As above (first record ; probably also first record from India). *Elsewhere* : Universal in stagnant waters with vegetation.

*Remarks*.—The specimens obtained are of medium size (45-93  $\mu$ ). Leidy (1879) gave the range 48-152  $\mu$ .

7. *Diffugia lobostoma* Leidy

(Text-fig. 3C)

1877. *Diffugia lobostoma* Leidy, *Proc. Acad. nat. Sci. Philad.*, Philadelphia, p. 307.

*Material*.—1 ex., Anasagar Lake, Ajmer (Ajmer Dist.), 18.x.63.

*Diagnosis.*—Test ovoid ; aperture terminal with 3-6 lobes ; test composed of sand grains ; endoplasm colourless ; size  $74.9 \times 58.6 \mu$ .

*Distribution.*—RAJASTHAN (first record from India) : As above.  
*Elsewhere* : Universal in stagnant waters.

*Remarks.*—My specimen is small. Leidy (1879) recorded the size as  $120 \times 100 \mu$ . The mouth is trilobed.

### 8. *Diffugia urceolata* Carter

(Text-fig. 3D)

1864. *Diffugia urceolata* Carter, *Ann. Mag. nat. Hist.*, London, 13, pp. 27 and 37, pl. 1, fig. 7.

*Material.*—(i) 1 ex., Pichola Lake near Udaipur (Udaipur Dist.), 9.xi.63. (ii) 1 ex., Fatehsagar Lake near Udaipur (Udaipur Dist.), 6.xi.63. (iii) 3 exs., Nagkund, Jodhpur (Jodhpur Dist.), 8.xii.63. (iv) 2 exs., Gajner (Bikaner Dist.), 21.xii.63.

*Diagnosis.*—Test large, round, with a short neck and a rim around aperture ; mouth large, circular and frequently truncating the neck ; pseudopodia ordinarily 3-6 and of simple digitate type ; size  $71.7-120.6 \times 55.4-88 \mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India).  
*Elsewhere* : Universal in stagnant waters.

*Remarks.*—The test is amphora-form and without spines. In the specimen observed, the mouth is circular. My specimens are small (cf. Leidy's, 1879, measurements, 180-440  $\mu$ ).

### 9. *Diffugia pyriformis* Perty

(Text-fig. 3E)

1848. *Diffugia pyriformis* Perty, *Mitt. naturf. Ges., Bern*, p. 168.

*Material.*—1 ex., Anasagar Lake Ajmer (Ajmer Dist.), 18.x.63.

*Diagnosis.*—Test pyriform or flask-shaped ; aperture terminal, typically circular ; test composed of angular sand grains ; size  $117.3 \times 92 \mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India).  
*Elsewhere* : Universal in stagnant waters.

*Remarks.*—The test is of medium size (*cf.* Leidy's 1879, specimens, 60—580×40—240 $\mu$ ). It is a rare species, occurring in the bottom ooze of ponds. The shell is composed of quartz grains.

### 10. *Centropyxis aculeata* (Ehrenberg)

(Text-fig. 3F)

1832. *Arcella aculeata* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 40.

1857. *Centropyxis aculeata* (Ehrenberg): Stein, *S. Bohn. Ges. Wiss.*, Prague, 5 (10), pp. 41—43.

*Material.*—3 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 18.×63.

*Diagnosis.*—Test circular with the fundus pressed to one side so as to render the mouth eccentric. Fundus of shell obtusely rounded and furnished with 4-6 divergent spines in a single somewhat regular row ; shell made up of yellowish chitinous membrane with variable proportions of thin, membranous plates ; size 124—130  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India)  
*Elsewhere* : Universal in freshwater ponds.

*Remarks.*—The tests of my specimens are of medium size (*cf.* Leidy's, 1879, specimens, 88—260  $\mu$ ). Empty tests are usually seen on the bottom ooze of ponds. The spinous processes on the test vary from 4—5 in number.

### 11. *Coleps hirtus minor* Kahl

(Text-fig. 3G)

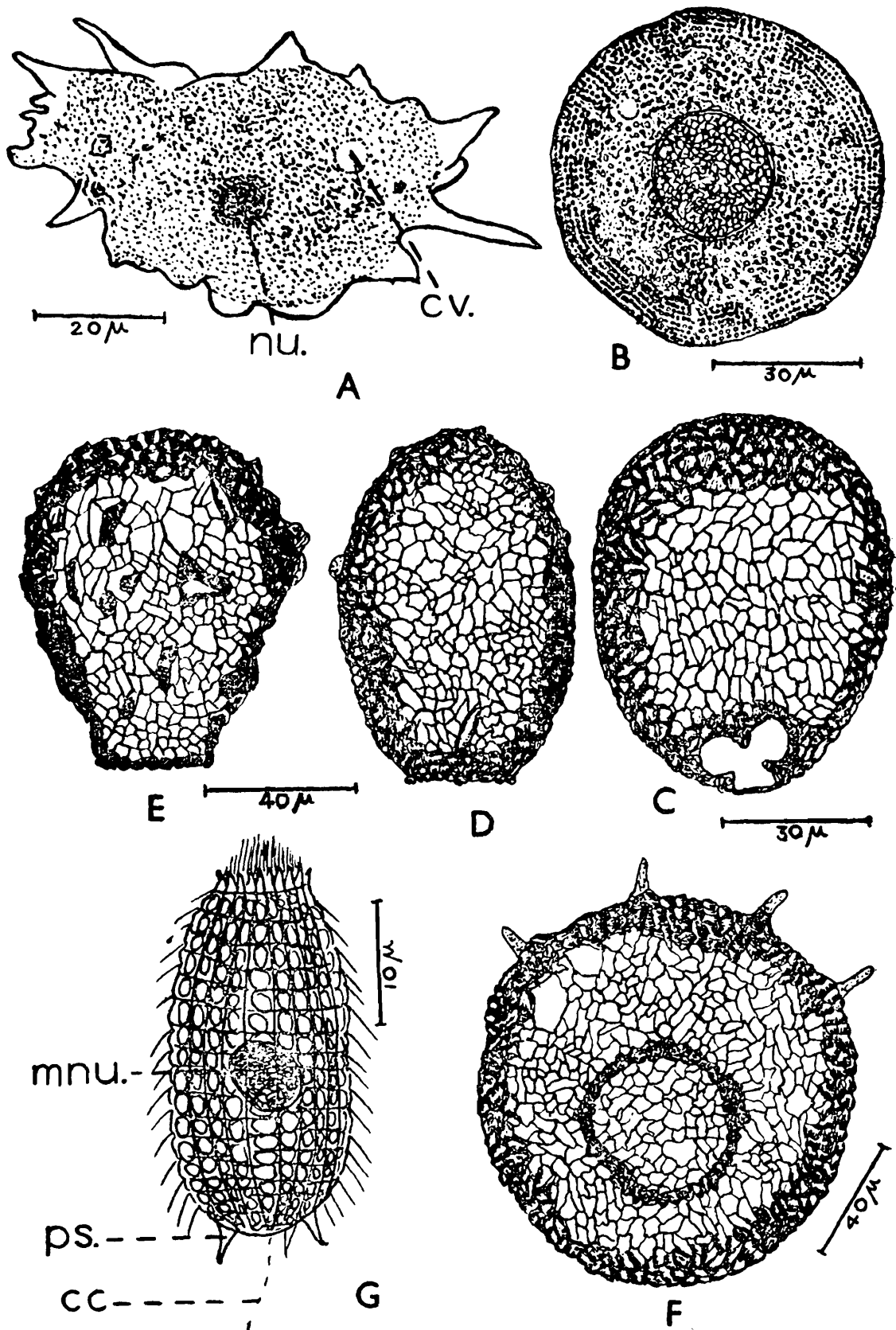
1930. *Coleps hirtus* var. *minor* Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Deutsch.*), Jena, p. 134, pl. 18, fig. 4.

*Material.*—(i) 1 ex., Galta near Jaipur (Jaipur Dist.), 10.ix.63. (ii) 3 exs., Sardar Samand (Pali Dist.), 24.xi.63.

*Diagnosis.*—Resembles *Coleps hirtus* in all respects, except being smaller ; size 74.9—84.7×45.6—49  $\mu$ .

*Distribution.*—RAJASTHAN (first record from India) : As above. *Elsewhere* : Universal in freshwater ponds among decaying vegetation.

*Remarks.*—It is found in lakes and ponds and in shallow waters having decaying vegetation, and is a very voracious eater, commonly feeding on dead Protozoa and rotifers.



TEXT-FIG. 3.—(A) *Amoeba vespertilio* Penard. (B) *Arcella vulgaris* Ehrenberg. (C) *Diffugia lobostoma* (Leidy). (D) *Diffugia urceolata* Carter. (E) *Diffugia pyriformis* Perty. (F) *Centropyxis aculeata* (Ehrenberg). (G) *Coleps hirtus* var. *minor* Kahl.



12. *Coleps inermis* Perty

(Text-fig. 4A)

1852. *Coleps inermis* Perty, *Zur Kenntniss kleinster Lebensformen*, Bern, pp 57—67.

*Material*.—3 exs., Galta near Jaipur (Jaipur Dist.), 22.ix.63.

*Diagnosis*.—Body oval, twice as long as broad ; longitudinal furrows, prominent ; plates quadrangular ; no transverse furrows ; posterior spines absent ; macronucleus single, spherical, central towards one side contractile vacuole terminal ; size  $32.6-37.5 \times 16-18 \mu$ .

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

*Remarks*.—The specimens observed are smaller than those of Perty (1852,  $80 \mu$ ).

13. *Coleps devdaniensis* n.sp.

(Text-fig. 4B)

*Material*.—3 exs., Devdani Temple tank near Sambhar (Jaipur Dist.). 7.x.63.

*Diagnosis*.—Body with hemispherical posterior and a conical anterior region, with a prominent girdle separating the two. Longitudinal furrows well pronounced ; transverse furrows not very deep. Body ciliation uniform. Posterior spines absent. Macronucleus single, spherical and sub-central. Size  $68.4-78.2 \times 52-55.4 \mu$ .

*Distribution*.—*Rajasthan* : As above.

*Comparison*.—The new species is separable from the allied ones as follows :

(1) From *C. hirtus* (Müller) : (i) Much broader than long. (ii) Posterior spines absent (vs. present in *hirtus*).

(2) From *C. kenti* Bhatia : (i) Length width ratio 3 : 2 (Vs. 4 : 3 in *kenti*). (ii) Body divided into two halves by a deep transverse furrow (vs. divided into four chief girdles by such furrows). (iii) Body hemispherical posteriorly and conical anteriorly (vs. barrel shaped in *kenti*).

(3) From *C. striatus* Smith : (i) Body proportionately broader and more clearly marked into quadrangular facets (not so in *striatus*).

*Type specimens*.—*Holotype* : on a slide ; Z. S. I. Reg. No. Pt. 385, Loc. as above. *Paratypes* : two, one on each slide ; Z. S. I. Reg. No. pt. 386 and Pt. 387, Loc. as above.

14. *Holophrya bengalensis* n. subsp. minor

(Text-fig. 4C)

*Material*.—(i) 1 Ex. Phulera, 2.×.63. (ii) 1 Ex., Devdani temple tank, Sambhar, 2.×.63. (both Jaipur Dist.) (iii) 1 Ex., Sarupsagar, Udaipur (Udaipur Dist.), 1.×.I.63.

*Diagnosis*.—Body cylindrical with uniform ciliation. Cytostome small and anterior. Longitudinal striations very clear. Macronucleus single, oval and situated at one side in the middle of body. Contractile vacuole situated in the posterior quarter towards one side. Size 34.2—48.9×16—19.5  $\mu$ .

*Distribution*.—RAJASTHAN : As above (first record from India).

*Comparison*.—The new variety differs from the nominal one, *H. bengalensis* Ghosh as follows :—

(i) Shape ovoid (vs. fusiform in *bengalensis*). (ii) Size smaller (34—49×16—20  $\mu$ ) as against 75×37  $\mu$  in *bengalensis*.

*Remarks*.—Bhatia (1936) described *Holophrya* species as *Holophrya bengalensis*, the description of which is based on the examination of single specimen by Ghosh (1919). Specimens under discussion are smaller in size but the length breadth ratio is almost same as that of the specimen described by Ghosh. The present form is ovoid whereas that of Ghosh is fusiform. In view of the above differences the present material has been considered to belong to a new variety of *Holophrya bengalensis* Ghosh.

*Type specimens*.—*Holotype* : on a slide ; Z. S. I. Reg. No. Pt. 380, Loc. Phulera (Jaipur Dist.). *Paratypes* : Two, one on each slide ; Devdani Temple tank (Jaipur Dist.) ; Z. S. I. Reg. No. Pt. 381, the other from Sarup Sagar (Udaipur Dist.) ; Z. S. I. Reg. No. Pt. 382.

15. *Holophrya simplex* Schewiakoff

(Text-fig. 4D)

1889. *Holophrya simplex* Schewiakoff, *Bibl. Zool.*, Leipzig, 5, pp. 30—32, pl. 2, fig. 31.

*Material*.—3 exs., Devdani Temple tank, near Sambhar (Jaipur Dist.), 2.×.63.

*Diagnosis*.—Body ellipsoid ; ciliation uniform with small, closely-set cilia, in 18—20 longitudinal rows ; cytostome small, terminal and detectable only at time of ingestion ; with trichocysts ; cytopharynx absent ; anus and contractile vacuole posterior ; macronucleus large, spherical, central ; size 22.8—27×16—19.5  $\mu$ .

*Distribution*.—RAJASTHAN (first record) : As above. *Elsewhere* : Universal in freshwater ponds.

*Remarks*.—My specimens are smaller than the ones recorded by Schewiakoff (1889).

16. *Lacrymaria olor* (Müller)

(Text-fig. 4E)

1786. *Vibrio olor* Müller, *Animalc. Infusoria, fluviat. et. marina. etc.*, Hafniae et Lipsiae, p. 75, pl. 10. figs. 12—15.
1832. *Lacrymaria olor* (Müller) : Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 105.

*Material*.—(i) 1 ex., Anasagar Lake, Ajmer (Ajmer Dist.), 21.x.63.  
(ii) 4 exs., Bikaner (Bikaner Dist.) 18.xii.63.

*Diagnosis*.—Body elongate ; cylindrical posterior portion with a pointed end and a long, highly contractile neck at the other end ; oral cone well-developed ; ciliation uniform and ciliary meridians spiral ; two contractile vacuoles on either ends of cylindrical body-portion. macronucleus consisting of two rounded parts united together ; size  $94.5-105 \times 26-31.5 \mu$ .

*Distribution*.—RAJASTHAN : As above (first record). *Elsewhere* Universal in stagnant waters with decaying vegetation.

*Remarks*.—The length varies considerably according to the state of extension of the neck. It is commonly met with in the surface bacterial films found on top of water samples kept in the laboratory. It is a voracious feeder of bacteria.

17. *Dileptus anser* (Müller)

(Text-fig. 4F)

1786. *Vibrio anser* Müller, *Animalc. Infusoria, fluviat. et. marina, etc.*, Havniae et Lipsiae, pp. 73, 74, pl.10, figs. 7—11.
1841. *Dileptus anser* (Müller) : Dujardin, *Histoire nat. des zoophytes infusoires*, Paris, pp. 407—409, pl. 7, fig. 17.

*Material*.—(i) 1 ex., Barli Tank near Jodhpur (Jodhpur Dist.), 8.xii.63. (ii) 1 ex., Khandia (Jodhpur Dist.), 8.xii.63. (iii) 2 exs., Lambia (Jodhpur Dist.), 9.xii.63. (iv) 8 exs., Devikund, Bikaner (Bikaner Dist.), 17.xii.63.

*Diagnosis*.—Body elongate, greyish white ; with a tail-like projection at posterior end ; neck elongated, contractile, showing characteristic movements ; very fine cilia all-over body ; cytopharynx funnel-shaped, longitudinally striated, and located at base of neck ; contractile vacuoles many, arranged in a row dorsally ; macronuclei numerous and scattered ; size (semi-contracted)  $283.5-341 \times 47-57 \mu$ .

*Distribution*.—RAJASTHAN : As above (first record). *Elsewhere* ; Universal in freshwater bodies with decaying vegetation.

*Remarks.*—The specimens studied were of medium size, the earlier recorded length being 200—400  $\mu$ . The endoplasm was finely granular and the tail drawn out into a distinct, pointed prolongation.

### 18. *Hemiophrys procera* (Penard)

(Text-fig. 4G)

1922. *Lionotus procerus* Penard, *Etudes sur les Infusoires d'eau douce*, Genève, p. 69, fig. 75.

1931. *Hemiophrys procera* (Penard): Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 21, p. 186, fig. 11.

*Material.*—(i) 1 ex., Fateh Sagar (Udaipur Dist.), 6.xi.63. (ii) 3 exs., Sardar Samand (Pali Dist.), 24.xi.63. (iii) 1 ex., Khandia (Jodhpur Dist.), 7.xii.63. (iv) 2 exs., Gajner (Bikaner Dist.), 20.xii.63.

*Diagnosis.*—Flask-shaped, elongate, flattened ; anterior region neck like ; posterior end with a tail-like prolongation ; middle portion broad with a convex dorsal surface and flat ventral side ; two rows of contractile vacuoles ; macronuclei two, oval, situated in middle of the body ; with uniform ciliation all over the body ; size 136.5—238  $\times$  36.7—49  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India). *Elsewhere* : Universal in freshwater ponds.

*Remarks.*—The specimens observed were smaller than the earlier records (600—800  $\mu$ ).

### 19. *Nassula ornata* Ehrenberg

(Text-fig. 4H)

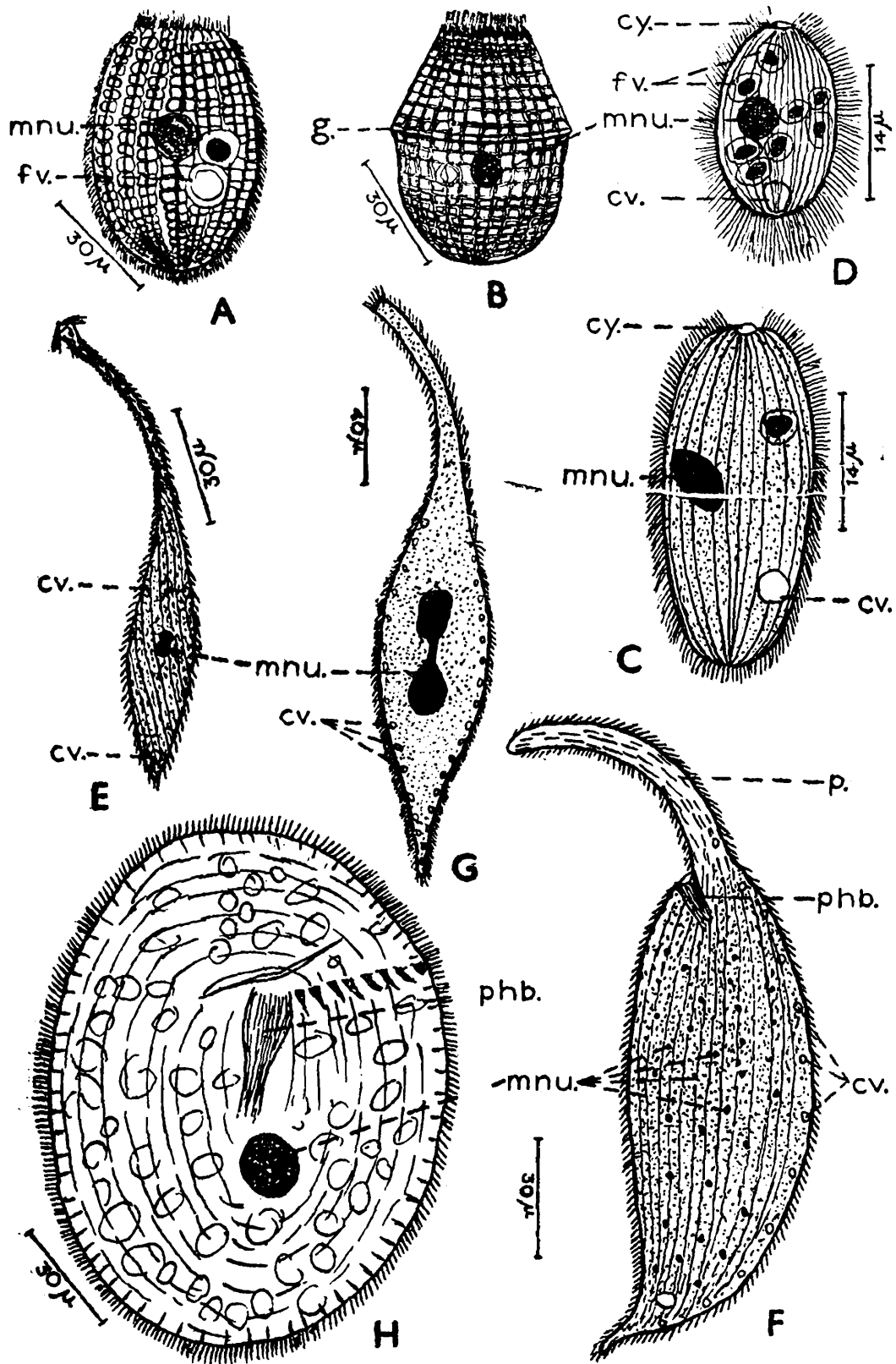
1833. *Nassula ornata* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 169, pl. 1, fig 2.

*Material.*—5 exs., Gajner (Bikaner Dist.), 18.xii.63.

*Diagnosis.*—Body ovate, twice as long as broad ; brownish green ; with many vesicles ; pharyngeal basket having straight trichites, even undilated tube ; ciliation uniform with fine cilia ; contractile vacuole single, subcentral ; macronucleus single, spherical, usually situated below pharyngeal tube ; size 132—138.5  $\times$  88—94  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India). *Elsewhere* : Universal in freshwater ponds.

*Remarks.*—The specimens observed were smaller than those recorded by previous workers.



TEXT-FIG. 4.—(A) *Coleps inermis* Perty. (B) *Coleps devdaniensis* n. sp. (C) *Holophrya bengalensis* var. *minor* nov. (D) *Holophrya simplex* Schewiakoff. (E) *Lacrymaria olor* (Müller). (F) *Dileptusanser* (Müller). (G) *Hemiophrys procera* (Penard). (H) *Nassula ornata* Ehrenberg.

20. *Colpoda inflata* (Stokes)

(Text-fig. 5A)

1885. *Tilinna inflata* Stokes, *Ann. mag. nat. Hist.*, London, (5), 15 p. 441 fig. 9.
1931. *Colpoda inflata* (Stokes): Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Deutsch.*), Jena, pt. 21, p. 280, fig. 47 (9).

*Material*.—2 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 21.x.63.

*Diagnosis*.—Body reniform, compressed; oral funnel a little anterior to middle of ventral side; anterior keel with 6—8 indentations; ciliary meridians 21—24; contractile vacuole single, posterior; macronucleus round, situated in the middle of body; size 39—40.7 × 27.7—31  $\mu$ .

*Distribution*.—RAJASTHAN: As above (first record from India). *Elsewhere*: Universal in freshwater ponds.

*Remarks*.—The specimens observed were smaller than those ones recorded by the earlier workers.

21. *Paramecium bursaria* (Ehrenberg)

(Text-fig. 5B)

1831. *Loxodes bursaria* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 109.
1836. *Paramecium bursaria* (Ehrenberg): Focke, *Lsis*, Brusells, pp. 786—787.

*Material*.—(i) 4 exs., Jodhpur (Jodhpur Dist.), 28.xi.63. (ii) 2 exs., Bijolai (Jodhpur Dist.), 9.xii.63. (iii) 2 exs., Shivbari (Bikaner Dist.), 14.xii.63.

*Diagnosis*.—Body foot-shaped, flat, rounded posteriorly; green, with abundant zoochlorellae as symbionts; peristomial groove broad anteriorly, extending obliquely backwards, followed by a cytostome which opens into a distinct cytopharynx; with two contractile vacuoles with radial canals; macronucleus oval and massive with a relatively large and compact micronucleus close to it; size 97.8—130 × 39—58.6  $\mu$ .

*Distribution*.—RAJASTHAN: As above. (first record) *Elsewhere*: Universal in freshwater ponds with green algae.

*Remarks*.—The specimens observed were of medium size, the length given by earlier workers being 90—306, usually 120—160  $\mu$ . The compact micronucleus lies at the notch found in the anterior pole of the macronucleus.

22. *Urocentrum turbo* (Müller)

(Text-fig. 5c)

1786. *Cercaria turbo* Müller, *Animalc. Infusoria, fluviat. et. marina. etc.*, Havniae et Lipsiae, pp. 123—124, pl. 26, figs. 13—16.
1817. *Urocentrum turbo* (Müller) Nitzsch, *Neue. Schrift der naturf. Ges. in Halle, Halle, 3, p. 3.*

*Material.*—4 exs., Fatehsagar (Udaipur Dist.), 6.xi.63.

*Diagnosis.*—Body flexible, unevenly cylindrical ; rounded at both ends ; with three ciliary girdles, the anterior widest, the posterior wider with long cilia, the middle narrow with short cilia ; cytostome just below the mid-ciliary girdle ; contractile vacuole posterior, with collecting canals ; macronucleus horse-shoe-shaped with swollen ends, located at posterior end ; size 45.6—50  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record). *Elsewhere* : Universal in freshwater bodies.

*Remarks.*—My specimens are rather small. In moving condition, the caudal cilia are very conspicuous.

23. *Frontonia atra* (Ehrenberg)

(Text-figs. 5D. E)

1833. *Ophryoglena atra* Ehrenberg, *Abh. preuss. Akad. wiss.*, Berlin, p. 265, pl. 7, fig. 9.
1931. *Frontonia atra* (Ehrenberg) : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*) Jena, pt. 21., p. 321., figs. 55(8 & 17).

*Material.*—(i) 1 ex., Devdyani, Sambhar (Jaipur Dist.), 7.  $\times$  63. (ii) 2 exs. Phulera, (Jaipur Dist.), 10.  $\times$  63. (iii) 1 ex., Anasagar Lakes (Ajmer Dist.), 21.  $\times$  63.

*Diagnosis.*—Body resembling a pin-pong paddle in general, except specimens fully laden with food ; anterior end bluntly rounded, posterior end with a blunt tail like projection. Mouth subterminal, ventral, and at about 1/4th the length of body from the anterior end. Macronucleus single, large and oval. Size 63—89  $\times$  42—78.8  $\mu$ .

*Distribution.*—RAJASTHAN : As above. (first record from India). *Elsewhere* : Universal in freshwater ponds with decaying vegetation.

*Remarks.*—*F. atra* is a large freshwater species seen by me in only one collection from a seasonal pond at Phulera and in association with other species of *Frontonia* described elsewhere. Butschli (1889) recognised it as a *F. acuminata* Ehrenberg. Conn (1905) apparently saw the same ciliate in Connecticut, U. S. A., but left it unidentified. Penard (1920) described a species under the name *F. nigricens*, with a

general form, at times, somewhat like a *Stentor* and having a purplish colour. Kahl (1931) recognised a difference in Ehrenburg's *O. acuminata* and *O. atra* and described *O. atra* as *Frontonia atra*. Kahl also thought *F. atra* identical with Burger's (1908), *Paramaecium nigricum*. Unfortunately I could not see the literature concerning this statement. Now from my own study of these forms found at Phulera, and on a study and comparison of the descriptions and drawings given by the above-mentioned authors, I think that all of them belong to the same species. The only apparent difference in Penard's and Kahl's species seems to be the colour which has been reported as purplish for *F. nigricens* Penard whereas Kahl's *F. atra* is black. Regarding size generally this species is quite large as compared to the other species of the genus.

#### 24. *Frontonia complanata* (Wetzel)

(Text-fig. 5F)

1927. *Frontonella complanata* Wetzel, *Arch. Protistenk*, Jena, 60, pp. 130—137, figs. 1—4.  
 1939. *Frontonia complanata* (Wetzel) : Bullington, *Arch. Protistenk*, Jena, 92, pp. 56—57, pl. 9, fig. 12.

*Material*.—1 ex., Anasagar, Lake Ajmer (Ajmer Dist.), 21.x.63.

*Diagnosis*.—Generally broad at both ends but with the posterior end slightly pointed. Possesses a typical *Frontonia* mouth. Contractile vacuole single and sub-central. Macronucleus oval, situated in anterior half of body. Size  $105 \times 78.7 \mu$ .

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

*Remarks*.—Kahl (1933) described a form *F. arenaria* which might be a synonym of Wetzel's (1927) *F. complanata* as both are of nearly the same size (*F. complanata*  $100—120 \mu$ , *F. arenaria*  $100—130 \mu$ ), and are very identical in certain other details. My specimens are on an average  $100 \mu$  in length ( $90—120 \mu$ ) and agree more with those figured by Wetzel.

#### 25. *Stentor coeruleus* Ehrenberg

(Text-fig. 5G)

1830. *Stentor coeruleus* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 41.

*Material*.—(i) 1 ex., Lambia (Jodhpur Dist.), 8.xii.63. (ii) 1 ex., Devikund, Bikaner (Bikaner Dist.), 19.xii.63.

*Diagnosis*.—Body blue and trumpet-shaped in fully extended condition, with alternative bands of clear and pigmented stripes; clothed with five cilia; peristomial disc slightly convex with membranellae at its margin; macronucleus moniliform; micronucleus many, lying close to macronucleus beads; contractile vacuole lying anteriorly and having a collecting canal; length in fully extended condition c. 1.5 mm



*Distribution.*—RAJASTHAN : (first record): As above. *Elsewhere* : Universal in stagnant waters.

*Remarks.*—The specimens are of average length (1.5 mm.) and are coloured bright blue in the fully distended condition. The macronucleus has only seven beads. This is a solitary form.

## 26. *Spirostomum ambiguum* Ehrenberg

(Text-fig. 5H)

1835. *Spirostomum ambiguum* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, p. 165.

*Material.*—(i) 1 ex., Sardar Samand (Pali Dist.), 14.xi.63. (ii) 2 exs., Jodhpur (Jodhpur Dist.), 28.xi.63. (iii) 1 ex., Khandia (Jodhpur Dist.), 7.xii.63.

*Diagnosis.*—Elongate, thread-like ; covered with rows of short cilia ; highly contractile ; peristome long, extending nearly to 2/3rds of body-length ; peristomial margin with short closely arranged membranelles ; contractile vacuole large, very conspicuous, situated posteriorly and with a long, slender dorsal canal extending from it ; macronucleus moniliform, multimicronucleate ; length of body 1.5-2.0 mm.

*Distribution.*—RAJASTHAN : As above (first record). *Elsewhere* : Universal in freshwater ponds with decaying vegetation.

*Remarks.*—In external contours it bears a striking resemblance to *Loxodes* Ehrenberg, 1830 and might readily be mistaken for a member of that genus if casually examined under low magnification. In the genus *Spirostomum* it is nearest to *S. teres* Claparede and Leichmann. The latter species, however, is devoid of the characteristic moniliform nucleus, etc.

## 27. *Saprodinium mimeticum* (Penard)

(Text-fig. 6A)

1922. *Epalxis mimetica* Penard, *Etudes sur les Infusories de l'eau douce*, Genève, p. 161, fig. 157.

1932.- *Saprodinium mimeticum* (Penard) : Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 527, fig. 84 (13 and 14).

*Material.*—(i) 1 ex., Jaipur (Jaipur Dist.), 2.ix.63. (ii) 1 ex., Fatehsagar (Udaipur Dist.), 11.xi.63.

*Diagnosis.*—Body laterally compressed, dorsal side more convex ; general shape 'rounded triangular' ; anterior end pointed and curved towards posterior end ; posterior end irregularly truncate and with four anal cirri (spines) ; macronucleus oval and dorsal ; contractile vacuole posterior and ventral ; size 21-23  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India). *Elsewhere* : Universal in freshwater bodies with decaying vegetation.

*Remarks.*—The specimens studied are smaller than the earlier recorded ones (Kahl, 1932).

## 28. *Euplotes pulmipes* Stokes

(Text-fig. 5i)

1884. *Euplotes pulmipes* Stokes, *Amer. mon. micr. J.*, Washington., 5, p. 229, pl. 12, figs. 7 and 8.

1960. *Euplotes pulmipes* Stokes : Tuffrau, *Hydrobiologia*, Den Haag, 15, pp. 47-50, figs. 31-33, 46(k).

*Material.*—(i) 3 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 30.x.63. (ii) 2 ex., Fatehsagar (Udaipur Dist.), 11.xi.63. (iii) 2 exs., Gajner (Bikaner Dist.), 20.xii.63.

*Diagnosis.*—Elongated ellipsoid ; peristome wide and deep, peristomial depression sigmoid ; membranellae forming a sigmoid curve ; end of cytopharynx far to the left and anterior to fifth anal cirrus : from to ventral cirri, 9, transverse cirri 5 and caudals 4 ; macronucleus nearly E-shaped ; micronucleus near flattened anterior corner of macronucleus ; size 89-120.8  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record from India). *Elsewhere* : Universal in freshwater ponds.

*Remarks.*—The specimens observed were smaller in size than those recorded earlier by Kahl, (1932 ; 125  $\mu$ ).

## 29. *Euplotes patella* (Müller)

(Text-fig. 5G)

1786. *Kerona patella* (?) Müller, *Animalc. Infusoria, fluviat. et marina etc.*, Havniae et Lipsiae, p. 238, pl. 23, figs. 14-17.

1838. *Euplotes patella* (Müller) : Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, p. 378, pl. 42, fig. 9.

1936. *Euplotes patella* (Müller) : Bhatia, *Faun. Brit. India*, Ciliophora, p. 386.

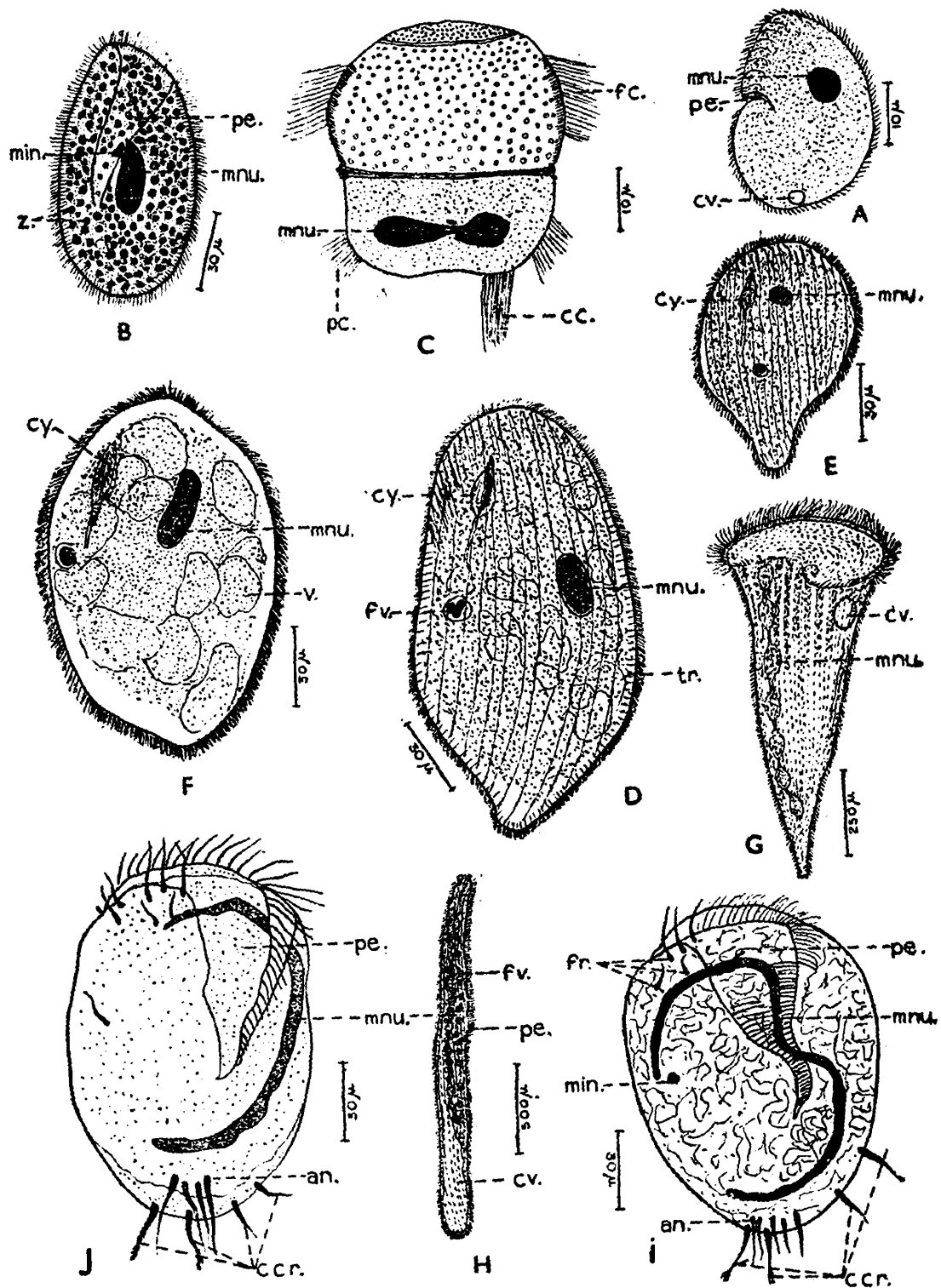
1960. *Euplotes patella* (Müller) : Tuffrau, *Hydrobiologia*, Den Haag, 15, pp. 40-43.

*Material.*—2 exs., Fatehsagar (Udaipur Dist.), 12.xi.63.

*Diagnosis.*—Body subcircular to elliptical ; fronto-ventral cirri 9, anals 5, caudals 4 ; aboral surface with six prominent ridges ; posterior end of cytopharynx situated anterior to and to left of the fifth anal cirrus ; macronucleus c-shaped ; with a single micronucleus ; contractile vacuole posterior ; size 124-130  $\times$  79-85  $\mu$ .

*Distribution.*—RAJASTHAN : As above (first record). *Elsewhere* : Universal in stagnant waters.

*Remarks.*—My specimens are slightly larger than those of Bhatia (1936) and Tuffrau (1960).



TEXT-FIG. 5.—(A) *Colpoda inflata* (Stokes). (B) *Paramecium bursaria* (Ehrenberg). (C) *Urocentrum turbo* (Müller). (D-E) *Frontonia atra* (Ehrenberg). (F) *Frontonia complanata* (Wetzel). (G) *Stentor coeruleus* Ehrenberg. (H) *Spirostomum ambiguum* Ehrenberg. (I) *Euplotes plumipes* Stokes. (J) *Euplotes patella* (Müller).

30. *Euplotes inkystans* Chatton (?)

(Text-fig. 6B)

1954. *Euplotes inkystans* Chatton, in Faure, Fremiet, Gauchery & Tuffrau, *Bull. biol.*, Paris, **88**, p. 157.

1960. *Euplotes inkystans*: Tuffrau, *Hydrobiologia*, Den Haag, **15**, pp. 50-51, figs. 34, 35 and 46l.

*Material*.—(i) 8 exs., Sadar Samand (Pali Dist.), 26.xi.63. (ii) 2 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 10.xi.63. (iii) 1 ex., Phulera (Jaipur Dist.), 12.x.63.

*Diagnosis*.—Body more or less round, fronto-ventral cirri 10, anals 5, caudals 4-5; peristome sickle-shaped; end of cytopharynx turning to left and ending in front of second anal cirrus; macronucleus, eshaped; size 39-88  $\mu$ .

*Distribution*.—RAJASTHAN: As above (first record from India). *Elsewhere*: Universal in freshwater ponds among decaying vegetation.

*Remarks*.—My specimens are of about the same size as those in the earlier records. Regarding the authorship and the date of erection of this species, it may be pointed out that E. Chatton named this species but never published any account of the same. It were Faure-Fremiet, Gauchery and Tuffrau (1954) who came across the slide inscribed as *Euplotes inkystans*, from Chatton's collection, during their studies of some species of genus *Euplotes* (through personal communication, 6 Aug. '64, from Dr. Michel Tuffrau, Paris). The authors, however, giving due credit to Chatton as the author, included an account of this species in their paper (1954), on receiving confirmation from Mme. E. Chatton that the account of that species has since been unpublished.

*Diagnosis*.—Body ovate, flattened, flexible, rounded and widest posteriorly; anterior end comparatively tapering; peristomial field extending to middle of the body; frontal cirri 8, ventrals 5, anals 5, caudals very short, marginals many; macronucleus in two parts; contractile vacuole just below and to the one side of peristomial region; size 88-98  $\times$  31-45  $\mu$ .

*Distribution*.—RAJASTHAN: As above (first record from India). *Elsewhere*: Universal in freshwater bodies with decaying vegetation.

*Remarks*.—My specimens are small, the previous recorded length being 150  $\mu$ .

31. *Oxytricha fallax* Stein

(Text-fig. 6C)

1859. *Oxytricha fallax* Stein, *Der Organismus der Infusionsthier*, Leipzig, **1**, p. 189, pl. 12, figs. 12-15.

*Material*.—(i) 1 ex., Anasagar (Ajmer Dist.), 10.xi.63. (ii) 1 ex., Faisagar (Ajmer Dist.), 10.xi.63. (iii) Several exs., Shivbari (Bikaner Dist.), 20.xii.63.

32. *Oxytricha hymenostomata* Stokes

(Text-fig. 6D)

1887. *Oxytricha hymenostomata* Stokes, *Ann. Mag. nat. Hist.*, London, (5) 2, p. 111, pl. 3, fig. 10.

1932. *Oxytricha hymenostomata* : Kahl, *Urtiere oder Protozoa* (in : Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 603, fig. 113 (27).

*Material*.—1 ex., Anasagar Lake, Ajmer (Ajmer Dist.), 7.xi.63.

*Diagnosis*.—Body long, oval ; broadly rounded posteriorly ; anterior and posterior regions more or less equal in width ; peristome extending upto 1/3rd of body-length ; macronucleus in two oval parts ; contractile vacuole situated just below peristome ; size  $101 \times 45 \mu$ .

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

*Remarks*.—This is a very rare species.

33. *Oxytricha ovalis* Kahl

(Text-fig. 6E)

1932. *Oxytricha ovalis* Kahl, *Urtiere oder Protozoa* (in Dahl's *Tierwelt Dtsch.*), Jena, pt. 25, p. 603, fig. 113 (32).

*Material*.—(i) 1 ex., Phulera (Jaipur Dist.), 24.x.63. (ii) 2 exs., Anasagar Lake, Ajmer (Ajmer Dist.), 9.xi.63. (iii) 2 exs., Faisagar (Ajmer Dist.), 10.xi.63. (iv) 2 exs., Sardar Samand (Pali Dist.), 26.x.63.

*Diagnosis*.—Body oval ; frontal cirri 9, ventrals 5, anals 5 ; anterior and posterior regions rounded ; peristome extending to about 1/3rd of the body-length ; macronucleus in two parts ; size 78-85 by 45-52  $\mu$ .

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

*Remarks*.—My specimens are smaller than those of Kahl (1932, average c. 120  $\mu$ ).

34. *Oxytricha oblongatus* n. sp.

(Text-fig. 6F)

*Material*.—2 exs., Sardar Samand (Pali Dist.), 26.xi.63.

*Diagnosis*.—Body broadly oval and oblong ; sides running parallel for a greater distance than in allied species of the genus ; frontal cirri 9, ventrals 5, anals 5, marginals running uninterrupted at posterior end. Macronucleus in two oval parts. Contractile vacuole situated on one side of peristome. Size 101-114 by 38  $\mu$ .

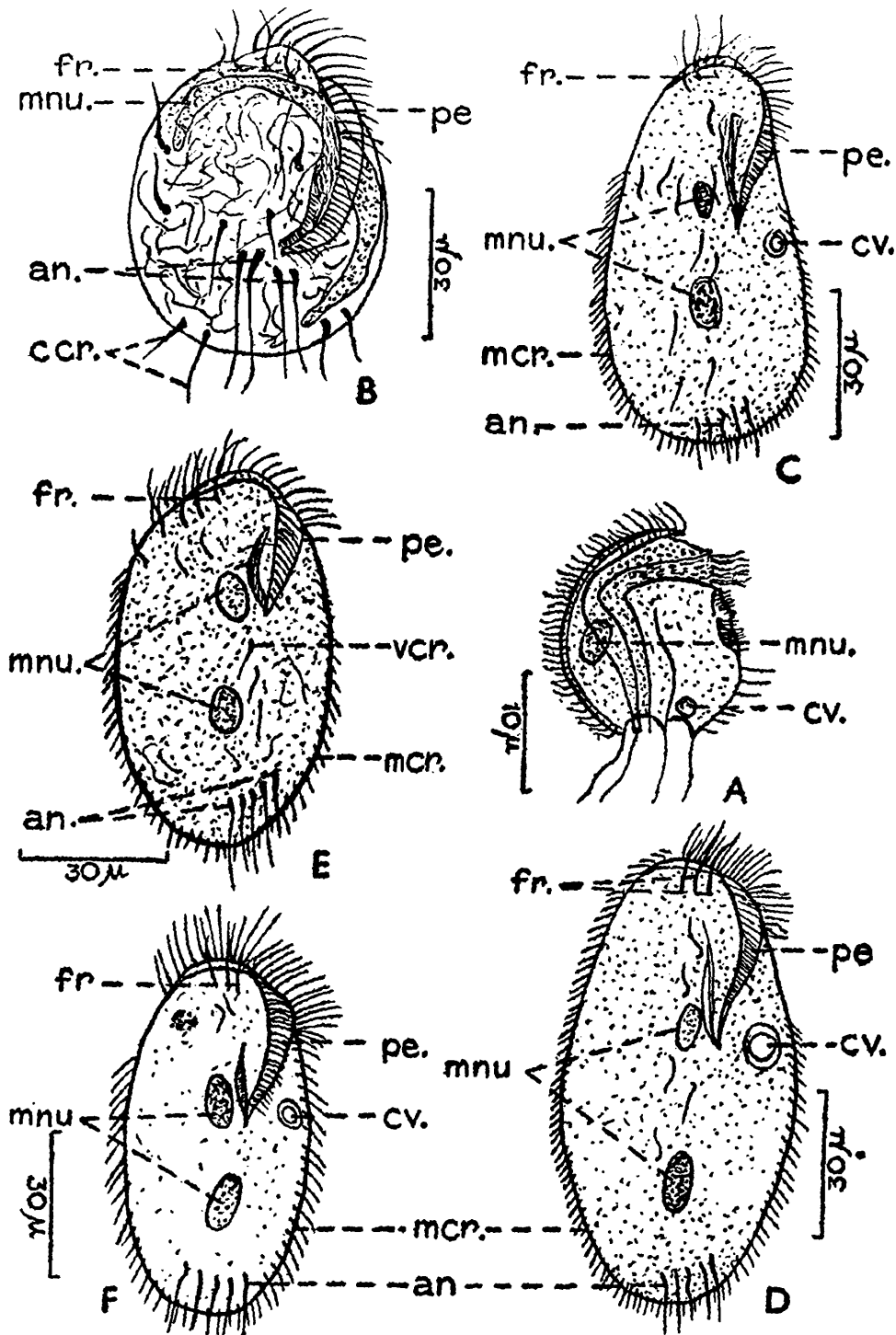
*Distribution*.—RAJASTHAN : As above.

*Comparison*.—The new species differs from the allied ones as follows :—

1. From *O. ovalis* Kahl : (i) Body more oblong and posterior by more rounded. (ii) Sides almost parallel (vs. not so in *ovalis*).

2. From *O. hymenostomata* Stokes: (i) Shape oblong, sides almost parallel, both ends rounded (Vs. widest in the middle and narrowing at both ends in *hymenostomatus*).

*Type specimens.*—*Holotype*: 1 ex., on a slide, Z.S.I. Reg. No. Pt.383, Loc. as above. *Paratype*: 1 ex., on a slide, Z.S.I. Reg. No. Pt. 384, Loc. as above.



TEXT-FIG. 6.—(A) *Saprodinium mimeticum* (Penard). (B) *Euplotes inkystans* Chatton. (C) *Oxytricha fallax* Stein. (D) *Oxytricha hymenostomata* Stokes. (E) *Oxytricha ovalis* Kahl. (F) *Oxytricha oblongatus* n. sp.

## V—SUMMARY

1. This paper (the second of the series of papers on the Protozoa of Rajasthan) deals with freshwater Protozoa collected by the author during September—December, 1963 in Rajasthan in the districts of Ajmer, Jaipur, Jodhpur, Bikaner, Pali, Udaipur and the Sambhar Salt Lake area (Nagaur and Jaipur districts).

2. Thirty-four species belonging to 21 genera, 19 families, 9 orders and 3 subclasses (Mastigophora, Sarcodina and Ciliata) are included. Of these, the following three taxa (2 species and one variety) of the class Ciliata are new to science :—

(A) Subcl. Holotricha, Ord. Gymnostomatida.

1 *Coleps devdaniensis* n. sp. (Fam. Colepidae).

2. *Holophrya bengalensis* n. subsp. *minor* : (Fam. Enchelyidae).

(B) Subcl. Spirotricha, Ord. Hypotrichida : (Fam. Oxytrichidae).

3. *Oxytricha oblongatus* n. sp.

3. All the 34 species are recorded for the first time from Rajasthan, and 25 of them are apparently first records from India.

4. Keys for the identification of freshwater protozoan genera known from Rajasthan and brief diagnostic characters of each species are given.

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#### VII—LETTERING USED IN TEXT-FIGURES

*afl.*, anterior flagellum ; *an.*, anal cirri ; *cc.*, caudal cilium ; *cer.*, caudal cirri ; *cv.*, contractile vacuole ; *cy.*, cytostome. *phb.*, pharyngeal basket., *fl.*, flagellum ; *fr.*, frontal cirri ; *g.*, girdle ; *fv.*, food vacuole ; *mar.*, marginal cirri ; *min.*, micronucleus ; *mmu.*, macronucleus ; *nu.*, nucleus ; *pe.*, peristome ; *ph.*, pharynx ; *ps.*, posterior spines ; *s.*, striation ; *tfl.*, trailing flagellum ; *tr.*, trichocysts.