FAUNA OF RAJASTHAN, INDIA.

PART 2.—PROTOZOA (No. 1)

By

K. K. MAHAJAN

Zoological Survey of India, Calcutta

(With one Table and 6 Text-figures)

CONTENTS

I—INTRODUCTION

(a) *General*

This is the first of a series of papers on the fauna of free-living Protozoa of Rajasthan, and is based on the collections made by the author during February-April, 1962, from the districts of Jodhpur, Pali and the Sambhar Salt Lake and its vicinity (Nagaur and Jaipur districts). Field cultures were prepared to obtain examples of the various species. The material was subjected to appropriate intra vitam staining and also observed under a phase contrast microscope. In some cases, owing to scarcity of material, this could be done only for one or two individuals. For the study of Ciliates, silver-line observations were taken as far as possible, and the fixatives used were Champy's fluid and saline Da Fano's fixative. A total of 30 species are listed here. The number of examples mentioned in the text, relates to the permanent preparations made, where as many individuals were observed and studied in the field before reaching any conclusion.

For an account of the topography, climate, vegetation, etc. of Rajasthan, *see* Part I (General Introduction) of this series of papers. (Roonwal, 1968. *Records of the Zoological Survey of India*, Vol. 61 (3 & 4), pp. 291—375).

(b) *Acknowledgements*

My thanks are due to the staff of the Protozoa Section for assistance in the field as well as in the laboratory and the staff of the Desert and Gangetic Plains Regional Station of the Zoological Survey of India at Jodhpur. To the authorities of the Sambhar Salt Lake I am thankful for considerable help in field work. I am also indebted to Dr. M. L. Roonwal, Director, Zoological Survey of India, for his kind suggestions and guidance.

(c) *Abbreviations used*

Dist., District ; *Ex(s).*, Example(s) ; *Hom.*, Homonym ; *Syn(s).*, Synonym(s) ; *Z.S.I.*, Zoological Survey of India.

(d) *List of Collecting Stations*

A list of the Collecting Localities in the Jodhpur, Pali, Nagaur and Jaipur districts of Rajasthan is given in Table 1.

TABLE 1—*List of Collecting Stations for freshwater Protozoa in Rajasthan (February-April, 1961), K. K. Mahajan coll.*

(Also *see* Text-fig. 1)

Collecting Station	Latitude and Longitude (approximate)	
	Lat. (N)	Long. (E)
(i) *Jodhpur District*		
1 Tank inside Zoological Gardens, Jodhpur	26° 18′	73° 04′
2. Tank ½ Km. W of Jodhpur Fort	26° 18′	73° 04′
3 Mandore (12 Km. N. of Jodhpur) .	26° 20′	73° 00′
4. Nagkund (near Mandore)	26° 19′	73° 02′
5. Balsamand (near Jodhpur) .	26° 18′	73° 04′
6. Takhatsagar Lake (part of Kaylana Lake, 9 km. W. of Jodhpur)	26° 18′	73° 00″
7. Pratapsagar (part of Kaylana Lake, 8 km. W. of Jodhpur)	26° 18′	73° 09′
8. Agolai village (46 Km. N.W. of Jodhpur)	26° 15′	72° 35′
9. Loridi village (16 Km. N.W. of Jodhpur)	26° 22′	72° 53′
10 Umedsagar Tank (10 Km. W. of Jodhpur)	26° 15′	72° 55′
(ii) *Pali District*		
11. Sardar Samand (Lake) (55 Km. S.E. of Jodhpur).	25° 54′	73°25′
(iii) *Nagaur District*		
12. Sambhar Salt Lake (main lake)	26° 55′	75° 25′
(iv) *Jaipur District*		
13. New Kyar (near Sambhar Salt Lake) .	26° 54′	75° 13′
14. Devdyani (near Sambhar Salt Lake) .	26° 55′	75° 13′
15. A tank in Khyra village (7 Km. S. of Sambhar)	26° 52′	75° 13′
16. Erolai Dani village (near Phulera) .	26° 52′	75° 16′
17. A shallow well, 50 metres W. of tank in Erolai Dani village	26° 52′	75° 16′

II—LIST OF FREE-LIVING PROTOZOA KNOWN FROM RAJASTHAN

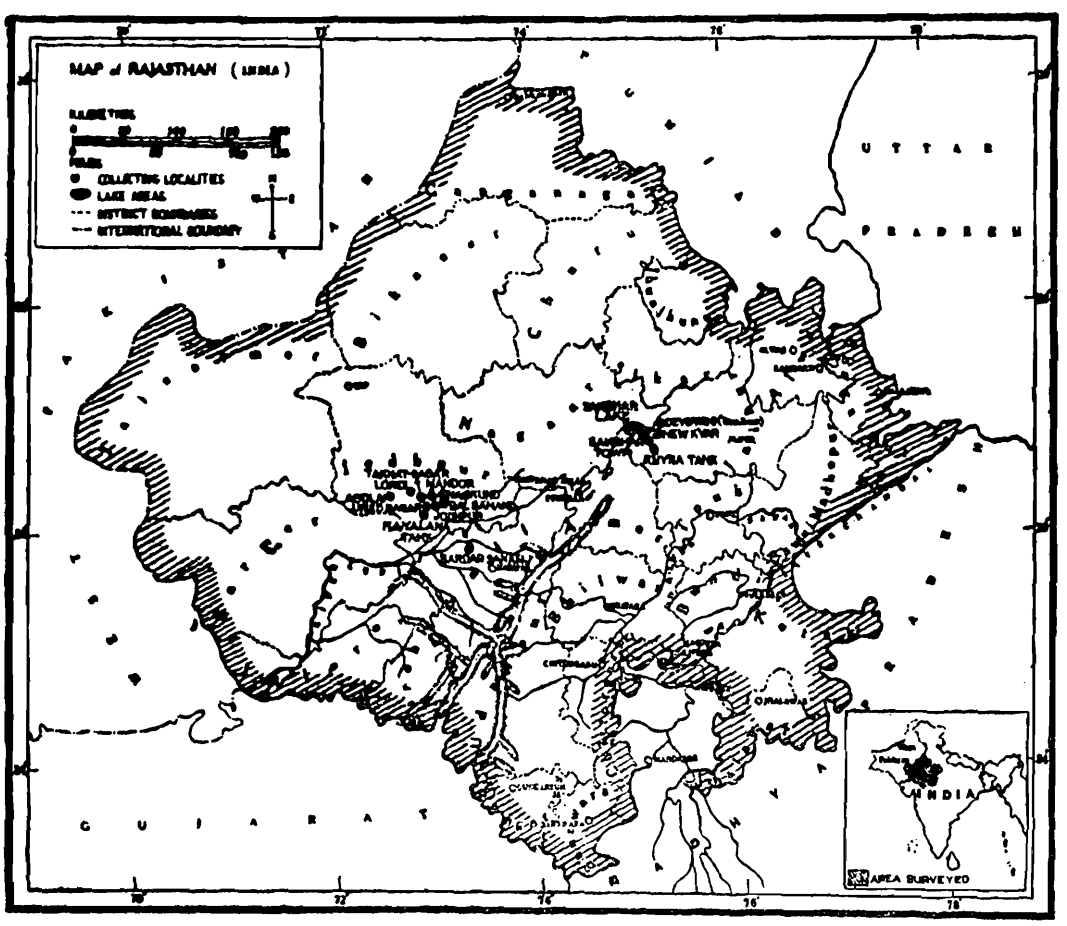
Class I. MASTIGOPHORA

Order 1. CRYPTOMONADINA

Family (i) CRYPTOMONADIDAE

Genus 1. **Chilomonas** Ehrenberg

1. *Chilomonas paramecium* Ehrenberg, 1831



TEXT-FIG. 1.—Map of Rajasthan, showing collecting localities for Protozoa.

Order 2. EUGLENOIDINA

Family (ii) EUGLENIDAE

Genus 2. **Euglena** Ehrenberg

2. *Euglena caudata* Hubner, 1886

Family (iii) ANISONEMIDAE

Genus 3. **Entosiphon** Stein

3. *Entosiphon ovatum* Stokes, 1885

Class II. SARCODINA
Order 1. TESTACEA
Family (iv) DIFFLUGIIDAE
Genus 4. **Difflugia** Lelerc
4. *Difflugia globulosa* Dujardin, 1837

Class III. CILIATA
Subclass (A) *Holotricha*
Order 2. GYMNOSTOMATIDA
Family (v) COLEPIDAE
Genus 5. **Coleps** Nitzsch
(Syns. *Cricocoleps, Dictyocoleps, Pinacocoleps*)
5. *Coleps hirtus* (Müller, 1786)

Family (vi) TRACHELIIDAE
Genus 6. **Dileptus** Dujardin
(Syn. *Phragelliorhynchus*)
6. *Dileptus americanns* Kahl, 1931

Genus 7. **Trachelius** Schrank
7. *Trachelius ovum* Ehrenberg, 1831

Family (vii) AMPHILEPTIDAE
(Syn. Litonotidae)
Genus 8. **Litonotus** Wrzes
(For *Leionota ;* Syn. *Lionotus*[hom.]
8. *Litonotus fasciola* Ehrenberg, 1831

Family (viii) DIDINIIDAE
(For Cyclodinidae ; Syn. Liliimorphidae)
Genus 9. **Didinium** Stein
9. *Didinium nasutum* (Müller, 1773)

Family (ix) CHLAMYDODONTIDAE
(Syns. Chilodonellidae [for Odontohypo Trichidae], Chilodontidae)
Genus 10. **Chilodonella** Strand
(For *Chilodon*)
10. *Chilodonella cucullulus* (Müller, 1883)
11. *Chilodonella uncinata* (Ehrenberg, 1838)

Order 3. SUCTORIDA
Family (x) PODOPHRYIDAE
(Syns. Metacinetidae, Sphaerophryidae, Urnulidae)
Genus 11. **Sphaerophrya** Clapar'ede & Lachmann
12. *Sphaerophrya pusilla* Clapar'ede & Lachmann, 1859

Order 4. HYMENOSTOMATIDA
Family (xi) OPHRYOGLENIDAE
(Syn. Icthyophthiriidae)
Genus 12. **Ophryoglena** Ehrenberg
(Syn. *Otostoma*)
13. *Ophryoglena flava* Ehrenberg, 1838

Family (xii) COHNILEMBIDAE
(For Lembidae)
Genus 13. **Cohnilembus** Kahl
(For *Lembus ;* syn. *Sparobucha*)
14. *Cohnilembus subulatus* (Kent, 1882)

Family (xiii) TETRAHYMENIIDAE
(Syn. Leucophryidae)
Genus 14. **Claucoma** Ehrenberg
(Syns. *Dallasia*, *Diplomastix*, *Diplomestoma*)
15. *Glaucoma pyriformis* (Ehrenberg, 1838)

Genus 15. **Monochilum** Schewiakoff
16. *Monochilum ovale* (Schewiakoff, 1893)

Family (xiv) PARAMECIIDAE
Genus 16. **Paramecium** Müller
(Syns. *Paramaccidium*, *Paramoccium*)
17. *Paramecium caudatum* Ehrenberg, 1833

Family (xv) CINETOCHILIDAE
Genus 17. **Cinetochilum** Perty
18. *Cinetochilum margaritaceum* Perty, 1852

Family (xvi) FRONTONIIDAE
(For Chiliferidae)
Genus 18. **Frontonia** Ehrenberg
(Syns. *Cyrtostomum*, *Frontoniella*, *Panophrys*)
19. *Frontonia leucas* Ehrenberg, 1838

Family (xvii) PLEURONEMATIDAE
(For Aphthoniidae ; Syn. Cyclidiidae)
Genus 19. **Cyclidium** Müller
(Syn. *Alyscum*)
20. *Cylidium gloucom* Müller, 1786

Order 5. PERITRICHIDA

Family (xviii) VAGINICOLIDAE

(For Vaginiferidae)

Genus 20. **Cothurnia** Ehrenberg (emend. Claparede & Lachmann)

21. *Cothurnia curva* Stein, 1854

Subclass (B) *Spirotricha*

Order 6. HETEROTRICHIDA

Family (xix) STENTORIDAE

Genus 21. **Stentor** Oken

(Syns. *Stentorella, Stentorina*)

22. *Stentor* sp.

Family (xx) GYROCORYTHIDAE

(Syns. Caenomorphidae, Gyrocoridae, Gyrocorycidae, Metopidae)

Genus 22. **Metopus** Claparede & Lachmann

(Syns. *Bothrostoma, Caenomorphina, Metopides* hom., *Spirorhynchus Trochella* hom.)

23. *Metopus es* Müller, 1786

24. *Metopus es* var. *rectus* Kahl, 1932

25. *Metopus ovalis* Kahl, 1927

Family (xxi) CONDYLOSTOMATIDAE

(Syn. Condylostomidae)

Genus 23. **Condylostoma** Bory

(Syns. *Kondyliostoma, Kondylostoma*)

26. *Condylostoma patens* (Müller, 1786)

27. *Condylostoma vorticella* (Ehrenberg, 1833)

Order 7. HYPOTRICHIDA

Family (xxii) EUPLOTIDAE

(Syn. Ploesconiidae)

Genus 24. **Euplotes** Ehrenberg

(Syns. *Ploesconia, Crateromorpha* hom.)

28. *Euplotes charon* (Müller, 1773)

Family (xxiii) OXYTRICHIDAE

(Syns. Keronidae, Kiitrichidae, Pleurotrichidae, Psilotrichidae, Spirofilida, Urostylidae)

Genus 25. **Chaetospira** Lachmann

(Syns. *Archimedia, Stichospira*)

29. *Chaetospira mulleri* Lachmann, 1856

Genus 26. **Stylonychia** Ehrenberg

(Syns. *Diplenrostyla, Drepanina, Prosopsenus*)

30. *Stylonychia pustulata* Ehrenberg, 1838

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

1(3). Permanent locomotory organelle absent.

2. Body mononucleate, in a monolocular shell formed by reinforcement of sand grains — *Difflugia*

3(1). Permanent locomotory organelle present.

4(8). Locomotory organelle long, flexible and whip-like (flagella) ; situated anteriorly.

5. Flagellum single and rooted in a reservoir — *Euglena*

6(7). Flagella two, both directed forwards — *Chilomonas*

7(6). Flagella two, one always trails behind during locomotion — *Entosiphon*

8(4). Locomotary organelle short and generally all over body, but sometimes restricted to certain regions.

9(34). Individuals free-living.

10(20). Cytostome present on body surface.

11(12). Cytostome anterior and at tip of an apical cone. Body barrel-shaped with 2 or 4 girdles of cilia at various levels — *Didinium*

12(11). Cytostome anterior, not apical but surrounded by slightly longer cilia. Body barrel-shaped and covered with regularly arranged, perforated ectoplasmic plates. — *Coleps*

13(14). Cytostome slit-like and situated on a convex ventral surface of a flattened, flask-shaped laterally compressed body. Anterior region drawn into a neck-like portion. Cilia only on right side ; cytostome with trichocysts. — *Litonotus*

14(13). Cytostome situated on a flattened ventral surface. Dorsal surface convex ; body dorso-ventrally flattened. Somatic ciliation restricted to ventral surface — *Chilodonella*

15(16). Cytostome rounded and at base of an anteriorly drawn out finger-like process. Body oval and rounded posteriorly — *Tracheliu*

16(15). Cytostome round and at base of a conspicuous neck-like projection. Body lanceolate and drawn out into a tail-like prolongation .. — *Dileptus*

17. Cytostome at about one-fourth of body-length towards anterior end, with inconspicuous undulating membrane on right and three membranellae on left ; ciliation uniform ; one contractile vacuole .. — *Glaucoma*

18(19). 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, centrally located — *Monochilum*

19(18). Cytostome at right of median line, in posterior half with a membrane on both edges which form a pocket. With one caudal cilium. Contractile vacuole single and terminal .. .. .. — *Cinetochilum*

20(10). Cytostome not on body surface but situated within peristome.

21(22). Peristome funnel-shaped, runs from anterior left to posterior right. Two typical contractile vacuoles which discharge through temporary excretory pore. Body foot-shaped — *Paramecium*

22(21). Peristome having no connection with cytostome, and with a complex organization. Body sole-shaped. Contractile vacuole with long radiating collecting canals — *Frontonia*

23(24). Peristome sickle-shaped and as ciliated slit sunk at right angles to body surface. One or two contractile vacuoles with long radiating canals — *Ophryoglena*

24(23). Peristome not sunk at right angles to body but starts from anterior end to middle of body ; curved to right. Body spindle-shaped.

25(28). Body uniformly ciliated. Individuals without cirri.

26(27). Conspicuous anterior peristome, slightly spirally diagonal, beginning at anterior end and reaching almost the middle of body. A narrow non-ciliated zone on right of adoral zone. Macronucleus one — *Metopus*

27(26). Peristome wide anteriorly, V-shaped and without non-ciliated zone. A large undulating membrane on right edge and adoral zone on left of peristome. Macronucleus moniliform .. .. — *Condylostoma*

28(25). Body ciliation extremely reduced ; individuals with cirri on ventral side and characteristic bristles on dorsal side.

29(31). Body loricated.

30. Individuals flask-shaped, flexible and free to move inside lorica. Cytostome at base of proboscis — *Chaetospira*

31(29). Body not loricated.

32(33). Individuals reniform, not flexible ; five ventrals in rows, five anals, innumerable marginals, three caudals and with short bristles on dorsal side — *Stylonychia*

33(32). Body ovoid, inflexible, longitudinally ridged ; nine fronto-ventrals, not in rows — *Euplotes*

34(9). Individuals sessile.

35(37). Individuals with non-contracile stalk ; food-procurement and ingestion with help of tentacles — *Sphaerophrya*

36(35). Individuals with a short contractile stalk, no suctorial tentacles and in a lorica — *Cothurnia*

37. Body trumpet-shaped and contractile — *Stentor*

IV—Systematic Account

1. **Chilomonas paramecium** Ehrenberg

(Text-fig. 2*a*)

1931. *Chilomonas paramecium* Ehrenberg, *Adh. preuss. Akad. Wiss.*, Berlin, **2**, p. **64**, pl. IV, fig. 6.

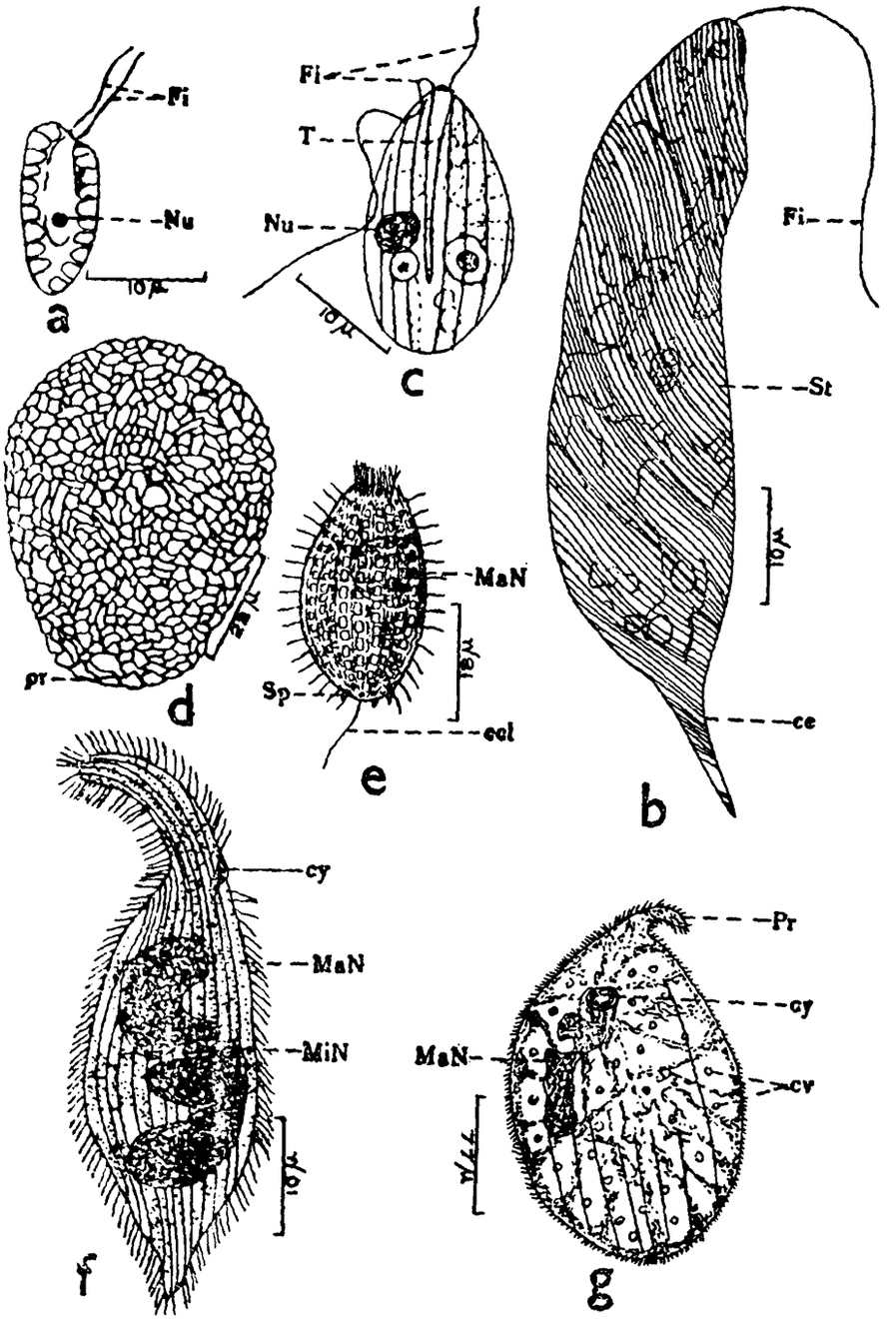
1942. *Chilomonas paramecium*, Holland, *Arch. Zool. exp. gen.*, Paris, **83**, pp. 25-26 pls. III, IV.

Material.—**One** lot, several exs., Takhatsagar, near Jodhpur (Jodhpur Dist.), **22. ii. 62.**

Diagnosis.—Body posteriorly narrow in live specimens (but wider in prepared slides) ; slightly bent dorsally ; size 16.5 by 7.5μ. Saprozoic in stagnant water.

Distribution.—Rajasthan (first record from India) : As above, *Elsewhere :* Universal. Found abundantly in vegetable infusions.

Remarks.—My specimens are very small. Butschli (1878) recorded larger examples (30—40μ by 10—15μ) and so did Kent (1882, 22—39μ, long).



TEXT-FIG. 2.—(*a*) *Chilomonas paramecium.* (*b*) *Euglena caudata.* (*c*) *Entosiphon ovatum.* (*d*) *Difflugia globulosa.* (*e*) *Coleps hirtus.* (*f*) *Dileptus americanus* (*g*) *Trachelius ovum.*

cel., Caudal cilium ; *ce.*, caudal projection ; *cv.*, Contractile vacuole ; *cy.*, Cytostome ; *Fl.*, *Flagellum* : *MaN.*. Macronucleus ; *Nu.*, Nucleus ; *or.*, Orifice ; *Pr.*, Proboscis ; *Sp.*, Spine ; *St.*, Striae.

2. **Euglena caudata** Hübner

(Text-fig. 2*b*)

1886. *Euglena caudata* Hübner, *Progr. Realgymn. Starlzund*, Starlzund, **20**, p. 4.

1956. *Euglena caudata* Pringshiem, *Nova Acta Leop.*, Leipzig, **18** (125), pp. 74-75, fig. 15.

Material.—One ex., pond in Khyra village, near Phulera (Jaipur Dist.), 6. iv. 62.

Diagnosis.—Body spindle-shaped, with a long tail-like posterior portion ; characteristic diagonal straiations ; size 73·5 by 18 μ.

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

Remarks.—My specimen is of medium size. Hübner (1886) recorded the largest (100 by 38 μ) and Chu (1947) the smallest (30 by 10 μ).

3. **Entosiphon ovatum** Stokes

(Text-fig. 2*c*)

1885. *Entosiphon ovatus* Stokes, *Ann. Mag. nat. Hist.*, London, (5) **15**, p. 440, pl. XV. fig. 12.

1888. *Entosiphon ovatus* Stokes, *J. Trenton nat. Hist. Soc.*, Trenton, **1**, p. 108. pl. I I. fig. 9.

Material.—One ex., Sardar Samand Lake (Pali Dist.), 6. iii. 62.

Diagnosis.—Cytopharyngeal tube very prominent ; two flagella ; nucleus centro-lateral ; size 24 by 13·5 μ.

Distribution.—Rajasthan (first record from India) : As above. *Elsewhere :* Universal in large sheets of freshwaters.

Remarks.—An extremely rare species. The only other record for the world was the first one by Stokes (1885) from N. America. The present is the first record from the Tropics. My specimens are rather small ; Stokes's specimens were 25-28 μ long.

4. **Difflugia globulosa** Dujardin

(Text-fig. 2*d*)

1837. *Difflugia globulosa* Dujardin, *Ann. Sci. nat.*, Paris, **8**, p. 311, pl. 9, figs. *la, b.*

1958. *Difflugia globulosa* Gauthier-Lievre & Thomas, *Arch. Protistenk.*, Jena, **103**, p. 130, figs. 36*a, b, c.*

Material.—One ex., tank in Devdani, near Sambhar Lake (Jaipur Dist.), 22. iii. 62.

Diagnosis.—Shell spheroidal, composed of quartzy sand ; mouth terminal ; pseudopodia, are thrown out in living condition, simple and finger-like ; size 73 by 56 μ.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Universal, found generally on the pond ooze.

Remarks.—My specimen is smaller to the earlier records. Dujardin 1837) recorded specimens 100 μ long and Gautheir-Lièvre & Thomas (1958) 100 by 80 μ.

Coleps hirtus (Müller, O.F.) Nitzsch

(Text-fig. 2*e*)

1786. *Cercaria hirta* Müller, O.F., *Animalc. infusoria fluviat. et marina etc.*, Hafniae et Lipsiae, p. 128, pl. xix, figs. 17-18.

1817. *Coleps hirtus*, Nitzsch, *Neue Schrift. der naturf. Ges. in Halle*, Halle, 3, p. 3.

1925. *Coleps hirtus*, Noland, *Trans. Amer. micr. Soc.*, Lancaster, 44, pp. 6-7, pl. 1, fig. 3.

Material.—(i) One ex., Takhatsagar Lake, near Jodhpur (Jodhpur Dist.), 22. ii. 62. (ii) One lot, two exs, Sardar Samand Lake (Pali Dist.) 6. iii. 62.

Diagnosis.—Body barrel-shaped, slightly narrower and turncated in front ; three spines at posterior end ; perforated quadrangular plates on cuticular surface ; size 34 by 19 μ.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Universal. Other records from India are Srinagar (Kashmir) ; Calcutta.

Remarks.—My specimens are smaller than those of Noland (1925, 40—65 μ long).

6. **Dileptus americanus** Kahl

(Text-fig. 2*f*)

1931. *Dileptus americanus*, Kahl, Urtiere order Protozoa, *Tierwelt Dtsch.*, Jena, Pt. 21, p. 209, fig. 32*a*.

Material.—One, ex., pond inside Zoological Gardens, Jodhpur (Jodhpur Dist.), 19. ii. 60.

Diagnosis.—Body sickle-shaped ; proboscis bent dorsally ; two contractile vacuoles on dorsal side ; macronucleus with two horse-shoe shaped parts ; size 51 by 16.5 μ.

Distribution.—Rajasthan (first record from India) : As above. *Elsewhere :* Wisconsin (U.S.A.).

Remarks.—The specimen is very small compared to other species of the genus ; very rare form.

7. **Trachelius ovum** Ehrenberg

(Text-fig. 2*g*)

1833. *Trachelius ovum* Ehrenberg, *Abd. preuss. Akad. Wiss.*, Berlin, **1835**, pp. 265-277.

1931. *Trachelius ovum* Kahl, Urtiere oder Protozoa. *Tierwelt Dtsch.*, Jena, Pt. 21, pp. 210-211, figs. 26,27.

Material.—One ex., tank in Devdani, near Sambhar Lake (Jaipur Dist.), 24. iii. 62.

Diagnosis.—Body somewhat oval, drawn out anteriorly into a finger-like process ; peristome at base of process ; anastomosing cytoplasmic branches penetrate endoplasm ; contractile vacuoles numerous ; macronucleus sausage-shaped; size 124.5 by 85 μ.

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

Remarks.—My specimen is much smaller than those of Kahl's (1930, 200—400 μ long).

8. **Litonotus fasciola** (Ehrenberg)

(Text-fig. 3*a*)

1831. *Amphileptus fasciola* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, (1832), p. 116.

1870. *Litonotus fasciola*, Wrgesniowski, *Z. wiss. Zool.*, **20**, Leipzig, p. 500, figs. 29-32.

Material.—Two lots : (i) One ex., Sardar Samand Lake (Pali Dist.), 6. iii. 62. (ii) One ex., shallow well in village Erolai Dani, near Sambhar Lake (Jaipur Dist.), 9. iv. 62.

Diagnosis.—Body lanceolate ; neck-like projection nearly one-half of body length ; single contractile vacule at beginning of tail-like posterior projection ; macronucleus bipartite ; size : 67·5 μ long.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Universal. Other records from India are : Srinagar (Kashmir) and Calcutta.

Remarks.—My specimens are smaller (in no case more than 67·5μ long) than those of Kahl (1931, 100 μ long) and Bhatia (1936, 94 μ long).

9. **Didinium nasutum** (Müller)

(Text-fig. 3*b*)

1773. *Vorticella nasuta* Müller, O.F., *Verminum terrest. et. fluvatil s. animal infusor· etc., historia*, Hafniae et Lipsiae, pp. 102-104.

1859. *Didinium nasutum*, Stein, *Lotos*, Prague, **9**, p. 5.

1962. *Didinium nasutum*, Dingfelder, *Arch. Protistenk.*, Jena, **105**, p. 547.

Material.—One lot, 3 exs., a well in village Erolai Dani, near Sambhar Lake (Jaipur Dist.), 9. iv. 62.

Diagnosis.—Body barrel-shaped, with 2 girdles of cilia ; a conical projection at anterior end ; a contractile vacuole at posterior end ; macronucleus curved and band-like ; size 137 by 97 μ.

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

Remarks.—My specimens are larger than those of Kent (1880, 83 μ), Conn & Edmondson (1918, 100—175 μ) and Bhatia (1936, 123 by 84 μ).

10. **Chilodonella cucullulus** (Müller)

(Text-fig. 3*c*).

1883. *Kolpoda cucullulus* Müller, O.F., *Verminum terrest. et. fluviatil s. animal infusor· etc., historia*, Hafniae et Lipsiae, p. 158.

1926. *Chilodonella cucullulus*, Strand, *Arch. Naturgesch.*, Berlin, **92**, p. 31.

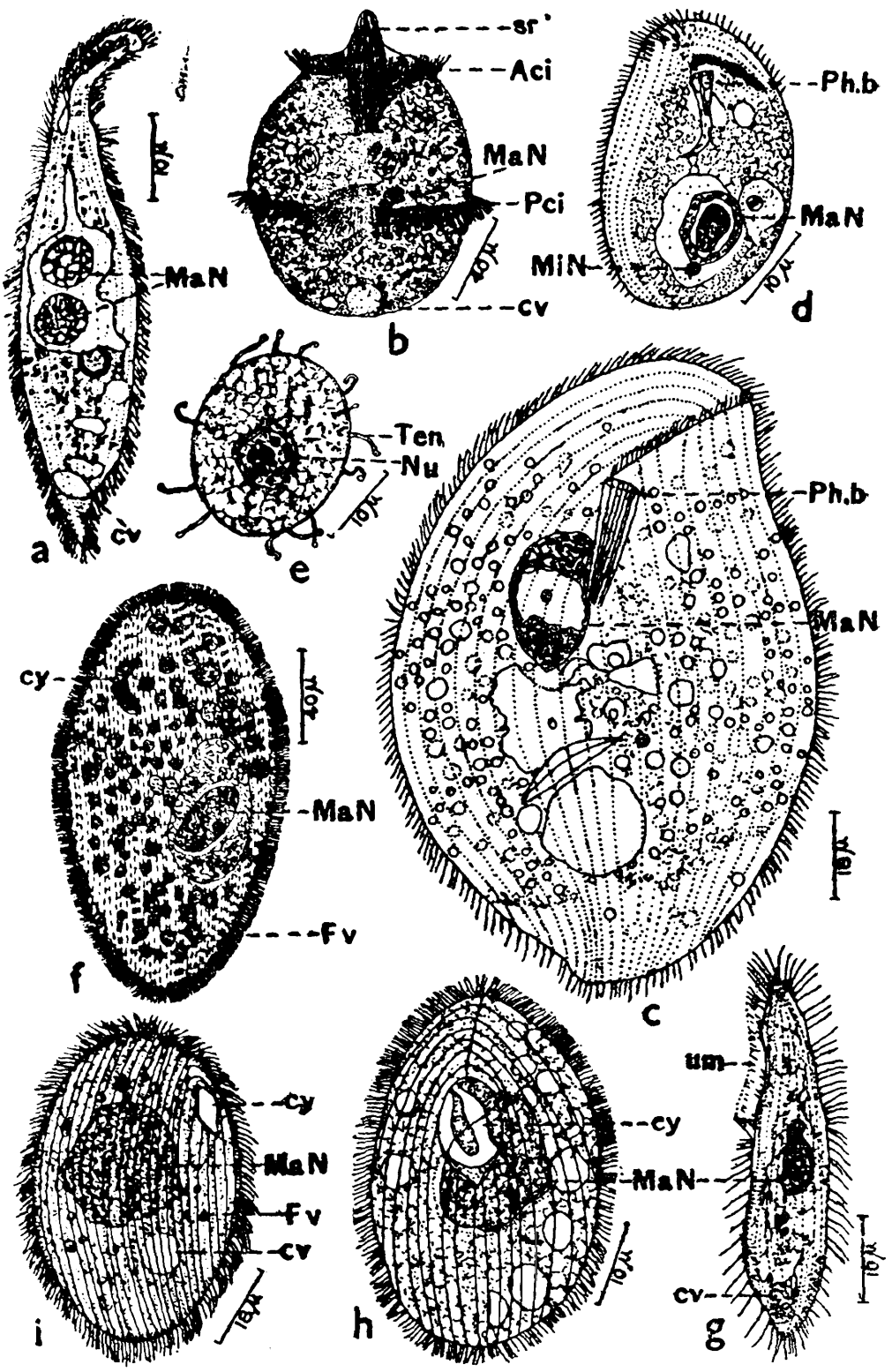
1962. *Chilodenella cucullulus* Dingfelder, *Arch. Protistenk.*, Jena, **105**, p. 566.

Material.—One lot, 2 exs., Sardar Samand Lake (Pali Dist.), 6. iii. 62

Diagnosis.—Body dorso-ventrally flattened ; a beak-like projection at anterior end ; dorsal surface convex, ventral surface flat ; cytopharynx straight ; macronucleus oval and characteristic ; size 130 by 87 μ

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Universal Other records from India are : Srinagar (Kashmir) and Bombay.

Remarks.—My specimens are of medium size. Previous records are : Kahl (1931, 130-150 μ, sometimes upto 300 μ) ; Bhatia (1936, 90 by 42 μ) ; and Dingfelder (1962, 100-110 μ).



TEXT-FIG. 3.—(*a*) *Litonolu asciola.* (*b*) *Didinium nasutum.* (*c*) *Chilodoneo cucullulus.* (*d*) *Chilodonella uncinata.* (*e*) *Sphaerophrya pusilla.* (*f*) *Ophryoglena fiava.* (*g*) *Cohnilembus subulatus.* (*h*) *Glaucoma pyriformis.* (*i*) *Monochilum oval e.*

Aci., Anterior circlet of cillia ; *cv.*, contractile vacuole ; *Cy.*, Cylostome ; *Fv.*, Fool vacuole ; *MaN*, Macronucleus ; *MiN.*, Micronucleus ; *Na.*, Nucleus ; *Pci.*, Posterida circlet of cilia ; *Phb.*, Pharyngeal basket ; *Sn.*, Snout ; *Ten.*, Tentacle ; *um.*, Undulatine membrane.

11. **Chilodonella uncinata** (Ehrenberg)

(Text-fig. 3*d*)

1838. *Chilodon uncinatus* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, **1838**, p. 337.
1926. *Chilodonella uncinata*, Strand, *Arch. Naturgesch*, Berlin, vol. **92**, p. 31.
1962. *Chilodonella uncinata*, Dingfelder, *Arch. Protistenk.*, Jena, **105**, p. 567.

Material.—One lot, 8 exs., Balsamand Lake, near Jodhpur (Jodhpur Dist.), 21. ii. 62.

Diagnosis.—Dorso-ventrally flattened body ; cytopharynx curved at posterior end ; macronucleus spherical and granular ; a micronucleus present posterior to it ; size 30 by 19μ.

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

Remarks.—My specimens are very small. Other records are : Kahl (1931, 50-90μ long) ; Dingfelder (1962, 43-40μ long).

12. **Sphaerophrya pusilla** Claparede & Lachmann

(Text-fig. 3*e*)

1859. *Sphaerophrya pusilla* Claparede & Lachmann, *Etudes sur les infusories et les rhizopodes*, Gèneve, p. 385, pl. 1, fig. 11.
1936. *Sphaerophrya pusilla*, Bhatia, *Fauna Brit., India, Protozoa*, Ciliophora, London, pp. 433-435, figs. 213, 214.

Material.—One ex., New Kyar, Sambhar Lake (Jaipur Dist.), 18.iii.62.

Diagnosis.—Body spherical ; minute, with few short knobbed tentacles ; no stalk ; size : 25·5μ diameter.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Other records from India are : Hoshiarpur (Punjab) ; and Bombay.

Remarks.—My specimens are larger than those of Bhatia (1936, 12-15μ diameter). A rare species.

13. **Ophryoglena flava** Ehrenberg

(Text-fig. 3*f*)

1838. *Ophryoglena flave* Ehrenberg. *Die Infusionsthierchen als volkommene Orgonismen*, Leipzig, p. 330, pl. XXXV, fig.
1962. *Ophryoglena flava*, Dingfelder, *Arch. Protistenk.*, Jena, 105, p. 595.

Material.—One lot, 3 exs., Sardar Samand Lake (Pali Dist.), 6.iii.62.

Diagnosis.—Body elongated oval ; cytostome situated at one-third of body length from anterior and on ventral side ; contractile vacuoles two, with long radiating canals ; macronucleus elliptical ; size 178 by 99μ.

Distribution.—*Rajasthan* (first record) : As above. *Elsewhere :* Universal, in stagnant water with decaying vegetation. Other record from India : Bombay.

Remarks.—My specimens are very small. Other records are : Roux (1901, 560μ long), Penard (1922, 500μ long), Kahl (1931, 250-400μ long) and Dingfelder (1962, 200-207 by 255 μ).

14. **Cohnilembus tubulasus** (Kent)

(Text-fig. 3*g*)

1882. *Lembus subulatus* Kent, *A Manual of the Infusoria*, London, p. 548, pl. XXVII, figs. 66, 67.

1935. *Cohnilembus* (nom. nov.) *subulatus* Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, pt. 30, p. 835.

Material.—Two lots : (i) 2 exs., New Kyar, Sambhar Lake (Jaipur Dist.), 19.iii.62 ; (ii) 2 exs., Sambhar Salt Lake (main lake) (Nagpur Dist.), 30.iii.62.

Diagnosis.—Body slender, spindle-shaped ; peristome extends upto middle of body, with two undulating membranes ; macronucleus oval and central ; size 33 by 10μ.

Distribution.—*Rajasthan* (first record from India) : As above. *Elsewhere :* Universal in salt waters, in association with the bacterial film on the water surface.

Remarks.—My specimens are the smallest recorded so far. Kahl (1931) had specimens 35μ long. A rare species.

15. **Glaucoma pyriformis** (Ehrenberg)

(Text-fig. 3*h*)

1838. *Leucophrys pyriformis* Ehrenberg, *Die Infusionsthierchen als vollkommene Organisman*, Leipzig, pp. 312-313, pl. XXXII, fig. 4.

1889. *Glaucoma pyriformies* Schewiakoff, *Bibl. zool.*, Leipzig, 5, pp. 35-36, pl. IV figs. 54, 55.

1936. *Glaucoma pyriformis*, Bhatia, *Fauna Brit India, Protozoa, Ciliophora*, London, pp. 170-171. fig. 75.

Material.—One lot, 4 exs., pond inside Zoological Gardens, (Jodhpur Dist.), 19.ii.62.

Diagnosis.—Body pear-shaped, narrowed but rounded anteriorly ; cytostome in anterior fourth of body, oval and elongated along long axis of body ; macronucleus rounded and central ; size 46 by 29μ.

Distribution.—*Rajasthan* (first record) : As above. *Elsewhere :* Widely distributed in India also recorded from Srinagar (Kashmir).

Remarks.—My specimens are of medium size. Other records are : Kahl (1931) length 38-80μ long ; and Bhatia (1936, 32-75 by 24-47μ).

16. **Monochilum ovale** (Schewiakoff)

(Text-fig. 3*i*)

1893. *Uronema ovale* Schewiakoff, *Mèm. Acad. Sci. St-Petersb.*, St. Petersberg, (7) 41, (8), pp. 191-201, (Abstract in *Zool. Anz.* (Literature), **17**, p. 122.

1931. *Monochilum ovale* Kahl, Urtiere order Protozoa, *Tiewielt Dtsch.*, Jena, pt. 21, p. 340, figs. 57, 30.

Material.—One lot, several exs., Mandore, near Jodhpur (Jodhpur Dist.), 20.ii.62.

Diagnosis.—Body ovoid ; cytostome oblong and placed in anterior fourth of body ; ciliation uniform and dense ; a contractile vacuole in middle ; size 64.5 by 37·5μ.

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

Remarks.—My specimens are of medium size. Kahl (1931) recorded specimens *cd.* 40-90μ long.

17. **Paramecium caudatum** Ehrenberg

(Text-fig. 4*a*)

1833. *Paramecium caudatum* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, **1833**, pp. 268, 323, pl. III, fig. 2.

1962. *Paramecium caudatum*, Dingfelder, *Arch. Protistenk.*, Jena, **105**, p. 587.

Material.—Two lots : (i) 2 exs., Mandore, near Jodhpur. (Jodhpur Dist.), 20.ii.62 ; (ii) 3 exs., Nagkund, near Jodhpur (Jodhpur Dist.), 20.ii.62.

Diagnosis.—Body foot-shaped ; anterior end broader and rounded ; posterior end gradually tapering and with a tuft of longer cilia ; single ; egg-shaped macronucleus ; a compact micronucleus ; size 198 by 56μ.

Distribution.—Rajasthan (first record) ; As above. *Elsewhere :* Cosmopolitan. Other records from India are ; Srinagar (Kashmir) ; Lucknow (Uttar Pradesh) ; and Calcutta.

Remarks.—A common species occuring in vegetable infusions. My specimens are of medium size. Other records are : Kahl (1931, 180-300μ long) ; Bhatia (1936, 120-330μ, usually 200-300μ, long) ; and Dingfelder (1962, 158-244μ long).

18. **Cinetochilum margaritaceum** Perty

(Text-fig. 4*b*)

1852. *Cinetochilum margaritaceum* Perty, *Mitth. nat. Ges.*, Bern, **1849**, p. 29.

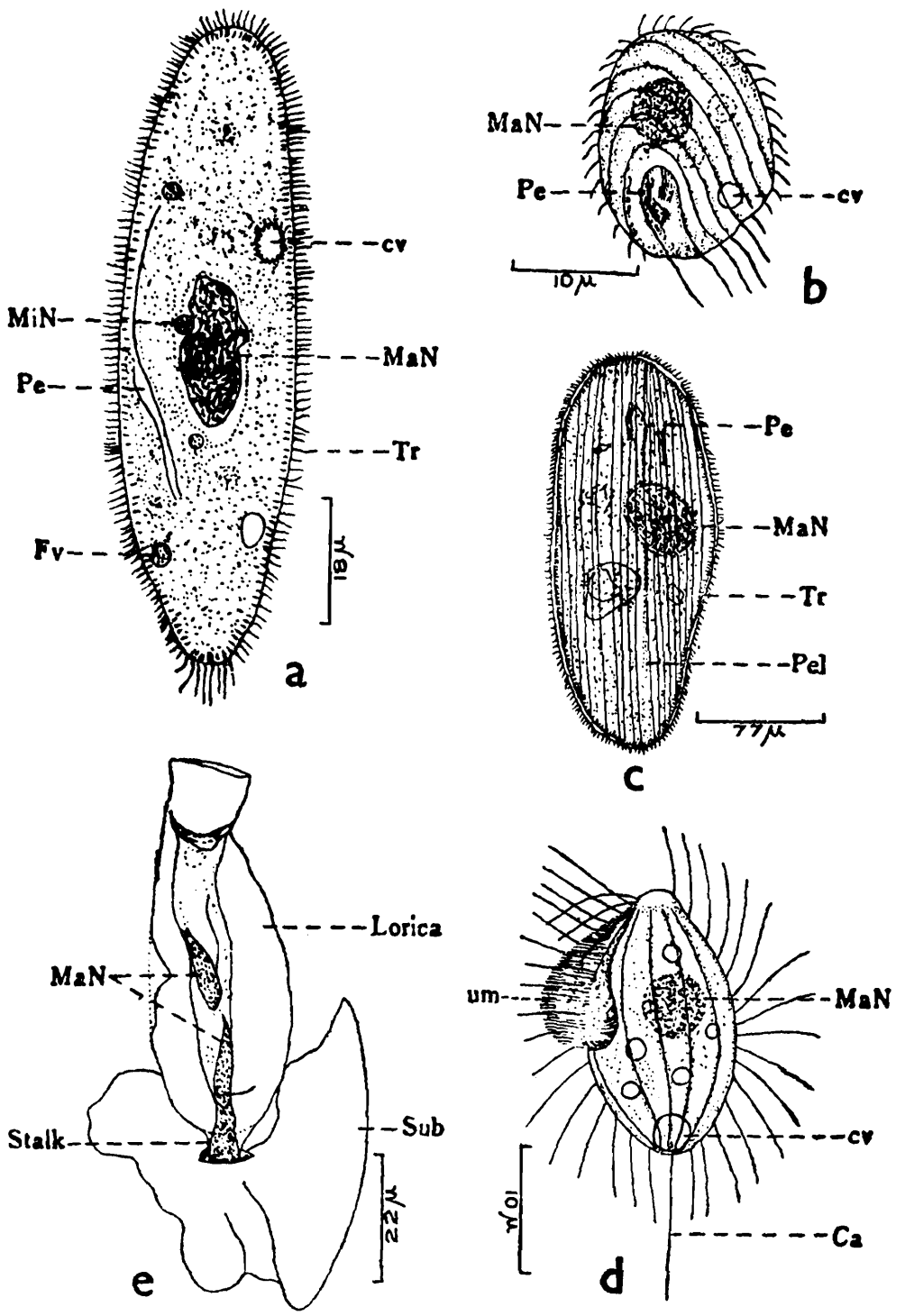
1931. *Cinetochilum margaritaceum*, Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.* Pt. 21, p. 351, fig. 60, 39 & 41.

Material.—Two lots : (i) 6 exs., New Kyar, Sambhar Lake (Jaipur Dist.), 17-18.iii.62. (ii) 3 exs., Sambhar Lake (main lake) (Nagau Dist.), 29-30.iii.62.

Diagnosis.—Small ; body oval and highly flattended ; cytostome at right of median line in posterior half, with membranes ; macronucleus spherical and central ; contractile vacuole terminal ; caudal cilia long ; size 21 by 16·5μ.

Distribution.—Rajasthan (first record from India) : As above. *Elsewhere* : Cosmopolitan. Inhabiting fresh and brackish waters.

Remarks.—My specimens are of medium size. Kahl (1931) recorded specimens 15-45μ long.



TEXT-FIG. 4.—(*a*) *Paramecium caudatum.* (*b*) *Cinetochilum margaritaceum.* (*c*) *Frontonia leucas* (*d*) *Cyclidium glaucoma.* (*e*) *Cothurnia curva.*

Ca., Caudal cilium ; *cv.*, Contractile vacuole ; *Fv.*, Food vacuole ; *MaN.*, Macronucleus ; *MiN.*, Micronucleus ; *Pe.*, Peristome ; *Pel.*, Peristomial elongation; *Sub.*, Substratum ; *Tr.*, Trichocyst ; *um.*, Undulating membrane.

19. **Frontonia leucas** (Ehrenberg)

(Text-fig. 4*c*)

1838. *Bursaria leucas* Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, p. 329, pl. XXXIV, fig. 8.

1858. *Frontonia leucas* Claparede & Lachmann, *Etudes surr les infusoires et les rhiz opodes*, Geneve, pp. 259-60.

1939. *Frontonia leucas* Bullington, *Arch. Protistenk.*, Jena, **92**, pp. 16-25, pl. 1, figs. 1-4.

Material.—One ex., Erolai Dani village, near Phulera (Jaipur Dist.), 9.iv.62.

Diagnosis.—Body foot-shaped, anterior end wider than posterior ; covered with fine short cilia arranged in longitudinal striations ; single contractile vacuole with long radiating canals in middle ; macronucleus single ; micronucleus few, around macronucleus ; size 330 by 142μ.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Universal, in freshwater bodies. Other records from India are : Srinagar (Kashmir) ; and Bombay.

Remarks.—My specimens are of medium size. Other records are: Bullington (1930, 258 by 96μ) ; Kahl (1931, 150-600μ long).

20. **Cyclidium glaucoma** Müller

(Text-fig. 4*d*)

1786. *Cyclidium glaucoma* Müller, O.F., *Animale. infusoria fluviat. et marina, etc.*, Havnial, et Lipsiae, p. 80,pl. XI, figs. 6-8.

1936. *Cyclidium glaucoma*, Bhatia, *Fauna Brit. India, Protozoa, Ciliophora* London pp. 183-184. fig. 85.

Material.—Two lots, Jodhpur Dist. : (i) Several exs., Nagkund, near Jodhpur, 20.ii.62. (ii) Several exs., Mandore, near Jodhpur, 20.ii.62.

Diagnosis.—Body ovate and compressed ; contractile vacuole at posterior end ; long and fine cilia on general body surface ; a conspicuous long caudal cilium ; prominent undulating membrane ; macronucleus spherical ; a micronucleus ; size 22 by 13·5μ.

Distribution.—Rajasthan (first record) : As above. *Elsewhere ;* Universal. Another record from India is Sibpur (W. Bengal).

Remarks.—My specimens are small. Kahl (1931) recorded a length of 25-30μ.

21. **Cothurnia curva** Stein

(Text-fig. 4*e*)

1854. *Cothurnia curva* Stein, *Die Infusionsthiere auf there Entwicklungsgeschichte untersucht*, Leipzig.

1935. *Cethurnia curva.* Kahl, Urtiere oder Protozoa, *Tierweit Dtsch.*, Jena, Pt. 30, p. 777, fic. 143, 40.

Material.—One ex., Balsamand, near Jodhpur (Jodhpur Dist.), 20. ii. 62.

Diagnosis.—Animalcule housed in a lorica which is attached to submerged substratum by short stalk ; a bend at anterior region of lorica; length of lorica 70μ.

Distribution.—Rajasthan (first record from India) : As above. *Elsewhere ;* Cosmopolitan. In freshwater bodies.

Remarks.—My specimen is the largest recorded so far. Kahl (1935) had specimens 72μ longer ; in extended condition the animal was *ca.* 15μ longer than the lorica.

22. **Stentor** sp.

(Text-fig. 5*a*)

Material.—One lot, 2 exs., pond inside Zoological Garden, Jodhpur (Jodhpur Dist.), 19.ii.62.

Diagnosis.—Body trumpet-shaped, colourless ; attached to submerged *Hydrilla* plants ; macronucleus long, band-shaped ; length in extended condition 520μ, in fixed condition 105μ.

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

Remarks.—My specimens resemble *Stentor polymorphus* (Müller) but differ somewhat in shape of macronucleus.

23. **Metopus es** Müller

(Text-fig. 5*b*)

1786. *Metopus es* Müller, O. F. *Animalc. infusoria, fluviat. et marina etc.*, Hafniae and Lipsiae, p. 126.

1932 *Metopus es* Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, pt. 25, pp. 416-417, figs. 70, 1.

Material.—One ex., Erolai Dani village, near Phulera (Jaipur Dist.), 9.iv.62.

Diagnosis.—Body S-shaped ; peristome conspicuous and slightly spirally diagonal ; ciliation uniform ; a conspicuous contractile vacuole at posterior end ; macronucleus in middle ; micronucleus adjacent to macronucleus ; size 12 by 43μ.

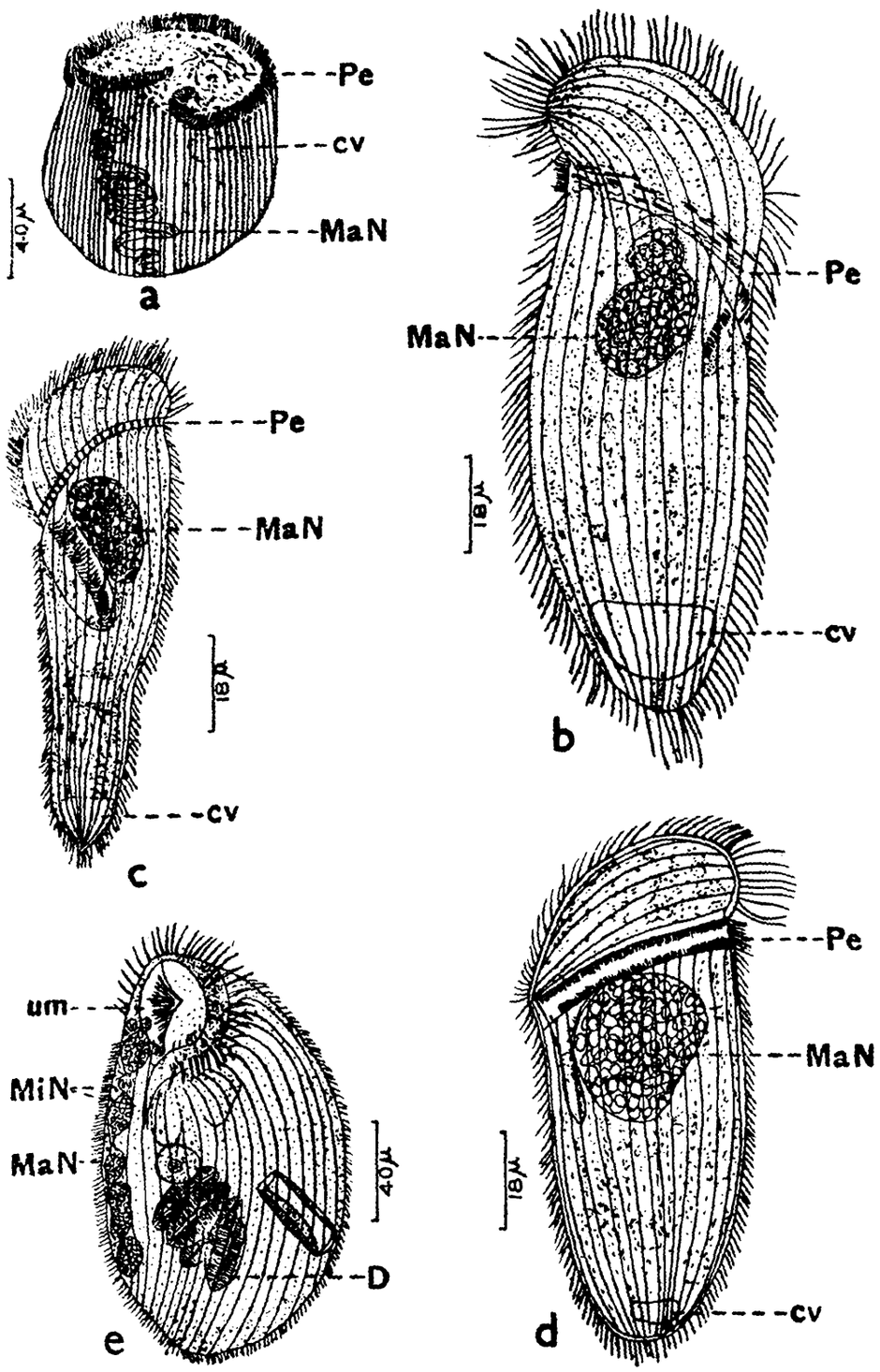
Distribution.—Rajasthan (first record) : As above. *Elsewhere :* India : Waltair (Andhra Pradesh). Not a common species A few record also from Europe.

Remarks.—My specimen is of medium size Kahl (1932) recorded specimene 120-160μ long.

24. Metopus es var rectus Kahl

(Text-fig. 5*c*)

1932. *Metopus es* var. *rectus* Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena., 25, p. 417, figs. 70, 3.



TEXT-FIG. 5.—(*a*) *Stentor* sp. (*b*) *Metopus es*. (*c*) *Metopus es* var *rectus*. (*d*) *Metopus ovalis*. (*e*) *Condylostoma patens*.

cv., Contractile vacuole ; *D.*, Ingested diatoms ; *MaN.*, Macronucleus ; *Min.* Micronucleus ; *Pe.*, Peristome ; *um.*, undulating membrane.

Material.—Two lots, Jodhpur Dist. : (i) One ex., Mandore, near Jodhpur, 20.ii.62. (ii) One ex., Nagkund, near Jodhpur, 20.ii.62.

Diagnosis.—Similar in shape to *Metopus es* Müller, but posterior end more tapering ; size 95 by 39μ.

Distribution.—*Rajasthan* (first record from India) : As above. *Elsewhere* : Cosmopolitan, but very rare species. In stagnate water with decaying vegetation.

Remarks.—My specimens are small. Kahl (1932) recorded specimens 120μ long.

25. **Metopus ovalis** Kahl

(Text-fig. 5*d*)

1927. *Metopus ovalis* Kahl, *Arch. Protistenk.*, Jena, **57**, p. 142, figs. 11 *a*, *b*.

1932. *Metopus ovalis* Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, Pt. 25, p. 418, fig. 70, 5.

Material.—One ex., Erolai Dani village, near Phulera (Jaipur Dist.), 9.iv.62.

Diagnosis.—Body oval, posterior end broad and rounded ; macronucleus single, reniform and placed in middle ; micronucleus single, adjacent to macronucleus ; size 97.5 by 39μ.

Distribution.—*Rajasthan* (first record from India) : As above. *Elsewhere* : In stagnant water. Very rare form. The only previous record is from Germany.

Remarks.—My specimen is small. Kahl (1927, 1932) recorded specimens 100-200μ long.

26. **Condylostoma patens** (Müller)

(Text-fig. 5*e*)

1786. *Trichoda patens* Müller, O. F., *Animal infusoria fluviat. et marine etc.*, Hafniae et Lipsiae, p. 181, pl. 26, figs. 1, 2.

1841. *Kondylostoma patens*, Dujardin, *Histoire nat. des Zoophytes infusoires*, Paris, p. 516, pl. 22, fig. 2.

1932. *Condylostoma patens*, Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, Pt. 25, p. 453, fig. 75, 1.

Material.—One lot, 10 exs., Sardar Samand Lake (Pali Dist.), 6.ii.62.

Diagnosis.—Body nearly cylindrical, highly elastic ; irregularly triangular peristome at anterior end on ventral side ; a prominent undulating membrane extends along with right border of peristome ; canal-like contractile vacuole ; macronucleus elongate and moniliform ; many micronuclei ; size 172 by 102μ.

Distribution.—*Rajasthan* (first record) : As above. *Elsewhere :* India: Mysore. Also Europe.

Remarks.—My specimens are very small. Kahl (1932) recorded specimens 500μ long and Kudo (1960) 250-550μ long.

27. **Condylostoma vorticella** (Ehrenberg)

(Text-fig. 6*a*)

1833. *Bursaria vorticella* Ehrenberg, *Abh. preuss. Akad. Wiss.*, Berlin, **1833**, p. 237.

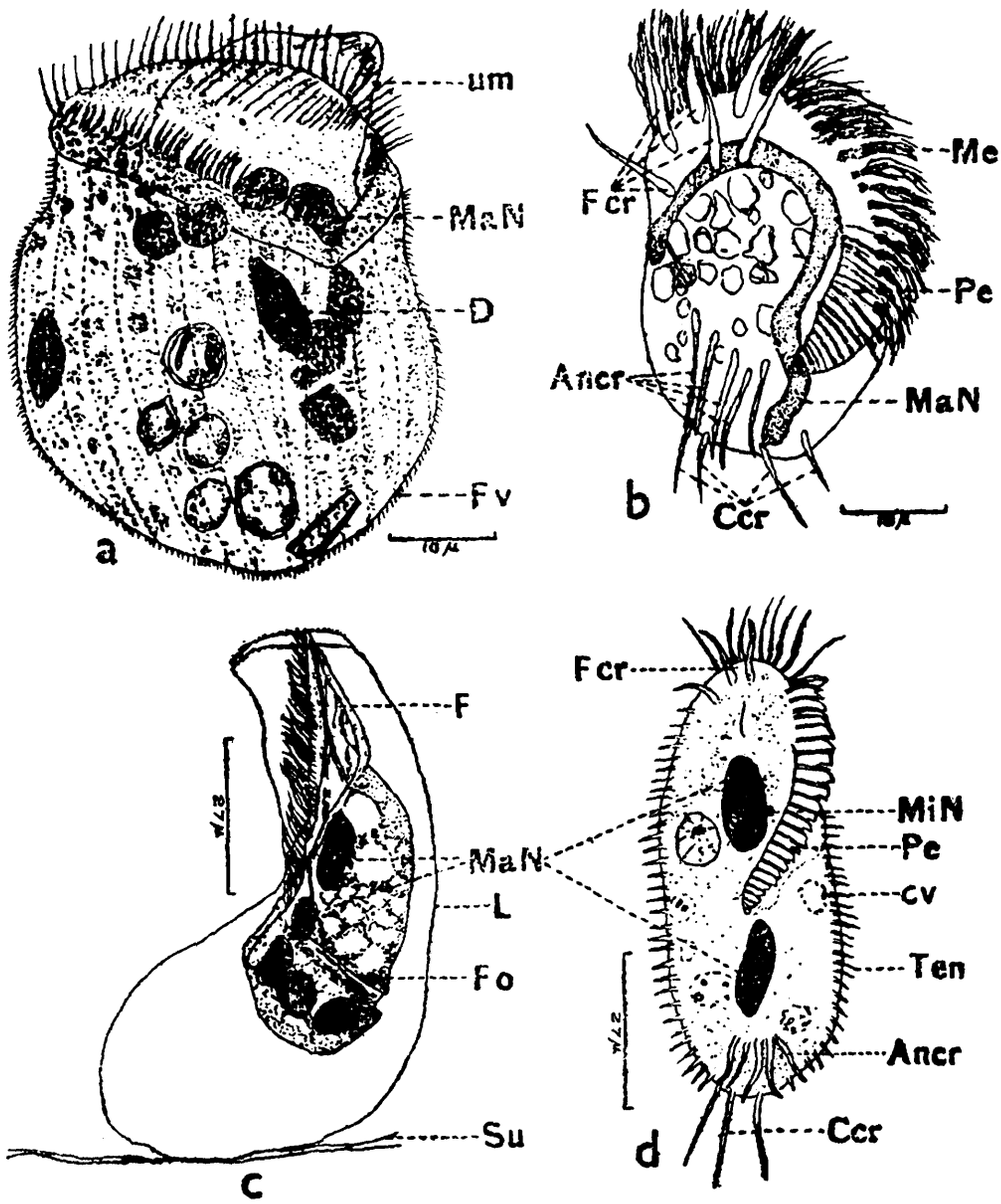
1932. *Condylostoma vorteiella*, Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, pt. 25, p. 457, figs. 12, 13, 14.

Material.—One lot, 2 exs., Khyra village near Phulera (Jaipur Dist.), 5.iv.62.

Diagnosis.—Body ellipsoid ; anterior end truncated, posterior end rounded ; a prominent undulating membrane on peristomial border ; macronucleus moniliform ; size 90 by 75μ.

Distribution.—Rajasthan (first record from India) : As above. *Elsewhere :* Previous records from Europe in ponds with lot of vegetation.

Remarks.—My specimens are smaller than those of Kahl (1932, 100-200μ long). Very rare form.



TEXT-FIG. 6.—(*a*) *Condylostoma vorticella.* (*b*) *Euplotes charon.* (*c*) *Chaetod pira mulleri.* (*d*) *Stylonychia pustulata.*

Ancr., Anal cirri ; *Ccr.*, caudal cirri ; *Cv.*, Contractile vacuole ; *D* , Ingested diatoms ; *F.*, Flexible Frontal end ; *Fer.*, Frontal cirri ; *Fo.*, Body fold ; *Fv.*, Food vacuole ; *L.*, Lorica ; *MaN.*, Macronucleus ; *Me.*, Membranella : *Min.*, Micronucleus *Pe.*, Per stom ; *Su.*, Substratum ; *Ten.*, Marginal cirri.

28. **Euplotes charon** (Müller)

(Text-fig. 6*b*)

1773. *Trichoda charon* Müller, O. F., *Verminum terrest et fluviatil. s. animal infusor. et Historia*, Havinae et. Lipsia, p. 83.

1838. *Euplotes charon* Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen*, Leipzig, p. 378, pl. 42, fig. 10.

1960. *Euplotes charon*, Kudo, *Protozoology* (4th ed.), Illinois, p. 841, fig. 358*b*.

Material.—One lot, 5 exs., in Devdani, near Sambhar Lake (Jaipur Dist.), 23 and 24.iii.62.

Diagnosis.—Body oval, medium sized, rounded at two extremities ; ten fronto-ventral cirri on anterior half of ventral side ; macronucleus band-shaped and curved ; size 66 by 45μ.

Distribution.—Rajasthan (first record) : As above. *Elsewhere :* Cosmopolitan, India : Bombay.

Remarks.—My specimens are small. Kahl (1932) recorded specimens 70-90μ long ; and Bhatia (1936) 80 by 38-40μ.

29. **Chaetospira muelleri** (Lachmann)

(Text-fig. 6*c*)

1856. *Chaetospira muelleri* Lachmann, *Ann. Mag. nat. Hist.*, London, (2) **19**, p. 216, figs. 6, 7.

1932. *Chaetospira muelleri* Kahl, Urtiere oder Protozoa, *Tierwelt. Dtsch.*, Jena, Pt. 25. p. 561, figs. 94, 24.

Material.—One lot, 2 exs., Sardar Samand Lake, (Pali Dist.), 6.iii.62.

Diagnosis.—Body flask-shaped, housed in a lorica, peristome bearing anterior part flexible ; macronucleus in 2-8 parts ; length 90μ.

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

Remarks.—Very rare species. My specimens are small ; Kahl (1932) recorded specimens 150-250μ long, and Kudo (1960) 60-200μ long.

30. **Stylonychia pustulata** Ehrenberg

(Text-fig. 6*d*)

1838. *Stylonychia pustulata* Ehrenberg. *Die Infusiansthiercheh als volihommene Organismen*, Leipzig, p. 371, pl. 13 fig. 1.

1932. *Stylonychia pustulata* Kahl, Urtiere oder Protozoa, *Tierwelt Dtsch.*, Jena, pt. 25, p. 619, figs. 121, 21, 21*a*.

Material.—One lot, 4 exs., Mandore near Jodhpur (Jodhpur Dist.), 20.ii.62.

Diagnosis.—Body elongate oval, posterior end rounded. Cirri : frontal 8, ventral 5, anal 5, caudal 3. Setae on margins ; macronucleus in two parts ; two micronuclei ; size 78 by 31μ.

Distribution. —Rajasthan (first record) : As above. *Elsewhere :* India : Srinagar (Kashmir). Previous records from Germany and U. S. A.

Remarks.—My specimens are very small. Kahl (1932) recorded specimens 150-220μ long and Kudo (1960) 150μ long.

V—Summary

1. This paper deals with freshwater Protozoa collected by the author during February-April, 1962 in western Rajasthan—districts of Jodhpur, Pali, Nagaur (Sambhar Lake and vicinity) and Jaipur.

2. Thirty species belonging to 26 genera and 23 families are described. The families are : Cryptomonadidae, Euglenidae, Anisonemidae, Difflugiidae, Colepidae,Trachel iidae, Amphileptidae, Didiniidae, Chlamydodontidae, Podophryidae, Ophryoglenidae, Cohnilembidae, Tetrahymeniidae, Parmeciidae, Cinetochilidae, Frontonudae, Pleuronematidae, Vaginicolidae,Stentoridae, Gyrocarythidae, Condylostom atidae, Euplotidae, and Oxytxichidae.

3. All the species are first records from Rajastham, and several are first records from India.

4. Keys for the indentification of genera and brief diagnostic characters of each species are given.

VI—References

Bhatia, B. L. 1936. *The Fauna of British India, Protozoa Ciliophoro.* xxii+1-493 pp—London (Taylor & Francis).

Bullington, W. E. 1939. A study of spiraling in the ciliate *Frontonia*, with a review of the genus and a description of two new species.—*Arch. Protistenk.*, Jena, 92, pp. 10-66, 9 pls.

Butschli, O. 1878. Beitrüge zur Kenntniss der Flagellaten und einiger verwandten Organismen.—Z. *wiss, Zool.*; Leipzig. 30, pp. 205-281, 5 pls.

Chu .. P. 1947, Contribution to our knowledge of genus *Euglena.*—*Sinensia*, Shanghai, 17, pp. 75-143.

Conn, H. W and Edmondson, C. H. 1918. Flagellate and ciliate Protozoa Protozoa (Mastigophora and Infusoria). In : Ward, H. B. and Whipple, G. C. : *Freshwater Biology*, pp. 238-500.—New York (Wiley & Sons).

Dingfelder, J. H. 1962. Die Ciliaten vorübergehender Gewässer.—*Arch. Protistenk.*, Jena, 105 (4), pp. 509-658.

Dujardin, F.1837. Surunenouvelle espéce de *Gromia* et sur les *Difflugia.—Ann. Sci. nat. (Zool.)*, Paris, (2) 8, pp. 310-314, 1 pl.

Gauthier, Lievre, L. and Thomas, R. 1958. Lesgenres *Difflugia, pentagonia, Maghrebia*, et *Hoogenraadia* (Rhizopodes testacés) en Afrique.—*Arch. Protistenk.*, **103**, pp. 241-370, 7 pls.

Hubner, E. F. W. 1886. Euglenaceen. Flora von Sralsund.—*Prog. Realgzmn Stralzund*, **22**, p. 4.

Kahl, A. 1927. Neue und erganzende Beobachtungen holotricher Ciliaten. I.—*Arch. Protisnenk.*, Jena, **60**, pp. 34-129.

Kahl, A. 1930-35. Urtiere oder Protozoa : Wimpertiere oder Ciliata (Infusoria). In Dahl's ; *Tierwelt Deutschland*, Jena, Parts 18, 21, 25, 30, pp. iv+1-886.

Kent, W. S. 1880-82. *A Manual of the Infusora.* x+913 pp., 51 pls.—London (David Bogue).

KUDO R. R. 1960. ***Protozoology***. (2nd ed.), xi + 966 pp.—Springfied (Charles C. Thomas).

NOLAND, E. L. 1925. A review of the genus *Coleps*, with descriptions of two new species.—*Trans. Am. microsc. Soc.*, Lancaster, **44**, pp. 3.33, 1 pl.

PENARD, E. 1922. *Études sur les Infusoires d' eau Douce*. 331 pp. —1968. Geneva, (George et Cie.).

ROONWAL, M. L. ..... Fauna of Rajasthan, India, Part 1—General Introduction, with a list of collecting localities and a bibliography of Rajasthan Zoology.—*Rec. Zool. Surv. India*, Delhi, 61 (3 & 4), pp. 291-375, 9 pls.

ROUX, J. 1901. *Faune Infusorienne des Eaux Stagnantes des Environs de Geneve*. 148 pp.—Genéve (Kundig).

STOKES, A. C. 1885. Some new Infusoria from American freshwater.—*Ann. Mag. nat. Hist.*, London, (5) 15 pp. 437-449.