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ZOOLOGICAL SURVEY OF INDIA
Ministry of Environment, Forest & Climate Change

PROTOZOA: TESTATE AMOEBAE

[1]Bindu L, [2]Jasmine P, [2]Athira A, [2]Srijani Biswas, and [2]Aradhana Chaudhary

[1]Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, Kerala
[2]Protozoology Section, Zoological Survey of India, Head Quarters, Kolkata-700053
Corresponding Author Email id: jasbose@gmail.com

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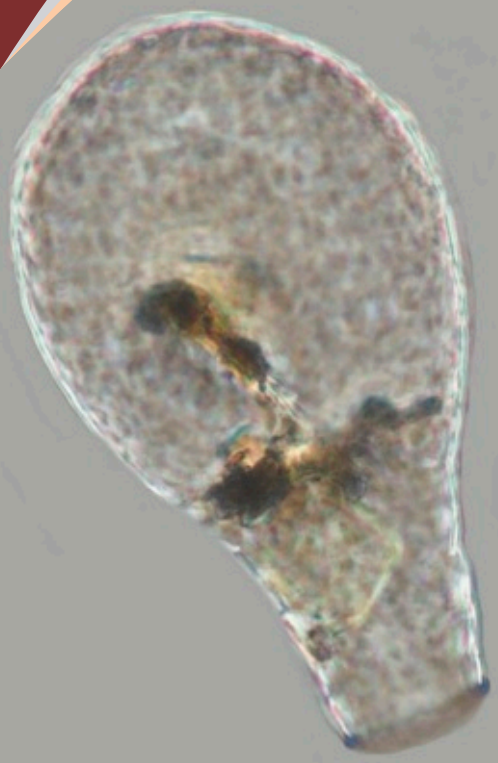


FAUNA OF INDIA CHECKLIST

PROTOZOA: TESTATE AMOEBAE

[1]Bindu L, [2]Jasmine P, [2]Athira A, [2]Srijani Biswas, and [2]Aradhana Choudhary

[1]Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, Kerala-673006
[2]Protozoology Section, Zoological Survey of India, Head Quarters, Kolkata-700053
Corresponding Author Email id: jasbose@gmail.com

Introduction

Testate amoebae are unicellular, free-living amoeboid protozoans enclosed inside an extracellular shell, called test, mostly with a single main opening which extrude pseudopodia. They are divided into two main groups based on the morphology of pseudopodia- Arcellinida (with lobose pseudopodia) and Euglyphida (with filose pseudopodia). Testate amoebae exhibit a cosmopolitan distribution, inhabiting a wide range of environments from tropical to polar regions. They are present across diverse ecosystems including terrestrial, freshwater, brackish, and marine habitats. However, their highest abundance and taxonomic diversity are typically observed within *Sphagnum* moss-dominated peatlands. They are a good model for taxonomy and evolutionary studies because of their abundance, diversity and presence of a shell which provides a reliable morphological feature for species identification. They are highly sensitive to environmental changes and respond rapidly, which make them valuable indicators for biomonitoring. Presently testate amoebae are a polyphyletic assemblage of at least three major unrelated taxonomic groups of unicellular eukaryotes: Amoebozoa, Stramenopiles and Cercozoa.

Global diversity

The global distribution of testate amoebae is more than 675 species under 104 genera and 22 families which include records from polar regions also.

Diversity in India

In India 227 species belong to 44 genera under three classes and two orders were recorded.

Diversity in States: Presented in table 1.

Sl. No.	State / Union Territory	No. of Species	No. of Endemic Species
1	Andhra Pradesh	34	-
2	Arunachal Pradesh	41	-
3	Assam	41	-
4	Bihar	0	-
5	Chhattisgarh	0	-
6	Gujarat	0	-
7	Goa	0	-
8	Haryana	0	-
9	Himachal Pradesh	107	-
10	Jharkhand	0	-
11	Karnataka	1	-
12	Kerala	62	-

Sl. No.	State / Union Territory	No. of Species	No. of Endemic Species
13	Madhya Pradesh	0	-
14	Maharashtra	17	-
15	Manipur	22	-
16	Meghalaya	31	-
17	Mizoram	21	-
18	Nagaland	21	-
19	Odisha	38	-
20	Punjab	1	-
21	Rajasthan	6	-
22	Sikkim	40	-
23	Tamil Nadu	48	-
24	Telangana	21	-
25	Tripura	27	-
26	Uttar Pradesh	43	-
27	Uttarakhand	64	-
28	West Bengal	110	-
29	Andaman & Nicobar	0	-
30	Chandigarh	8	-
31	Dadra Nagar Haveli, Daman & Diu	0	-
32	Delhi	1	-
33	Jammu & Kashmir	3	-
34	Ladakh	0	-
35	Lakshadweep	0	-
36	Puducherry	0	-
	INDIA TOTAL	**227**	**-**

Endemism: No testate amoebae species has so far been demarcated as endemic to India.

Habitat: Testate amoebae are found in most of the moist habitats like ponds, rivers, streams, estuaries, marine habitats, leaf-litter, *sphagnum* mosses and soil.

Ecological significance: They are valuable bio-indicators for ecological and environmental monitoring studies and as proxies for hydrological changes and the shells remain well preserved in peat and sediment for a quite long time makes them excellent microfossils and widely used in micro paleontological studies.

Human significance: Testate amoebae are widely used in bio-monitoring of various ecosystems and also used in sewage treatment plants. Soil protozoa play an important role in mineralizing nutrients and making them available for plants.

Threatened species: Testate amoebae species are not assessed for IUCN threat categories.

Protected Species as per WPA (2022): Testate amoebae are not listed under any schedules of Wildlife Protection Act (2022).

Species under CITES: Testate amoebae are not listed under any appendices of CITES.

Invasive alien species: No testate amoebae species is reported as invasive.

Gap areas: Testate amoebae are not documented from many states such as Bihar, Chhattisgarh, Gujarat, Goa, Haryana, Jharkhand, Madhya Pradesh, Andaman & Nicobar, Dadra Nagar Haveli, Daman & Diu, Ladakh, Lakshadweep and Puducherry and only meagre reports from many other states.

Systematic list:

Domain **Amorphea** Adl *et al*., 2012
Supergroup **Amoebozoa** Lühe, 1913, *sensu* Cavalier-Smith, 1998
Phylum **Tubulinea** Smirnov *et al*., 2005
Class **Corycida** Kang *et al.*, 2017
Genus ***Amphizonella*** Greeff, 1866
1. *Amphizonella violacea* Greeff, 1848
Genus ***Diplochlamys*** Greeff, 1888
2. *Diplochlamys leidy* Greeff, 1883
3. *Diplochlamys timida* Penard, 1909
Class **Elardia** Kang *et al*., 2017
Order **Arcellinida** Kent, 1880
Suborder **Glutinoconcha** Lahr *et al.*, 2019
Infraorder **Sphaerothecina** Kosakyan *et al.*, 2016
Family **Arcellidae** Ehrenberg, 1843
Genus ***Arcella*** Ehrenberg, 1830
4. *Arcella conica* Playfair, 1918
5. *Arcella crenulata* Deflandre, 1928
6. *Arcella excavata* Cunningham, 1919
7. *Arcella geosphaira* Ogden, 1991
8. *Arcella gibbosa* Penard, 1890
9. *Arcella gibbosa var. mitriformis* Deflandre, 1928
10. *Arcella hemisphaerica* Perty, 1852
11. *Arcella indica* Chattopadhyay and Das, 2003
12. *Arcella intermedia* Deflandre, 1938; Tsyganov and Mazei, 2006
13. *Arcella manipurensis* Chattopadhyay and Das, 2003
14. *Arcella mitrata* Leidy, 1876
15. *Arcella oblonga* Schaudinn, 1898
16. *Arcella papyracea* Playfair, 1914
17. *Arcella pyramidalis* Van oye, 1926
18. *Arcella rotundata* Playfair, 1918
19. *Arcella rotundata var. scorbiculata* Playfair, 1918
20. *Arcella vulgaris* Ehrenberg, 1832
21. *Arcella vulgaris var.* angulosa Perty, 1852
22. *Arcella vulgaris var. undulatum* Deflandre, 1852
Genus ***Galeripora*** González-Miguéns, Soler-Zamora, Villar-dePablo, Todorov & Lara, 2021
23. Galeripora arenaria (Greeff, 1866) González-Miguéns et al., 2021
24. *Galeripora artocrea* (Leidy, 1876) Gonzalez-Miguens *et al*., 2021
25. *Galeripora catinus* (Penard, 1890) Gonzalez-Miguens *et al*., 2021
26. *Galeripora dentata* (Ehrenberg, 1830) Gonzalez-Miguens *et al*., 2021
27. *Galeripora discoides* (Ehrenberg, 1871) Gonzalez-Miguens *et al*., 2021
28. *Galeripora megastoma* (Penard, 1902) Gonzalez-Miguens *et al*., 2021
29. *Galeripora megastoma var. arcuata* Deflandre, 1928
30. *Galeripora polypora* (Penard, 1890) González-Miguéns et al., 2021
Family **Netzeliidae** Kosakyan *et al.,* 2016

Genus ***Cyclopyxis*** Deflandre, 1929

31. *Cyclopyxis arcelloides* (Penard, 1902) Deflandre, 1929
32. *Cyclopyxis arenata* (Cushman, 1930) Boltovskoy, 1956
33. *Cyclopyxis bharateii* Bindu, 2012
34. *Cyclopyxis eurystoma* Deflandre, 1929
35. *Cyclopyxis gibbosa* Van Oye, 1949
36. *Cyclopyxis gramen* Penard, 1902
37. *Cyclopyxis kahli* Deflandre, 1929
38. *Cyclopyxis leidy* Couteaux and Chardez, 1981
39. *Cyclopyxis lismorensis* Playfair, 1921
40. *Cyclopyxis lithophila* Penard, 1902
41. *Cyclopyxis parvula* Bonnet et Thomas, 1960
42. *Cyclopyxis tronconica* Godeanu, 1972

Genus ***Netzelia*** Ogden, 1979

43. *Netzelia achlora* (Penard, 1902) Gomaa *et al*., 2017
44. *Netzelia corona* Wallich, 1864; Gomaa et al., 2017
45. *Netzelia oviformis* Ogden, 1979

Incertae sedis **Sphaerothecina**

Genus ***Cucurbitella*** Penard, 1902

46. *Cucurbitella mespiliformis* Penard, 1902

Genus ***Trigonopyxis*** Penard, 1912

47. *Trigonopyxis arcula* Penard, 1912
48. *Trigonopyxis complanatum* Penard, 1912

Infraorder **Longithecina** Lahr *et al.*, 2019

Family **Difflugiidae** Wallich, 1864

Genus ***Difflugia*** Lecrec, 1815

49. *Difflugia acutissima* Deflandre, 1931
50. *Difflugia amphora* Leidy, 1874
51. *Difflugia amphoralis* Hopkinson, 1958
52. *Difflugia ampla* Rampi, 1950
53. *Difflugia ampullula* Playfair, 1918
54. *Difflugia arcula* Leidy,1879
55. *Difflugia avellana* Penard, 1890
56. *Difflugia bacillifera* Penard, 1890
57. *Difflugia binucleata* Penard, 1902
58. *Difflugia brevicaulis* Thomas & Mabille, 1956
59. *Difflugia brevicolla* Cash, 1909
60. *Difflugia bryophila* (Penard, 1902) Jung, 1942
61. *Difflugia capreolata* Penard, 1902
62. *Difflugia carinata* Van Oye, 1956
63. *Difflugia corona* Wallich, 1864
64. *Difflugia curvicaulis* Penard, 1899
65. *Difflugia difficilis* Thomas, 1954
66. *Difflugia distenda* (Penard, 1899) Ogden, 1983
67. *Difflugia dragana* Ogden and Zivkovic, 1983
68. *Difflugia dujardini* Chardez, 1957
69. *Difflugia echinulata* Penard, 1911
70. *Difflugia geosphaira* Ogden, 1991
71. *Difflugia globularis* (Wallich, 1864) Chardez, 1956
72. *Difflugia globulosa* (Dujardin, 1837) Penard, 1902
73. *Difflugia globulus* Ehrenberg, 1990
74. *Difflugia gramen* Penard, 1902

75. *Difflugia kabylica* Gauthier-Lievre and Thomas, 1958
76. *Difflugia lacustris* Penard, 1890
77. *Difflugia lebes* Penard, 1890
78. *Difflugia leidyi Wailes, 1913*
79. *Difflugia limnetica* (Levander, 1900) Penard, 1902
80. *Difflugia lismorensis* Playfair, 1890
81. *Difflugia lithophila* Penard, 1902
82. *Difflugia lithoplites* Penard, 1902
83. *Difflugia lobostoma* Leidy, 1879
84. *Difflugia minuta var. minor* Godeanu, 1972
85. *Difflugia muriformis* Gauthier-lievre and Thomas, 1958
86. *Difflugia oblonga* Ehrenberg, 1831
87. *Difflugia microclaviformis* (Kourov, 1925) Ogden, 1983
88. *Difflugia oblonga* var. *muscicola* Chattopadhyay and Das, 2003
89. *Difflugia penardi* Hopkinson, 1909
90. *Difflugia pyriformis Perty, 1849*
91. *Difflugia rubescens* Penard, 1891
92. *Difflugia styla* Ogden & Zivkovic, 1983
93. *Difflugia tuberculata* Wallich, 1864
94. *Difflugia urceolata* Carter, 1864
95. *Difflugia ventricosa* Deflandre, 1926
96. *Difflugia venusta* Penard, 1905

Family **Lesquereusiidae** Jung, 1942

Genus ***Lesquereusia*** Schlumberger, 1845

97. *Lesquereusia minor* Walton, 1930
98. *Lesquereusia modesta* Rhumbler, 1895
99. *Lesquereusia spiralis* Ehrenberg, 1840
100. *Lesquereusia spiralis var. penardi* Thomas & Gauthier-Lievre, 1959

Genus ***Paraquadrula*** Deflandre, 1932

101. *Paraquadrula irregularis* Wallich, 1863

Infraorder **Excentrostoma** Lahr *et al.*, 2019

Family **Centropyxidae** Jung, 1942

Genus ***Centropyxis*** Stein, 1857

102. *Centropyxis aculeata* (Ehrenberg, 1838)
103. *Centropyxis aculeata minima* Van Oye, 1956
104. *Centropyxis aculeata var. oblonga* Deflandre *f. minima* Kufferath
105. *Centropyxis aculeata var. tropics* Deflandre
106. *Centropyxis aerophila* Deflandre, 1929
107. *Centropyxis arunachalensis* Chattopadyay and Das, 2003
108. *Centropyxis bipilata* (Baković, Siemensma, Baković and Rubinić, 2019)
109. *Centropyxis cassis* (Wallich, 1864) Deflandre, 1929
110. *Centropyxis circularis* (Wallich, 1864) Decloitre, 1968
111. *Centropyxis constricta* (Ehrenberg, 1907) Penard, 1902
112. *Centropyxis delicatula* Penard, 1902
113. *Centropyxis discoides* Penard, 1902
114. *Centropyxis ecornis* (Ehrenberg, 1843) Leidy, 1879
115. *Centropyxis elongata* (Penard, 1890) Thomas, 1959
116. *Centropyxis faizabadensis* Bindu, 2012
117. *Centropyxis gibba* Deflandre, 1929
118. *Centropyxis hemisphaerica* (Barnard, 1875) Deflandre, 1929
119. *Centropyxis himachalensis* Bindu, 2012
120. *Centropyxis laevigata* Penard, 1890

121. *Centropyxis minuta* Deflandre, 1929
122. *Centropyxis mizoramensis* Chattopadhyay and Das, 2002
123. *Centropyxis oblonga* Deflandre, 1929
124. *Centropyxis orbicularis* Deflandre, 1929
125. *Centropyxis plagiostoma* Bonnet and Thomas, 1955
126. *Centropyxis platystoma* (Penard, 1890) Deflandre,1929
127. *Centropyxis purthiensis* Bindu, 2012
128. *Centropyxis sphagnicola* Deflandre, 1929
129. *Centropyxis spinosa* (Cash and Hopkinson, 1905) Deflandre, 1929
130. *Centropyxis stellata* Wailes, 1927
131. *Centropyxis sylvatica* (Deflandre, 1929) Bonnet and Thomas, 1955

Family **Plagiopyxidae** Bonnet *et* Thomas, 1960

Genus ***Bullinularia*** (Penard, 1907) Deflandre, 1953

132. *Bullinularia indica* (Penard, 1907)

Genus ***Plagiopyxis*** Penard, 1910

133. *Plagiopyxis bicamera* Couteaux, 1978
134. *Plagiopyxis callida* Penard, 1919
135. *Plagiopyxis declivis* Bonnet and Thomas, 1955
136. *Plagiopyxis labiata* Penard, 1911
137. *Plagiopyxis minuta* Bonnet, 1959

Genus ***Golemanskia*** González-Miguéns et al., 2021

138. *Golemanskia viscidula* (Penard, 1902) n. comb. González-Miguéns et al., 2021

Infraorder **Hyalospheniformes** Lahr et al., 2019

Family **Hyalospheniidae** Schultze, 1977, emend. Kosakyan and Lara, 2012

Genus ***Certesella*** Loeblich and Tappan, 1961

139. *Certesella martiali* Certes, 1889

Genus ***Gibbocarina*** Kosakyan et al., 2016

140. *Gibbocarina galeata* Penard, 1890

Genus ***Hyalosphenia*** Stein, 1859

141. *Hyalosphenia elegans* Leidy, 1874
142. *Hyalosphenia nobilis* Cash and Hopkinson, 1905
143. *Hyalosphenia papilio* Leidy, 1874

Genus ***Nebela*** Leidy, 1874

144. *Nebela bohemica* Taranek, 1882
145. *Nebela collaris* (Ehrenberg, 1848) Leidy, 1879
146. *Nebela denticulata* Chattopadyay and Das, 2003
147. *Nebela dentistoma* Penard, 1890
148. *Nebela flabellalum* Leidy, 1974
149. *Nebela galeata* Penard, 1890
150. *Nebela himalayana* Chattopadhyay and Das, 2003
151. *Nebela lageniformis* Penard, 1890
152. *Nebela longitubulata* Gauthier-Lievre, 1953
153. *Nebela penardiana* Deflandre, 1936
154. *Nebela tincta* (Leidy, 1879) Awerintzew, 1906
155. *Nebela wailesi* Deflandre, 1936

Genus ***Padaungiella*** Lara and Todorov, 2012

156. *Padaungiella tubulata* (Brown, 1910) Lara and Todorov, 2012

Genus ***Porosia*** Jung, 1942

157. *Porosia paracarinata* Bobrov and Kosakyan, 2015

Genus ***Quadrulella*** Cockerell, 1909

158. *Quadrulella elegans* Gauthier-lievre, 1958
159. *Quadrulella madibai* Kosakyan *et al*., 2016

160. *Quadrulella quadrigera* Deflandre, 1936
161. *Quadrulella symmetrica* (Wallich, 1863) Kosakyan *et al*., 2016
162. *Quadrulella tropica* Wailes, 1912
163. *Quadrulella variabilis* Kosakyan, 2016

Infraorder **Volnustoma** Lahe *et al.*, 2019
Family **Heleoperidae** Jung, 1942
Genus ***Heleopera*** Leidy, 1879
164. *Heleopera lucida* (Penard, 1890) Porfirio-Sousa et al., 2023
165. *Heleopera papilio* Leidy, 1879
166. *Heleopera petricola* Leidy 1879
167. *Heleopera petricola var.amethystea* Penard, 1902
168. *Heleopera rosea* Penard, 1890
169. *Heleopera sphagni* Leidy, 1874
170. *Heleopera sylvatica* Penard, 1890

Genus ***Hoogenraadia*** Gauthier-Lièvre & Thomas, 1958
171. *Hoogenraadia ovata* Bonnet, 1974

Suborder **Organoconcha** Lahr *et al.*, 2019
Family **Microchlamyidae** Ogden, 1985
Genus ***Microchlamys*** Cockerell, 1911
172. *Microchlamys patella* Cockerell, 1911

Genus ***Pyxidicula*** Ehrenberg, 1838
173. *Pyxidicula invisitata* Awerinzew, 1906
174. *Pyxidicula operculata* (Agardh, 1827) Ehrenberg, 1838

Suborder **Phryganellina** Bovee, 1985
Family **Phryganellidae** Jung, 1942
Genus ***Phryganella*** Penard, 1902
175. *Phryganella acropodia* Hopkinson, 1909
176. *Phryganella hemisphaerica* Penard, 1902
177. *Phryganella paradoxa* Penard,1902

Family **Cryptodifflugiidae** Jung, 1942
Genus ***Cryptodifflugia*** Penard, 1890
178. *Cryptodifflugia oviformis* Penard, 1902

Infraorder **Cylindrothecina** González-Miguéns et al., 2022
Family **Cylindriflugiidae** González-Miguéns et al., 2022
Genus ***Cylindrifflugia*** González-Miguéns et al., 2022
179. *Cylindrifflugia acuminata* (Ehrenberg, 1838) González-Miguéns et al., 2022
180. *Cylindrifflugia bacillariarum* (Perty, 1849) González-Miguéns et al., 2022
181. *Cylindrifflugia elegans* (Penard, 1890) n. comb. González-Miguéns et al., 2022
182. *Cylindrifflugia lanceolata* (Penard, 1890) González-Miguéns et al., 2022

Incertae sedis **Arcellinida**
Genus ***Argynnia*** Vucetich, 1974
183. *Argynnia caudata* (Leidy, 1879)

Genus ***Awerintzewia*** Schouteden, 1906
184. *Awerintzewia cyclostoma* Schouteden, 1906
185. *Awerintzewia schoutedeni* Chattopadyay & Das, 2003

Genus ***Erugomicula*** Nasser, Gregory, Singer, Patterson and Roe, 2021
186. *Erugomicula bidens* (Penard, 1902)

Genus ***Leptochlamys*** West, 1901
187. *Leptochlamys ampullacea* West, 1901

Genus ***Schwabia*** Jung, 1942
188. *Schwabia robustus* Chardez, 1964

Domain **Diaphoretickes** Adl *et al.*, 2012

Supergroup **Rhizaria** Cavalier-Smith, 2002
Phylum **Cercozoa** Cavalier-Smith, 1988, *emend*. Adl *et al*., 2005., *emend.* Cavalier-Smith, 2018
Class **Silicofilosea** Adl *et al*.,2005, *emend.* Adl *et al*., 2012
Order **Euglyphida** Copeland, 1956, *emend.* Cavalier-Smith, 1997
Family **Assulinidae** Lara *et al*., 2007
Genus ***Assulina*** Ehrenberg, 1872
189. *Assulina discoides* Bobrov et al., 2012
190. *Assulina muscorum* Greeff, 1888
191. *Assulina quadratum* Van Oye, 1958
192. *Assulina seminulum* Ehrenberg, 1848
Genus ***Placocista*** Leidy, 1879
193. *Placocista lens* Penard, 1902
Family **Euglyphidae** Wallich, 1864, *emend.* Lara *et al.*, 2007
Genus ***Euglypha*** Dujardin, 1841
194. *Euglypha acanthophora* (Ehrenberg,1842) Perty, 1849
195. *Euglypha acanthophora var. flexusa* Penard, 1890
196. *Euglypha capsiosa* Couteaux, 1978
197. *Euglypha ciliata forma. glabra* Cash, Wailes and Hopkinson, 1915
198. *Euglypha ciliata* Leidy, 1878
199. *Euglypha compressa* Carter, 1864
200. *Euglypha cristata* Leidy, 1874
201. *Euglypha denticulata* Brown, 1912
202. *Euglypha filifera cylindracea* Playfair, 1918
203. *Euglypha filifera* Penard, 1890
204. *Euglypha hyalinea* Couteaux, 1978
205. *Euglypha laevis* Perty, 1849
206. *Euglypha rotunda* Wailes and Penard, 1911
207. *Euglypha scutigera* Penard, 1890
208. *Euglypha simplex* Decloitre, 1965
209. *Euglypha strigosa* Leidy, 1878
210. *Euglypha tuberculata* Dujardin, 1841
Family **Trinematidae** Hoogenraad and De Groot, 1940, emend Adl *et al*., 2012
Genus ***Corythion*** Taranek 1881
211. *Corythion asperulum* Schonborn, 1988
212. *Corythion constricta* Jung, 1942
213. *Corythion dubium* Taranek, 1881
214. *Corythion pulchellum* Penard, 1890
Genus ***Pileolus*** Coûteaux and Chardez, 1981
215. *Pileolus tuberosus* (Coûteaux and Chardez, 1981)
Genus ***Playfairina*** Thomas, 1961
216. *Playfairina valkanovi* Golemansky, 1966
Genus ***Trinema*** Dujardin, 1841
217. *Trinema chardezi* Decloitre, 1981
218. *Trinema complanatum* Penard, 1890
219. *Trinema enchelys* Ehrenberg, 1838
220. *Trinema galeata* Jung, 1942
221. *Trinema grandis* Chardez, 1960
222. *Trinema lineare* Penard, 1902
223. *Trinema penardi* Thomas & Chardez, 1958
Family **Cyphoderiidae** de Saedeleer, 1934
Genus ***Cyphoderia*** Schlumberger, 1845
224. *Cyphoderia ampulla* Ehrenberg, 1840

***Incertae sedis* Euglyphida**

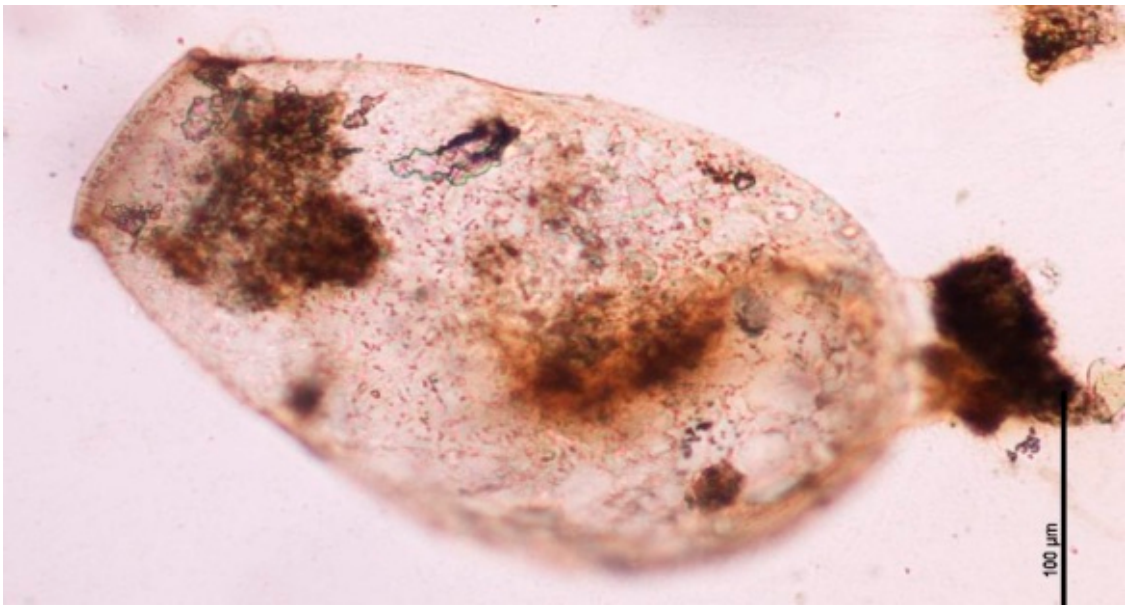
Genus ***Pareuglypha*** Penard, 1902

225. *Pareuglypha indica* Nair and Mukherjee, 1968

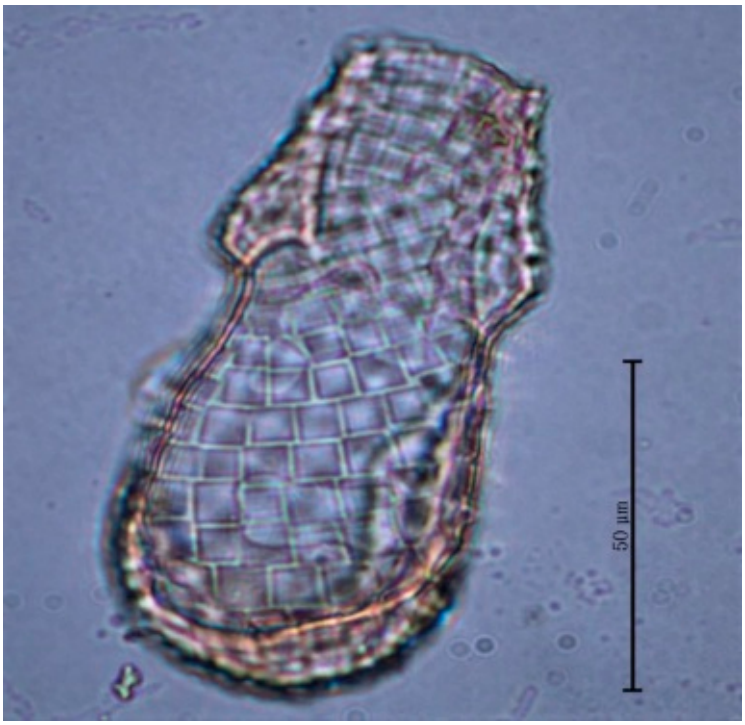
226. *Pareuglypha reticulata* Penard, 1902

Genus ***Tracheleuglypha*** Deflandre, 1928

227. *Tracheleuglypha dentata* (Moniez, 1888) Deflandre, 1928



Porosia paracarinata Bobrov and Kosakyan, 2015



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