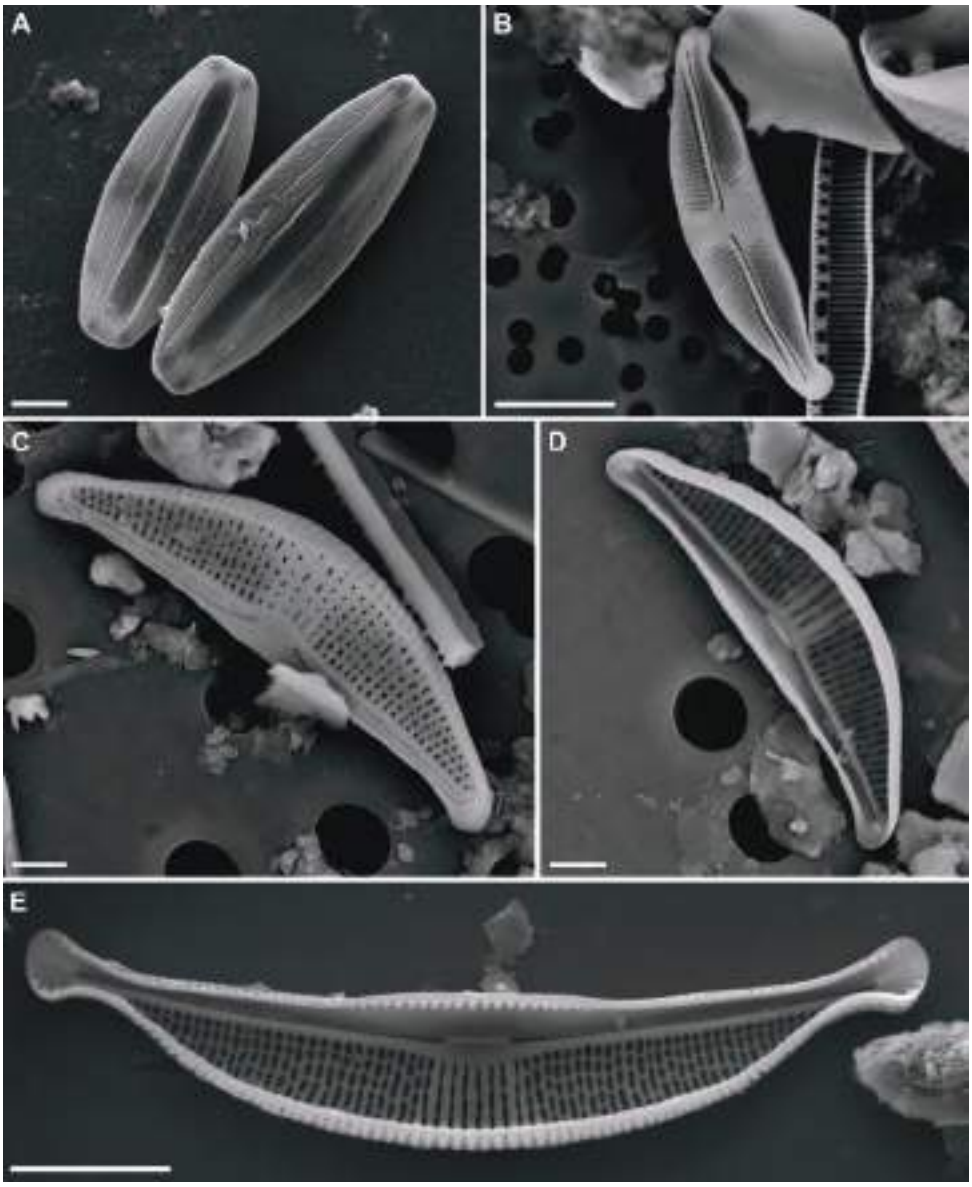


Fig. 163. *Halamphora* spp. **A-E**. SEM. **A-C.** External view of valves. **B.** *Halamphora submontana*. **D-E.** Internal view of valves. Scale bar = 5 µm (A-B, E), 2 µm (C-D).

Bacillaria J.F. Gmelin 1791

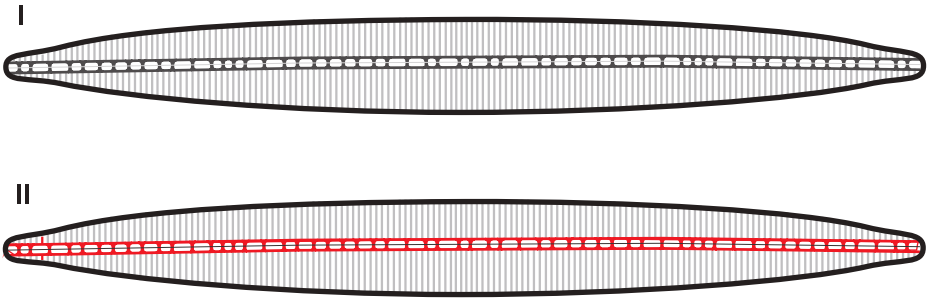
Type species: *Bacillaria paradoxa* J.F. Gmelin

Characteristics – Cells **biraphid**, large and rather robust, valve shape **linear**. Raphe located close to the center of the valve supported by robust **fibulae** (II; Fig. 164: A-B, E-F). Striae are coarse and easily discernable in LM but the areolae are indistinct.

Plastid structure – Two plate-like plastids on either side of the nucleus.

Identification of species – Up till now only one species occurs commonly in the inland waters of the tropics: *Bacillaria paradoxa.*

Ecology – Cells colonial, benthic. Found in tropical waters with high conductivity, usually in brackish to marine waters.



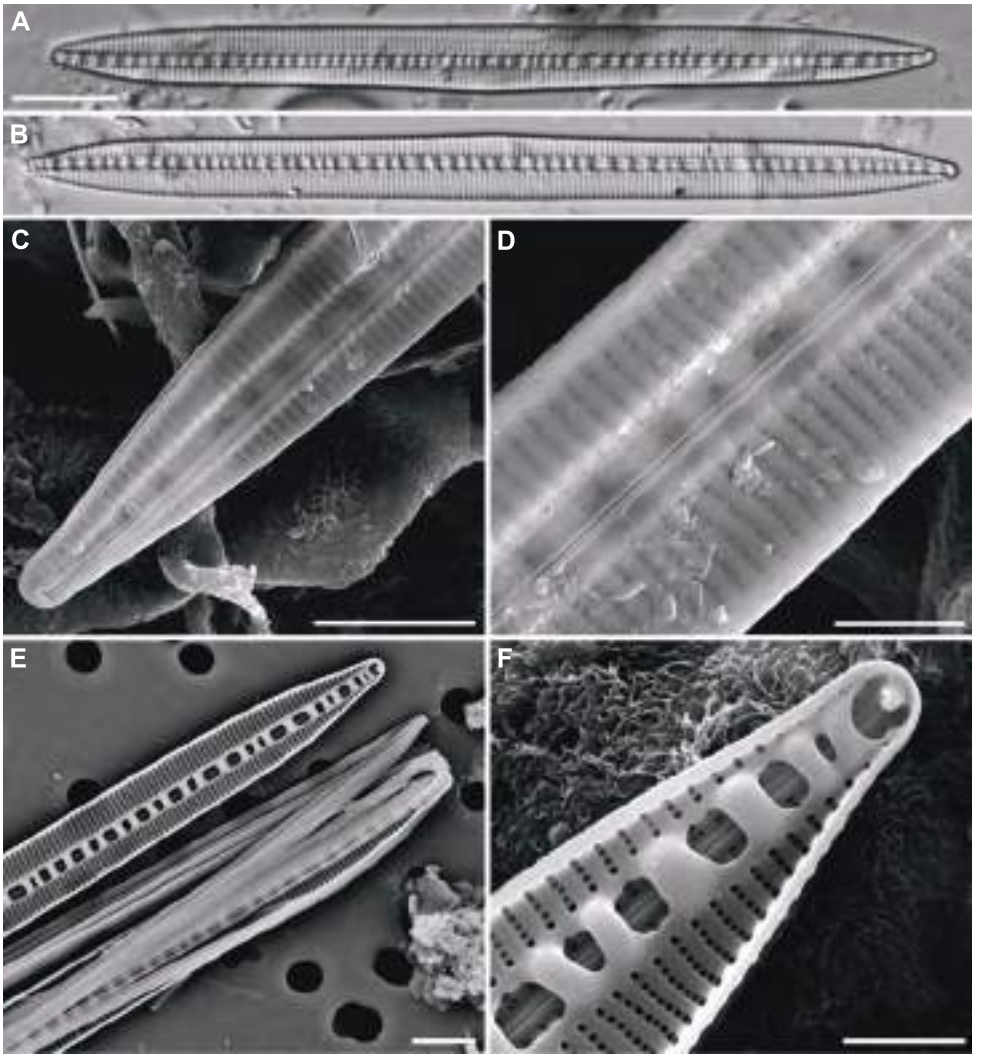


Fig. 164. *Bacillaria paradoxa*. **A-B.** LM, cleaned material, valve view. **C-F.** SEM. **C**. External view of valve showing detail of the terminal raphe ending. **D**. External view of valve showing detail of raphe slit. **E-F.** Internal view of valve showing structure of the fibulae and the copulae (**E**).
Scale bars = 10 µm (A-B), 5 µm (C, E), 2 µm (D, F).

Denticula Kützing 1844

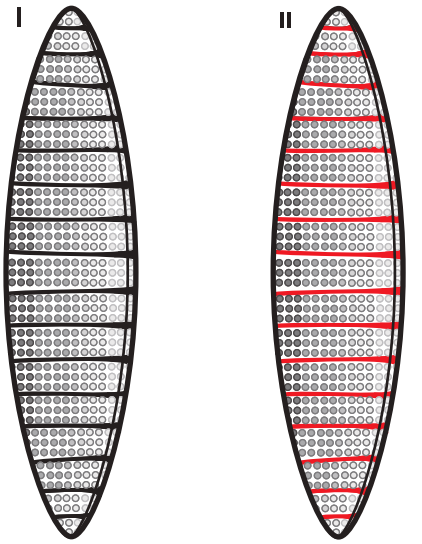
Type species: *Denticula elegans* Kützing

Characteristics – Cells **biraphid**, of variable size with prominent ribs or **transapical costae** (II) stretching across the valve face; these costae are extensions of the **fibulae**. Striae may be coarse and easily discernable or rather fine and in this case only the costae are readily discernable (Fig. 165: C-D). Costae are also clearly visible under LM in girdle view (Fig. 165: B). Raphe, not visible under LM, located at the junction of the valve face and valve mantle above the fibulae.

Plastid structure – Cells with 2 lobed plastids, each one extending from mid-valve to each apex (Fig. 165: A-B). Several small lipid droplets scattered throughout the cell (Fig. 165: B).

Identification of species – Species can be identified by cell size, cell shape, shape of the apices and structure and density of the **costae** and striae as well as the structure and density of the areolae.

Ecology – Cells solitary and motile. Found in the benthos of hard waters with medium conductivity.



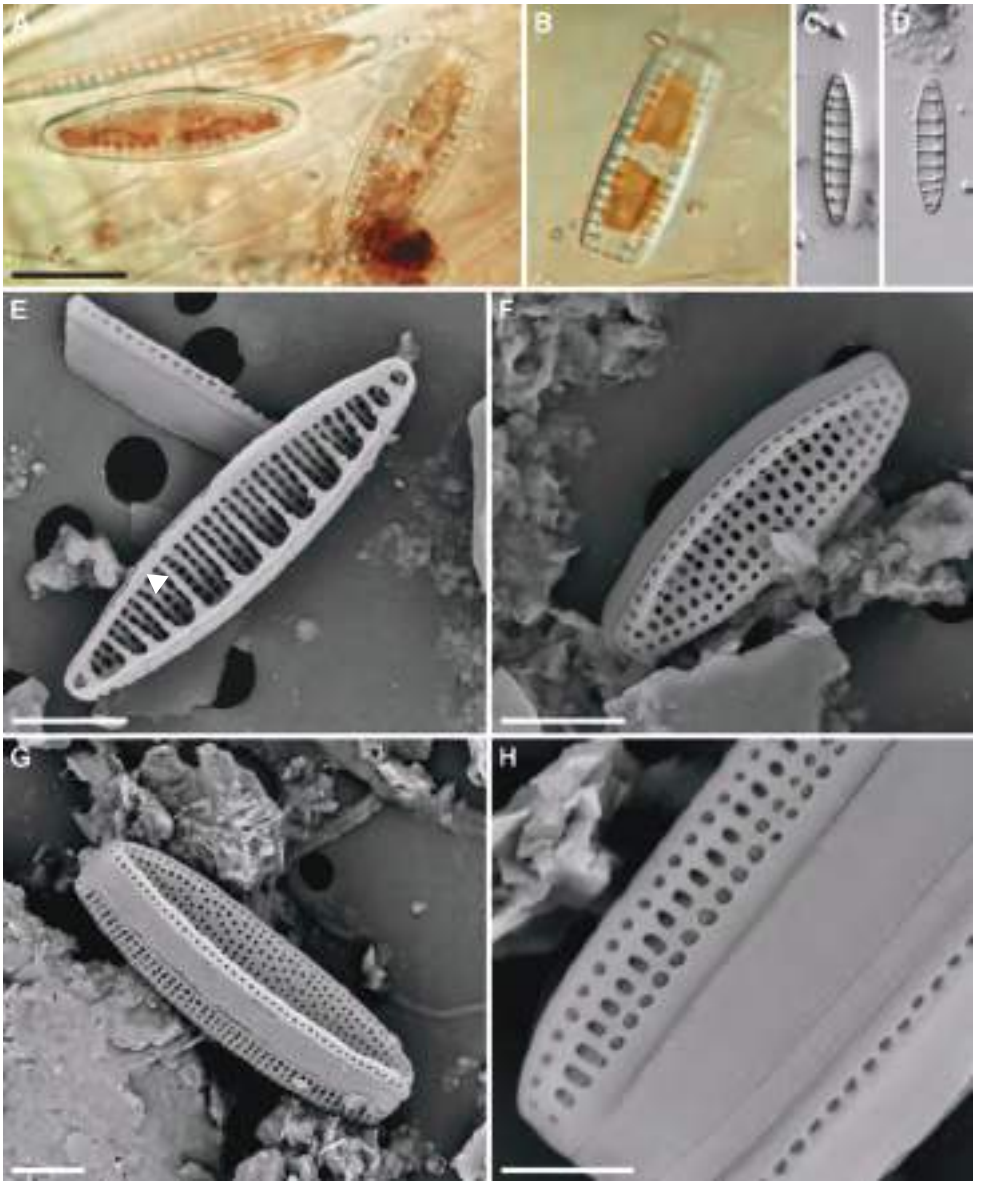


Fig. 165. *Denticula* spp. **A-D.** LM. **A-B**. Living cells of *Denticula kuetzingii* Grunow. **A**. Valve view (left), girdle view (right). **B**. Girdle view. **C-D.** *D. elegans*, valve views. **E-H**. SEM, *D. kuetzingii*. **E**. Internal view of valve, note costae (arrow). **F-G**. External view of valves. **H**. External view of girdle. Scale bars = 10 µm (A-D), 5 µm (E-G), 3 µm (H).

Gomphonitzschia Grunow 1868

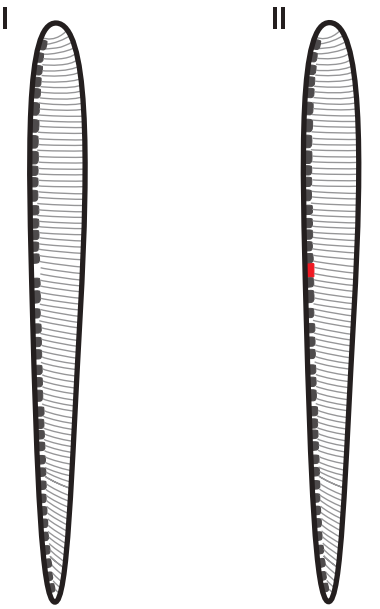
Type species: *Gomphonitzschia ungeriana* Grunow

Characteristics – Cells **biraphid**, **heteropolar**, head pole broadly rounded with a narrow foot pole. Marginal raphe supported by fibulae, central gap (II; Fig. 166: A-I, L) between the fibulae present. Striae fine, radiate, slightly curved near the head pole, composed of single rows of areolae which are discernable under LM.

Plastid structure – Cells with 2 plastids, each one extending from mid-valve to each apex.

Identification of species – Up till now only one species known from tropical Africa: *Gomphonitzschia ungeriana*.

Ecology – Cells solitary, free living and motile. Found in the plankton and benthos of alkaline waters with moderate conductivity.



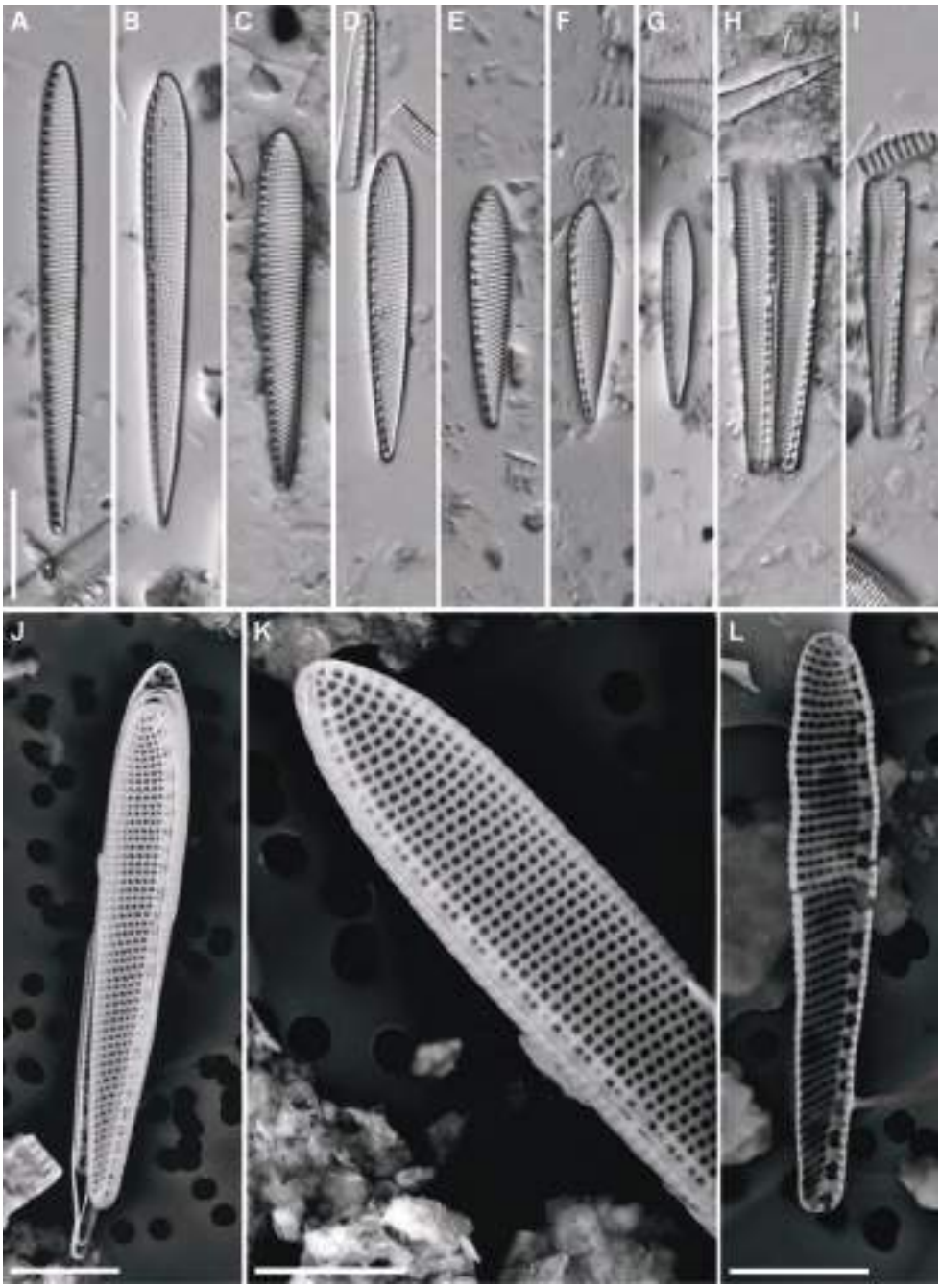


Fig. 166. *Gomphonitzschia ungeriana*. **A-I.** LM. **A-G.** Valve views. **H-I.** Girdle views. **J-L.** SEM. **J-K.** External view of valve. **L.** Internal view of valve. Scale bars = 10 µm (A-D), 5 µm (J-L).

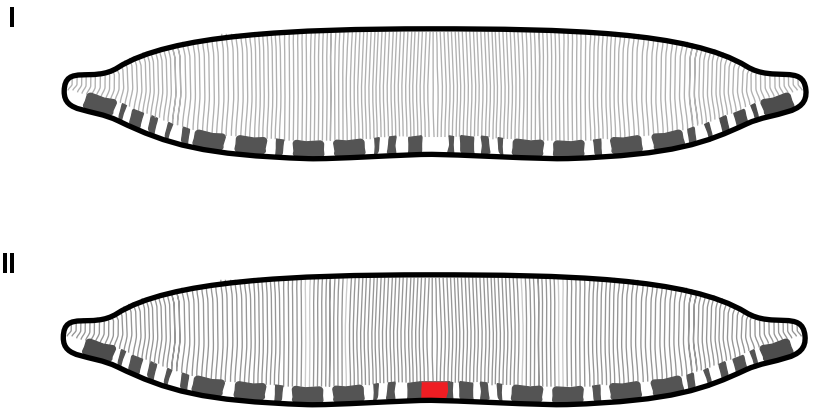
Hantzschia Grunow 1877

Type species: *Hantzschia amphioxys* (Ehrenberg) Grunow

Characteristics – Cells **biraphid**, weakly **dorsiventral**, ventral valve margin slightly concave and dorsal margin slightly convex. Rostrate apices. Raphe on the junction of valve face and mantle. Striae vary from fine to coarse, composed of single rows of areolae which may or may not be discernable under LM. Fibulae robust, easily discernable, with a central gap (I; Fig. 167: A-G) and carried on the ventral margins of both valves (**hantzschioid symmetry**).

Plastid structure – Two simple or complexly lobed plastids (Fig. 167: A-B) on either side of the central nucleus against the ventral side of the cell, or two girdle-appressed plates connected by a central pyrenoid (Fig. 167: A).

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae, density and structure of the fibulae as well as structure of the areolae.



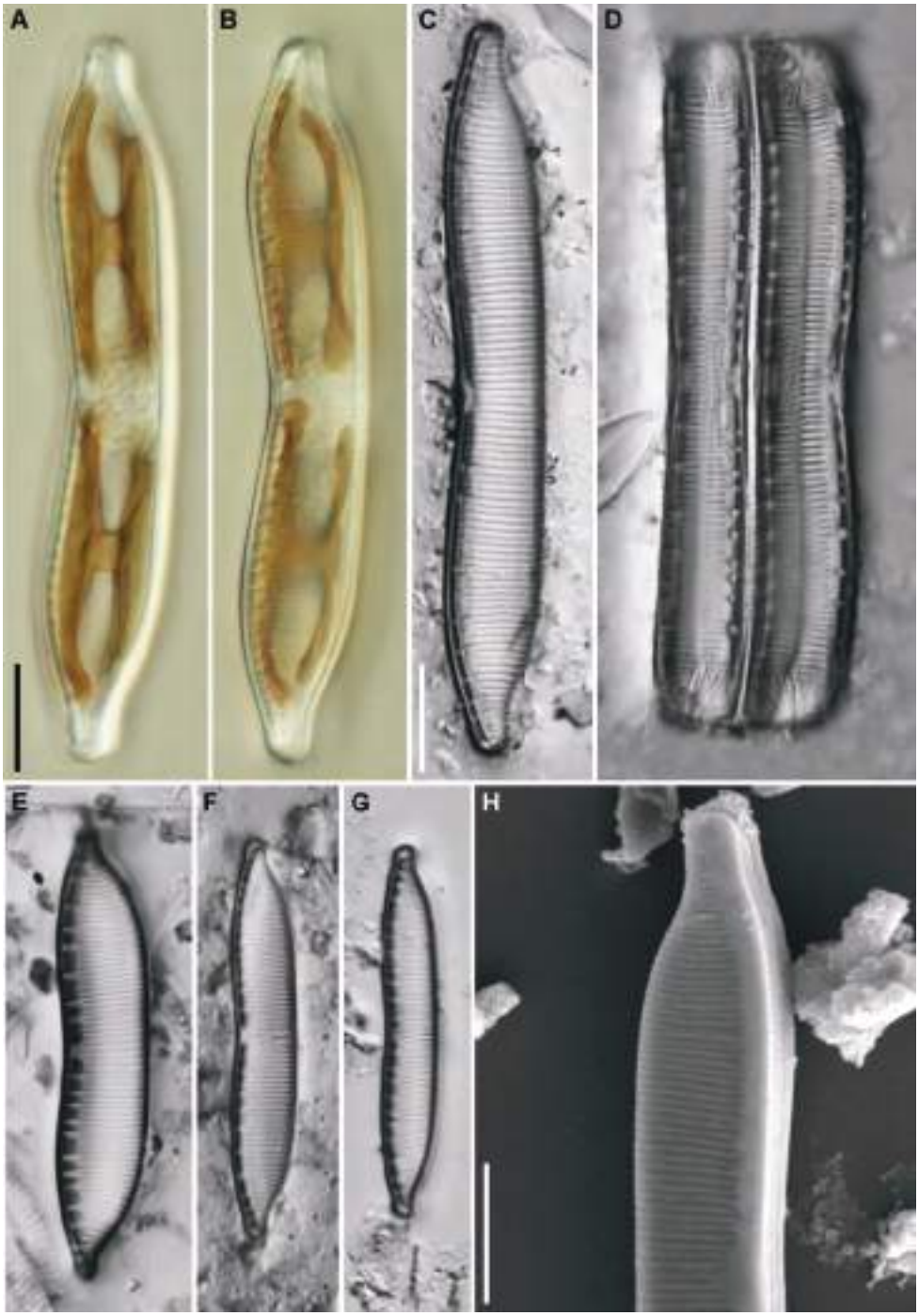


Fig. 167. *Hantzschia* spp. **A-G.** LM. **A-B.** Living cells. **C, E-G.** Cleaned valves. **D.** Girdle views. **H.** SEM, detail of external view of valve. Scale bars = 10 µm (A-G), 5 µm (H).

Nitzschia Hassall 1845

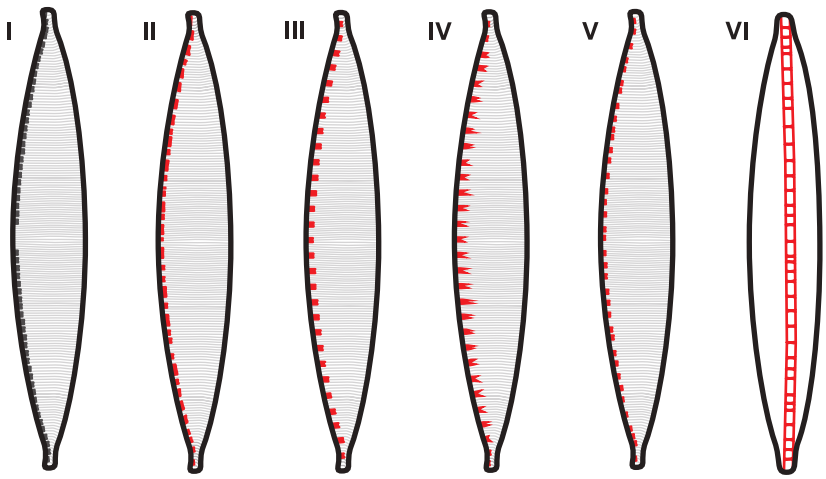
Type species: *Nitzschia elongata* Hassall

Characteristics – Cells **biraphid**, raphe eccentric, usually found at the junction of the valve face and mantle. Raphe keel is supported internally by **fibulae** (Fig. 170: H). Raphe may be continuous through the length of the valve or interrupted mid-valve (Fig. 170: D). The raphe is not discernable under LM but the presence of central raphe endings is indicated by a central gap in the fibulae (Fig. 169: A). The fibulae are variable in terms of shape (II), size (width) (III), extent across the valve face (IV) as well as the spacing between them (V). *Nitzschia dissipata* (Kützing) Rabenhorst and allied taxa are characterised by a raphe which is eccentric but not located at the junction of the valve face and mantle but more toward the valve centre (VI). This group also has an external conopeum covering the raphe (Fig. 170: G). Striae composed of single rows of round areolae which may or may not be discernable under LM, individual areolae may be discernable under LM.

Plastid structure – Cells with 2 plastids, each one extending from mid-valve to each apex (Fig. 168: F). Several small lipid droplets scattered throughout the cell (Fig. 168: A-C).

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae as well as structure and arrangement of the fibulae and the presence or absence of a central gap.

Ecology – Cells usually solitary, usually free living and motile but do form colonies within mucilage tubes. Found in the plankton and benthos of acidic to alkaline, oligotrophic to hypereutrophic waters in low to high conductivities.



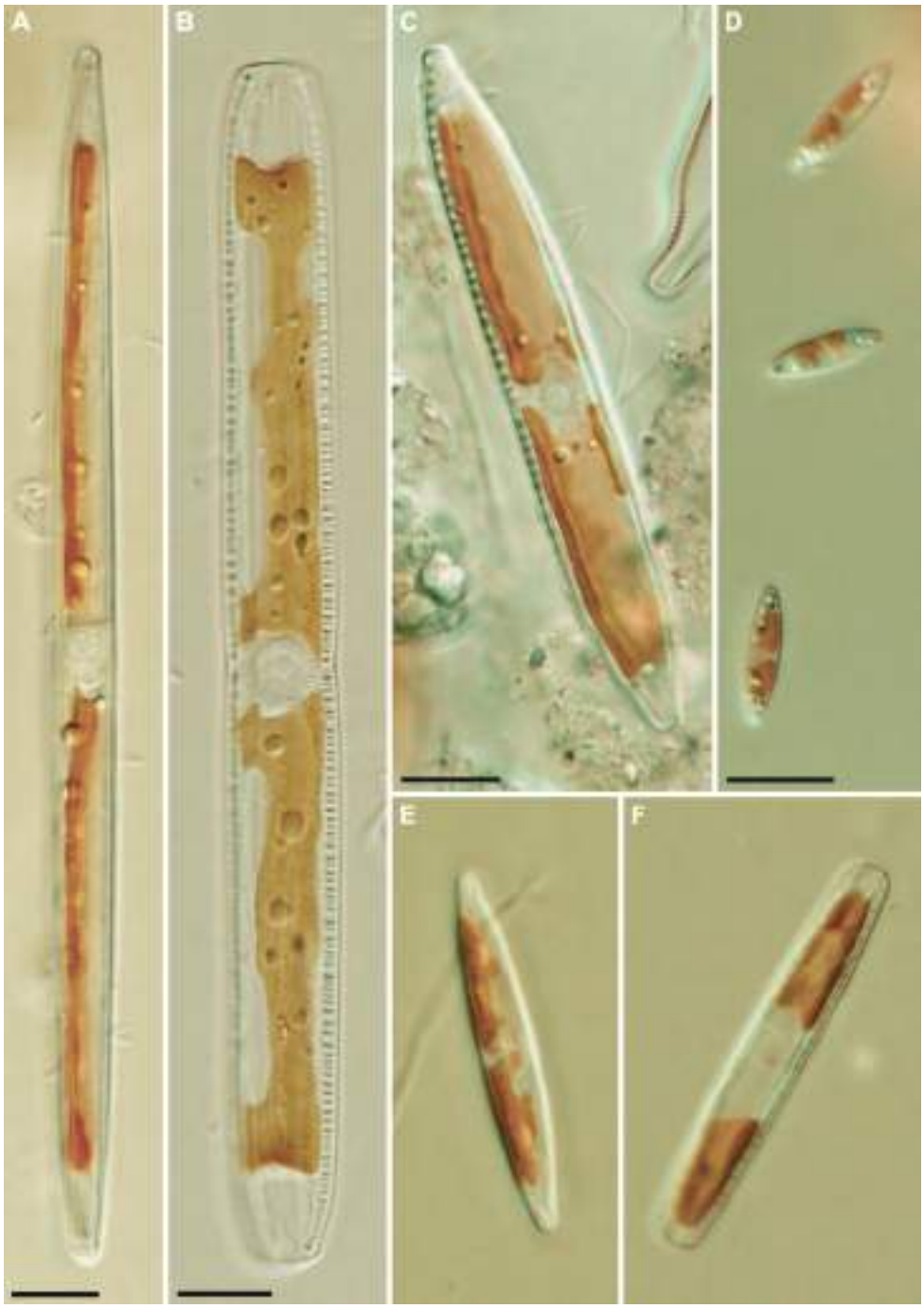


Fig. 168. *Nitzschia* spp. **A-F.** LM, living cells. **A, C-E.** Valve views, note lipid bodies. **B, F.** Girdle view, note lipid bodies.
Scale bars = 10 µm (A-F).

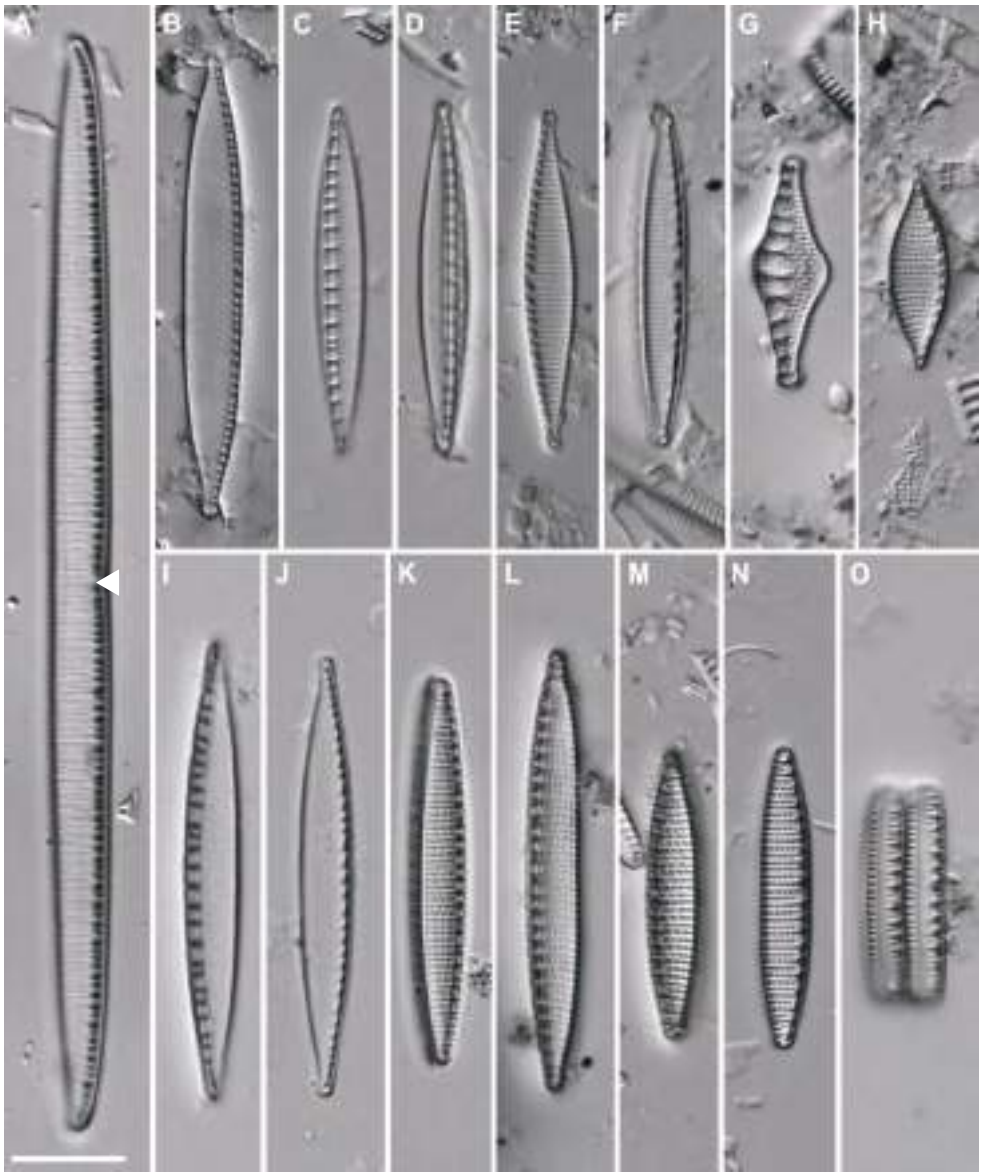


Fig. 169. *Nitzschia* spp. **A-O.** LM, cleaned valves. **A-N.** Valve views. **A.** *N. linearis* (C. Agardh) W. Smith, note central gap in the fibulae (arrow). **C-D.** *N. dissipata*. **G.** *N. sinuata* var. *tabellaria* (Grunow) Grunow. **H.** *N. lancetulla* O. Müller. **M-N.** *N. amphibia* Grunow. **I.** *N. recta* Hantzsch ex Rabenhorst. **O.** Girdle view. Scale bar = 10 µm (A-O).

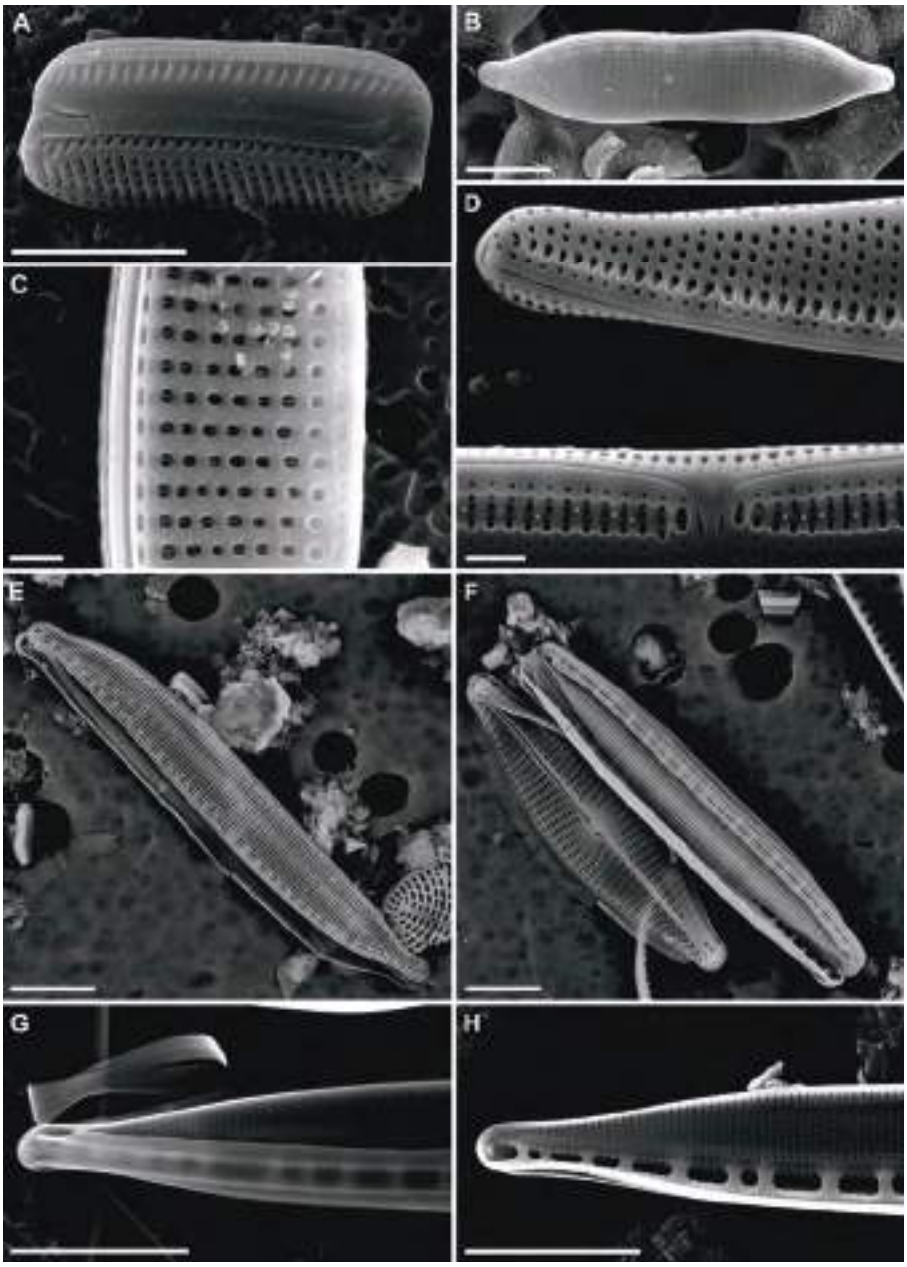


Fig. 170. *Nitzschia* spp. **A-H.** SEM. **A-E.** External view of valves. **A.** Oblique view showing the valve mantle and girdle bands. **D.** Detail of terminal raphe ending and central raphe endings. **F-G.** *N. dissipata,* detail of terminal raphe ending (**G**), note the external conopeum covering the raphe. **H.** Internal view of valve of *N. dissipata*, note the fibulae.
Scale bars = 5 µm (A-B, E-H), 1 µm (C-D).

Simonsenia Lange-Bertalot 1979

Type species: *Simonsenia delognei* (Grunow) Lange-Bertalot

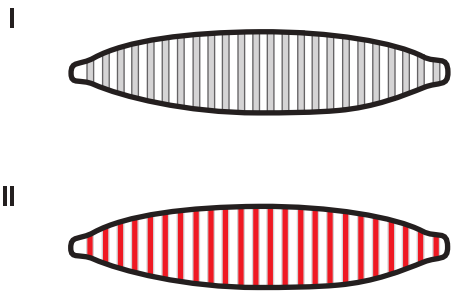
SYNONYM:
Nitzschia Hassall 1845 pro parte

Characteristics – Cells **biraphid**, very small, elliptical to linear elliptical with narrow rostrate apices. Striae fine, parallel, composed of double rows of areolae which are not discernable under LM. Raphe carried on a keel at the junction of one side of the valve face and mantle, supported by **costae** (II) which traverse the width of the valve face (Fig. 171: F-H). **Costae** are the only structure clearly discernable in LM. Cells similar in appearance to *Nitzschia* but **fibulae** are absent (Fig. 171: F-H).

Plastid structure – Cells with 2 plastids, each one extending from mid-valve to each apex (see *Nitzschia*).

Identification of species – Up till now only one species known: *Simonsenia delognei.*

Ecology – Cells solitary, free living and motile. Found in the benthos of waters with moderate conductivities.



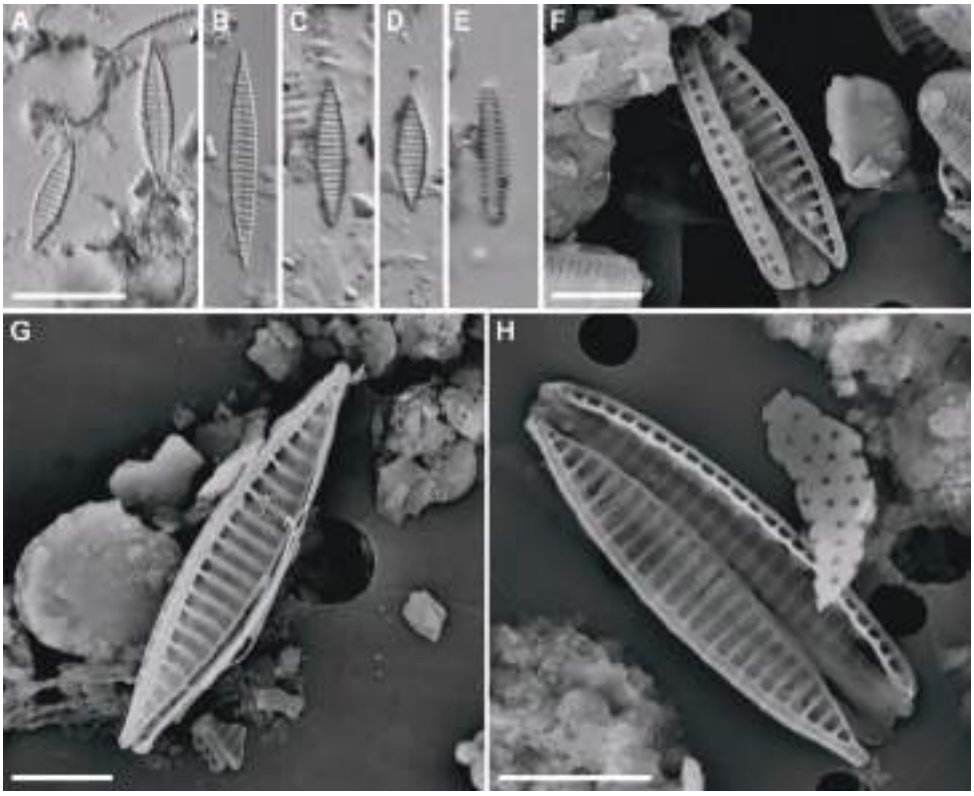


Fig. 171. *Simonsenia delognei*. **A-E.** LM, cleaned valves. **F-H.** SEM. **F** Internal view of valve. **G-H**. External view of valves.
Scale bars = 10 µm (A-E), 3 µm (F-H).

Tryblionella W. Smith 1853

Type species: *Tryblionella acuminata* W. Smith

SYNONYM:

Nitzschia Hassall 1845 pro parte

Characteristics – Cells **biraphid**, elliptical to linear elliptical with cuneate and occasionally subrostrate apices. Marginal raphe carried in canal at junction of valve face and valve mantle. Raphe difficult to discern, supported by fibulae (Fig. 173), interrupted mid-valve. Striae very fine composed of rows of small round areolae which are not discernable under LM. Valve face strongly longitudinally undulated (II; Fig. 173: A-C, E-G). **Costae** cross the valve face. Occasionally silica granules may be scattered on the valve face (Fig. 174: B).

Plastid structure – Cells with 2 large plastids, each one extending from mid-valve to each apex (Fig. 172: A-B). Several small lipid droplets scattered throughout the cell (Fig. 172: A-C).

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae as well as the degree of the constriction mid-valve.

Ecology – Cells solitary, free living and motile. Found in the benthos of oligotrophic to eutrophic waters in both moderate to high conductivities.

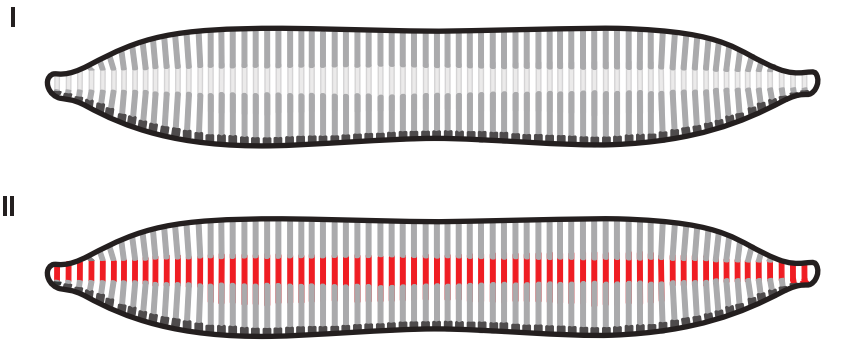


Fig. 172. *Tryblionella* spp. **A-F.** LM, living cells, note two 2 large plastids, each one extending from mid-valve to each apex, and several small lipid droplets. **A.** *T. littoralis* (Grunow) D.G. Mann. **B.** *T. calida* (Grunow) D.G. Mann. **C.** *T. apiculata* (W. Gregory) D.G. Mann. **D-F.** *T. debilis* Arnott. Scale bar = 10 µm (A-F).

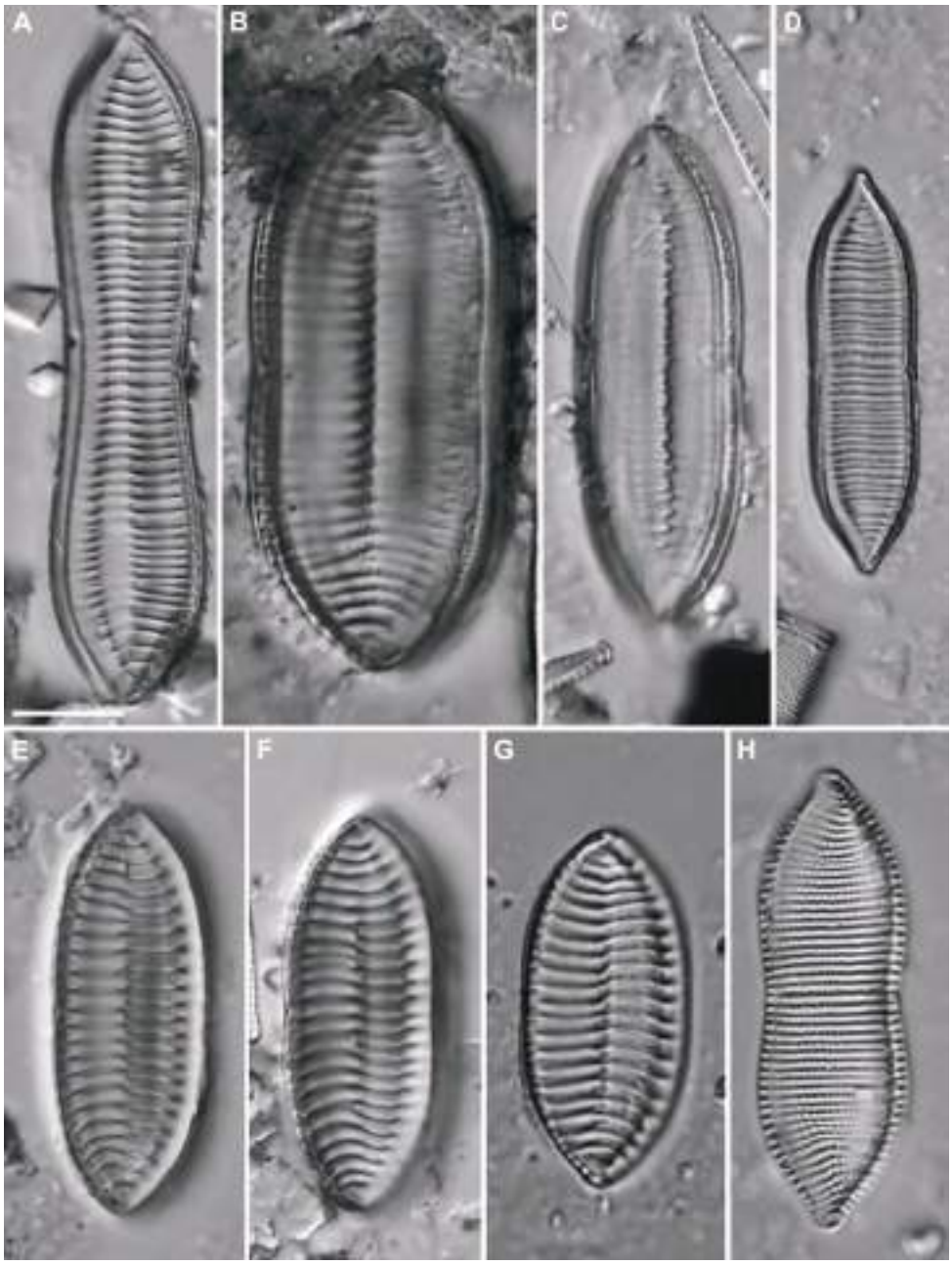


Fig. 173. *Tryblionella* spp. **A-H.** LM, cleaned valves. **C.** *T. littoralis*. **D.** *T. calida*. **E-F.** *T. levidensis* W. Smith. **H.** *T. coarctata* (Grunow) D.G. Mann. Scale bar = 10 µm (A-H).

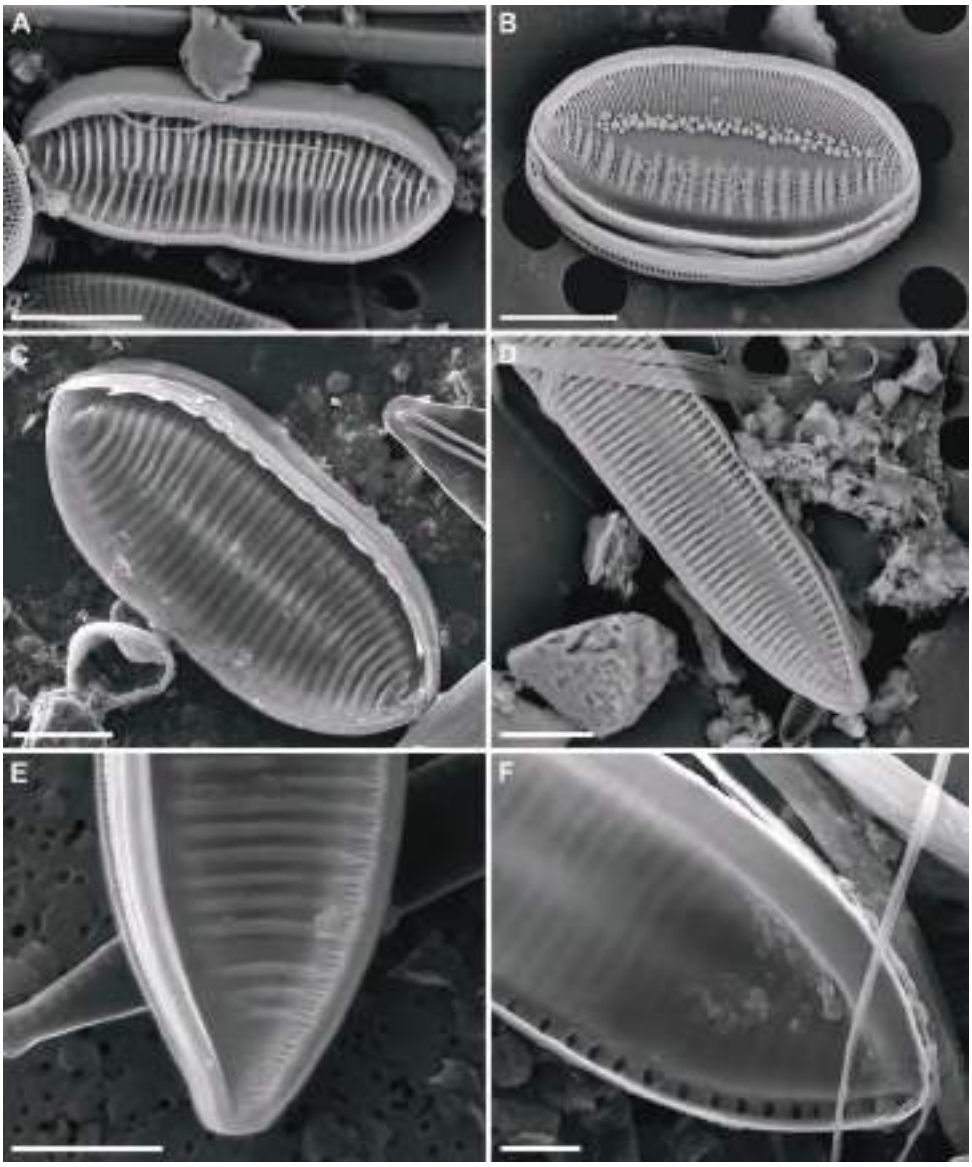


Fig. 174. *Tryblionella* spp. **A-F.** SEM. **A-E.** External view of valves. **B.** *T. debilis*, note scattered silica granules on valve face. **C.** *T. levidensis*. **D.** *T. hungarica* (Grunow) Frenguelli. **E.** *T. calida.* **F.** Internal view of valve, note fibulae.
Scale bars = 10 µm (A, C), 5 µm (B, D-F).

Epithemia Kützing 1844

Type species: *Epithemia turgida* (Ehrenberg) Kützing

Characteristics – Cells **biraphid**, **dorsiventral**, robust and heavily silicified. **Costae** (I) traverse the valve face in the transapical plane. Striae are easily discernable and composed of complex areolae (Fig. 176; Fig. 177: D). Raphe (II) supported by **fibulae** (III; Fig. 177: F) and located in a canal close to the ventral margin near the apices, each branch of the raphe is arched towards the dorsal valve margin. Septum like extensions found on the valvocopula (first girdle band next to the valve mantle) (Fig. 177: B).

Plastid structure – Cells with single, many-lobed plastid (Fig. 175: A-C). Many scattered lipid droplets.

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae and costae as well as shape and degree of arching of the raphe.

Ecology – Cells solitary, free living and motile. Found in the benthos of oligotrophic to eutrophic waters in both low and moderate conductivities. Cells can contain endosymbiotic prokaryotes which are able to fix nitrogen.

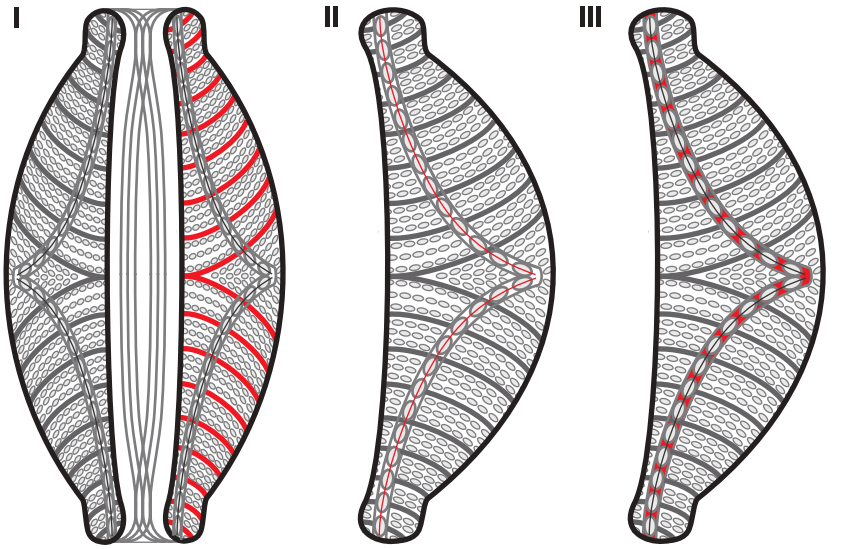


Fig. 175. *Epithemia* spp. **A-C.** LM. **A.** Living cell, girdle view (left) and valve view (right). **B-C.** Living cells of *Epithemia adnata* (Kützing) Brébisson, girdle view showing highly lobed plastid (**B**) and valve view (**C**).
Scale bar = 10 µm.

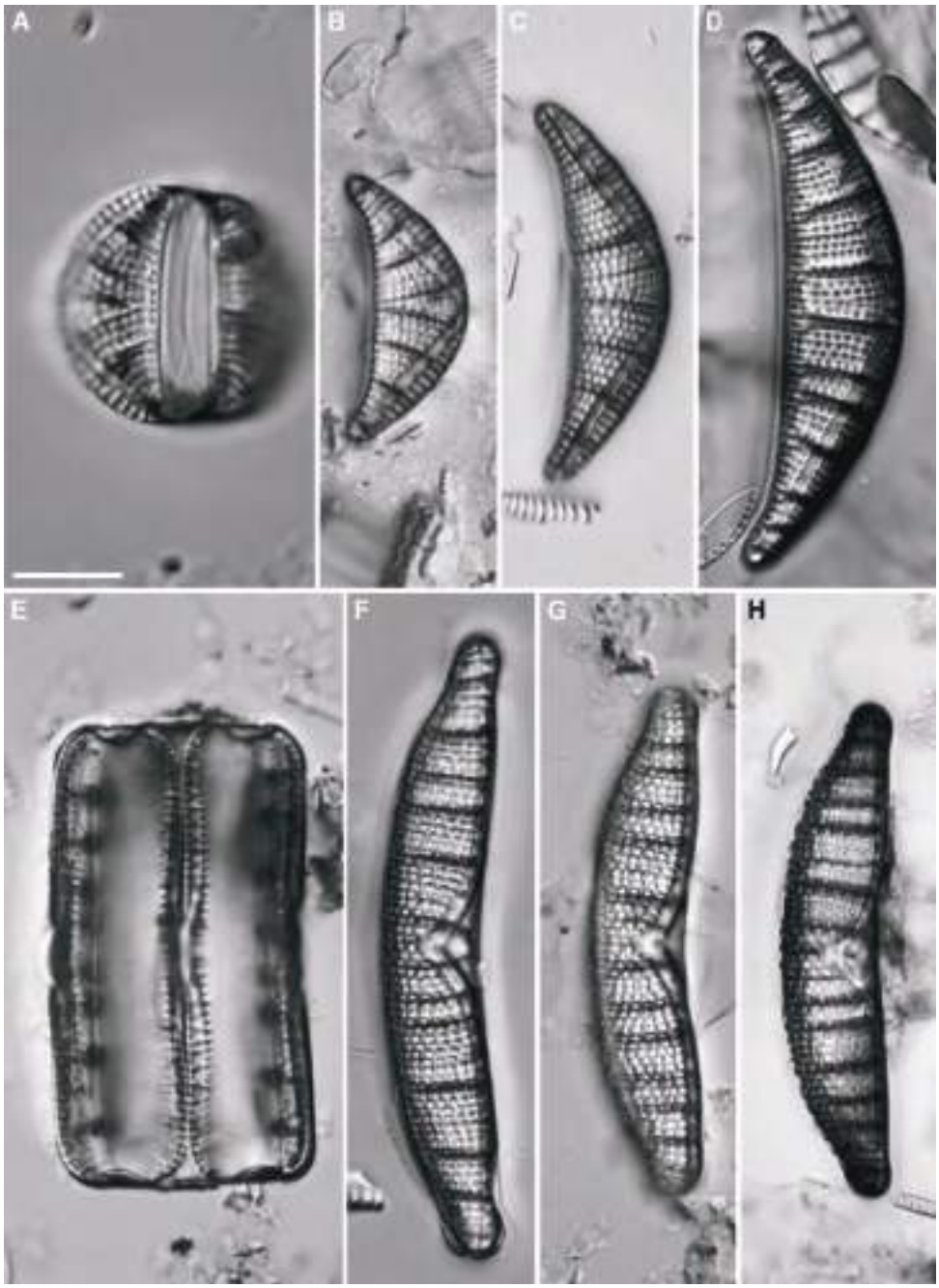


Fig. 176. *Epithemia* spp. **A-H.** LM. **A-D.** *Epithemia* sp., valve view. **E.** *E. adnata*, girdle view of cell undergoing asexual reproduction. **F-H.** *E. adnata* valve view. Scale bar = 10 µm.

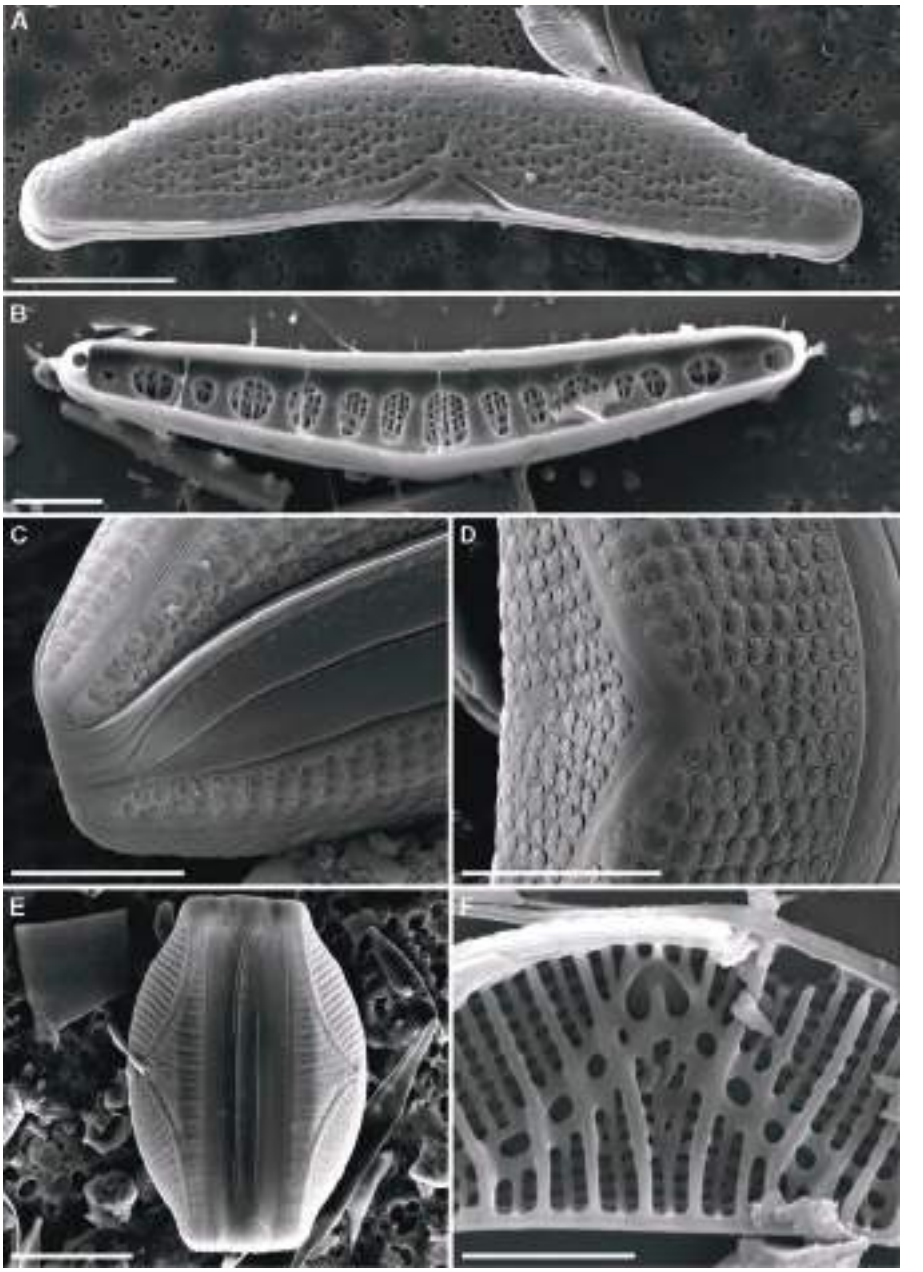


Fig. 177. *Epithemia* spp. **A-F.** SEM. **A.** *E. adnata*, external view of valve. **B.** Internal view of valve showing septum like extensions from the valvocopula. **C-F.** *E. sorex* Kützing. **C.** External view of terminal raphe endings. **D.** External view of central raphe endings. **E.** External view of ventral margin of intact cell. **F.** Internal view of valve showing heavily silicified costae. Scale bars = 10 µm (A-B, E), 5 µm (C-D, F).

Rhopalodia O. Müller 1897

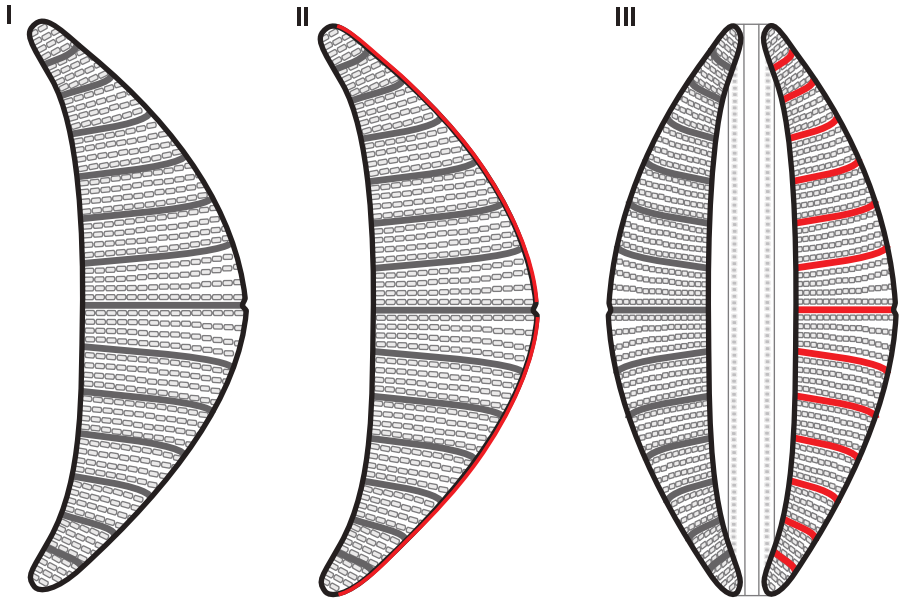
Type species: *Rhopalodia gibba* (Ehrenberg) O. Müller

Characteristics – Cells **biraphid**, **dorsiventral** with often straight ventral side, sometimes **heteropolar**, robust and heavily silicified. Cells large to extremely large. **Costae** traverse the valve face in the transapical plane (III; Fig. 180: E-I). Striae are easily discernable and composed of complex areolae (Fig. 181: F). Raphe (II) is very difficult to discern in LM, located in a canal on the dorsal valve margin, each branch of the raphe follows the curvature of the margin and is usually indented at the central nodule (Fig. 181: C). Girdle bands not complex such as those found in *Epithemia*.

Plastid structure – Single plate-like plastid lying along the ventral side of the girdle with highly lobed margins extending under the valve faces (Fig. 178: A-D).

Identification of species – Species can be identified by cell size, cell shape, shape and curvature of the apices, structure and density of the striae and costae as well as the degree of heteropolarity.

Ecology – Cells solitary, free living and motile or attached with mucilage stalks. Found in the benthos of oligotrophic to eutrophic waters in both low and moderate conductivities. Cells can contain endosymbiotic prokaryotes which are able to fix nitrogen.



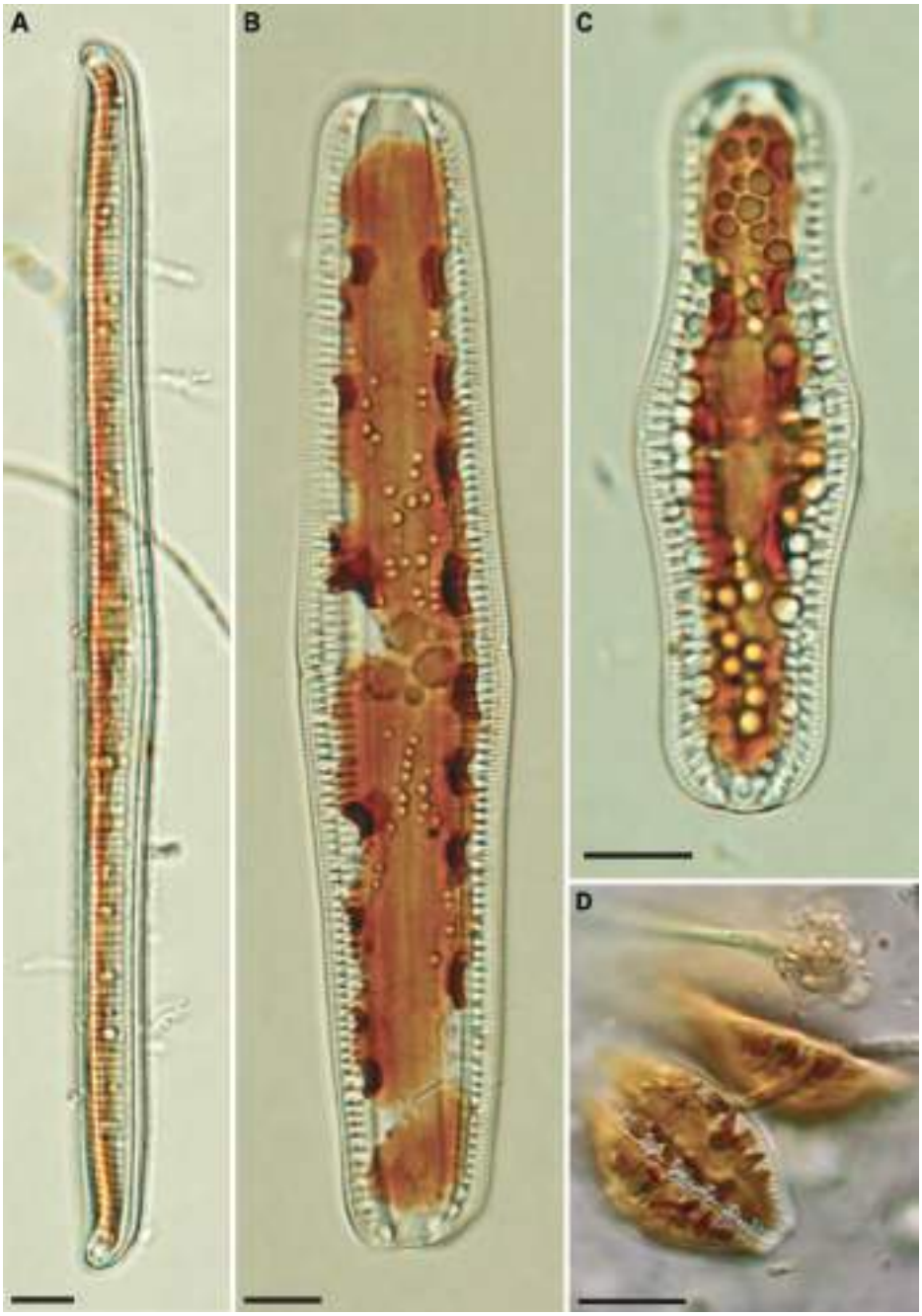


Fig. 178. *Rhopalodia* spp. **A-D.** LM, living cells. **A.** *Rhopalodia gibba*, valve view. **B-C.** *Rhopalodia gibba*, girdle view. **D.** *Rhopalodia* sp., girdle view, showing highly lobed plastid.
Scale bars = 10 µm.

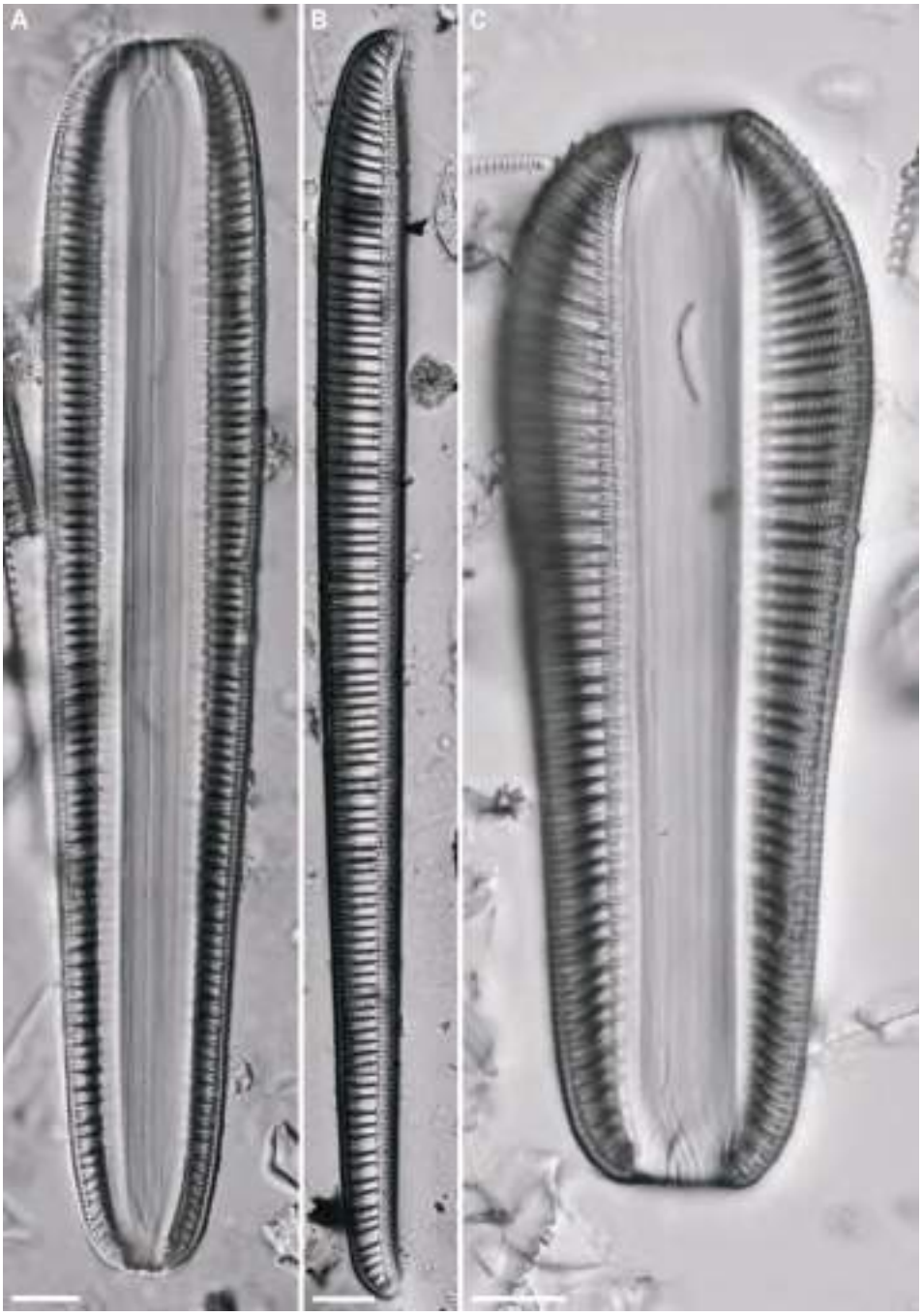


Fig. 179. *Rhopalodia hirudiniformis* O. Müller. **A-C.** LM, cleaned valves. **A, C.** Girdle view. **B.** Valve view.
Scale bars = 10 µm.

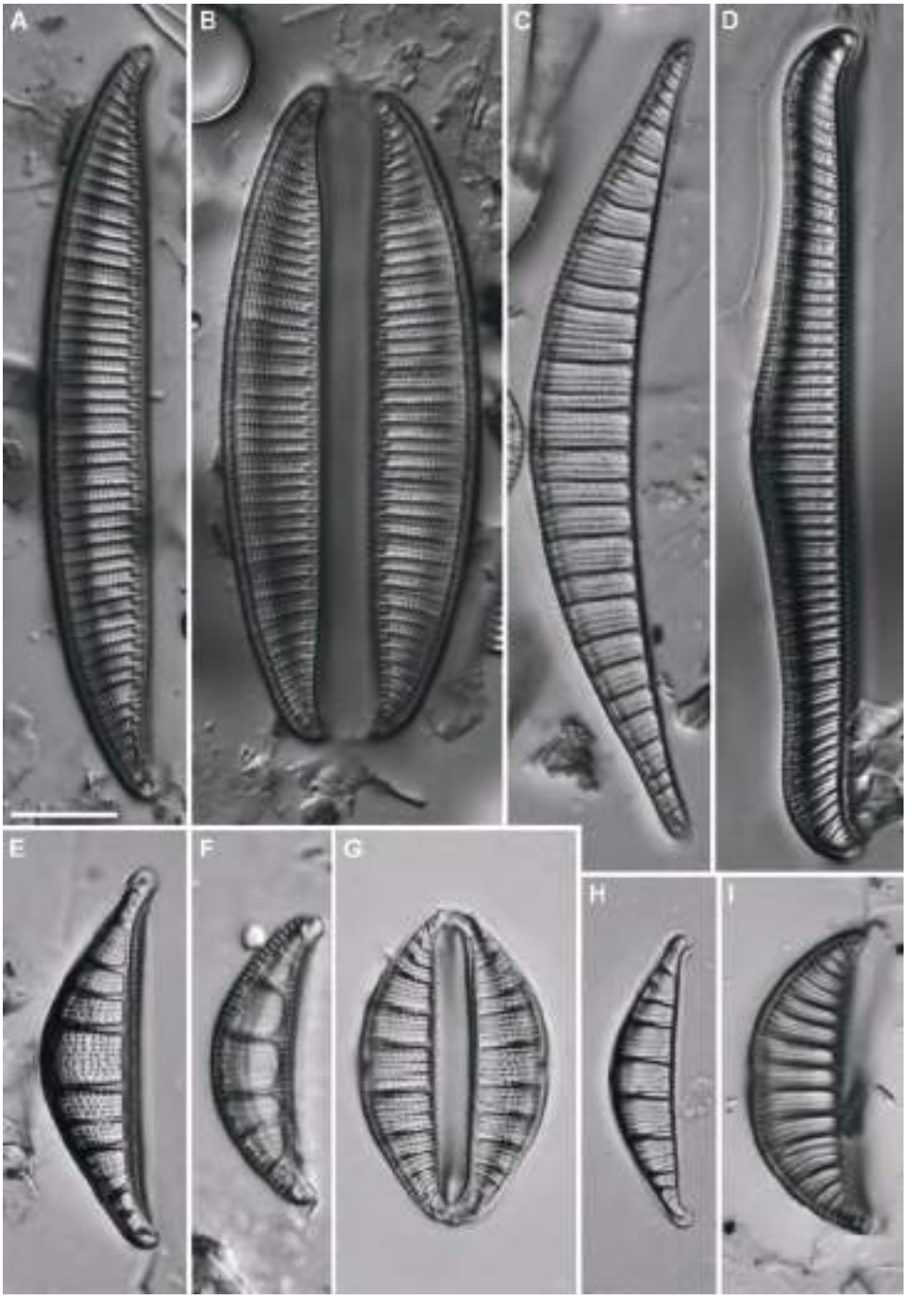


Fig. 180. *Rhopalodia* spp. **A-I.** LM, cleaned valves. **A.** Valve view. **B.** *Rhopalodia* sp., girdle views. **C.** *Rhopalodia* sp., valve view. **D.** *R. gibba*, valve view. **E-F.** *Rhopalodia* sp., valve views. **G.** *Rhopalodia* sp., girdle view. **H.** *R. gibberula* var. *vanheurckii* O. Müller, valve view. **I.** *Rhopalodia* sp., valve view. Scale bar = 10 µm.

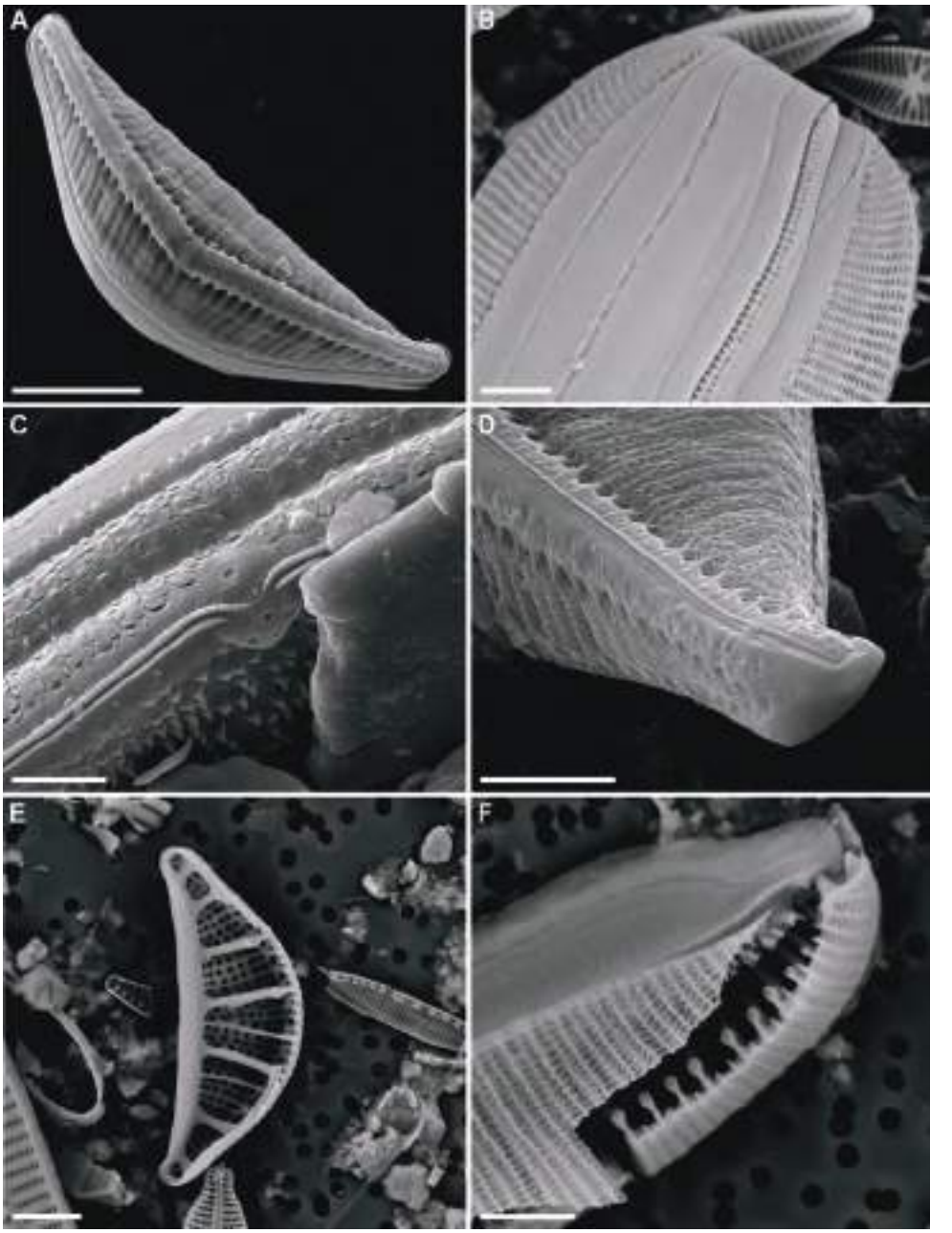


Fig. 181. *Rhopalodia* spp. **A-F.** SEM. **A-D, F.** External views. **B.** *Rhopalodia hirudiniformis*, detail of girdle bands. **C.** Detail of central raphe endings. **D.** Detail of terminal raphe ending. **E.** Internal view of valve. **F.** broken valve showing the complex structure of the areolae.
Scale bar = 10 µm (A), 5 µm (B, E-F), 2 µm (C-D).

Crucicostulifera J.C. Taylor & Lange-Bertalot 2010

Type species: *Crucicostulifera areolata* (Hustedt) J.C. Taylor & Lange-Bertalot

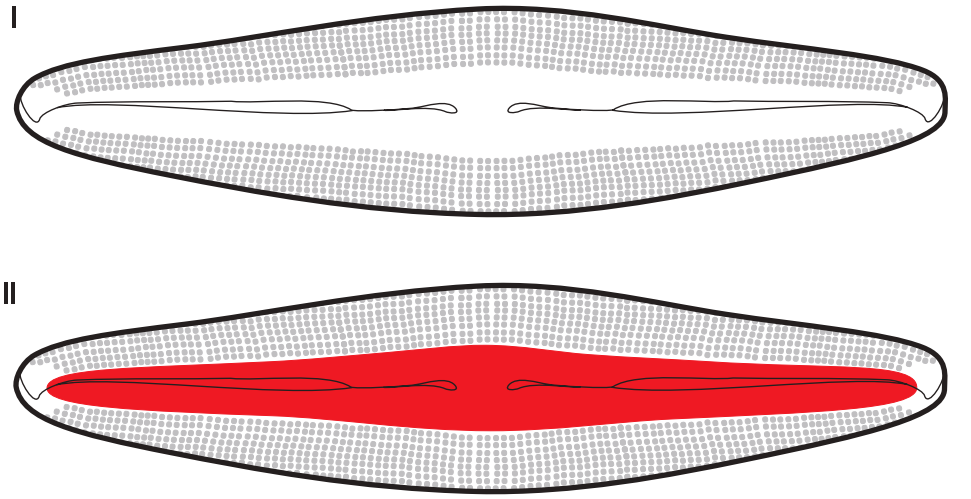
SYNONYM:
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid** with parallel striae through the length of the valve, areolae large, regularly arranged and easily observed under LM (Fig. 183: A-B). **Axial area** very broad (II; Fig. 183: A-B). Areolae have a typical X-shape when observed under SEM and are separated by transapical costae (Fig. 183: C-D).

Plastid structure – Cells with one H-shaped plastid and a large pyrenoid in the central area against one girdle. Several small lipid droplets scattered throughout the cell (Fig. 182).

Identification of species – Up till now only one species known from tropical Africa: *Crucicostulifera areolata.*

Ecology – Cells solitary and motile. Found in the benthos of oligotrophic slightly acidic water and extending into moist habitats such as splash zones near waterfalls.



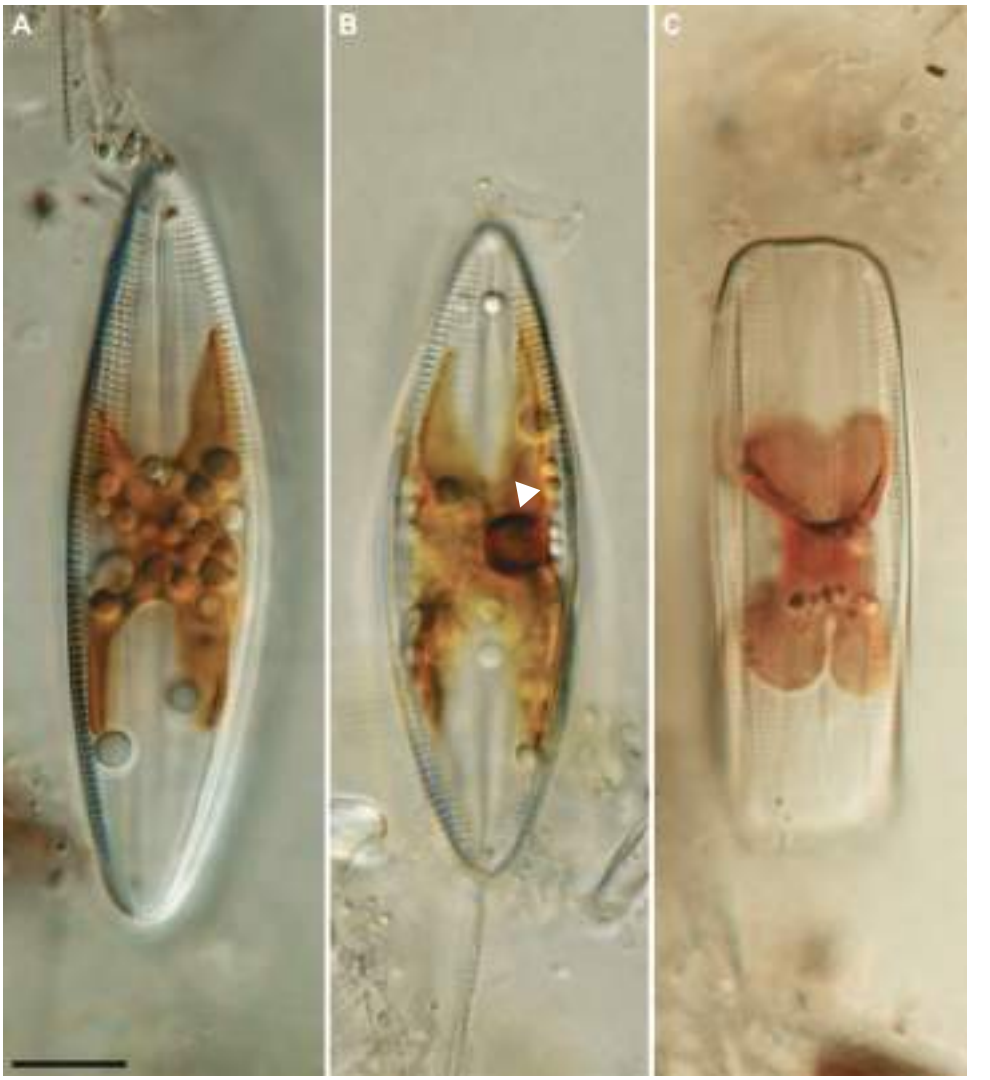


Fig. 182. *Crucicostulifera areolata*. **A-C.** LM, living cells, note H-shaped plastid and large pyrenoid (arrow - **B**).
Scale bars = 10 µm (A-C).

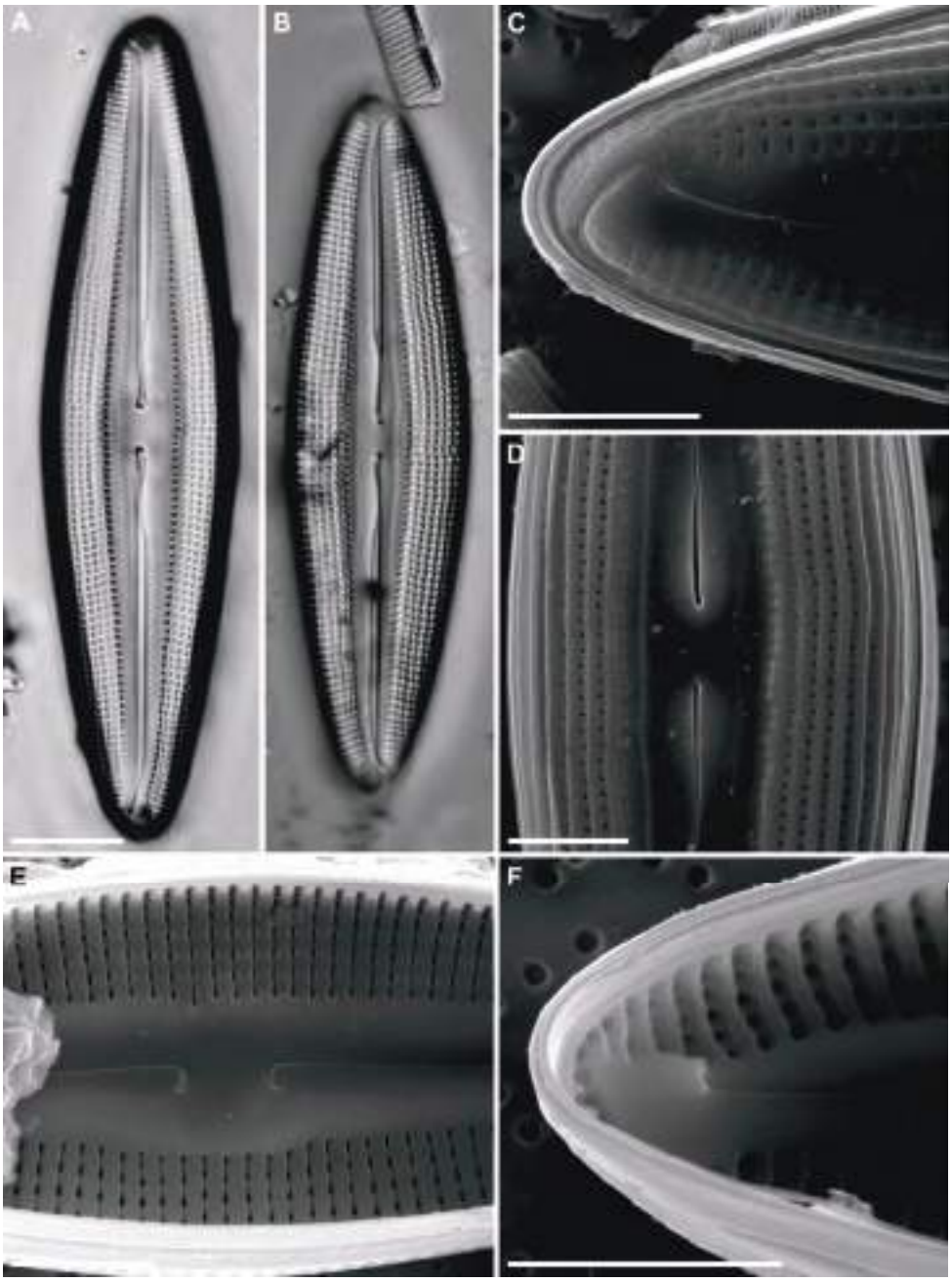


Fig. 183. *Crucicostulifera areolata*. **A-C.** LM, cleaned valves. **C-F.** SEM. **C.** Detail of external terminal raphe ending, note X-shaped areolae. **D.** Detail of external central raphe endings. **E.** Detail of internal central raphe endings. **F.** Detail of internal terminal raphe ending
Scale bars = 10 µm (A-B), 5 µm (C-F).

Campylodiscus Ehrenberg ex Kützing 1844

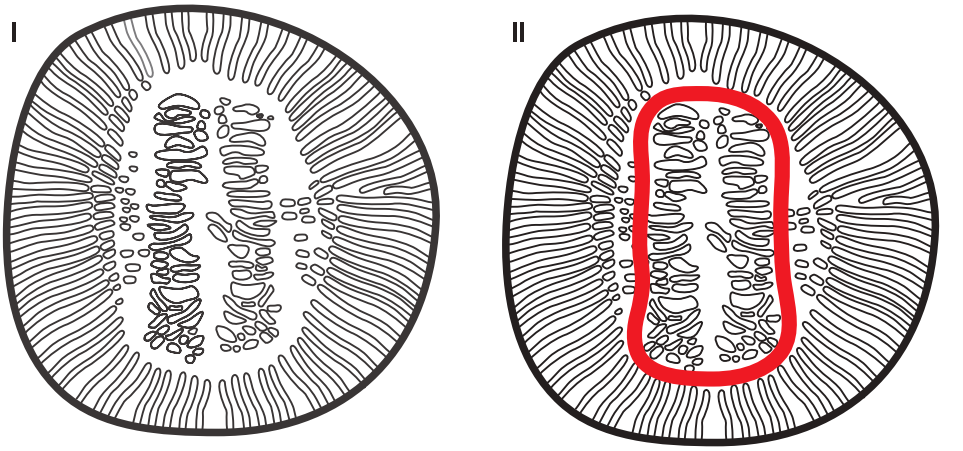
Type species: *Campylodiscus clypeus* (Ehrenberg) Ehrenberg ex Kützing

Characteristics – Cells **isopolar**, **biraphid**, saddle-shaped and very large. Concentric transapical valve undulations run parallel to the valve outline enclosing a (semi)circular area. Striae interrupted by a hyaline area (II). Raphe in a canal, raised on a keel above the valve (Fig. 184 F). This keel may be significantly higher than the valve face forming a wing. Open fenestrae sometimes present on the wing and in line with the depressions of the transapical valve undulations.

Plastid structure – Cells with one large lobed plastid.

Identification of species – Species can be identified by cell size, structure and density of the striae, and structure of the central region.

Ecology – Cells solitary, benthic, re-suspended in the plankton. Found in waters with moderate to high conductivity.



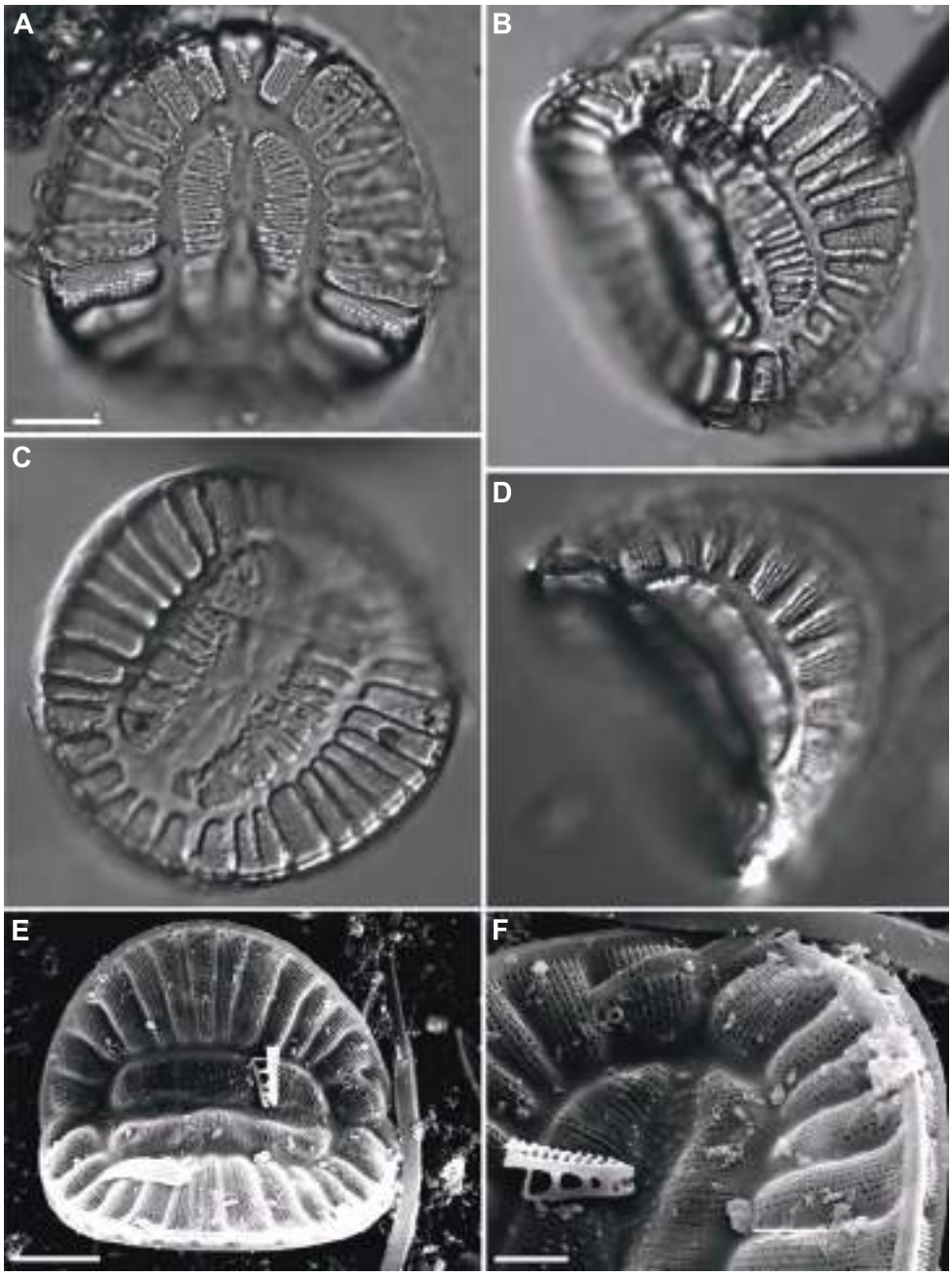


Fig. 184. *Campylodiscus clypeus*. **A-D.** LM. Cells at various angles and foci. **E-F.** SEM, external view of valve, note elevated keel bearing the raphe slit (arrow - **F**).
Scale bars = 10 µm (A-F).

Cymatopleura W. Smith 1851

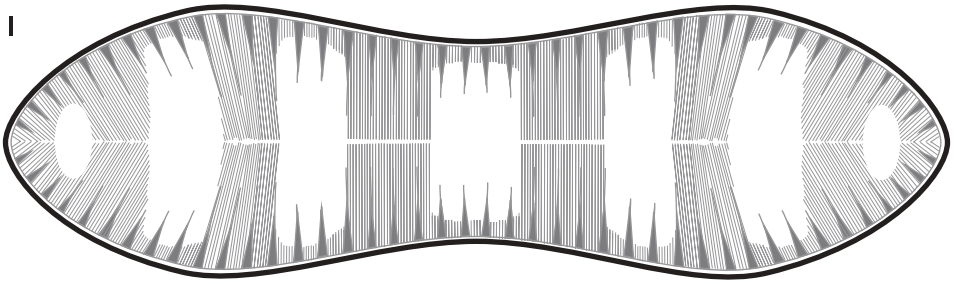
Type species: *Cymatopleura solea* (Brébisson) W. Smith

Characteristics – Cells **isopolar**, **biraphid**, large, elliptical, panduriform or linear with valve margins straight or constricted mid-valve. **Raphe** in a shallow **keel** on the entire circumference of the valve face supported by robust **fibulae** (Fig. 185: B-D; Fig. 186: D). Striae radiate, very fine, composed of small areolae which cannot be resolved using LM. Valve undulates in the transapical plane (Fig. 185: C, D).

Plastid structure – Cells with one large many lobed plastid (Fig. 185: A).

Identification of species – Cell shape, shape of the apices and size, number and position of the transapical valve undulations, structure and density of the fibulae.

Ecology – Cells benthic or planktonic, motile. Found in alkaline waters of low to moderate conductivity.



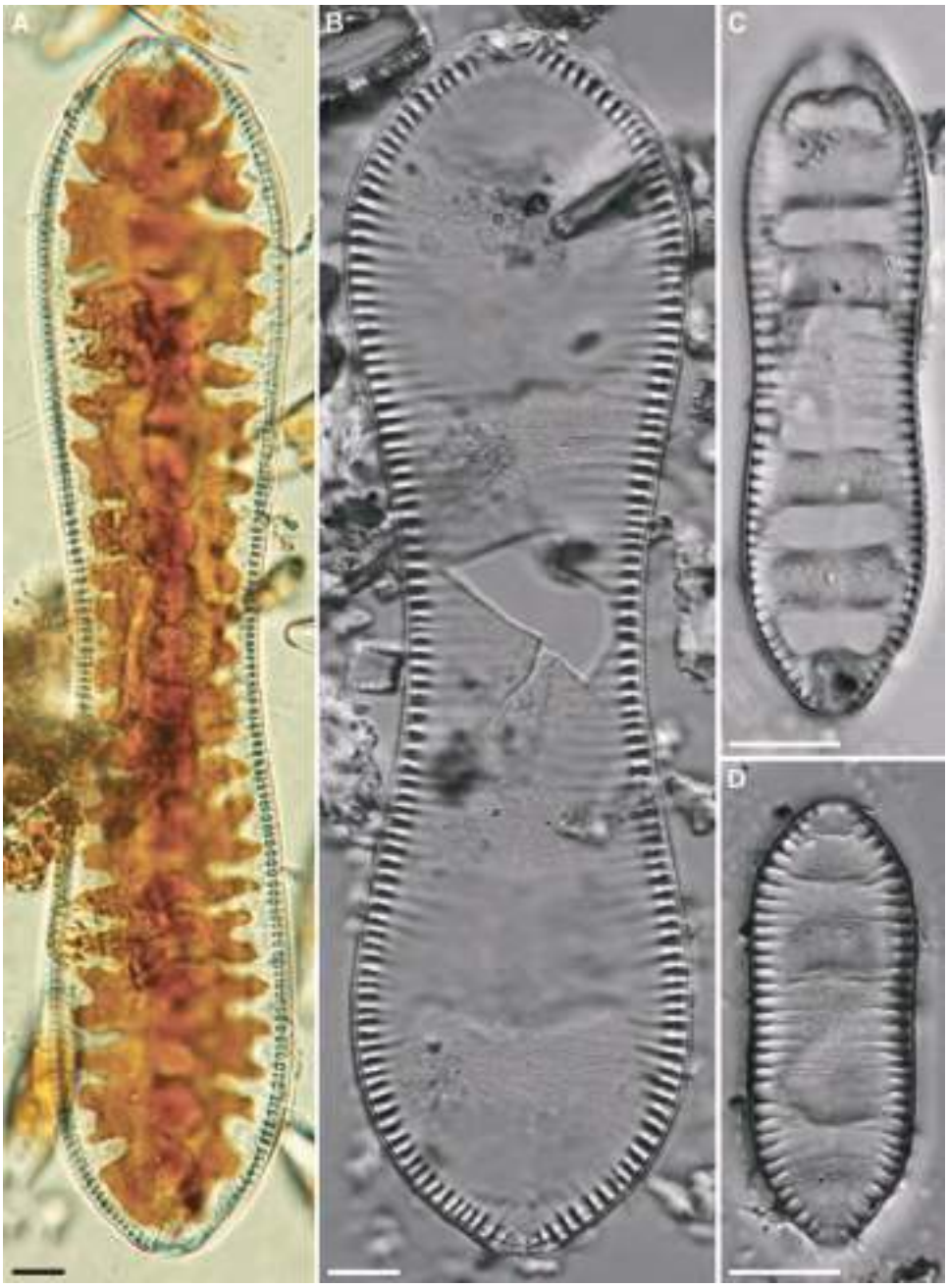


Fig. 185. *Cymatopleura* spp. **A-D.** LM. **A.** Living cell of *Cymatopleura clavata* (O. Müller) Cocquyt & R. Jahn, valve view, note highly lobed plastid. **B-D.** Cleaned material, valve view. **C-D.** *C. comperei* Cocquyt & R. Jahn, note undulations on valve face.
Scale bars = 10 µm (A-D).

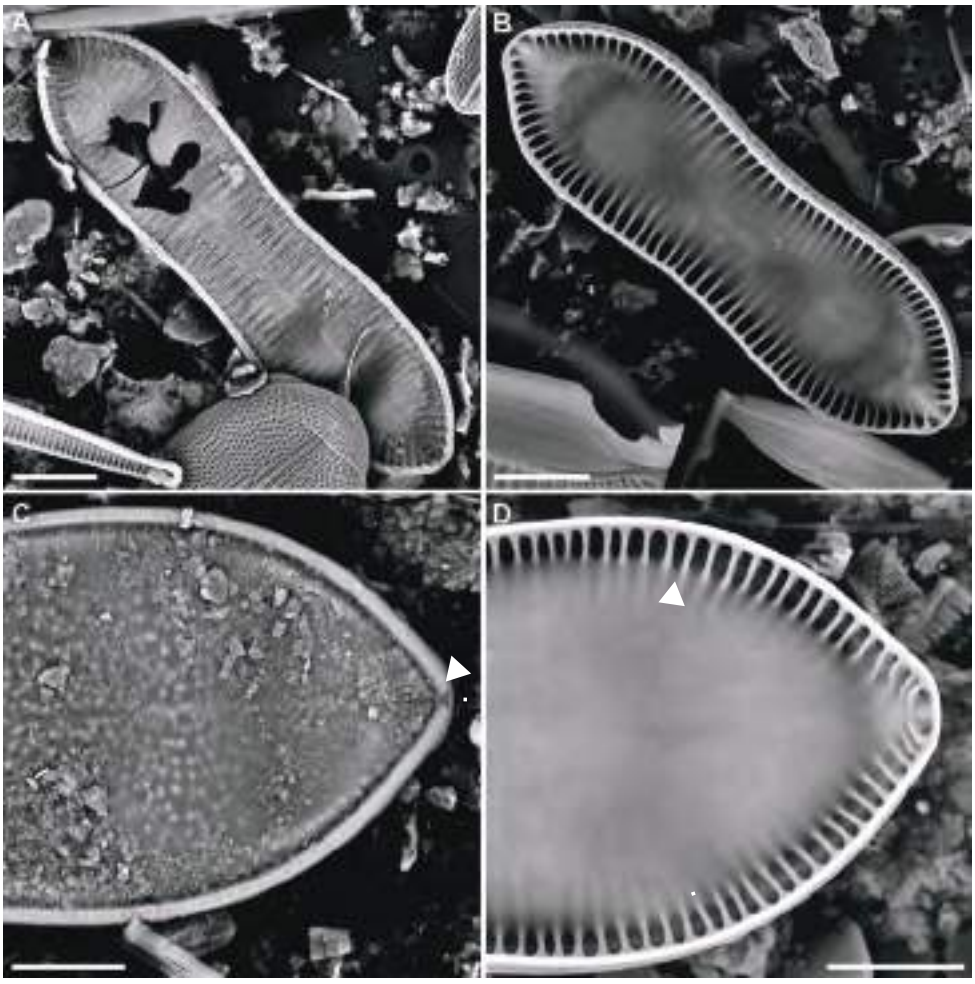


Fig. 186. *Cymatopleura* spp. **A-D.** SEM. **A-B.** *C. comperei.* **A.** View of valve exterior. **B.** View of valve interior. **C.** Valve exterior showing cell apex and raphe endings (arrow). **D**. Valve interior showing fibulae (arrow).
Scale bars = 10 µm (A-D).

Stenopterobia (Brébisson) Van Heurck 1896

Type species: *Stenopterobia sigmatella* (W. Gregory) R. Ross

SYNONYM:
Surirella Turpin 1828 pro parte

Characteristics – Cells **isopolar**, **biraphid**, valves narrow lanceolate or sigmoid. Striae fine, parallel composed of 2-3 rows of areolae which are not discernable under LM. **Costae** (Fig. 188: A-D; Fig. 189: A) cross the raphe and interrupted by a narrow axial area (Fig. 189: A-B). Raphe runs the length of the valve on both margins in a canal on a keel raised above the valve (Fig. 189: A-D).

Plastid structure – Cells with one plastid divided into 2 plates (Fig. 187: C, F), one against each valve connected by a narrow isthmus near one pole.

Identification of species – Species can be identified by cell size, cell shape (lanceolate or sigmoid), shape of the apices, structure and density of the costae, density of the striae as well as structure and width of the axial area.

Ecology – Cells solitary, free living and motile. Found in the benthos of acidic, oligotrophic waters in low conductivities.

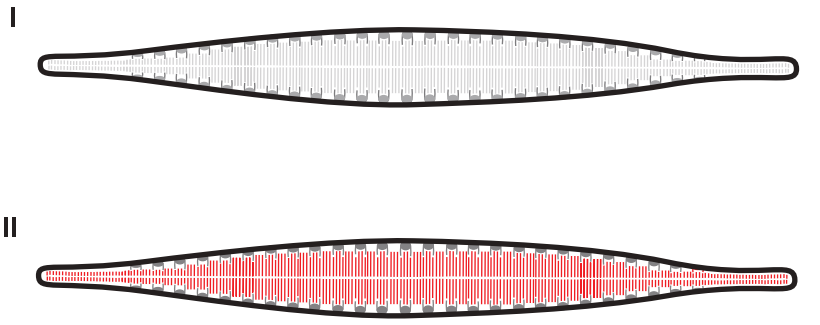


Fig. 187. *Stenopterobia* spp. **A-F.** LM, living cells. **A-B**. *Stenopterobia* sp. valve views. **C.** *Stenopterobia* sp. girdle view. **D-E.** *S. delicatissima* (F.W. Lewis) Brébisson ex Van Heurck, valve views. **F.** *S. delicatissima*, girdle view. Scale bars = 10 µm (A-F).

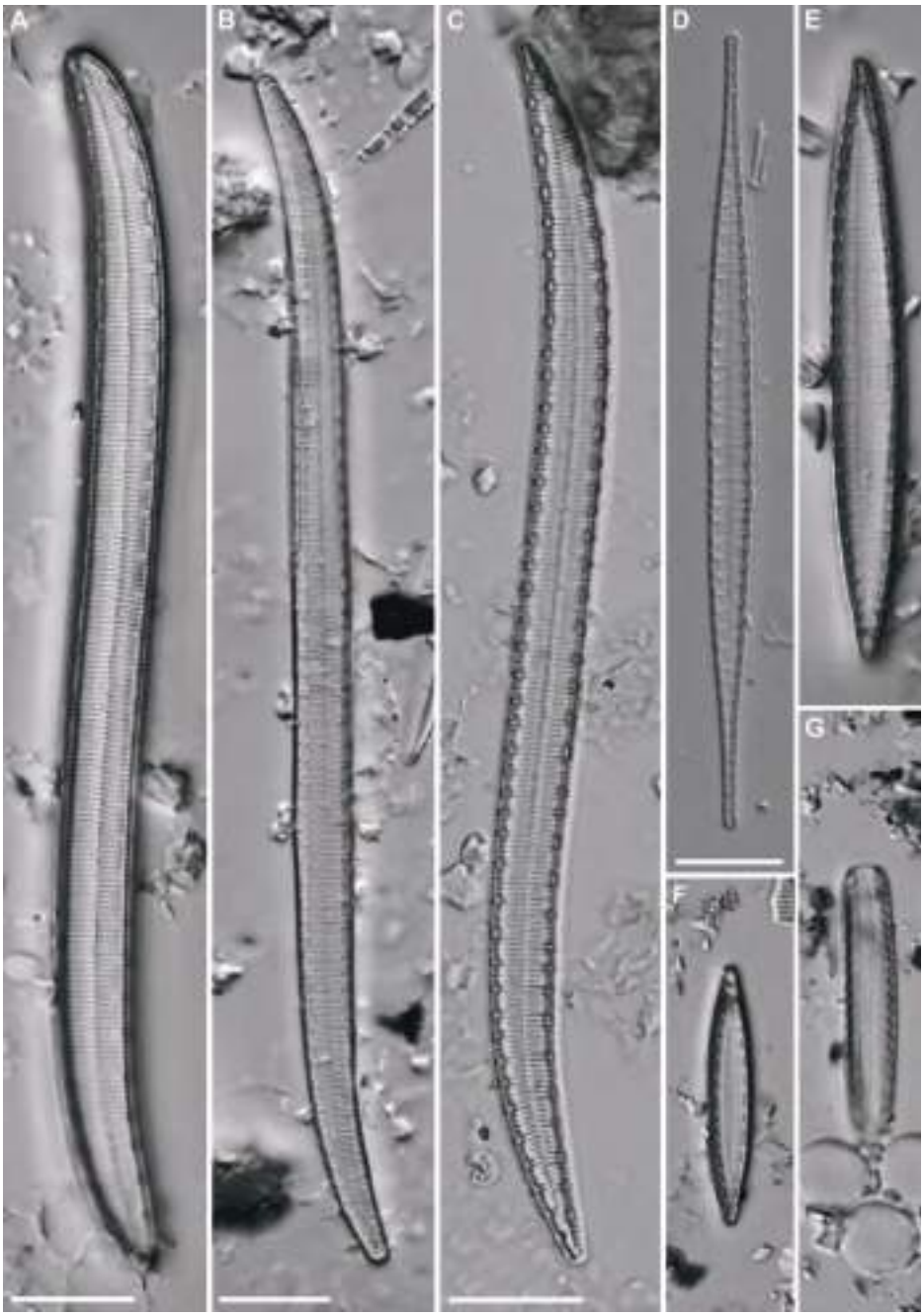


Fig. 188. *Stenopterobia* spp. **A-G.** LM, cleaned valves. **A-C.** *Stenopterobia* spp., valve views. **D.** *S. delicatissima*, valve view. **E-F.** *Stenopterobia* spp., valve views. **G.** *Stenopterobia* sp., girdle view.
Scale bars = 10 µm (A-G).

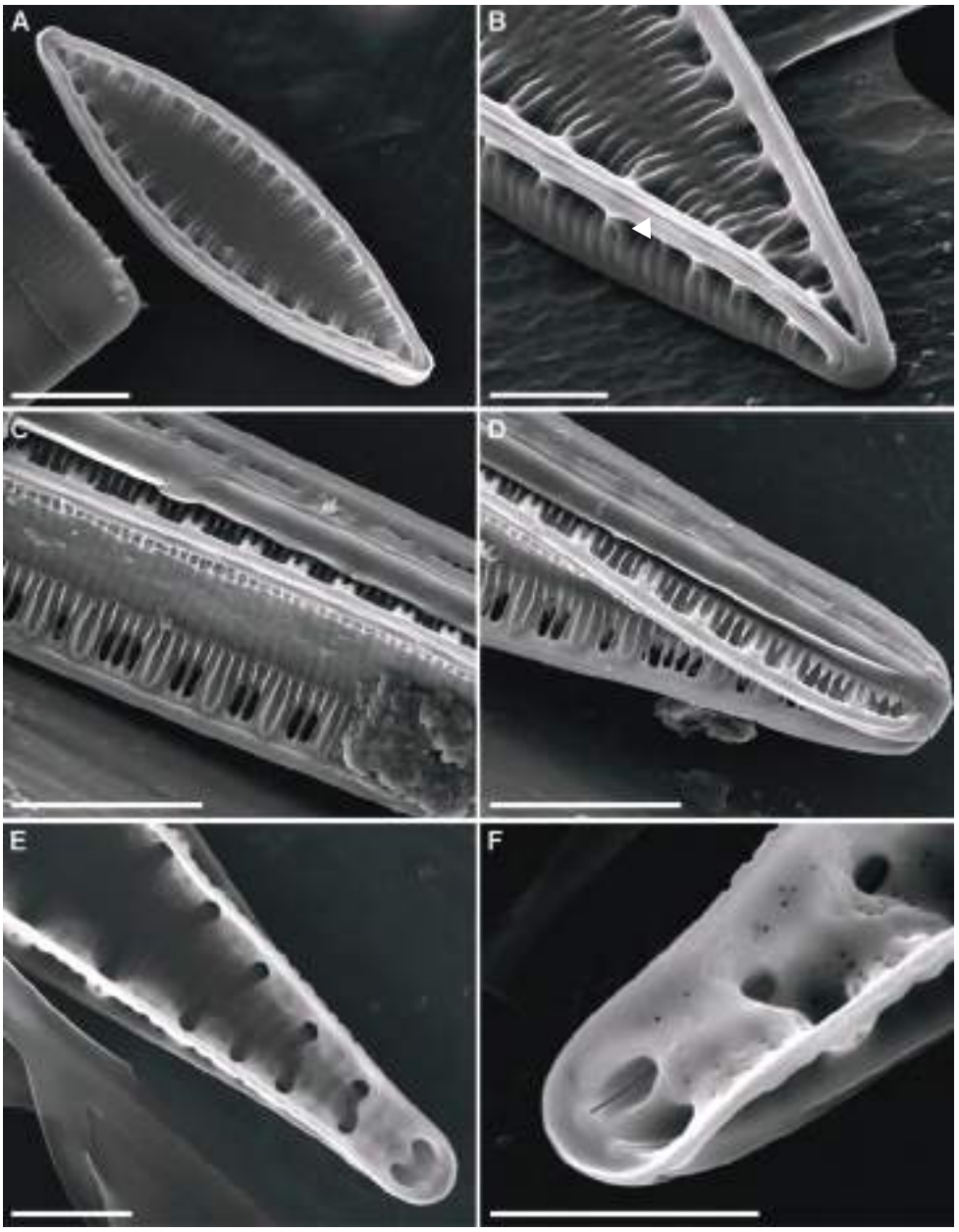


Fig. 189. *Stenopterobia* spp. **A-F.** SEM. **A-B.** *S. delicatissima*, external view of valves, note the raphe keel (arrow - **B**). **C-D.** *Stenopterobia* sp., detail of valve mantle and girdle bands. **E-F.** *S. delicatissima*, internal view of valves, detail of apices and terminal raphe endings..
Scale bars = 5 µm (A, C-D) 2 µm (B, E-F).

Surirella Turpin 1828

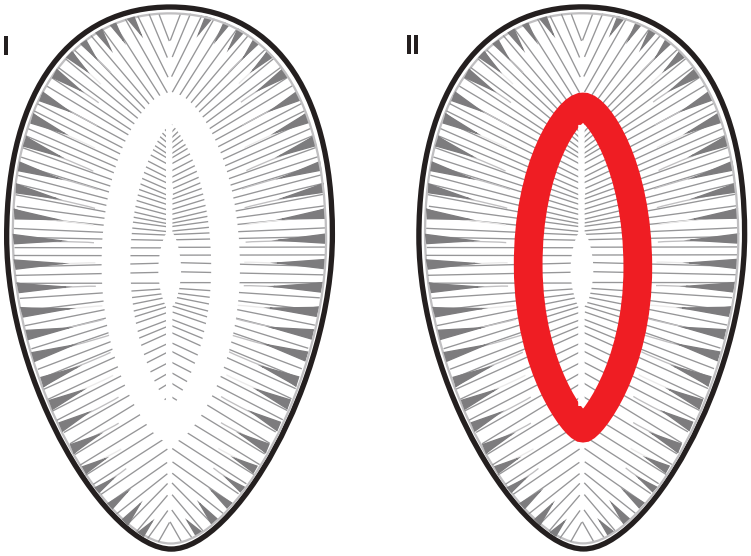
Type species: *Surirella striatula* Turpin

Characteristics – Cells **isopolar** or **heteropolar**, **biraphid**, sometimes constricted mid-valve. Striae fine, parallel to radiate composed of one or several rows of small round areolae which are not discernable under LM (Fig. 191). **Transapical valve undulations** (Fig. 191) cross the valve face, interrupted by the axial area which is variable in width (Fig. 191). Raphe runs around the whole circumference of the valve face, interrupted at the foot pole (Fig. 192: D). Raphe in a canal on both margins which may be raised on a keel above the valve face (Fig. 192: A-B, E-F) forming a wing, **fenestrae** may be present. Valve face may have small scattered spines (Fig. 191: B), granules (Fig. 192: E) or other siliceous structures. Some species have one to several large spines in the axial area (Fig. 192: A).

Plastid structure – Cells with one large lobed plastid divided into 2 plates, one against each valve connected by a very narrow isthmus near one pole (Fig. 190).

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the costae, presence and structure of spines, structure of the axial area, as well as structure of the wings.

Ecology – Cells solitary, free living and highly motile. Found in the benthos and plankton of oligotrophic to eutrophic waters in low to high conductivities.



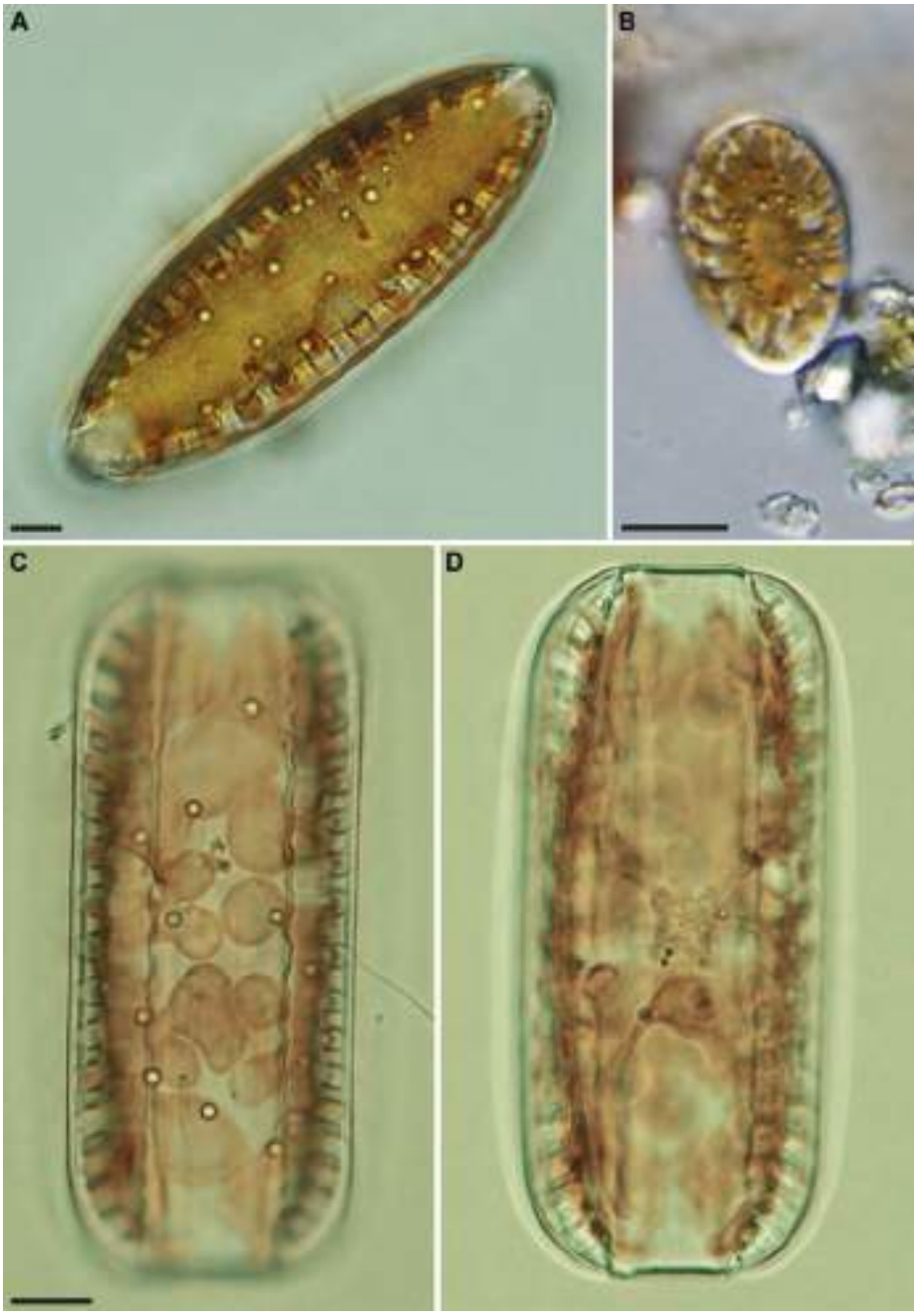


Fig. 190. *Surirella* spp. **A-F.** LM, living cells. **A.** *Surirella* sp., valve view. **B.** *S brebissonii* Krammer & Lange-Bertalot, valve view. **C-D.** *Surirella* sp., girdle view of the same cell taken at different foci.
Scale bars = 10 µm (A-F).

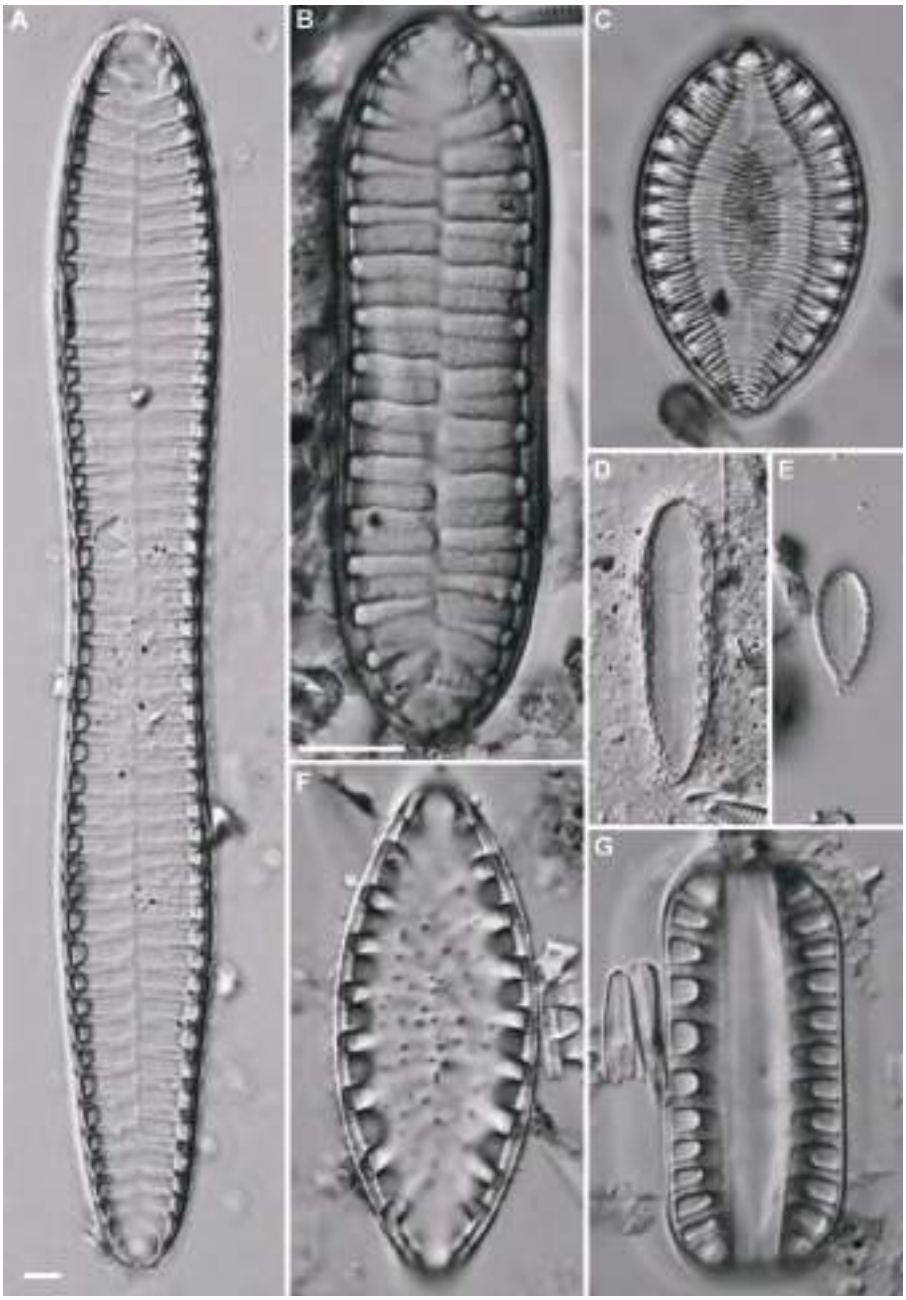


Fig. 191. *Surirella* spp. **A-G.** LM, cleaned valves. **A-F.** Valve views. **B.** *S. ebalensis* Cocquyt & J.C. Taylor. **C.** *S. brebissonii*. **D.** *S. congolensis* Cocquyt & J.C. Taylor. **E.** *S. ostentata* Cholnoky. **F.** *S. bifrons* (Ehrenberg) Ehrenberg. **G**. *Surirella* sp., girdle view.
Scale bars = 10 µm (A-G).

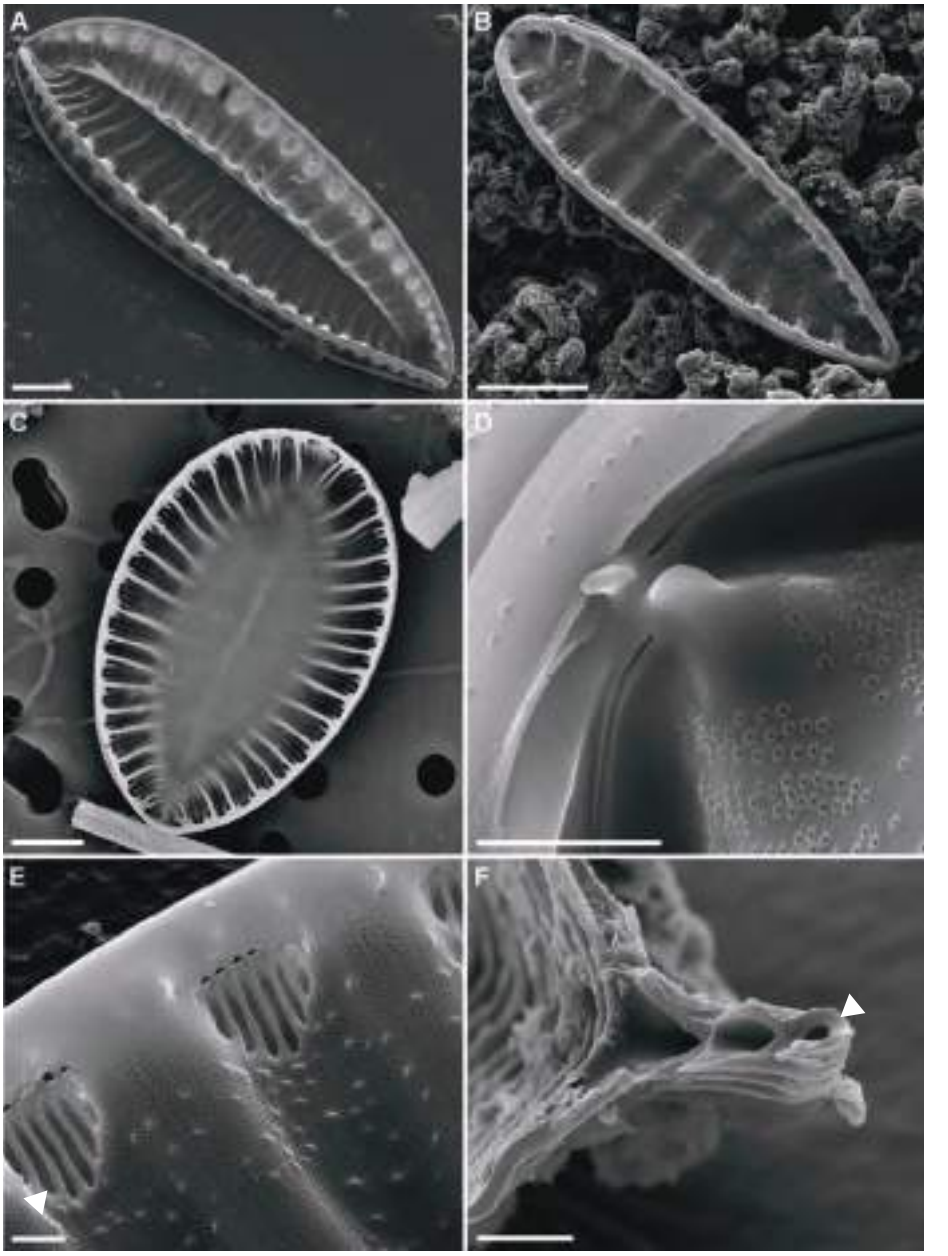


Fig. 192. *Surirella* spp. **A-F.** SEM. **A-B, E.** External view of valves. **A.** *S. nervosa* (A.W.F. Schmidt) Ant. Mayer **B.** *S. congolensis*. **C-D.** Internal view of valves. **C.** *S. brebissonii*. **D.** *S. ebalensis*, detail of internal raphe endings and helictoglossae at the foot pole. **E.** Detail of open fenestrae with fenestral bars (arrow), note the uniseriate striae becoming bi- to triseriate near the keel. **F.** Cross-section of the keel with raphe canal (arrow).
Scale bars = 10 µm (A, C), 5 µm (B), 1 µm (D-F).

13. References

ARCHIBALD R.E.M. 1972. Diversity in some South African diatom associations and its relation to water quality. *Water Research* 6: 1229-1238.

BACHMANN H. 1933. Phytoplankton von Victoria Nyanza-, Albert Nyanza und Kiogasee. *Berichte der Schweizerischen botanischen Gesellschaft* 42: 705-717.

BACHMANN H. 1938. Beiträge zur Kenntnis des Phytoplantons ostafrikanischer Seen. *Schweizerische Zeitschrift für Hydrologie* 8: 119-140.

BATE G.C., ADAMS J.B. & VAN DER MOLEN J.S. 2002. Diatoms as indicators of water quality in South African river systems. *WRC Report* 814/1/02. Pretoria, Water Research Commission.

BELLINGER B.J., COCQUYT C. & O'REILLY C.M. 2006. Benthic diatoms as indicators of eutrophication in tropical streams. *Hydrobiologia* 573: 75-87.

BEYENE A. 2010. Development and validation of ecological water quality monitoring tools for Ethiopian Rivers. PhD thesis, Vrije Universiteit Brussel, Belgium.

BEYENE A., ADDIS T., FIFKE D., LEGESSE W., KLOOS H. & TRIEST L. 2009. Comparative study of diatoms and macroinvertebrates as indicatiors of severe water pollution: Case study of the Kebena and Akaki rivers in Addis Ababa, Ethiopia. *Ecological Indicators* 9: 381-392.

BEYENE A. AWOKE A. & TRIEST L. 2014. Estimation of environmental optima and tolerances of diatoms using multifactor multiplicative modeling. *Ecological Informatics* 19: 53-61.

BIJKERK R. (ED.) 2014. Handboek Hydrobiologie. Biologisch onderzoek voor de ecologische beoordeling van Nederlandse zoete en brakke oppervlaktewateren. Deels aangepaste versie. Rapport 2014-02, Stichting Toegepast Onderzoeke Waterbeheer, Amersfoort.

CALJON A. 1987. Phytoplankton of a recently landlocked brackish-water lagoon of Lake Tanganyika: a systematic account. *Hydrobiologia* 153: 31-54.

CALJON A. 1988. Les algues planctoniques d'un marais d'eau douce de la plaine de la Rusizi (Burundi). *Bulletin de la Société royale de Botanique de Belgique* 121: 18-34.

CHOLNOKY B.J. 1968. Die Ökologie der Diatomeen in Binnengewässern. Lehre, J. Cramer.

CHOLNOKY B.J. 1970. Bacillariophyceae from the Bangweulu swamps. *In*: Hydrobiological survey of the Lake Bangweulu Luapula river system. Bruxelles, Cercle Hydobiologique de Bruxelles.

COCQUYT C. 1998. Diatoms from the northern basin of Lake Tanganyika. *Bibliotheca Diatomologica* 39: 1-276 pp.

COCQUYT C. 2006. Lacustrine and riverine algal biodiversity in the African Great Rift Area. *In*: De Dapper M. & de Lame M. (eds.), Africa's Great Rift: Diversity and Unity. Proceedings of the Internal Conference, Brussels, 29–30 September 2005. *The Royal Academy of Overseas Sciences and The Royal Museum for Central Africa*: 59-71.

COCQUYT C., VYVERMAN W. & COMPÈRE P. 1993. A check-list of the algal flora of the East African Great Lakes (Malawi, Tanganyika and Victoria). *Scripta Botanica Belgica* 8: 56 pp.

COMPÈRE P. 1989. *Stauroneis zairense* sp. nov. d'un étang de pisciculture à Kinshasa, Zaïre. *Diatom Research* 4: 217-225.

COMPÈRE P. 1995. *Gomphonema zairense* sp. nov. from the Tshopo waterfalls (Kisangani, Zaïre). *Diatom Research* 10: 31-37.

CRONBERG G. 1997. Phytoplankton in Lake Kariba 1986-1990. *In:* Moreau J. (ed.) Advances in the ecology of Lake Kariba. University of Zimbabwe Publications, Harare, Zimbabwe 3: 66-101.

DICKIE G. 1880. Notes on algae from Lake Nyasa, East Africa. *Journal of the Linnean Society, Botany* 17: 281-283.

GASSE F. 1986. East African diatoms – Taxonomy, ecological distribution. *Bibliotheca Diatomologica* 11: 1–202 + 44 pls.

GOLAMA S. K. A. 1996. Bacillariophycées, Desmidiées et Euglénophycées de la région de Kisangani (Zaïre). *Académie Royale des Sciences d'Outre-Mer. Classe des Sciences naturelles et médicales. Mémoires in-8°, Nouvelle Série* 23(3): 232 pp.

HANCOCK F.D. 1979. Diatom associations and succession in Lake Kariba, South Central Africa. *Hydrobiologia* 67: 33-50.

HANCOCK F.D. 1985. Diatom associations in the aufwuchs of inundated trees and underwater leaves of *Salvinia*, drowned Mwenda River, Lake Kariba, Zimbabwe. *Hydrobiologia* 121: 65-76.

HUBER-PESTALOZZI G. 1942. Das Phytoplankton des Süsswassers: Diatomeen. *In:* Die Binnengewasser 16(2/2): 367-549. Stuttgart, Schweizerbart'sche Verlag.

HUSTEDT F. 1949. Süsswasser-Diatomeen. *In:* Exploration du Parc National Albert - Mission H. Damas (1935-1936), vol. 8: 199 pp + 16 plates Bruxelles, Institut des parcs nationaux du Congo belge.

KELLY M.G. & WHITTON B.A. 1995. The trophix diatom index: A new index for monitoring eutrophication in rivers. *Journal of Applied Phycology* 7: 433-444.

KUFFERATH H. 1948. Potamoplancton du fleuve Congo prélevé près de Nouvelle-Anvers. *Bulletin Musée royal d'Histoire naturelle de Belgique* 24 (23): 1-18.

KUFFERATH H. 1956a. Algues et protistes du fleuve Congo au large de l'Île de Mateba. *In*: Expédition océanographique belge dans les eaux côtières africaines de l'Atlantique Sud (1948-1949). Resultats Scientifiques 5(1): 1–26. Bruxelles, Institut royal des Sciences naturelles de Belgique

KUFFERATH H. 1956b. Algues et Protistes prélevés au large et dans la crique de Banana. *In*: Expédition océanographique belge dans les eaux côtières africaines de l'Atlantique Sud (1948-1949). Resultats Scientifiques 5(1): 35-75. Bruxelles, Institut royal des Sciences naturelles de Belgique.

LUNG'AYIA H.B.O. 2002. Assessment of water quality using diatoms as bio-indocators in catchments of Lake Victoria, Kenya. PhD thesis, Vrije Universiteit Brussel, Belgium.

MPAWENAYO B. 1996. Les eaux de la plaine de la Rusizi (Burundi): Les milieux, la flore et la végétation algales. *Académie Royale des Sciences d'Outre-Mer. Classe des Sciences naturelles et médicales. Mémoires in-8°, Nouvelle Série* 23(2): 236 pp.

MÜLLER O. 1897. *Rhopalodia*, ein neues Genus der Bacillariaceen. *Botanische Jahrbücher* 22: 71.

MÜLLER O. 1903. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. I. *Botanische Jahrbücher* 34: 9-38.

MÜLLER O. 1904. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. II. *Botanische Jahrbücher* 35: 256-301.

MÜLLER, O. 1905. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. III. *Botanische Jahrbücher* 36: 137-205.

MÜLLER O. 1910. Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. IV. *Botanische Jahrbücher* 45: 69-122.

MUZAVAZI B., NDEBELE-MURISA M.R. & NHIWATIWA T. 2008. A study of the phytoplankton community and primary production in Lake Kariba. Waterinetonline.ihe.nl: 21 pp.

OSTENFELD C.H. 1908. Phytoplankton aus dem Victoria Nyanza. *Botanische Jahrbücher* 41: 330-350.

OSTENFELD C.H. 1909. Notes on the phytoplankton of Victoria Nyanza, East Africa. *Bulletin of the Museum of Comparative Zoology, Harvard College* 50(10): 171-181 + 2 pl.

ROUND F.E., CRAWFORD R.M. & MANN D.G. (1990). The diatoms. Biology & morphology of the genera. Cambridge University Press, Cambridge.

SCHMIDT A. (ED.) 1847-1959. Atlas der Diatomaceenkunde. Leipzig, O.R. Reisland.

SCHOEMAN F.R. 1976. Diatom indicator groups in the assessment of water quality in the Jukskei-Crocodile river system (Transvaal, Republic of South Africa). *Journal of the Limnological Society of South Africa* 2: 21-24.

SCHOEMAN F.R. 1979. Diatoms as indicators of water quality in the upper Hennops River. *Journal of the Limnological Society of South Africa* 5: 73-78.

SCHRÖDER B. 1911. *Rhizosolenia victoriae* n. sp. *Berichten der Deutschen Botanischen Gesellschaft* 29: 739-743.

STOWA 2014. Handboek Hydrobiologie. Hydrobiologische onderzoeksmethoden in samenhang met voor Nederland relevante beoordelingssystemen. Stichting Toegepast Onderzoek Waterbeheer, Amersfoort, Nederland. (www.stowa.nl/handboekhydrobiologie)

TAYLOR J.C 2004. The application of diatom-based pollution indices in the Vaal catchment. Unpublished Master thesis, Potchefstroom Campus of the North-West University, Potchefstroom, South Africa.

TAYLOR J.C. & COCQUYT C. Diatom research in southern and central Africa: Historical perspectives and current activities*. Mededelingen van de Zittingen van de Koninklijke Academie voor Overzeese Wetenschappen*: in press.

TAYLOR J.C., JANSE VAN VUUREN M.S. & PIETERSE A.J.H. 2007a.The application and testing of diatom-based indices in the Vaal and Wilge rivers, South Africa. *Water SA* 33: 51-60.

TAYLOR J.C., PRYGIEL J., VOSLOO A., DE LA REY P.A. & VAN RENSBURG L. 2007b. Can diatom based pollution indices be used for bio-monitoring in South

Africa? A case study of the Crocodile West and Marico water management area. *Hydrobiologia* 592: 455-464.

TAYLOR J.C., HARDING W.R. & ARCHIBALD C.G.M. 2007c. *A methods manual for the collection, preparation and analysis of diatom samples*. WRC Report TT 281/07. Water Research Commission, Petroria, South Africa.

THOMASSON K. 1925. Methoden zur Untersuchung der Mikrophyton der limnischen Litoral und Profundalzone. *In*: ABDERHALDEN, E. (ed.), Handbuch der Biologischen Arbeitsmethoden, Abt. IX, Teil 2, 1. Berlin.

THOMASSON K. 1965. Notes on algal vegetation of Lake Kariba. *Nova Actae Regiae Sicietatis Scientiarum Upsaliensis* Ser. 4, 19: 1-34.

UTETE B., MUTASA L., NDHLOVU N. & TENDAUPENYUT I.H. 2013. Impact of aquaculture on water quality in Lake Kariba, Zimbabwe. *International Journal of Aquaculture* 3 (4): 11-16 (doi: 10.5376/ija.2013. 03.0004)

VAN DAM H., MERTENS A. & SINKELDAM J. 1994. A coded checklist and ecological indicator values of freshwater diatoms from the Netherlands. *Netherlands Journal of Aquatic Ecology* 28: 177-133.

VAN MEEL L. 1954. Le phytoplancton. *In*: Résultats scientifiques de l'exploration hydrobiologique du lac Tanganika (1946-1947) 4(1) A : 681 pp, B. 76 pl. Bruxelles, Institut royal des Sciences naturelles de Belgique.

VIRIEUX J. 1913. Plancton du lac Victoria Nyanza. *In:* Voyage de Ch. Alluaud et R. Jeannel en Afrique Orientale (1911-1912). Résultats scientifiques: 20 pp. Paris.

WEST G.S. 1907. Report on the freshwater algae, including phytoplankton of the Third Tanganyika Expedition, conducted by Dr. W.A. Cunnington 1904-1905. *Journal of the Linnean Society of London, Botany* 38: 81–197.

WHITTAKER R.H. 1969. New concepts of kingdoms of organisms. *Science* 163: 150-160.

WOESE C.R. & FOX G.E. 1977. Phylogenetic structure of the prokaryotic domain: The primary kingdoms. *Proceedings of the National Academy of Sciences of the United States of America* 74: 5088-5090.

WOESE C.R. , KANDLER O. & WHEELIS M.L. 1990. Toward a natural system of organisms: Proposal for the domains Archae, Bacteria and Eucarya. *Proceedings of the National Academy of Sciences of the United States of America* 87: 4576-4579.

WOLOSZYNSKA J.1914. Zellpflanzen Ostafrikas. V. Studien über das Phytoplankton des Viktoriasees. *Hedwigia* 55: 184-223 + 8pl.

ZANON V. 1938. Diatomee della regione del Kivu (Congo Belga). *Commentationes Pontificia Academia Scientiarum* 2 (14): 535-668.

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16. Taxonomic index

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