

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 μ m (A-B, E), 2 μ m (C-D).

Bacillaria J.F. Gmelin 1791

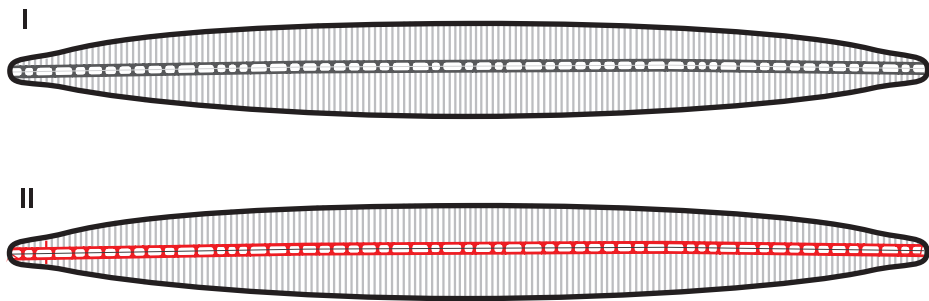
Type species: *Bacillaria paradoxa* J.F. Gmelin

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.



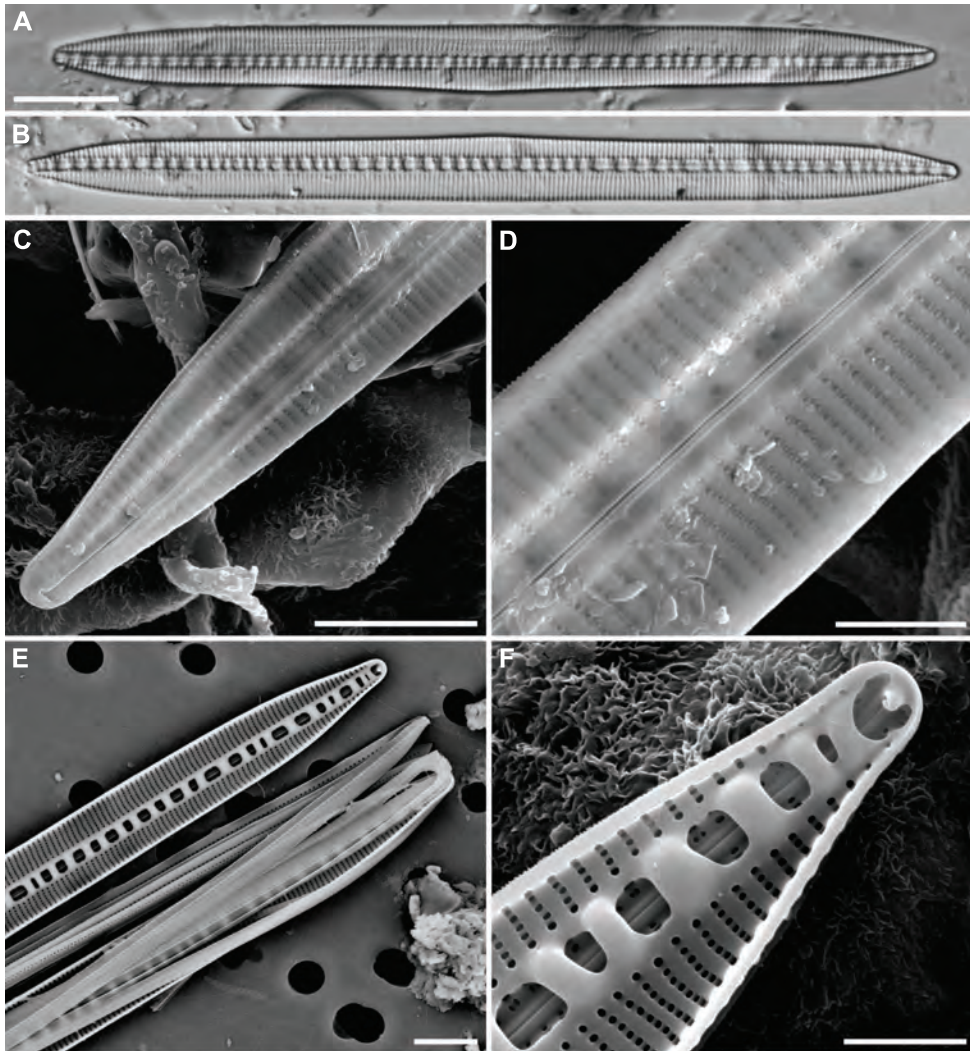


Fig. 164. *Bacillaria paradoxa*. **A-B.** LM, cleaned material, valve view. **C-F.** SEM. **C.** External view of valve showing detail of the terminal raphe ending. **D.** External view of valve showing detail of raphe slit. **E-F.** Internal view of valve showing structure of the fibulae and the copulae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

***Denticula* Kützing 1844**

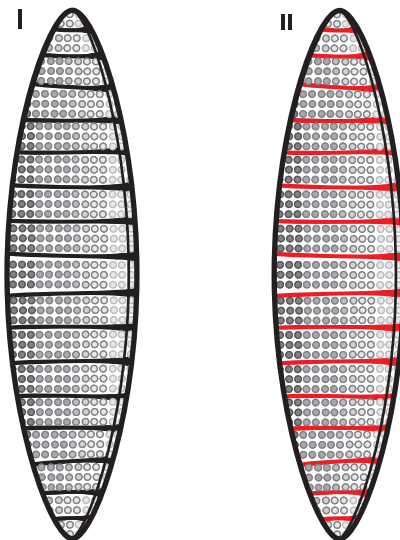
Type species: *Denticula elegans* Kützing

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.



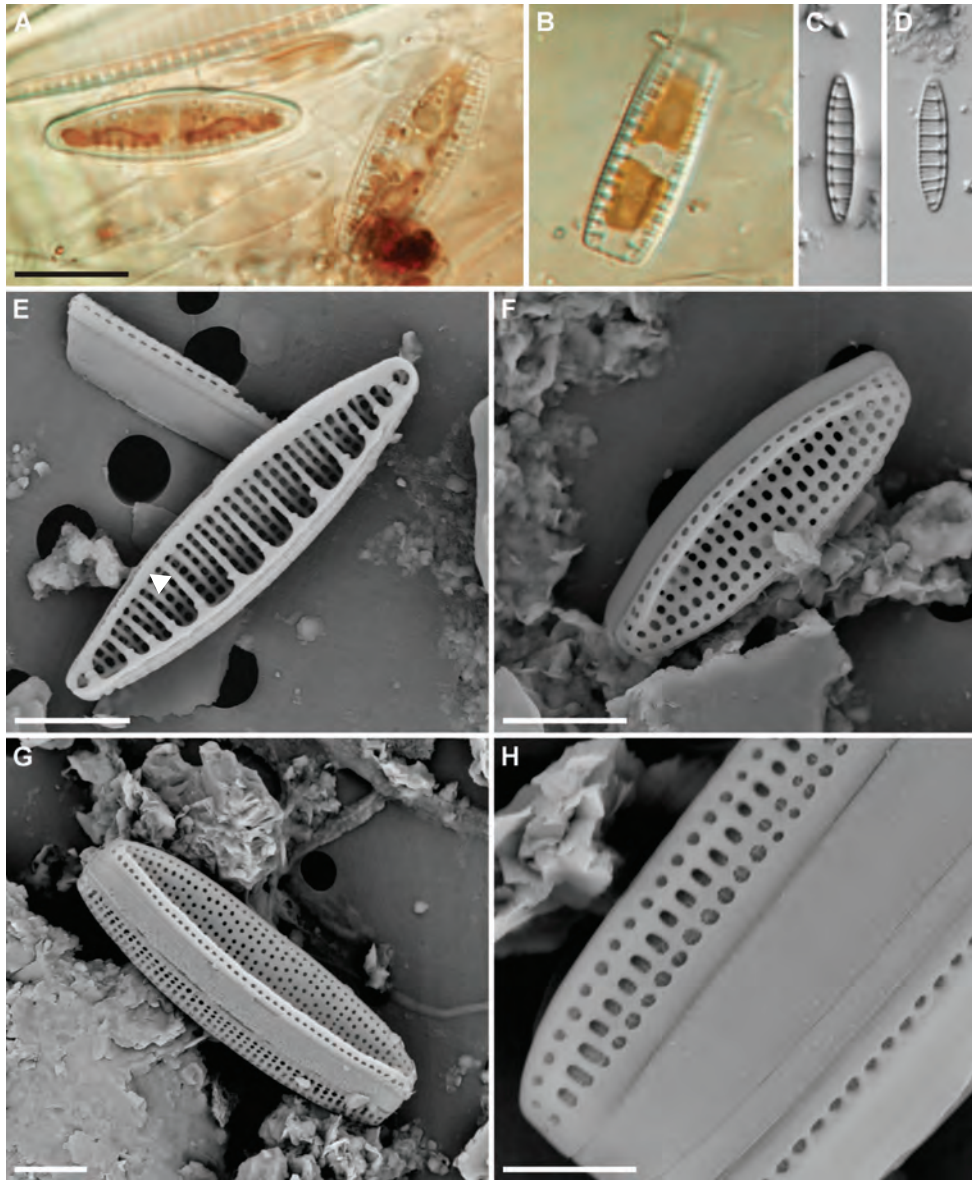


Fig. 165. *Denticula* spp. **A-D.** LM. **A-B.** Living cells of *Denticula kuetzingii* Grunow. **A.** Valve view (left), girdle view (right). **B.** Girdle view. **C-D.** *D. elegans*, valve views. **E-H.** SEM, *D. kuetzingii*. **E.** Internal view of valve, note costae (arrow). **F-G.** External view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

Gomphonitzschia Grunow 1868

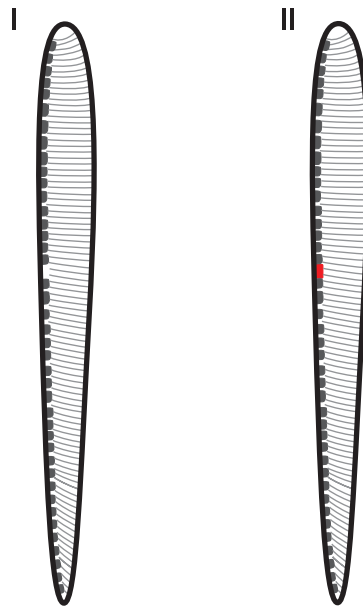
Type species: *Gomphonitzschia ungeriana* Grunow

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.



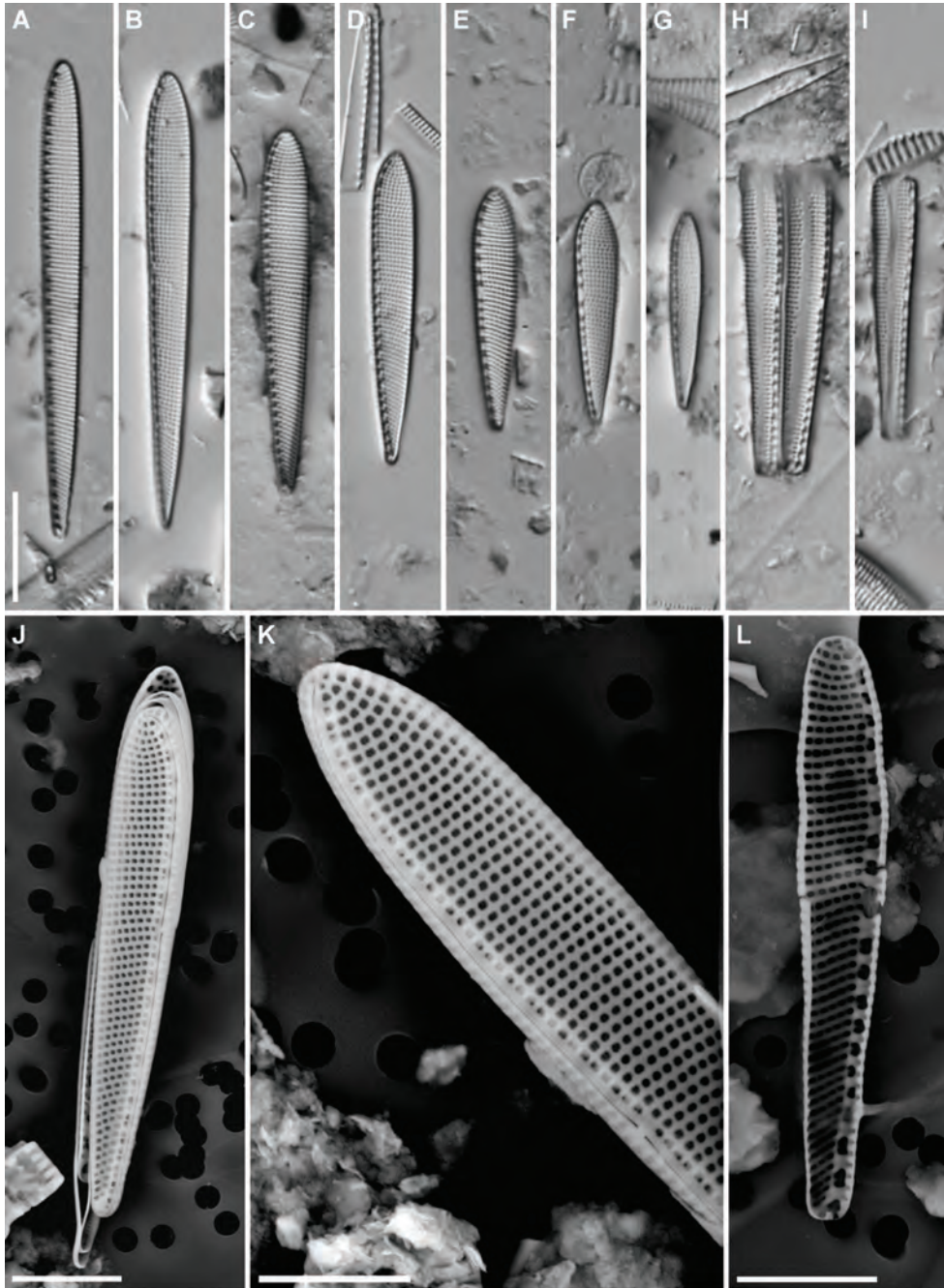


Fig. 166. *Gomphonitzschia ungeriana*. **A-I.** LM. **A-G.** Valve views. **H-I.** Girdle views. **J-L.** SEM. **J-K.** External view of valve. **L.** Internal view of valve. Scale bars = 10 μm (A-D), 5 μm (J-L).

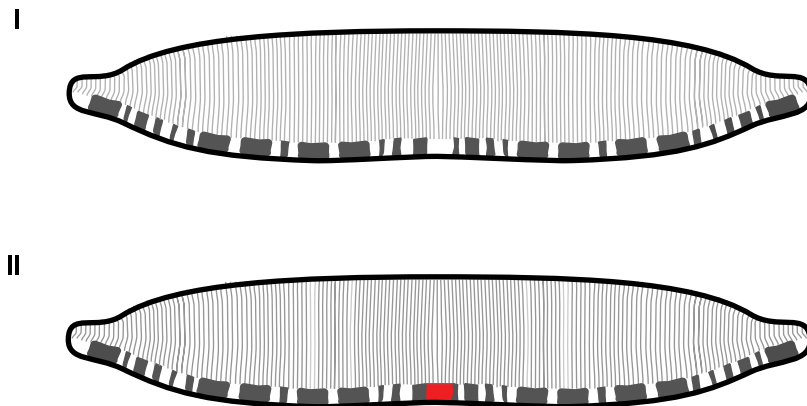
Hantzschia Grunow 1877

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 (**hantzschoid 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.



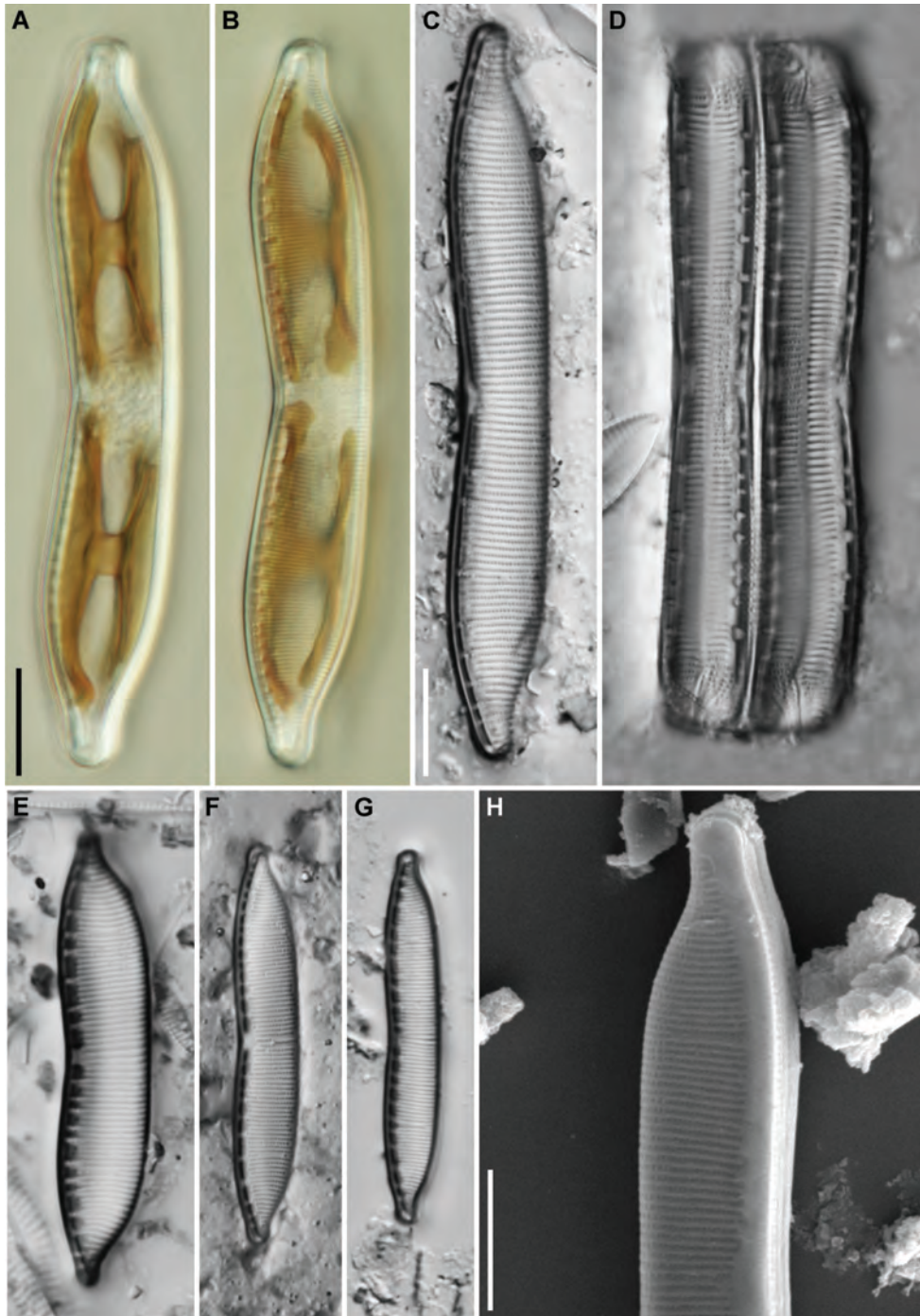


Fig. 167. *Hantzschia* spp. **A-G.** LM. **A-B.** Living cells. **C, E-G.** Cleaned valves. **D.** Girdle views. **H.** SEM, detail of external view of valve. Scale bars = 10 μm (A-G), 5 μm (H).

***Nitzschia* Hassall 1845**

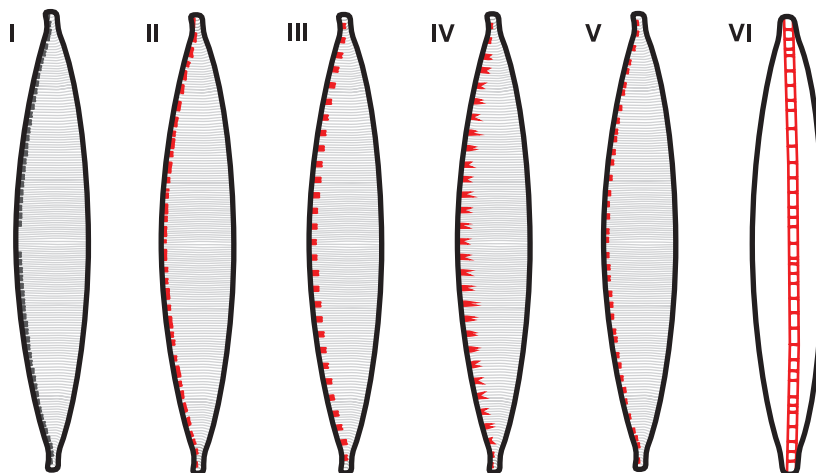
Type species: *Nitzschia elongata* Hassall

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* (Kützting) 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.



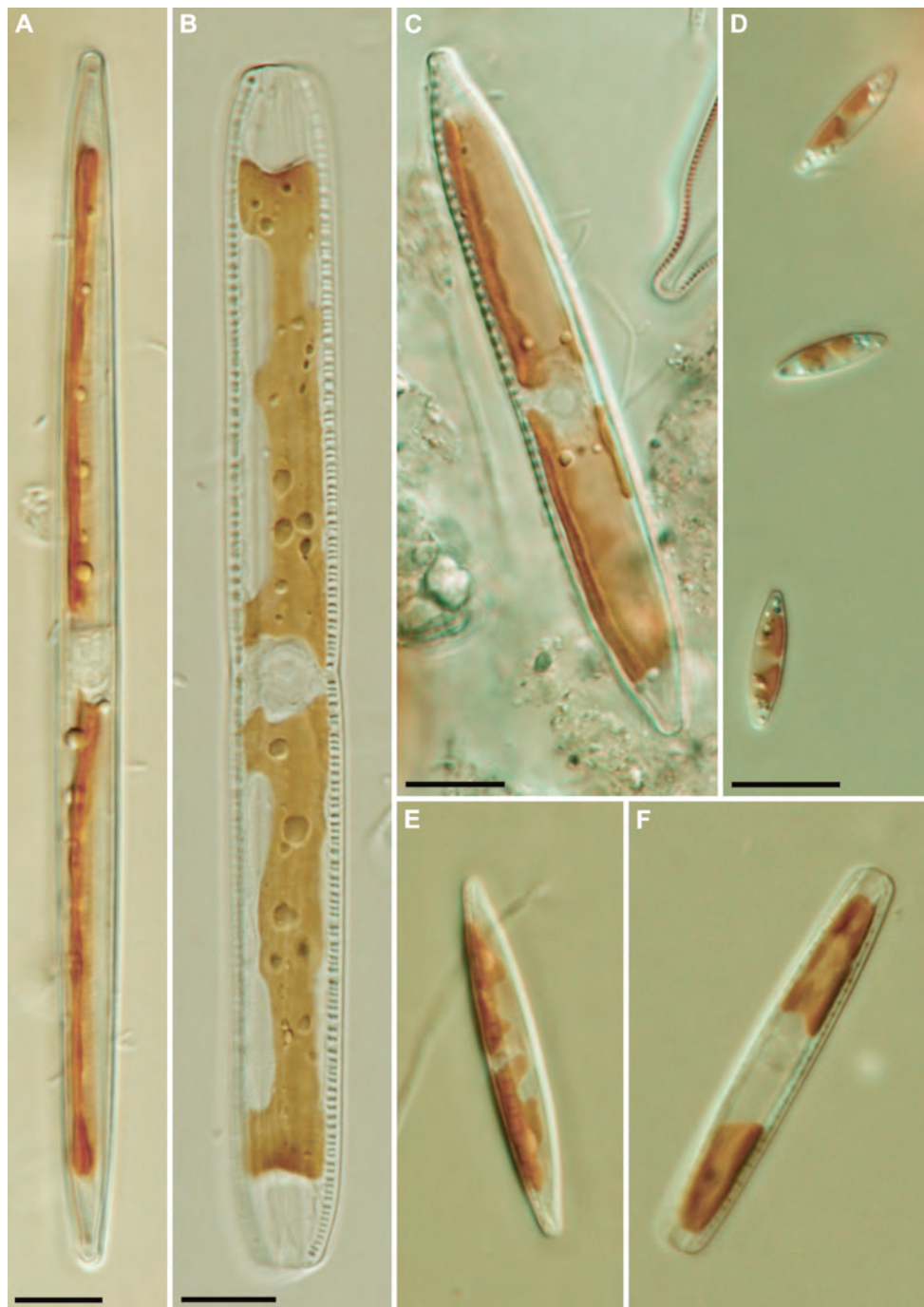


Fig. 168. *Nitzschia* spp. **A-F.** LM, living cells. **A, C-E.** Valve views, note lipid bodies. **B, F.** Girdle view, note lipid bodies. Scale bars = 10 μ m (A-F).

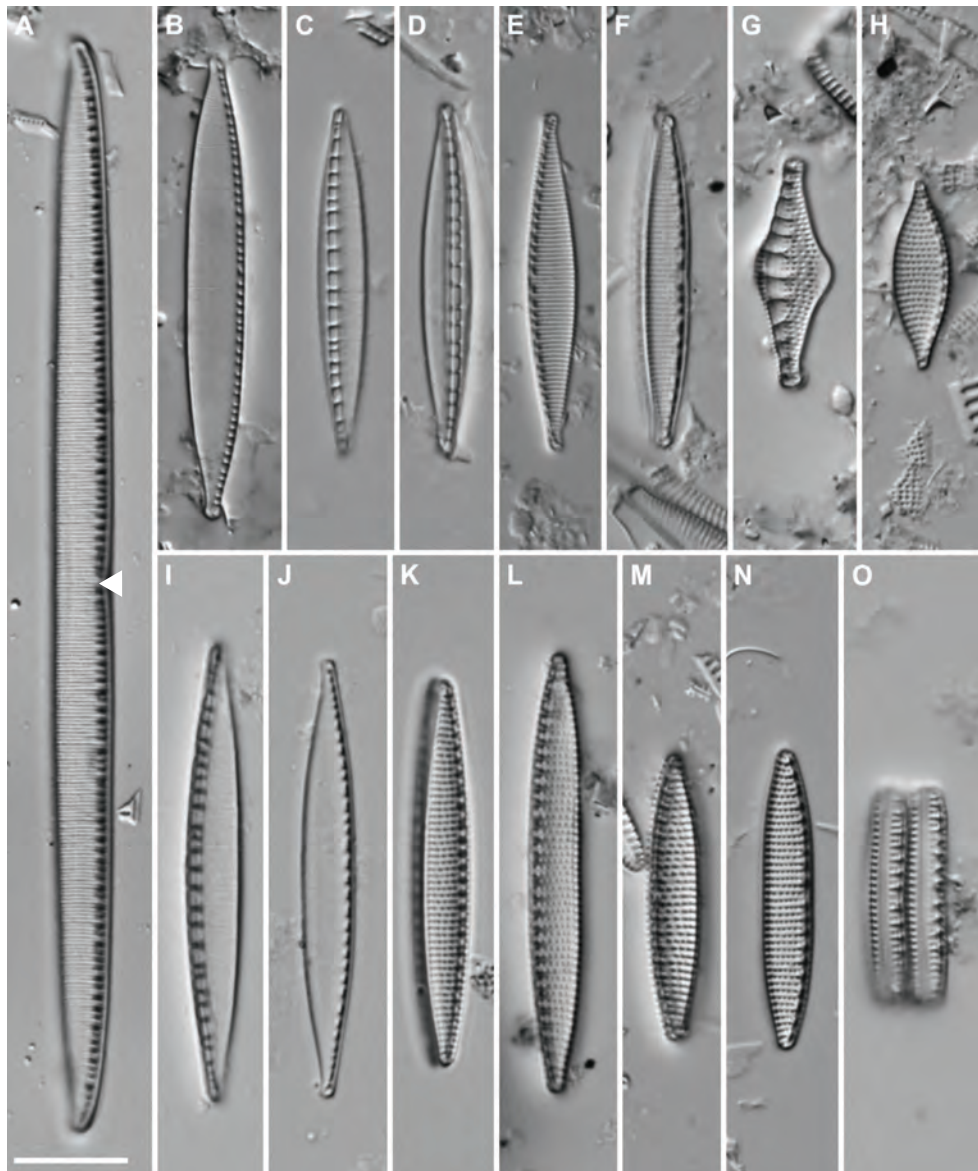


Fig. 169. *Nitzschia* spp. **A-O.** LM, cleaned valves. **A-N.** Valve views. **A.** *N. linearis* (C. Agardh) W. Smith, note central gap in the fibulae (arrow). **C-D.** *N. dissipata*. **G.** *N. sinuata* var. *tabellaria* (Grunow) Grunow. **H.** *N. lancetulla* O. Müller. **M-N.** *N. amphibia* Grunow.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

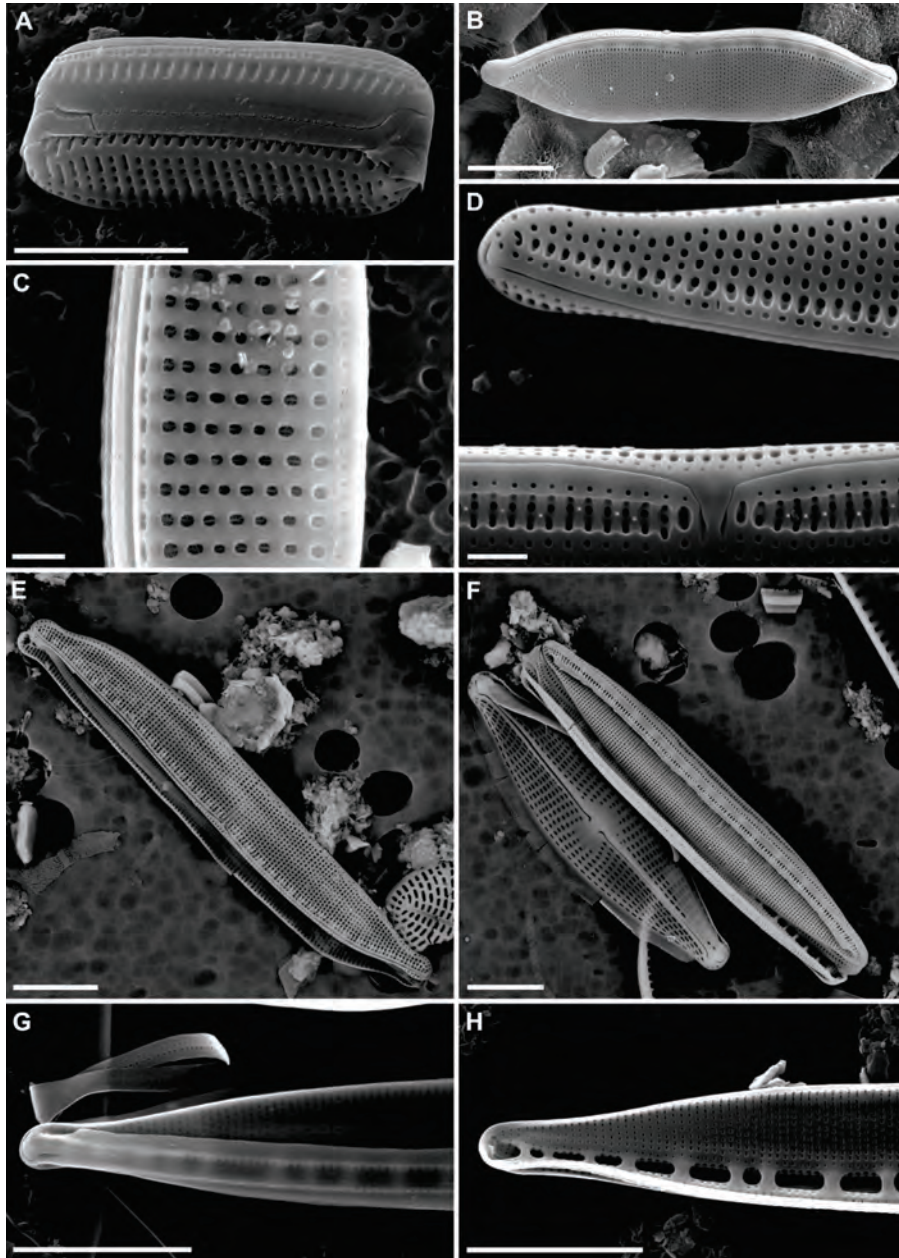


Fig. 170. *Nitzschia* spp. **A-H.** SEM. **A-E.** External view of valves. **A.** Oblique view showing the valve mantle and girdle bands. **D.** Detail of terminal raphe ending and central raphe endings. **F-G.** *N. dissipata*, detail of terminal raphe ending (**G**), note the external conopeum covering 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:

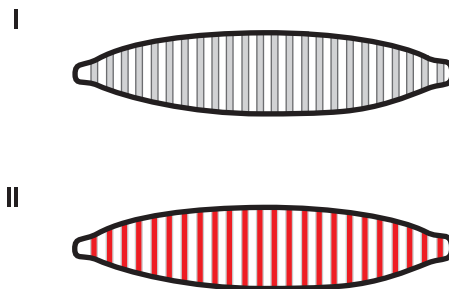
Nitzschia Hassall 1845 pro parte

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.



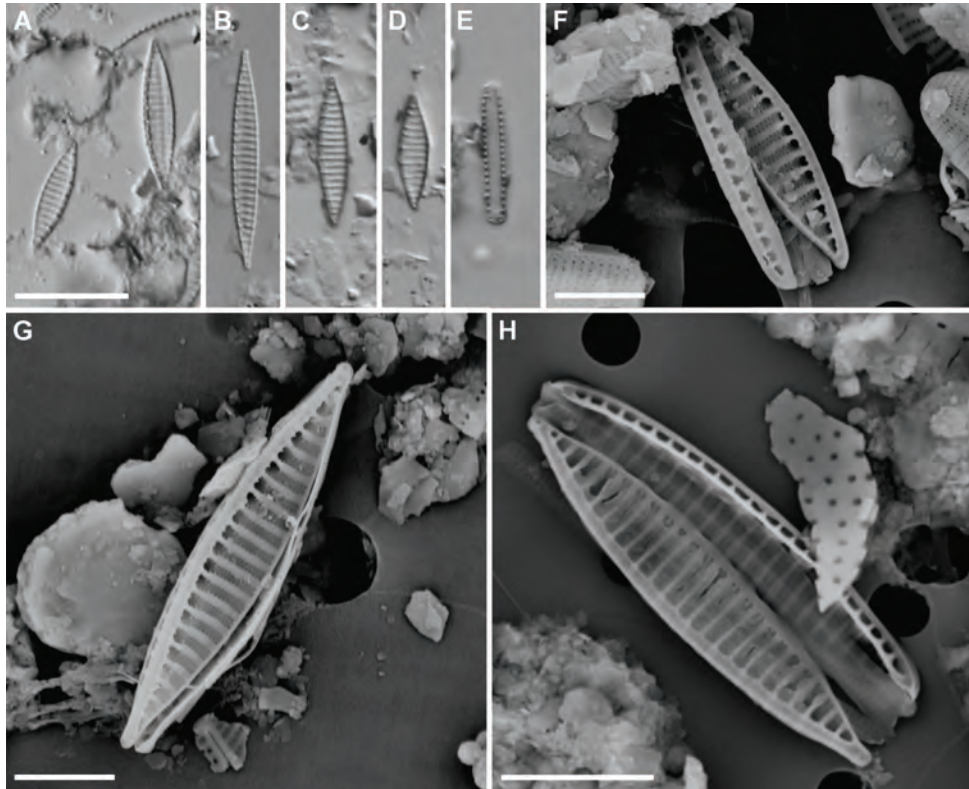


Fig. 171. *Simonsenia delognei*. **A-E.** LM, cleaned valves. **F-H.** SEM. **F** Internal view of valve. **G-H.** External view of valves. Scale bars = 10 μm (A-E), 3 μm (F-H).

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.

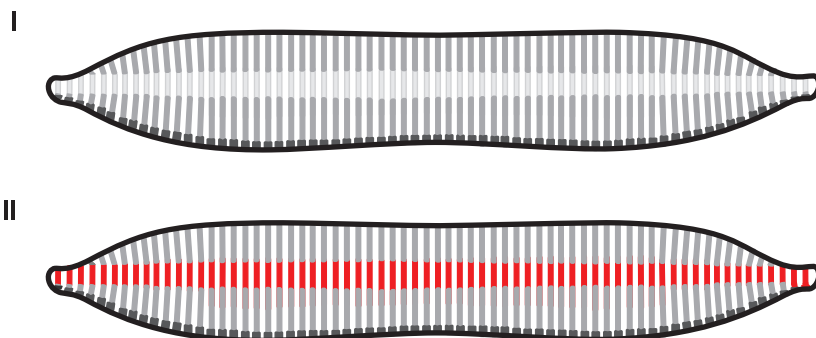




Fig. 172. *Tryblionella* spp. **A-F.** LM, living cells, note two large plastids, each one extending from mid-valve to each apex, and several small lipid droplets.

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 μ m (A-F).

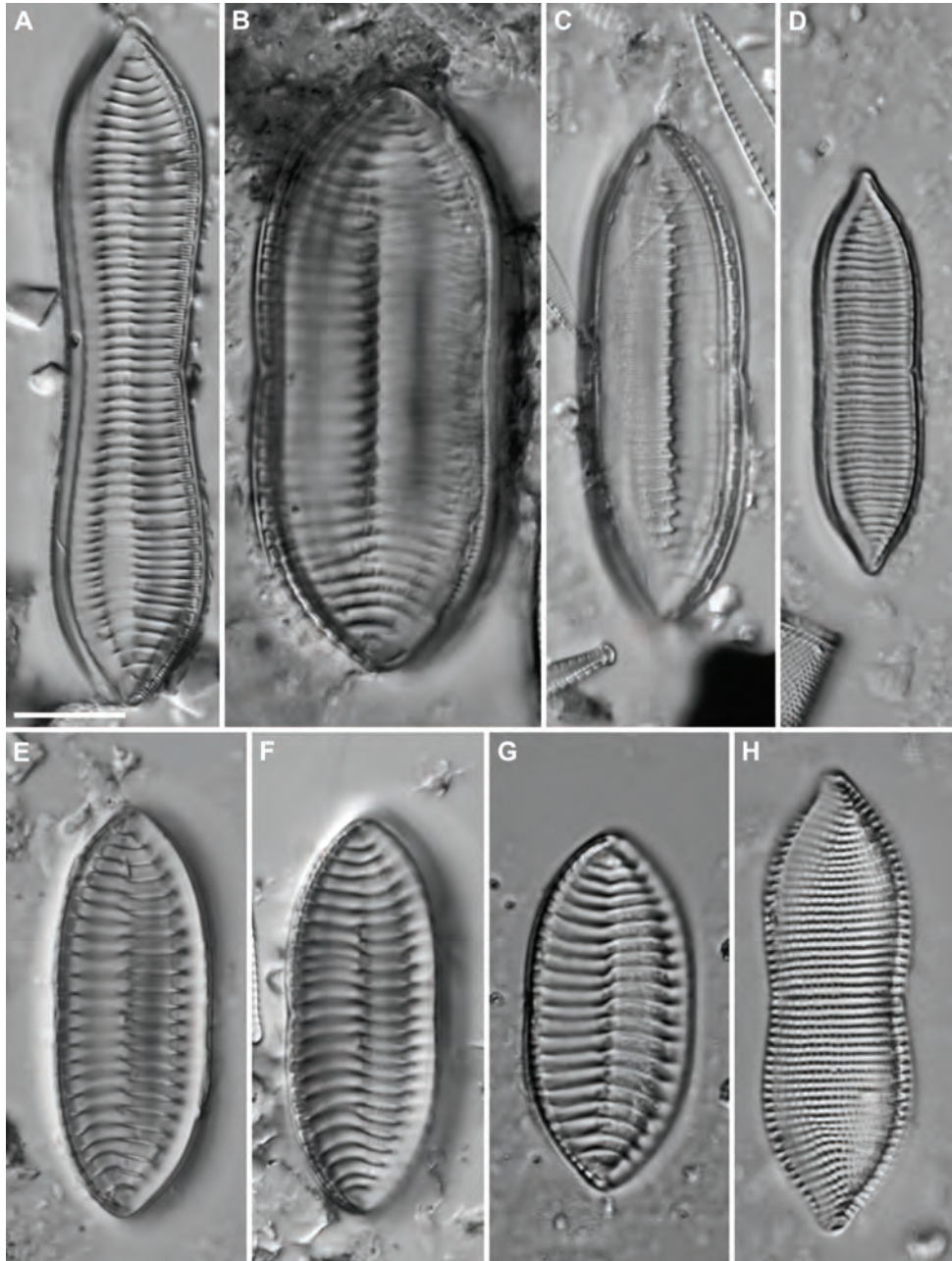


Fig. 173. *Tryblionella* spp. **A-H.** LM, cleaned valves. **C.** *T. littoralis*. **D.** *T. calida*.
E-F. *T. levidensis* W. Smith. **H.** *T. coarctata* (Grunow) D.G. Mann.
Scale bar = 10 μ m (A-H).

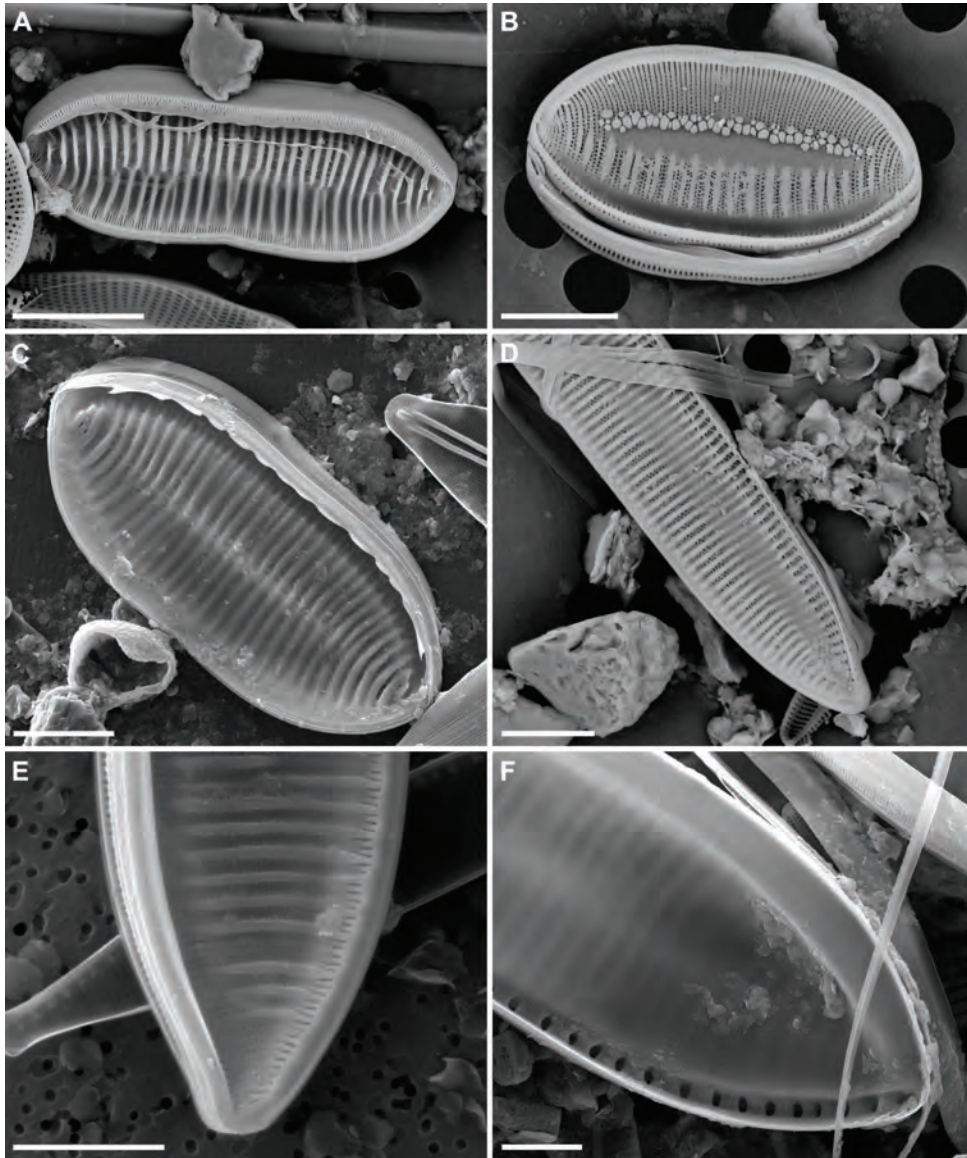


Fig. 174. *Tryblionella* spp. **A-F.** SEM. **A-E.** External view of valves. **B.** *T. debilis*, note scattered silica granules on valve face. **C.** *T. levidensis*. **D.** *T. hungarica* (Grunow) Frenguelli. **E.** *T. calida*. **F.** Internal view of valve, note fibulae.
Scale bars = 10 μ m (A,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

***Epithemia* Kützing 1844**

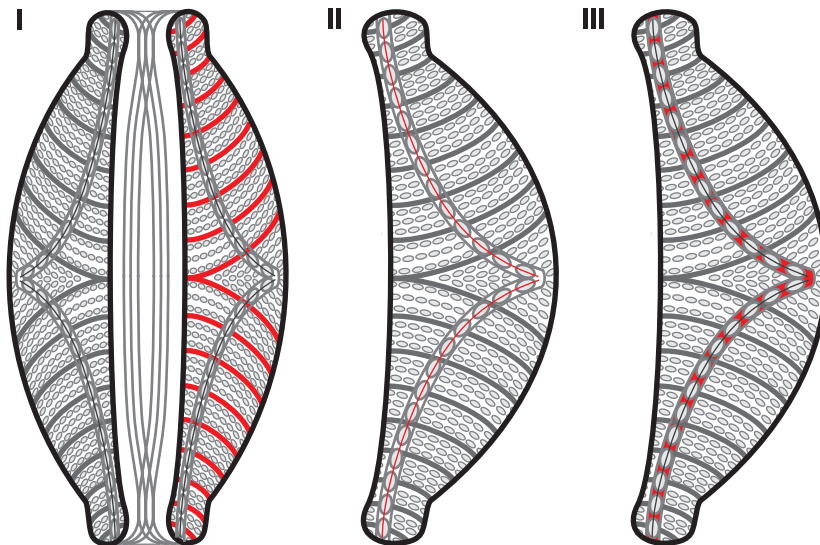
Type species: *Epithemia turgida* (Ehrenberg) Kützing

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.



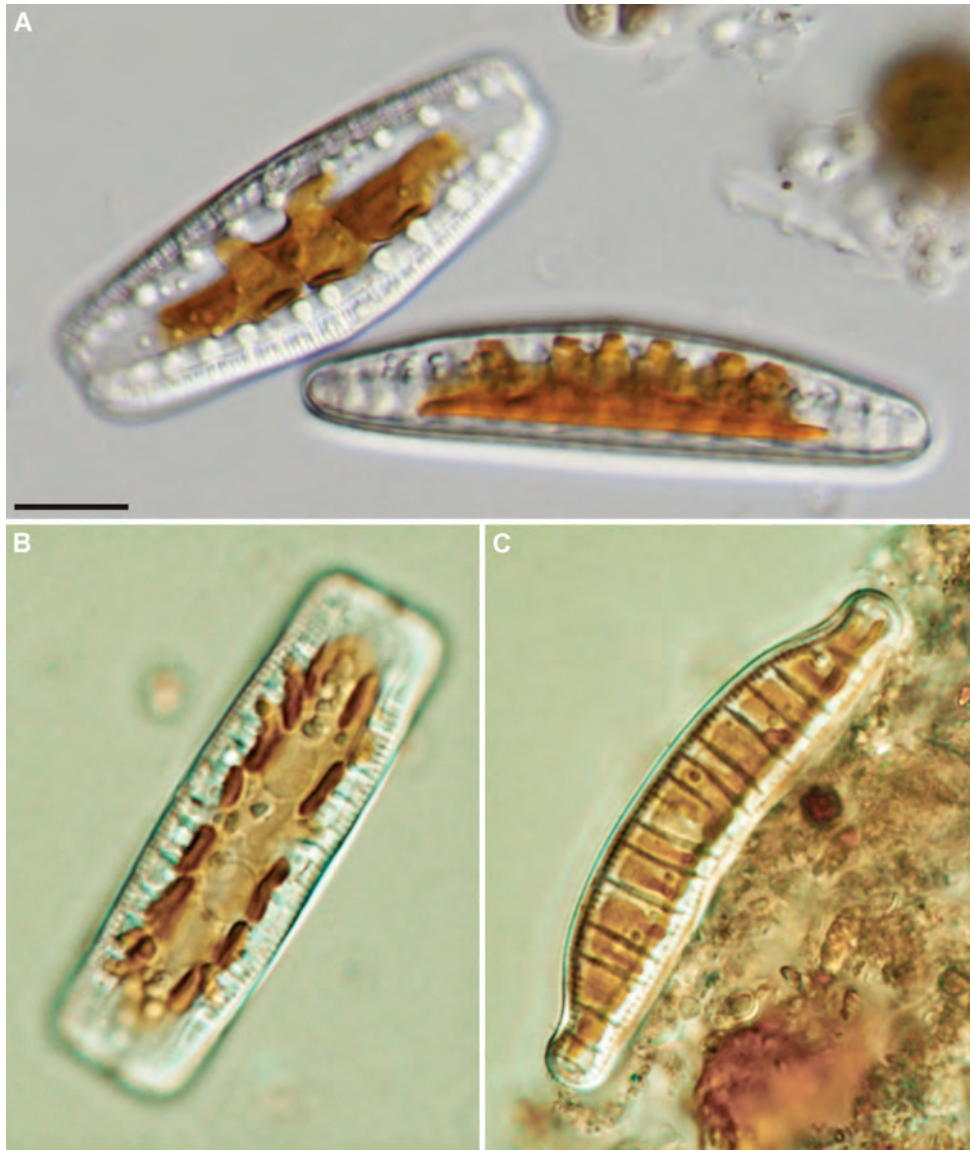


Fig. 175. *Epithemia* spp. **A-C.** LM. **A.** Living cell, girdle view (left) and valve view (right). **B-C.** Living cells of *Epithemia adnata* (Kützing) Brébisson, girdle view showing highly lobed plastid (**B**) and valve view (**C**).
Scale bar = 10 μ m.

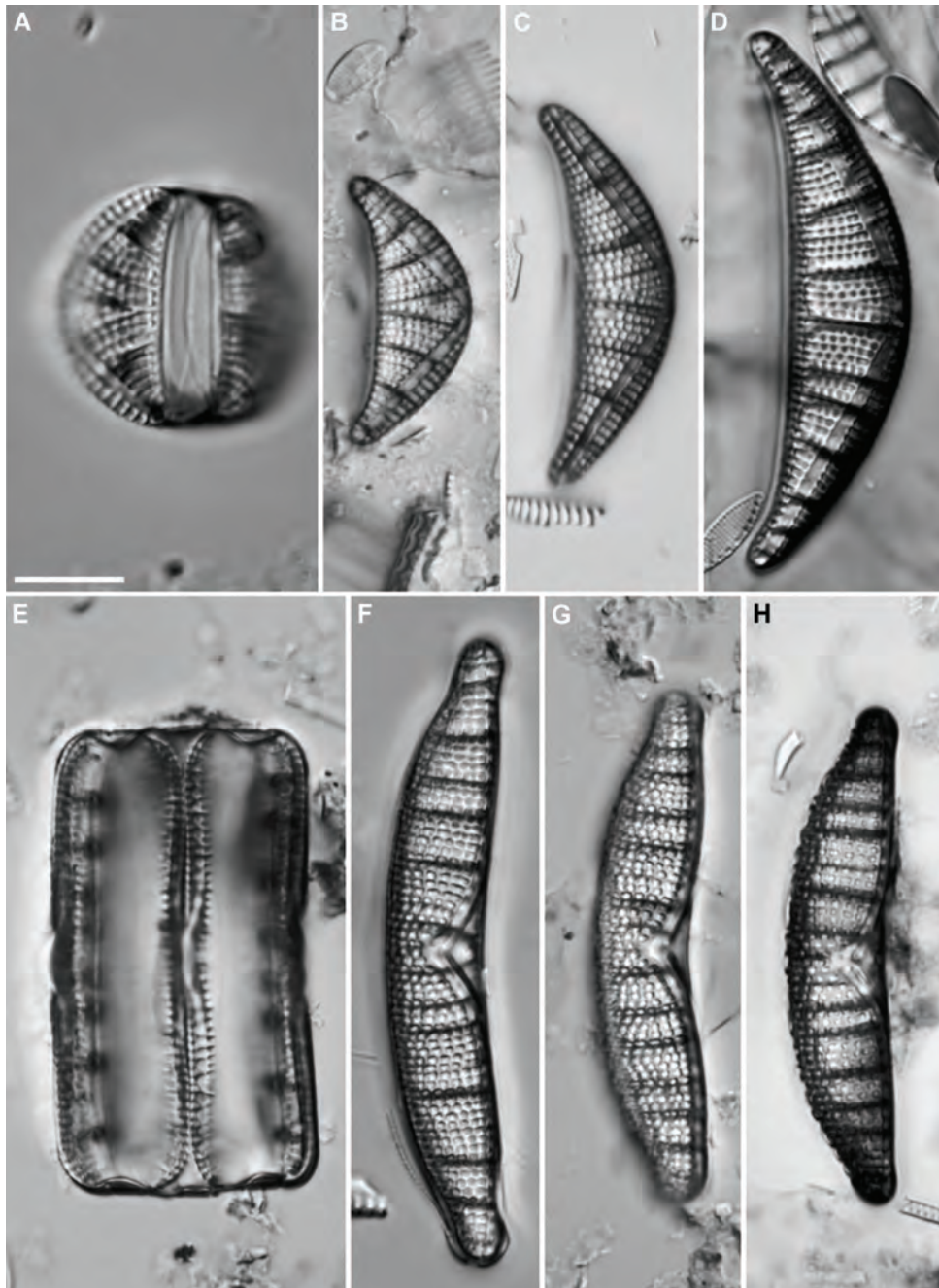


Fig. 176. *Epithemia* spp. **A-H.** LM. **A-D.** *Epithemia* sp., valve view. **E.** *E. adnata*, girdle view of cell undergoing asexual reproduction. **F-H.** *E. adnata* valve view. Scale bar = 10 μ m.

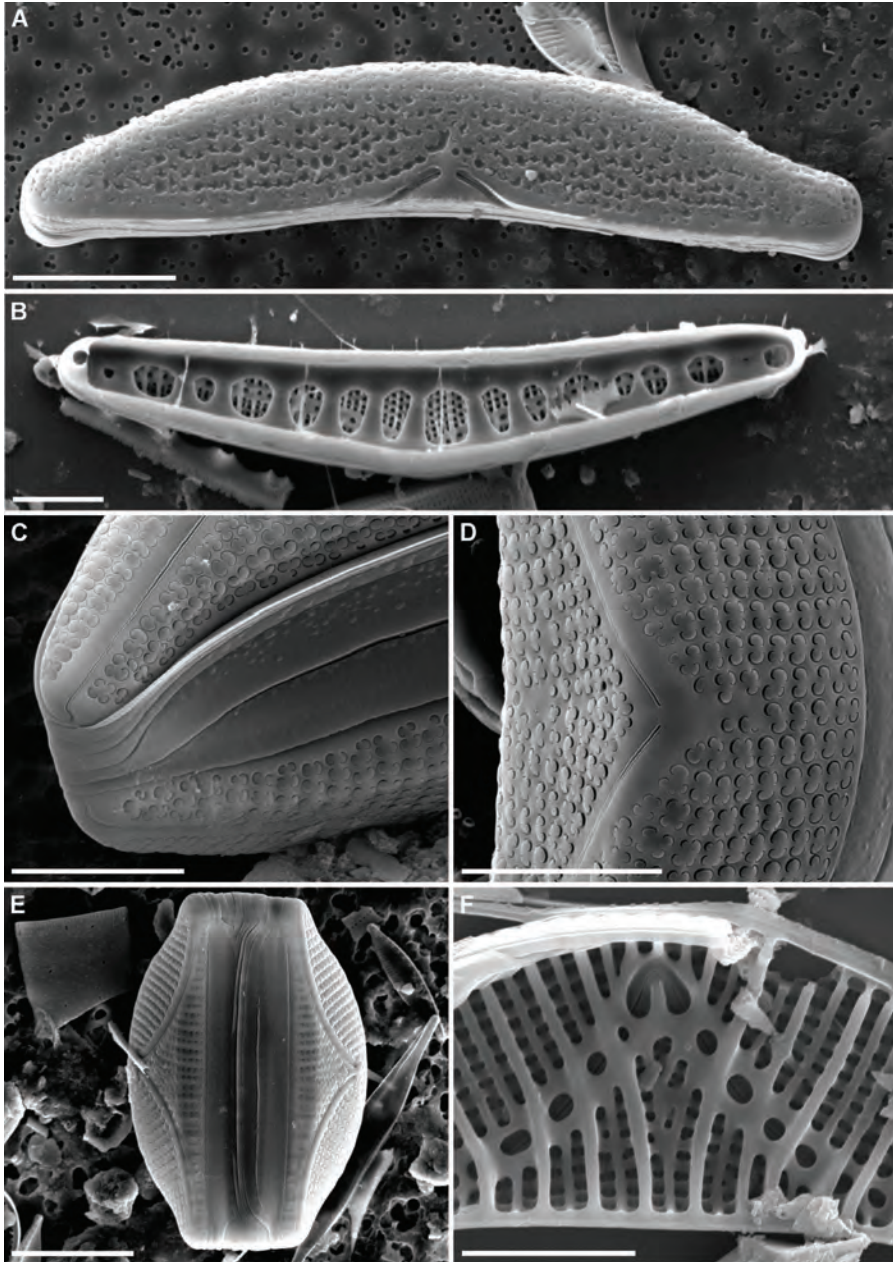


Fig. 177. *Epithemia* spp. **A-F.** SEM. **A.** *E. adnata*, external view of valve. **B.** Internal view of valve showing septum like extensions from the valvocopula. **C-F.** *E. sorex* Kützing. **C.** External view of terminal raphe endings. **D.** External view of central raphe endings. **E.** External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

Rhopalodia O. Müller 1897

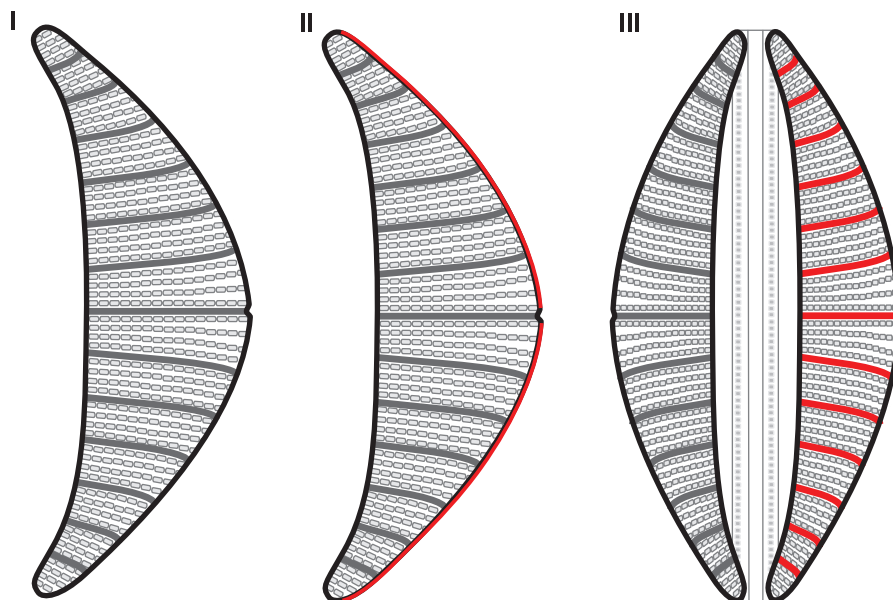
Type species: *Rhopalodia gibba* (Ehrenberg) O. Müller

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 discernible 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.



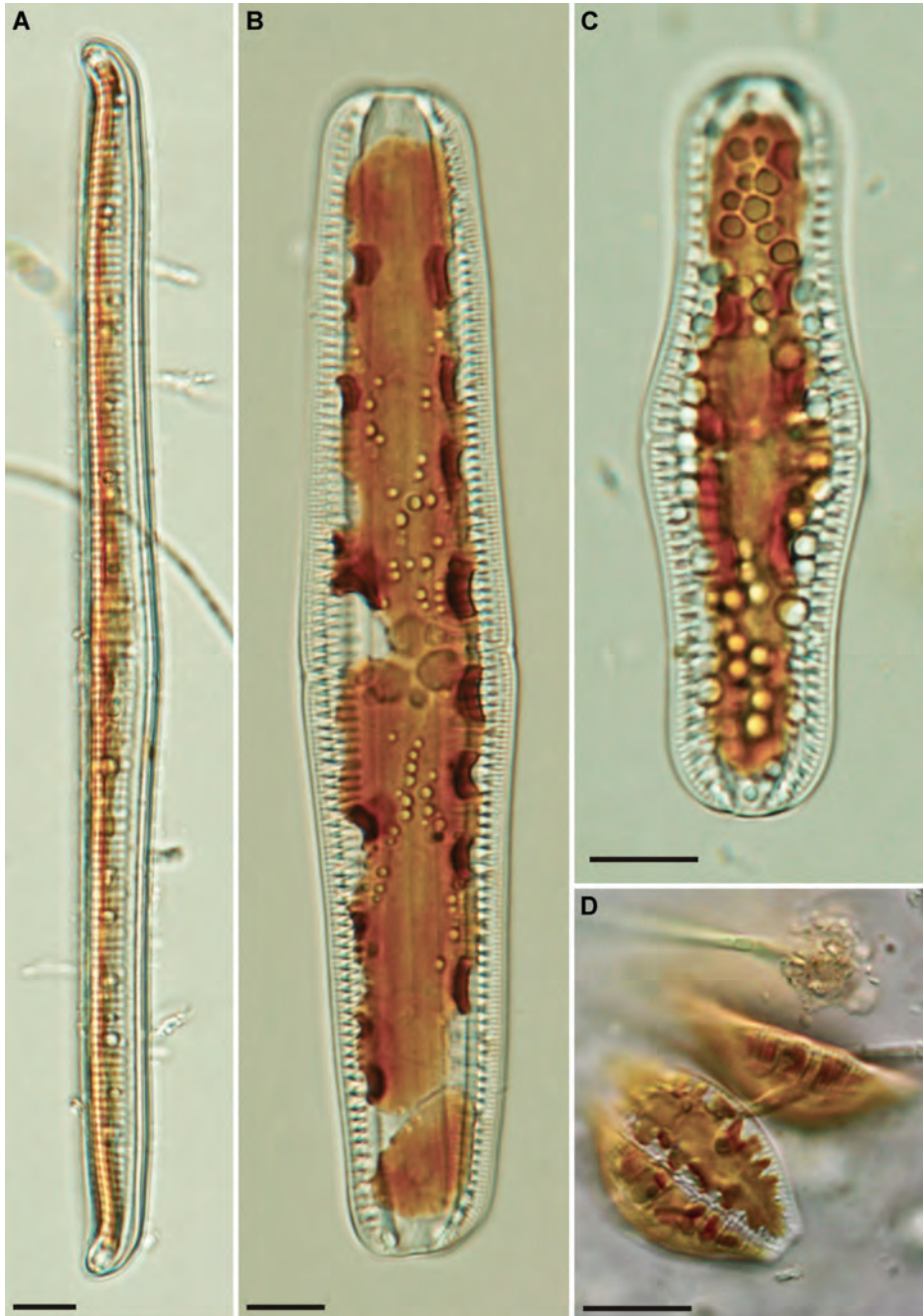


Fig. 178. *Rhopalodia* spp. **A-D.** LM, living cells. **A.** *Rhopalodia gibba*, valve view. **B-C.** *Rhopalodia gibba*, girdle view. **D.** *Rhopalodia* sp., girdle view, showing highly lobed plastid. Scale bars = 10 μ m.

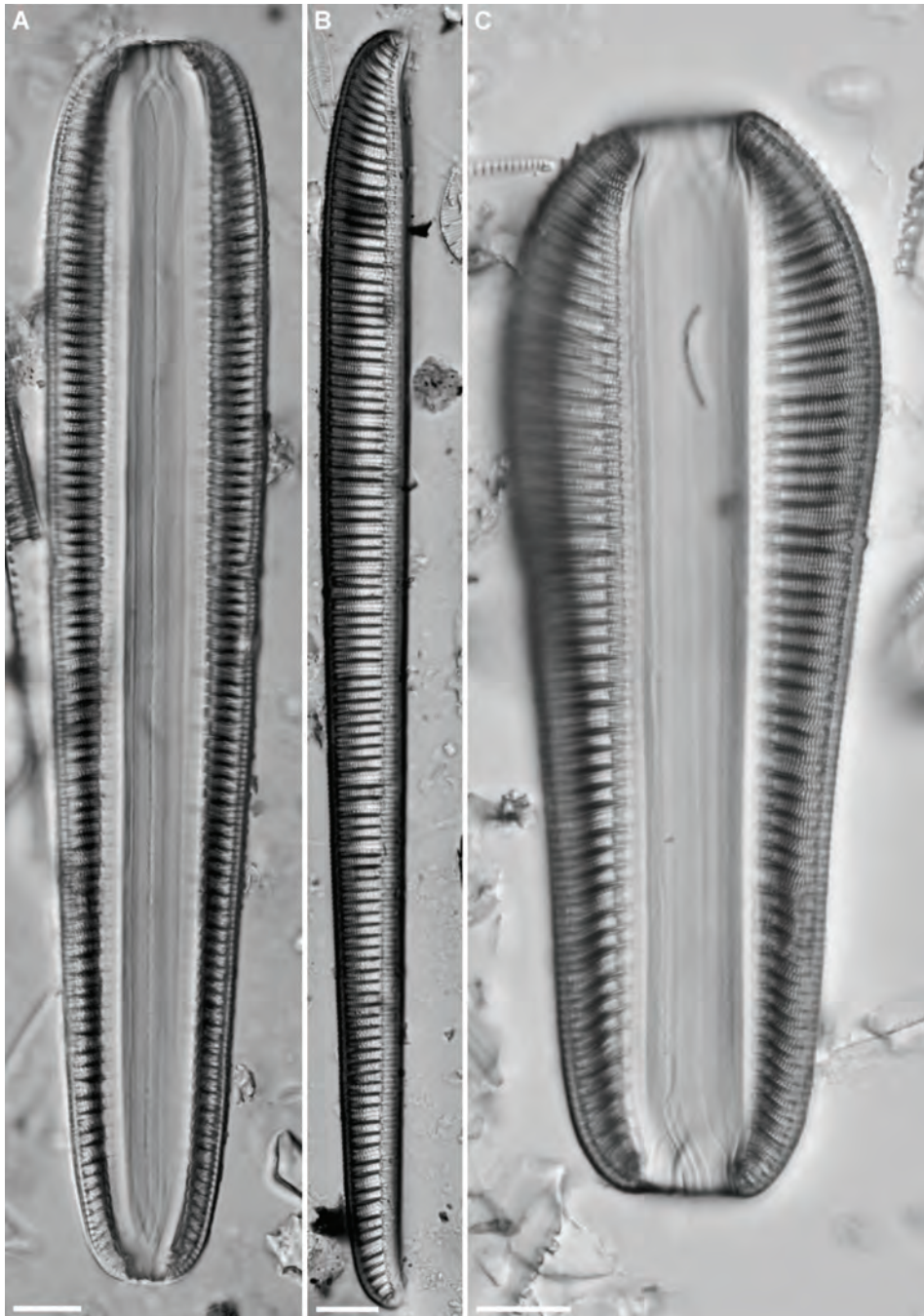


Fig. 179. *Rhopalodia hirudiniiformis* O. Müller. **A-C.** LM, cleaned valves. **A, C.** Girdle view. **B.** Valve view.
Scale bars = 10 μ m.

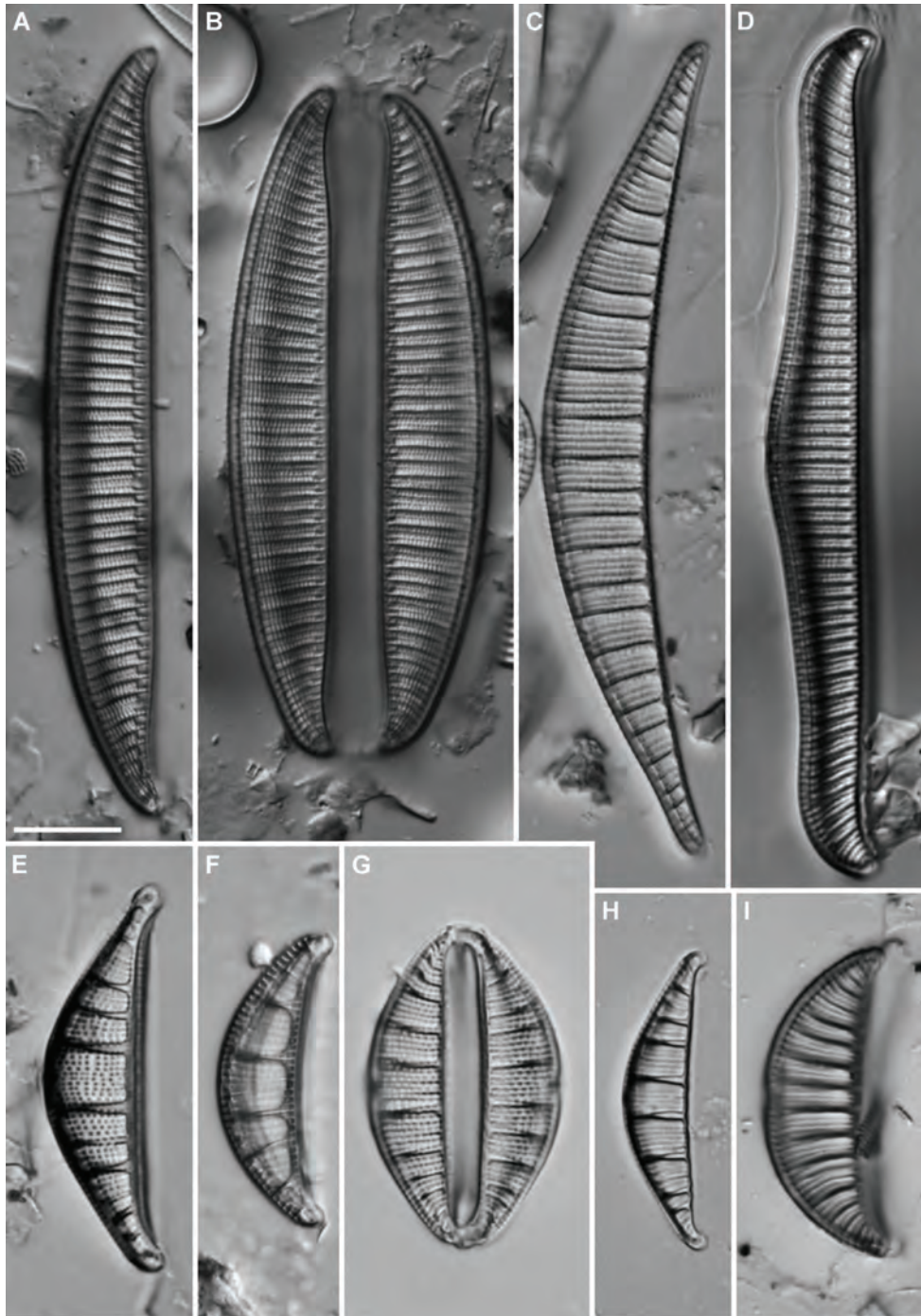


Fig. 180. *Rhopalodia* spp. **A-I.** LM, cleaned valves. **A.** Valve view. **B.** *Rhopalodia* sp., girdle views. **C.** *Rhopalodia* sp., valve view. **D.** *R. gibba*, valve view. **E-F.** *Rhopalodia* sp., valve views. **G.** *Rhopalodia* sp., girdle view. **H.** *R. gibberula* var. *vanheurckii*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

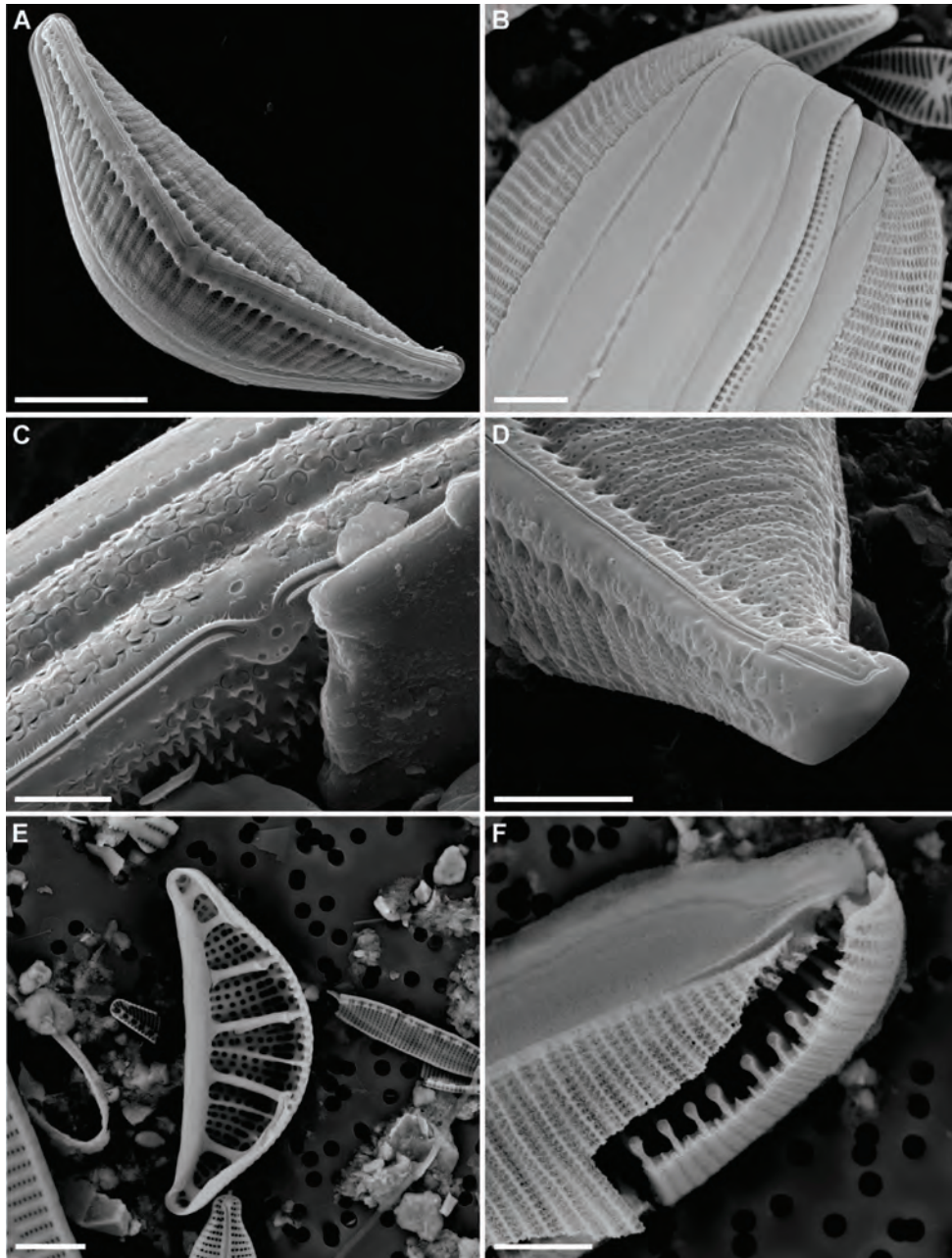


Fig. 181. *Rhopalodia* spp. **A-F.** SEM. **A-D, F.** External views. **B.** *Rhopalodia hirudiniformis*, detail of girdle bands. **C.** Detail of central raphe endings. **D.** Detail of terminal raphe ending. **E.** Internal view of valve. **F.** broken valve showing the complex structure of the areolae.

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

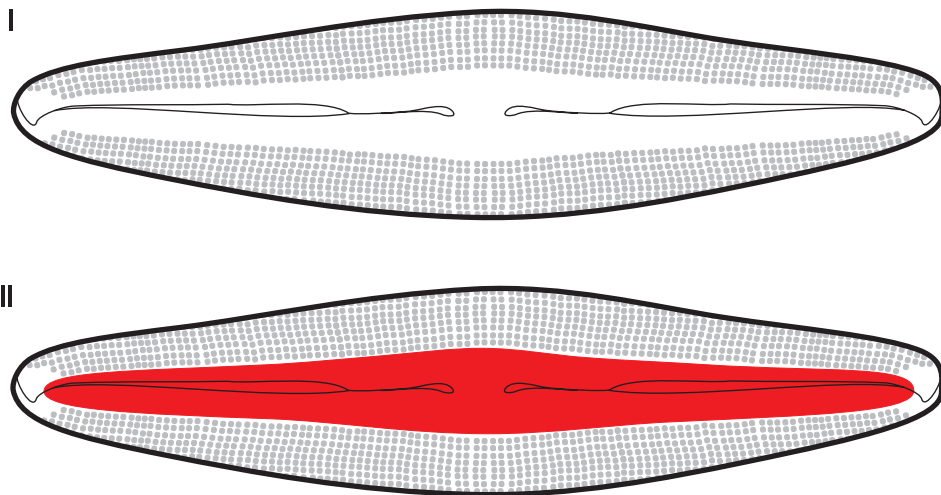
Characteristics – Cells **biraphid** with parallel striae through the length of the valve, areolae large, regularly arranged and easily observed under LM (Fig. 183: A-B).

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.



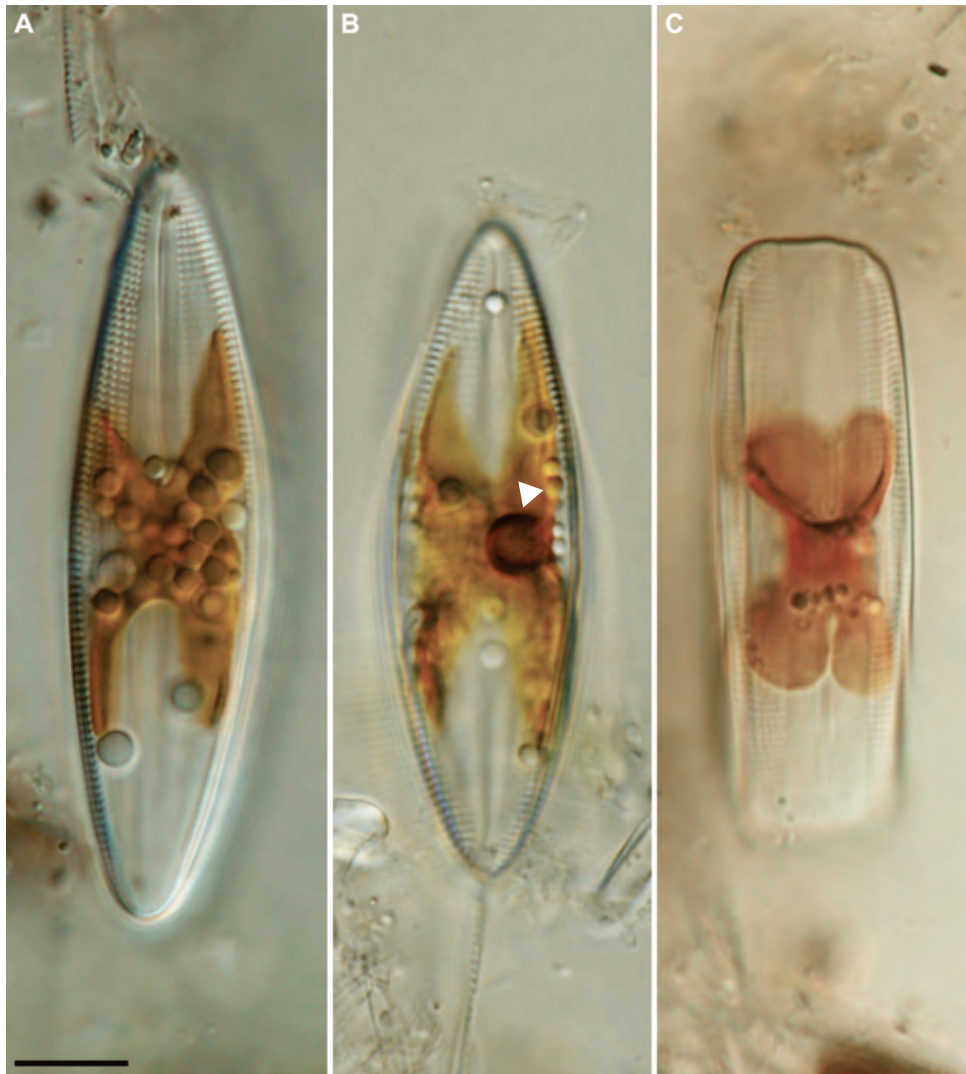


Fig. 182. *Crucicostulifera areolata*. **A-C.** LM, living cells, note H-shaped plastid and large pyrenoid (arrow - **B**). Scale bars = 10 μ m (A-C).