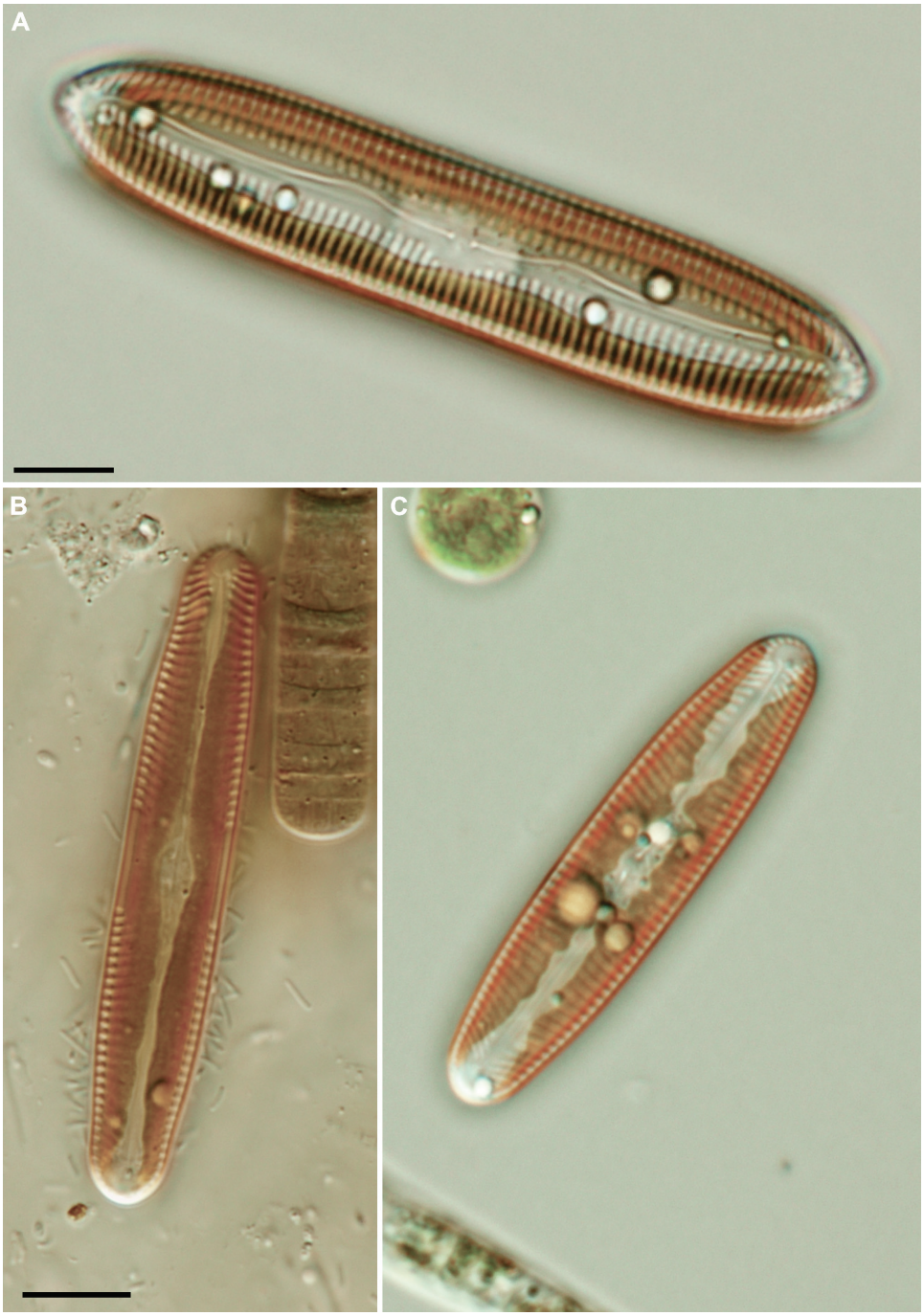


Fig. 129. *Pinnularia* spp. **A-C.** LM, living cells, note the scattered lipid bodies. **C.** undulate plastid.
Scale bars = 10 µm (A-C).

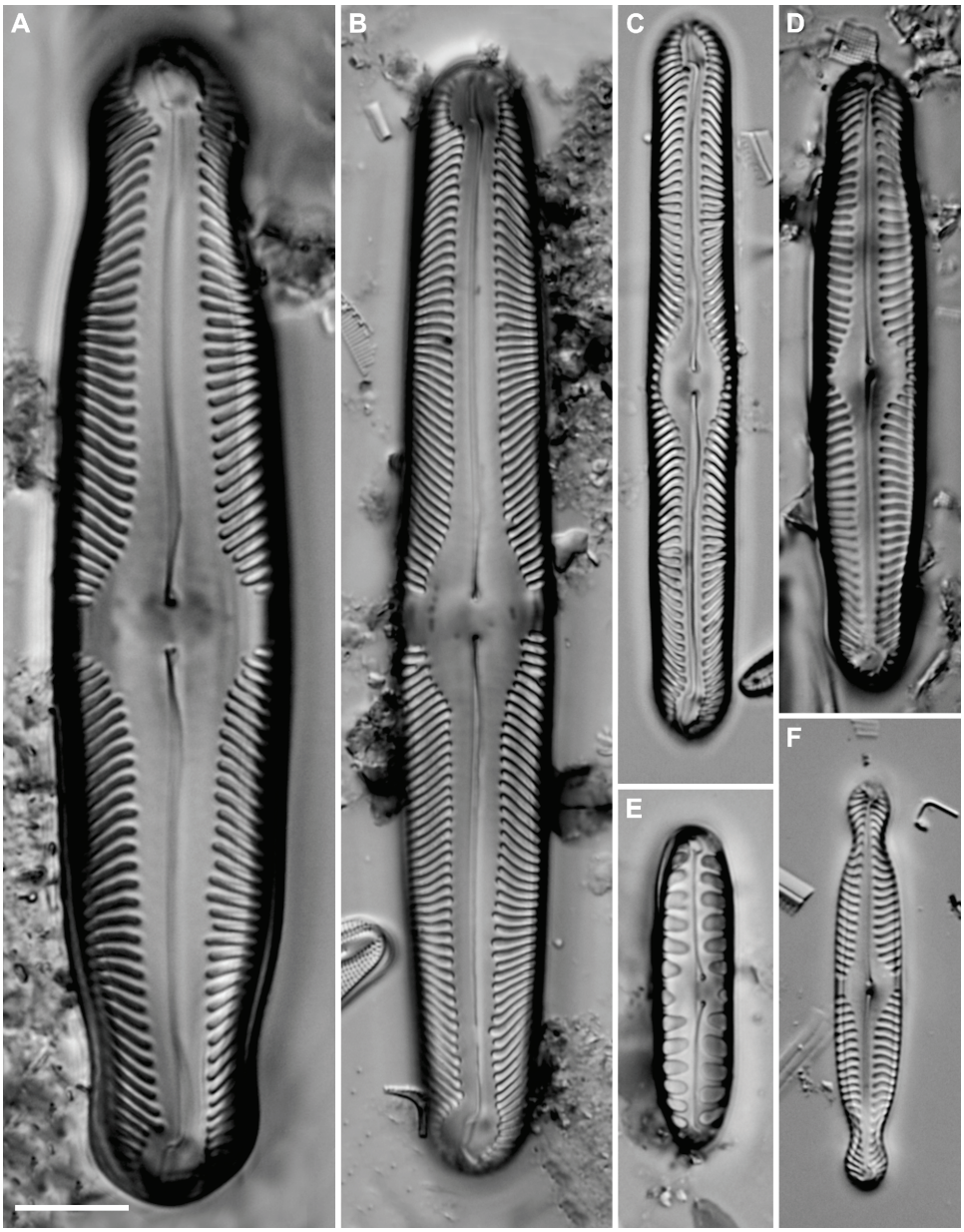


Fig. 130. *Pinnularia* spp. **A-F**. LM, valve views of cleaned material. **E.** *P. borealis* Ehrenberg sensu lato.
Scale bar = 10 µm (A-F).

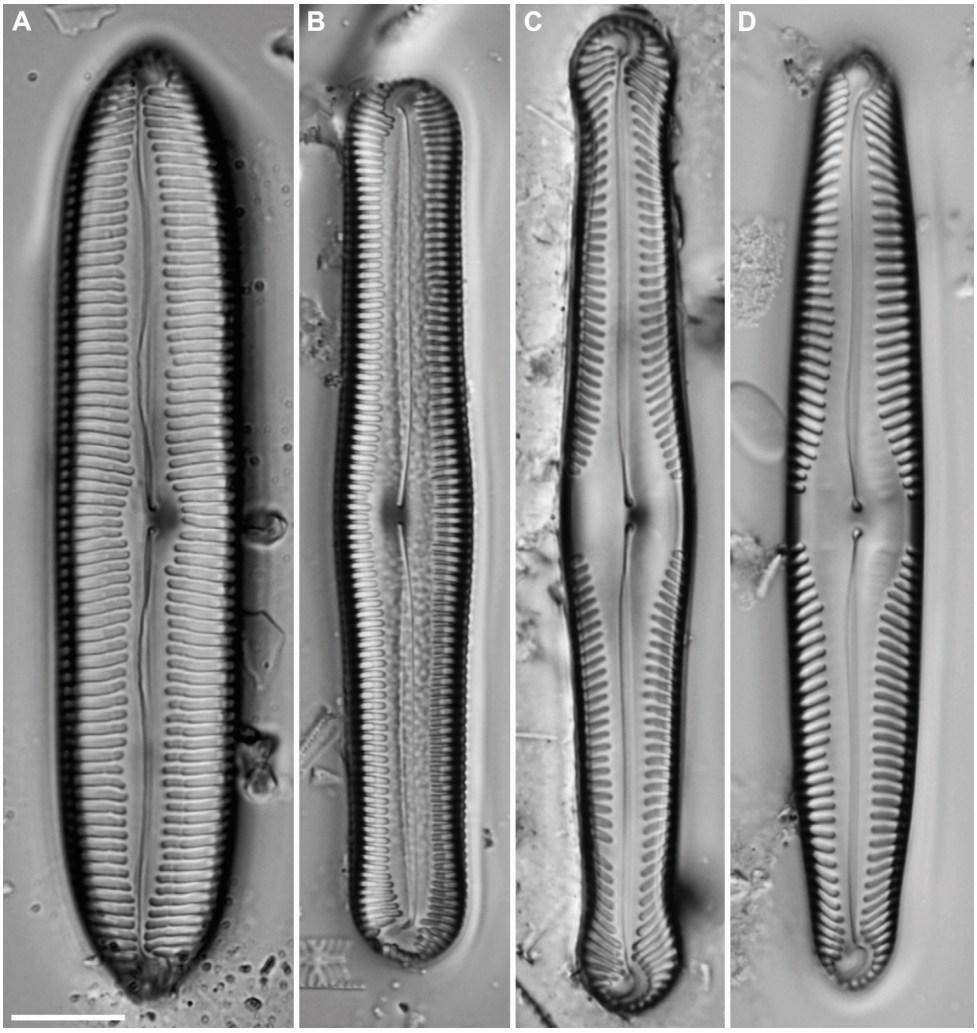


Fig. 131. *Pinnularia* spp. **A-D**. LM, valve views of cleaned material.
B. *P. acrosphaeria* (Brébisson) Rabenhorst.
Scale bar = 10 µm (A-D).

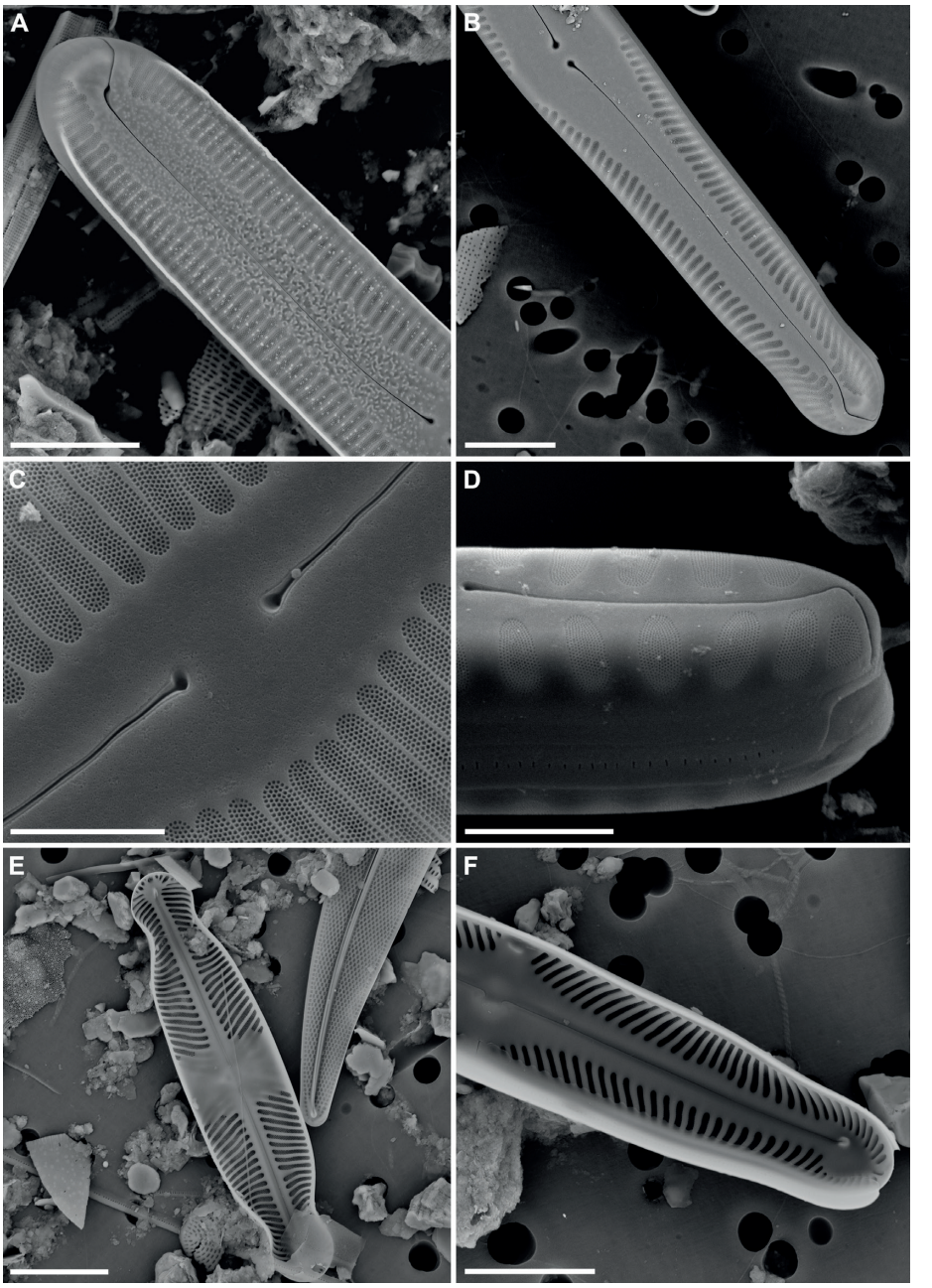


Fig. 132. *Pinnularia* spp. **A-F.** SEM. **A-D.** External view of valves. **A.** *P. acrosphaeria*, note irregular silica ornamentations in axial area. **B.** Detail of central and terminal raphe ending. **C.** Detail of central raphe endings and striae, composed of numerous small round areolae. **D.** Mantle view. **E-F.** Internal view of valves, note the alveolate striae.
Scale bars = 10 µm (A, B, E, F), 5 µm (C, D).

Diploneis (Ehrenberg) Cleve 1894

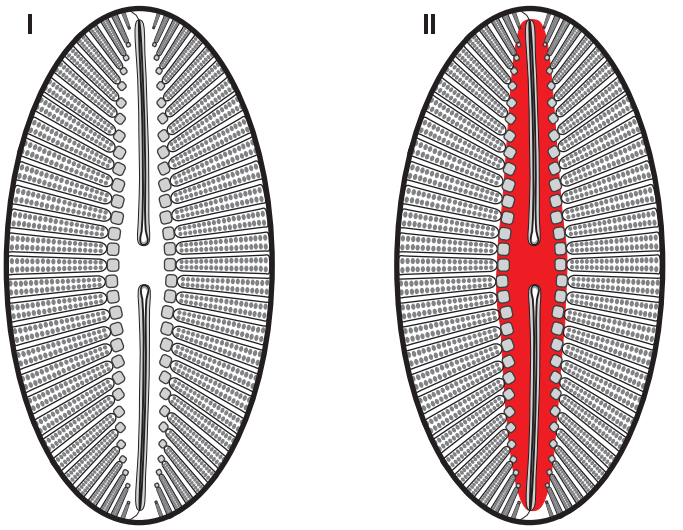
Type species: *Diploneis didyma* (Ehrenberg) Cleve

Characteristics – Cells **biraphid**, elliptical with bluntly rounded apices, sometimes constricted mid-valve (Fig. 133: C). **Longitudinal canals** (ll) parallel to the raphe, striae composed of complex (**loculate**) areolae, usually clearly visible under LM (Fig. 133: E-G; Fig. 134: D). When observed under SEM the longitudinal canals are perforated on the exterior of the valve with areolae but not on the interior (Fig. 134: C). Cells heavily silicified.

Plastid structure – Cells with two plastids, one on either side of the apical plane, may be many lobed (Fig. 133: A, C, D) or simple (Fig. 133: B).

Identification of species – Species can be identified by cell size, cell shape and structure and density of the striae as well as the shape of the axial and central area and the presence and degree of the mid-valve constriction. Some species have unique structures such as square openings in the longitudinal canals (Fig. 134: A).

Ecology – Cells solitary and motile. Freshwater forms found in the benthos of acidic oligotrophic waters as well as alkaline waters with higher trophic status and conductivity. Also found in moist sub-aerial habitats.



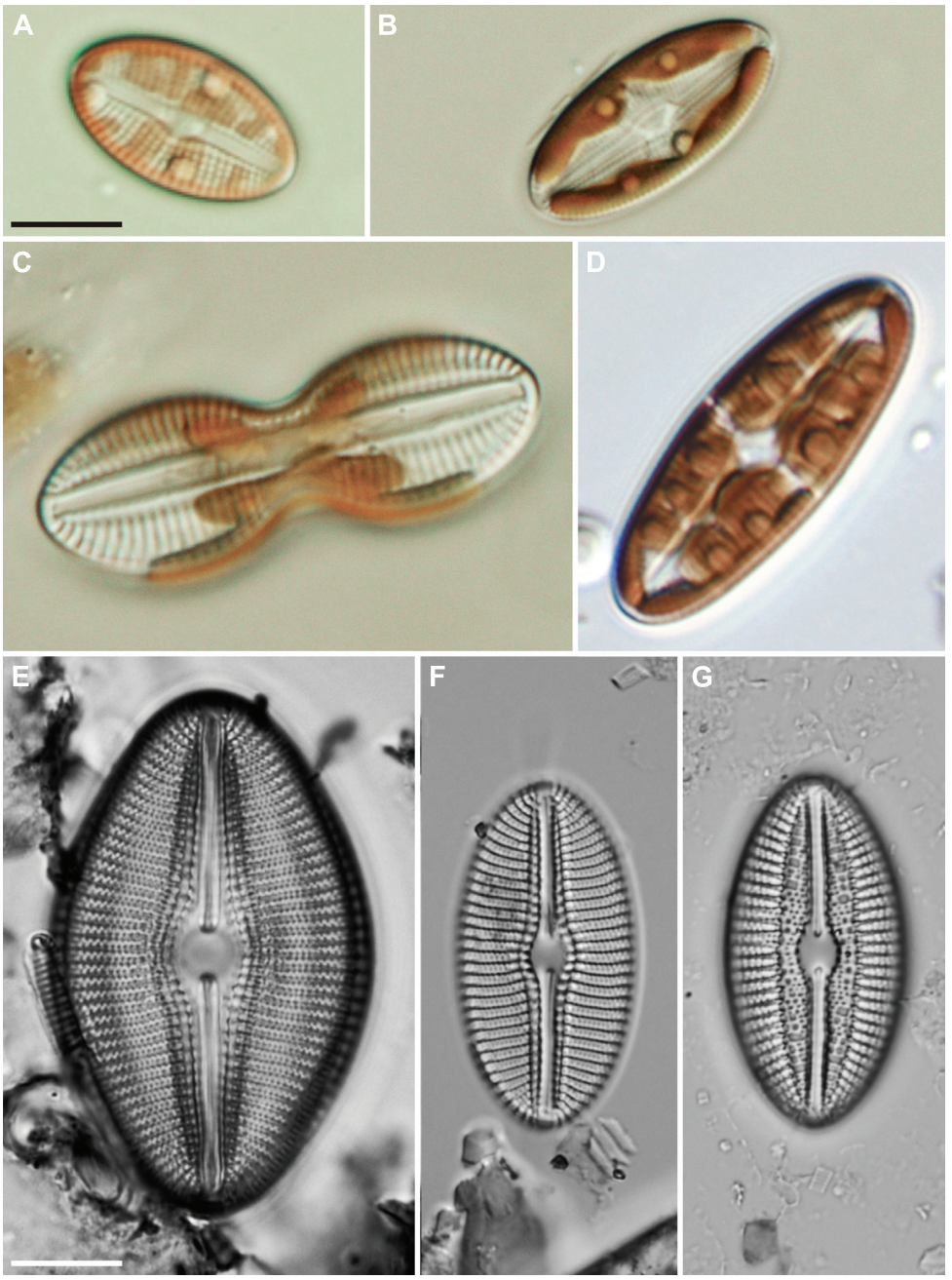


Fig. 133. *Diploneis* spp. **A-G.** LM. **A-D.** Living cells, valve views showing a variety of plastid shapes. **E-F.** Valve views of cleaned material. **G.** Valve view of *Diploneis fenestrata* J.C. Taylor & B. Karthick. Scale bars = 10 µm (A-G).

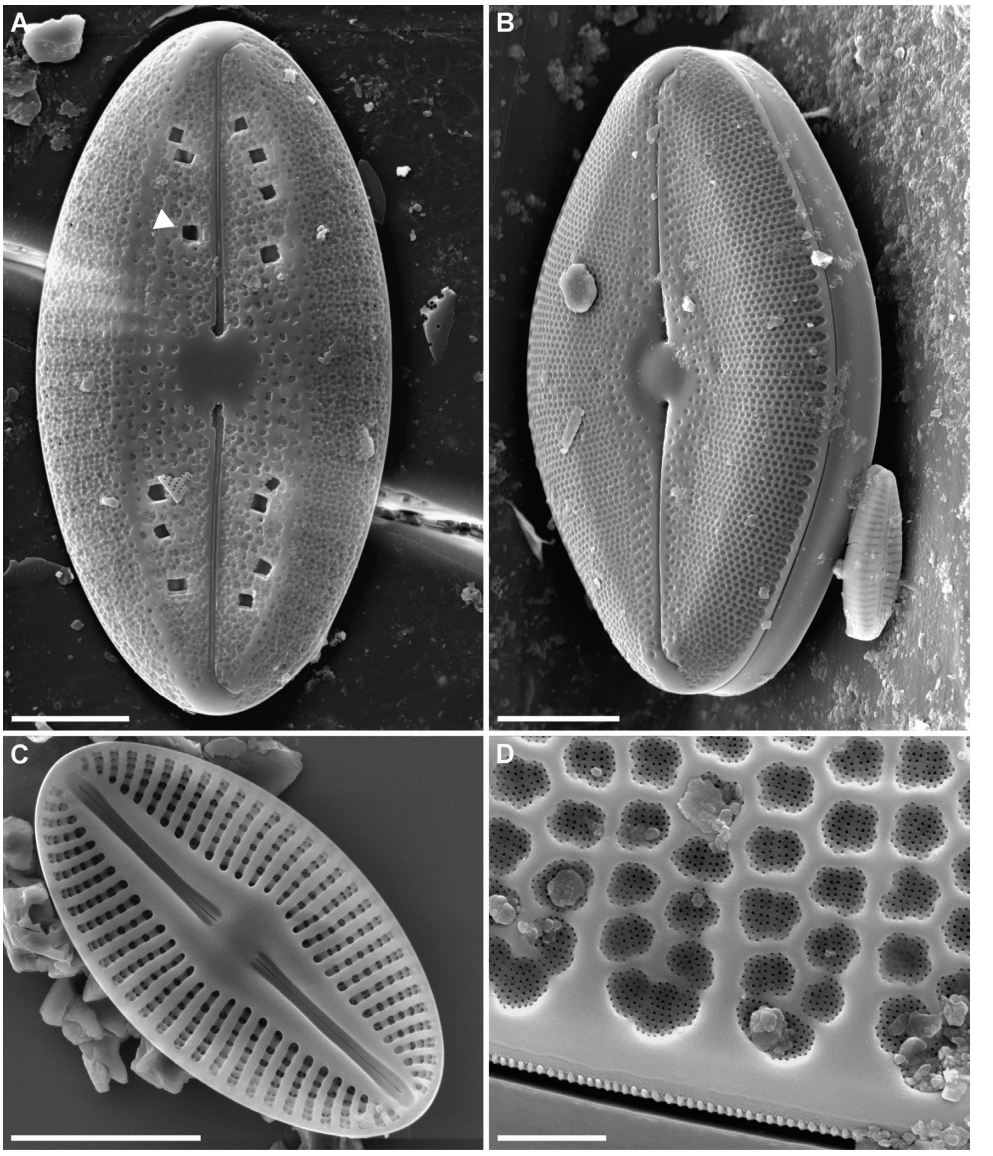


Fig. 134. *Diploneis* spp. **A-D.** SEM. **A.** *Diploneis fenestrata*, valve view, note square openings in longitudinal canals (arrow). **B.** *Diploneis* sp., oblique view of valve exterior. **C.** *Diploneis* sp., view of valve interior. **D.** Exterior view, detail of complex loculate areolae.
Scale bars = 5 µm (A), 10 µm (B-C), 1 µm (D).

Adlafia Gerd Moser, Lange-Bertalot & Metzeltin 1998

Type species: *Adlafia muscora* (Kociolek & Reviers) Gerd Moser, Lange-Bertalot & Metzeltin

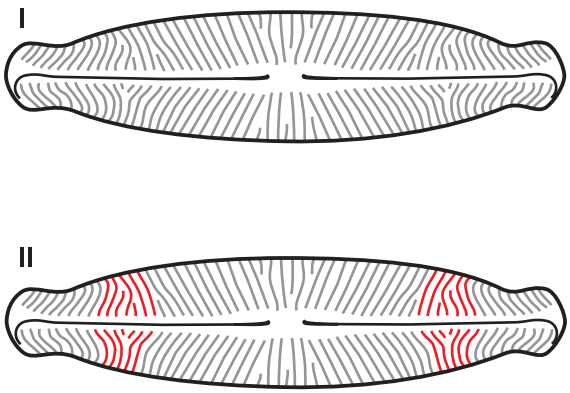
SYNONYM:
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid,** small, striae can often be rather fine and difficult to resolve in LM. Striae mid-valve are strongly radiate and curved becoming strongly **convergent** towards the apices (II). Cells may have slightly undulating margins (Fig. 135: C) and in some cases the areolae may be visible (Fig. 135: C-D). The closely related *Kobayasiella* (see Fig. 141) usually has denser striation and a small bend or kink about halfway along the length of the raphe which is not found in *Adlafia*.

Plastid structure – Single plastid with two lobes connected by a bridge (H-shape) (Fig. 135: B).

Identification of species – Species in this genus are distinguished based on cell size and shape and the shape of the apices. Striae density and angle relative to the **transapical axis** are also important characteristics to consider.

Ecology – Cells solitary. Found in acidic oligotrophic waters and moist sub-aerial habitats.



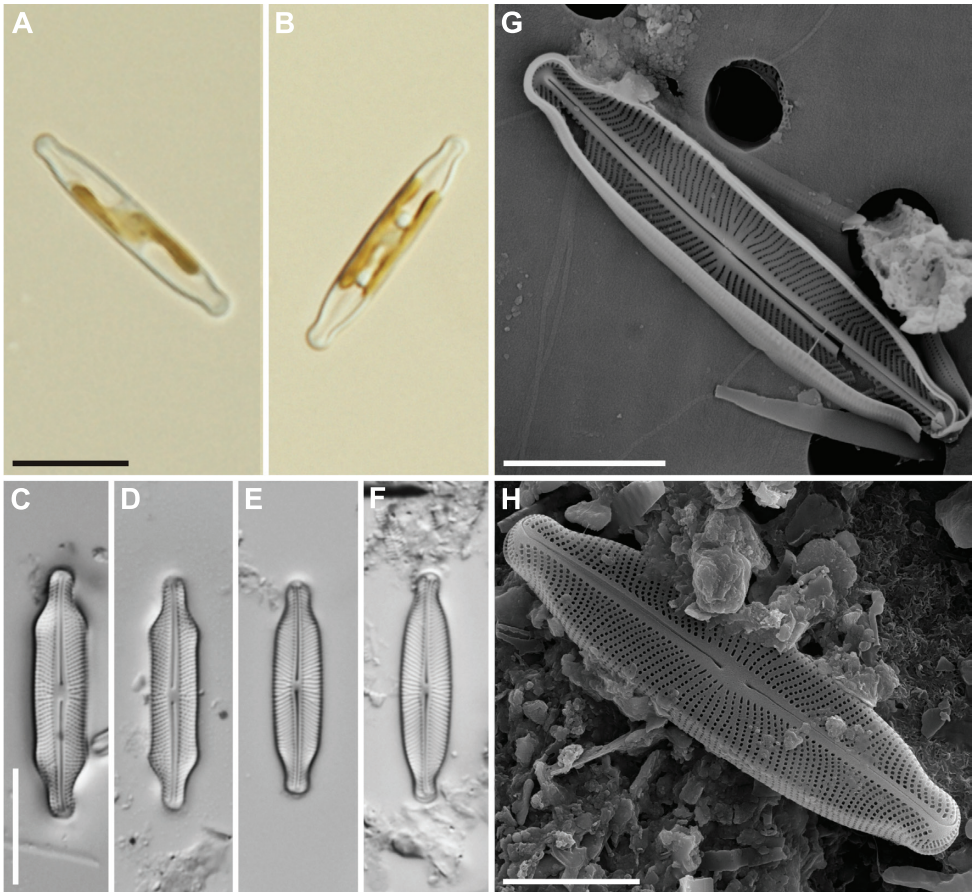


Fig. 135. *Adlafia* spp. **A-F.** LM. **A-B.** Living cells, valve views. **C-F.** Valve views of cleaned material. **G-H.** SEM. **G.** Internal view of valve. **H.** External view of valve. Scale bars = 10 µm (A-F), 5 µm (G-H).

Capartogramma Kufferath 1956

Type species: *Capartogramma jeanii* Kufferath

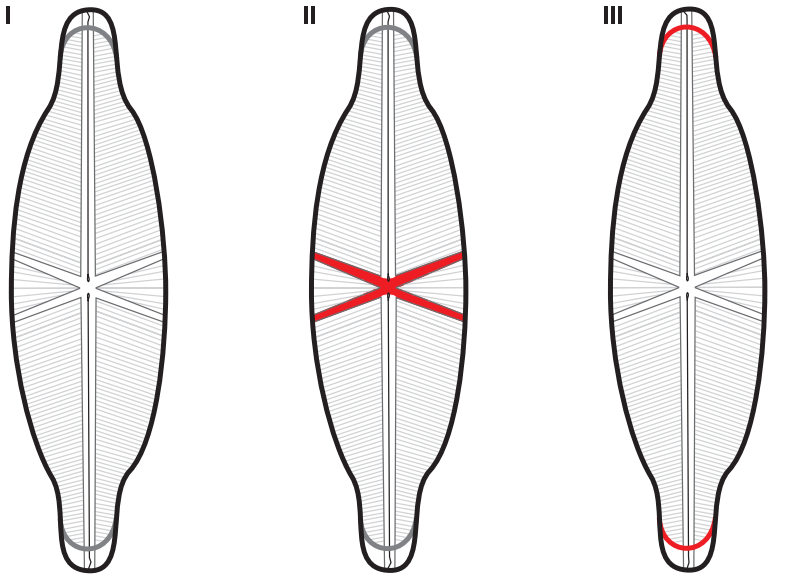
SYNONYM:
Schizostauron Grunow 1867 pro parte
Stauroneis Ehrenberg 1843 pro parte

Characteristics – Cells **biraphid** with fine striae, areolae small and difficult to observe under LM. This genus is characterised by X-shaped silica thickening in the central area (II, Fig. 136: L) and a **pseudoseptum** (III) which is present at each apex. Axial area very narrow. Cells usually bilaterally symmetrical, however *Capartogramma amphoroides* R. Ross has a dorsiventral symmetry.

Plastid structure – Cells with one large plastid (Fig. 136: A).

Identification of species – Species in this genus are distinguished based on cell size, cell symmetry and shape, and the shape of the apices.

Ecology – Cells solitary and motile. Found in the benthos and plankton, with greatest species diversity in tropical African waters



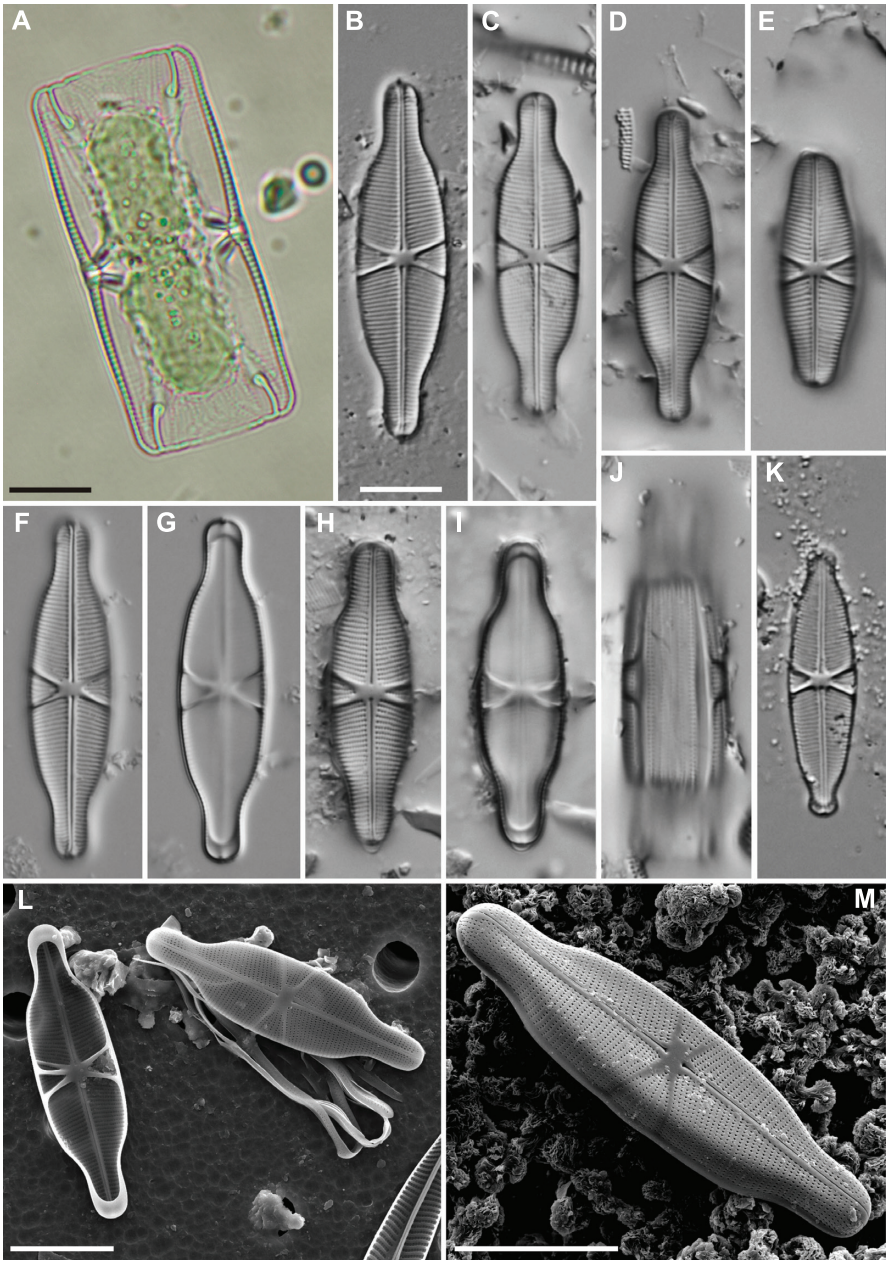


Fig. 136. *Capartogramma* spp. **A-K.** LM. **A.** Living cell of *C. karstenii* (O. Müller) R. Ross, girdle view. **B-J.** *C. crucicula* (Grunow ex R. Cleve) Ross; valve views at various foci (**B-I.**); girdle view (**J**). **K.** Valve view of *C. crucicula* [var. *parva* Fusey]. **L-M.** SEM. **L.** External view of valve and copulae (right); internal view of valve (left). **M.** External view of valve showing valve mantle.
Scale bars = 10 µm.

Eolimna Lange-Bertalot & W. Schiller 1997

Type species: *Eolimna martinii* W. Schiller & Lange-Bertalot

SYNONYM:
Navicula Bory 1822 pro parte

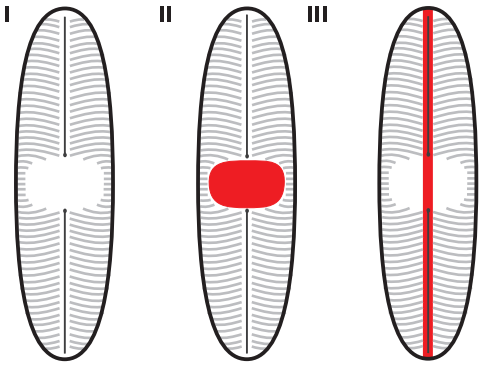
Characteristics – Cells **biraphid**, very small, elliptical to linear elliptical with broadly rounded apices. Striae fine, radiate or parallel composed of single rows of areolae which are not discernable under LM. Raphe straight and simple (I). Central area (II) variable in size but never extending to the valve margins. Axial area very narrow (III).

Plastid structure – Cells with one plastid which may be simple (Fig. 137: A) or lobed (Fig. 137: 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 shape of the central area.

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

Note – We have provided a description and illustration of the genus *Eolimna* to demonstrate the recent (last decade) concept of this genus. This genus was originally described from fossil material. Recently small naviculoid diatoms ascribed to *Eolimna* have been examined in terms of plastid structure and genetic relationships and it has been concluded that the majority of the small species we currently consider *Eolimna* (e.g. *Eolimna minima* (Grunow) Lange-Bertalot) should be included with *Selllaphora* or in other genera such as *Craticula* (e.g. *Craticula subminuscula* (Manguin) Wetzel & Ector).



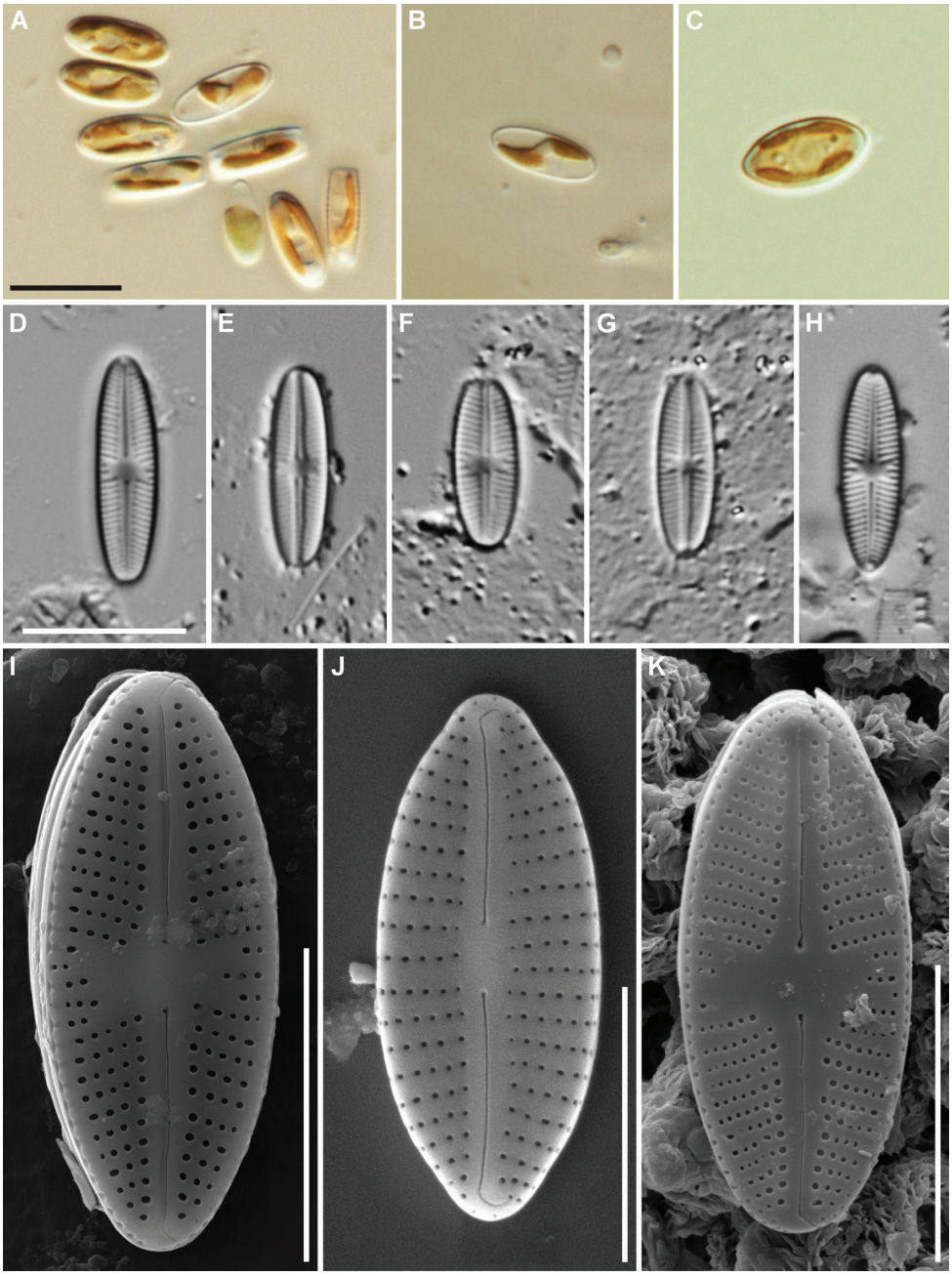


Fig. 137. *Eolimna* spp. **A-H.** LM. **A-B.** Living cells, valve and girdle views. **C.** Living cell, valve view of *Eolimna subminuscula* (Manguin) Gerd Moser, Lange-Bertalot & Metzeltin. **D-H.** *Eolimna* sp., valve view. **I-K.** SEM. **I, K.** External view of valve of *Eolimna* sp. **J.** *E. subminuscula*, external view of valve.
Scale bars = 10 µm (A-H), 5 µm (I-K).

Fistulifera Lange-Bertalot 1997

Type species: *Fistulifera saprophila* (Lange-Bertalot & Bonik) Lange-Bertalot

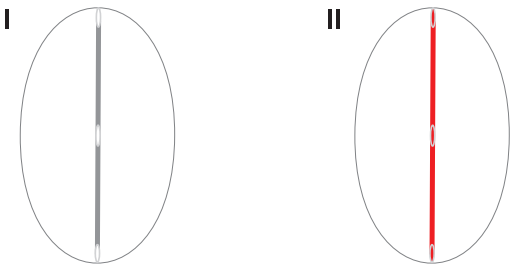
SYNONYM:
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid**, very small, elliptical with broadly rounded apices. Striae not discernable under LM (Fig. 138: A-D) and also difficult to resolve with SEM (Fig. 138: E). Raphe straight and simple (Fig. 138: A-D) carried in a sternum which is usually the only structure which can be seen using LM (II). Slight swellings present in the sternum at the central nodule and apices.

Plastid structure – Cells with one H-shaped plastid with 2 large lipid bodies.

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

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



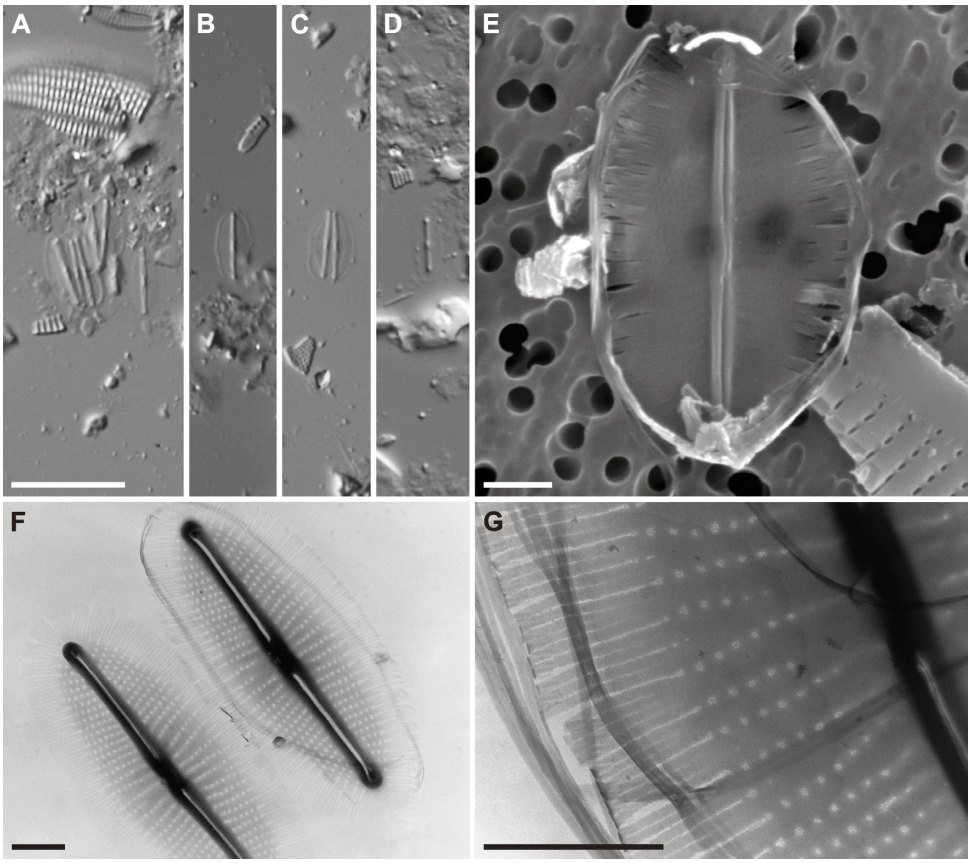


Fig. 138. *Fistulifera saprophila*. **A-D.** LM, valve views. **E.** SEM, internal view of valve. **F-G.** Transmission electron microscopy.
Scale bars = 10 µm (A-D), 1 µm (E-G).

Geissleria Lange-Bertalot & Metzeltin 1996

Type species: *Geissleria moseri* Metzeltin, Witkowski & Lange-Bertalot

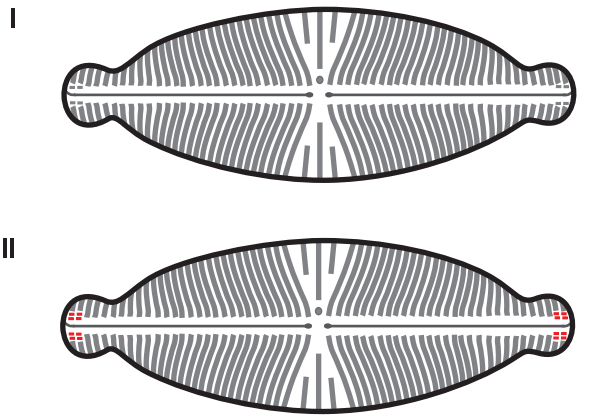
SYNONYM:
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid**, elliptical to linear elliptical with capitate to broadly rounded apices. Raphe straight. Striae parallel in the mid-valve becoming radiate and often curved (Fig. 139), and parallel to convergent at the apices. Areolae are discernable under LM. Isolated punctum often present in the central area (Fig. 139: D-E). Chief distinguishing characteristic of this genus is the presence of **annulae** at the poles (II). **Annulae** are 1-4 transapical striae, often composed of areolae with a distinctive structure, which interrupt the striae.

Plastid structure – Not observed in tropical African material.

Identification of species – Species can be identified by cell size, cell shape, shape of the apices, and orientation, curvature and density of the striae as well as shape of the central area. Presence/absence and position of an isolated punctum and the structure of the **annulae**.

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



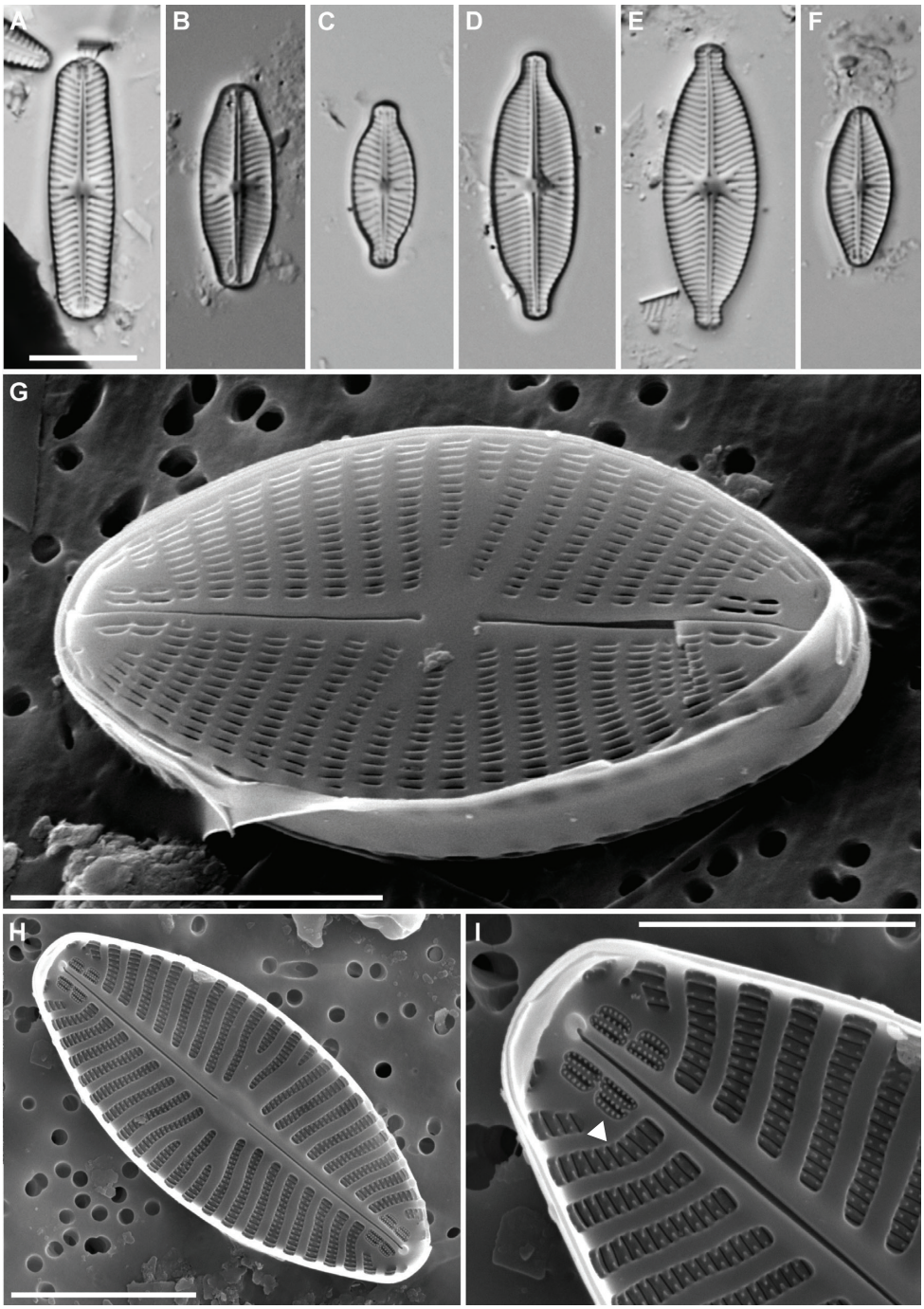


Fig. 139. *Geissleria* spp. **A-F.** LM, valve views of various species. **G-I.** SEM. **G.** External view of valve. **H-I.** Internal view of valve. **I.** Detail of annulae (arrow). Scale bars = 10 µm (A-F), 5 µm (G-H), 3 µm (I).

Hippodonta Lange-Bertalot, Metzeltin & Witkowski 1996

Type species: *Hippodonta lueneburgensis* (Grunow) Lange-Bertalot, Metzeltin & Witkowski

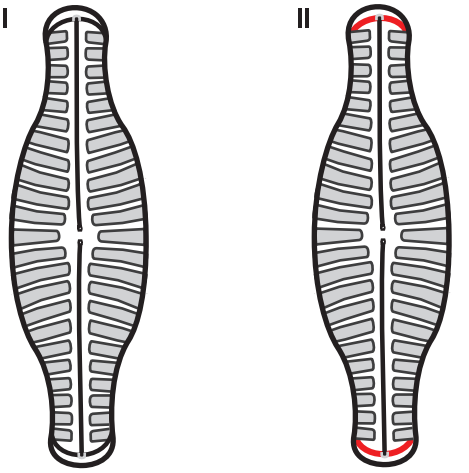
SYNONYM:
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid**, small, elliptical to linear elliptical with broadly rounded, rounded or subcapitate apices. Striae very robust composed of double, rarely single rows of areolae which are usually not discernable under LM. Raphe straight and simple (Fig. 140: C-P), terminal endings do not extend onto the valve mantle. Thickened bars of silica present at the poles (II; Fig. 141: F) on the valve interior.

Plastid structure – Two plastids one each side of the cell next to the girdles (Fig. 140: A-B).

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

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



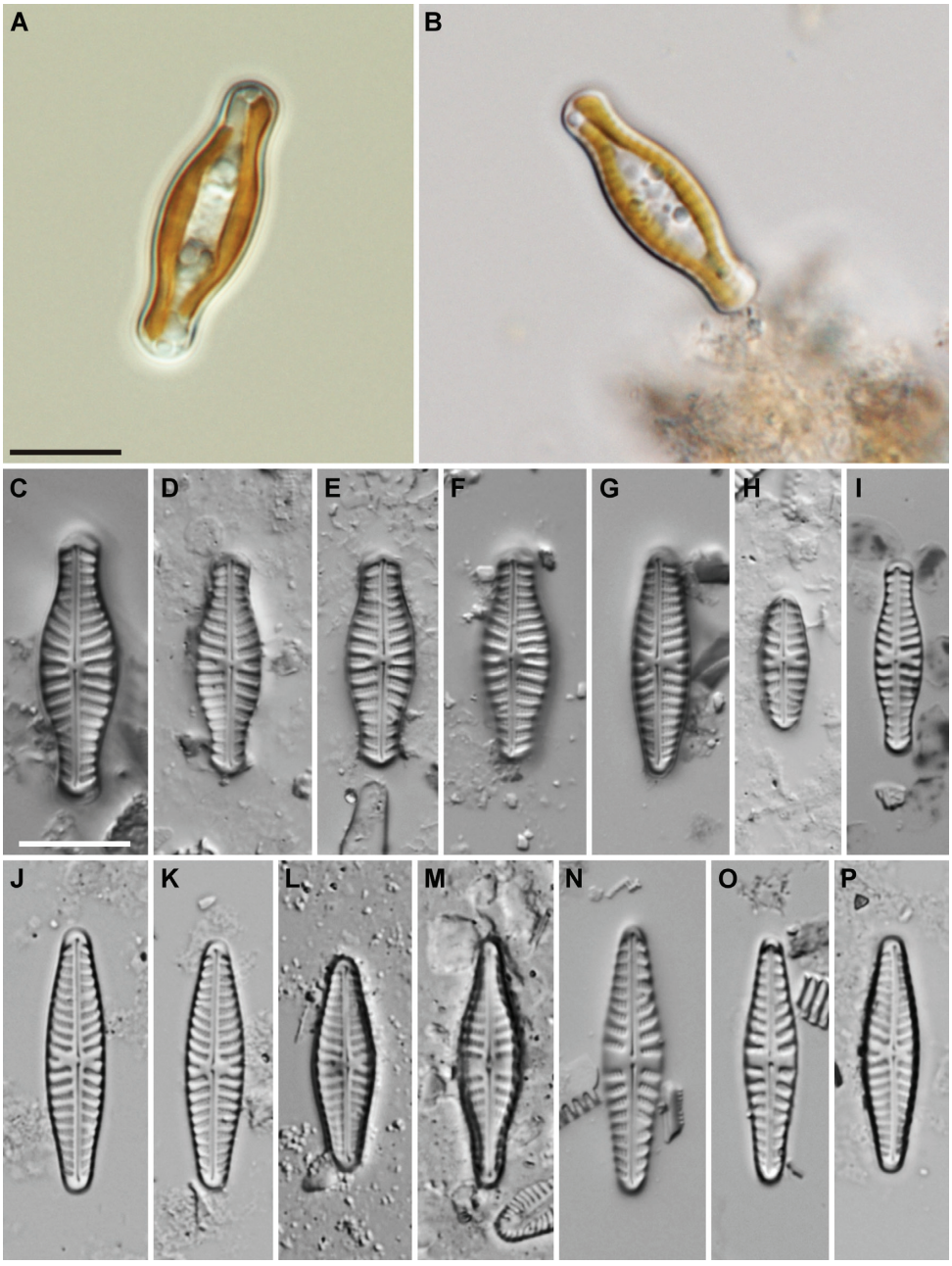


Fig. 140. *Hippodonta* spp. **A-F**. LM. **A-B.** Living cells of *Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski. **B-P.** Cleaned valves. **G-H.** *Hippodonta hungarica* (Grunow) Lange-Bertalot, Metzeltin & Witkowski. Scale bar = 10 µm (A-P).

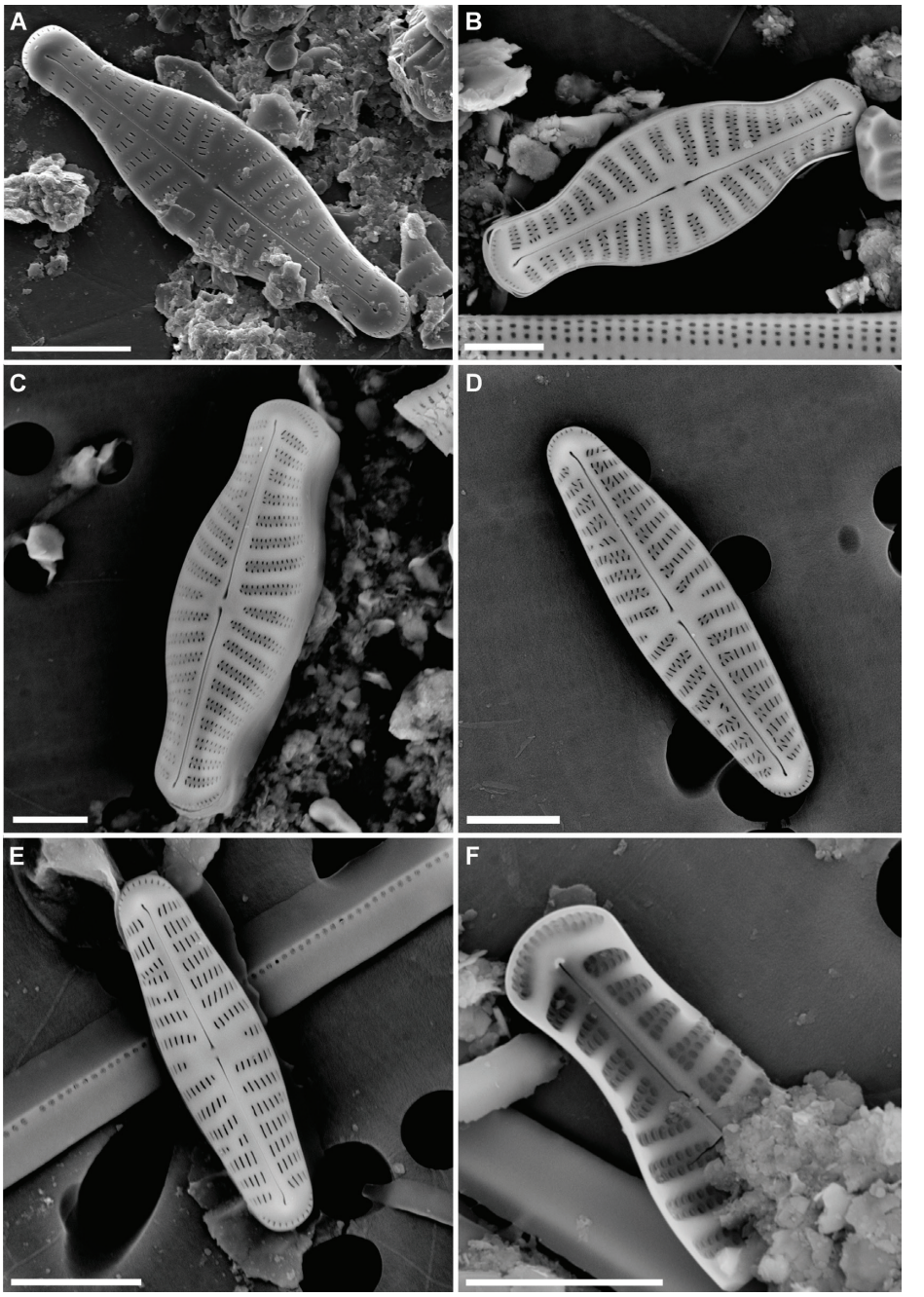


Fig. 141. *Hippodonta* spp. **A-F**. SEM. **A.** *Hippodonta* sp., external view of valve. **B-C.** *H.* capitata, external view of valve. **D-E.** *Hippodonta* spp., external view of valves. **F.** *H. capitata*, internal view of valve, note thickened bar of silica at apex. Scale bars = 5 µm (A, E-F), 4 µm (C-D), 2 µm (B).

Kobayasiella Lange-Bertalot 1999

Type species: *Kobayasiella bicuneus* (Lange-Bertalot) Lange-Bertalot

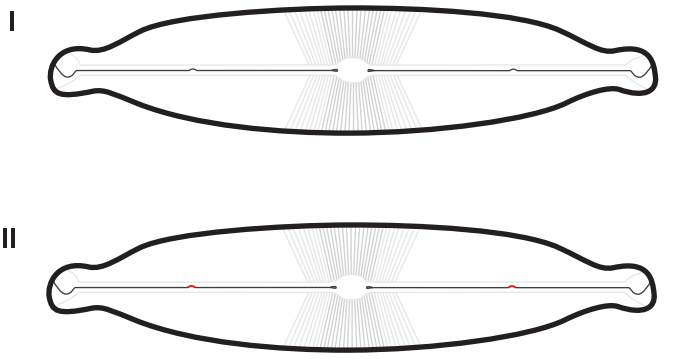
SYNONYM:
Navicula Bory 1822 pro parte
Kobayasia Lange-Bertalot 1996

Characteristics – Cells **biraphid**, mostly linear elliptical in shape with broadly subcapitate, capitate or rostrate apices. Striae very fine, composed of areolae difficult to resolve even under SEM, radiate at mid-valve becoming abruptly convergent near the apices. Raphe straight and simple (Fig. 142: B-F) with a characteristic undulation or kink approximately halfway along the length of the raphe branch (II; Fig. 142: G). Central area variable in size, usually small but may be slightly expanded. Axial area very narrow.

Plastid structure – Single plastid with 2 lobes connected by one or more bridges (Fig. 142: A).

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

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



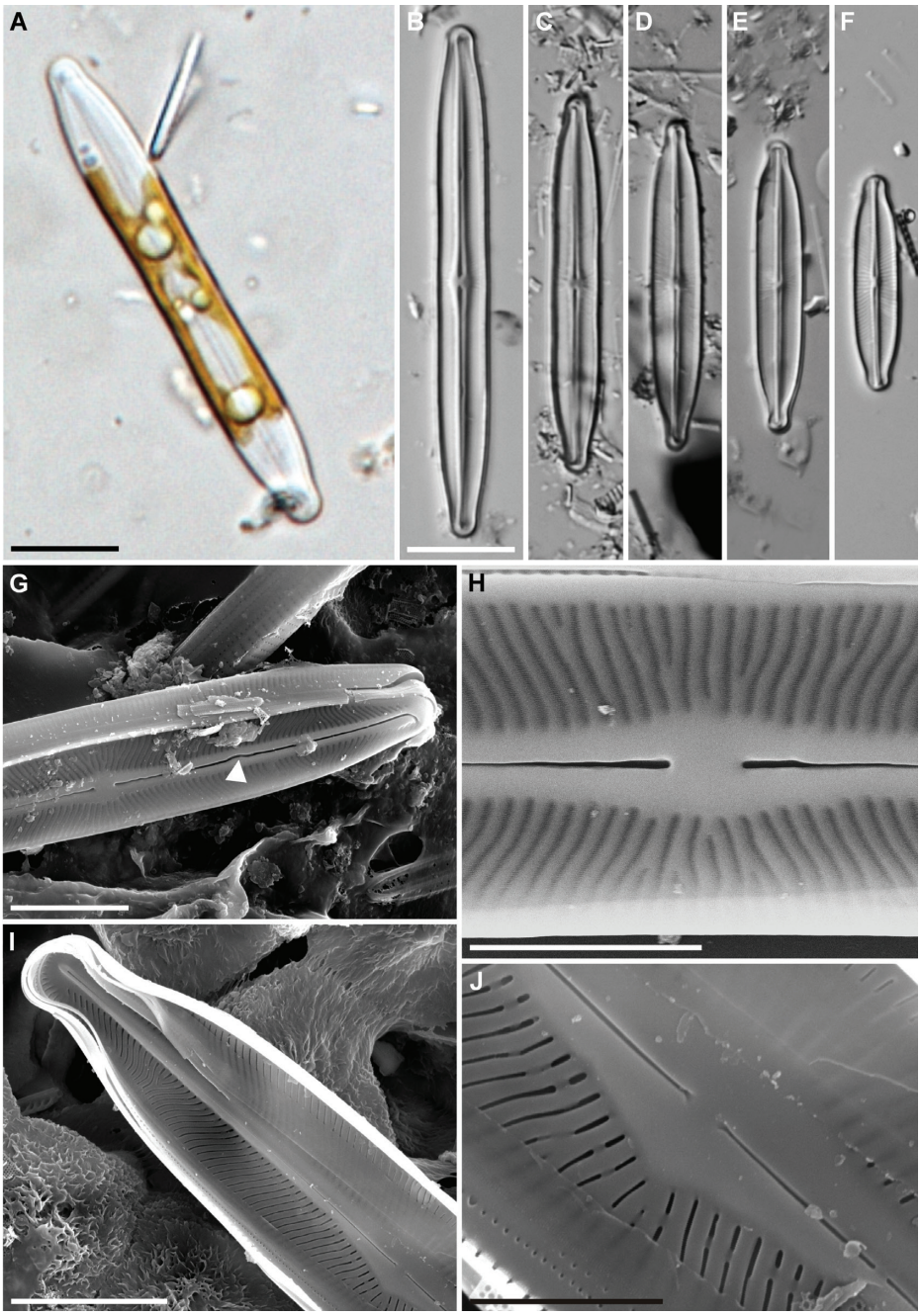


Fig. 142. *Kobayasiella* spp. **A-F.** LM. **A.** Living cell. **B-F.** Cleaned valves. **G-J.** SEM. **G-H.** External view of valve, note kink in the raphe (arrow). **I-J.** Internal view of valve.
Scale bars = 10 µm (A-F), 5 µm (G, I), 3 µm (H), 2 µm (J).

Mayamaea Lange-Bertalot 1997

Type species: *Mayamaea atomus* (Kützing) Lange-Bertalot

SYNONYM:

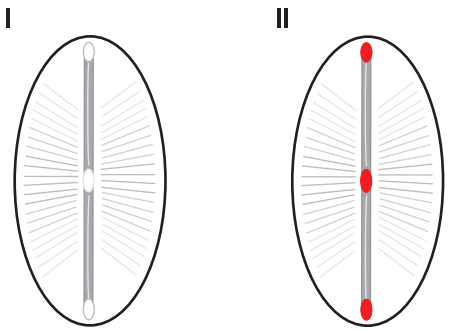
Navicula Bory 1822 pro parte

Characteristics – Cells **biraphid**, very small, elliptical with broadly rounded apices. Striae very difficult to discern under LM (Fig. 143: C-K) and also rather difficult to resolve with SEM. Raphe straight and simple (Fig. 143: C-K) carried in a sternum which, along with the striae mid-valve and near the valve margin, are usually the only structures which can be seen using LM. Slight swellings denoting the central and terminal nodules in the sternum at the central area and apices (II).

Plastid structure – Cells with one lobed plastid (Fig. 143: A-B), several lipid bodies scattered throughout the cell.

Identification of species – Species can be identified by cell size, cell shape, orientation and density of the striae as well as structure of the axial area.

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



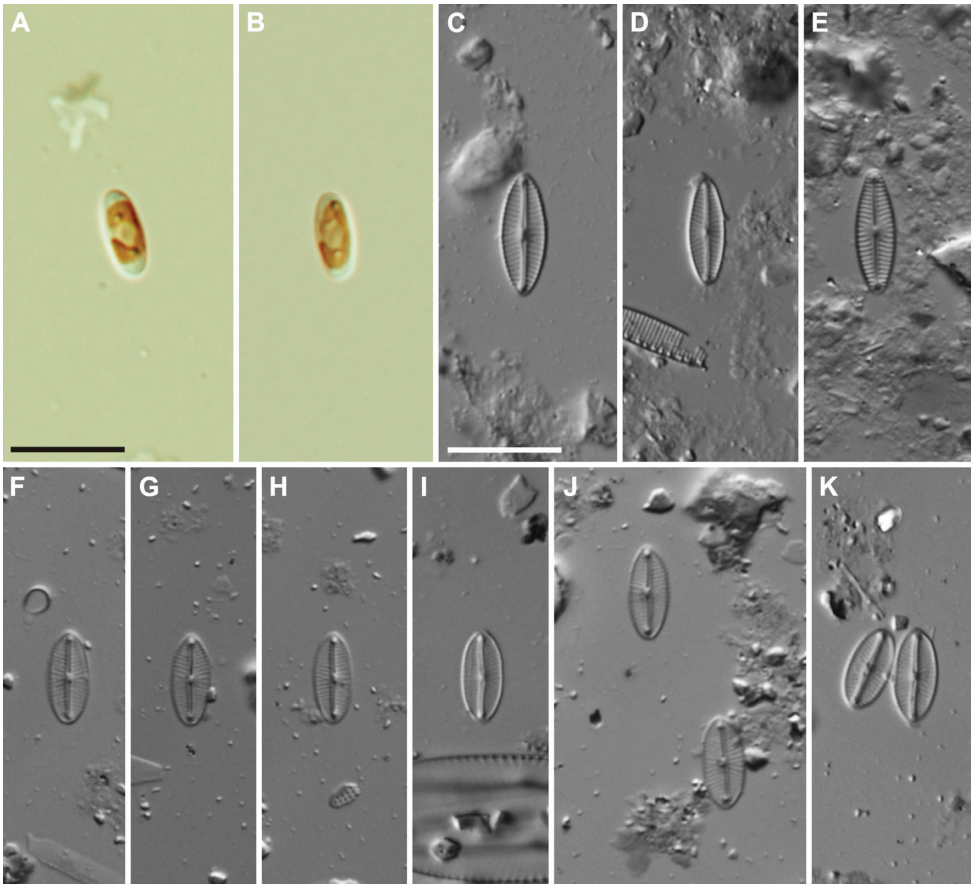


Fig. 143. *Mayamaea* spp. **A-B.** LM, living cells. **C-K.** LM, valve view of cleaned material.
Scale bar = 10 µm (A-K).

Navicula Bory 1822

Type species: *Navicula tripunctata* (O.F. Müller) Bory

Notes – Throughout this book many genera have *Navicula* listed as a synonym. For many years all diatoms cells exhibiting isobilateral symmetry and having a median raphe were placed into *Navicula* sensu lato. *Navicula* sensu stricto (in the strict sense) is now restricted to the former section lineolatae or those taxa having striae composed of linear areolae. Over the last 3 decades many taxa have been split off from *Navicula*; it is important to remember that this is an on-going process and that many more species currently in *Navicula* may in future be placed in other genera. In the interim, what may be termed as a 'catch all' genus has been established - *Naviculadicta* Lange-Bertalot 1994. This genus contains taxa without enough characteristics for description as a separate genus and which cannot be placed in *Navicula* sensu stricto. As more data (morphological or molecular) become available these taxa will be placed in new genera. We will not discuss or illustrate *Naviculadicta* in this volume as we do for the other genera as it not clearly a delimited entity.

Navicula Bory 1822

Type species: *Navicula tripunctata* (O.F. Müller) Bory

Characteristics – Cells **biraphid**, size, shape and apex structure variable. Striae discernable under LM (Fig. 145) and composed of a single row of linear areolae (**lineolae;** Fig. 146). In general striae are parallel mid-valve, become radiate and then often convergent towards the apices. Raphe carried in a sternum which in some taxa has a slight unilateral inflation (II) at the central nodule. The central area is variable in size and may not always be symmetrical (III).

Plastid structure – Cells with 2 plate-like chloroplasts, one along each side of the girdle (Fig. 144: B-E).

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 of the axial area and central area and the shape of the central and terminal raphe endings.

Ecology – Cells solitary, free living and motile. Found in the benthos of waters ranging from acidic to alkaline, oligotrophic to hypereutrophic and from low to high conductivities.