

**Fig. 85.** *Placoneis*. **A-F.** SEM. **A-B.** External view of valve. **C.** Internal view of valve. **D.** Detail of the internal central raphe endings. **E.** Internal view of valve, note the stigmata in the central area. **F.** Internal view of valve, detail of the striae composed of single rows of denticulate areolae.

Scale bars = 10  $\mu\text{m}$  (A-C), 1  $\mu\text{m}$  (D-F).

## ***Gomphonema*** Ehrenberg 1832

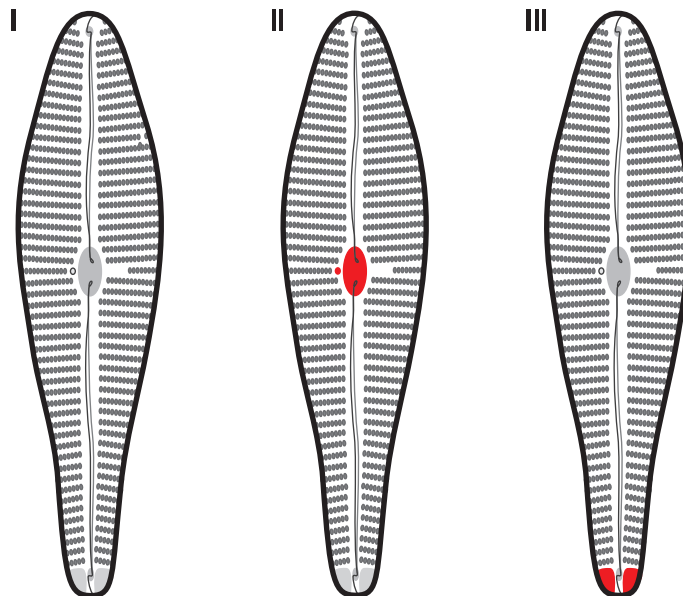
Type species: *Gomphonema acuminatum* Ehrenberg

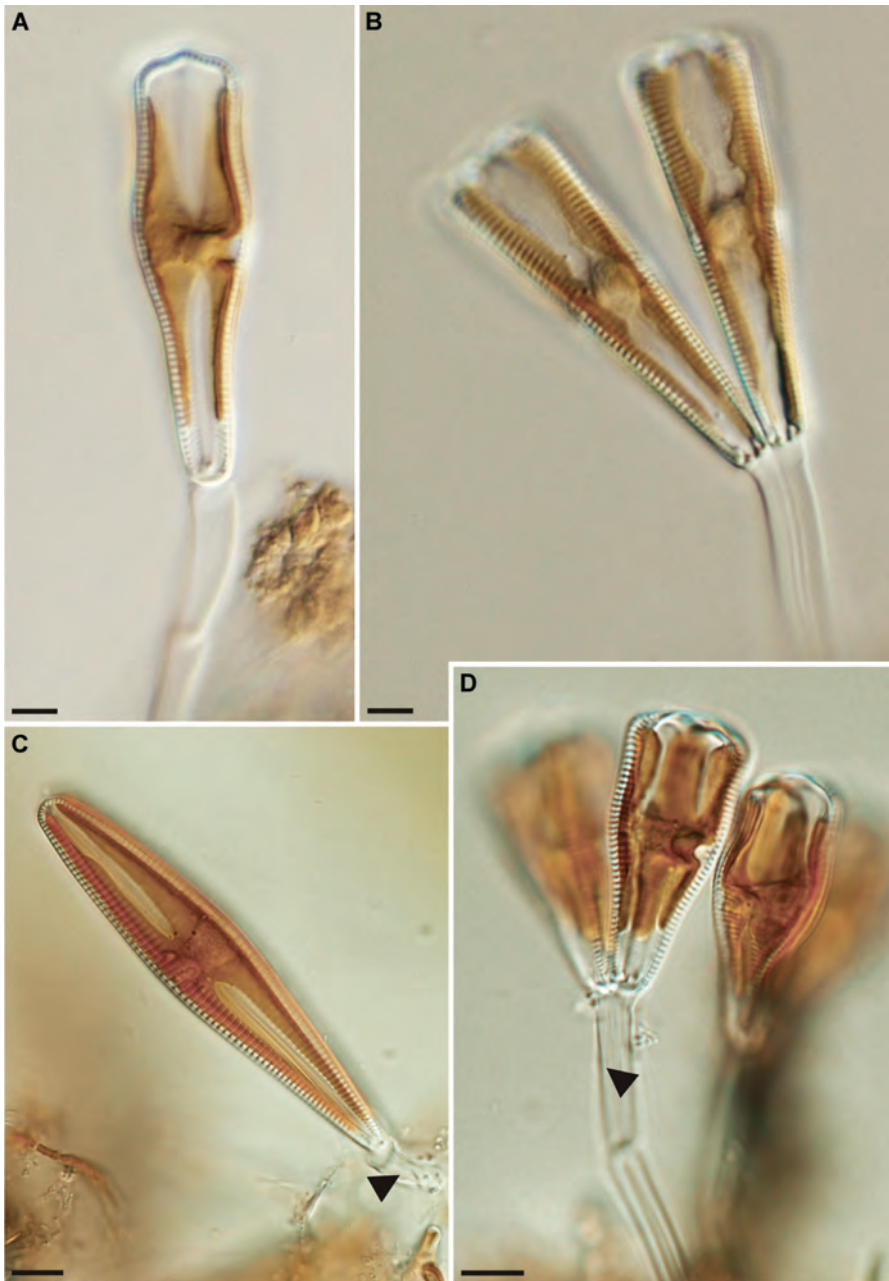
**Characteristics** – Cells **biraphid**, **heteropolar**, highly variable in cell size, valve shape and apex shape. Striae composed of single or double rows of areolae which may not be discernable under LM. Raphe straight and simple (Fig. 87: D-H). Central area (II) variable in size and usually with one stigma present. Apical pore field present at the foot pole (III; Fig. 91: C). Rarely large species from tropical Africa have an isolated apical spine (Fig. 91: A, B).

**Plastid structure** – Single H-shaped plastid extending under both valve faces with a central pyrenoid against the girdle (Fig. 86; Fig. 87: 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 of the central and axial area. The proximity of the stigma to the striae and the presence of an apical spine are also important characters.

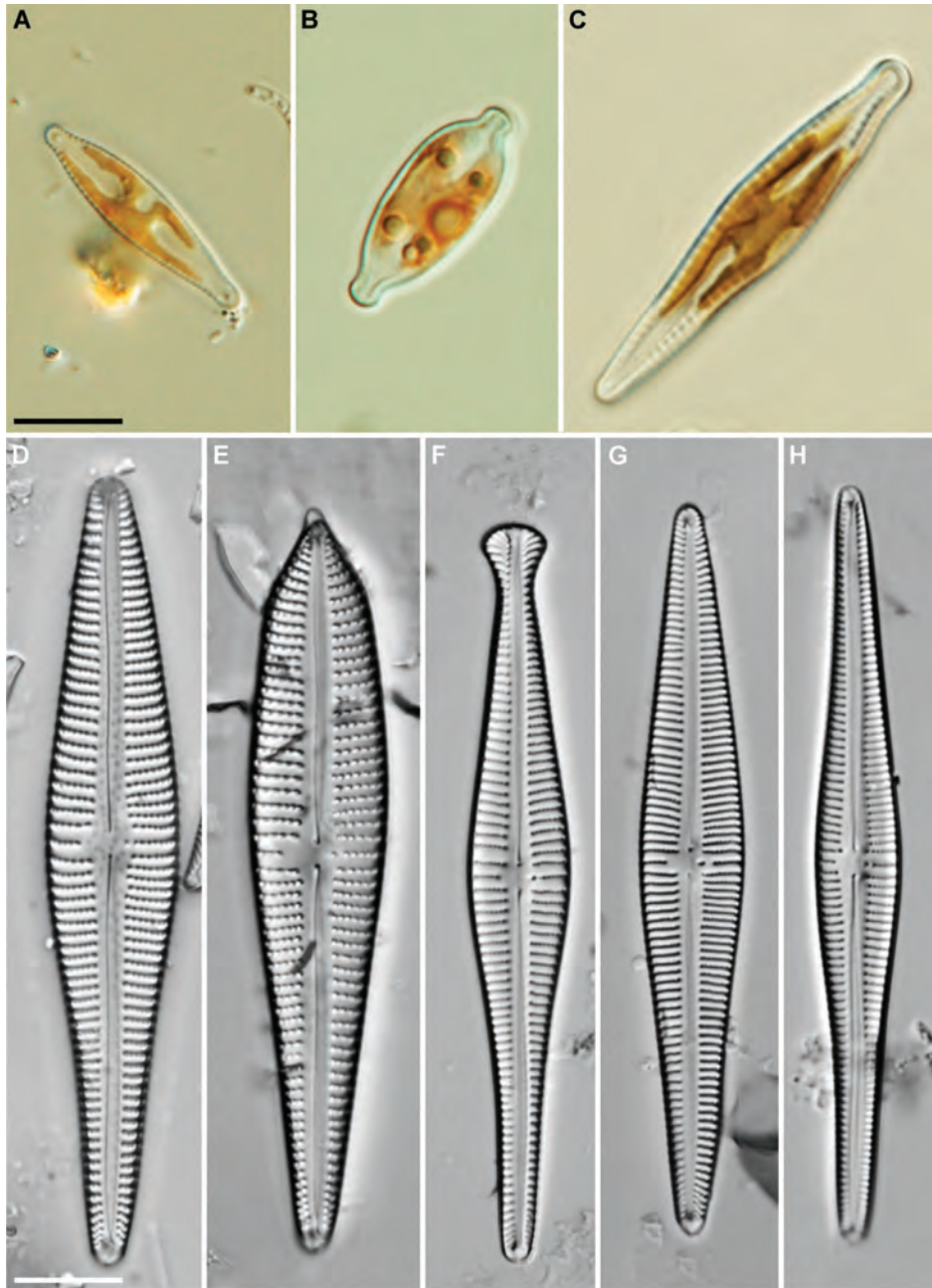
**Ecology** – Cells solitary or in pairs commonly attached by mucilage stalks (Fig. 86; Fig. 87: A-C) and forming colonies. Also solitary, free living and motile. Found in the benthos of oligotrophic to eutrophic waters in both low and moderate conductivities.





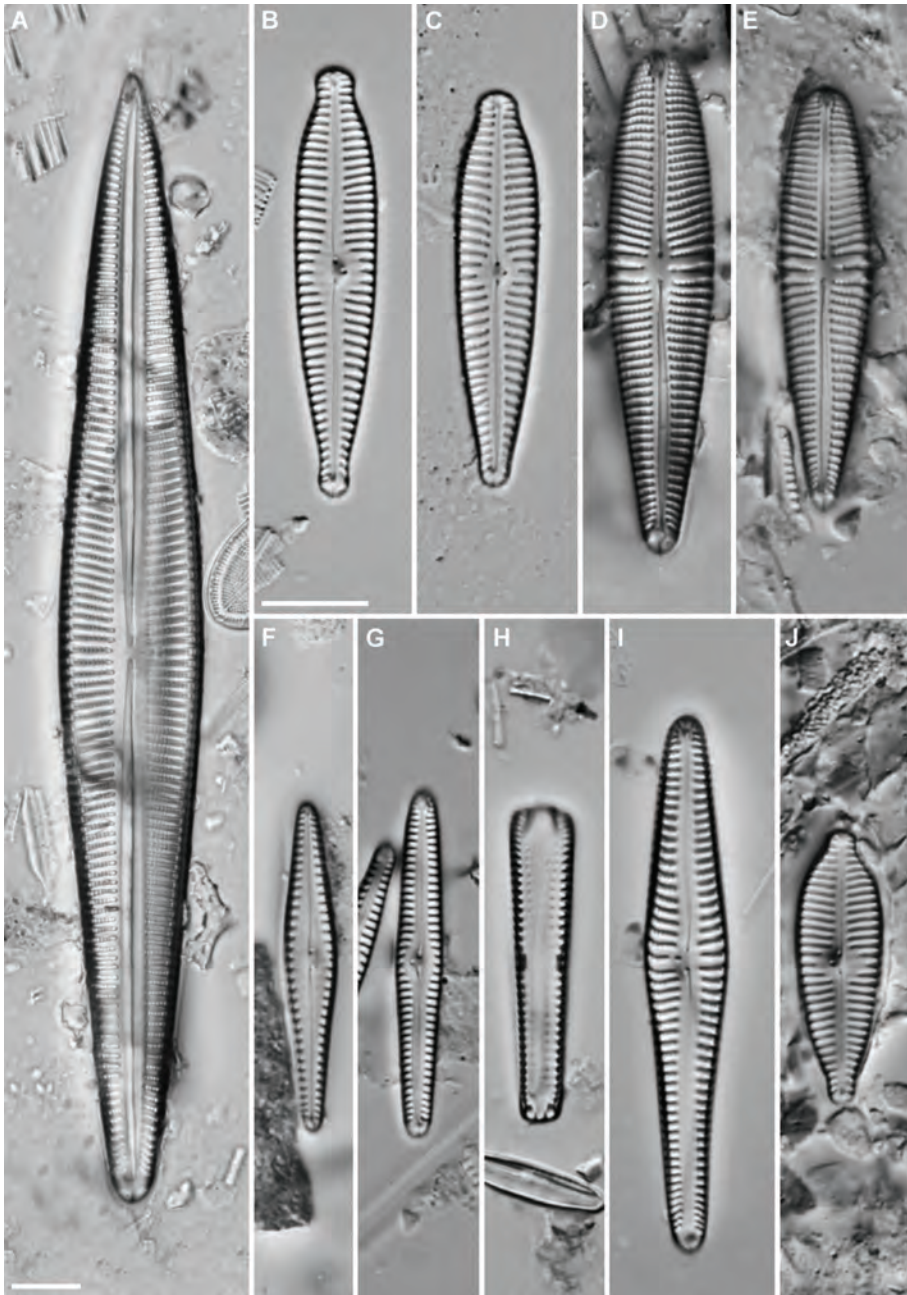
**Fig. 86.** *Gomphonema* spp. **A-D.** LM, living cells. **A.** *G. truncatum* Ehrenberg, valve view. **B.** *Gomphonema* sp., girdle views. **C.** *Gomphonema* sp., valve view, note mucilage stalk (arrow). **D.** *G. truncatum*, girdle views, note mucilage stalks (arrow).

Scale bars = 10  $\mu$ m (A-D).

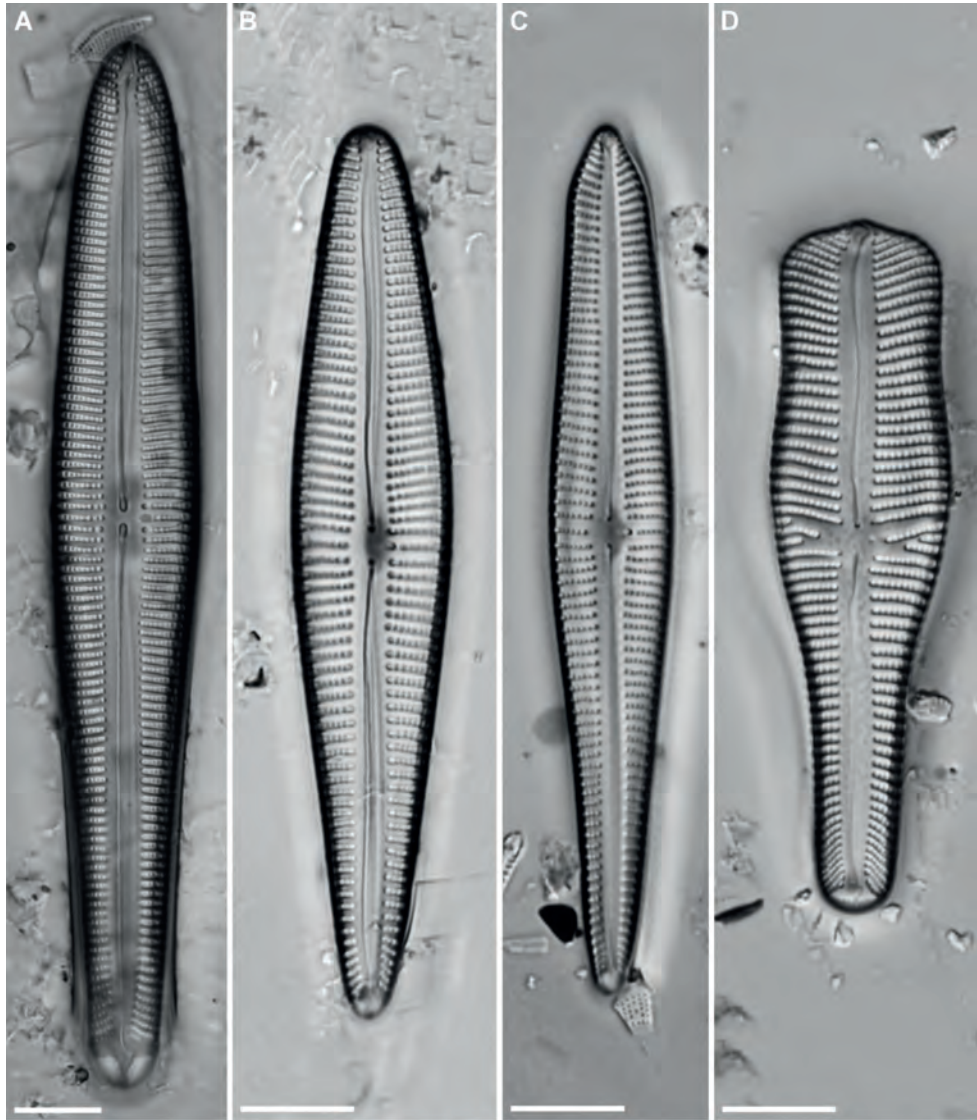


**Fig. 87.** *Gomphonema* spp. **A-H.** LM. **A C.** Living cells, valve views. **B.** *Gomphonema parvulum* Kützing. **D-H.** Cleaned valves. **D.** *Gomphonema affine* Kützing.

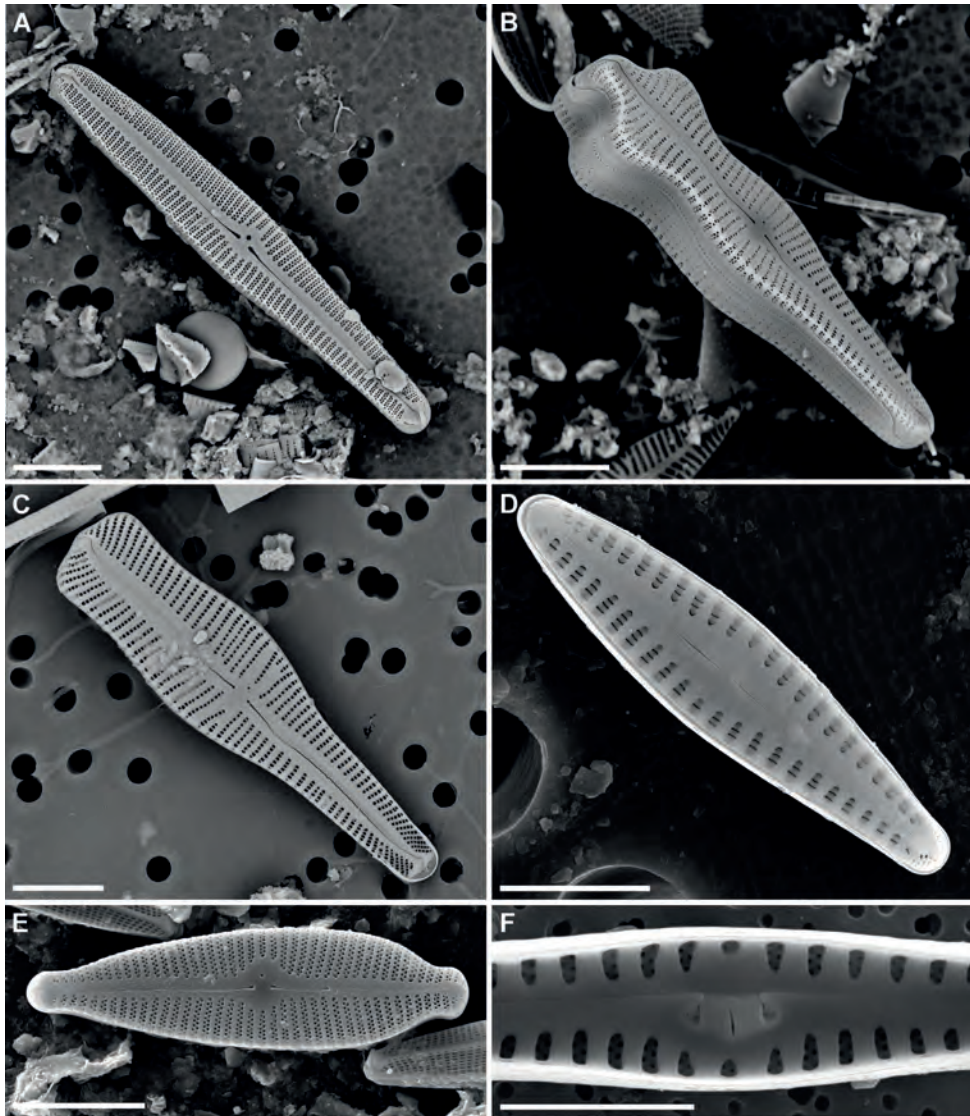
Scale bars = 10  $\mu$ m (A-H).



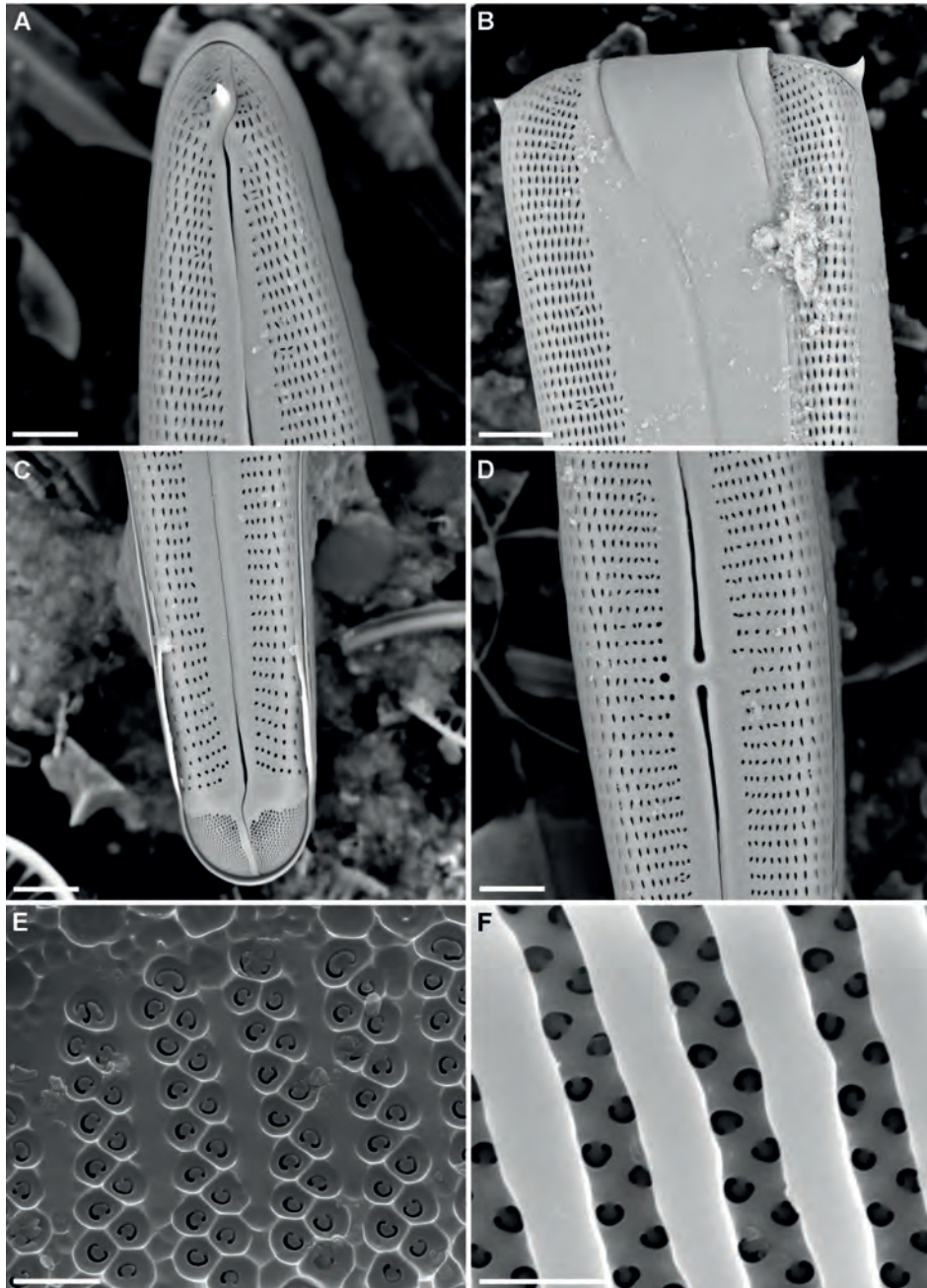
**Fig. 88.** *Gomphonema* spp. **A-J.** LM, cleaned valves. **A.** *G. kilhamii* Kociolek & Stoermer, valve view. **B-C.** *G. zairense* Compère, valve view. **D-E.** *G. aequatoriale* Hustedt, valve views. **F-G.** *Gomphonema* spp., valve view. **H.** *Gomphonema* sp., girdle view. **I-J.** *Gomphonema* spp., valve view. Scale bar = 10 µm (A-I).



**Fig. 89.** *Gomphonema* spp. **A-D.** LM, cleaned valves. **A, C.** *G. africanum* G.S. West, valve view. **B.** *Gomphonema* sp., valve view. **D.** *G. truncatum*, valve view. Scale bars = 10  $\mu\text{m}$  (A-D).



**Fig. 90.** *Gomphonema* spp. **A-F.** SEM. **A.** *Gomphonema* sp., external view of valve, note striae composed of double rows of areolae. **B.** *G. acuminatum*, external view of valve. **C.** *G. truncatum*, external view of valve, note striae composed of single rows of areolae. **D.** *G. brasiliense* subsp. *pacificum* Gerd Moser, Lange-Bertalot & Metzeltin, external view of valve. **E.** *G. zairense*, external view of valve. **F.** *Gomphonema* sp., internal view of valve. Scale bars = 10  $\mu\text{m}$  (A-C, E), 5  $\mu\text{m}$  (D, F).



**Fig. 91.** *Gomphonema* spp. **A-F.** SEM. **A, C-D.** *G. kilhamii*, external view of valve, note apical spine (**A**) and apical pore field (**C**). **B.** *G. kilhamii*, girdle view, note apical spines. **E.** *G. grande* Karthick, Kociolek, J.C. Taylor & Cocquyt, external view of valve, detail of striae. **F.** *G. grande*, internal view of valve, detail of striae. Scale bars = 4  $\mu\text{m}$  (A, C-D), 5  $\mu\text{m}$  (B), 1  $\mu\text{m}$  (E-F).



***Gomphosphenia*** Lange-Bertalot 1995

Type species: *Gomphosphenia lingulatiformis* (Lange-Bertalot & E. Reichardt) Lange-Bertalot

SYNONYM:

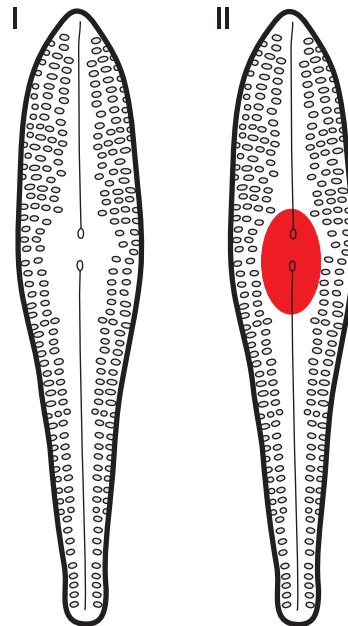
*Gomphonema* Ehrenberg 1832 pro parte

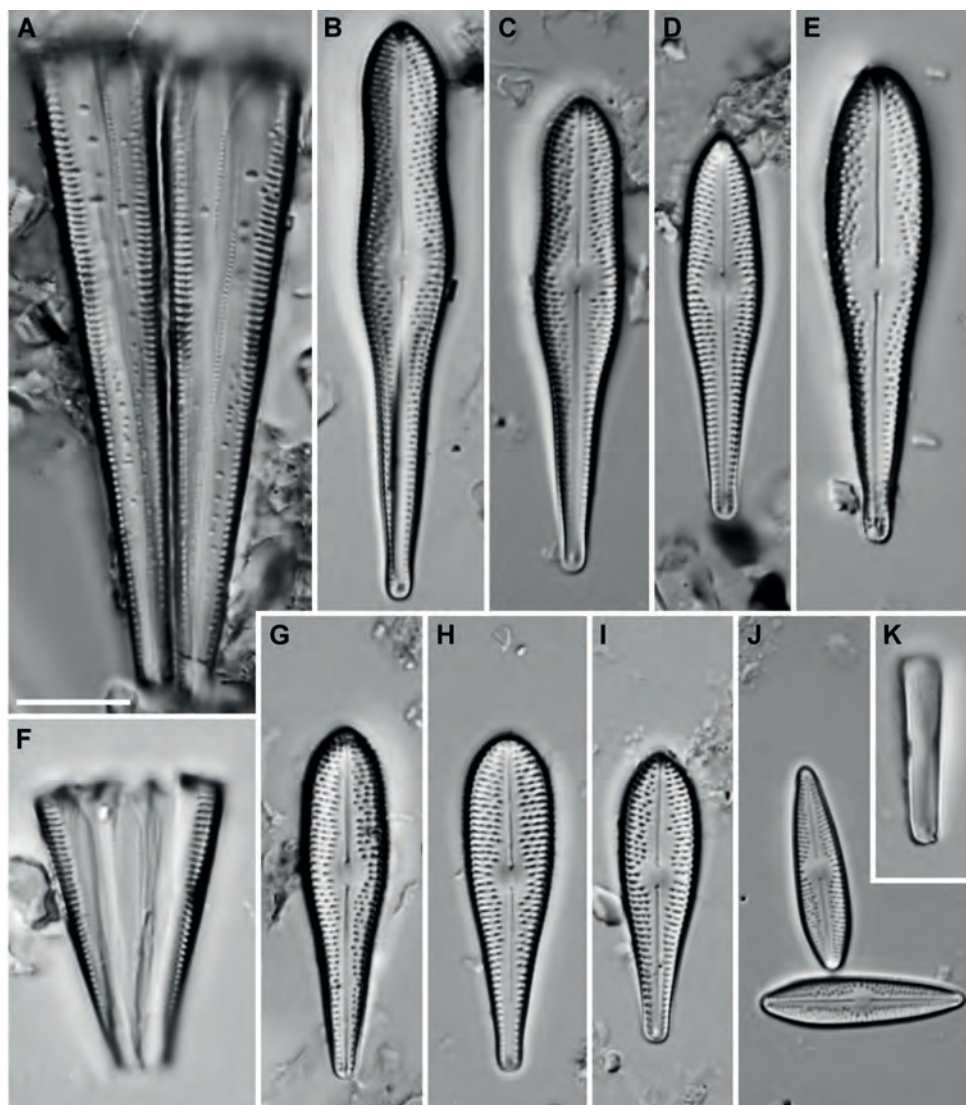
**Characteristics** – Cells **biraphid, heteropolar**, elliptical to linear elliptical with broadly rounded apices. Striae coarse composed of single rows of clearly discernable areolae. Raphe simple, straight, not extending onto the valve mantle. Central area (II) variable in size. Axial area broad to very broad (Fig. 92: B-E, G-J). Mantle with row of single large elongate areolae (Fig. 93: B). Stigma and apical pore field absent.

**Plastid structure** – Not observed in tropical African material.

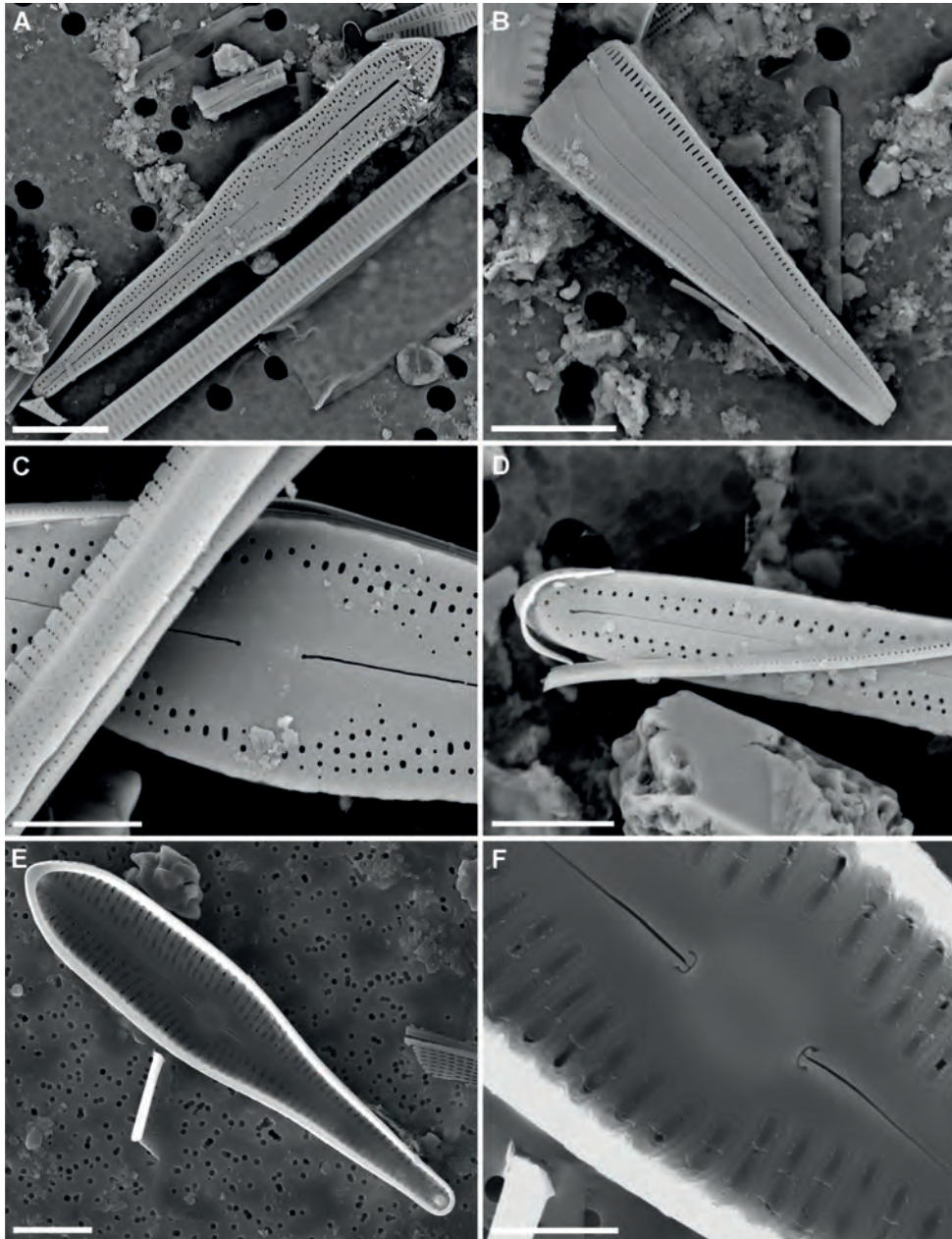
**Identification of species** – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae as well as structure of the central and axial area.

**Ecology** – Cells solitary or in pairs, free living and motile. Found in the benthos of oligotrophic to eutrophic waters in both low and moderate conductivities. Some taxa e.g. *G. pfannkucheae* (Cholnoky) Lange-Bertalot are found in oligotrophic, acidic tropical African waters.





**Fig. 92.** *Gomphosphenia* spp. **A-K.** LM. **A.** *Gomphosphenia* sp., girdle views. **B-E, G-J.** *Gomphosphenia* spp., valve views, note variable size of central area and broad to very broad axial area. **F, K.** *Gomphosphenia* sp., girdle views. Scale bar = 10  $\mu$ m (A-K).



**Fig. 93.** *Gomphosphenia* spp. **A-F.** SEM. **A.** External view of valve. **B.** Girdle view. **C.** External view of valve, detail of central area. **D.** External view of valve, detail of apex. **E.** Internal view of valve. **F.** Internal view of valve, detail of central raphe endings.

Scale bars = 10  $\mu\text{m}$  (A-B), 5  $\mu\text{m}$  (C-E), 2  $\mu\text{m}$  (F).

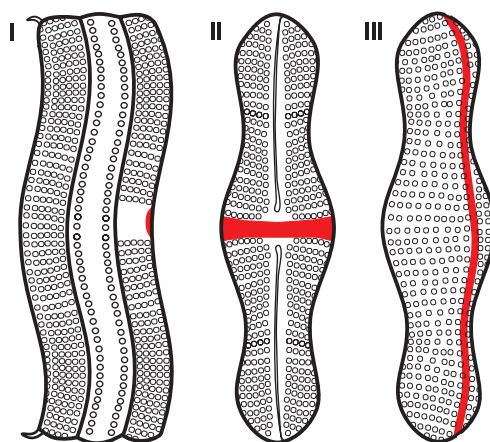
***Achnanthes* Bory 1822**Type species: *Achnanthes adnata* Bory

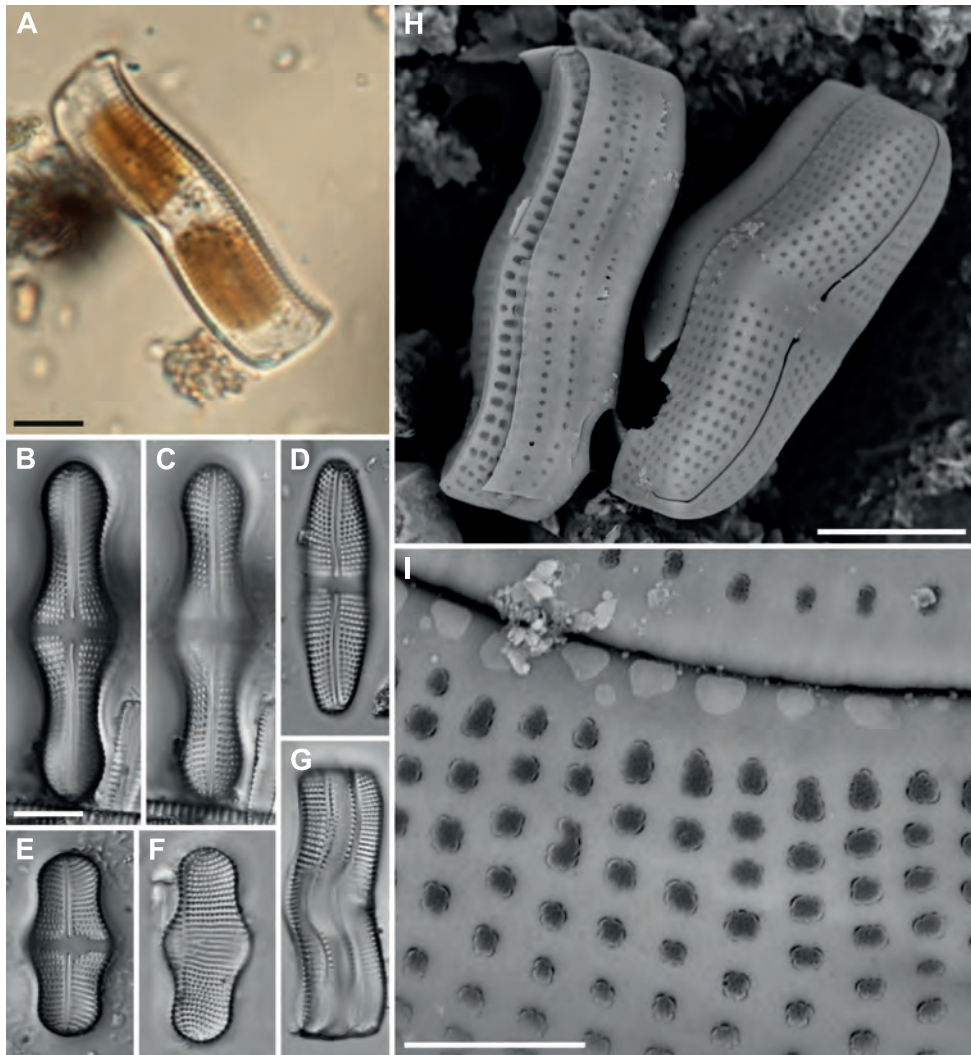
**Characteristics** – A relatively large and robust **monoraphid** taxon often seen in girdle view with the cell bent or flexed. One valve carries a raphe while the other does not (**heterovalvar**). When seen in valve view the valve margin is often more or less undulating and the apices are swollen (as in *A. inflata* (Kützing) Grunow – Fig. 94: B-C, E-F). Cells in valve view are difficult to focus due to the flexed shape of the cell (see Figs 94; B-C both represent the same valve). There is a pronounced and clear gap between the striae at the central area of the raphe bearing valve (RV), with a **fascia** or thickening visible on the inside of the cell wall (I, II). This **fascia** is absent on the **rapheless valve** (RLV). A narrow **sternum** is present near one of the margins of the RLV (III). The areolae are clearly visible and appear under LM as large distinctly separate dots, under SEM the areolae can be seen to have a rather complex structure (**cribra** with **volae**) (Fig. 94: I).

**Plastid structure** – There may be many granular plastids or two large plastids on either side of the transapical plane (Fig. 94: A). In valve view these are H-shaped and connected by a bridge bearing a pyrenoid.

**Identification of species** – Species and varieties in this genus are distinguished based on cell size and shape as well as the shape of the apices.

**Ecology** – Cells solitary or in pairs, usually attached by an apical mucilage stalk but also motile. Commonly found in waters of medium to high conductivity.





**Fig. 94.** *Achnanthes* spp. **A-G.** LM. **A.** Living cell, girdle view. **B-C.** Valve view of the RV of *Achnanthes inflata* (Kützing) Grunow, different foci of the same cell. **D.** Valve view of RV of *A. coarctata* (Brébisson ex W. Smith) Grunow. **E.** RV of *A. inflata*, small specimen. **F.** RLV of *A. inflata*, small specimen. **G.** Girdle view of *A. inflata*. **H-I.** SEM. **H.** Broken valve of *A. inflata*, oblique view. **I.** Detail of valve margin of *A. inflata* showing the structure of the areolae occlusions. Scale bars = 10  $\mu$ m (A-H), 3  $\mu$ m (I).

## ***Lemnicola*** Round & Basson 1997

Type species: *Lemnicola hungarica* (Grunow) Round & Basson

SYNONYM:

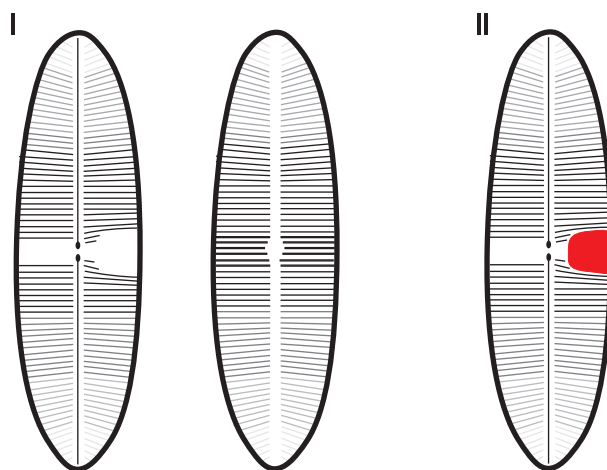
*Achnanthes* Bory 1822 pro parte

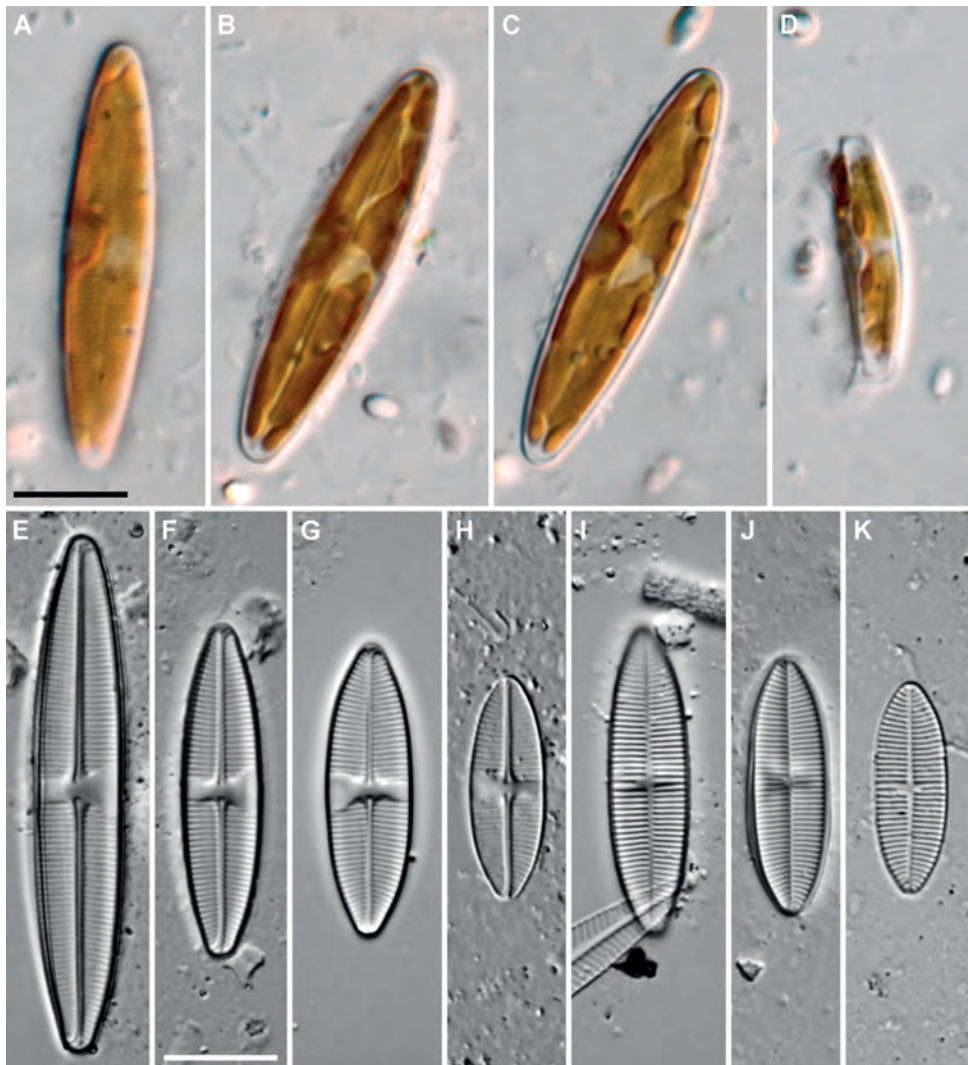
**Characteristics** – Cells **heterovalvar**, **monoraphid**, linear to elliptical with broadly rounded or cuneate apices. Curved in girdle view (one valve slightly convex the other slightly concave). Striae robust and clearly discernable under LM (Fig. 95: E-K), composed of 2 rows of very small round areolae, visible only under SEM (Fig. 96). Raphe straight and simple (Fig. 95: E-K) with expanded central endings, terminal endings curved to opposite sides. Rapheless valve (RLV) has a narrow axial area and may have a unilateral gap in the central striation. The raphe valve (RV) has a thickened asymmetric **stauros** (II; Fig. 96: A-B).

**Plastid structure** – Single plate-like plastid lying under the araphid valve extending under one or both girdles (Fig. 95: A-D).

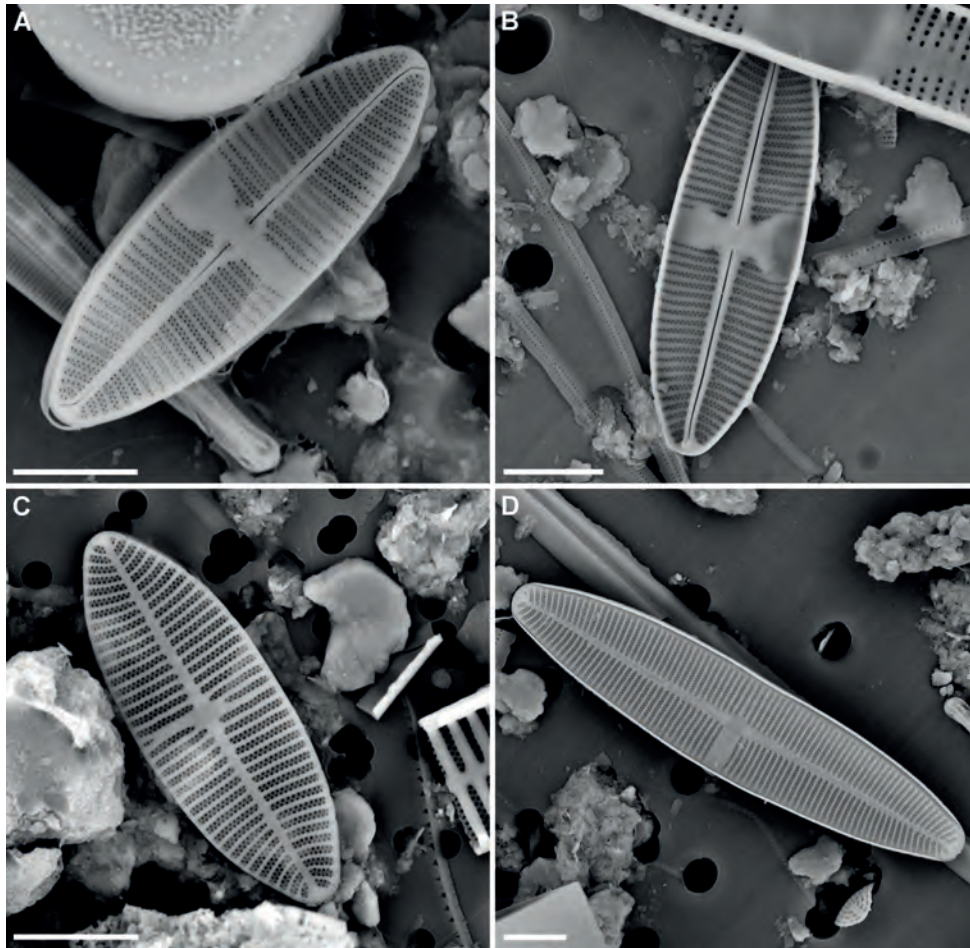
**Identification of species** – Up till now only one species is included in this genus: *Lemnicola hungarica*.

**Ecology** – Cells solitary, usually attached (**adnate**) on benthic substrates in particular aquatic plants. Found in neutral to alkaline waters.





**Fig. 95.** *Lemnicola hungarica*. **A-K.** LM. **A-D.** Living cells. **E-K.** Cleaned valves.  
**E-H.** Raphe valves, note asymmetric stauros. **I-K.** Rapheless valves, note narrow axial area.  
 Scale bars = 10 μm (A-K).



**Fig. 96.** *Lemnicola hungarica*. **A-D.** SEM. **A.** External view of raphe valve. **B.** Internal view of raphe valve. **C-D.** External view of rapheless valves. Scale bars = 5  $\mu$ m (A-D).



***Psammothidium*** Bukhtiyarova & Round 1996

Type species: *Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round

SYNONYM:

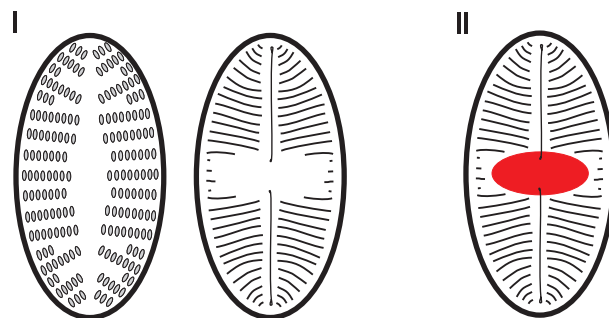
*Achnanthes* Bory 1822 pro parte

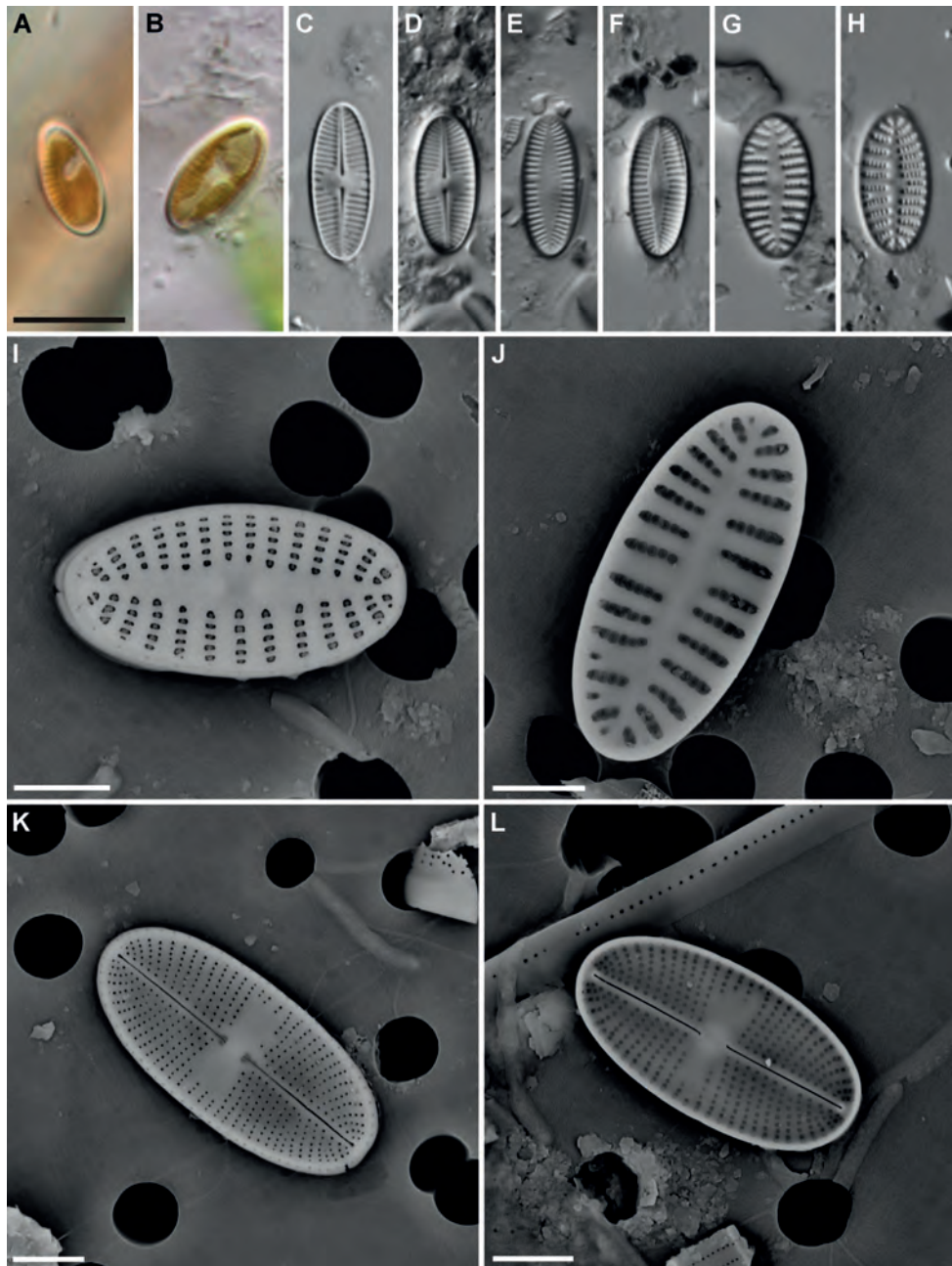
**Characteristics** – Cells **heterovalvar**, **monoraphid**, elliptical with broadly rounded apices. Slightly curved in girdle view (one valve slightly convex the other slightly concave). Striae robust and clearly discernable under LM (Fig. 97: C-H), composed of 1 row of small round areolae on the raphe valve (RV) and slightly larger areolae on the raphe-less valve (RLV), visible only under SEM (Fig. 97: I-L). Raphe straight and simple (Fig. 97: C-D) with expanded central endings. RLV often has a broad axial area. The RV often has a large central area which may stretch to the valve margins (II; Fig. 97: C-D, K-L).

**Plastid structure** – Single plate-like plastid lying under the rapheless valve extending under the girdle (Fig. 97: A-B).

**Identification of species** – Species can be identified by cell size, cell shape, shape of the apices, structure and density of the striae, the structure of the central and axial areas as well as the shape and curvature of the central raphe endings.

**Ecology** – Cells solitary, attached (**adnate**) by the raphe valve face to the substrata. Found in the benthos of mesotrophic to hypereutrophic waters with moderate to high conductivities.





**Fig. 97.** *Psammothidium* spp. **A-H.** LM. **A-B.** Living cells. **C-H.** Cleaned valves. **C-D.** Raphe valves. **E-H.** Rapheless valves. **I-L.** SEM. **I.** External view of rapheless valve. **J.** Internal view of rapheless valve. **K.** External view of raphe valve. **L.** Internal view of raphe valve. Scale bars = 10  $\mu$ m (A-H), 2  $\mu$ m (I-L).

***Anorthoneis*** Grunow 1868

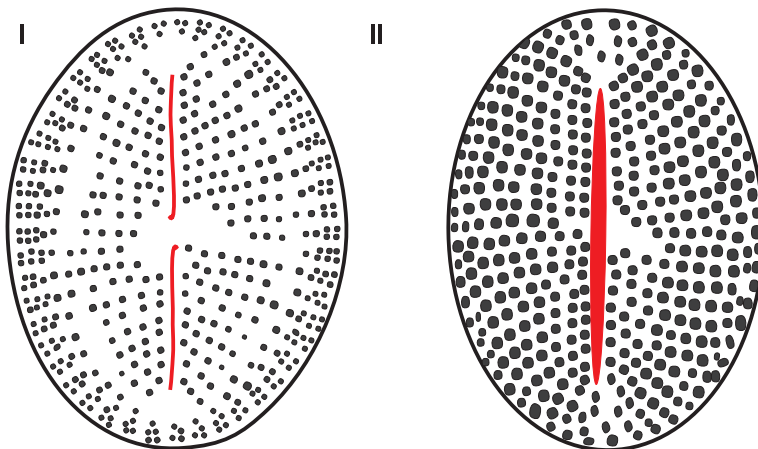
Type species: *Anorthoneis excentrica* (Donkin) Grunow

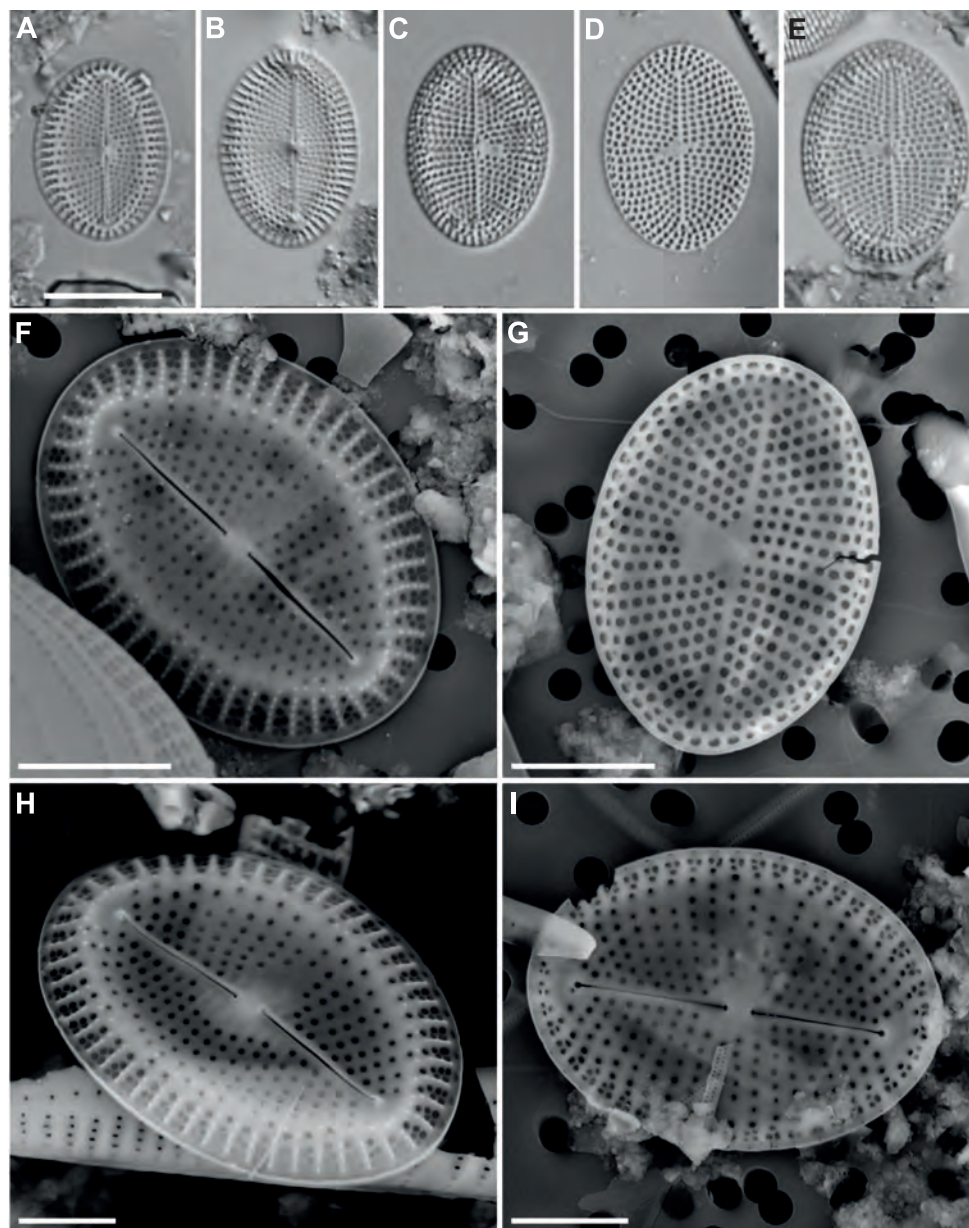
**Characteristics** – Cells **monoraphid**, elliptical to almost circular in shape. Cells **heterovalvar**, the raphe (I) and the **axial area** (II) are both located slightly off-center (eccentric). The central and terminal raphe endings are straight. Areolae clearly visible under LM. The valves are very shallow and the mantle is absent.

**Plastid structure** – Single flat C-shaped plastid (comparable to that of *Cocconeis* Ehrenberg).

**Identification of species** – Up till now only one species occurs commonly in the freshwaters of the tropics: *Anorthoneis dulcis* M.K. Hein.

**Ecology** – Cells solitary, free living but usually attached. *Anorthoneis dulcis* is found in benthic habitats in tropical African alkaline oligotrophic waters. Other members of this genus are considered to be restricted to marine habitats.





**Fig. 98.** *Anorthoneis dulcis*. **A-E.** LM, cleaned material. **A-C, E.** Valve view of RV. **D.** Valve view of RLV. **F-I.** SEM. **F, H.** External view of RV. **I.** Internal view of RV. **G.** Internal view of RLV, note unilateral expansion of the central area. Scale bars = 10 μm (A-E), 5 μm (F-G), 3 μm (H), 4 μm (I).

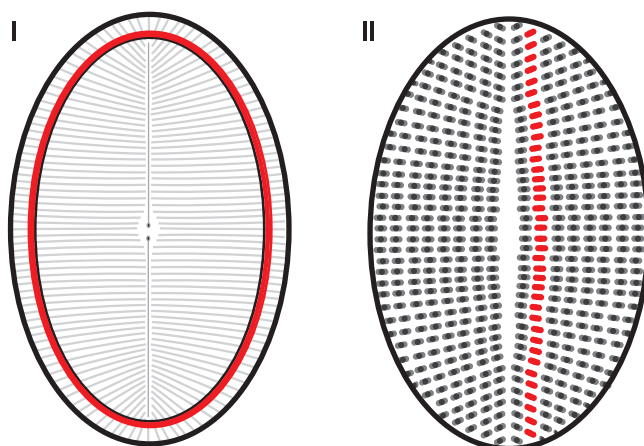
***Cocconeis*** Ehrenberg 1836Type species: *Cocconeis scutellum* Ehrenberg

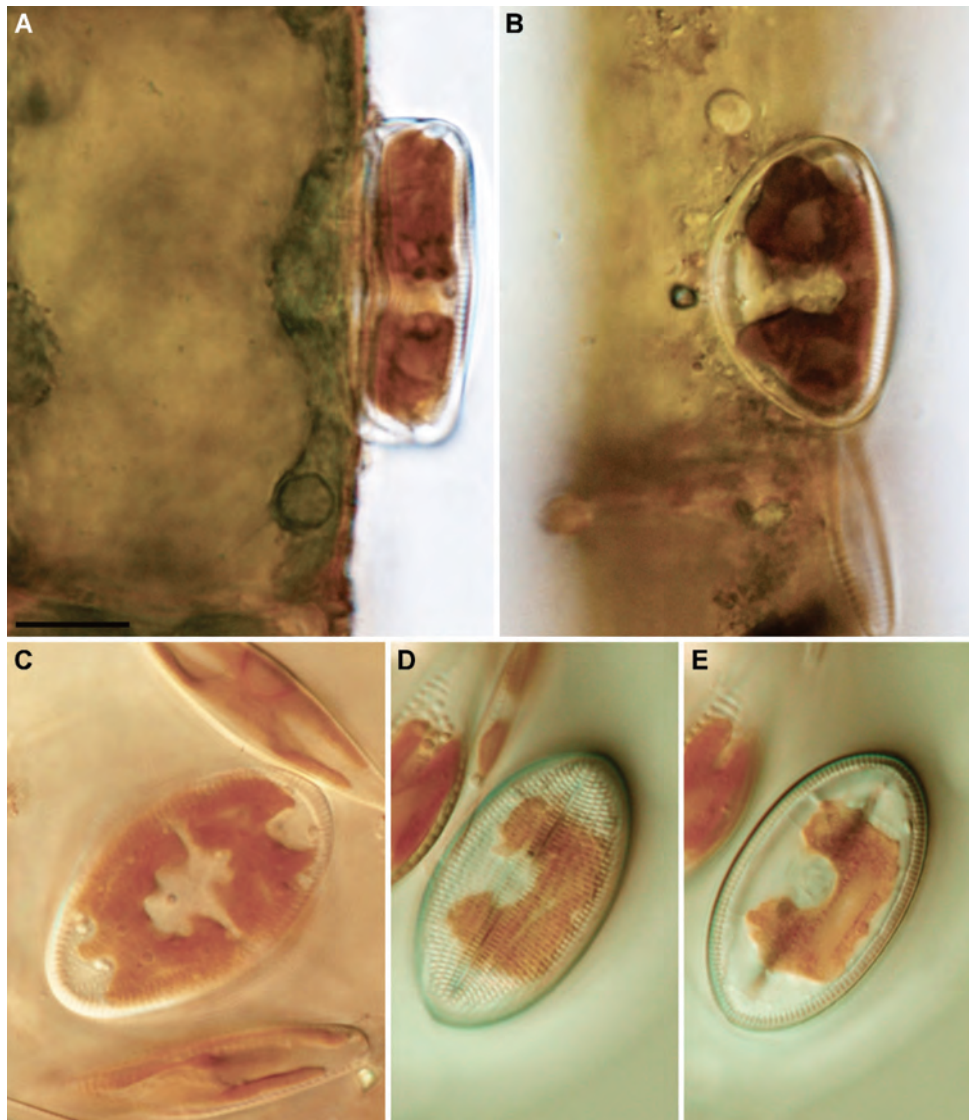
**Characteristics** – Cells **monoraphid**, ranging in size. Shape elliptical to almost round. Strongly **heterovalvar** with the raphid valve (I) having fine striae composed of small areolae, while the rapheless valve (II) has striae composed of large easily discernable areolae which often form undulating longitudinal lines (II, Fig. 100: C, G). Raphid valve usually has a **hyaline ring** (I, Fig. 100: B, D, H, I) running close to the valve margin. Valve may be strongly curved on the transapical axis (e.g. *Cocconeis pediculus* Ehrenberg; Fig. 101: A, D).

**Plastid structure** – A single C-shaped plastid is present (Fig. 99: A-E).

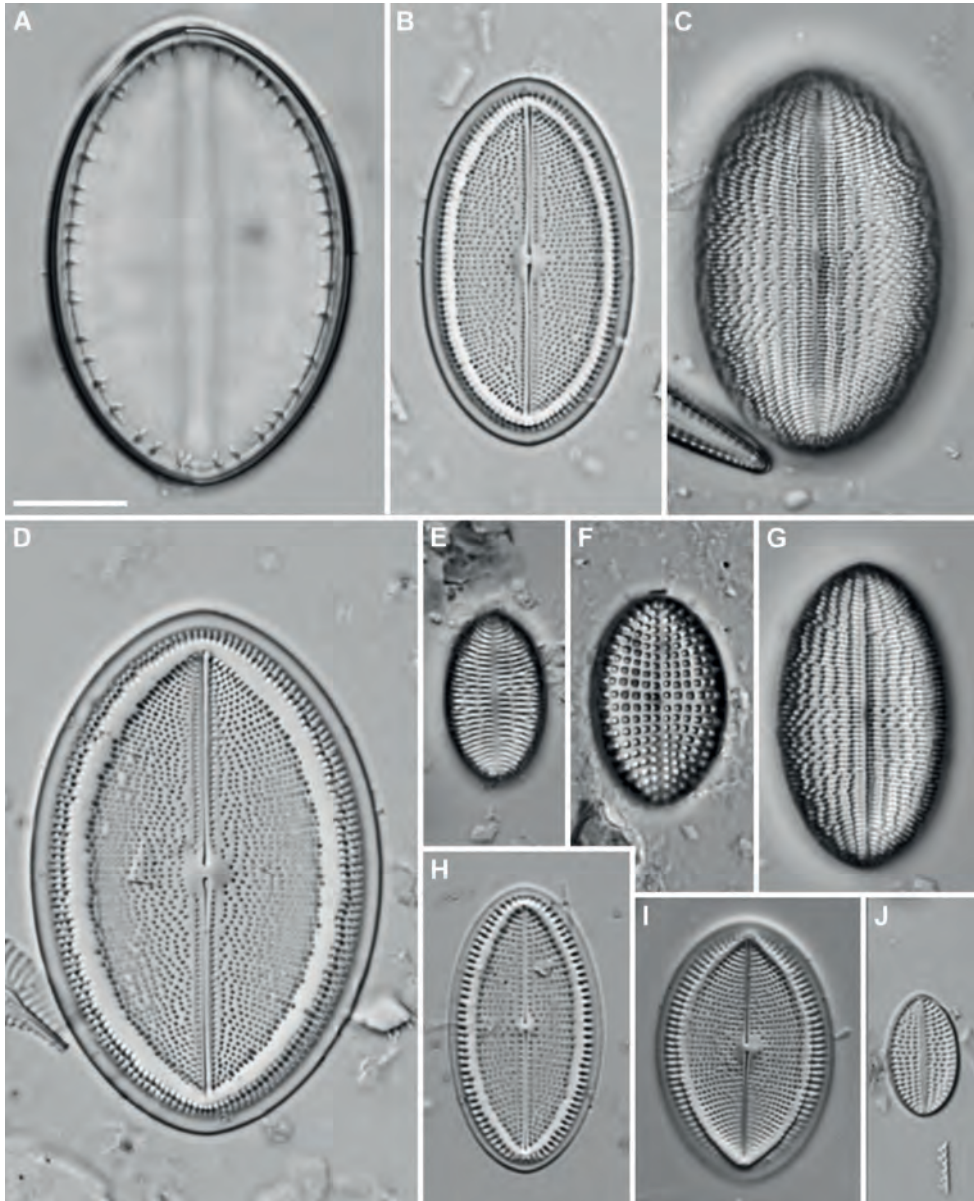
**Identification of species** – Species in this genus are distinguished based on cell size and shape as well as the areolae size and number and distribution on the rapheless valve as well as the width of the axial area. The raphid valve is very similar between species. The structure and presence/absence of the hyaline ring as well as the curvature of the cell in girdle view can be of importance in distinguishing species.

**Ecology** – Cells solitary and attached. Found in both fresh and brackish waters across a range of pH and trophic levels. Cells adapted to attach to a variety of substrata, may occur *en-masse* completely covering the surface of filaments of green algae (Fig. 99: A-B; Fig. 101: A).

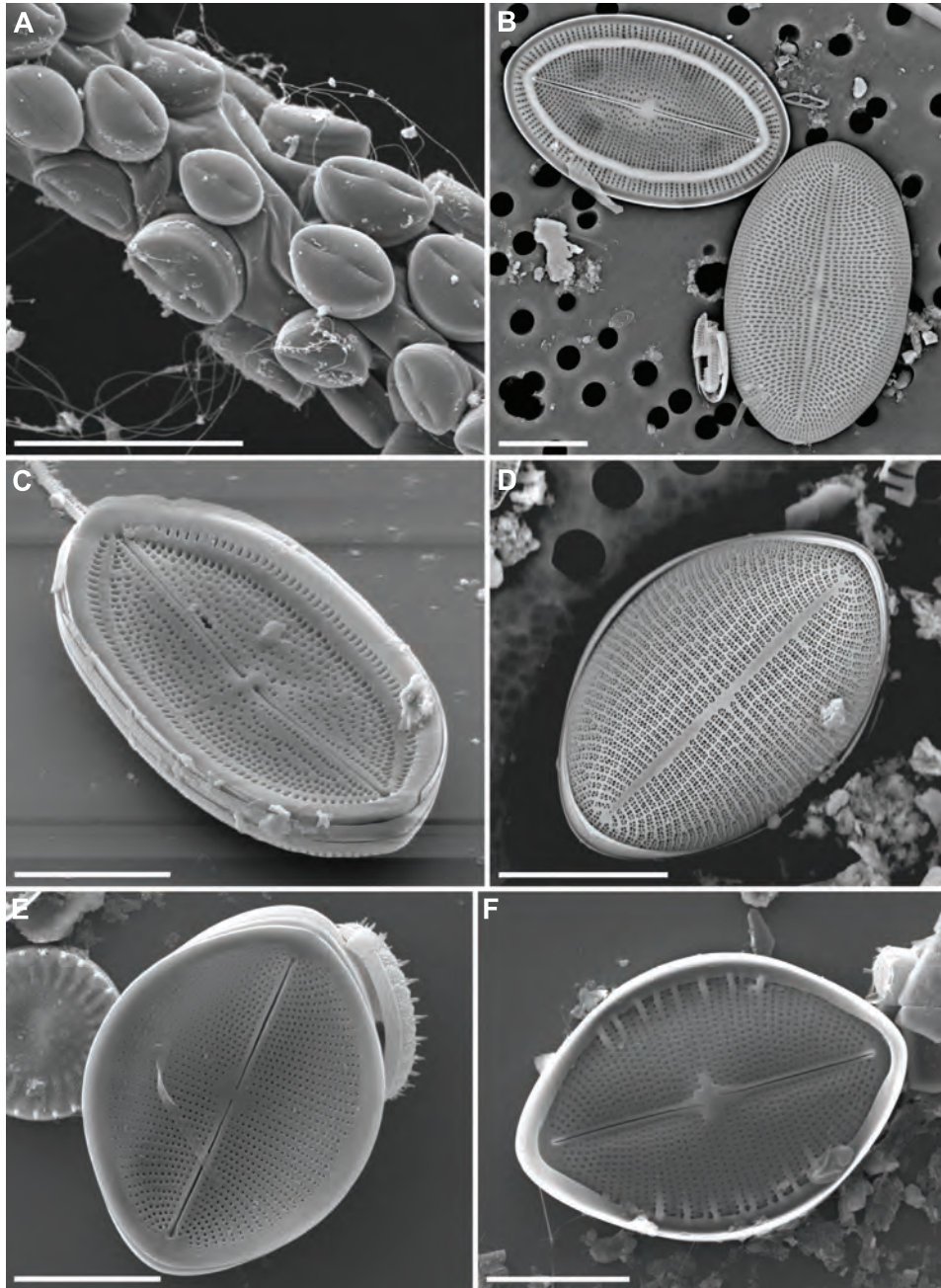




**Fig. 99.** *Cocconeis* spp. **A-E.** LM. **A-B.** Living cells, girdle view, cells appressed to the surface of filamentous algae. **C.** Living cell showing lobed chloroplast and lipid droplets. **D-E.** Living cells valve view, different foci of the same cell.  
Scale bar = 10 µm.

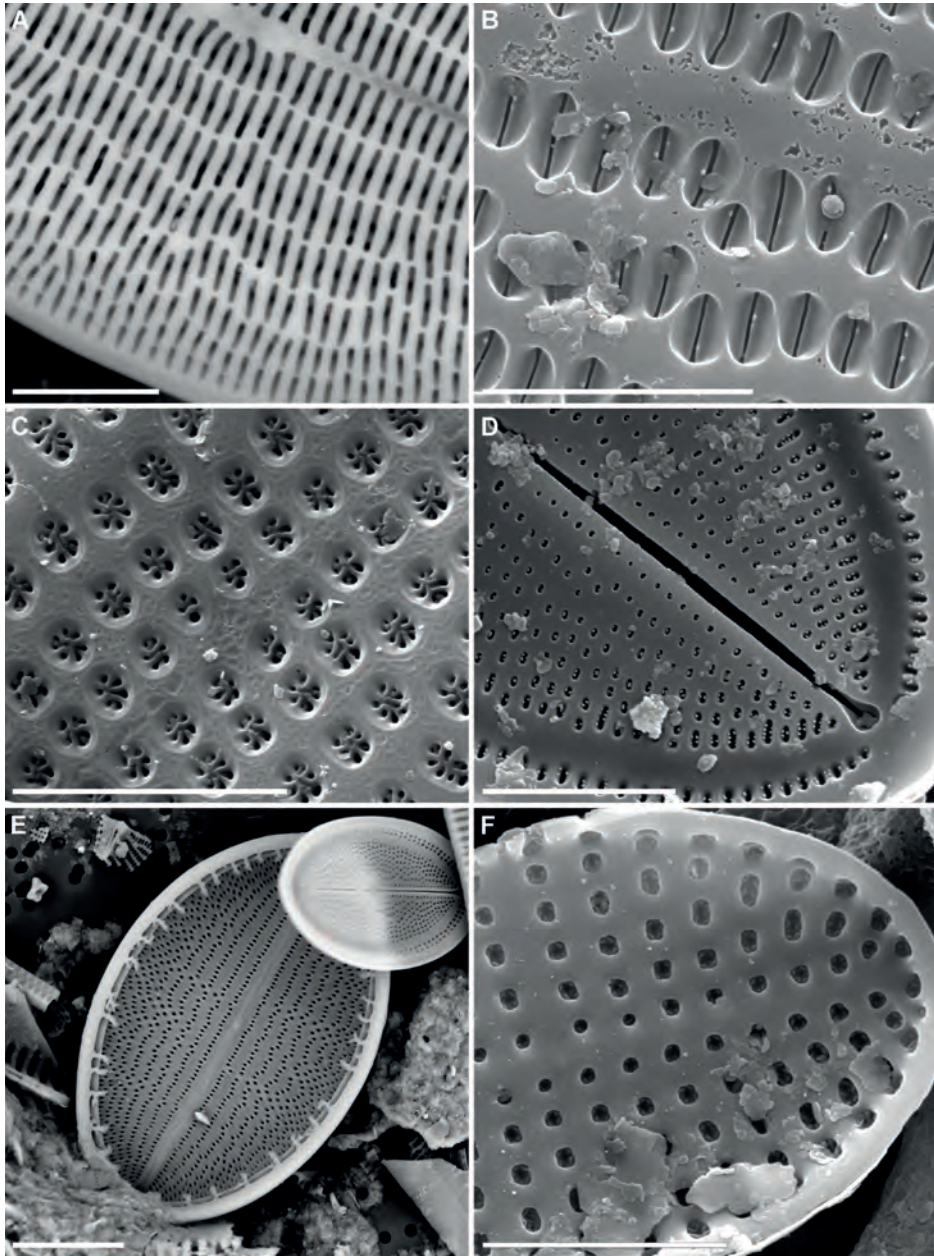


**Fig. 100.** *Cocconeis* spp. **A-J.** LM. **A.** Copula of *Cocconeis* sp. **B, D, H, I.** RV views of *Cocconeis* spp. **C, E, F, G, J.** RLV views of *Cocconeis* spp. **F.** *C. schroederi* Faged. Scale bar = 10  $\mu$ m.



**Fig. 101.** *Cocconeis* spp. **A-F.** SEM. **A.** Cells of *Cocconeis pediculus* on the surface of a filament of green algae. **B.** *Cocconeis placentula* Ehrenberg RV (left) and RLV (right). **C.** Oblique view of RV of *Cocconeis* sp. **D-F.** External view of *Cocconeis pediculus*, RLV (**D**), RV (**E**), internal view of valve (**F**). Scale bars = 5  $\mu$ m (A), 10  $\mu$ m (B-F).





**Fig. 102.** *Cocconeis* spp. **A-F.** SEM. **A.** Areolae on RLV of *Cocconeis pediculus*. **B.** Areolae on RLV of a *Cocconeis* sp. **C.** Areolae on RLV of *C. schroederi*. **D.** Areolae on RV of a *Cocconeis* sp. **E.** Internal view of RV of *Cocconeis* sp., note copula with silica outgrowths. **F.** Internal view of valve showing areolae on RV of *C. schroederi*.

Scale bars = 3  $\mu\text{m}$  (A-B), 4  $\mu\text{m}$  (C), 5  $\mu\text{m}$  (D, F), 10  $\mu\text{m}$  (E).

## ***Achnanthes*** Kützing 1844

Type species: *Achnanthes microcephalum* Kützing

SYNONYM:

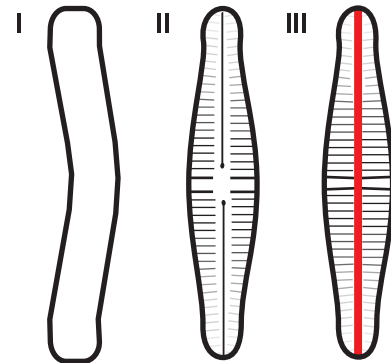
*Achnanthes* Bory 1822 pro parte

**Characteristics** – Cells of *Achnanthes* are **monoraphid**, mostly delicate and the valve structure can be difficult to observe in LM. The cells are bent in girdle view (I) and **heterovalvar** with only one valve bearing a raphe (II) and the second bearing no raphe slit and only an **axial area** (III). Striae are rather difficult to resolve in LM and usually no areolae can be observed. As cells are bent, it is difficult to focus on both the central and apical striae at the same time; this may be a useful tool to distinguish *Achnanthes* from other similar sized taxa such as *Eolimna* Lange-Bertalot & W. Schiller which have a flat valve face, as well as a more elliptical shape.

**Plastid structure** – There is one large plastid lying against the girdle which may extend beneath one (Fig. 103: A) or both valves (Fig. 103: D). Often 2 lipid droplets may be observed at each end of the cell (Fig. 103: A, E).

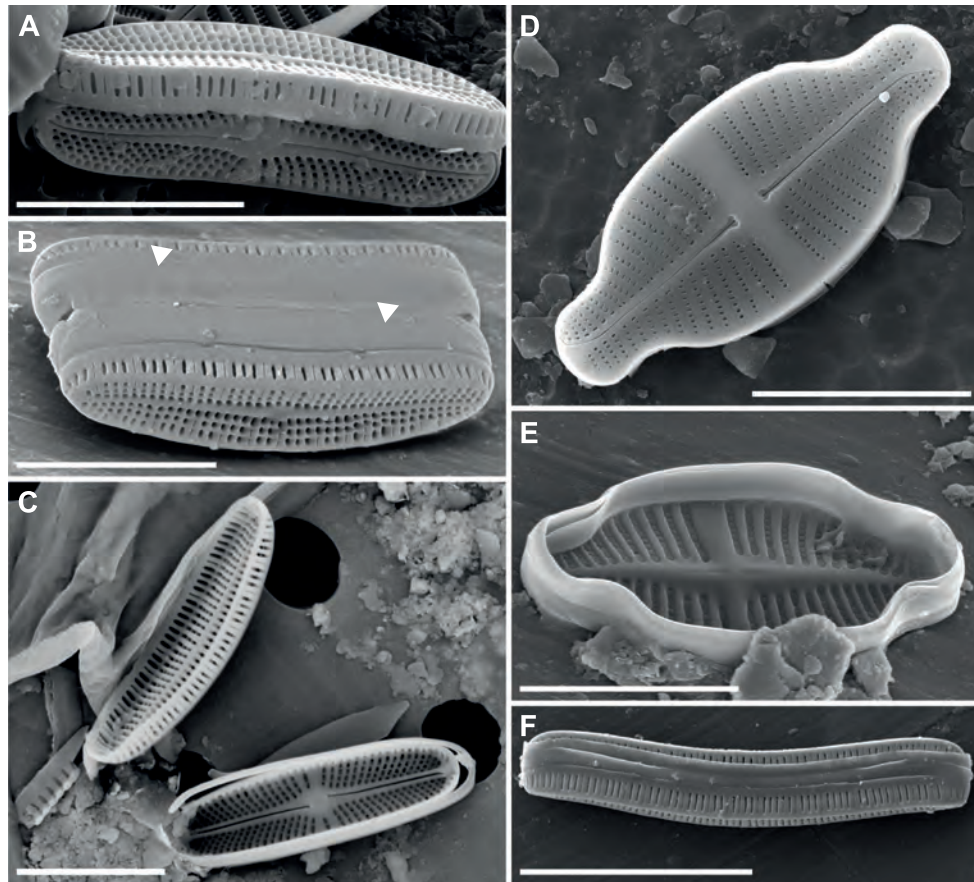
**Identification of species** – Species and varieties in this genus are distinguished based on cell size and shape as well as the shape of the apices. The orientation and or presence/absence of striae in the central area as well as the shape of the central area are very important.

**Ecology** – Cells solitary or in pairs, usually attached by an apical mucilage stalk (Fig. 103: A-B) but also motile. Found in waters of varying trophic state but most taxa in this genus are thought to occur in well oxygenated waters. It may occur *en-masse* completely covering the surface of, for example, filamentous green algae.





**Fig. 103.** *Achnanthes* spp. **A-I.** LM. **A-B.** Living cells with mucilage stalks (arrows). Living cell, girdle view. **C-D.** Living cells of *Achnanthes exiguum* (Grunow) Czarnecki. **E.** Living cell, valve view, note lipid droplets (arrow). **F-I.** Cleaned material of *Achnanthes* spp. **F-G.** *Achnanthes taiaense* (J.R. Carter & Deny) J.C.Taylor, E. Morales & Ector. Scale bars = 10 μm (A-H).



**Fig. 104.** *Achnanthes* spp. **A-F.** SEM. **A-B.** Exterior view of valve, oblique view. **B.** Exterior view, detail of the valvocopulae (arrows). **C.** Internal views of valve of RLV and RV. **D.** External view of valve of *Achnanthes exiguum*. **E.** Internal view of valve of *A. exiguum*. **F.** Girdle view. Scale bars = 5  $\mu\text{m}$  (A-E), 10  $\mu\text{m}$  (F).

***Planothidium*** Round & Bukhtiyarova 1996

Type species: *Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot

SYNONYM:

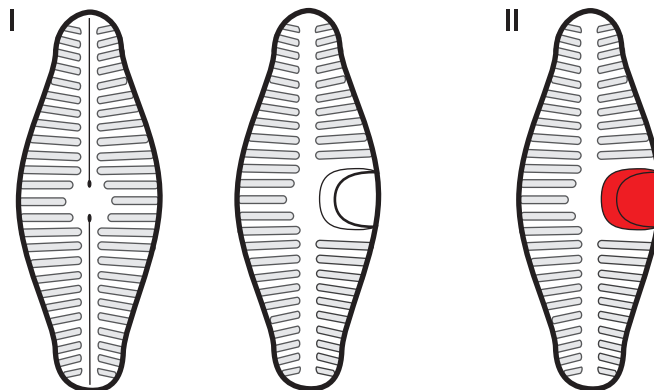
*Achnanthes* Bory 1822 pro parte

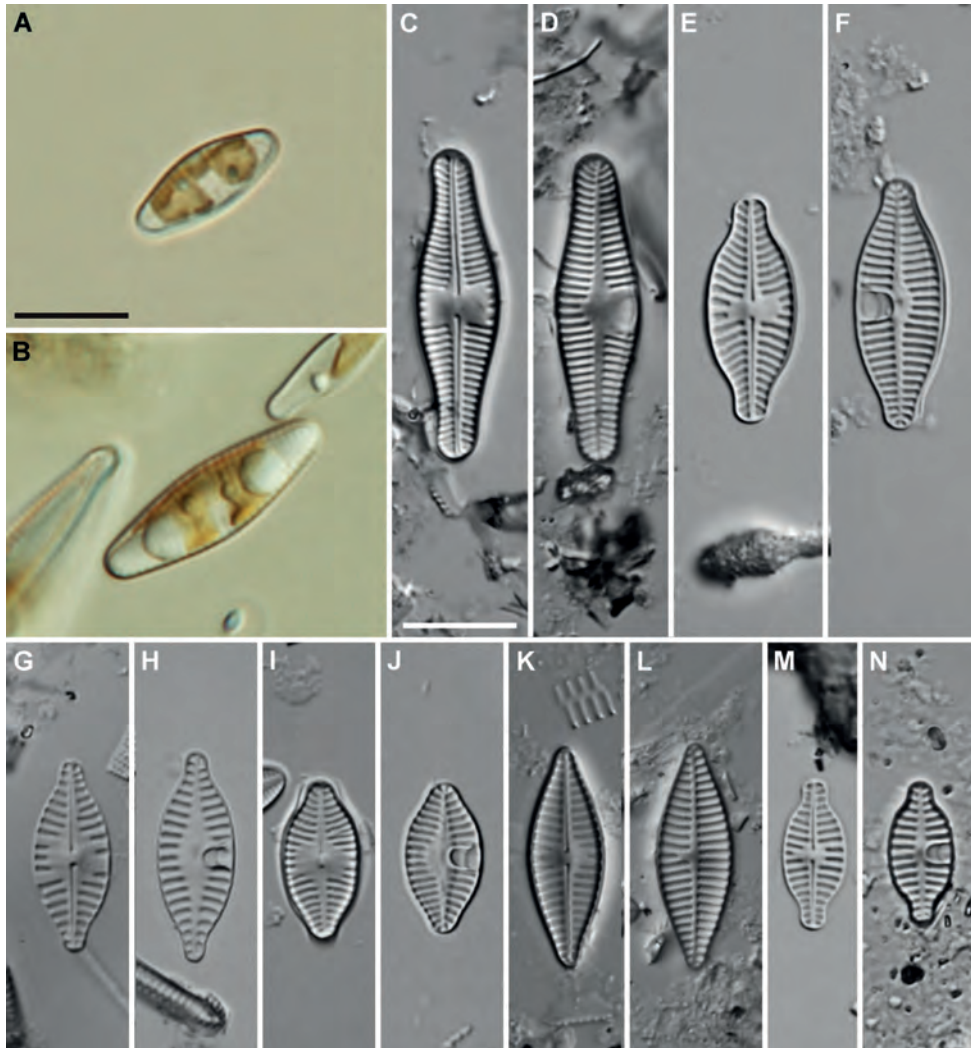
**Characteristics** – Cells **heterovalvar**, **monoraphid**, elliptical with rounded, broadly rounded or sub-capitate apices. Curved in girdle view (one valve slightly convex, the other slightly concave). Striae robust and clearly discernable under LM (Fig. 105: C-N), composed of 2 rows of very small round areolae, visible only under SEM (Fig. 106: A-D). Raphe straight and simple (Fig. 105: C, E, G, K, M) with expanded central endings. Rapheless valve (RLV) has a narrow axial area and may possess a **silica hood** (also known as a “horseshoe structure”) or other unilateral silica thickening on the interior of the valve (II).

**Plastid structure** – Single plate-like plastid lying under the RLV valve extending under the girdle (Fig. 105: A-B).

**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 central and axial areas, the shape and curvature of the central raphe endings as well as structure and positioning of the silica thickenings of the RLV.

**Ecology** – Cells solitary, attached (**adnate**) by the raphe valve face to the substrata. Found in the benthos of mesotrophic to hypereutrophic waters with moderate to high conductivities.





**Fig. 105.** *Planothidium* spp. **A-N.** LM. **A-B.** Living cells. **C-N.** Cleaned valves. **C, E, G, I, M.** *Planothidium* spp., raphe valves. **D, F, H, J, N.** *Planothidium* spp., rapheless valve, note “horseshoe structure” of silica hood. **K.** *Planothidium delicatulum* (Kützing) Round & Bukhtiyarova, raphe valve. **L.** *Planothidium delicatulum*, rapheless valve.  
Scale bar = 10 µm (A-N).