An Illustrated Guide to Some Common Diatom Species from South Africa

JC Taylor, WR Harding & CGM Archibald

TT 282/07

Water Research Commission

An Illustrated Guide to Some Common Diatom Species from South Africa

Report to the
Water Research Commission

by

JC Taylor*, WR Harding
and CGM Archibald*****

* School of Environmental Sciences and Development
North-West University (Potchefstroom Campus)
** DH Environmental Consulting [DHEC]
*** KZN Aquatic Ecosystems [KZNAE]

WRC Report TT 282/07
January 2007

This report is part of a set on Diatoms. The other report is :

WRC report TT 281/07: A Methods Manual for the Collection, Preparation and Analysis of Diatom Samples

Each report is provided with a DVD of
1. Training Videos for Diatom Field Sampling and Laboratory Practice
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The publication of this report emanates from a Water Research Commission project entitled: *Development of a Diatom Assessment Protocol (DAP) for River Health Assessment*, (WRC Project no K5/1588), for which DH Environmental Consulting was the Lead Consultant.

ISBN 1-77005-484-7
SET No 1-77005-482-0

Printed in the Republic of South Africa

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Background

There is a long and proud history of diatom research in South Africa, mainly as a result of the work of the late Dr Bela Cholnoky, a the pioneer diatom specialist. This is described in the WRC report TT242/04 – "*The South African Diatom Collection: An Appraisal and Overview of Needs and Opportunities*".

The WRC research project K5/1588, envisaged and planned by DH Environmental Consulting, and undertaken in collaboration with KZN Consulting and North West University, has resulted in a series of practical tools for the collection, processing and examination of diatom samples from South African Rivers.

Diatoms provide a valuable and well-understood means of biomonitoring – one which is focused at the base of the aquatic foodweb and highly representative of water quality. Although the need for careful microscopic examination and taxonomic identification of species is somewhat demanding, the technique is intended to provide a 'fourth leg' to the River Health Programme suite of monitoring tools (currently invertebrates, vegetation and fish).

Project K5/1588 has produced the following tools:

- A Methods Manual which details sampling procedures and the laboratory processing of samplings for slide mounting and microscopic examination. The content of the manual also provides general information pertaining to the occurrence of diatoms in aquatic systems. (WRC Report TT 281/07)
- An Illustrated Guide to some common diatom species from South Africa
  (WRC Report TT 282/07)
- Two DVD-quality videos that demonstrate the field and laboratory procedures described in the manual. These training videos will also be available on CD.
- A stand-alone software-based taxonomic key to the diatom species most commonly encountered in South African rivers and streams. This is an hierarchical, interactive tool that assists the user in learning more about diatoms and diatom taxonomy while seeking an identification for an observed species. The taxonomic key allows the user to undo incorrect entries, and includes photomicrographs in various formats that assist with confirming the final result.

The results of this project are dedicated to the memory of South African diatom specialist "Archie" Archibald.

Introductory remarks

This guide has been compiled for those who wish to begin a study of the diatom flora of South Africa. Although much material is available concerning diatom species occurring throughout the country, there is only a small amount of material in which common diatom species are photographically or otherwise illustrated.

This guide is not intended as an exhaustive flora of the diatoms of South Africa, but rather to serve as an introduction to the common species found in fresh and brackish inland waters. It is also hoped that this volume will serve to inspire interest, not only the morphology of the diatoms, but in their biology as well. For this reason, where possible, a series of photographs are provided illustrating life-form (e.g. attachment, colony formation etc.), chloroplast structure, cleaned valves as well as high magnification scanning electron (SEM) micrographs. It should be stressed that all images except those of the cleaned material are accessory, but it is hoped that by providing, for example SEM images, the reader's understanding of the concept of a particular species may be broadened.

Information on the structure and morphology of each species included is provided together with short notes on their specific ecology. Although these notes are by no means complete they are intended to provide a reference point for meaningfully differentiating between species and not simply just matching a specimen under the microscope to a picture.

It should be pointed out that diatoms should never be identified to a "nearest match". If the particular taxon cannot be found in this guide, the researcher should consult one of the many diatom floras available which deal with sometimes many thousands of species (e.g. Süßwasserflora von Mitteleuropa. Band 2. Bacillariophyceae). If this is not possible the diatom should be left unidentified and preferably photographed or drawn for future reference.

It is hoped that this guide may also serve as a valuable *aid-memoir* for those diatomists involved in inferring water quality based on diatom communities as it is limited in the most part to ecologically relevant taxa.

Source material

Individual references in the text have been kept to a minimum and may be found at the end of this section. However, several key source works were used as a source for taxonomic and ecological information. Without these valuable works the compilation of this guide would have been impossible.

CHOLNOKY BJ (1968) *Die Ökologie der Diatomeen in Binengewässern.* J Cramer, Lehre. Germany

COX EJ (1996) *Identification of Freshwater Diatoms from Live Material.* Chapman & Hall. London. UK.

KRAMMER K (2000) *The genus Pinnularia. Diatoms of Europe, Volume 1*. Edited by H. Lange-Bertalot. A.R.G. Gantner Verlag K.G. Germany.

KRAMMER K and LANGE-BERTALOT H (1986) *Süßwasserflora von Mitteleuropa. Band 2. Bacillariophyceae. Teil 1. Naviculaceae.* Gustav Fischer Verlag, Stuttgart. Germany.

KRAMMER K and LANGE-BERTALOT H (1988) *Süßwasserflora von Mitteleuropa. Band 2. Bacillariophyceae. Teil 2. Bacillariaceae, Epithemiaceae, Surirellaceae.* Gustav Fischer Verlag, Stuttgart. Germany.

KRAMMER K and LANGE-BERTALOT H (1991) *Süßwasserflora von Mitteleuropa. Band 2. Bacillariophyceae. Teil 3. Centrales, Fragilariaceae, Eunotiaceae.* Gustav Fischer Verlag, Stuttgart. Germany.

KRAMMER K and LANGE-BERTALOT H (1991) *Süßwasserflora von Mitteleuropa. Band 2. Bacillariophyceae. Teil 4. Achnanthaceae, Kritische Ergänzungen zu Navicula (Lineolatae) and Gomphonema.* Gustav Fischer Verlag, Stuttgart. Germany.

LANGE-BERTALOT H (2001) *Diatoms of Europe. Diatoms of European Waters and Comparable Habitats Vol. 2.* ARG Gantner Verlag Kommanditgesellschaft, Ruggell. Germany.

PRYGIEL J and COSTE M (2000) *Guide méthodologique pour la mise en œuvre de l'indice Biologique Diatomées* NF T 90-354. Agences de l'Eau-Cemagref de Bordeaux, mai 2000, 134 pages + Clés de détermination (89 planches) + cédérom français-anglais (tax'IBD). France.

SCHOEMAN FR (1973) *A systematical and ecological study of the diatom flora of Lesotho with special reference to water quality.* V&R Printers, Pretoria, South Africa.

Acknowledgements

Without the assistance and help of the following people and organizations the compilation of this guide would have been impossible.

Prof. Andrzej Witkowski of the University of Szczecin, Department of Palaeoceanology, who generously financed two trips to his laboratory and allowed free access to his laboratories and library. The majority of the LM images of cleaned material were collected in his laboratory.

Prof. Horst Lange-Bertalot of the Johan Wolfgang Goethe-Universität Frankfurt am Main, Botaniesches Institut, Germany, who spent many hours identifying and confirming the identity of diatoms recorded from South Africa.

Dr. Richard Crawford and Ms. Friedel Hintz from the Fredriech Hustedt Diatom Collection, Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany for freely making available microscope facilities, material and literature.

Prof. Leon van Rensburg of the School for Environmental Sciences and Management, Potchefstroom Campus of the North-West University for partially funding the trips to the Poland and Germany.

Mr. G.P. Kriel for providing some of the scanning electron microscope images used in this volume.

Dr. Laurens Tiedt and Ms. Wilna Pretorius from the Laboratory for Electron Microscopy, Potchefstroom Campus of the North-West University for their many hours of help and assistance with the collection of electron micrographs.

Key terminology

Although a detailed Glossary will be provided at the end of Part 2 there are several key ecological terms that should be explained at this point for the meaningful reading of the text.

Trophy

Dystrophic – rich in organic matter, usually in the form of suspended plant colloids, but of a low nutrient content.

Oligotrophic – low levels or primary productivity, containing low levels of mineral nutrients required by plants.

Mesotrophic – intermediate levels of primary productivity, with intermediate levels of mineral nutrients required by plants.

Eutrophic – high primary productivity, rich in mineral nutrients required by plants.

Hypereutrophic – very high primary productivity, constantly elevated supply of mineral nutrients required by plants.

Mineral content

Very electrolyte poor – <50 µS/cm

Electrolyte-poor (low electrolyte content) – 50-100 µS/cm

Moderate electrolyte content – 100-500 µS/cm

Electrolyte-rich (high electrolyte content) – >500 µS/cm

Brackish (very high electrolyte content) – >1000 µS/cm

Saline – 6000 µS/cm

Pollution (Saprobity)

Unpolluted to slightly polluted – BOD <2 , O_2 deficit <15% (oligosaprobic)

Moderately polluted – BOD <4 , O_2 deficit <30% (β-mesosaprobic)

Critical level of pollution – BOD <7(10) , O_2 deficit <50% (β-ά-mesoosaprobic)

Strongly polluted – BOD <13 , O_2 deficit <75% (ά-mesosaprobic)

Very heavily polluted – BOD <22 , O_2 deficit <90% (ά-meso-polysaprobic)

Extremely polluted – BOD >22 , O_2 deficit >90% (polysaprobic)

Presentation of images and scaling

All images of cleaned material have been rescaled to 1500x as this is the most commonly used magnification in diatom floras and identification guides. Where possible, images of live material have also been kept at this magnification.

The majority of the light micrographs of cleaned diatom were collected using a microscope equipped with bright-field optics. However, a few of the micrographs were taken using either phase-contrast or differential interference contrast optics. The majority of the micrographs of living diatoms were collected using phase-contrast optics.

All scale bars are equal to **10 µm** unless otherwise indicated.

How do you recognise diatoms in natural environments?

A common source of error in inferring ecological conditions using diatom communities arises from sampling from un-colonised substrata. Diatom communities may be detected on substrata by feel (slimy or mucilaginous) or may be seen as a thin golden-brown film covering substrata. In some conditions or at certain times of the year this film may become thicker and much more noticeable. The essential natural microhabitats are solid substrata, exposed damp sediments and the stems of rooted vegetation. Diatoms are also present in the seston or suspended component of the phytoplankton. Man-made and other objects (paper or plastic bags, pieces of wood) are also frequently colonised by diatoms.

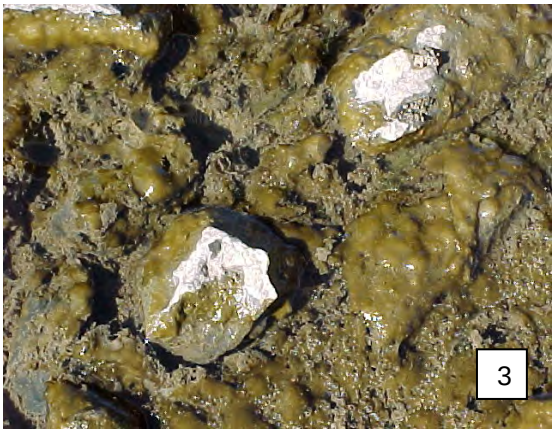


Fig. 1 and **Fig. 2** show a thick layer of diatom cells attached to boulders.
Fig. 3 shows a layer of diatom cells growing both on sediment and on pebbles.
Fig. 4 shows diatoms growing thickly around submerged tree branches.
Fig. 5 shows the film of diatoms to be found on the submerged stems of *Phragmites australis*.
Fig. 6 shows diatoms inhabiting sediments.

Diatoms – Living cells with a role in aquatic food webs

Diatoms – Living cells with a role in aquatic food webs

Diatoms are a key component of aquatic ecosystems and constitute a fundamental link between primary (autotrophic) and secondary (heterotrophic) production. Many micro-organisms feed on diatoms and in this way they are integrated into aquatic food webs. Diatoms are frequently used as bio-indicators, and if they are not investigated live they may be perceived simply as “glass boxes” used to give information about water quality. It is worth the time to study the living communities and to note the other algae and the interactions between the algae and other micro-organisms.

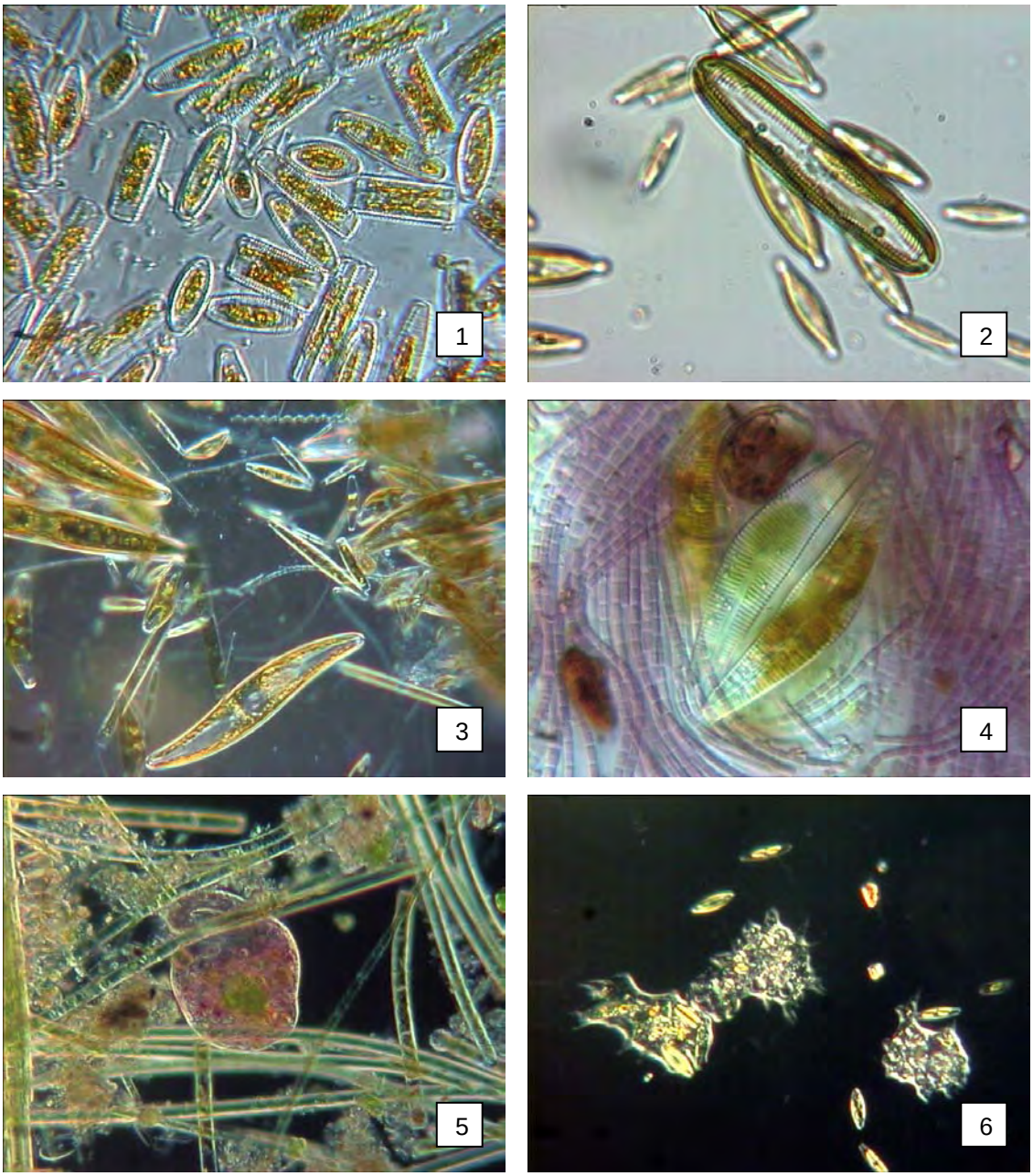


Fig. 1 a diatom community completely dominated by *Diatoma vulgaris*
Fig. 2 a sediment diatom community with *Navicula* spp. and *Pinnularia viridis*.
Fig. 3 mixed diatom community with large cells of *Gyrosigma* sp.
Fig. 4 shows cells of *Cymbella* sp. living in association with the blue-green algae *Oscillatoria*.
Fig. 5 shows the filamentous diatom *Aulacosiera granulata* being grazed by a protozoan.
Fig. 6 shows diatoms being grazed by *Amoeba* sp.

Diatoms – Colony formation and attachment

Diatoms release mucilage through various structures in the cell wall to facilitate locomotion or attachment of the cells to various substrata. Mucilage secretions can also be used to form colonies of various patterns. This material must be eliminated for microscopic detailed examination of the cell wall. After a diatom sample has undergone the necessary steps to prepare it for light microscopy at high magnifications all that can be seen is a silica structure. This skeleton or cell wall is typically referred to as the frustule. Chemical treatment eliminates all organic material from both inside as well as outside the cell walls.

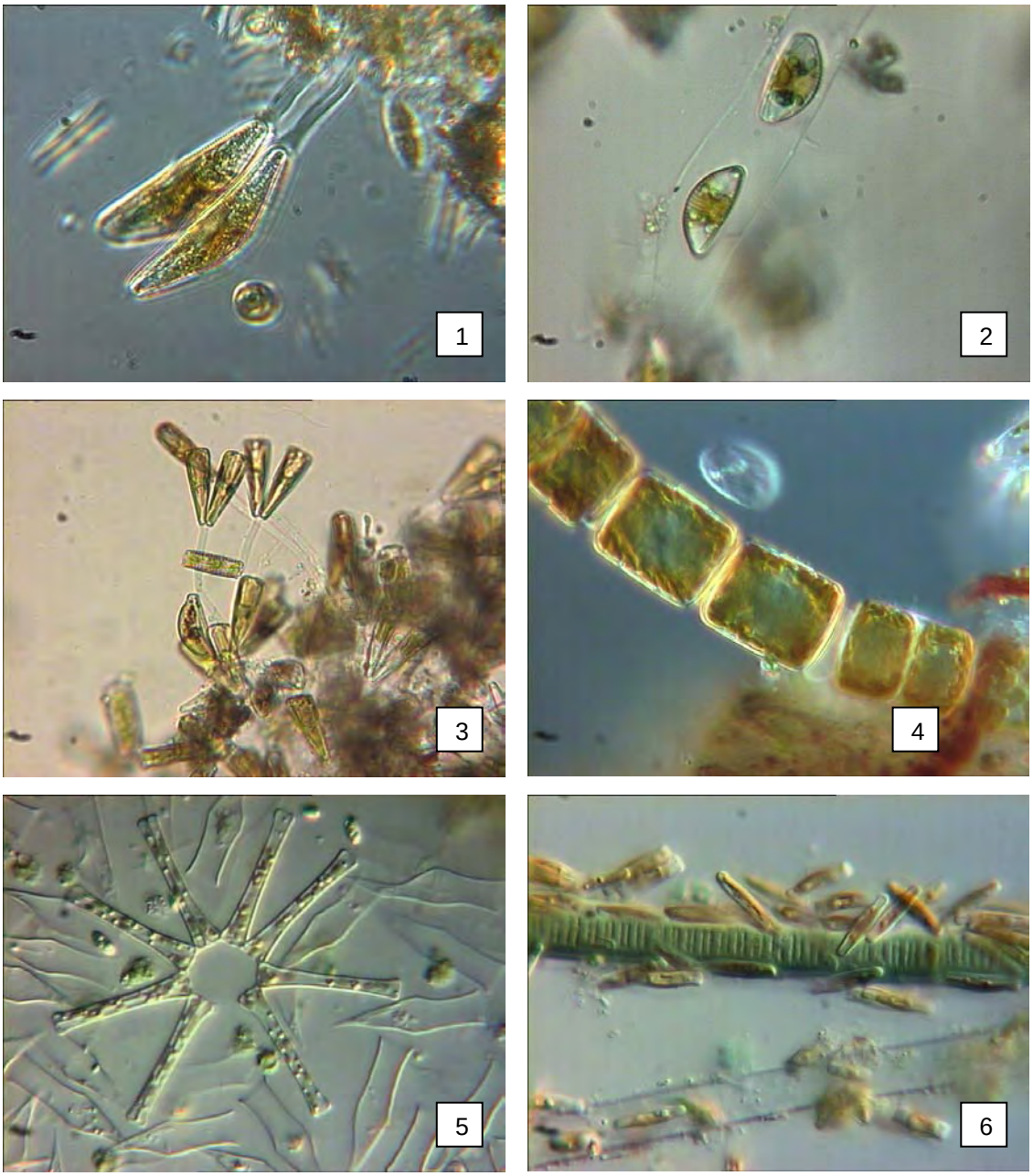
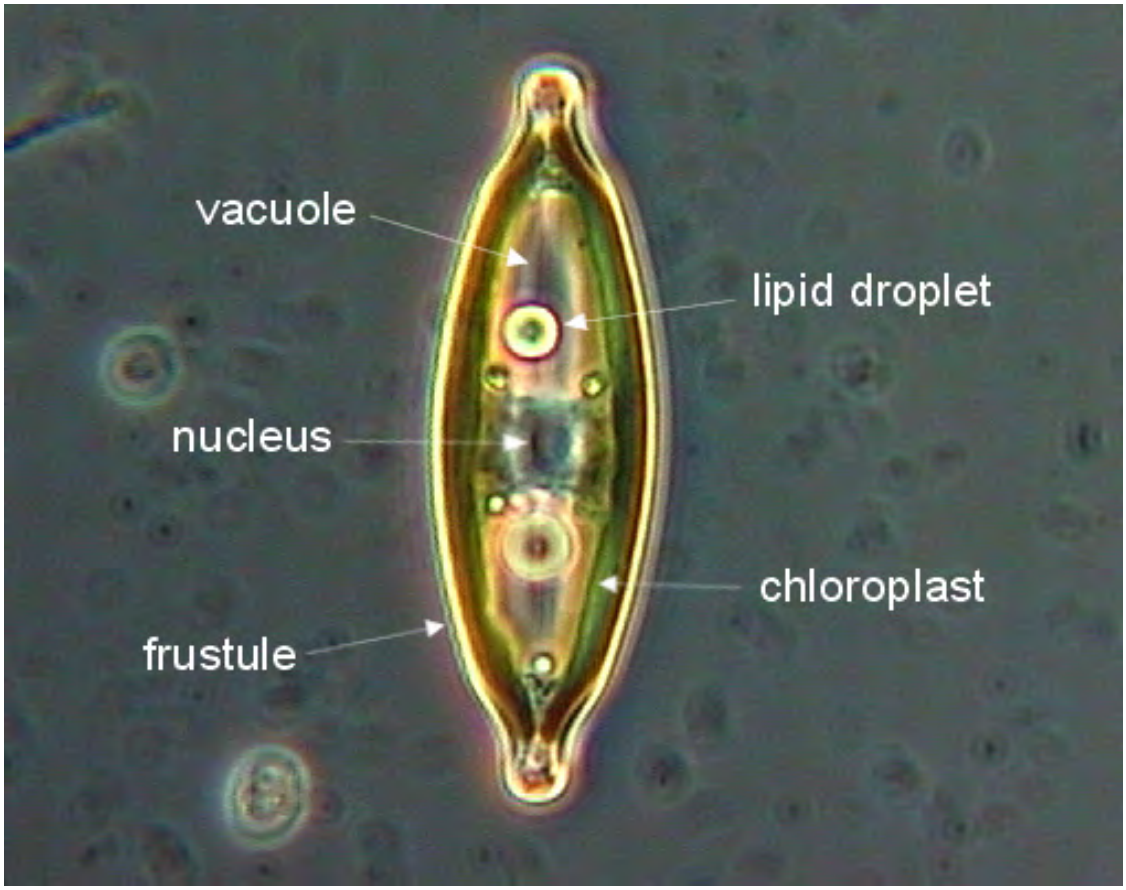


Fig. 1 shows the attachment of *Cymbella* sp. to a substratum with a mucilage stalks.
Fig. 2 shows *Encyonema caespitosum* inhabiting a mucilage tube.
Fig. 3 shows the dichotomously branching mucilage stalks to which cells of *Gomphonema* sp. are attached.
Fig. 4 *Melosira varians* with cells attached both to the substratum and each other by mucilage pads.
Fig. 5 stellar colonies of the diatom *Asterionella Formosa*.
Fig. 6 *Achnanthidium minutissimum* attached by means of micuilage staks to *Lyngbya* sp.

Diatom frustules – What do living diatoms look like?

Diatoms are unicellular algae that occur mostly as single cells but some species form colonies. They have certain features which make them unique amongst the algae. The particular features include the siliceous cell wall (frustule) the possession of unique photosynthetic pigments and specific storage products (oil and chrysolaminarin). There are two groups of diatom common in freshwaters namely the centric diatom species which are in general circular in shape and adapted to live in the water column as part of the phytoplankton and the pennate diatoms that live in benthic habitats but are often temporarily re-suspended in the water column.



What can you expect to see when viewing a prepared diatom slide?

A series of neatly aligned pictures that have been cropped and graphically enhanced are normally displayed to illustrate diatom taxa in books, manuals and guides. Whole cells are usually illustrated in valve view in such guides and most of the morphological characteristics are visible. Fragments or broken pieces are not normally shown. However, your slides will have diatom cells that are orientated at different angles, often lying obliquely or in girdle view and some may be damaged or fractured fragments. Different types of microscope illumination may also provide slightly different images to those found in routine identification guides.

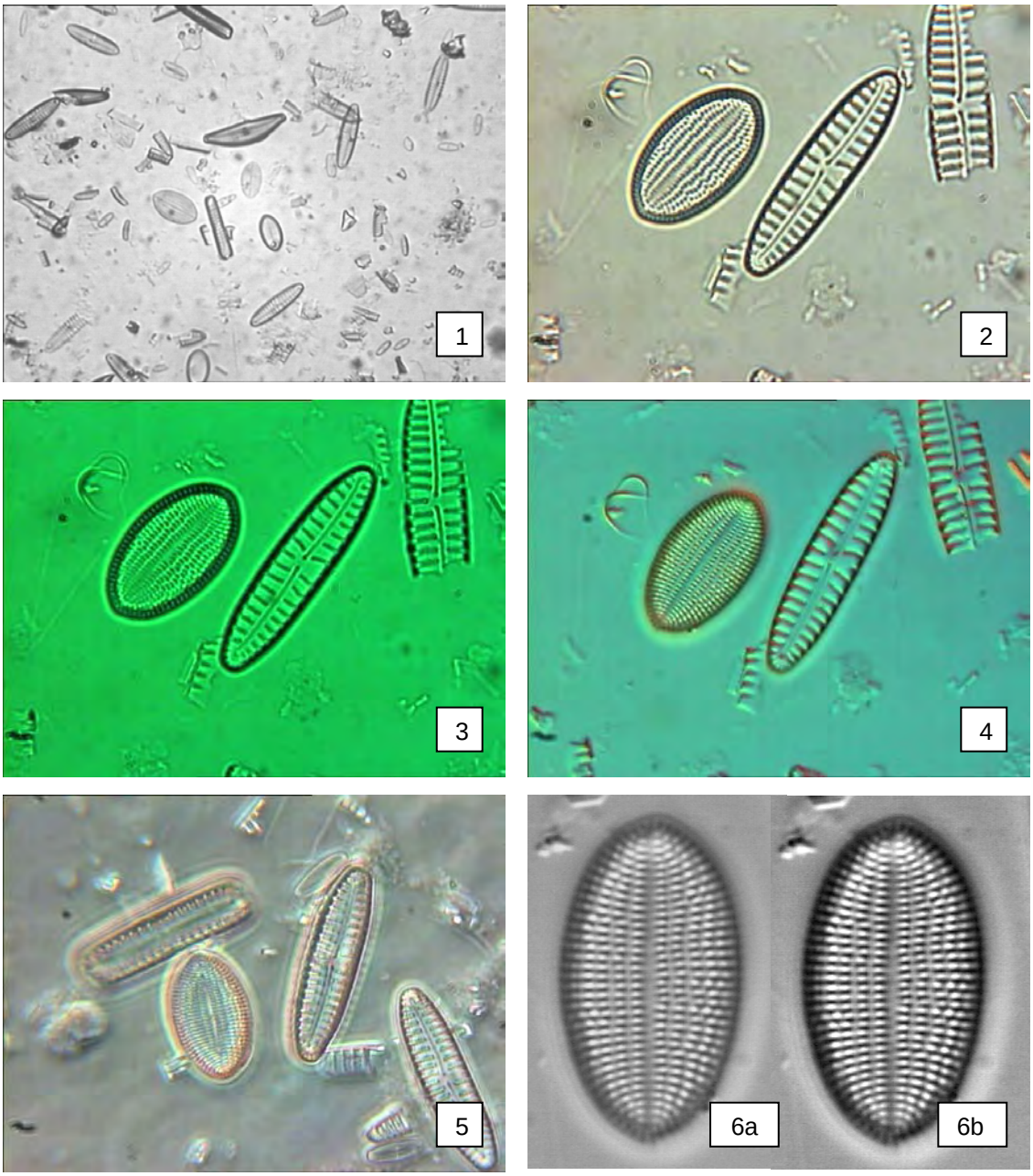


Fig. 1 shows a scattered slide mount of diatoms under low magnification.
Fig. 2 shows the same mount under high magnification (x1000) using incident light.
Fig. 3 shows the same as **Fig 2** but a green filter is used to increase contrast.
Fig. 4 shows the use of differential interference (DIC) optics.
Fig. 5 shows the use of Phase contrast optics and
Fig 6a shows Fig. 4 correctly orientated, cropped and converted to greyscale, while
6b shows digital enhancement and contrast correction.

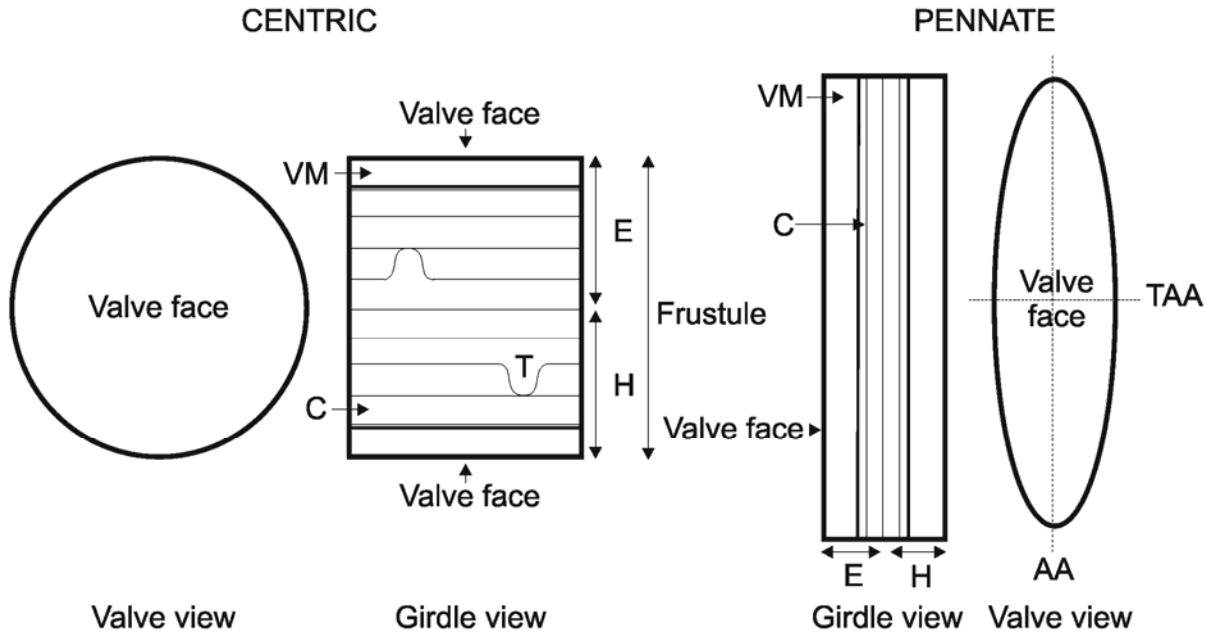
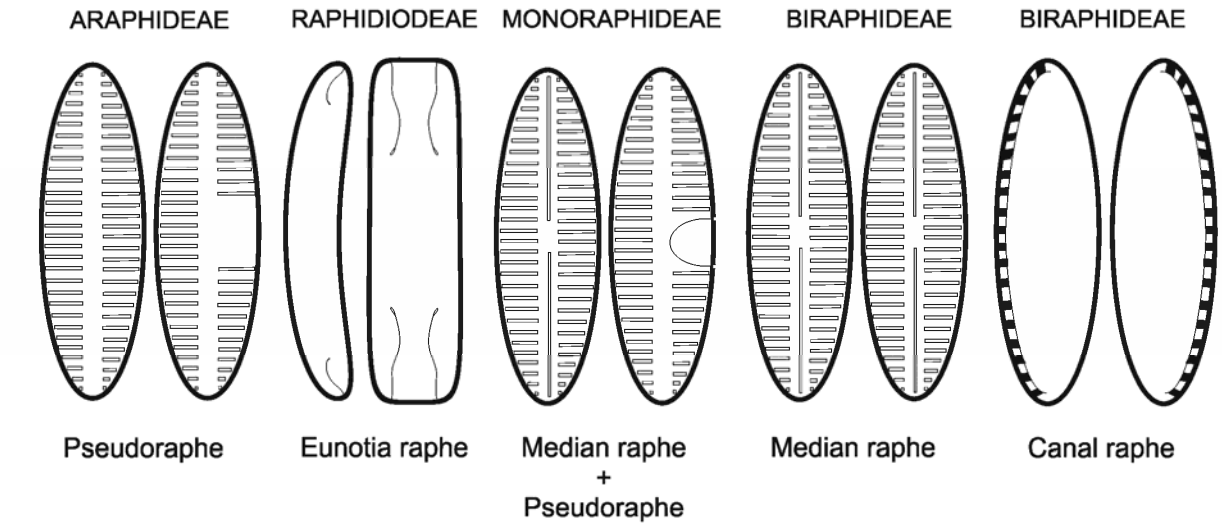
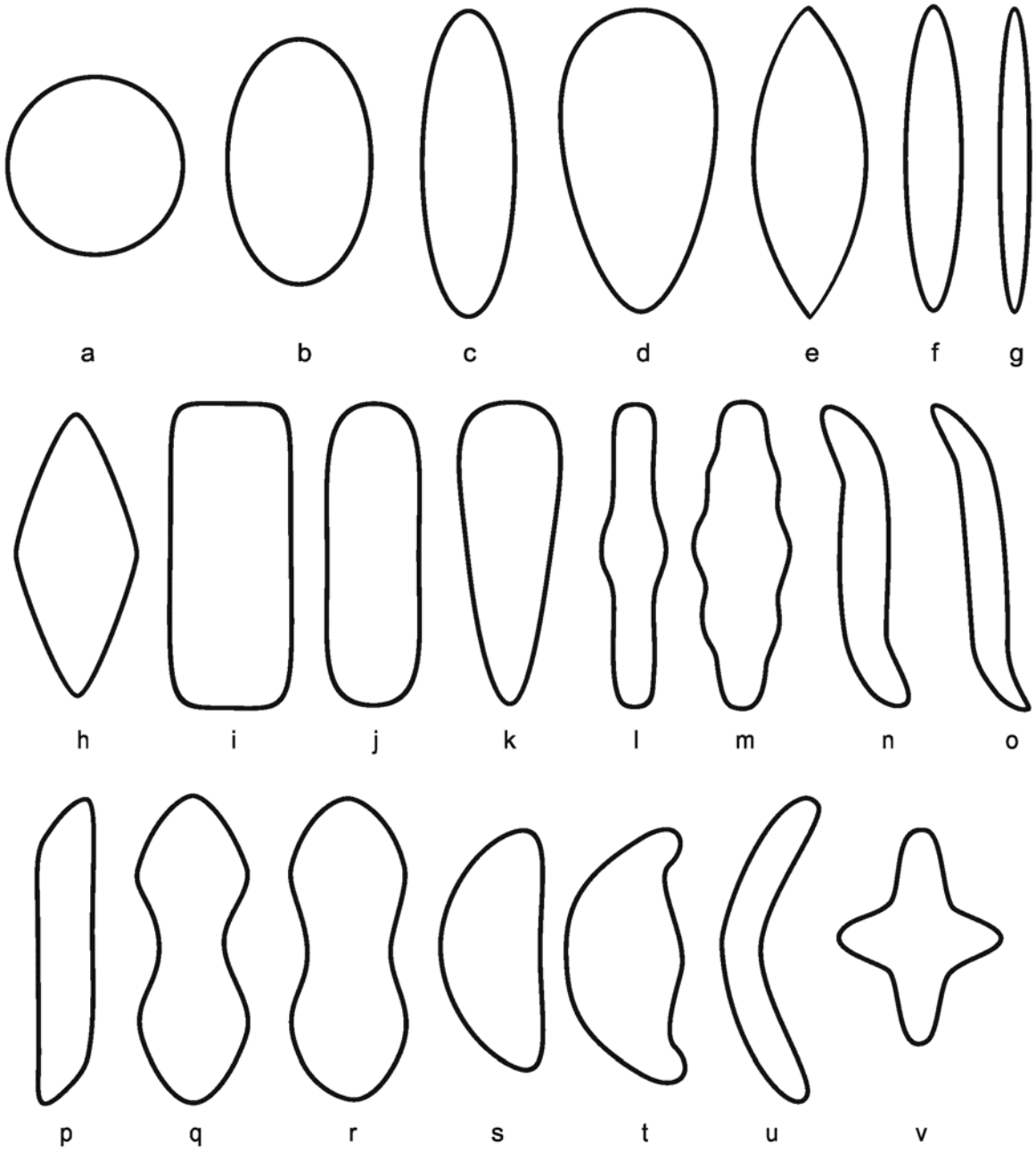


Diagram of diatom cells to show the relationships of the siliceous components.
E = epivalve + epicingulum; **H** = hypovalve + hypocyngulum; **C** = copulae or girdle bands;
VM = valve mantle. Copulae (girdle bands) may have a tongue- like extension (**T**) which inserts into any space between the ends of the adjacent split copula. **AA** = apical axis, **TAA** = transapical axis

Suborders of pennate diatoms with associated raphe types

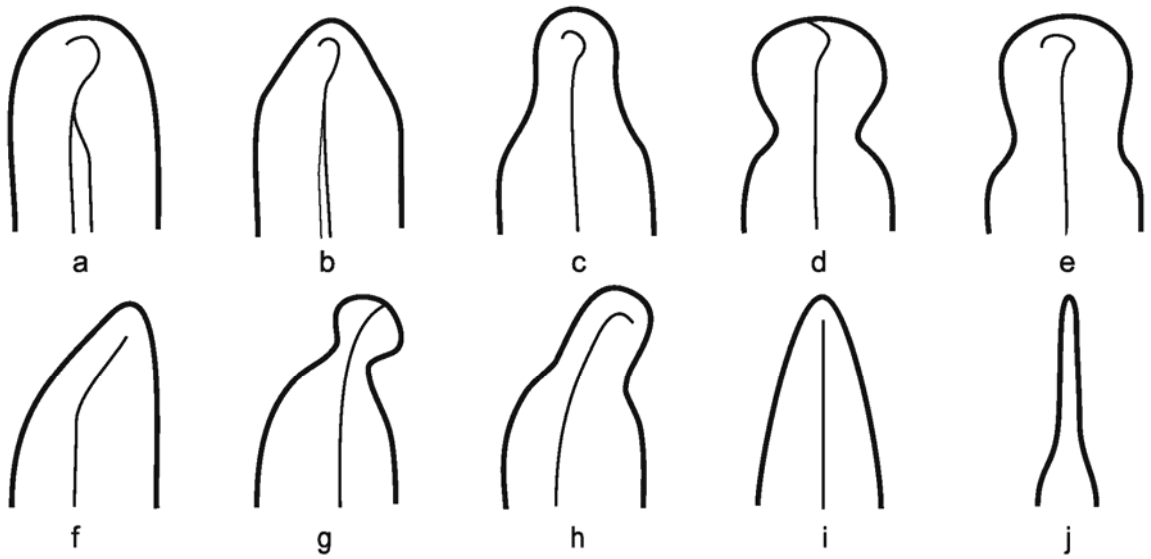


Valve outlines



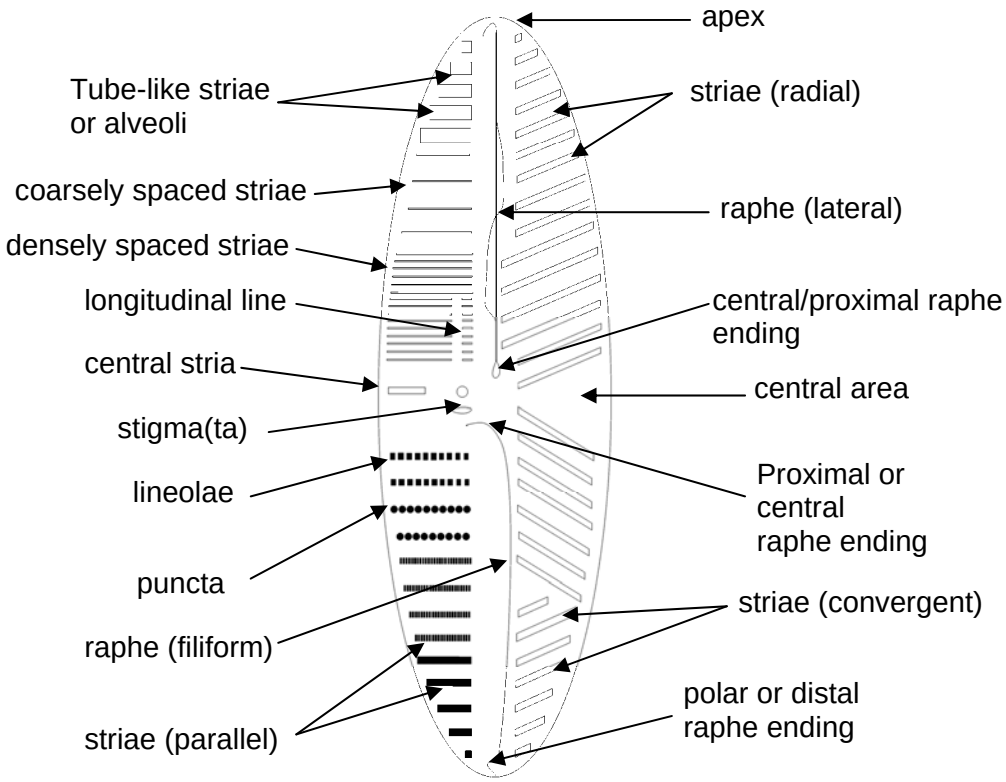
Diagrams to show valve and girdle shapes. All isopolar with the exception of **d** and **k** which are heteroplar and **s**-**u** which are dorsiventral.
a, circular ; **b**, elliptical; **c**, narrow elliptical; **d**, ovate; **e** broadly lanceolate; **f**, lanceolate; **g,** narrowly lanceolate (fusiform); **h**, rhomboidal ; **i** ,rectangular; **j**, linear; **k**,clavate; **l**, linear with swollen or expanded mid-region; **m**, triundulate (3:2); **n**, sigmoid; **o**, sigmoid lanceolate; **p**, sigmoid linear; **q**,paduriform; **r**, panduriform, slightly constricted; **s**, semi-circular; **t**, semi-circular with ventral edge swollen (tumid); **u**, lunate or arcuate; **v**, cruciform.

Apex shapes



Diagrams to show valve apices. **a**, obtusely or broadly rounded; **b**, cuneate; **c**, rostrate; **d**, capitate; **e**, subcapitate; **f**, sigmoidly cuneate; **g**, capitate; **h**, rostrate; **i**, acutely or sharply rounded; **j,** elongate.

Some general features of pennate diatoms (composite diagram)



Detailed morphological structures of diatom frustules

Septae and pseudoseptae

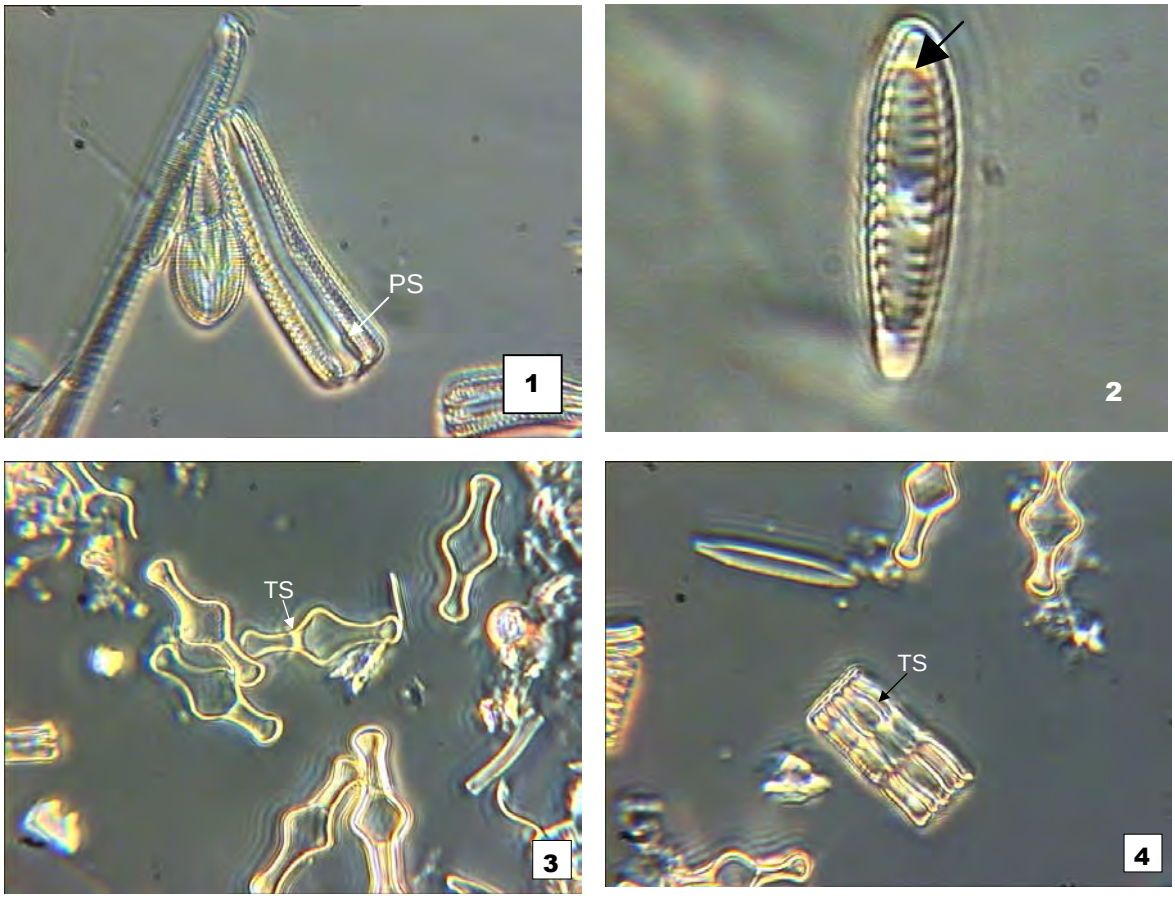


Fig. 1: *Rhoicosphenia abreviata*, girdle view, showing the thickening of the valve mantle known as the pseudoseptum (PS).
Fig. 2: *Rhoicosphenia abbreviata*, valve view showing the pseudoseptum (arrow).
Fig. 3: *Tabellaria floculosa* valve view showing girdle elements with true septum (TS).
Fig. 4: Girdle view of *Tabellaria floculosa* showing true septum (TS).

Wall perforations

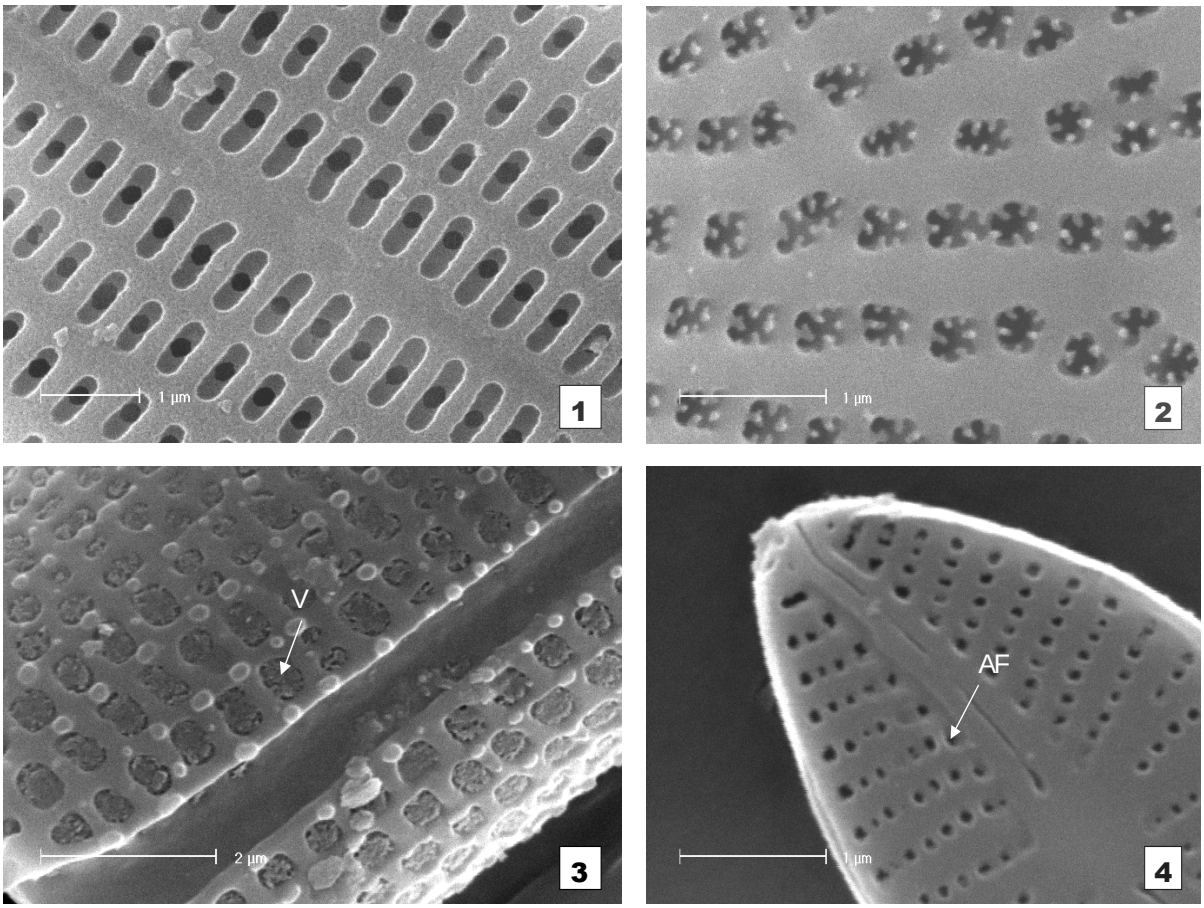
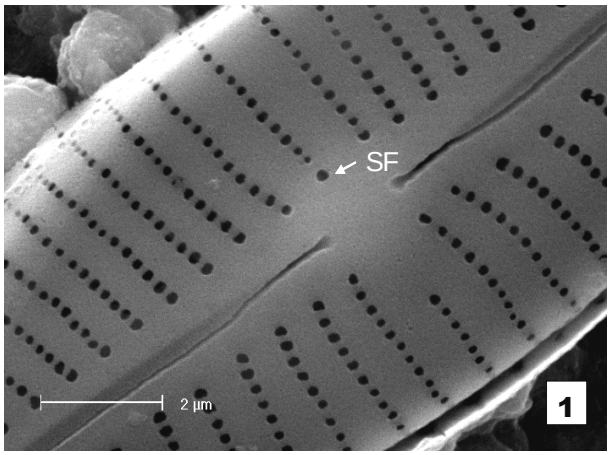


Fig. 1: Valve view of *Cocconeis pediculus* showing characteristic oval to circular areolae.
Fig. 2: Valve view of a perforated plate in *Cyclostephanos* sp. showing extensions of the foramen border into the foramen.
Fig. 3: Girdle view of *Aulacosiera granulata* showing the internal hemispherical silica velum (V).
Fig. 4: *Eolimna* sp. showing the simple areola foramen (AF).

Stigmata



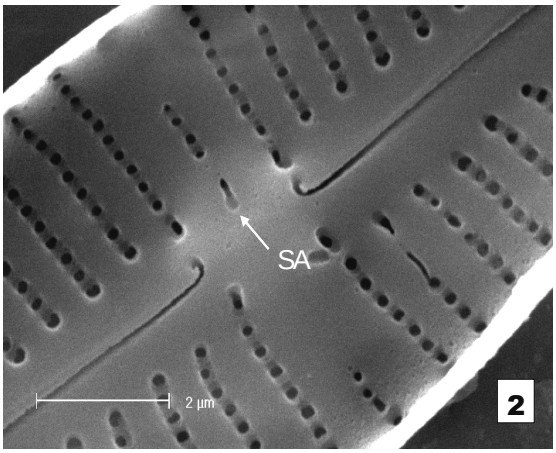
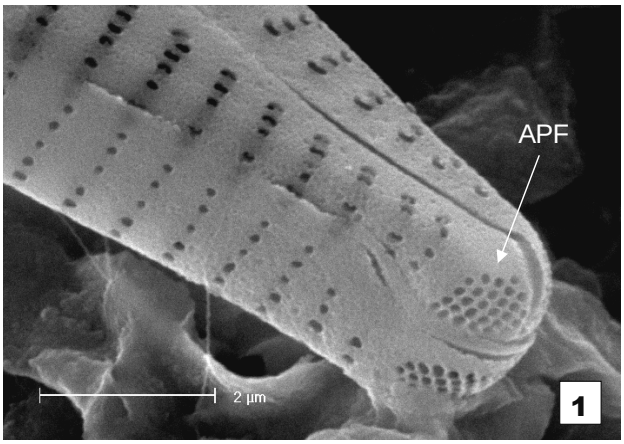


Fig. 1: *Gomphonema parvulum*, ventral view showing the sigma foramen (SF).
Fig. 2: *Gomphonema parvulum*, internal view showing stigma areolus (SA)

Apical pore fields



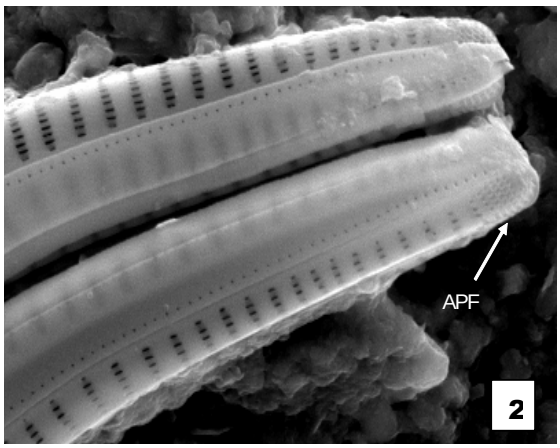


Fig 1: Acute pole of *Gomphonema parvulum* showing apical pore field (APF).
Fig. 2: *Rhoicosphenia abreviata*, girdle view, showing the apical pore field (APF).

Rib structures

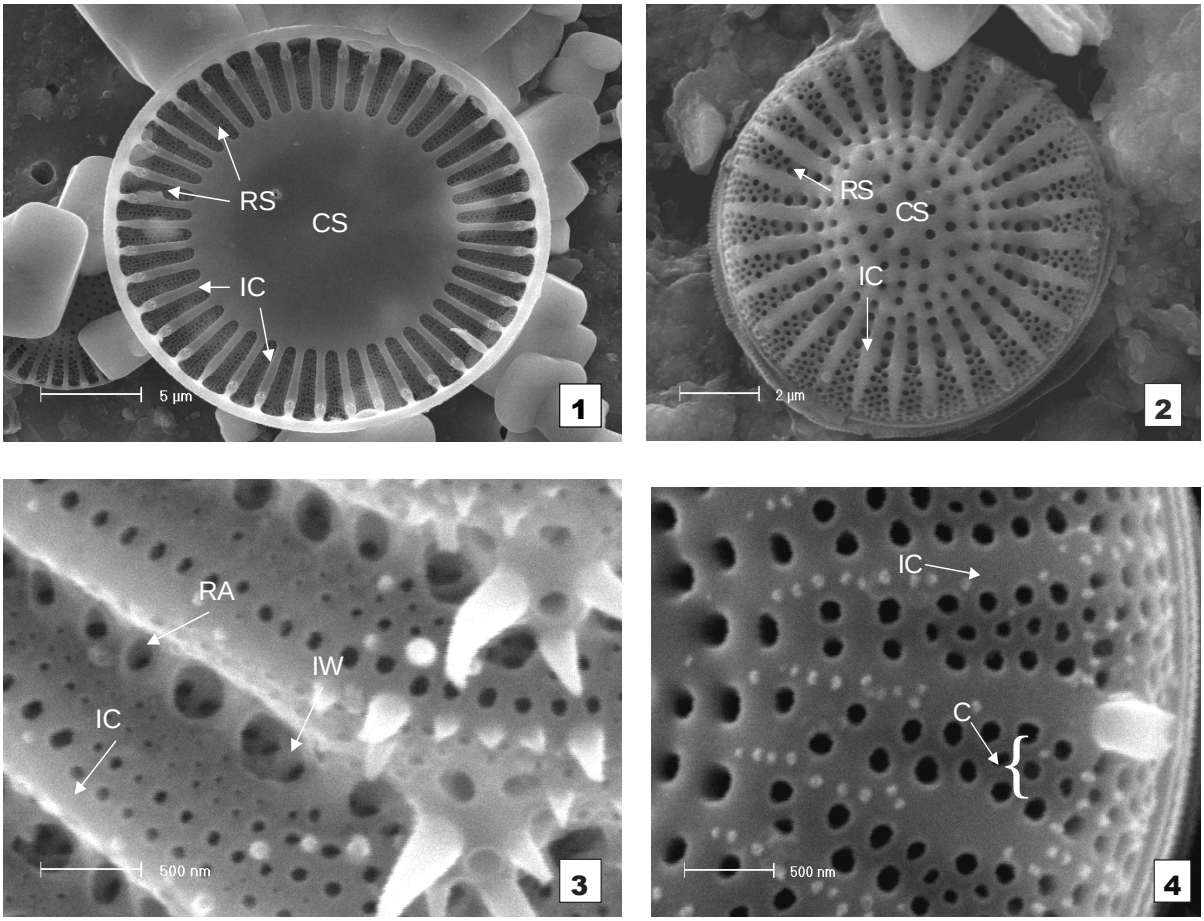
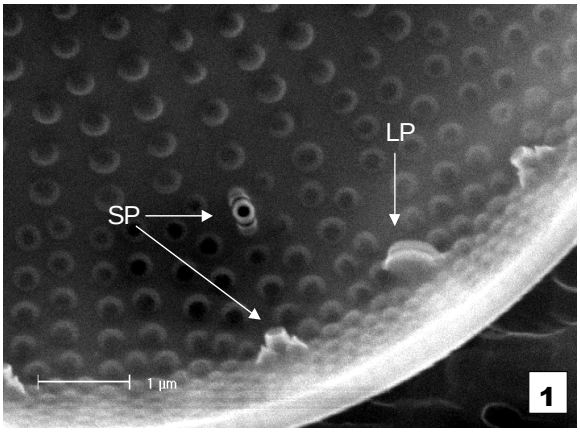
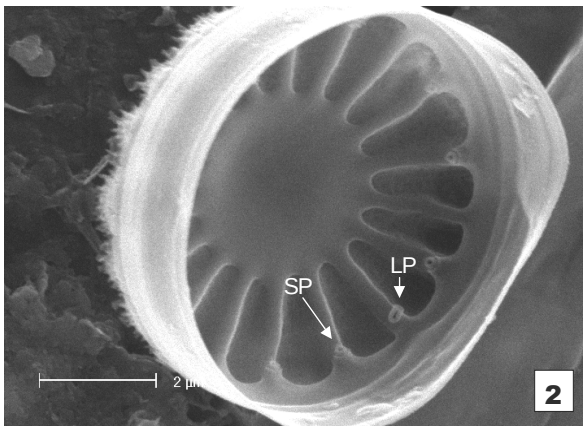
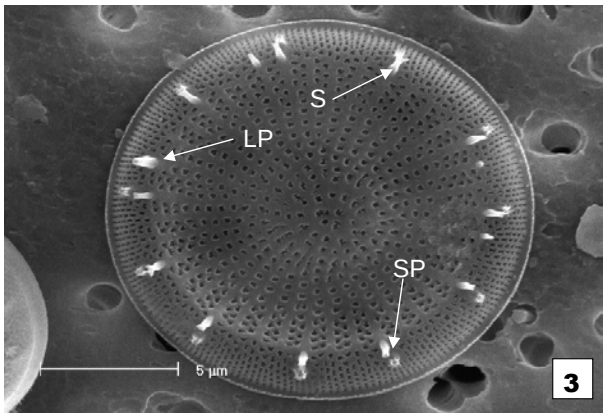


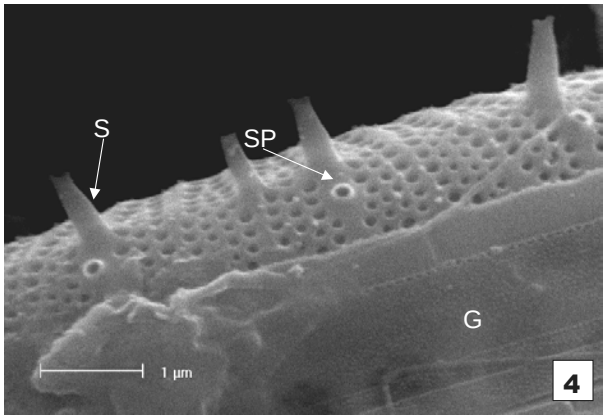
Fig. 1: *Cyclotella meneghinana*, internal valve view showing the main elements of an alveolate rib system, the central swelling (CS), and the intercostae (IC) which lay between the radial striae (RS).
Fig. 2: Exterior valve view of *Cyclostephanos dubius* showing the central swelling (CS), and the intercostae (IC) which lay between the radial striae (RS).
Fig. 3: *Cyclotella meneghinana* showing detail of intercostae (IC), radial alveoli (RA) and inner wall of the valve (IW).
Fig. 4: *Cyclostephanos dubius* showing detail of intercostae (IC) and costae (C).

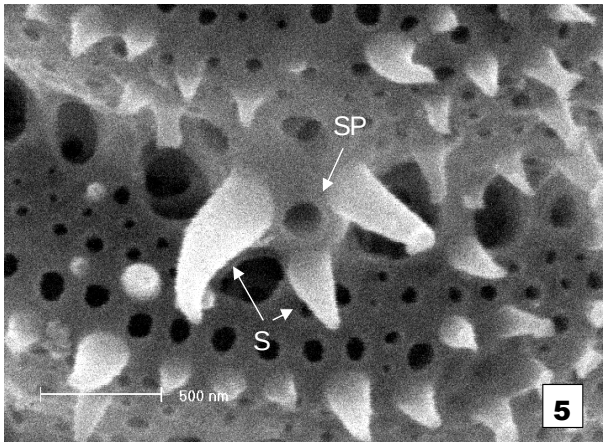
Rimoportulae (labiate processes) and fultoportulae (strutted processes)











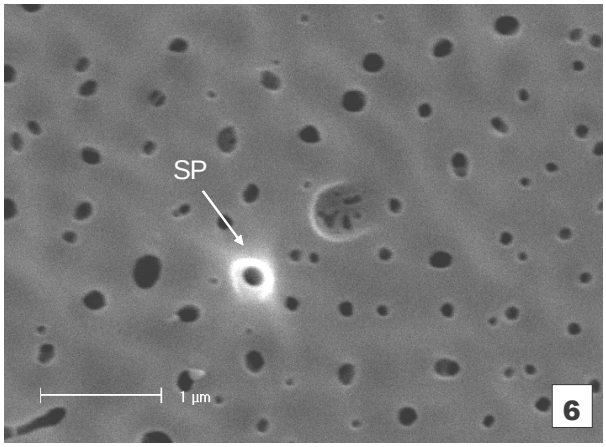
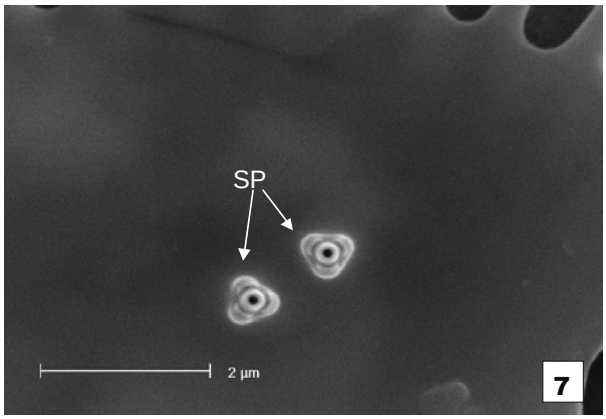
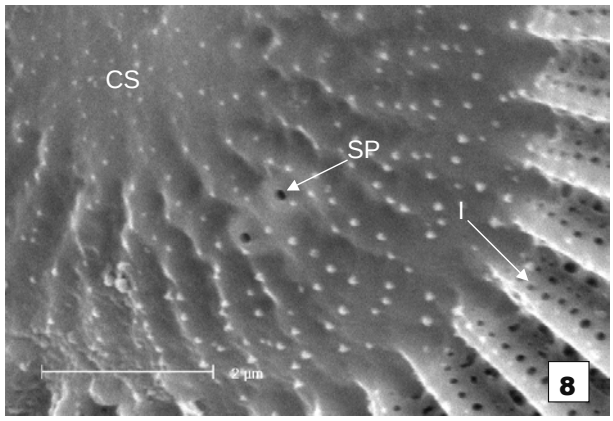
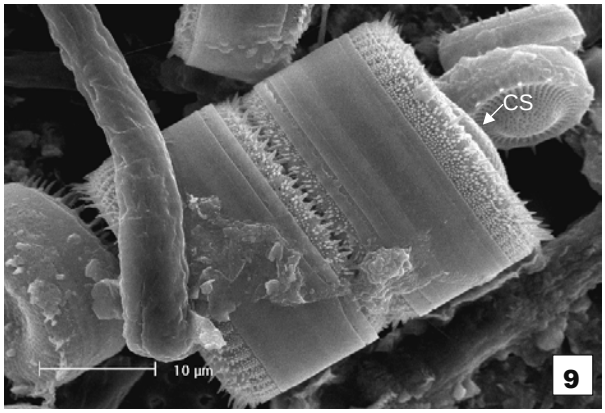


Fig. 1: Internal view of *Stephanodiscus* sp. showing the labiate process (LP) and strutted processes (SP).
Fig 2: *Cyclotella meneghiniana* internal view showing the labiate process (LP)(note different structure to Fig. 1) and marginal strutted processes (SP).
Fig 3: Exterior valve view of *Stephanodiscus* sp. showing external tube of the labiate process (LP), external tubes of the marginal strutted processes (SP) and bifurcating spines (S). Fig. 4: Girdle view of *Stephanodiscus* sp. Showing Marginal strutted processes (SP) spine (S) and girdle (G).

Rimoportulae (labiate processes) and fultoportulae (strutted processes) cont.







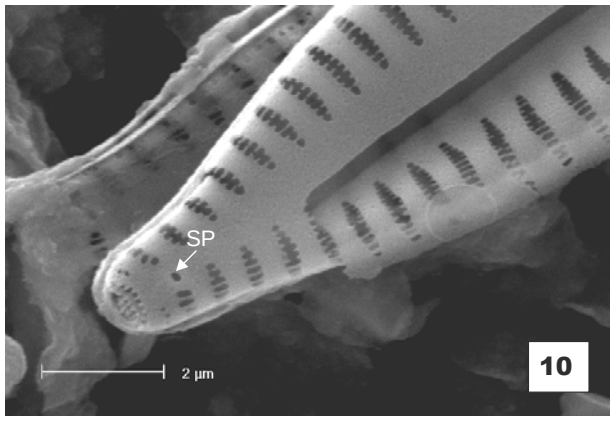
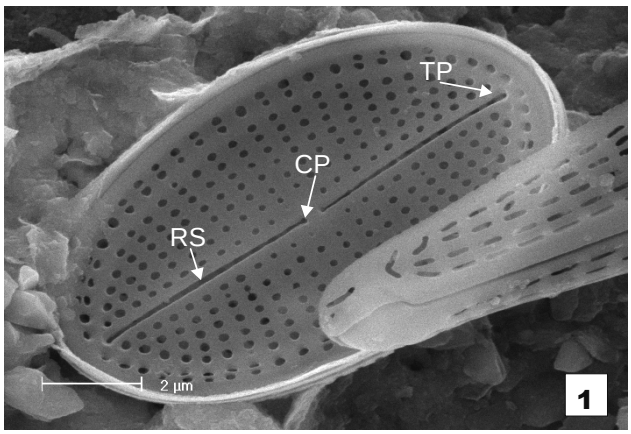
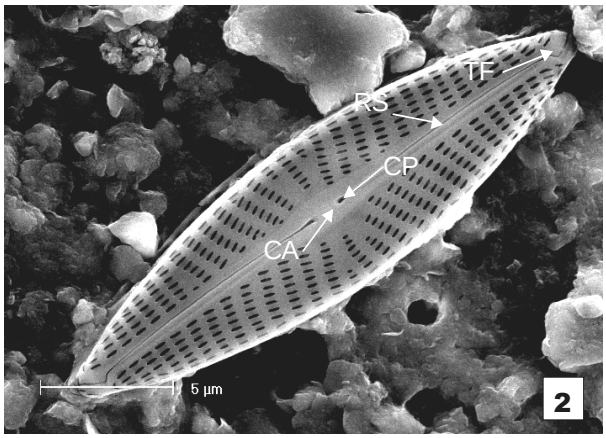
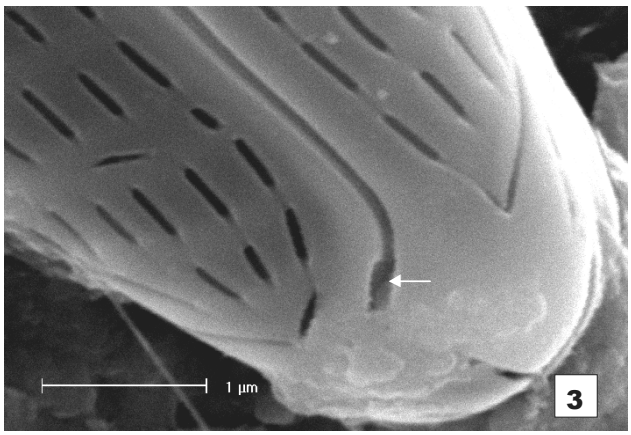


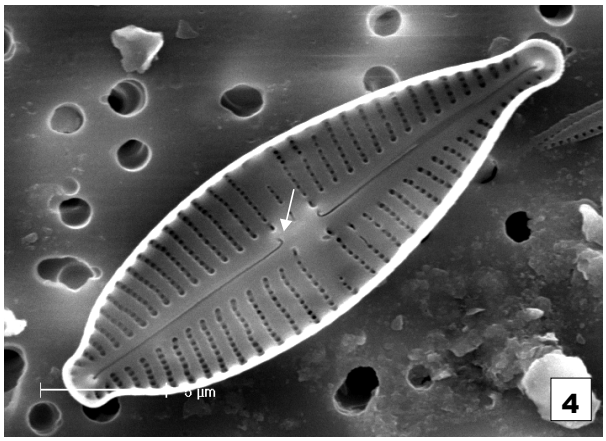
Fig 7: Internal view of the central swelling of *Cyclotella meneghiniana* showing the central processes (SP) surrounded by three struts or auxiliary pores.
Fig. 8: Valve view of *Cyclotella meneghiniana* showing the external openings of the central strutted processes (SP) through the central swelling (CS).
Fig. 9: Chain formation in *Cyclotella meneghiniana* facilitated by the central strutted processes located in the central swelling (CS).
Fig. 10: *Pseudostaurosira brevistriata* valve view showing an apical strutted process (SP).

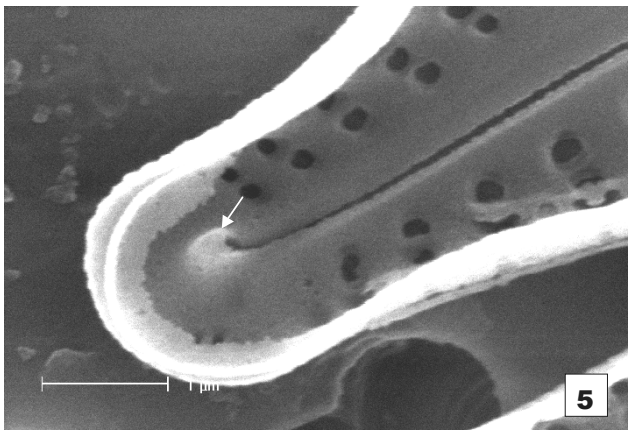
Raphes











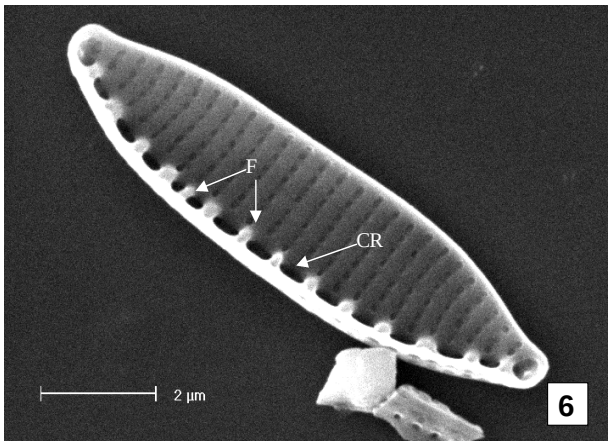
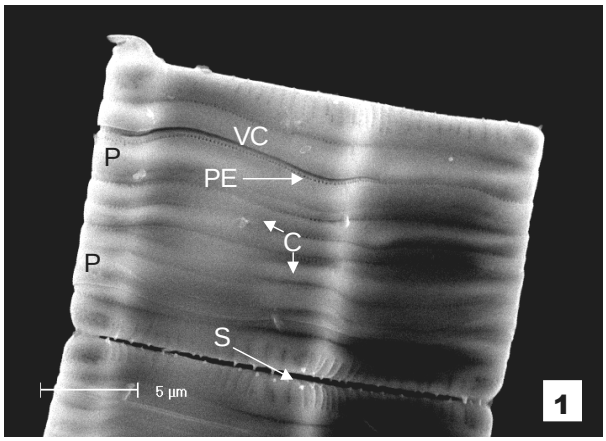
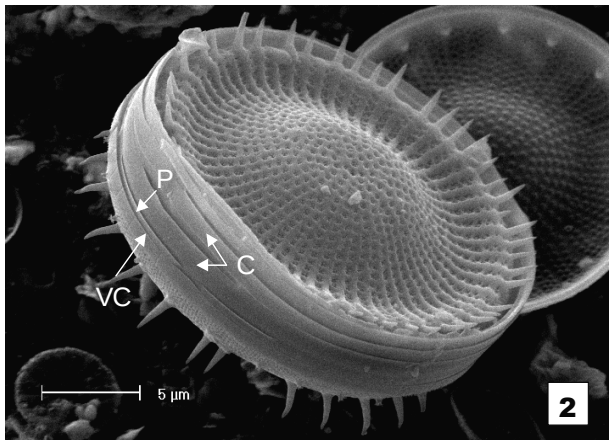
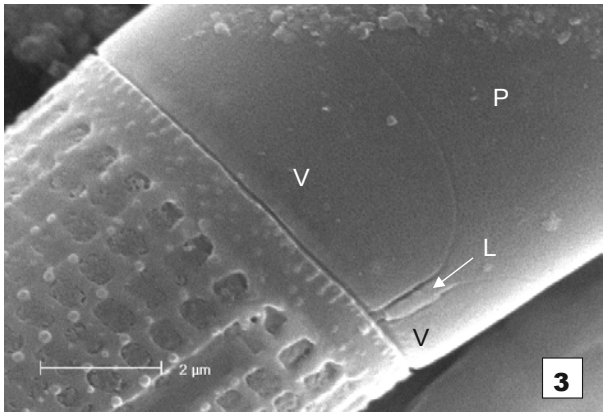


Fig. 1: *Cocconeis pediculus*, showing the most simple for of median raphe - round central (CP) and distal pores (TP) delimit the raphe slit (RS) proximally and distally.
Fig. 2: *Navicula cryptotonella* showing the elements of a median raphe, the central area (CA), raphe slit (RS), central pore (CP) and terminal fissure (TF).
Fig. 3: *Navicula* sp. showing round distal broadening of the terminal fissure (arrow).
Fig. 4: *Gomphonema parvulum* showing the internal dorsal deflection of the raphe slit (arrow) in the central area.
Fig. 5: Apical pole of *Gomphonema parvulum* showing the terminal nodule with lip-like process the helictoglossa (arrow).
Fig. 6: Canal raphe system of *Nitzschia* sp. showing the principal elements, raphe slit (CR) and fibulae (F).

Girdle structures







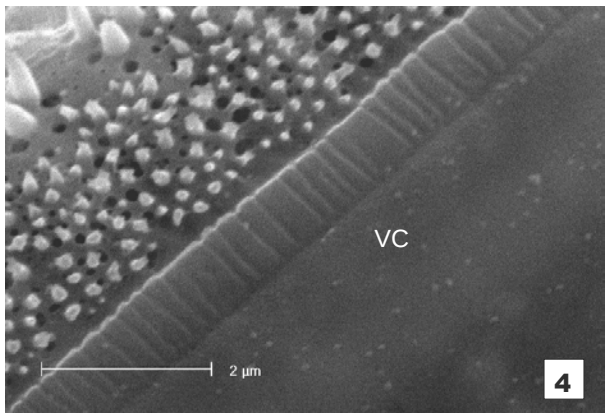
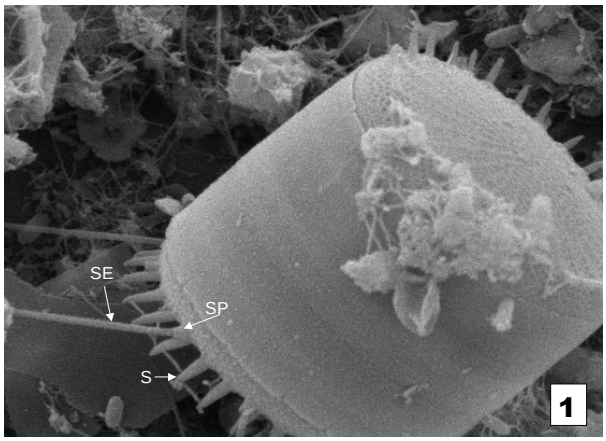


Fig. 1: Girdle view of the pennate diatom *Tabellaria floculosa* showing scattered spines (S), perforations in the girdle band (PE), and the three elements of the cingulum; the valvocopula (VC), copulae (C.) and pleura (P).
Fig. 2 *Stephanodiscus agassizensis* showing the elements of a centric girdle; the valvocopula (VC), copulae (C.) and pleura (P).
Fig 3. *Aulacoseira granulata*, showing the valvocopula (V), pleura (P) and ligula (L).
Fig. 4: Detail of the valvocopulae (VC) of *Cyclotella meneghiniana* to show crimping at the junction to the valve mantle.

Spines, connecting spines and setae



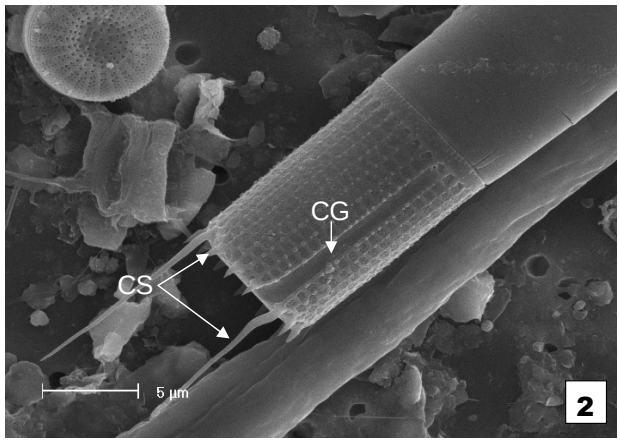


Fig. 1: *Stephanodicus hantzschii* Showing simple spines (S) and setae (SE) emanating from the marginal strutted process (SP).
Fig. 2: *Aulacoseira granulata* showing connecting spines (CS) and the connecting groove (CG) in which they lay.

Glossary

This glossary has been adapted in part from: KRAMMER K and LANGE-BERTALOT H (2000) Bacillariophyceae. 5. In: Ettl H, Gerloff J, Heynig H and Mollenhauer D (eds) Süßwasserflora von Mitteleuropa Band 2. Spektrum Akademischer Verlag, Heidelberg, Berlin.

Abbreviations – The following abbreviations were used: LM = light microscope, SEM = scanning electron microscope, TEM = transmission electron microscope.

Aerophilic – regularly found out of water-bodies, e.g. occurring in the air-water interface, and (or) temporarily living in dry habitats (moss, water-doused rocks, moist earth, vleis).
Alveoli – trough-shaped, transapical depressions on the inner side of the valve. Apically, they are delimited by the transapical ribs, and towards the valve edge by one or more rows of areolae. On the inside they are either completely open, or as in many *Pinnularia* species, partly occluded by an inner wall.
Apex – the distal tip or point of the valve in the biraphid diatoms.
Apical –in pennate diatoms it refers to the cell poles.
Apical pore-fields – group of pores at a pole (e.g. *Gomphonema*) or at both valve-ends (e.g. many araphid genera and *Cymbella* sensu stricto). Those pores not closed by vela produce a secretion which solidifies into fine threads with which the cells are fixed to an appropriate substrate.
Areolae – chamber-forming perforations, rounded to angular in cross-section, in the valve wall. They are closed either on the outside, or inside, by a velum.
Axial area – in pennate diatoms this is a puncta-free zone on either side of the apical axis.
Axial ribs – strongly developed apical ribs parallel to both raphe branches. They can be on the inside (*Frustulia rhomboides*) or on the outside (*Brachysira vitrea*) of the valve. The axial ribs are not identical with the median costa (=sternum), which runs along the entire length of the apical axis.
Canal raphe – a raphe whose fissure is in a canal-shaped hollow linked to the inner cell through a slit.
Conopeum (canopy) – a thin sheath of silica attached to the axial area. It covers the areolate portion of the valve. Cover ranges from minor to total.
Central – the valve middle.
Central area – hyaline area in the middle of the valve. In some cases this is identical with the central nodule. Frequently there is no visible border between the central and the axial areas, and thus the two form a single hyaline zone.

Central nodule – a nodular thickening, of varying degree and extent, of the median costae within the central area. In extreme cases the central nodule reaches the valve margin, and is then termed a stauros.

Chitinous setae (threads) – flexible, often very long, setae issuing usually from marginal or occasionally from central strutted processes.

Convergent – striae that radiate towards the terminal nodules. In older literature the term divergent has also been used.

Copulae – mostly open elements of the cell girdle, set aside form the other girdle elements by their structure. Copulae often contain septae.

Costae – longitudinal thickenings of the valve.

Craticula – a strongly silicified rib-system within the frustule.

Distal raphe ending - external terminus of raphe at the pole/apex.

Dorsal – in diatoms that are asymmetrical along the apical axis, it is the side whose outer margin is more convex. The other side is the ventral side.

Dorsiventral – frustules in which dorsal and ventral sides can be distinguished.

Fascia – puncta-free transapical bar in the middle of the valve. The valve surface over a stauros is always a fascia.

Fascicle - Series or groups of rows of areolae, oriented radially in centric diatoms.

Fibulae (carinal dots) – support in the form of a silica strut, bridging the raphe-bearing keel on the inner side of the valve in many species with a canal raphe. The fibulae can end in one or more transapical striae, and be solid, tubular or flattened.

Filiform raphe – in small, but also sometimes by larger species, the raphe slit appears only as a fine line as a result of the resolution limits of LM.

Fimbriate – finger like structures.

Foramen, foramina – an opening in the outer wall or chamber side-walls. The openings in the girdle are also foramina. A valve surface with foramina is perforated, in contrast to the hyaline structural elements without foramina. Thin sieve-membranes can be stretched across the foramina.

Frustule – the complete silicified cell-wall, consisting of the epi- and hypovalve.

Fultoportula – hollow processes on the outside of the valve, normally as a marginal ring; tubes with 2-5 closely associated structures ("satellite pores") that penetrate the valve wall. They can be arranged in marginal ring and/or otherwise arranged on the valve surface. Their organisation and number (including their presence and absence) are held as important taxonomic characters.

Ghost striae – the faint, indistinct striae that may be seen in the central are of some diatoms, especially in species of *Fragilaria*.

Girdle – collective term for all structural elements between two valves.

Girdle-band – general term for all open and closed bands (segments) of the cell-girdle, i.e. valvocopulae, intercalary bands.

Hyaline – description of unperforated parts of the valve, i.e. those parts lacking ornamentation (opposite: perforated).

Intercostae – the areolate and alveolate area between the transapical costae.

Lateral raphe – in the median raphe of most species, two or more lines are visible in LM. These imitate the course of the inner- and outer-fissures, and additionally in some cases, the raphe key and slot. In all of these cases the term lateral raphe is used in diagnoses.

Linking spines – mostly a large number of spines serving to link single frustules into a chain.

Longitudinal bands (longitudinal lines or furrows) – structures outside the median costa, running apically, and visible in LM. Morphologically, they are of varying structure (e.g. inner alveoli openings in *Pinnularia*, longitudinal canals in *Neidium*.

Lineolae – in LM, the foramina, or the underlying areolae appear rectangular in some species, or round in others. Lineolae is used to describe the former structure.

Linking spine – structures connecting valves in various centric and pennate diatoms that form chains. In *Aulacoseira* they can be used to delimit species.

Mantle border – imagined line separating the valve surface from the valve mantle. In many cases it is clearly defined by right – or obtuse-angled valve edges, by a hyaline area, or by a change in the form and organisation in the foramina. There are however many valves (e.g. initial cells), where such differentiation does not exist.

Marginal – near the valve edge.

Median raphe (central raphe) – raphe systems that lie in the median costa (Achnanthaceae, Naviculaceae), and that consist of two raphe branches separated by the central nodule. The raphe fissures end directly inside the cell, in contrast to a canal raphe.

Parallel – striae running at right-angles to the apical axis. The term is imprecise as radial and convergent striae are often parallel.

Polar – identical with terminal.

Pores – circular wall perforations without vela.

Portula – in canal raphes an opening in the inner wall of a raphe canal to the cell interior.

Proximal – positioned nearer to the cell middle. In the Naviculaceae, nearer the central nodule.

Proximal raphe ends - raphe ends on the central nodule (internally) and near the central portion of the valve (externally)

Pseudoseptum – short, expanded transverse walls, generally parallel to the valve-surface at the poles of some frustules.

Puncta – LM portrayal of foramina, areolae and intercostal ribs. There is no correlation between the clarity of the puncta in LM, and the species size, or number of puncta or lineolae per stria. It is thus a good and constant character. Large puncta can appear faint under conditions of poor contrast. In description, “coarsely punctate” can mean a few faint puncta/striae.

Radial striae – a striae pattern where they point away from the central nodule.

Raphe – slit-shaped opening in the valve surface, serving as an organelle for movement. All valves with raphes have two symmetrical raphe branches. In the Achnanthaceae and Naviculaceae, the raphe lies within the median costa. Species with a canal raphe however, have the raphe in the angle between the valve surface and the mantle, or raised on a specialised raphe-keel.

Raphe canal – in species with a canal raphe, the raphe ends in an apically running, tube shaped canal. This in turn connects with the inside of the cell via the alar canals or portulae.

Raphe costa – the costal structures accompanying the raphe slot on the outer and/or inner side of the valve. Particularly well developed raphe costae are called axial costae.

Raphe fissure – the arrangement of the outer and inner fissures is often taxonomically very significant.

Raphe keel – apically running solid ridge rising above the valve surface, bounded distally by a median raphe or a raphe canal with canal raphe.

Rimoportula (labiate process) – a tube penetrating the valve wall. On the outer valve surface is either only one foramen, or an elongated structure looking like a thorn in LM. The process in centric diatoms lies either near the normal marginal spines, or is displaced towards the mantle. On the inner side of the valve it takes the form of a lip-like shaped structure.

Ringleiste – circular ledge or shelf running around the inside of the valve.

Septum – in contrast to the pseudoseptum, the septum is not attached to the valve, but to the copulae, and is flat to undulating.

Stauros - central nodule (more heavily silicified) expanded to valve mantle.

Sternum – the "pseudoraphe" of araphid diatoms, i.e. a puncta-free apically running stria.

Stigmata - perforation through valve face whose external opening is rounded (or nearly so) and whose internal opening is slit-like or highly modified.

Striae - rows of puncta/areolae, usually oriented along transapical axis, separated by unornamented ribs.

Terminal (polar) – at the valve ends in pennate diatoms.

Terminal nodule – a siliceous thickening at the distal ends of the raphe.

Transapical costae – costae between the median costa and the valve mantle. Under LM the striae are visible between these costae.

Transapical striae – depending on focus in LM, rows of foramina, areolae or puncta running between the transapical costae. They are described as being parallel when at ninety degrees to the apical axis, radial when angled towards the central nodule and convergent when angled away from the central nodule.

Transverse – see transapical.

Valve - siliceous part of the frustule containing most of the morphological features used to describe diatoms (taxonmically, morphologically, etc.). Each valve has two surfaces, the face and the mantle.

Valve surface – the part of the valve surrounded by the mantle. In the sausage-shaped initial cells of many pennate diatoms, the valve surface and mantle have the same structure.

Valve mantle – the side walls of the valve. In many cases it has a different structure from the valve face. Sometimes it is unperforated but may have the same structure as the valve surface. The structure of mantle may be separated from the valve face by a hyaline area.

Velum – a structured or unstructured thin silica membrane stretched across the inside of the foramen, or that closes off the inside of an areola. Cleaning with strong acid usually destroys the fine velum.

Ventral – in dorsiventral species, the less convex side.

Voight discordance/fault – shorter striae or other irregularities on one side of the axial area, usually half-way along the raphe.

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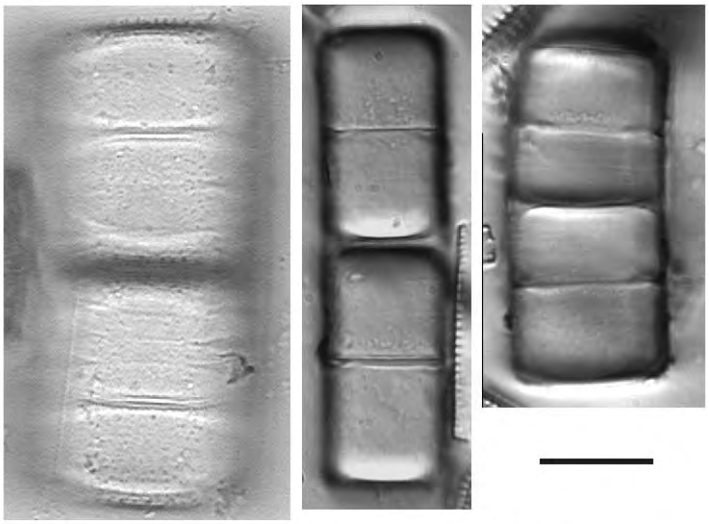
INDEX

CENTRICS

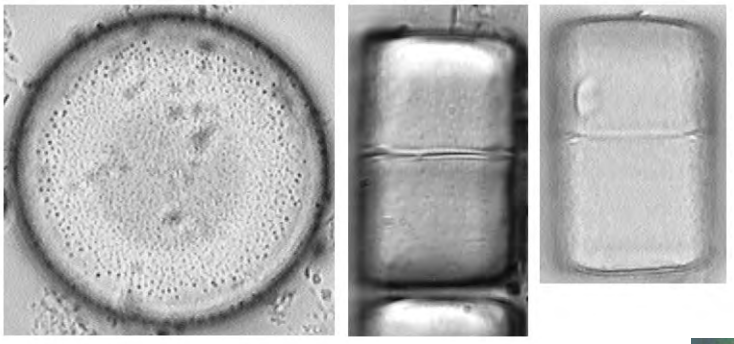
Cylindrical/filamentous taxa

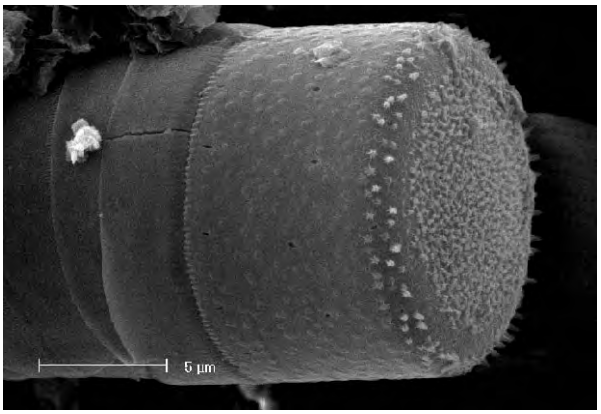
These taxa are most often seen in girdle view with the sibling valves usually remaining connected after preparation.

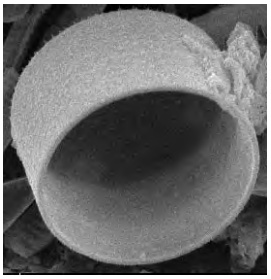
***Melosira varians* Agardh**



Dimensions:
Valve diameter = 8-35 µm
Valve mantle depth = 4-14 µm
Comments: Striae, puncta and other valve ornamentation are not clearly visible using LM, although this taxon is ornamented when viewed using SEM.
Ecology: This cosmopolitan taxon is found in both the benthos as well as the plankton and becomes particularly abundant in eutrophic, occasionally slightly brackish, waters.







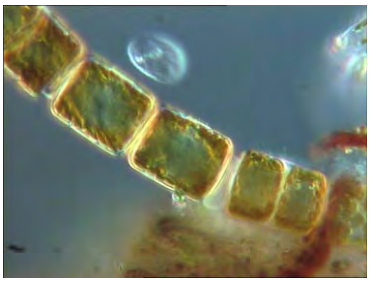


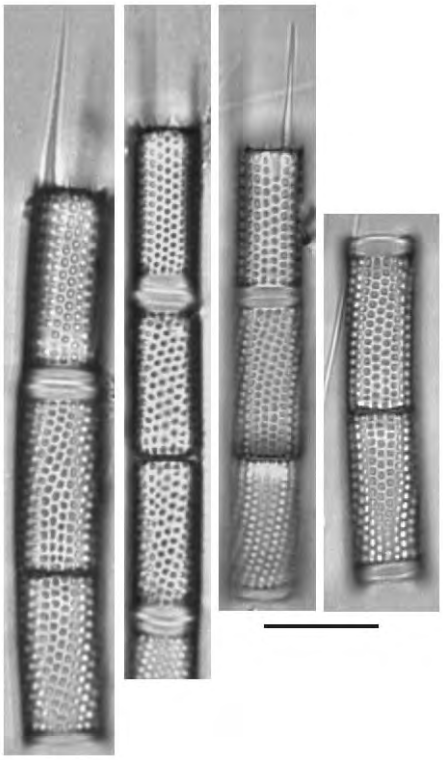
Plate 1

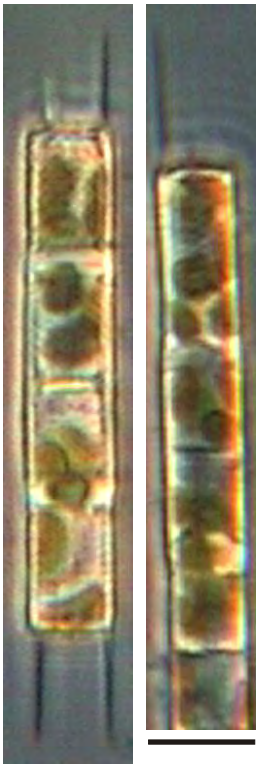
CENTRICS

Cylindrical/filamentous taxa

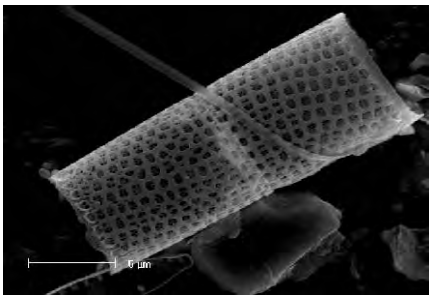
These taxa are most often seen in girdle view with the sibling valves usually remaining connected after preparation.

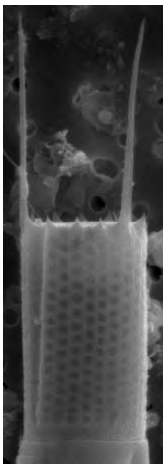
***Aulacoseira granulata* (Ehrenberg) Simonsen**

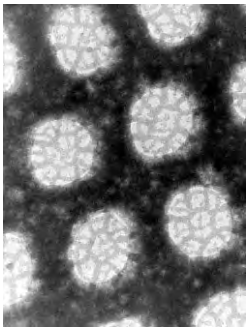




LM image of living *A. granulata* filaments







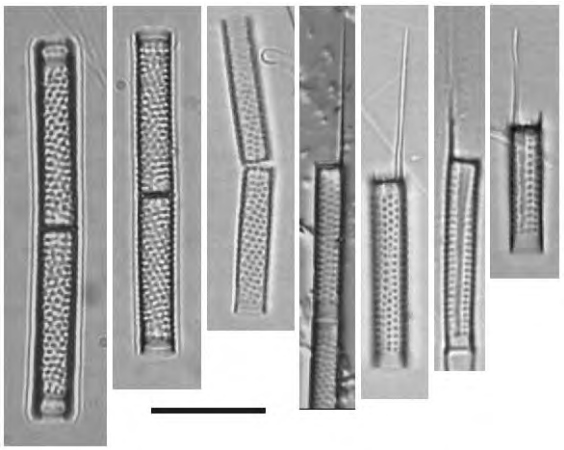
TEM image of the pore structure of *A. granulata*

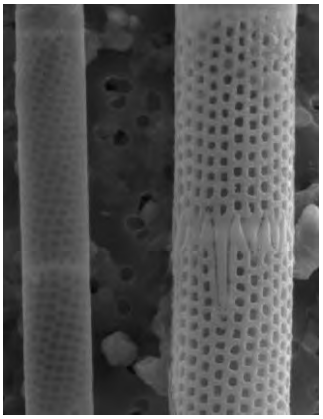
Dimensions:
Valve diameter = 4-30 µm
Valve mantle depth = 5-24 µm
Striae density = 7-15 /10 µm

Comments:
Terminal cell of filament is characterised by elongated linking spines.

Ecology: Found in both the benthos and plankton of eutrophic rivers and lakes.

***Aulacoseira granulata* var. *angustissima* (O Müller) Simonsen**





SEM image of *A. granulata* (right) and *A. granulata var. angustissima* (left) side by side

Dimensions:
Valve diameter = 3-5 µm
Valve mantle depth = 5-24 µm
Striae density = 7-15 /10 µm

Comments:
Distinguished from nominate species by smaller cell diameter.

Ecology:
The same as the nominate species.

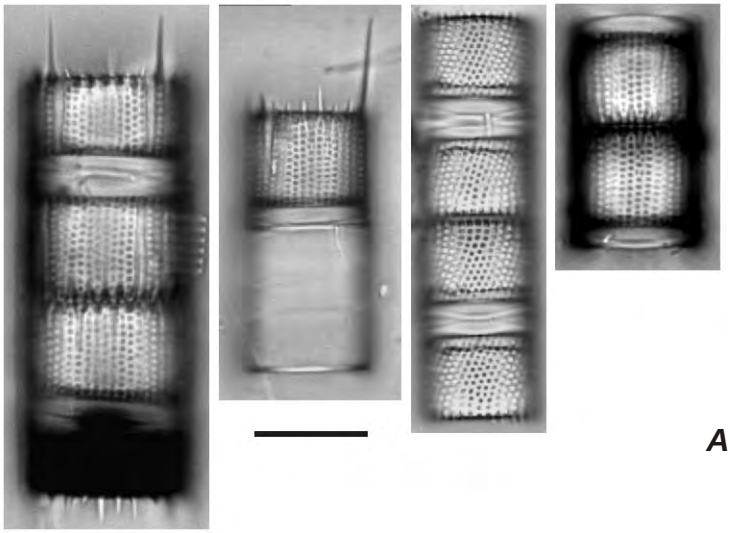
Plate 2

CENTRICS

Cylindrical/filamentous taxa

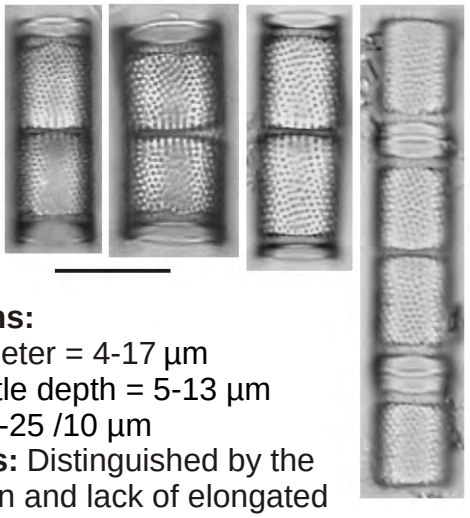
These taxa are most often seen in girdle view with the sibling valves usually remaining connected after preparation.

Aulacoseira muzzanensis **(Meister) Krammer**



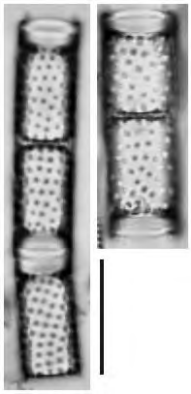
Dimensions:
Valve diameter = 8-25 µm
Valve mantle depth = 4-8 µm
Striae = 8-21 /10 µm
Comments: Characterised by elongated linking spines, similar to, but shorter than those found in *A. granulata*. The valve mantle depth is also less than in *A. granulata*.
Ecology: A planktonic and benthic species found in eutrophic waters.

Aulacoseira ambigua **(Grunow) Simonsen**



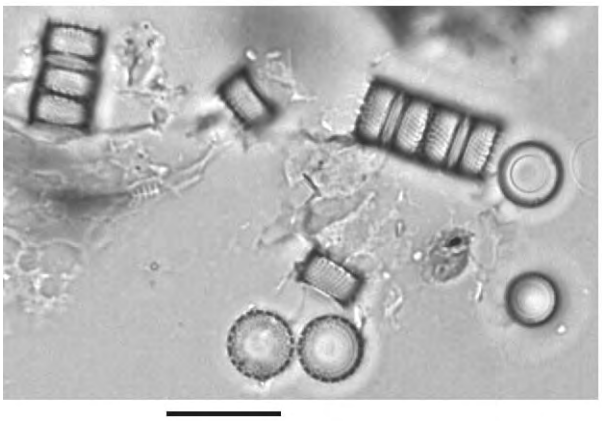
Dimensions:
Valve diameter = 4-17 µm
Valve mantle depth = 5-13 µm
Striae = 20-25 /10 µm
Comments: Distinguished by the fine striation and lack of elongated linking spines.
Ecology: Similar to *A. granulata* - found in eutrophic lakes and rivers.

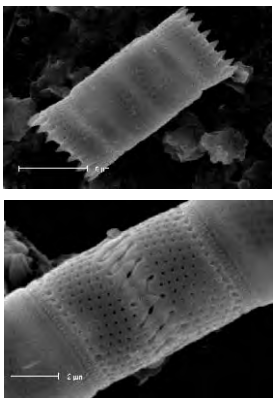
Aulacoseira crassipunctata **(Ehrenberg) Simonsen**



Dimensions:
Valve diameter = 6-10 µm
Valve mantle depth = 10-17 µm
Striae = 6-9 /10 µm
Comments: Distinguished, as the name would imply, by large clearly visible puncta.
Ecology: Found in oligotrophic lakes with a low electrolyte concentration.

Aulacoseira subartica **f. *subborealis*** **Nygaard**





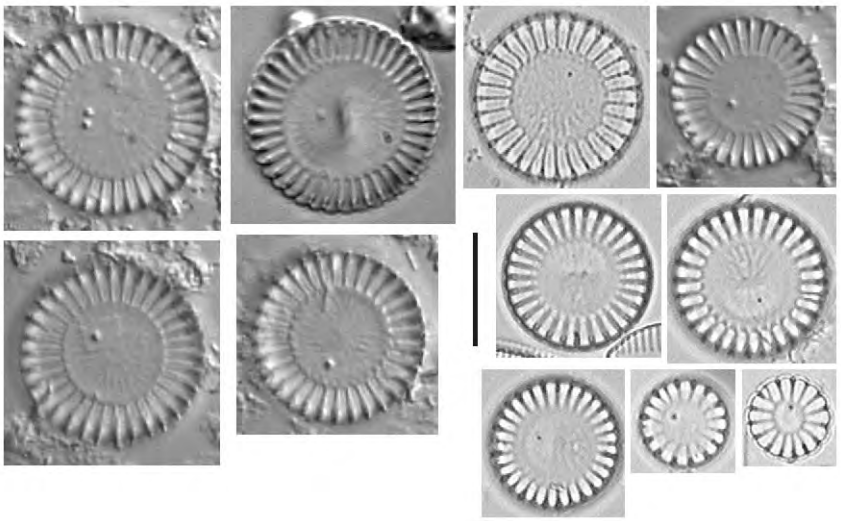
Dimensions:
Valve diameter = 5-6.5 µm
Valve mantle depth = 2.5-4 µm
Striae = 20-30 /10 µm
Comments: Cell periphery has many short pointed linking spines, valve face finely puncate near margins. Clear *ringleiste*.
Ecology: Occurs alkaline, eutrophic lakes and rivers with moderate electrolyte content.

CENTRICS

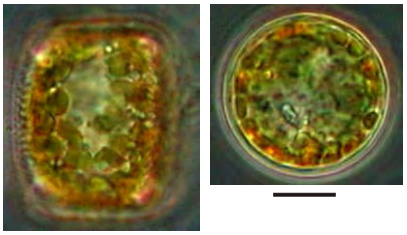
Single-celled taxa

These taxa are most often seen in valve view. The sibling valves usually separate after preparation.

***Cyclotella meneghiniana* Kützing**

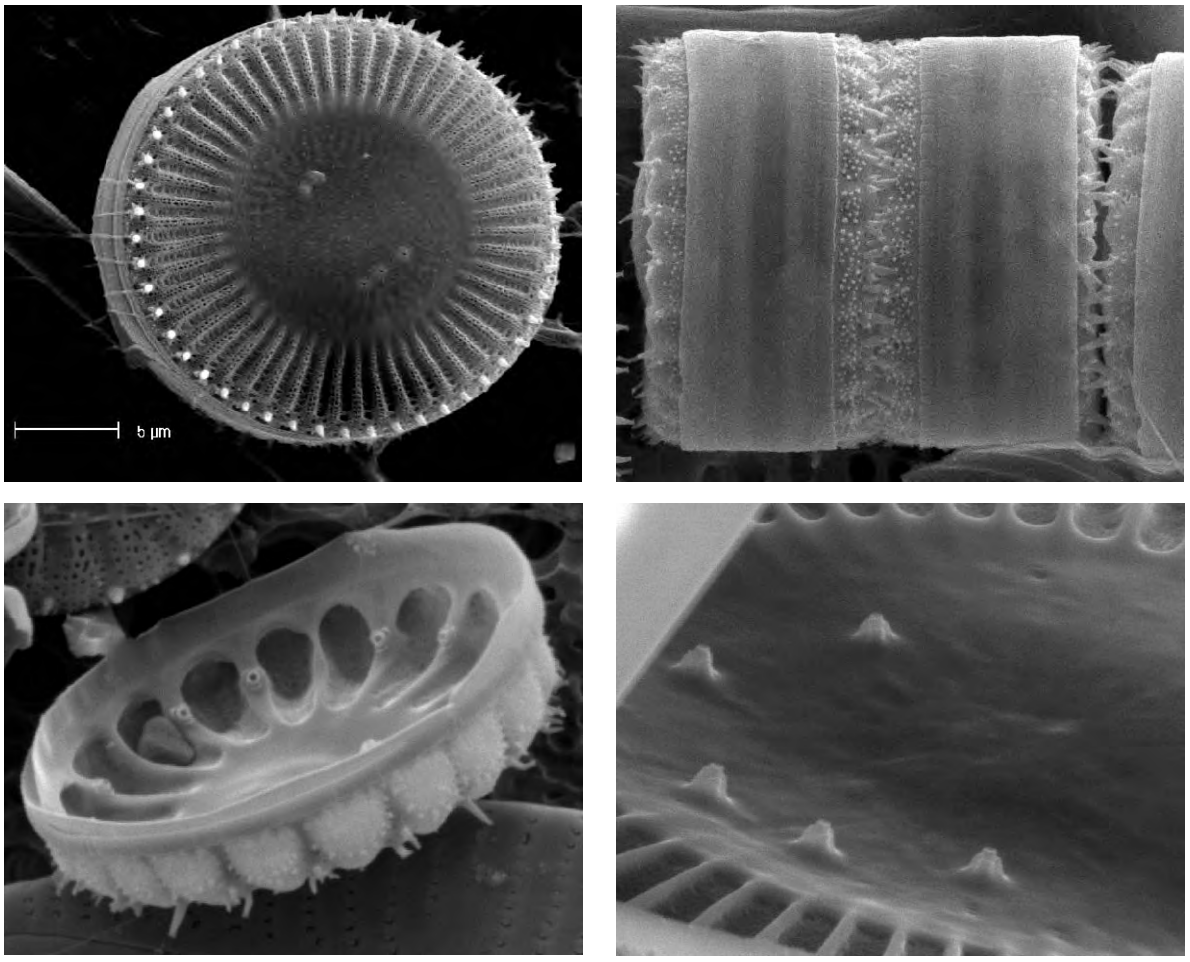


Dimensions:
Valve diameter = 5-43 µm
Striae = 6-10 /10 µm
Comments:
Characterised by an unornamented, tangentially undulate, central region with 1-5 valve face fultoportulae. The fascicles are not clearly visible in LM, but separated by interfascicular costae, each ending in a spine.
Ecology: This taxon has a cosmopolitan distribution in the benthos and plankton of eutrophic, electrolyte rich rivers, streams and lakes.



LM image of *C. meneghiniana* cells (girdle view - left, valve view - right).

SEM images of *C. meneghiniana* showing linked cells (top right), the interior openings of the valve mantle fultoportulae (bottom left) and the interior openings of the valve face fultoportulae (bottom right).

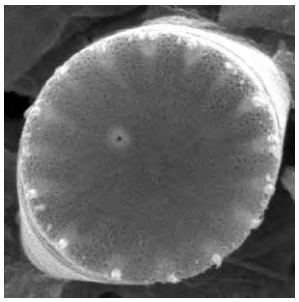


CENTRICS

Single-celled taxa

These taxa are most often seen in valve view. The sibling valves usually separate after preparation.

Cyclotella atomus Hustedt

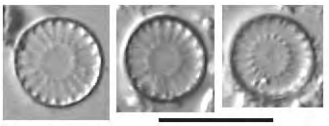


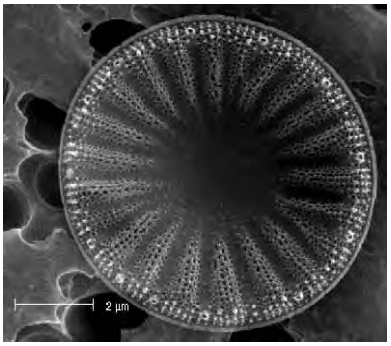
Dimensions:
Valve diameter = 3.5-7 µm
Stria/10 µm = 16-20

Comments:
This taxon has a flat unornamented central area not clearly distinguished from the peripheral fascicles. *C. atomus* is characterised by the thickening of every third to seventh fascicle and the presence of a single valve face fultoportula, which may be clearly seen with LM

Ecology: Occurs in the plankton of electrolyte rich waters.

Cyclotella medunae Germain



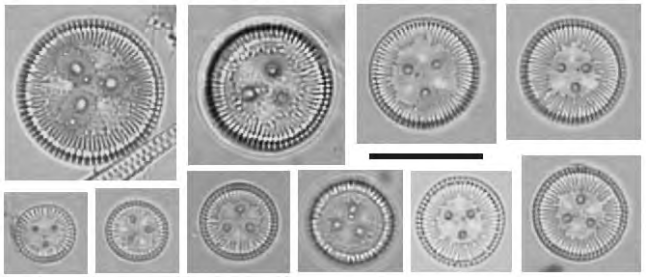


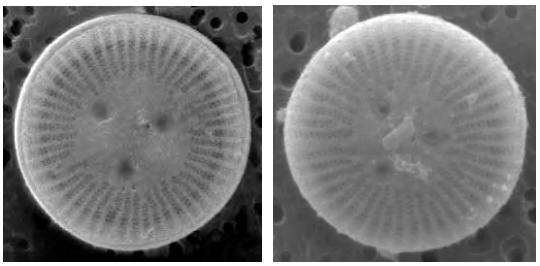
Dimensions:
Valve diameter = 5-11
Stria/10 µm = 6-10

Comments:
Characterised by an unornamented central area, clearly distinguished from the peripheral fascicles. The central region is NOT perforated by a valve face fultopotula.

Ecology: This taxon has a cosmopolitan distribution in the benthos and plankton of eutrophic, electrolyte rich rivers, streams and lakes.

Cyclotella ocellata Pantocsek



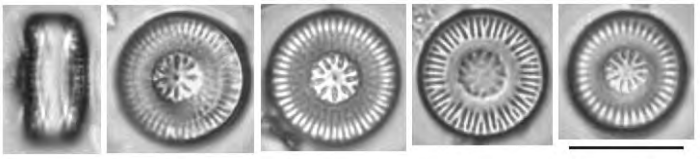


Dimensions:
Valve diameter = 6-25 µm
Stria/10 µm = 6-10

Comments:
Characterised by three to five (mostly 3) clearly visible depressions in the central region and costae (ribs) of an irregular length.

Ecology: Found in the plankton of rivers and lakes. This taxonoccurs in meso- to eutrophic waters with an elevated pH (optimum pH 8.4).

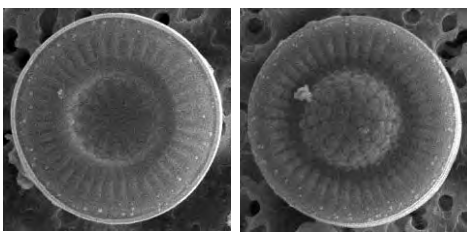
Discostella stelligera (Hustedt) Houk & Klee
Syn. *Cyclotella stelligera* Hustedt



Dimensions:
Valve diameter = 5-40 µm
Stria/10 µm = 10-14

Comments:
Characterised by concentrically undulate valve face with clearly visible stellate ornamentation. A central valve face fultoportula may also be visible.

Ecology: Found in freshwater in the plankton of inland rivers and lakes.

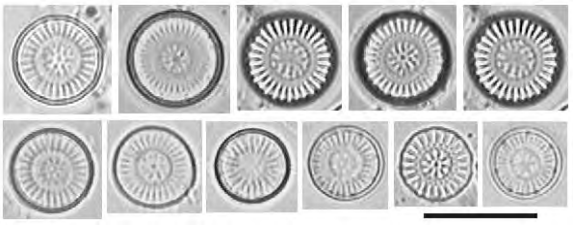


CENTRICS

Single-celled taxa

These taxa are most often seen in valve view. The sibling valves usually separate after preparation.

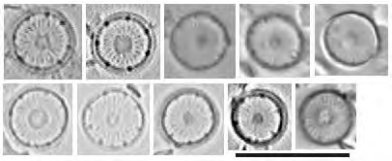
Discostella pseudostelligera (Hustedt) Houk & Klee
Syn. *Cyclotella pseudostelligera* Hustedt



Dimensions:
Valve diameter = 4-10
Striae = 18-22 /10 µm

Comments:
Characterised by concentrically undulate valve face with clearly visible stellate ornamentation. A central valve face fultoportula may also be visible. Differentiated from *D.stelligera* by a smaller diameter and less striae and external thickening of the marginal fultoportulae.
Ecology: Found in freshwater in the plankton of inland rivers and lakes.

Discostella woltereckii (Hustedt) Houk & Klee
Syn. *Cyclotella woltereckii* Hustedt

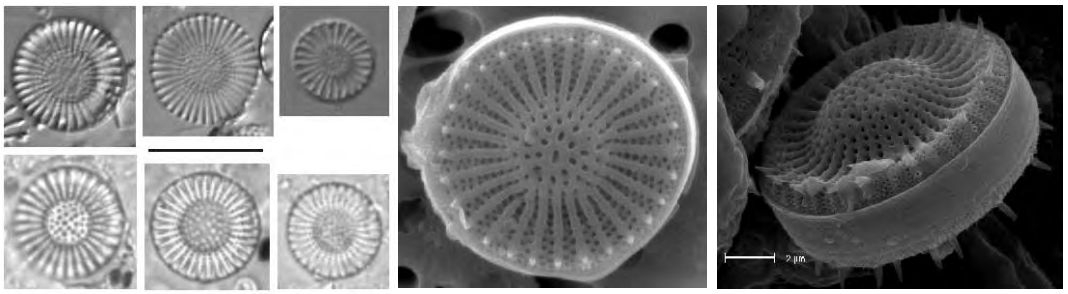


Dimensions:
Valve diameter = 8-25 µm
Valve mantle depth = 4-8 µm
Striae = 8-21 /10 µm

Comments:
Characterised by a flat valve face with weakly visible stellate ornamentation. Differentiated from *D.stelligera and D. pseudostelligera* by a smaller diameter and less striae.

Ecology: Found in freshwater in the plankton of inland rivers and lakes. It is thought this may be a form of *D. pseudostelligera* occurring in silica limited conditions.

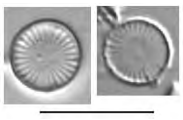
Cyclostephanos dubius (Fricke) Round



Dimensions:
Valve diameter = 4.5-35 µm
Striae = 12-18 /10 µm

Comments:
Concentrically undulate cells with a clearly differentiated irregularly punctate central region. Strong radial costae are visible in LM.
Ecology: A euplanktonic species found in inland waters with elevated chloride concentration as well as calcareous, alkaline waters.

Cyclostephanos invisitatus (Hohn & Hellerman)
Theriot, Stoermer & Håkansson



Dimensions:
Valve diameter = 6.4-14 µm
Striae = 15-20 /10 µm

Comments:
Radial costae faintly visible with a differentiated central region.
Ecology: Found in the plankton of fresh waters with elevated electrolyte content.

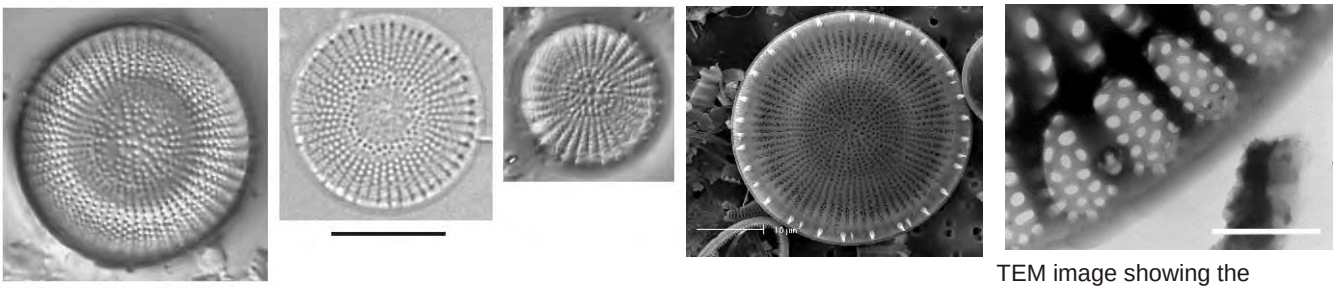
Plate 6

CENTRICS

Single-celled taxa

These taxa are most often seen in valve view. The sibling valves usually separate after preparation.

Stephanodiscus agassizensis Håkansson & Kling

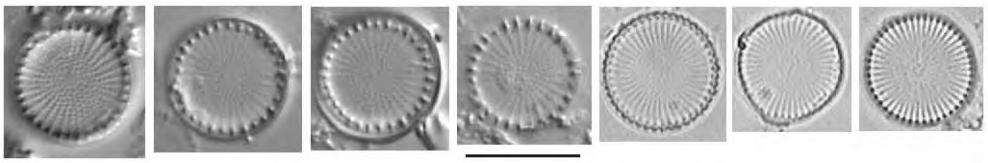


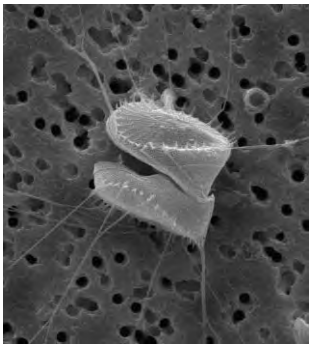
TEM image showing the structure of the valve mantle. Note the finley punctate cribra occluding the areolae, the marginal fultoportula can also be seen.

Comments: Relatively large valves with costae extending almost to the centre of the concentrically undulate valve face. The areolae are clearly visible, with the fascicles composed of single rows of areolae near the valve centre becoming 2 or 3 rows towards the valve mantle. Spines are present on every 1st to 3rd costa.
Ecology: A planktonic species found in eutrophic rivers and lakes with an elevated electrolyte concentration and turbidity.

Dimensions:
Valve diameter = 7-41.2 µm
Striae = 5-14 /10 µm

Stephanodiscus hantzschii Grunow



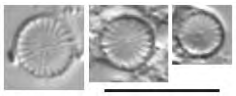


SEM image of *S. hantzschii* showing radiating chitenous threads.

Dimensions:
Valve diameter = 5-30 µm
Stria/10 µm = 20-25

Comments:
Characterised by a planar valve face with radiating interfascicular costae terminating in spines at the junction of the valve face and mantle. No distinct central region. Areolae clearly visible in LM.
Ecology: A planktonic taxon found in rivers and lakes with elevated electrolyte concentrations.

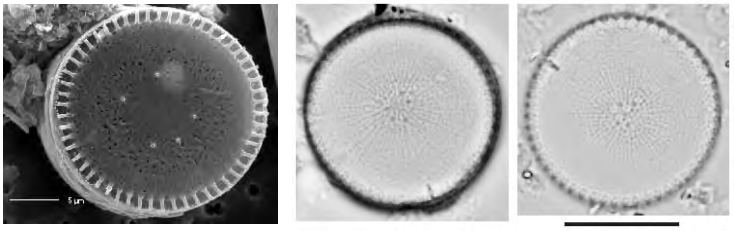
Stephanodiscus minutulus (Kützing) Cleve and Möller



Dimensions: Valve diameter = 2-12 µm

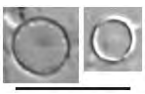
Comments: Weakly visible costae terminating in spines.
Ecology: Found in strongly polluted water with a high electrolyte content.

Thalassiosira weissflogi (Grunow) Fryxell & Hasle



Dimensions:
Valve diameter = 4-32 µm
Comments: Characterised by several valve face fultoportulae (2-15) found in the central region. A ring of fultoportulae is present at the junction of the valve face and mantle.
Ecology: A halophilic riverine species.

Thalassiosira pseudonana Hasle & Heimdal



Dimensions:
Valve diameter = 2.5-9 µm

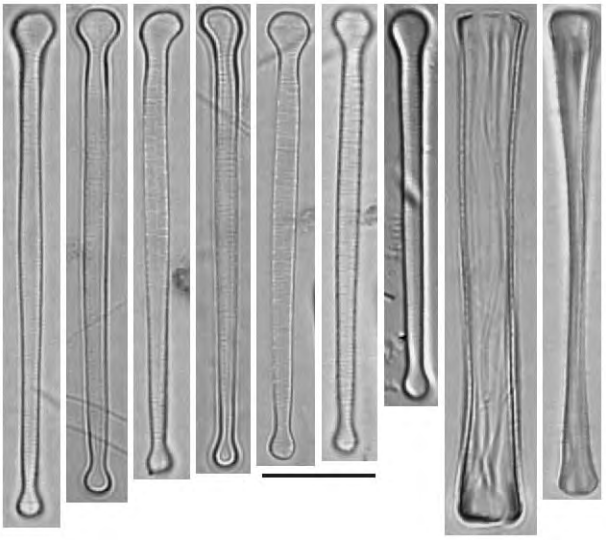
Comments: Valve face planar with poorly visible structures. Characterised by a marginal row of fultoportulae and a single valve face fultoportula at the centre of the valve.
Ecology: Halophilic planktonic taxon.

ARAPHIDEAE

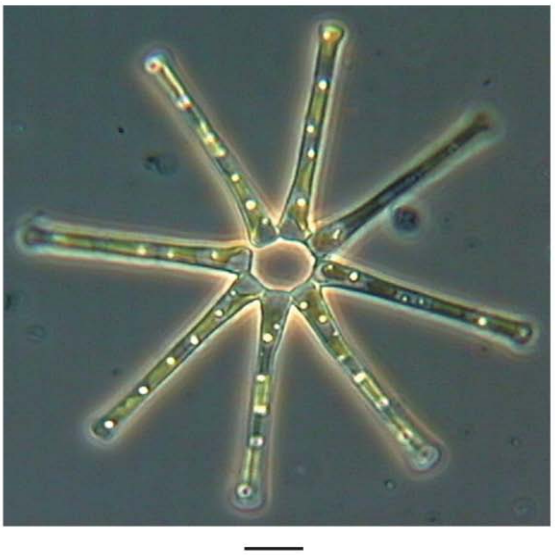
Taxa with no true raphe system

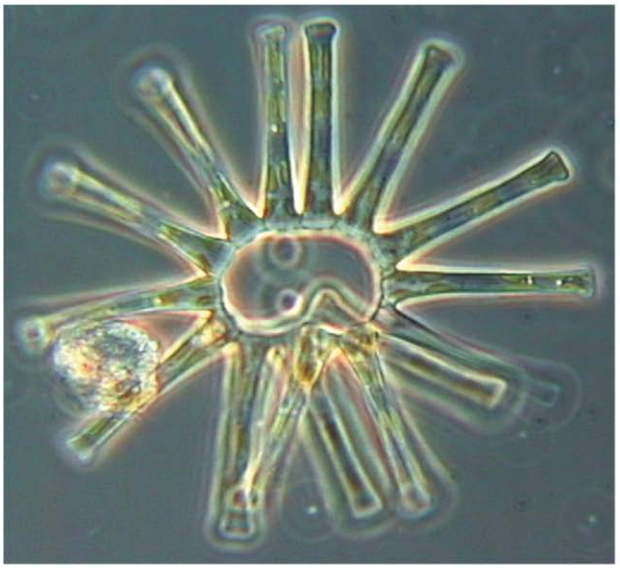
These taxa have a rimoportula at the apex of the valve

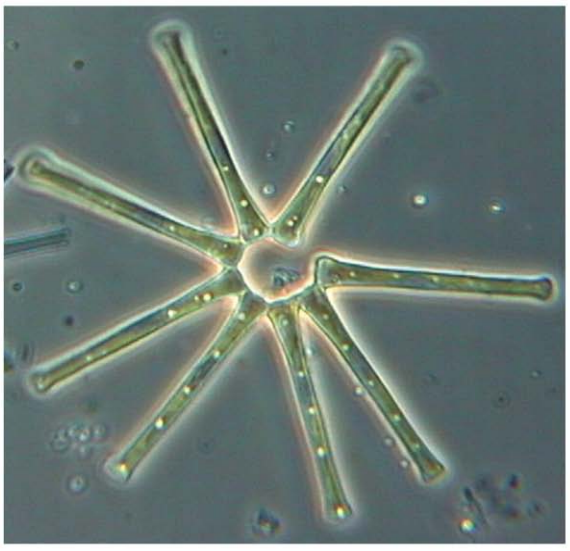
***Asterionella formosa* Hassal**



Dimensions:
Valve length = (30-)40-80(-160) µm
Valve breadth = 1.3-6 µm
Striae density = 24-28 /10 µm
Comments: Valves are elongate and "bone-shaped" with one apex larger than the other. In girdle view the basal pole is slightly lager than the other.
Ecology: Widely distributed in the plankton of eutrophic lakes and rivers. Cells are attached by the larger basal pole to form stellate colonies.







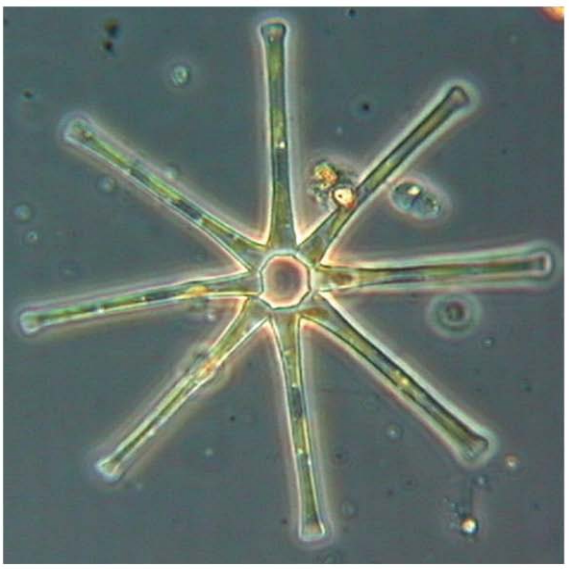


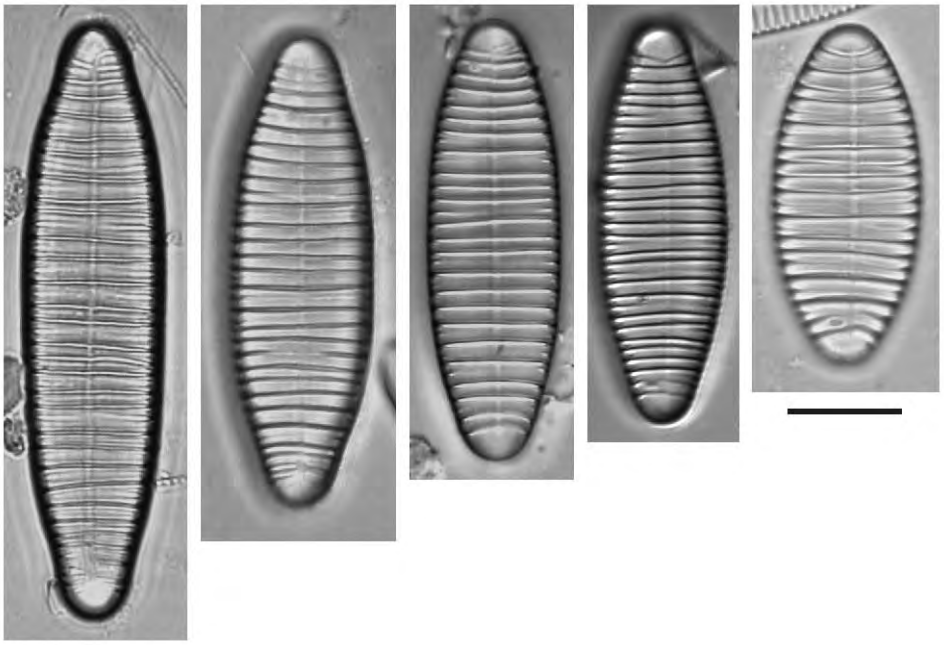
Plate 8

ARAPHIDEAE

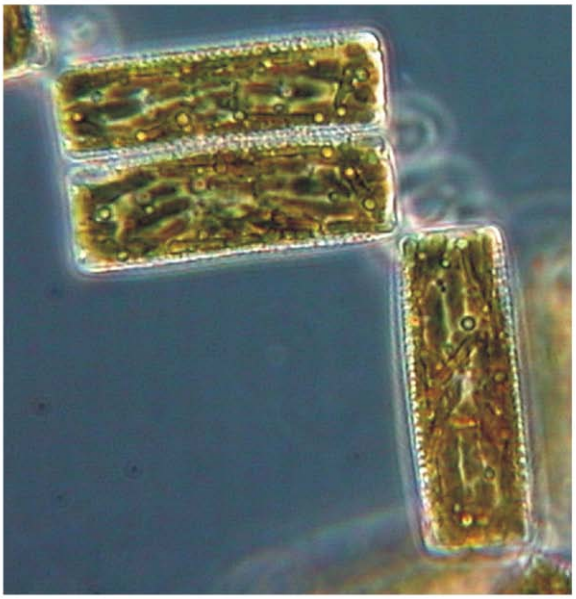
Taxa with a pseudoraphe

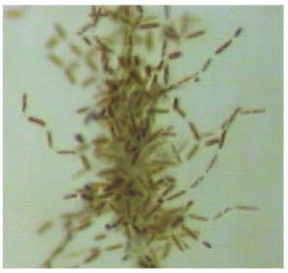
These taxa have a rimoportula at the apex of the valve

***Diatoma vulgaris* Bory**

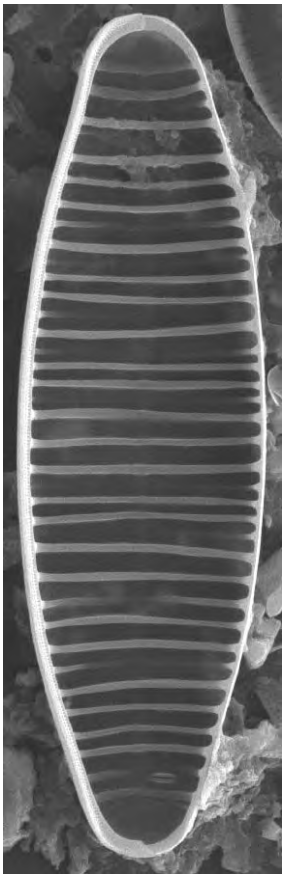


Dimensions:
Valve length = 8-75(60) µm
Valve breadth = 7-18 µm
Striae density = >40 /10 µm (i.e. not visible in LM)
Costae density = 5-12 / 10 µm
Comments: Valves are lanceolate to elliptical with a very narrow axial area. This taxon is characterised by thickened transverse costae.
Ecology: Found in mesotrophic to eutrophic waters with average electrolyte content. The cells are joined at the corners forming zig-zag colonies.





Typical colony formation in *D. vulgaris*. Cells are joined at the corners by mucilage pads forming zig-zag colonies .



SEM images showing the internal structure of *D. vulgaris* including the costae and rimoportula.

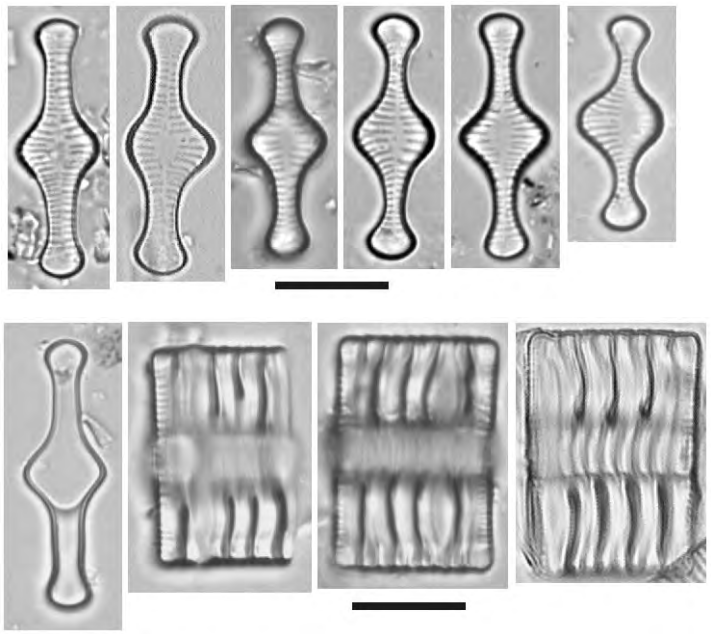
Plate 9

ARAPHIDEAE

Taxa with a pseudoraphe

This taxon has a rimoportula at the centre of the valve

***Tabellaria flocculosa* (Roth) Kützing**



Dimensions:
Valve length = 6-130 µm
Valve breadth = 3.8-8.5 µm
Striae density = 13-20 /10 µm
Comments: Valves are cruciform in valve view. The axial area is narrow, widening at the centre of the cell. A rimoportula is present to one side of the axial area. The valves are connected by a number of girdle bands with asymmetrical septae.
Ecology: This taxon flourishes in electrolyte-poor, oligotrophic, circumneutral or slightly acidic waters. The cells are linked at the corners forming zig-zag colonies which may be attached or planktonic in lakes, pools and streams.

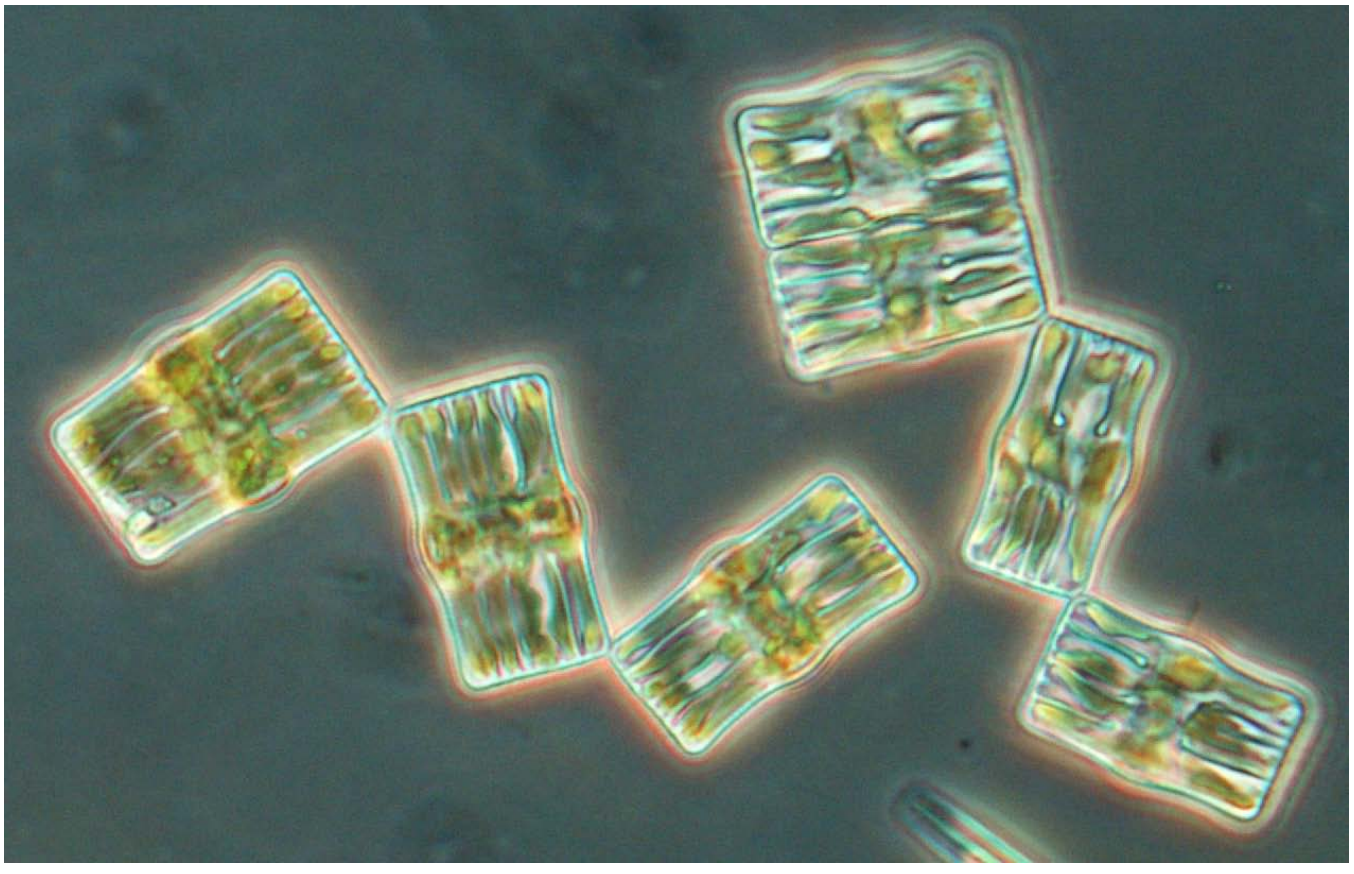


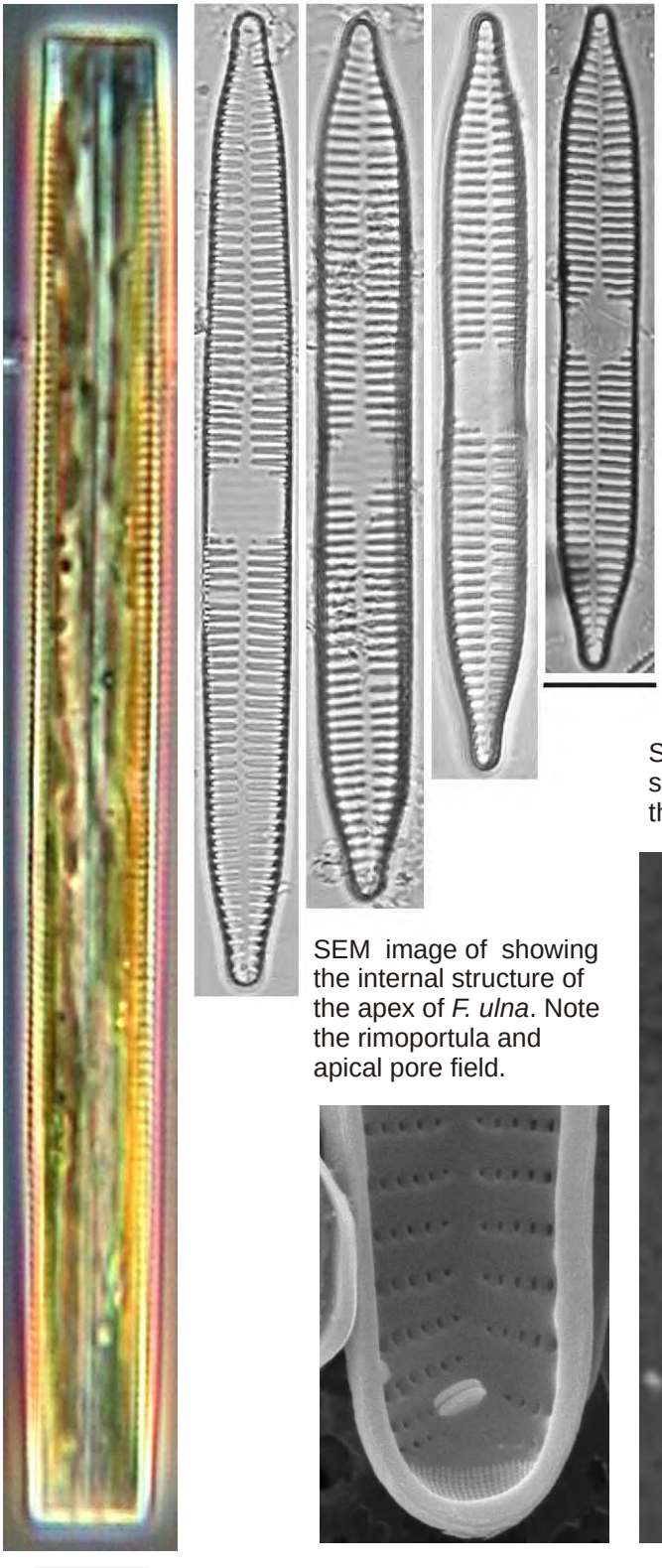
Plate 10

ARAPHIDEAE

Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve

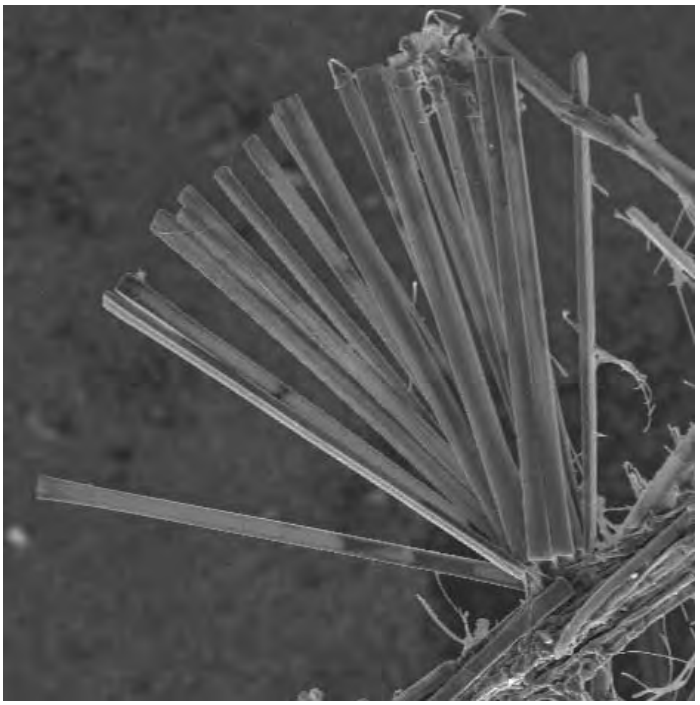
***Fragilaria ulna* (Nitzsch) Lange-Bertalot**
Syn. *Synedra ulna* (Nitzsch) Ehrenberg



Dimensions:
Valve length = (27)50-250(600) µm
Valve breadth = (1.5)2-9 µm
Striae density = 7-15(24) /10 µm
Comments:
Valves are linear with cuneate poles and sub-capitate apices. A well defined hyaline area is present at the centre of the cell in which ghost striae may be visible. Rectangular in girdle view. Living cells are usually apically attached to a substratum by a mucilage pad or free living.
Ecology:
This cosmopolitan taxon is found in the benthos of rivers and lakes and is easily suspended in the plankton due to its relatively large surface area. Often found in mesotrophic to eutrophic, alkaline waters.

SEM image of showing the internal structure of the apex of *F. ulna*. Note the rimoportula and apical pore field.

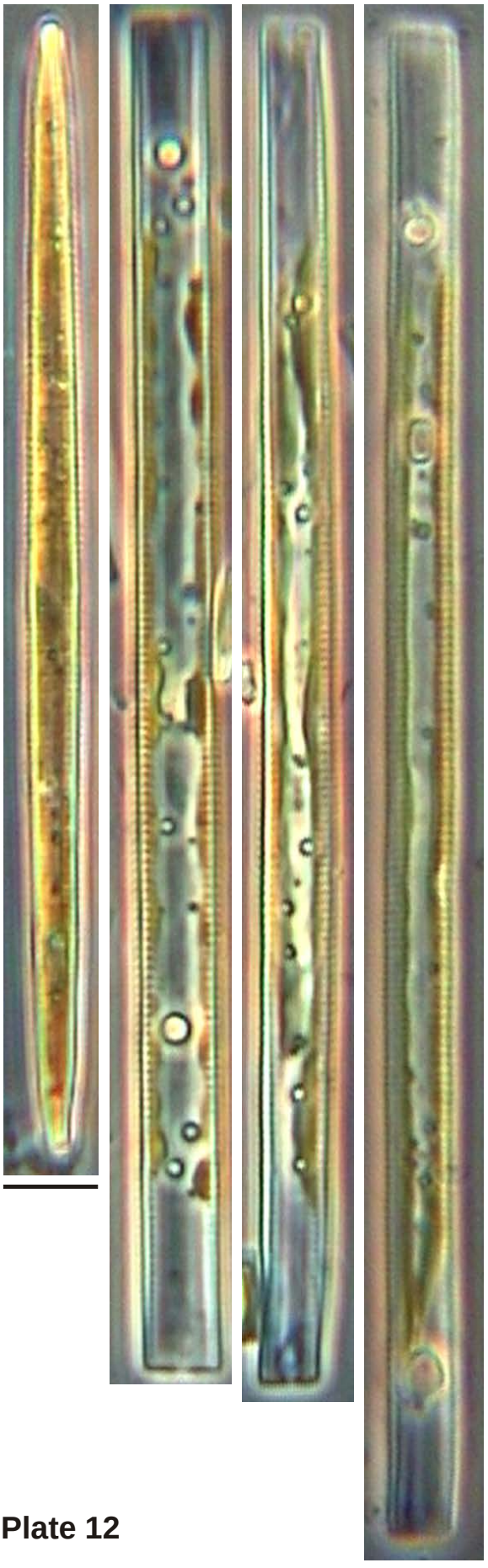
SEM image of valves *F. ulna* apically attached to substratum material. Note the rectangular appearance of the valves in girdle view.

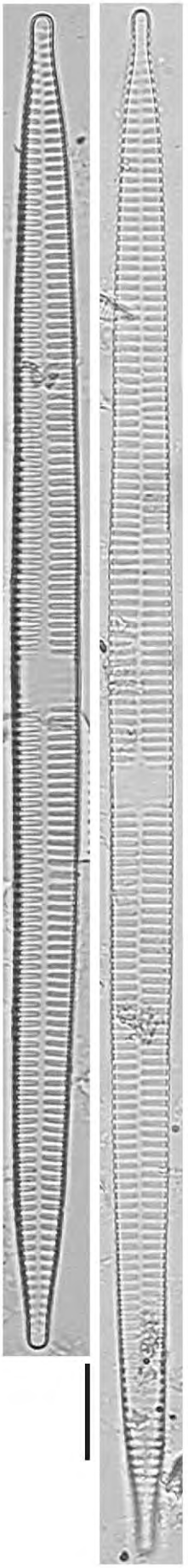


ARAPHIDEAE

Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve





***Fragilaria ulna* var. *acus* (Kützing) Lange-Bertalot**
Syn. *Synedra acus* Kützing

Dimensions:
Valve length = (27)50-250(600) µm
Valve breadth = (1.5)2-9 µm
Striae density = 7-15(24) /10 µm

Comments:
Valves are needle-like with sub-capitate apices. A well defined hyaline area is present at the centre of the valve in which ghost striae may be visible.

Ecology:
This cosmopolitan taxon is found in the benthos of rivers and lakes and is easily suspended in the plankton due to its relatively large surface area. Found in mesotrophic to eutrophic, alkaline freshwaters. Living cells are usually apically attached to a substratum.

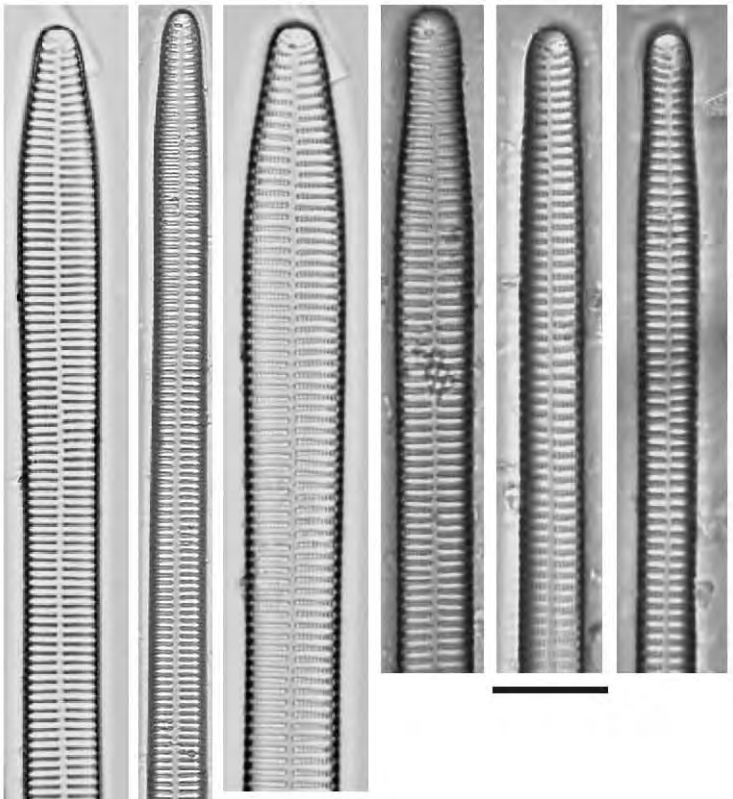
LM image of showing of the radial colonies *F. ulna* var. *acus.* The valves are apically attached by means of a common mucilage pad.

Plate 12

ARAPHIDEAE

Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve

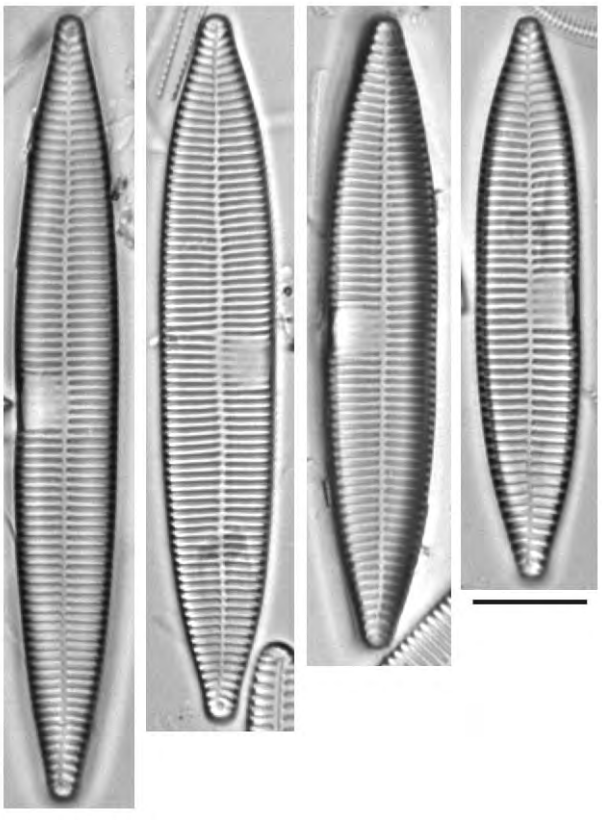


***Fragilaria biceps* (Kützing) Lange-Bertalot Syn. *Synedra ulna* var. *biceps* (Kützing) Kirchner in Cohn**

Dimensions:
Valve length = 160-750 µm
Valve breadth = 7-10 µm
Striae density = 7-9 /10 µm
Comments:
Valves are linear with rounded, sub-capitate or capitate apices. The central area is small, hyaline and poorly defined. Striae are composed of a single row of easily discernible puncta. Rectangular in girdle view.

Ecology:
This cosmopolitan taxon is found in the benthos of rivers and lakes and is easily suspended in the plankton due to its relatively large surface area. Often found in mesotrophic to eutrophic waters together with *F. ulna.* Living cells are usually apically attached to a substratum by a mucilage pad or free living.

***Fragilaria ungeriana* Grunow**



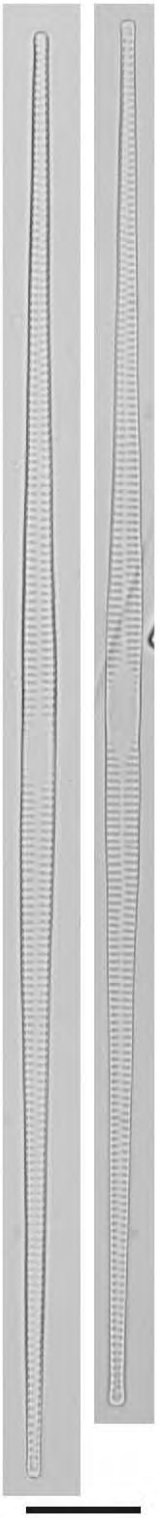
Dimensions:
Valve length = 65-135 µm
Valve breadth = 6.5-7.5 µm
Stria density = 9-11 striae /10 µm
Comments:
Valves are linear with cuneate poles and sub-capitate apices. A well defined hyaline area is present at the centre of the valve, reaching one valve margin only. Ghost striae may be visible in the hyaline area.
Ecology:
Cells attached face to face. Found in tropical and sub-tropical, weakly alkaline, oxygen-rich waters.

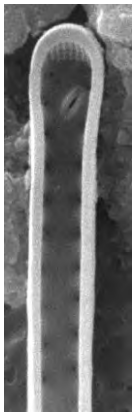
ARAPHIDEAE

Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve

Fragilaria tenera (WM Smith) Lange-Bertalot
Syn. *Synedra tenera* WM Smith



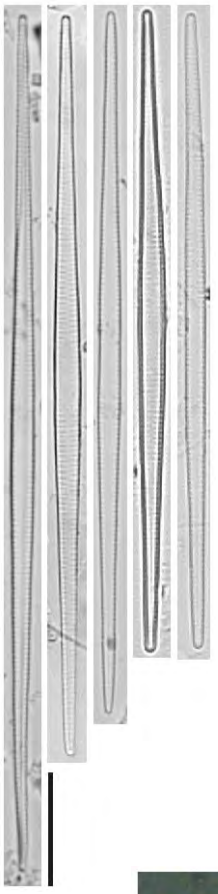


SEMimage showing the internal structure of the apex of *F. tenera*. Note the rimoportula and apical pore field.

Dimensions:
Valve length = 30-100 µm
Valve breadth = 2-3 µm
Stria density = 17-20 /10 µm

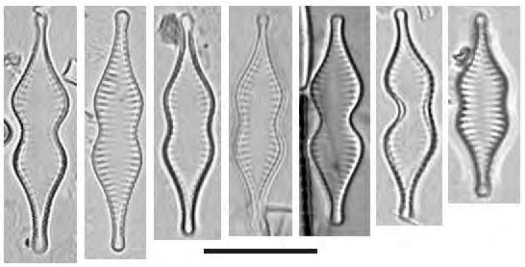
Comments:
Valves are needle shaped with narrow rounded apices. A well defined hyaline area is present at the centre of the cell in which ghost striae may be visible.
Ecology: This cosmopolitan taxon is found in the benthos of rivers and lakes and is easily suspended in the plankton due to its relatively large surface area. Often found in mesotrophic to eutrophic waters.

Fragilaria nanana Lange-Bertalot
Syn. *Synedra nana* Meister



Dimensions:
Valve length = 40-90 µm
Valve breadth = 1.5-2 µm
Stria density = 22-25(30) striae /10 µm
Comments: Valves are needle shaped with narrow rounded apices. A well defined, broad hyaline area is present at the centre of the cell. Striae weakly visible.
Ecology: A cosmopolitan species found in the plankton of oligotrophic lakes.

Fragilaria parasitica var. *constricta* Grunow
Syn. *Synedra binodis* (Ehrenberg) Chang & Steinberg



Dimensions:
Valve length = 10-25 µm
Valve breadth = 3-5 µm
Striae density = 16-20 /10 µm

F. parasitica var. *constricta* attached to *Surirella* sp.

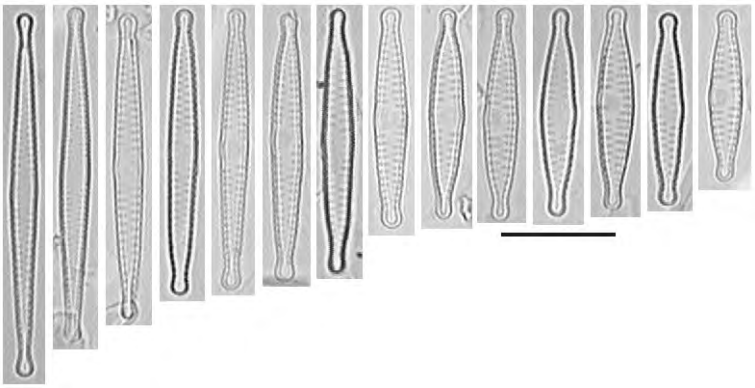
Comments: Valves are characterised by protracted capitate apices, a broad axial area and slight to pronounced central constriction of the valve.
Ecology: A cosmopolitan benthic taxon found in meso-eutrophic, circumneutral waters. Often found attached to other algae, including other diatoms.

ARAPHIDEAE

Taxa with a pseudoraphe

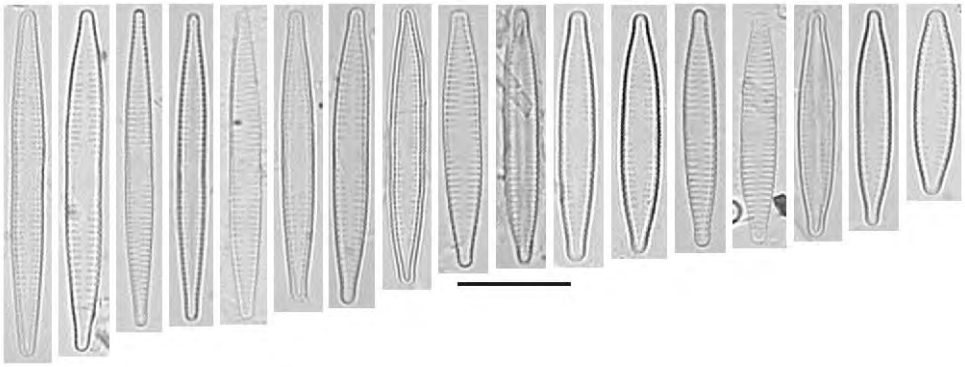
These taxa have no raphe system and may possess a rimoportula at the apex of the valve

Fragilaria capucina Desmazières



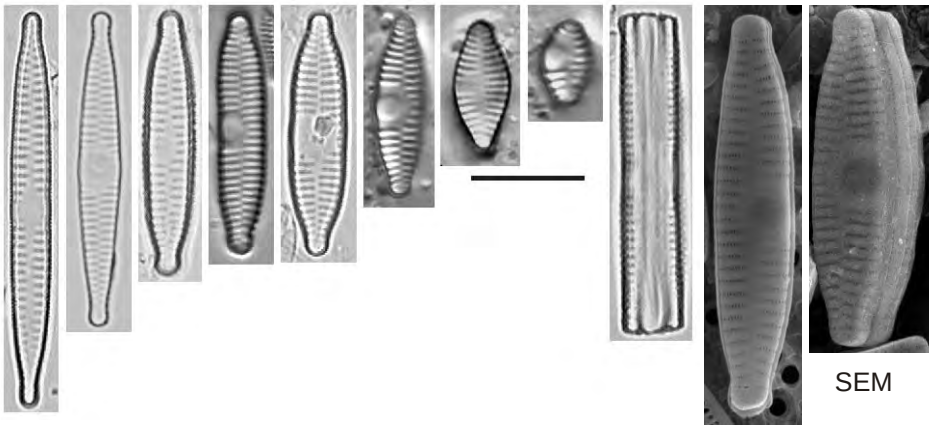
Dimensions:
Valve length = 10-100 µm
Valve breadth = 3.5-4.5 µm
Striae density = 12-17 /10 µm
Comments: Valves are lanceolate with sub-capitate to capitate apices. A well defined hyaline area is present at the centre of the cell which may be unilaterally or bilaterally inflated.
Ecology: This benthic cosmopolitan taxon is found in circumneutral, oligo- to mesotrophic waters with moderate electrolyte content.

Fragilaria capucina var. *rumpens* (Kützing) Lange-Bertalot



Dimensions:
Valve length = 10-100 µm
Valve breadth = 2-6.5 µm
Striae density = 18-20 /10 µm
Comments: Valves lanceolate with slightly protracted, rounded to sub-capitate apices. A well defined hyaline region is present at the centre of the cell. Striae weakly visible.
Ecology: A cosmopolitan benthic taxon in oligo- to mesotrophic fresh waters.

Fragilaria capucina var. *vaucheriae* (Kützing) Lange-Bertalot



SEM

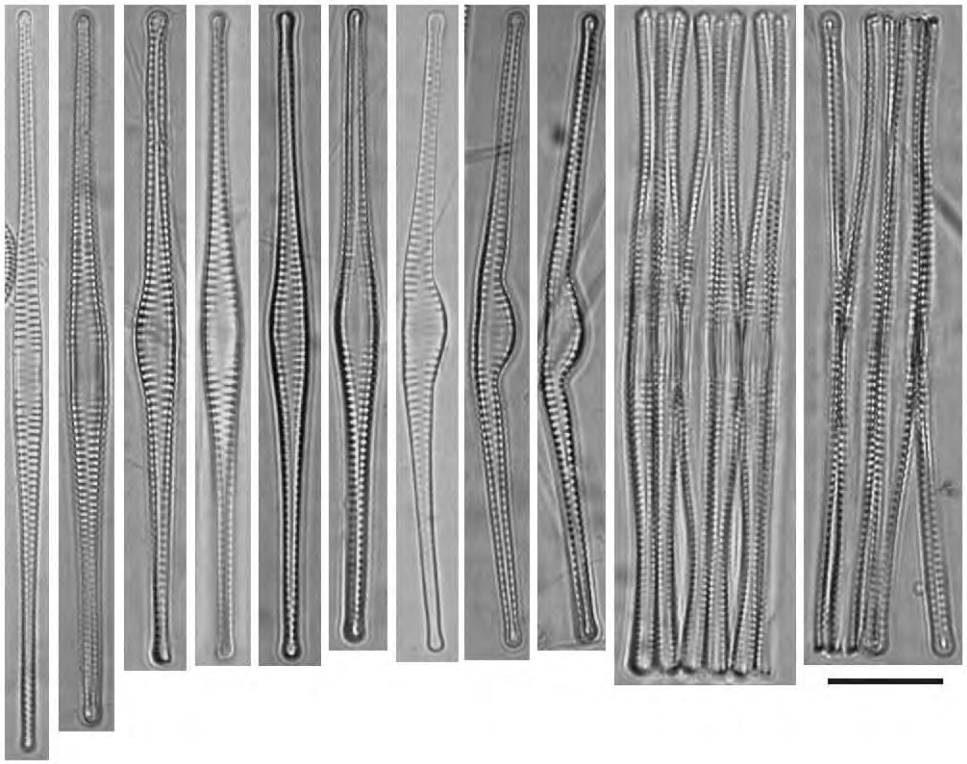
Dimensions:
Valve length = (6)10-50 µm
Valve breadth = 4-5 µm
Stria density = 9-14 striae /10 µm
Comments: Valves are linear, linear-lanceolate to elliptical with a pronounced unilateral central inflation. Distinguished by coarse striation.
Ecology: Wide ecological range, not clearly defined.

ARAPHIDEAE

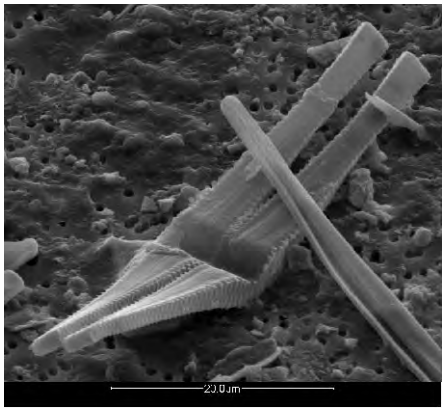
Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve

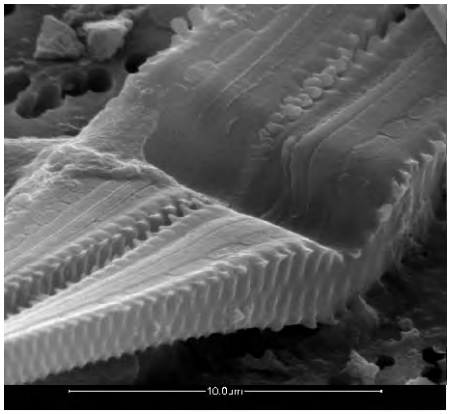
***Fragilaria crotonensis* Kitton**

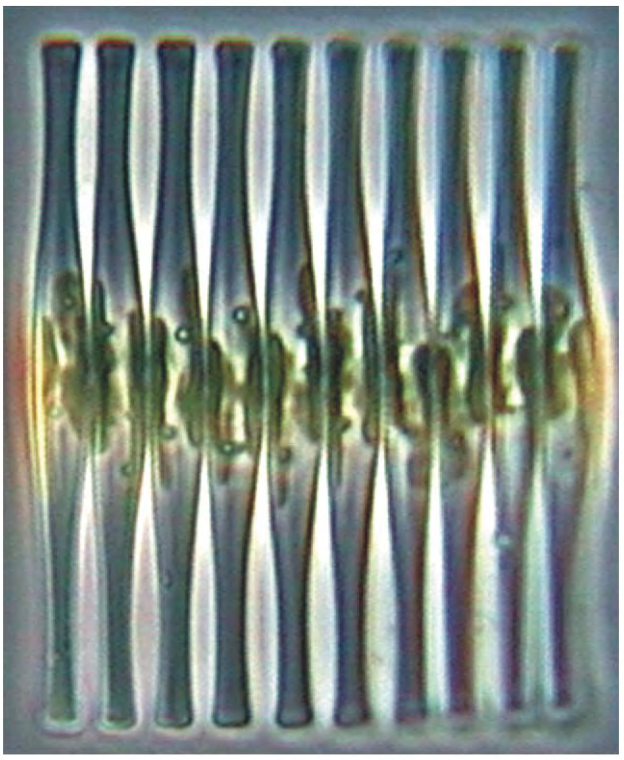


Dimensions:
Valve length = 40-170 µm
Valve breadth = 2-4(5) µm
Striae density = (11)15-18 /10 µm
Comments: Valves are narrow with capitate apices and often have either a symmetrical or asymmetrical central swelling or constriction. Sibling valves may remain linked after preparation.
Ecology: This cosmopolitan taxon is found in the plankton of lakes and standing water bodies. Occurs in oligotrophic to weakly eutrophic, slightly alkaline freshwater with moderate electrolyte content.



SEM images showing the central constriction of *F. crotonensis*. Also note the connecting spines linking the sibling valves.





Typical colony formation in *F. crotonensis*. Valves are linked in ribbon-like colonies and are usually seen in girdle view

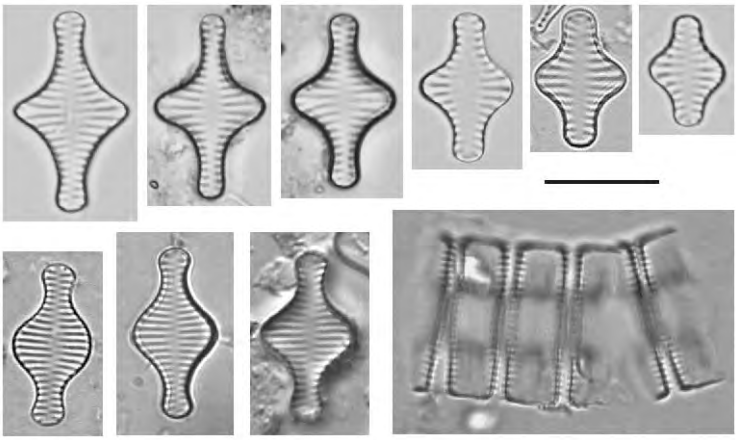
Plate 16

ARAPHIDEAE

Taxa with a pseudoraphe

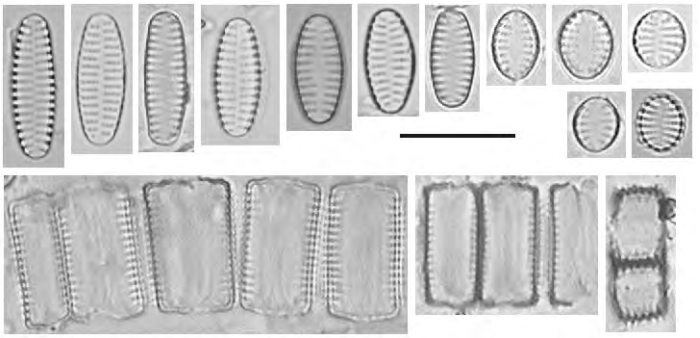
These taxa have no raphe system and may possess a rimoportula at the apex of the valve

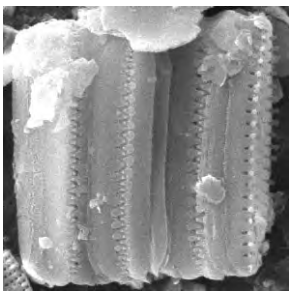
Staurosira construens Ehrenberg
Syn. *Fragilaria construens* f. *construens* (Ehrenberg) Grunow



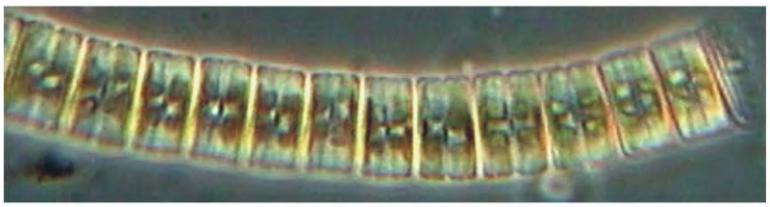
Dimensions:
Valve length = 4-35 µm
Valve breadth = 2-12 µm
Striae density = (12)14-18(20) /10 µm
Comments: Valves are cruciform with rounded apices. The striae are usually widely spaced. Valves may remain linked after preparation.
Ecology: This taxon occurs in standing waters of a good quality.

***Staurosira elliptica* (Schumann) Williams & Round**
Syn. *Fragilaria elliptica* Schumann





SEM



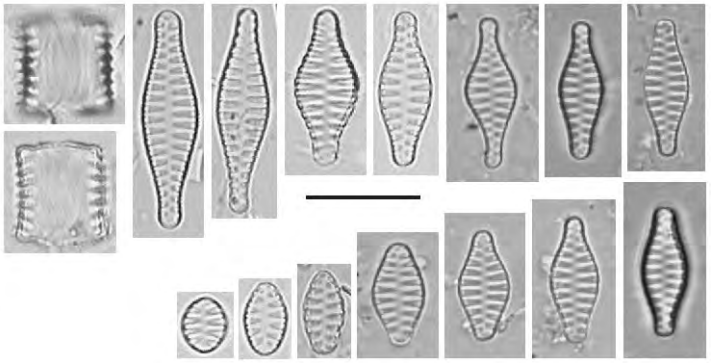
Dimensions:
Valve length = 3-10 µm
Valve breadth = 2.8-6 µm
Striae density = 11-16 /10 µm
Comments: A small species characterised by bluntly rounded, elliptical valves. Striae composed of single rows of puncta which may be visible in LM.
Ecology: Found in the benthos of electrolyte-rich fresh or brackish waters. Valves are linked by spines forming long ribbon-shaped colonies.

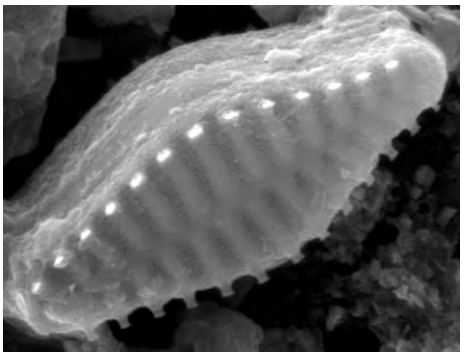
ARAPHIDEAE

Taxa with a pseudoraphe

These taxa have no raphe system and may possess a rimoportula at the apex of the valve

***Staurosirella pinnata* (Ehrenberg) Williams & Round**
Syn. *Fragilaria pinnata* Ehrenberg

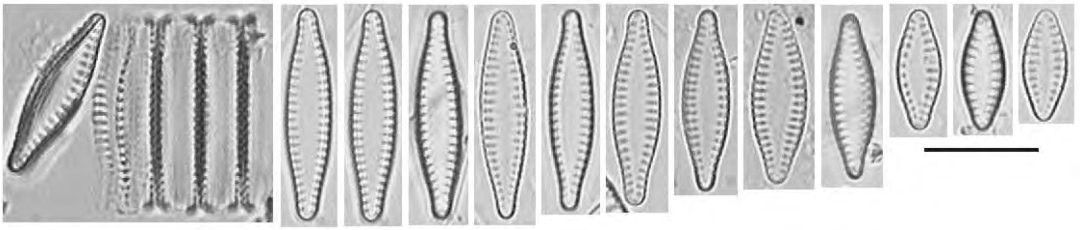


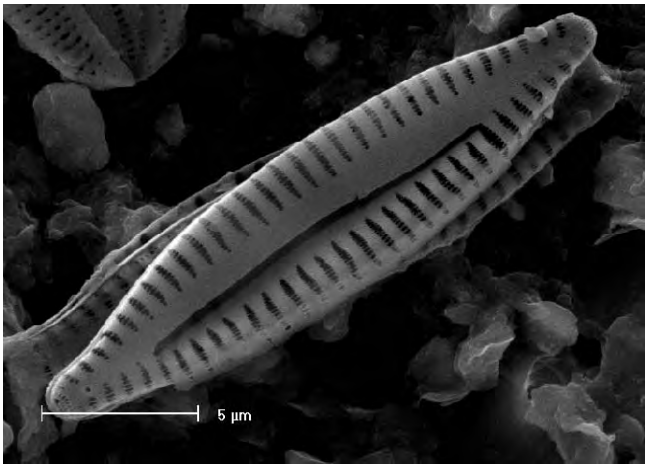


SEM

Dimensions:
Valve length = 3-35(60) µm
Valve breadth = 2-8 µm
Striae density = 10-22 /10 µm
Comments: Valves cruciform to elliptical with rounded apices. The broad striae are characteristic and are composed of several rows of puncta (multiseriate).
Ecology: Found in clean waters with moderate to high electrolyte content. The valves are linked together forming short chains.

***Pseudostaurosira brevistriata* (Grunow in van Heurk) Williams & Round**
Syn. *Fragilaria brevistriata* Grunow





SEM

Dimensions:
Valve length = 11-30 µm
Valve breadth = 3-5 µm
Striae density = 12-17 /10 µm
Comments: Valves are lanceolate to elliptical and characterised by a broad lanceolate axial area and short striae found near the edge of the valve face. The apices are rounded and may be slightly protracted.
Ecology: This taxon is found in clean alkaline fresh waters ranging from oligotrophic to eutrophic. Valves are joined by the valve face forming tightly bound filaments.

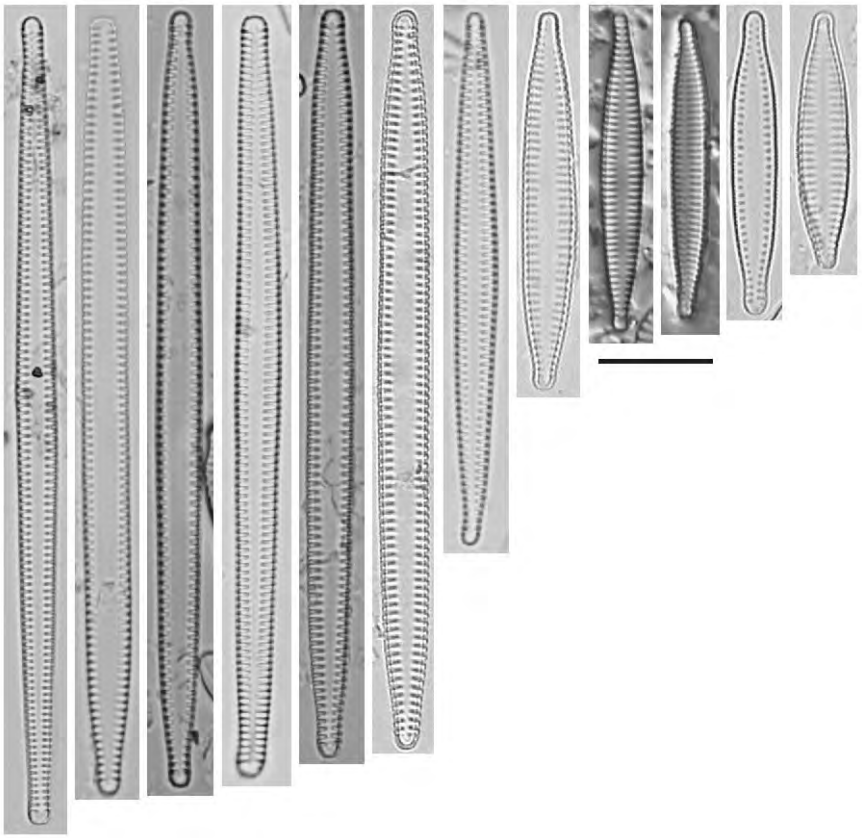
Plate 18

ARAPHIDEAE

Taxa with a pseudoraphe

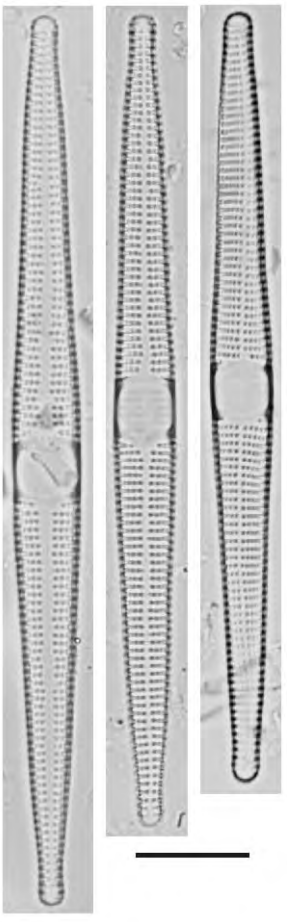
These taxa have no raphe system and may possess a rimoportula at the apex of the valve

Tabularia fasciculata (Agardh) Williams & Round
Syn. _Fragilaria fasciculata_ (Agardh) Lange-Bertalot



Dimensions:
Valve length = (12)20-400 µm
Valve breadth = 2-8 µm
Stria density = 7.5-26 striae /10 µm
Comments: Valves linear to linear lanceolate, very variable. Apices are narrowly rounded and may be slightly protracted. Valves characterised by short striae and a large axial area.
Ecology: A cosmopolitan species with a broad ecological amplitude. It does however appear that this taxon favours moderately to high electrolyte concentrations. *T. fasciculata* has also been reported from critically polluted industrial wastewater.

Ctenophora pulchella (Ralfs ex Kützing) Williams & Round
Syn. _Fragilaria pulchella_ (Ralfs ex Kützing) Lange-Bertalot



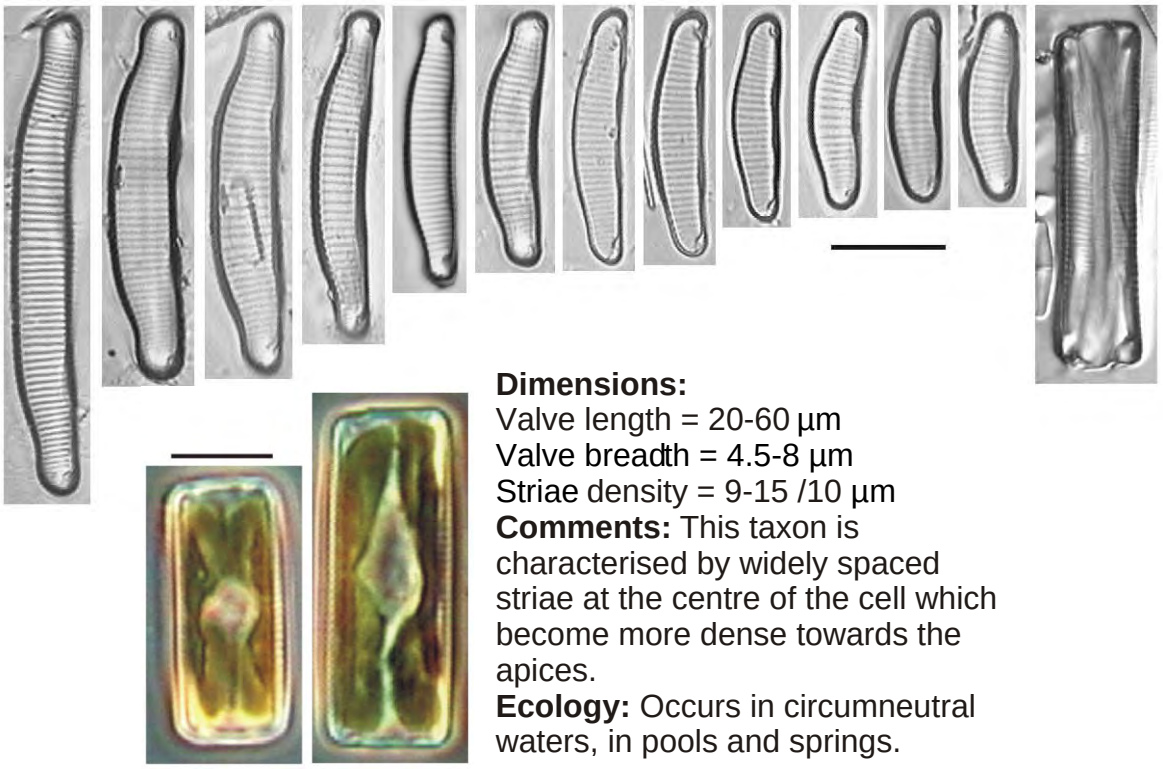
Dimensions:
Valve length = 20-200 µm
Valve breadth = 5-8.5 µm
Stria density = 9-17 striae /10 µm
Comments: Cells are needle shaped with narrow rounded slightly protracted apices. A very well defined hyaline area is present at the centre of the cell in which ghost striae may be visible. The individual puncta composing the striae are clearly distinguishable under LM.
Ecology: Occurring in brackish inland waters and may also be found in waters impacted by industrial activities and mining.

RAPHIDIOIDEAE

Taxa with a raphe on both valves

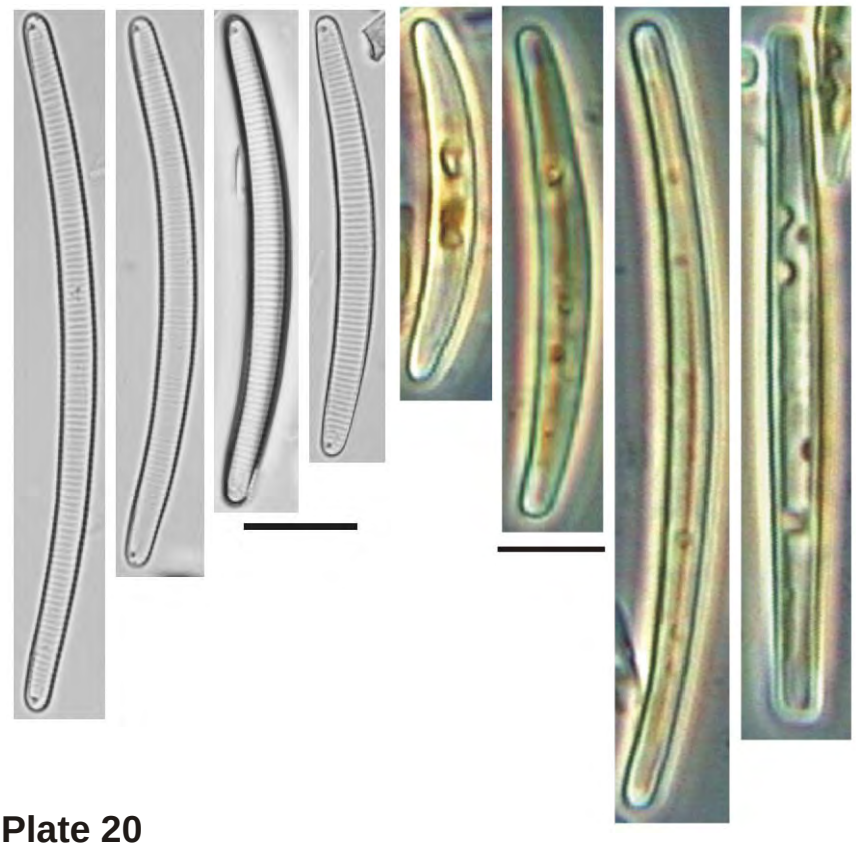
These taxa have a short raphe system extending from the valve face on to the valve mantle

Eunotia minor (Kützing) Grunow



Dimensions:
Valve length = 20-60 µm
Valve breadth = 4.5-8 µm
Striae density = 9-15 /10 µm
Comments: This taxon is characterised by widely spaced striae at the centre of the cell which become more dense towards the apices.
Ecology: Occurs in circumneutral waters, in pools and springs.

Eunotia bilunaris (Ehrenberg) Mills



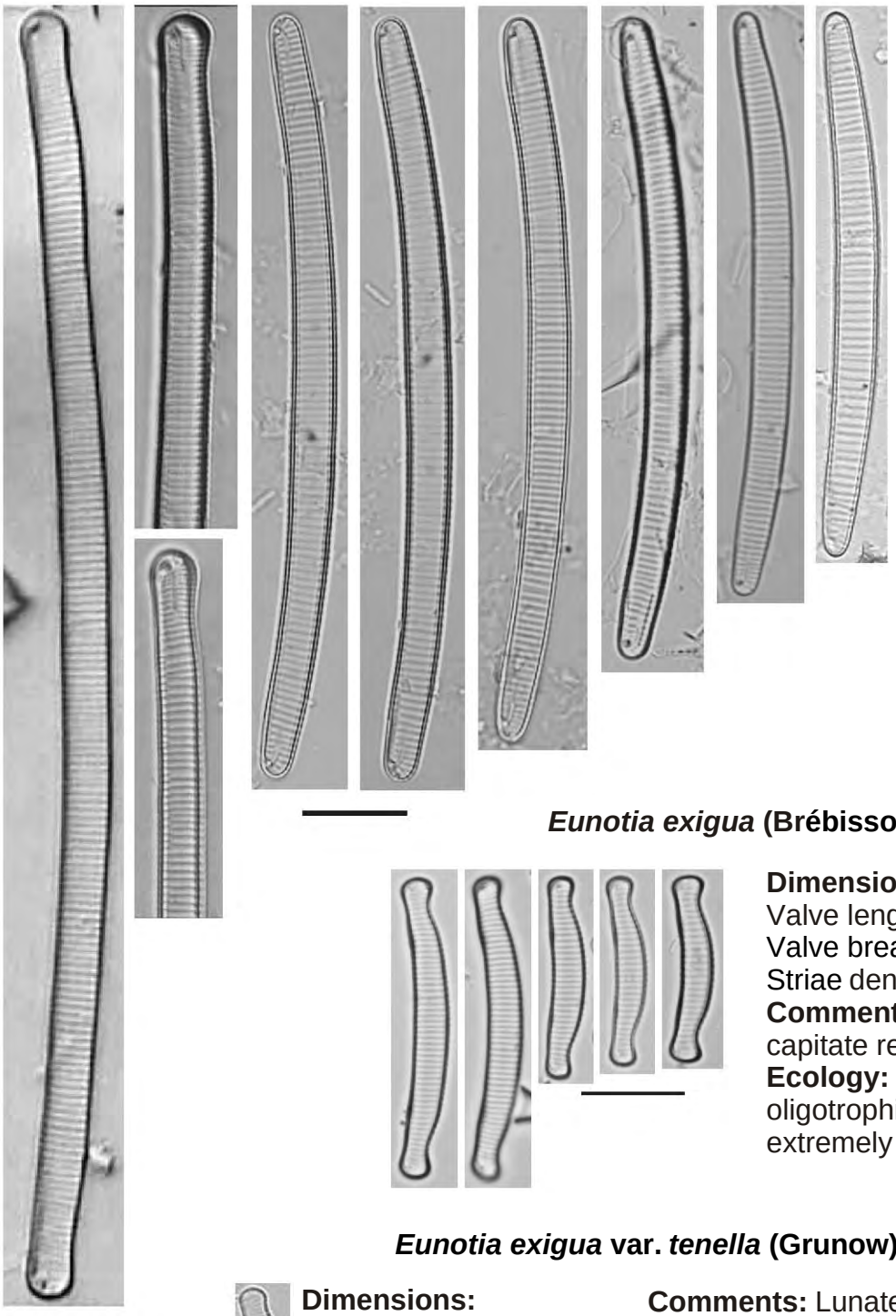
Dimensions:
Valve length = 10-150 µm
Valve breadth = 1.9-6 µm
Striae density = 9-28 /10 µm
Comments: Valves are lunate or curved with only a short portion of the raphe visible on the valve face.
Ecology: Found in acidic, flowing or standing waters with a low electrolyte content.

RAPHIDIOIDEAE

Taxa with a raphe on both valves

These taxa have a short raphe system extending from the valve face on to the valve mantle

***Eunotia flexuosa* (Brébisson) Kützing**
Syn. *Eunotia mesiana* Cholnoky



Dimensions:
Valve length = 5-300 µm
Valve breadth = 2-7 µm
Striae density = 9-20 /10 µm
Comments: Lunate valves with capitate or rounded apices.
Ecology: Occur in oligotrophic, standing or slow flowing waters.

***Eunotia exigua* (Brébisson) Rabenhorst**

Dimensions:
Valve length = 8-60 µm
Valve breadth = 2.5-4 µm
Striae density = 18-24 /10 µm
Comments: Lunate valves with capitate reflexed apices.
Ecology: Found particularly in oligotrophic electrolyte-poor and extremely acidic habitats.

***Eunotia exigua* var. *tenella* (Grunow) Nörpel & Alles**

Dimensions:
Valve length = 6-35 µm
Valve breadth = 3-4 µm
Striae density = 14-19 /10 µm

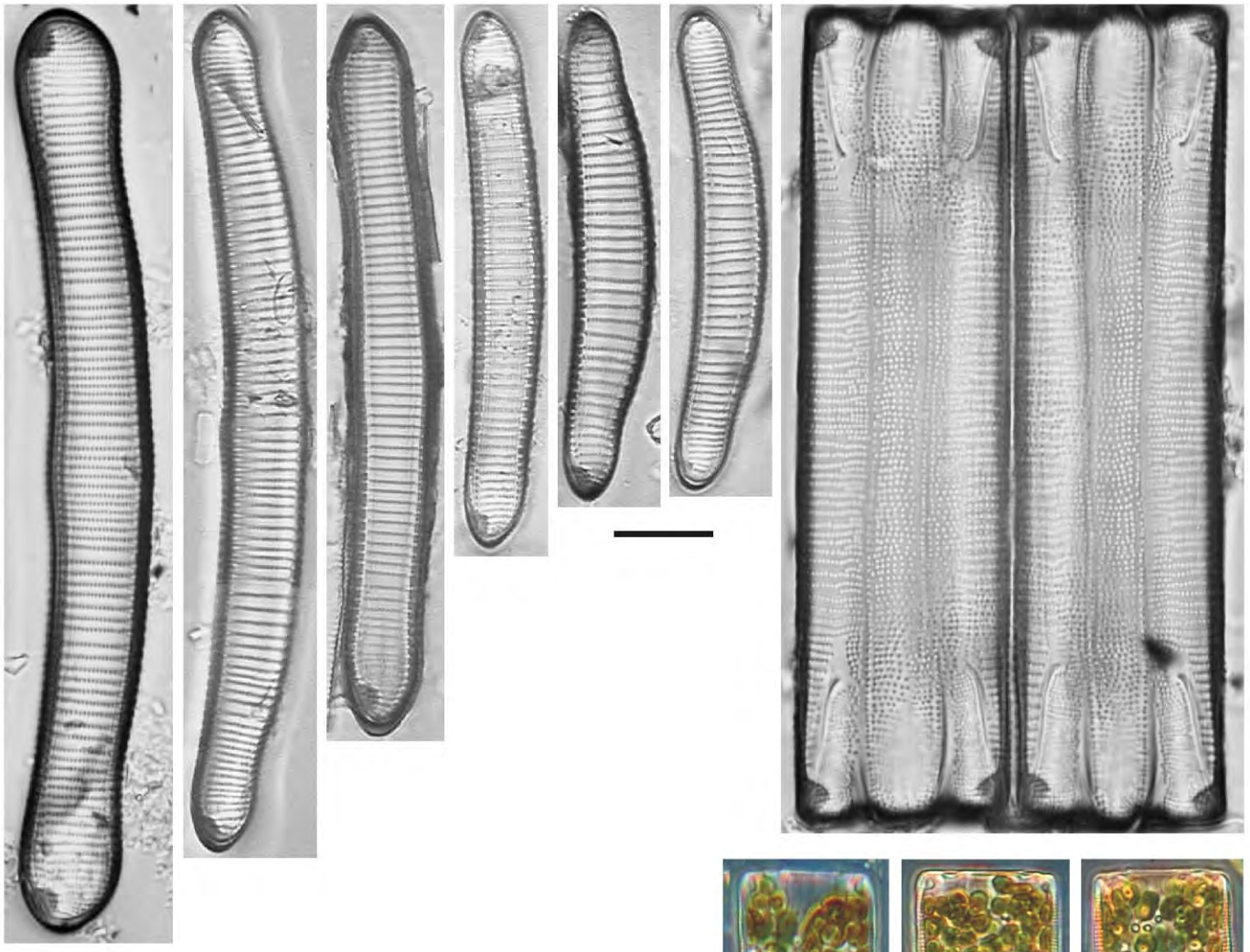
Comments: Lunate valves with capitate reflexed apices.
Ecology: Found in acidic habitats but not as tolerant of low pH as the nominate variety.

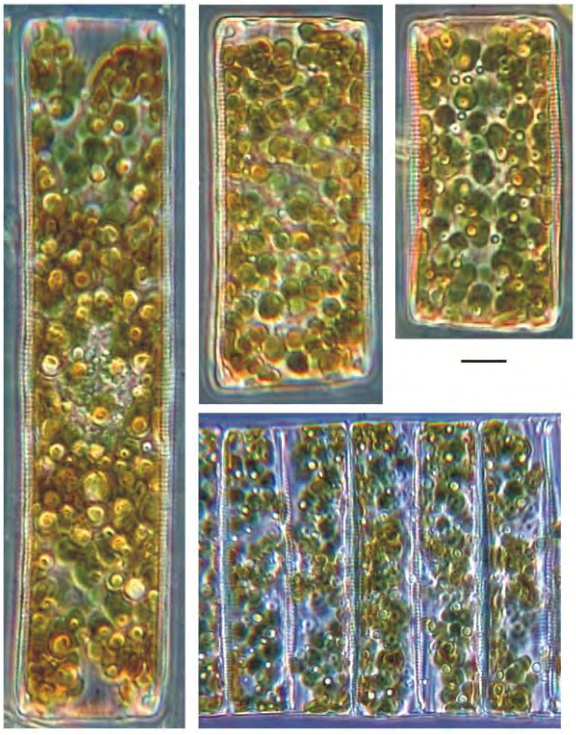
RAPHIDIOIDEAE

Taxa with a raphe on both valves

These taxa have a short raphe system extending from the valve face on to the valve mantle

***Eunotia formica* Ehrenberg**





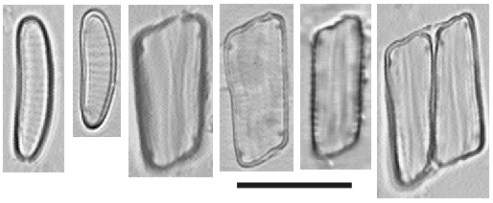
Dimensions:
Valve length = (12)35-200(230) µm
Valve breadth = 7-14 µm
Striae density = 6-12 /10 µm
Comments: Large lunate valves with a more or less pronounced central inflation on the concave ventral margin. The poles are slightly enlarged and cuneate in shape.
Ecology: Found in standing or slow flowing dystrophic to oligotrophic waters with an average electrolyte content, although this has not been confirmed. Cells aggregated and joined by the valve faces to form ribbon-shaped colonies of up to as many as a thousand cells.

RAPHIDIOIDEAE

Taxa with a raphe on both valves

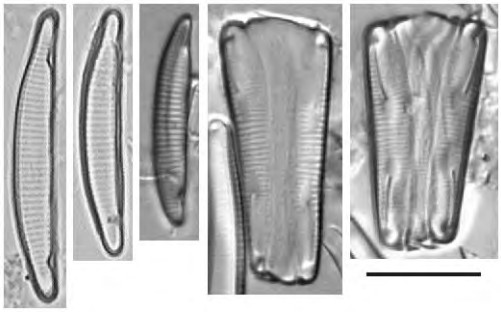
These taxa have a short raphe system extending from the valve face on to the valve mantle

Eunotia rhomboidea **Hustedt**



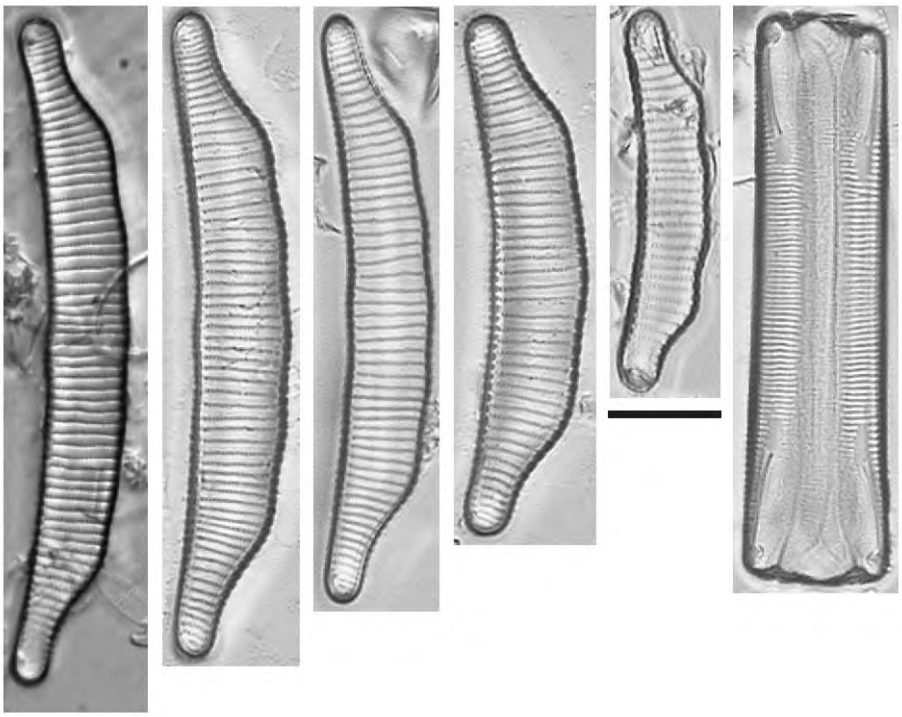
Dimensions:
Valve length = 10-25 µm
Valve breadth = 2-4 µm
Striae density = 12-19 /10 µm
Comments: These relatively small valves are often heteropolar and asymmetrical. Frustules are frequently seen in girdle view and are also heteropolar.
Ecology: Found in oligotrophic, electrolyte-poor waters.

Eunotia incisa **Gregory**



Dimensions:
Valve length = 13-65 µm
Valve breadth = 2-8 µm
Striae density = 9-20 /10 µm
Comments: The dorsiventral valve has a straight ventral margin. This taxon is characterised by narrow pointed slightly asymmetrical apices (heteropolar).
Ecology: Occurs in upland streams in acidic, oligotrophic, electrolyte-poor waters.

Eunotia pectinalis **var.** ***undulata*** **(Ralfs) Rabenhorst**



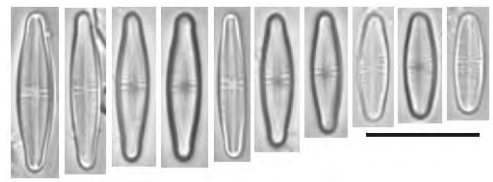
Dimensions:
Valve length = 10-140 µm
Valve breadth = (3?)5-10 µm
Striae density = 7-15 /10 µm
Comments: Dorsiventral valves with an undulating dorsal margin and a slight central inflation on the convex ventral margin. The apices are protracted and rounded.
Ecology: Found in circumneutral to weakly acidic, electrolyte-poor waters.

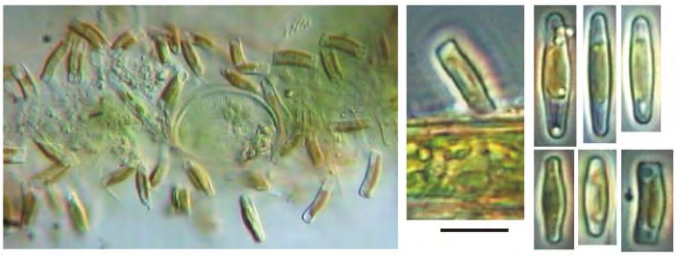
MONORAPHIDEAE

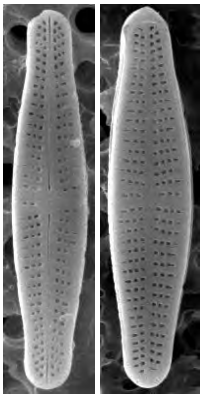
Taxa with a raphe on only one valve

These taxa have usually have a curved or flexed valve face

Achnanthidium minutissimum (Kützing) Czarnecki
Syn. *Achnanthes minutissima* Kützing



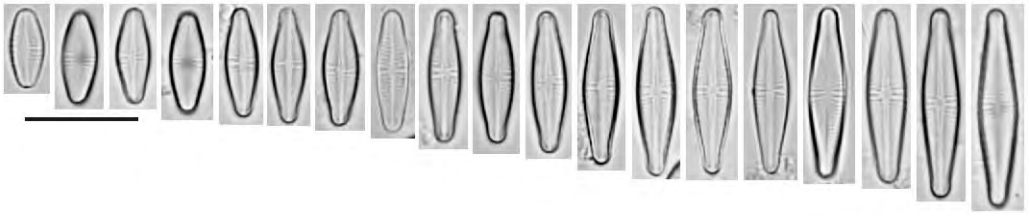


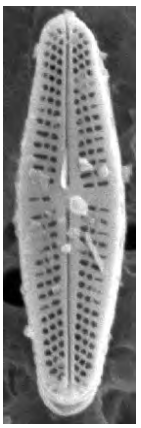


SEM

Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Striae density = 27-32 /10 µm
Comments: Valves are lanceolate to elliptical and may have slightly protracted sub-capitate apices. Valves are bent or flexed in girdle view.
Ecology: Found in well oxygenated, clean, fresh waters. Usually attached to a substratum by a short mucilage stalk.

Achnanthidium eutrophilum (Lange-Bertalot) Lange-Bertalot

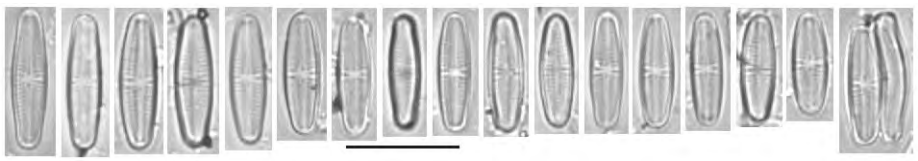


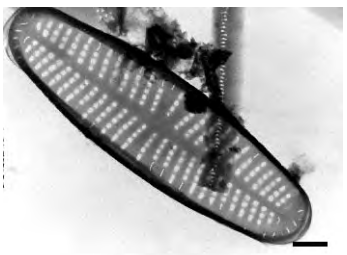


SEM

Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Striae density = 27-32 /10 µm
Comments: Valves are distinguished from *A. minutissimum* by the rhombic valve outline and the arrangement of the central striae.
Ecology: Found in well oxygenated eutrophic fresh waters. Tolerant only to slight or moderate pollution.

Achnanthidium saprophilum (Kobayasi & Mayama) Round & Bukhtiyarova
Syn. *Achnanthes minutissima* var. *saprophila* Kobayasi & Mayama





TEM

SEM

Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Striae density = 27-32 /10 µm
Comments: Valves are distinguished from *A. minutissimum* by the bluntly rounded, never protracted apices. Valves also have a slightly more robust appearance than *A. minutissimum.*
Ecology: Found in organically enriched and eutrophic fresh waters.

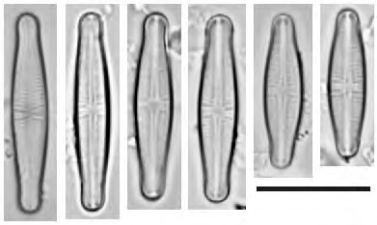
Plate 24

MONORAPHIDEAE

Taxa with a raphe on only one valve

These taxa have usually have a curved or flexed valve face

***Achnanthidium affine* (Grunow) Czarnecki**
Syn. *Achanathes minutissima* var. *affinis* (Kützing) Lange-Bertalot

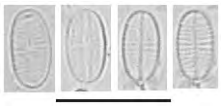


Dimensions:
Valve length = 8-30 µm
Valve breadth = 3.5-5 µm
Striae density = 22-30 /10 µm

Comments: Valves are distinguished from *A. minutissimum* by the lack of central striae.
Ecology: Found in clean well oxygenated oligotrophic, alkaline, calcareous, fresh waters with moderately elevated electrolyte content.

***Achnanthidium straubianum* (Lange-Bertalot) Lange-Bertalot**
Syn. *Achnanthes straubiana* Lange-Bertalot

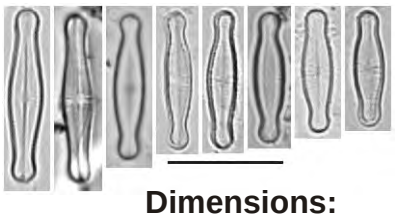
SEM



Dimensions:
Valve length = 6-10 µm
Valve breadth = 3.5-4 µm
Striae density = 26-29 /10 µm

Comments: Valves are elliptical with bluntly rounded apices.
Ecology: Found in calcereous, meso-to eutrophic fresh waters.

SEM

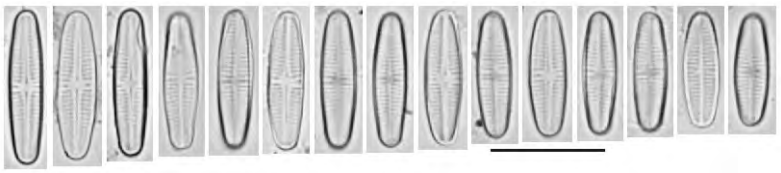


***Achnanthidium macrocephalum* (Hustedt) Round & Bukhtiyarova**
Syn. *Achnanthes minutissima* var. *macrocephala* Hustedt

Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Striae density = 27-32 striae /10 µm

Comments: Valves are distinguished from *A. minutissimum* by larger protracted sub-capitate spices and central striation.
Ecology: Found in calcareous, oligo- to mesotrophic fresh waters.

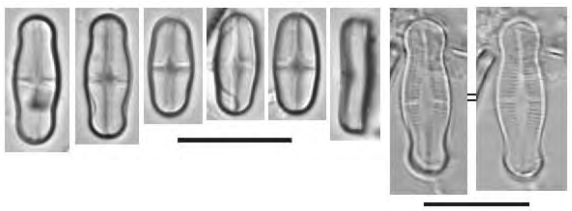
***Achnanthidium biasolettianum* (Grunow) Lange-Bertalot**
Syn. *Achnanthes biasolettiana* Grunow



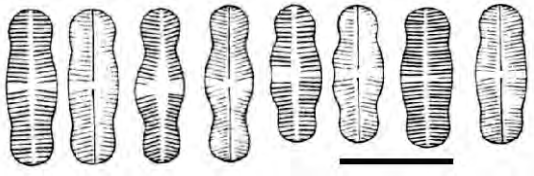
Dimensions:
Valve length = 6-35 µm
Valve breadth = 3-6 µm
Striae density = 20-27 /10 µm

Comments: Valves elliptical with bluntly rounded never protracted apices. Valves are distinguished from *A. minutissimum* by striae density and arrangement, as well as valve shape.
Ecology: Found in calcareous olig- to mesotrophic waters with moderate to elevated electrolyte content.

***Achnanthes swazi* Cholnoky**



Dimensions:
Valve length = 9-12 µm
Valve breadth = 4 µm
Striae density = 32-36 striae /10 µm
Comments: Valves are elliptical with broad well defined sub-capitate apices and fine striation interrupted at the centre of the cell on one or both sides.
Ecology: This endemic South African species is found in clean well oxygenated oligotrophic fresh waters.



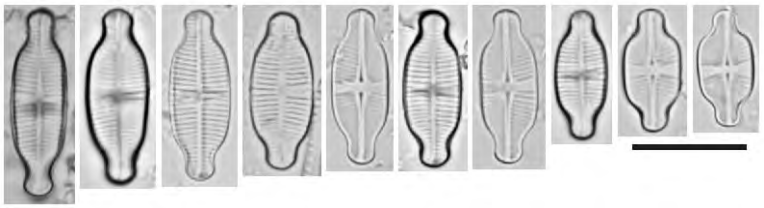
Iconotype Cholnoky (1960a)

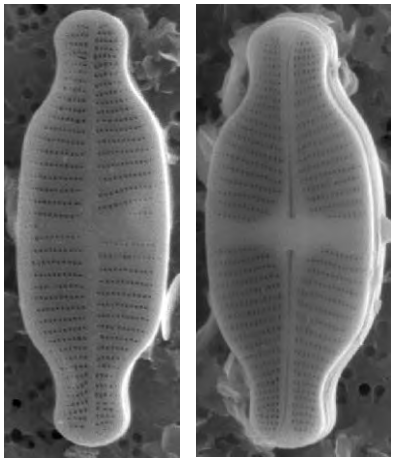
MONORAPHIDEAE

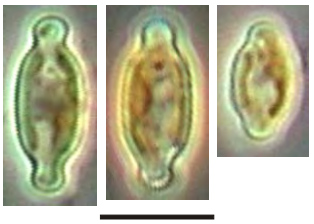
Taxa with a raphe on only one valve

These taxa have usually have a curved or flexed valve face

***Achnanthidium exiguum* (Grunow) Czarnecki**
Syn. *Achnanthes exigua* Grunow







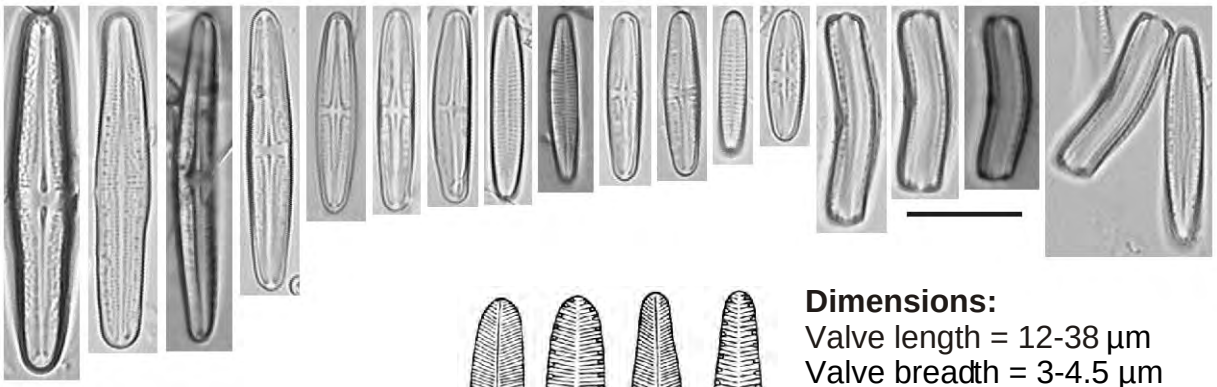
SEM

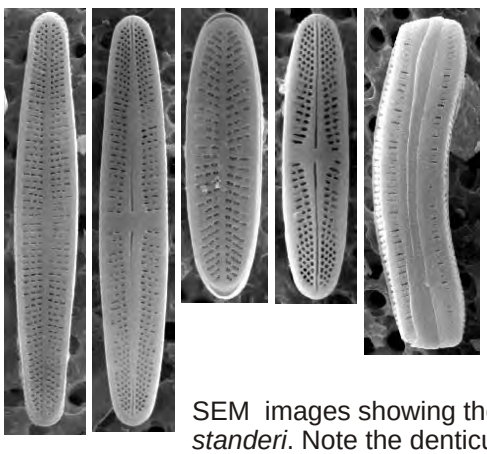
Dimensions:
Valve length = 5-17(20) µm
Valve breadth = 4-8(10) µm
Striae density = 24-30 /10 µm RV
= 20-20 /10 µm RLV

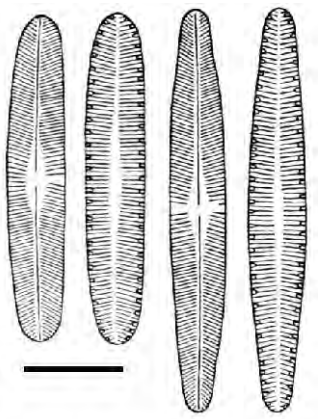
Comments: Cell shape ranges from elliptical to linear-elliptical. Raphid Valves have a characteristic butterfly-shaped central area.

Ecology: This cosmopolitan species has a very wide ecological amplitude and is found in many different types of water, including industrial and other waste water. It is also able to grow under very low light and can tolerate temperatures of up to 40°C. The optimum growth conditions for this taxon are alkaline water with moderate to elevated electrolyte content.

***Achnanthes standeri* Cholnoky**







Iconotype Cholnoky (1957b)

SEM images showing the external structure of *A. standeri*. Note the denticulations found in the puncta giving the striae their irregular appearance in LM.

Dimensions:
Valve length = 12-38 µm
Valve breadth = 3-4.5 µm
Striae density = 24-26 /10 µm

Comments: The valves are lanceolate usually having a clearly defined butterfly-shaped central area on the raphid valve. The striae of this species have a characteristic irregular appearance due to denticulations in thepuncta.

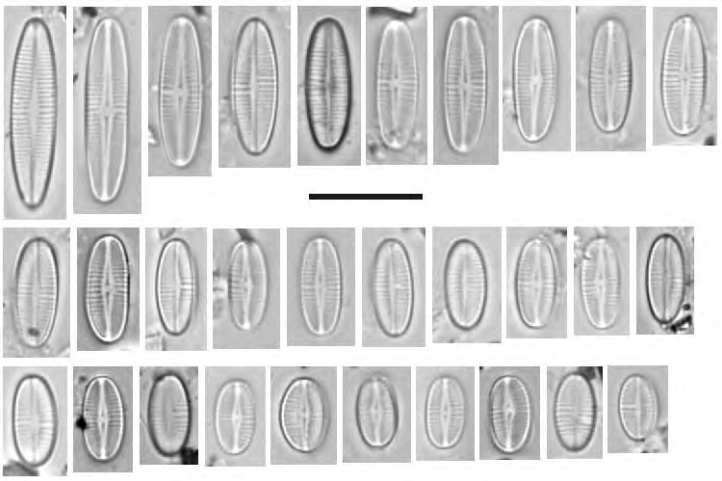
Ecology: This species is endemic to South Africa and is found in well oxygenated, oligotrophic slightly acidic fresh waters.

MONORAPHIDEAE

Taxa with a raphe on only one valve

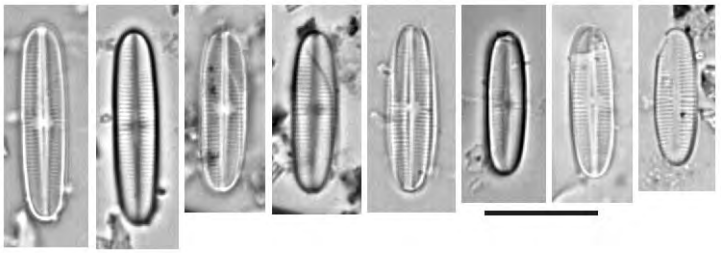
These taxa usually have a curved or flexed valve face

Achnanthidium crassum (Hustedt) Potapova & Ponader
Syn. *Achnanthes crassa* Hustedt



Dimensions:
Valve length = 8-15(18) µm
Valve breadth = 3-4.5 µm
Striae density = 32 /10 µm RV
= 26-28 /10 µm RLV
Comments: Valves are broadly linear with never protracted, bluntly rounded apices.
Ecology: Found in alkaline streams and slow flowing waters.

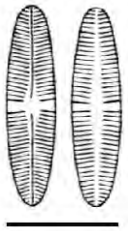
Achnanthes linearoides Lange-Bertalot
Syn. *Achnanthes linearis* (WM Smith) Grunow



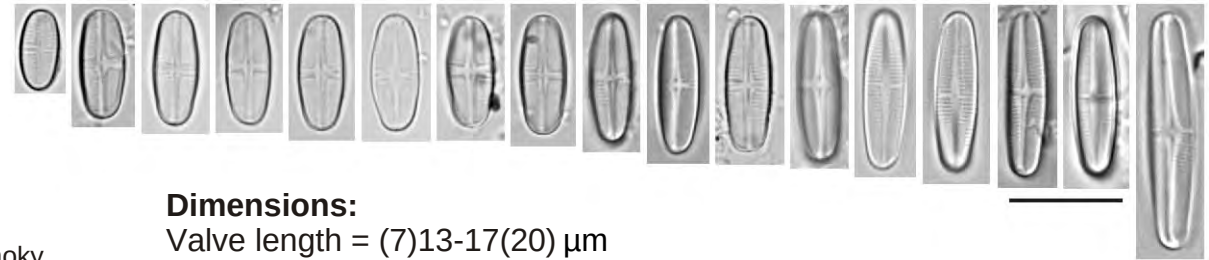
Dimensions:
Valve length = 15-28 µm
Valve breadth = 3.8-5 µm
Striae density = 24-28 /10 µm

Comments: Valves are linear, rarely linear-elliptical with bluntly rounded, never protracted apices. The striae are parallel, interrupted by a narrow rounded central area.
Ecology: Found in circumneutral to slightly acidic, oligotrophic waters constantly supplied with oxygen.

Achnanthes subaffinis Cholnoky



Iconotype Cholnoky (1959)



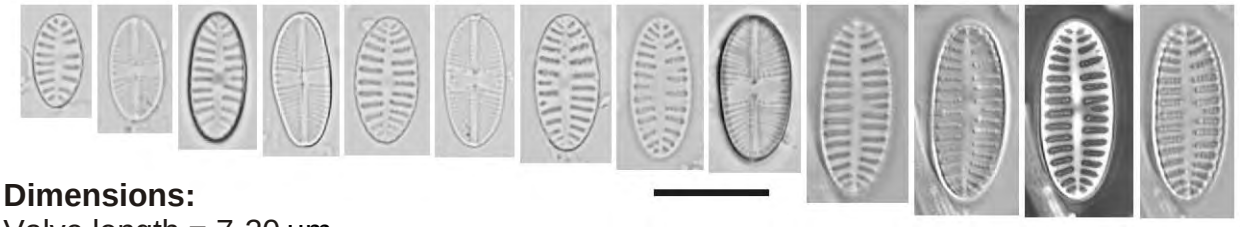
Dimensions:
Valve length = (7)13-17(20) µm
Valve breadth = 4-4.5 µm
Striae density = 30-32 /10 µm RV
Comments: Valves are broadly linear with never protracted bluntly rounded apices. The striae are interrupted by a small well-defined central area on both raphid and raphe-less valves.
Ecology: Found in oligotrophic streams and slow flowing waters.

MONORAPHIDEAE

Taxa with a raphe on only one valve

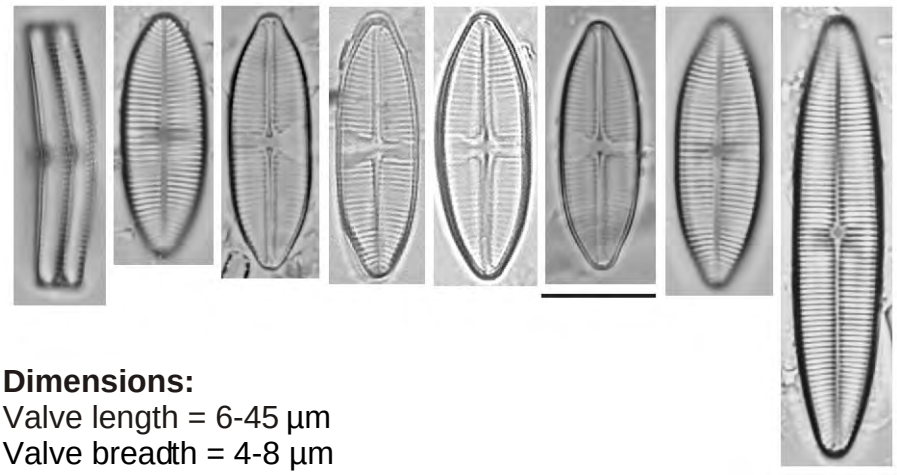
These taxa usually have a curved or flexed valve face

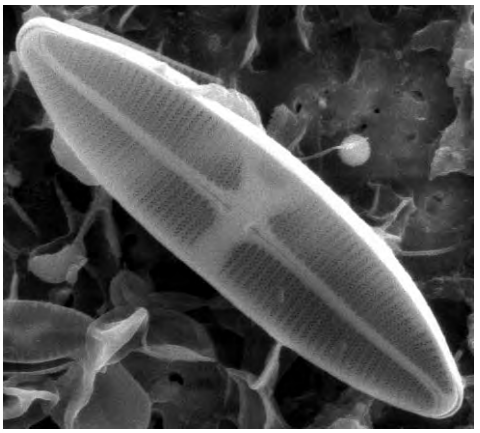
***Achnanthes oblongella* Oestrup**
Syn. *Achnanthes saxonica* Krasske

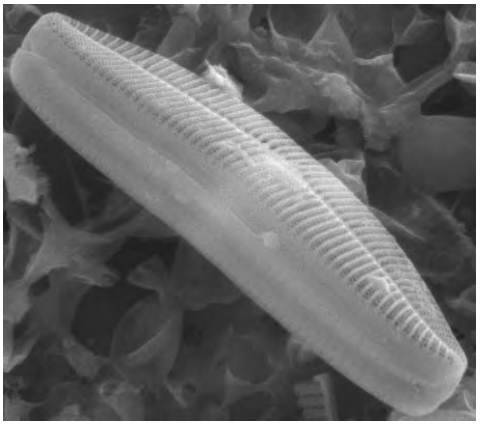


Dimensions:
Valve length = 7-20 µm
Valve breadth = 4-8 µm
Striae density = 23-27 /10 µm RV
= 10-14 /10 µm RLV
Comments: Valves are elliptical to linear elliptical. The araphid valve or raphe-less valve (RLV) is characterised by very coarse striation with individual puncta clearly distinguishable. The raphid valve has much finer striation interrupted by a irregularly rounded, to rectangular central area.
Ecology: This species is found in small, circumneutral, oligotrophic, electrolyte poor streams.

***Lemnicola hungarica* (Grunow) Round & Basson**
Syn. *Achnanthes hungarica* Grunow







SEM

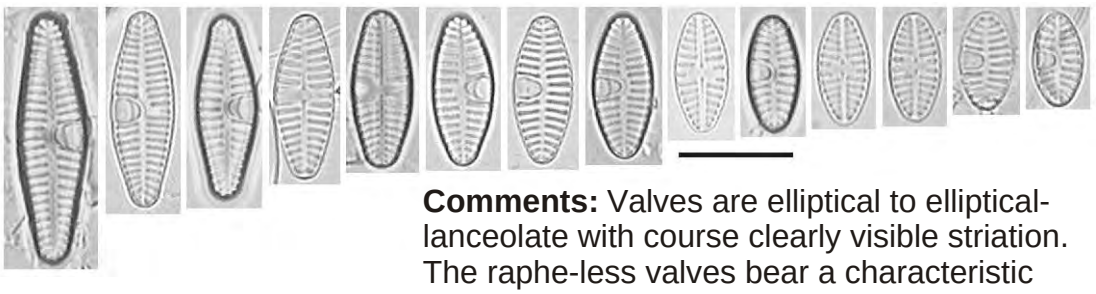
Dimensions:
Valve length = 6-45 µm
Valve breadth = 4-8 µm
Striae density = 16-23 /10 µm
Comments: Valves linear-elliptical to linear lanceolate with cuneate poles and rounded apices. Striae of the raphid valve are interrupted by an asymmetrical central area.
Ecology: Occurs in weakly alkaline waters with moderate to elevated electrolyte content and may also occur in critically polluted waters. Found mostly as an epiphyte, commonly found associated with *Lemna* spp. (duckweed).

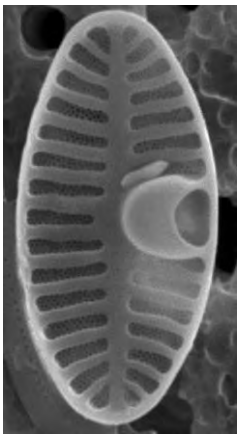
MONORAPHIDEAE

Taxa with a raphe on only one valve

These taxa usually have a curved or flexed valve face

***Planothidium frequentissimum* (Lange-Bertalot) Round & Bukhityarova**
Syn. *Achnanthes lanceolata* ssp. *frequentissima* var. *frequentissima* Lange-Bertalot



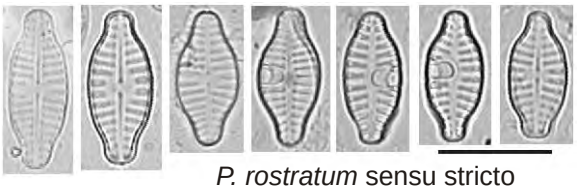


SEM

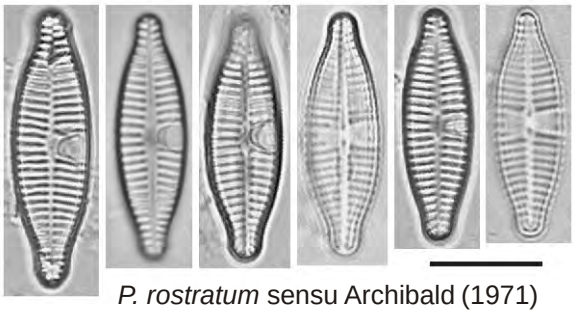
Dimensions:
Valve length = 4-30(40?) µm
Valve breadth = 3.5-7 µm
Striae density = 13-20 /10 µm

Comments: Valves are elliptical to elliptical-lanceolate with course clearly visible striation. The raphe-less valves bear a characteristic horseshoe-shaped septum in the central region.
Ecology: A common species in standing and flowing, circumneutral to alkaline waters with a moderate to high electrolyte content. Capable of tolerating critically polluted conditions.

***Planothidium rostratum* (Oestrup) Round & Bukhityarova**
Syn. *Achnanthes lanceolata* ssp. *frequentissima* var. *rostrata* (Oestrup) Hustedt



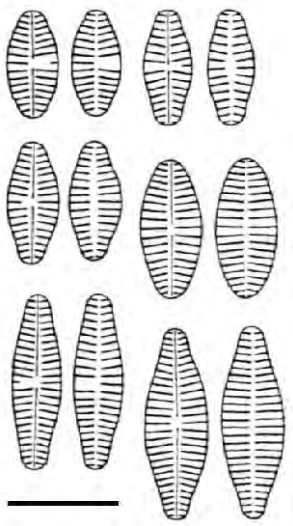
P. rostratum sensu stricto



P. rostratum sensu Archibald (1971)

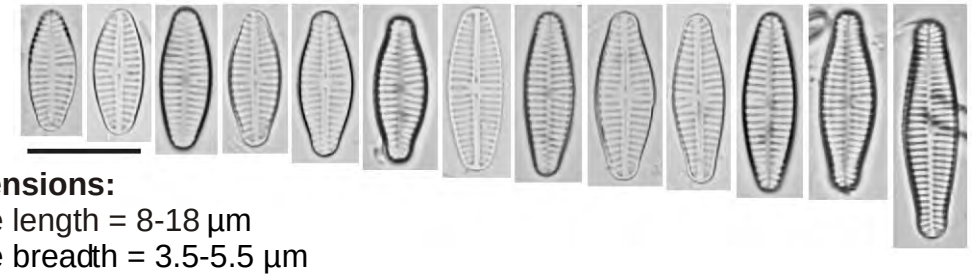
P. rostratum
Archibald (1971)

Dimensions:
Valve length = 4-30(40?) µm
Valve breadth = 3.5-7 µm
Striae density = 13-20 /10 µm
Comments: Valves are distinguished from *P. frequentissimum* by their rostrate apices and more elliptical outline.
Ecology: Occurring in circumneutral to alkaline waters with low to moderate electrolyte content. More often attached to plants than stones.



Iconotype Cholnoky (1955a)

***Planothidium engelbrechtii* (Cholnoky) Round & Bukhityarova**
Syn. *Achnanthes engelbrechtii* Cholnoky



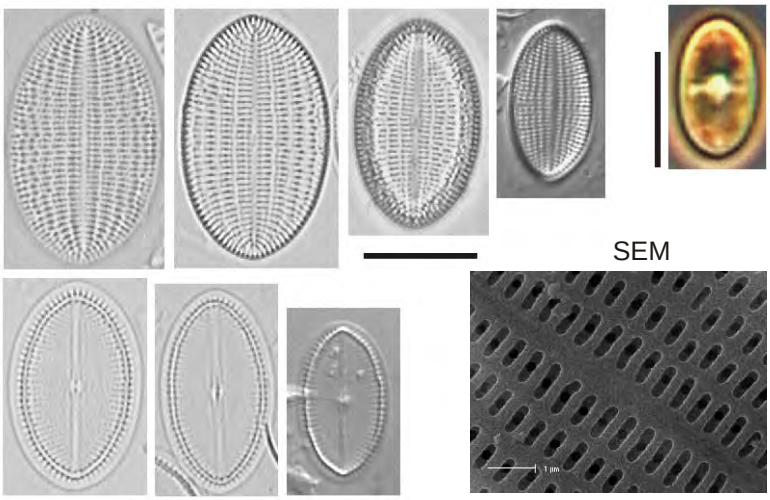
Dimensions:
Valve length = 8-18 µm
Valve breadth = 3.5-5.5 µm
Striae density = 15-17 /10 µm
Comments: Valves lanceolate with broad protracted apices. Valves of this species do not have a septum.
Ecology: Found abundantly in saline inland waters with a very high electrolyte content. Capable of tolerating critical to very heavy organic pollution.

MONORAPHIDEAE

Taxa with a raphe on only one valve

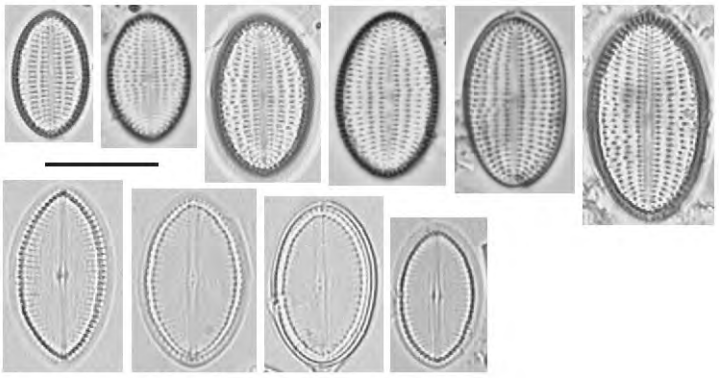
These taxa usually have a curved or flexed valve face

Cocconeis placentula Ehrenberg



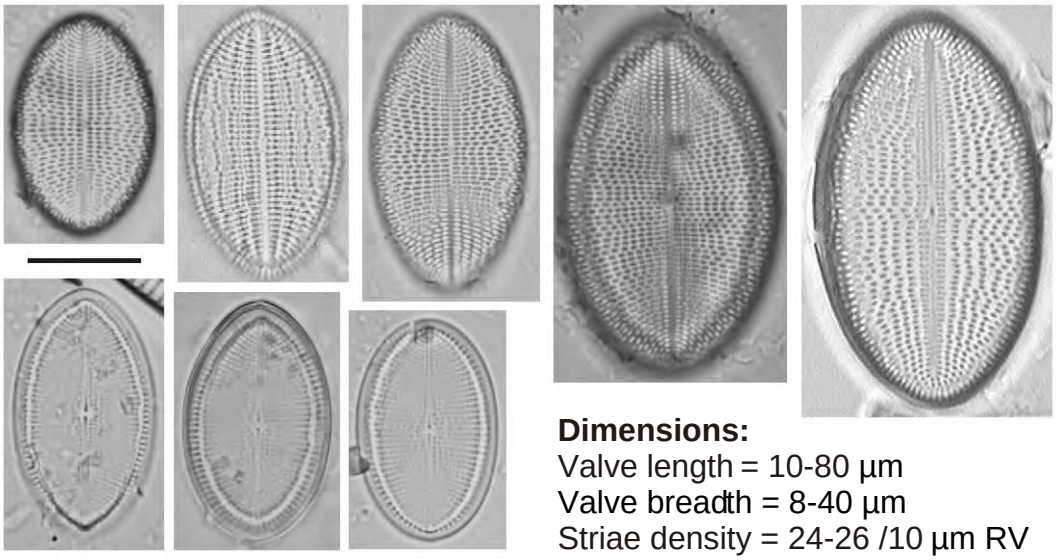
Dimensions:
Valve length = 7.5-98 µm
Valve breadth = 8-40 µm
Striae density = 24-26 /10 µm RV
= 20-23 /10 µm RLV
Comments: Valves range from broadly elliptical, elliptical, linear-elliptical to lanceolate-elliptical. Striae composed of funnel-shaped puncta.
Ecology: Occurring in meso- to eutrophic flowing and standing waters. Found in abundance on plants, wood and stone.

Cocconeis placentula var. *euglypta* (Ehrenberg) Grunow



Dimensions:
Valve length = 10-46 µm
Valve breadth = 8-40 µm
Striae density = 224-26 /10 µm RV
= 19-22 /10 µm RLV
Comments: Differentiated from other varieties of *C. placentula* by having only 3-5 puncta per stria.
Ecology: Similar to the nominate variety.

Cocconeis placentula var. *lineata* (Ehrenberg) Van Heurck



Comments: Differentiated from other varieties of *C. placentula* by undulating longitudinal striae and larger valve size.
Ecology: Similar to the nominate variety but occurring in oligotrophic waters.

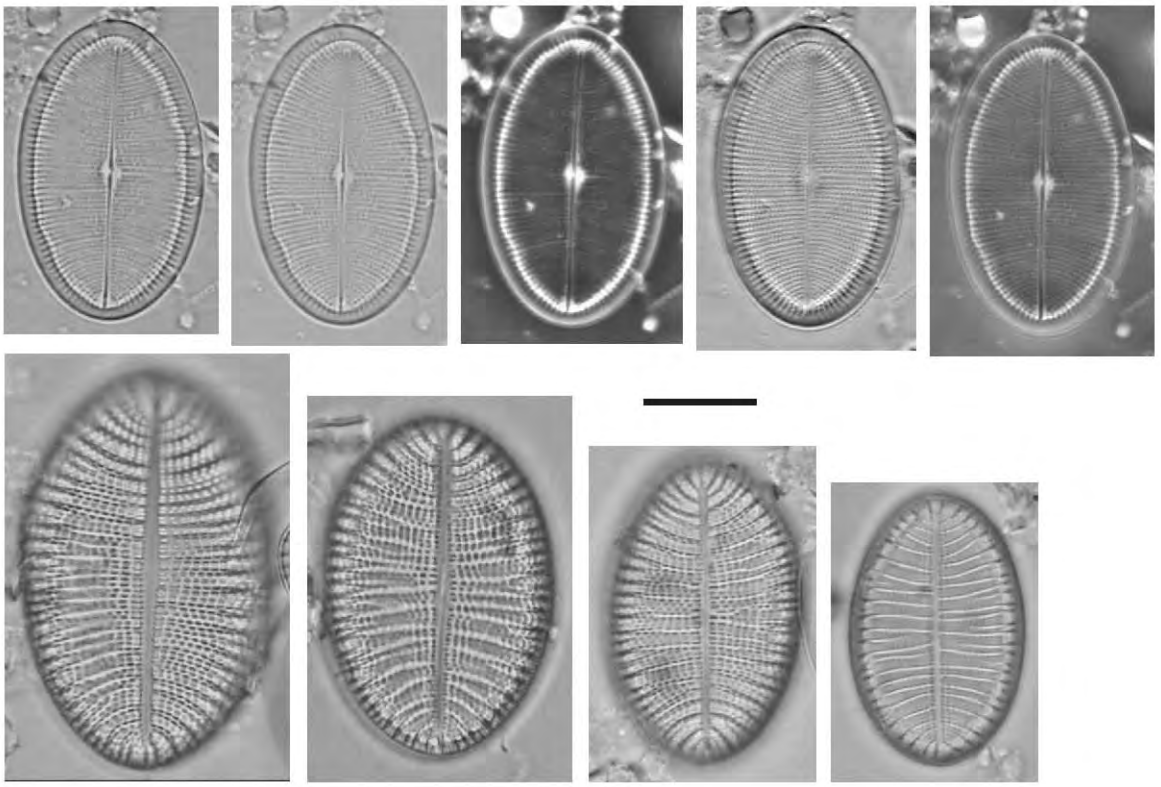
Dimensions:
Valve length = 10-80 µm
Valve breadth = 8-40 µm
Striae density = 24-26 /10 µm RV
= 16-23 /10 µm RLV

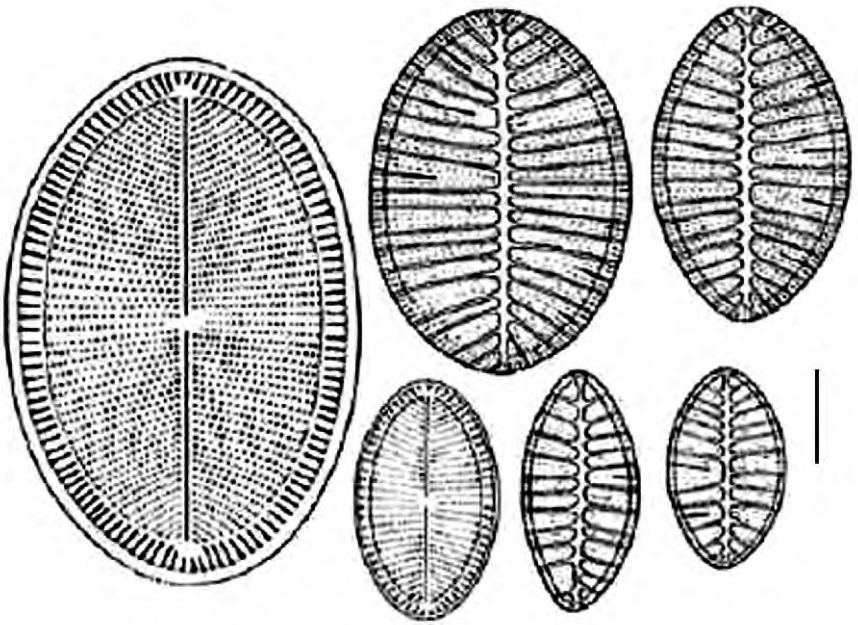
MONORAPHIDEAE

Taxa with a raphe on only one valve

These taxa usually have a curved or flexed valve face

***Cocconeis engelbrechtii* Cholnoky**





Iconotype Cholnoky (1955a)

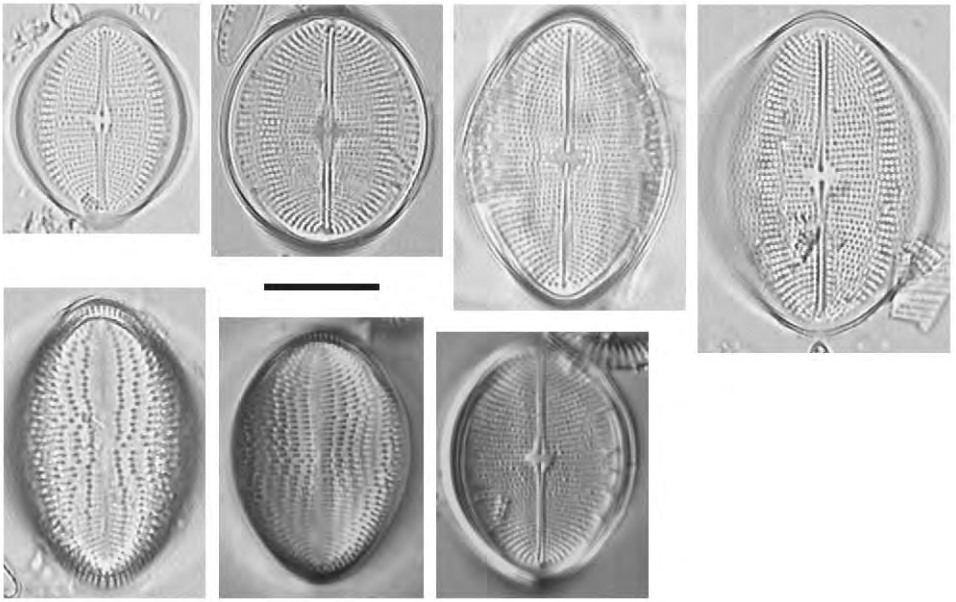
Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Strie density = 27-32 /10 µm
Costae density = 6-10 /10 µm
Comments: The raphid valve lacks the hyaline ring found in *C. placentula,* instead possessing only a downward fold in the valve parallel to the margin. The raphe-less valve is characterised by a thickened axial rib and a number of transapical costae.
Ecology: This endemic South African species occurs in alkaline inland waters with highly elevated electrolyte concentrations (i.e. brackish waters).

MONORAPHIDEAE

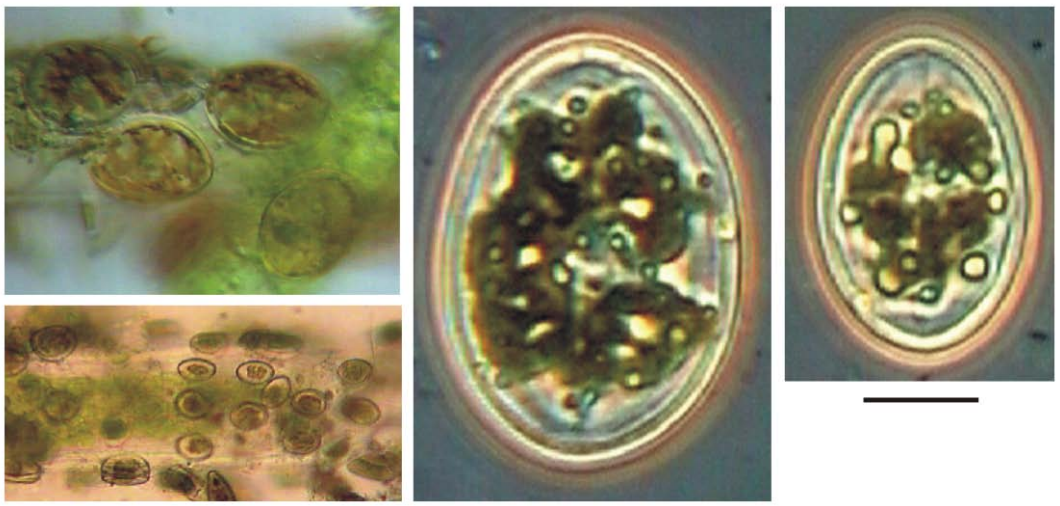
Taxa with a raphe on only one valve

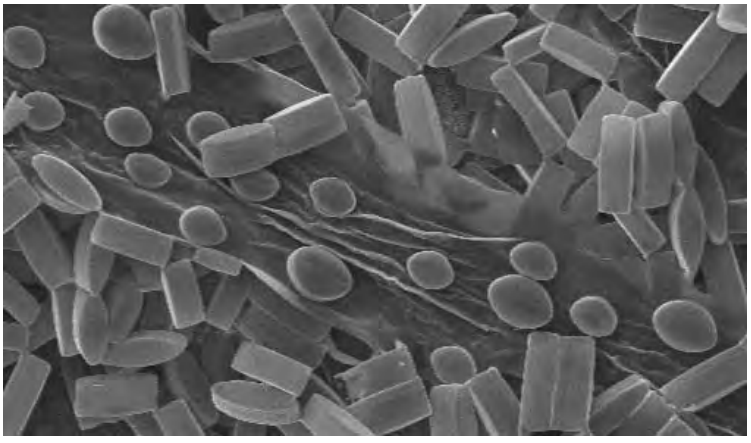
These taxa usually have a curved or flexed valve face

Cocconeis pediculus Ehrenberg

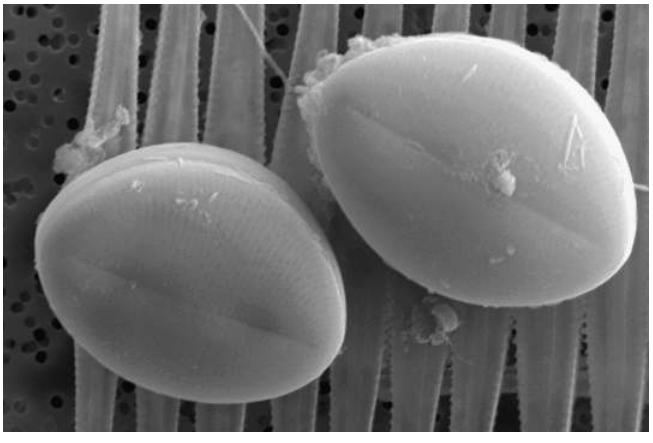


Dimensions:
Valve length = 5-25 µm
Valve breadth = 2.5-4 µm
Striae density = 27-32 /10 µm
Comments: The elliptical valves of this species are broader than those of *C. placentula* and more strongly curved. The raphid valves have a well defined asymmetrical, rhohmbic to rounded central area.
Ecology: A cosmopolitan epiphytic species occurring in waters of a moderate to high electrolyte content, including brackish conditions.





SEM



SEM

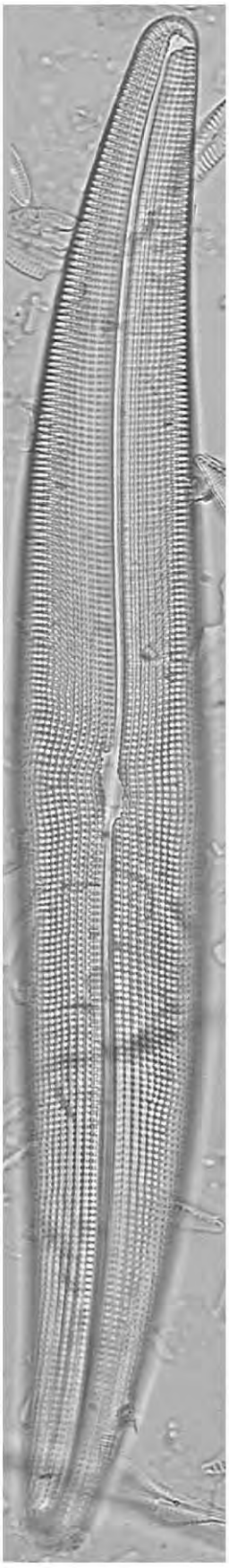
Plate 32

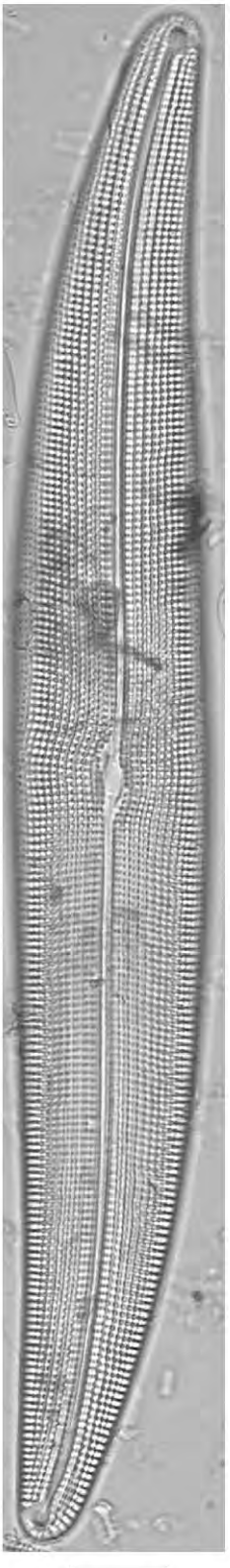
BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa have a sigmoid or S-shaped valve

***Gyrosigma attenuatum* (Kützing) Cleve**





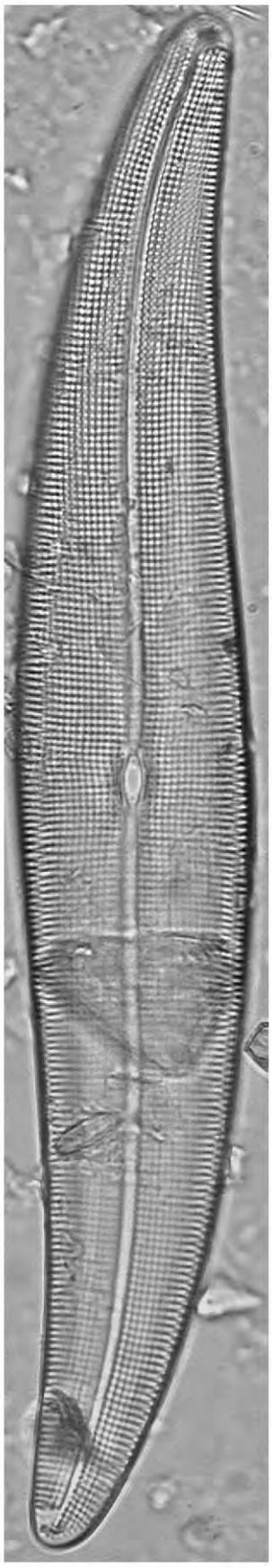
Dimensions:
Valve length = 150-240 µm
Valve breadth = 23-26 µm
Striae density = 14-16
transverse striae /10 µm
= 10-12
longitudinal striae /10 µm
Comments: Valves linear-sigmoid and characterised by the oblique orientation of the central area and longitudinal as well as transverse striation.
Ecology: Found in standing and flowing waters with a moderate to high electrolyte content (i.e. brackish waters). This species is unable to tolerate critical levels of pollution.

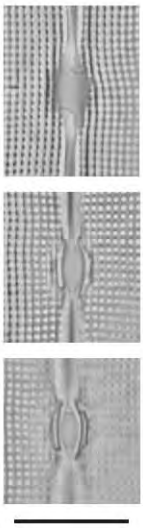
BIRAPHIDEAE

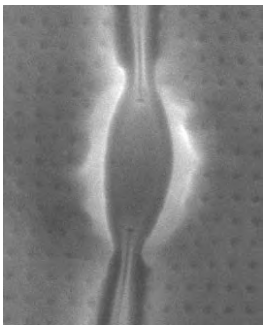
Taxa with a raphe on both valves

These taxa have a sigmoid or S-shaped valve

***Gyrosigma rautenbachiae* Cholnoky**

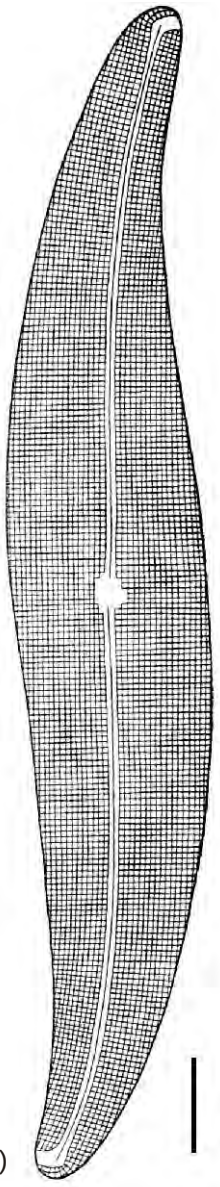






SEM

Dimensions:
Valve length = 117-165 µm
Valve breadth = 17.5-26 µm
Striae density = 14-16 /10 µm
Comments: The central area has a characteristically different structure. Externally the proximal raphe endings curve in opposite directions bisecting 1 or 2 longitudinal striae. Internally the central area has two thickened and raised margins.
Ecology: This species has been found in abundance in standing and slow flowing, brackish inland waters impacted by industrial pollutants.



Iconotype Cholnoky (1957a)

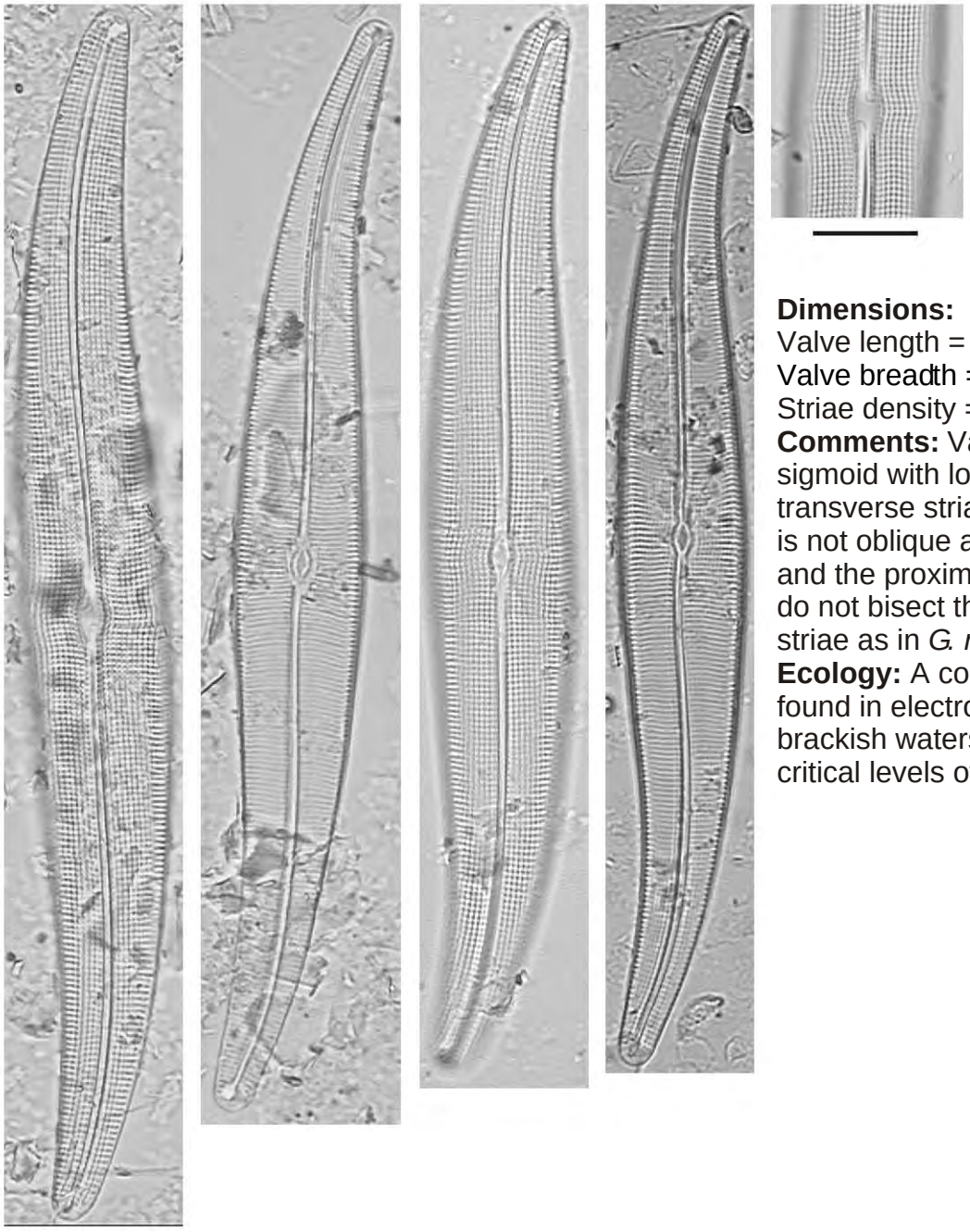
Plate 34

BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa have a sigmoid or S-shaped valve

***Gyrosigma acuminatum* (Kützing) Rabenhorst**



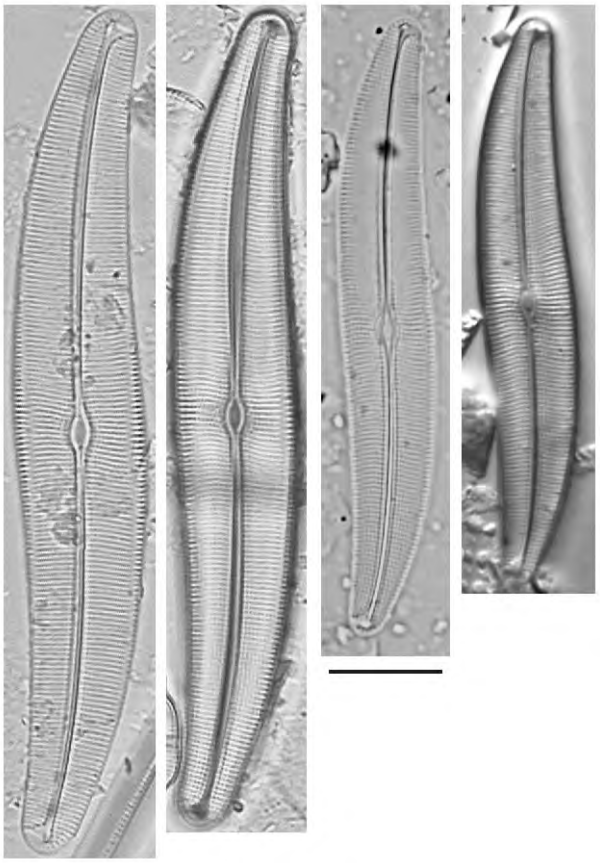
Dimensions:
Valve length = 60-180 µm
Valve breadth = 11-18 µm
Striae density = 16-18(22) /10 µm
Comments: Valves lanceolate sigmoid with longitudinal and transverse striation. Central area is not oblique as in *G. attenuatum* and the proximal raphe endings do not bisect the longitudinal striae as in *G. rautenbachiae*.
Ecology: A cosmopolitan species found in electrolyte-rich to brackish waters. May tolerate critical levels of organic pollution.

BIRAPHIDEAE

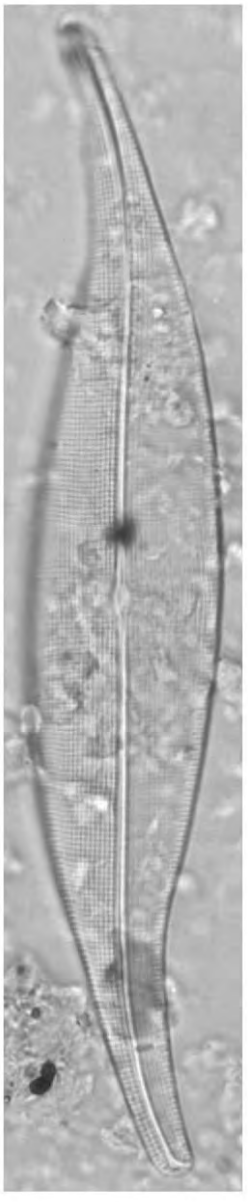
Taxa with a raphe on both valves

These taxa have a sigmoid or S-shaped valve

Gyrosigma scalproides (Rabenhorst) Cleve



Dimensions:
Valve length = 40-70 µm
Valve breadth = 7-11 µm
Striae density = 20-24 /10 µm
Comments: Small linear-sigmoid valves with bluntly rounded broad apices. Only the transverse striation is clearly visible in LM.
Ecology: A cosmopolitan species found in fresh waters with a moderate to elevate electrolyte content. This species appears to be able to grow in limited light and is often found in turbid waters.



Gyrosigma parkerii (Harrison) Elmore

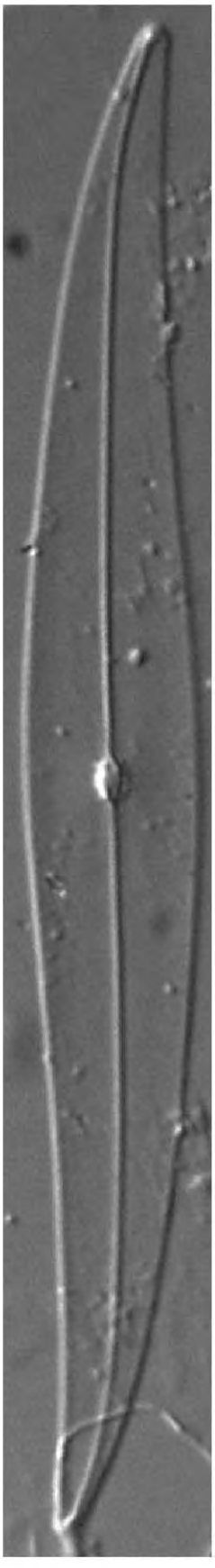
Dimensions:
Valve length = 80-150 µm
Valve breadth = 15-25 µm
Striae density = 19-23 transverse striae /10 µm
= 22-27 longitudinal striae /10 µm
Comments: Cells are lanceolate-sigmoid with strongly convex margins. The poles are strongly narrowed for about a quarter of the valve length. The apices may be rostrate or bluntly rounded.
Ecology: Distribution is uncertain. Found in brackish inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

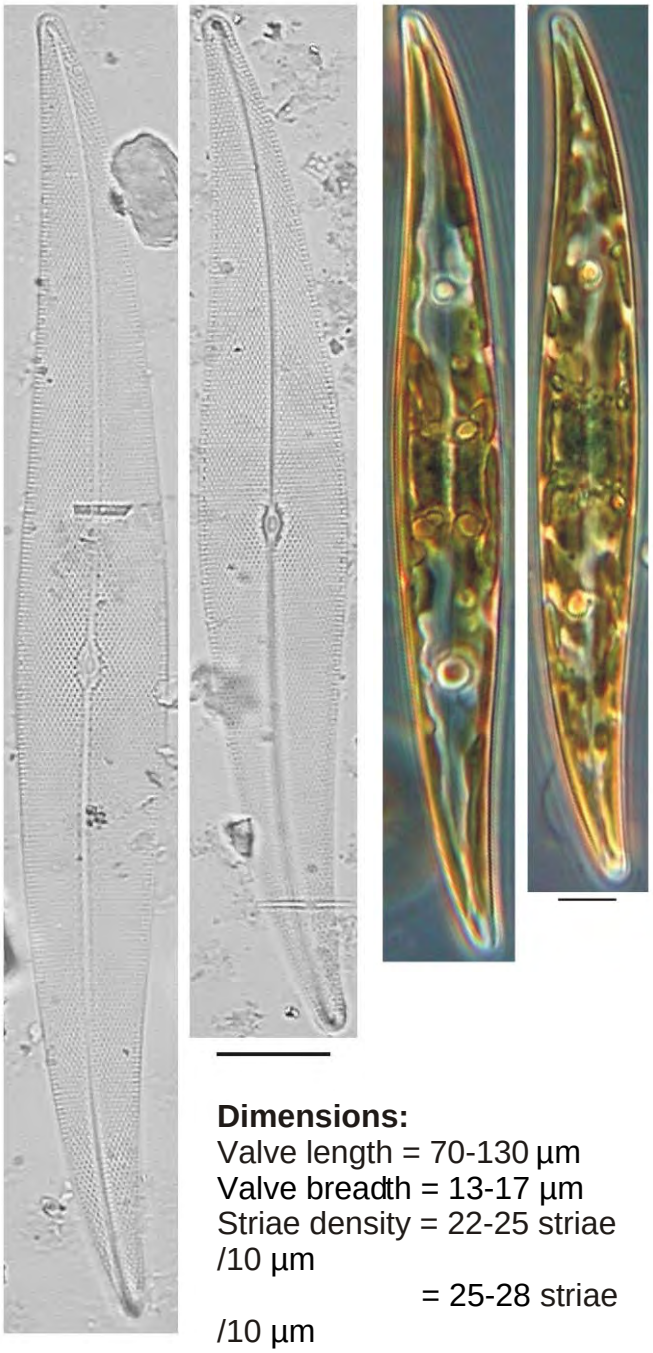
These taxa have a sigmoid or S-shaped valve

***Pleurosigma elongatum* W Smith**



Dimensions:
Valve length = 150-180 µm
Valve breadth = 20-30 µm
Striae density = 18-20 /10 µm
Comments: Valves weakly sigmoid, narrow linear-lanceolate. Characterised by narrow pointed apices and oblique striation at and angle of 63-68°.
Ecology: Cosmopolitan, found in brackish inland waters.

***Pleurosigma salinarum* Grunow**



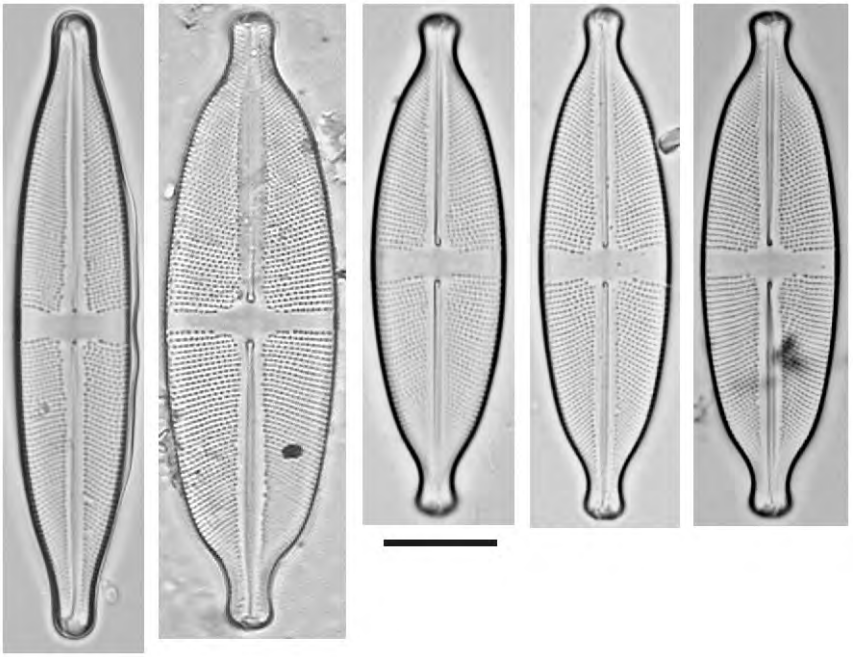
Dimensions:
Valve length = 70-130 µm
Valve breadth = 13-17 µm
Striae density = 22-25 striae /10 µm
= 25-28 striae /10 µm
Comments: Valves weakly sigmoid, lanceolate to linear-lanceolate. Differentiated from *P. elongatum* by coarser striation orientated at an angle of 46-53°.
Ecology: Cosmopolitan, found in brackish and saline inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

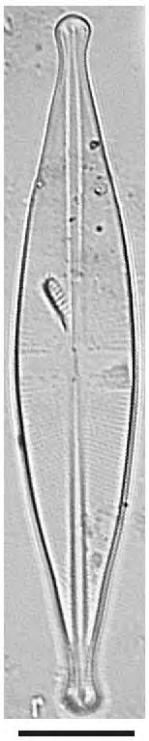
These taxa are characterised by a central hyaline thickening - a stauros

Stauroneis anceps Ehrenberg sensu lato



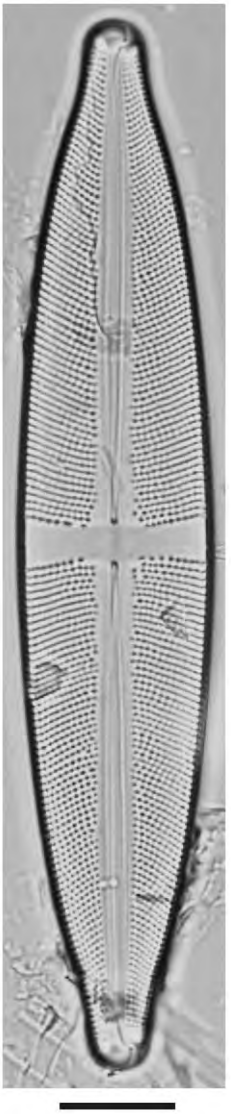
Dimensions:
Valve length = 150-240 µm
Valve breadth = 23-26 µm
Striae density = 14-16 /10 µm
Comments: Valves of species within this complex are elliptic-lanceolate to linear-elliptical. The apices are protracted, usually sub-capitate or capitate.
Ecology: Widespread in all types of water.

Stauroneis gracilior Reichart



Dimensions:
Valve length = 47-53 µm
Valve breadth = 9 µm
Striae density = 25-26 /10 µm
Comments: Valves narrow-lanceolate with protracted, capitate apices. The stauros is narrow, linear and weakly differentiated in LM. The striae have an irregular appearance.
Ecology: A cosmopolitan, but not common, species found in alkaline waters with elevated electrolyte content.

Stauroneis phoenicenteron (Nitzsch) Ehrenberg sensu lato



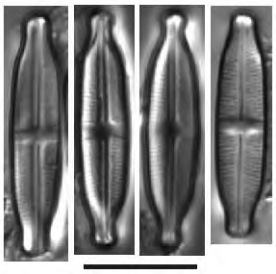
Dimensions:
Valve length = 70-360(380) µm
Valve breadth = 16-53 µm
Striae density = 12-20 /10 µm
Comments: Members of this species complex have lanceolate valves. The apices may be rounded, weakly protracted or sub-capitate.
Ecology: A cosmopolitan species found in eutrophic, sometimes polluted waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

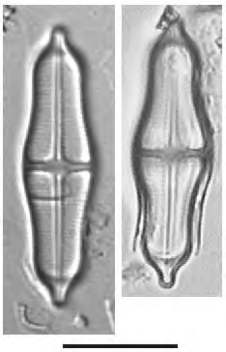
These taxa are characterised by a central hyaline thickening

Stauroneis kriegerii **Patrick**



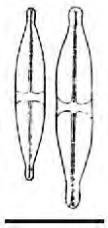
Dimensions:
Valve length = 17-24 µm
Valve breadth = 4-6 µm
Striae density = 26-30 /10 µm
Comments: Valves linear with protracted capitate apices. Puncta clearly visible, unevenly spaced.
Ecology: Found in electrolyte poor waters. In South Africa this species has been found associated with very low pH acid mine drainage.

Stauroneis smithii **Grunow**



Dimensions:
Valve length = 12-55 µm
Valve breadth = 4-9 µm
Striae density = 26-30 /10 µm
Comments: Valves elliptical-lanceolate to linear with a pronounced central inflation. Apices are characteristically narrow and pointed with clearly visible pseudoseptae near the poles.
Ecology: A cosmopolitan species reported variously from electrolyte poor water as well as from eutrophic waters with a moderate electrolyte content. Usually, only isolated examples of this species are seen making it difficult to determine its ecological amplitude.

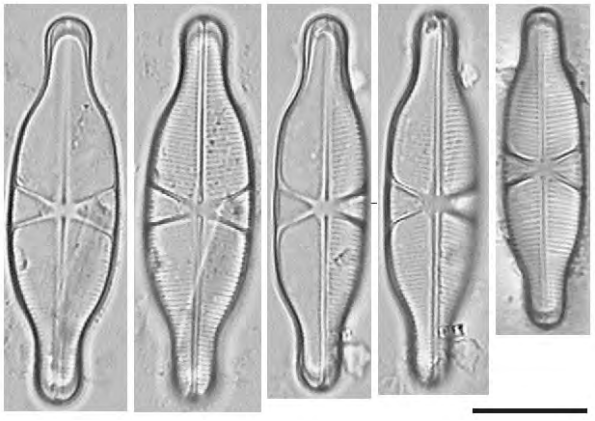
Stauroneis abbottii **Cholnoky**



Iconotype Cholnoky & Claus (1961)

Dimensions:
Valve length = 16-28 µm
Valve breadth = 3-4 µm
Striae density = >40 /10 µm (i.e. not visible under LM)
Comments: This small *Stauroneis* is characterised by a linear lanceolate valve outline and sub-capitate to capitate protracted apices.
Ecology: South African endemic species occurring in acid water biotopes.

Capartogramma crucicula **(Grunow ex Cleve) Ross**
Syn. *Stauroneis brasiliensis* (Zimmerman) Compére



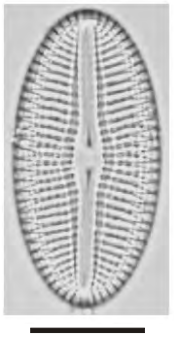
Dimensions:
Valve length = 23-47 µm
Valve breadth = 8-12 µm
Striae density = 21-24 /10 µm
Comments: Easily distinguished by the cross-shaped thickened ribs in the centre of the valve. Also note the pseudoseptae near the poles.
Ecology: A tropical to subtropical diatom species.

BIRAPHIDEAE

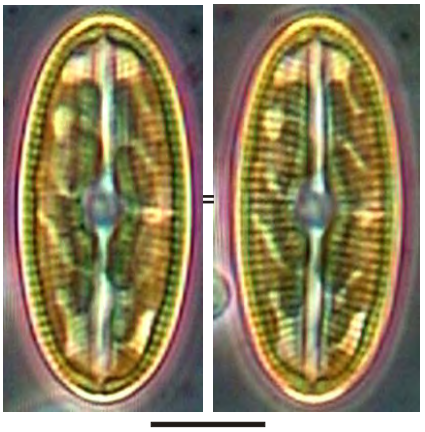
Taxa with a raphe on both valves

These taxa are characterised by axial hyaline thickenings

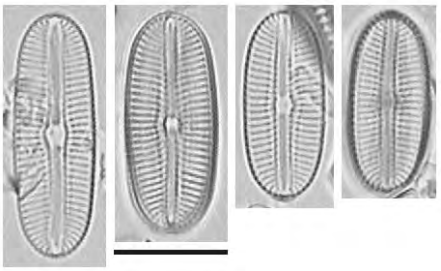
Diploneis elliptica (Kützing) Cleve



Dimensions:
Valve length = 20-130 µm
Valve breadth = 10-60 µm
Striae density = 8-14 /10 µm
Comments: Valves broad, rhombic-elliptical, elliptical, to linear-elliptical. Perforations of the foramina not visible in LM.
Ecology: A cosmopolitan species occurring in oligotrophic standing waters, especially those with a moderate electrolyte content.

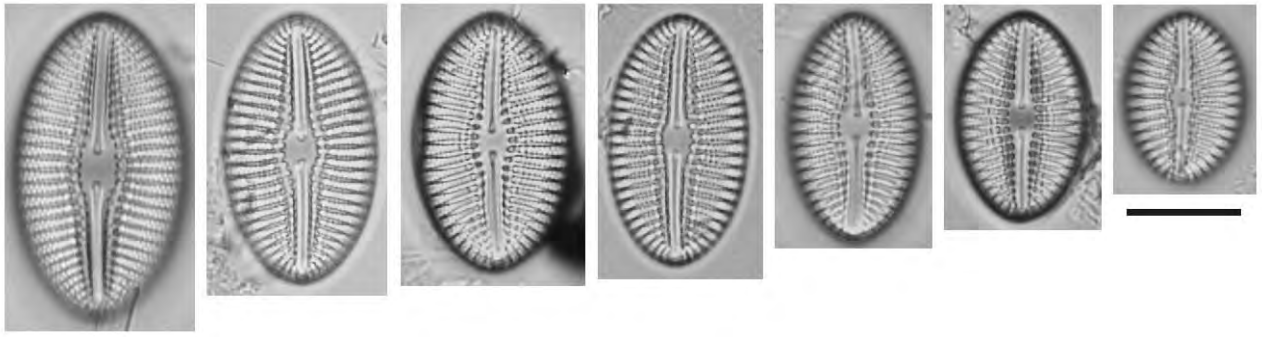


Diploneis oblongella (Naegeli) Cleve-Euler



Dimensions:
Valve length = 10-40 µm
Valve breadth = 4-6 µm
Striae density = 18-24 /10 µm
Comments: Valves linear, linear-elliptical to elliptical. Foramina not clearly distinguishable in striae.
Ecology: Found in well-aerated clean or mildly polluted water with a moderate electrolyte content.

Diploneis subovalis Cleve



Dimensions:
Valve length = 10-50 µm
Valve breadth = 8-20 µm
Striae density = 18-22 /10 µm
Comments: Valves elliptical to linear-elliptical. Foramina with clearly visible perforations.
Ecology: A tropical freshwater diatom species, found in standing waters and occasionally in flowing waters. Occurs in water with moderate to elevated electrolyte content.

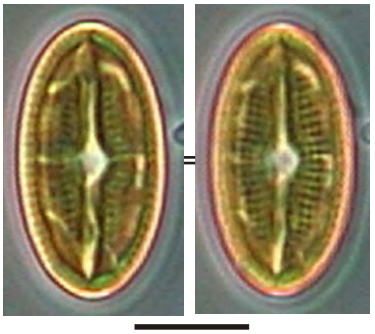


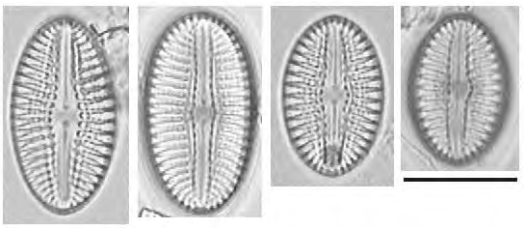
Plate 40

BIRAPHIDEAE

Taxa with a raphe on both valves

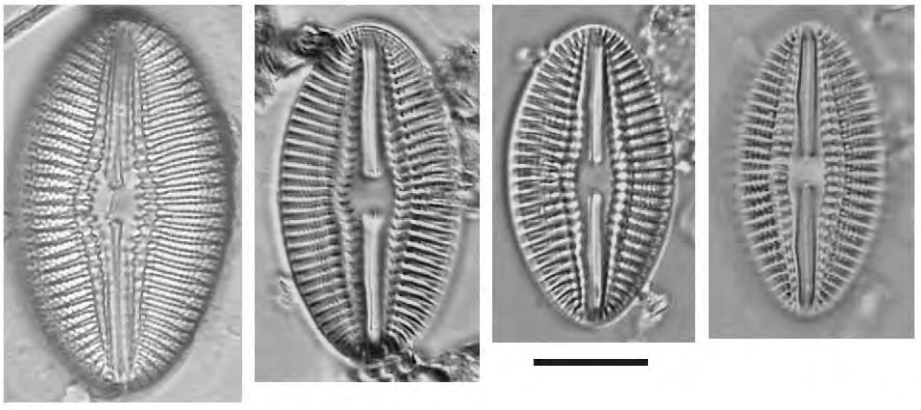
These taxa are characterised by axial hyaline thickenings

Diploneis puella (Schumann) Cleve



Dimensions:
Valve length = 13-25 µm
Valve breadth = 8-14 µm
Striae density = 13-18 /10 µm
Comments: Valves strictly elliptical with bluntly rounded apices. Only the foramina adjacent to the axial area have clearly visible perforations.
Ecology: Found in oligotrophic waters with moderate to elevated electrolyte content.

Diploneis smithii (Brébisson) Cleve



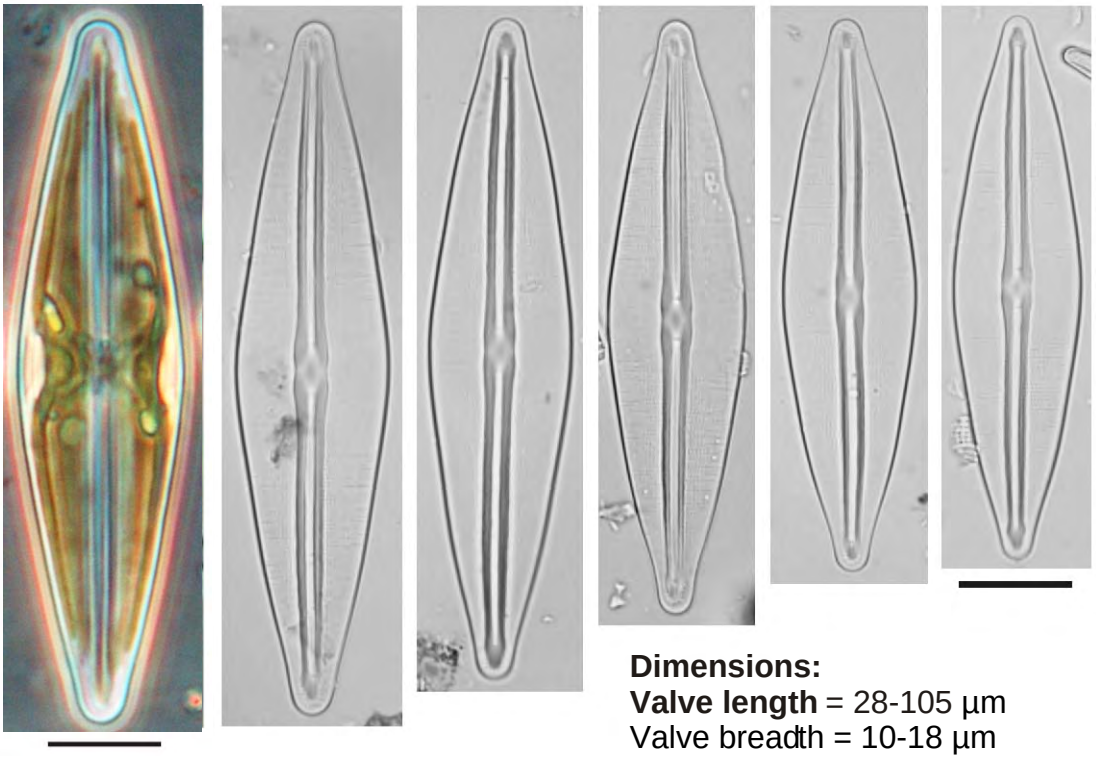
Dimensions:
Valve length = 12-200 µm
Valve breadth = 6.5-75 µm
Striae density = 5-15 /10 µm
Comments: Valves variable ranging from broad-elliptical, linear-elliptical to rhombic elliptical. Characterised by a broad rounded central area. Perforations in foramina clearly visible.
Ecology: Found in brackish to weakly saline inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa are characterised by thickened silica ribs flanking the raphe

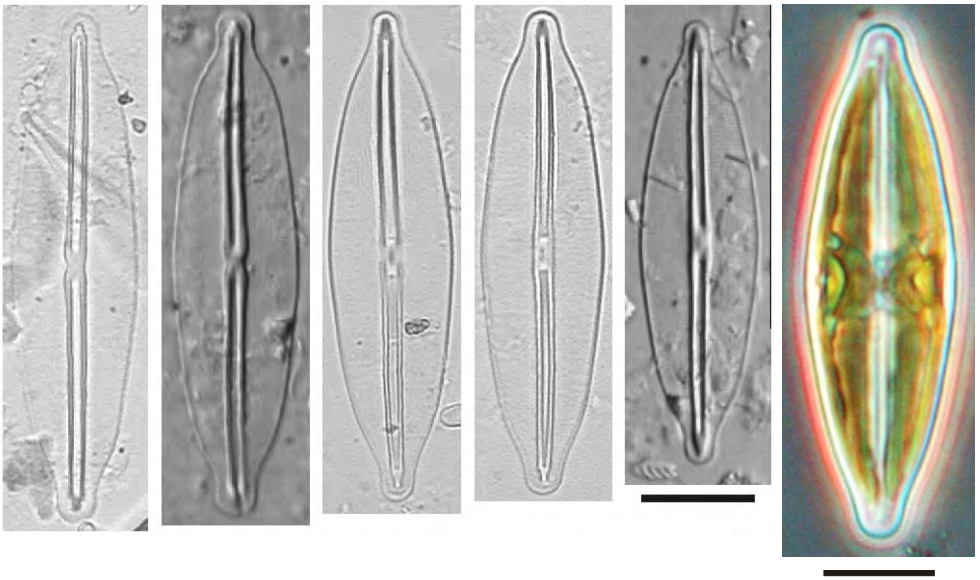
***Frustulia saxonica* Rabenhorst**



Comments: Valves broad-lanceolate to rhombic-lanceolate. Apices short-protracted, weakly subcapitate or sub-rostrate. Transverse and longitudinal striae weakly visible.
Ecology: A cosmopolitan species occurring in dystrophic, acidic, electrolyte-poor waters.

Dimensions:
Valve length = 28-105 µm
Valve breadth = 10-18 µm
Striae density = 29-32 /10 µm

***Frustululia crassinervia* (Kützing) Cleve**
Syn. *Frustulia rhomboides* var. *crassinervia* (Brébisson) Ross



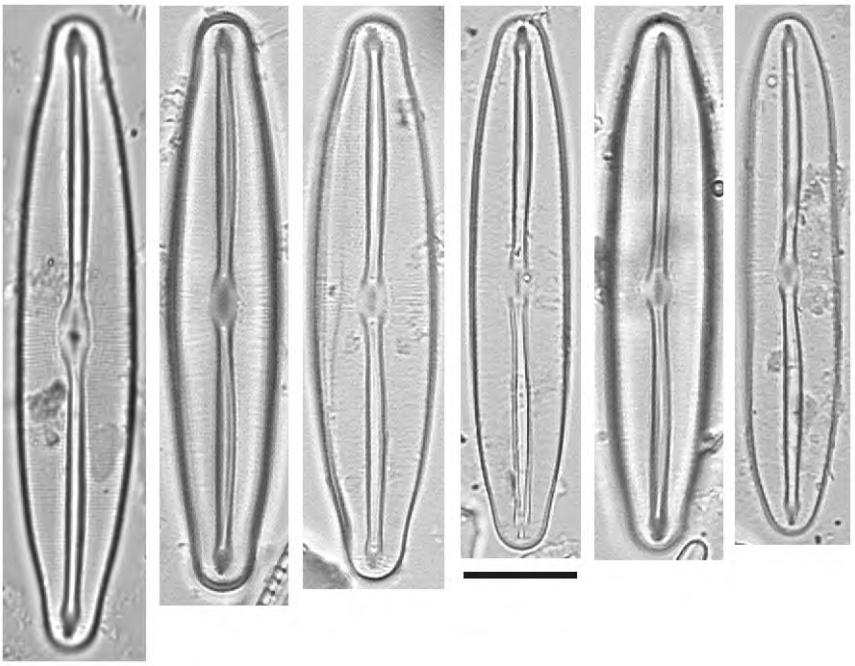
Dimensions:
Valve length = 30-55 µm
Valve breadth = 8-12.5 µm
Striae density = 30-35 /10 µm
Comments: Valves lanceolate to elliptic-lanceolate. Outline commonly weakly triundulate. Apices rostrate to subrostrate.
Ecology: A (possibly) cosmopolitan species occurring in oligotrophic standing waters, especially those with a low electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

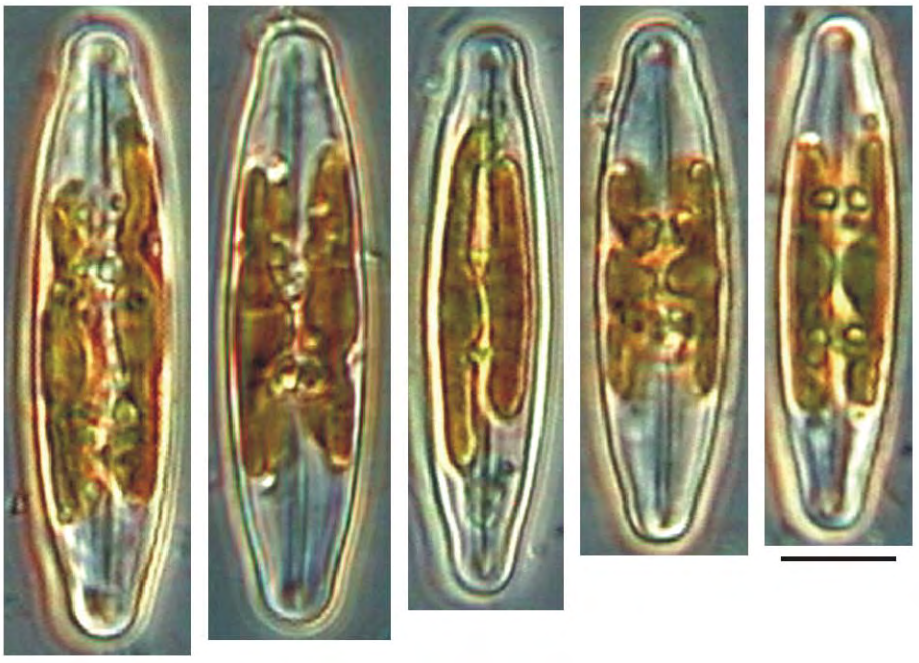
These taxa are characterised by thickened silica ribs flanking the raphe

Frustulia vulgaris **(Thwaites) De Toni**



Dimensions:
Valve length = 40-60 µm
Valve breadth = 8-12 µm
Striae density = 27-32 /10 µm
Comments: Valves elliptic-lanceolate, linear-elliptical to linear-lanceolate. Apices broadly rounded or protracted, more or less subcapitate. The axial ribs are discontinuous; interrupted in the central area by the central nodule. This is different from most other *Frustulia* species. Central striae are weakly radial.
Ecology: A cosmopolitan species with a wide ecological amplitude. Occurring in fresh to slightly brackish water habitats. Also found ranging from oligotrophic to highly polluted waters.

SEM images showing the internal structure of *F. vulgaris.* Note the interruption of the axial ribs in the central region.

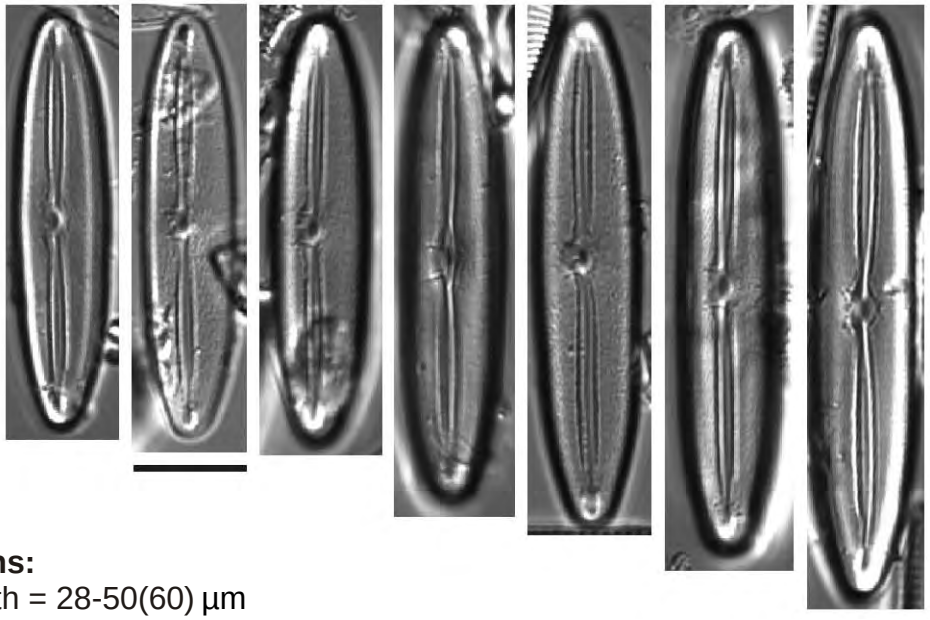


BIRAPHIDEAE

Taxa with a raphe on both valves

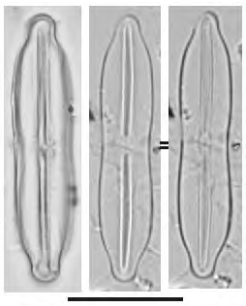
These taxa are characterised by thickened silica ribs flanking the raphe

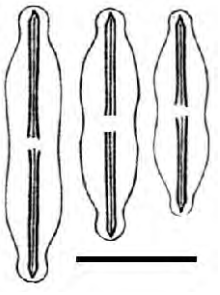
Frustulia weinholdii **Hustedt**



Dimensions:
Valve length = 28-50(60) µm
Valve breadth = 6.5-10 µm
Striae density = 32-34 /10 µm
Comments: Valves linear-elliptical. Apices broadly rounded, never protracted The axial ribs are discontinuous, interrupted in the central area by the central nodule as in *F. vulgaris*. Central or proximal raphe endings are elongated and curve to the same side at almost 90° to the raphe.
Ecology: Ecological amplitude not precisely known however thought to occur in oligo- to eutrophic waters with a low or moderate electrolyte content.

Frustulia tugelae **Cholnoky**





Cholnoky (1957a)

Dimensions:
Valve length = 17-26 µm
Valve breadth = 4-5 µm
Striae density = >40 /10 µm (i.e. not visible in LM)
Comments: A very small *Frustulia* species linear in shape with strongly concave valve margins and weakly protracted, rounded to sub-capitate apices.
Ecology: A rare diatom only reported from the eastern mountainous regions of South Africa. Associated with weakly acidic waters.

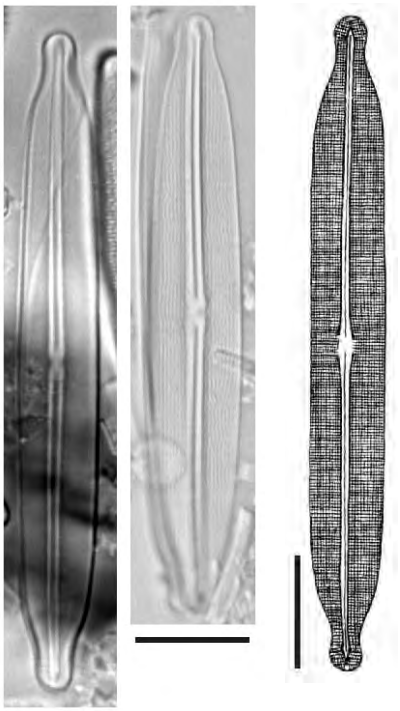
Plate 44

BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa are characterised by thickened silica ribs flanking the raphe

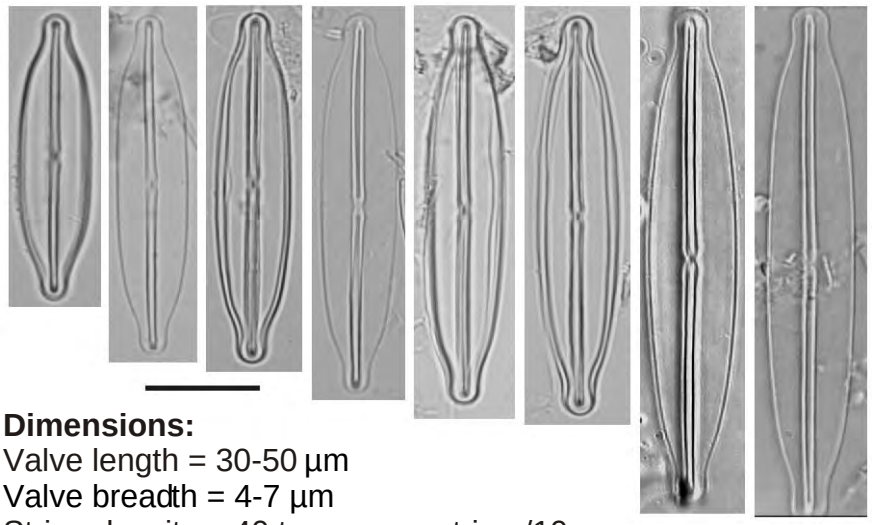
Frustulia magaliesmontana Cholnoky



Dimensions:
Valve length = 30-75 µm
Valve breadth = 6-8 µm
Striae density = 38 /10 µm
Comments: Valves linear with protracted capitate apices. Axial ribs are continuous throughout the valve.
Ecology: Ecological amplitude not precisely known however thought to occur in acidic, oligotrophic waters with a low electrolyte content.

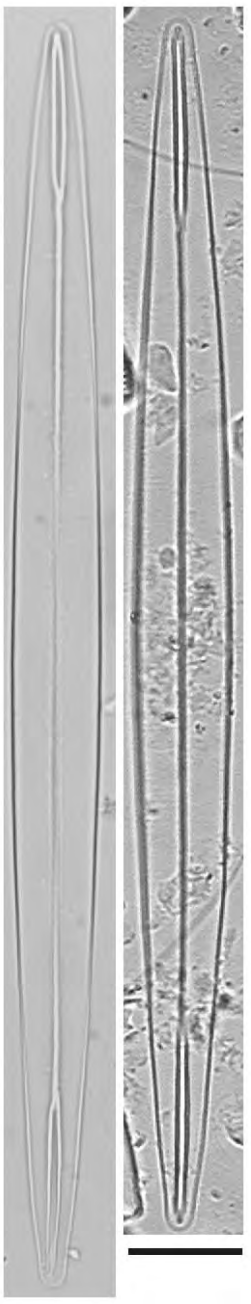
Iconotype Cholnoky (1957b)

Frustulia rostrata Hustedt



Dimensions:
Valve length = 30-50 µm
Valve breadth = 4-7 µm
Striae density = 40 transverse striae /10 µm
= 36 longitudinal striae /10 µm
Comments: Valves linear, with slightly convex margins and protracted, subcapitate apices.
Ecology: Found in acidic standing or flowing waters also associated with bryophytes.

Amphipleura pellucida (Kützing) Kützing



Comments: Valves are lanceolate with narrow (acutely) rounded apices. The raphe branches are short and flanked by axial ribs resembling the eye of a needle. The raphe branches are connected by a long central axial rib.
Ecology: A cosmopolitan species found in alkaline waters of moderate electrolyte content, extending into slightly brackish conditions.

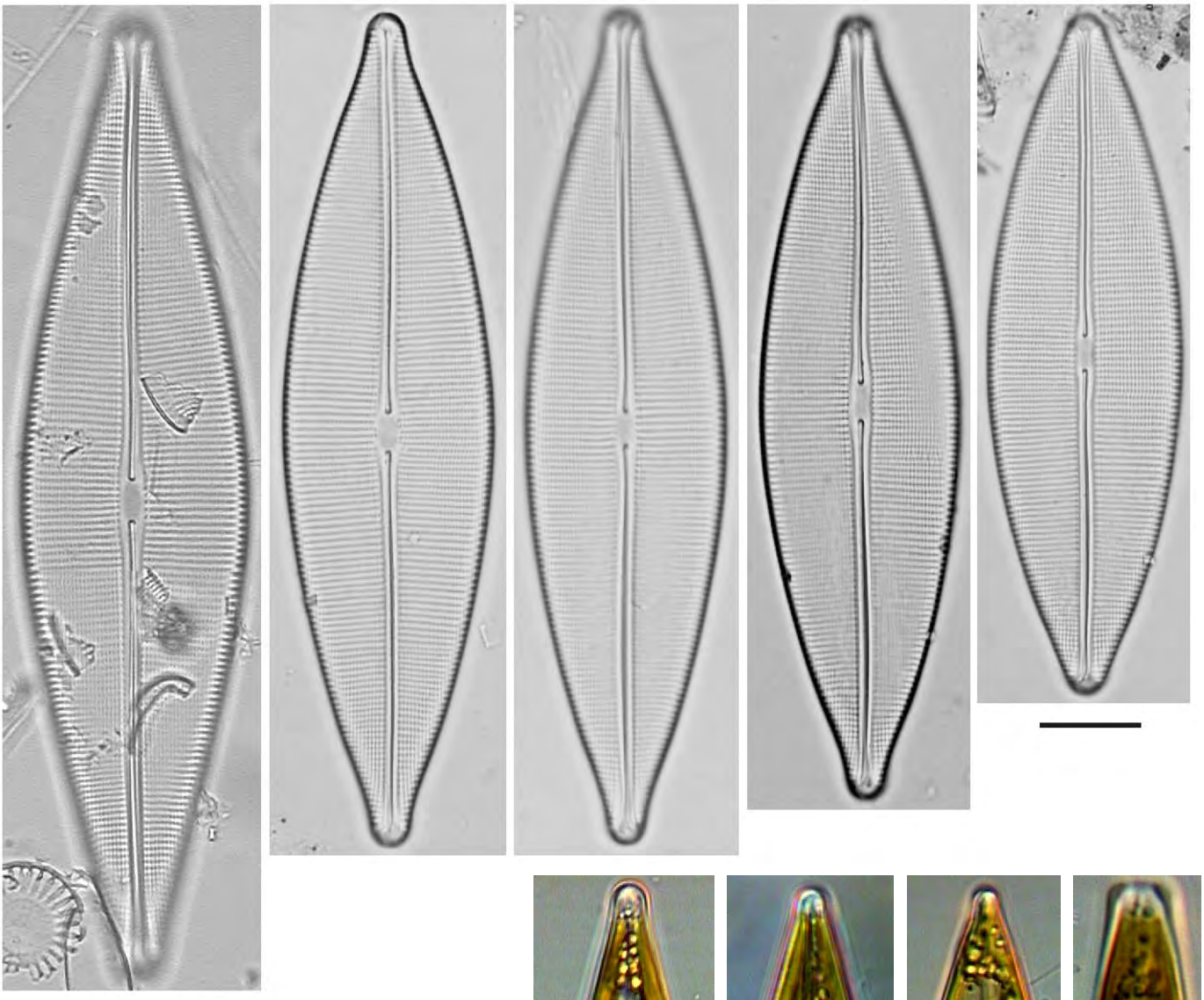
Dimensions:
Valve length = 80-140 µm
Valve breadth = 7-9 µm
Striae density = 37-40 /10 µm

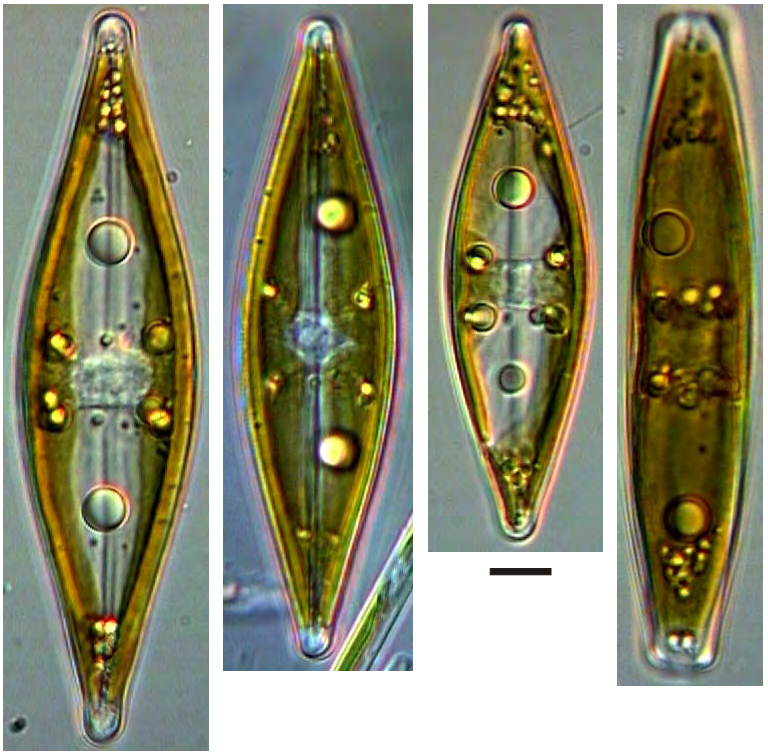
BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa are characterised by parallel transverse striation

***Craticula cuspidata* (Kützing) DG Mann**
Syn. *Navicula cuspidata* (Kützing) Kützing





Dimensions:
Valve length = 65-170 µm
Valve breadth = 17-35 µm
Striae density = 11-15 /10 µm
Comments: Valves rhombic-lanceolate or broad-lanceolate. Apices only slightly protracted and narrowly rounded. Striae are parallel to slightly convergent near the apices.
Ecology: A cosmopolitan epipelic species occurring in eutrophic waters with moderate to high electrolyte content, extending into brackish waters. May tolerate critical to very heavy pollution.

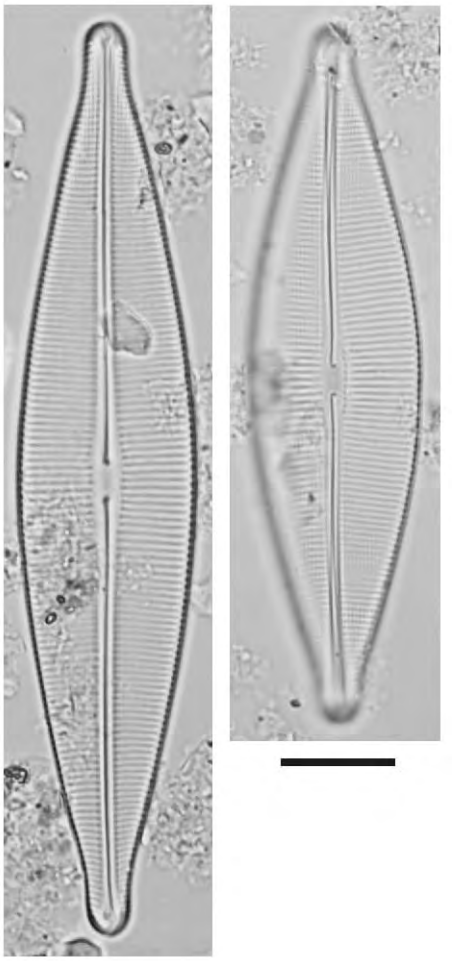
Plate 46

BIRAPHIDEAE

Taxa with a raphe on both valves

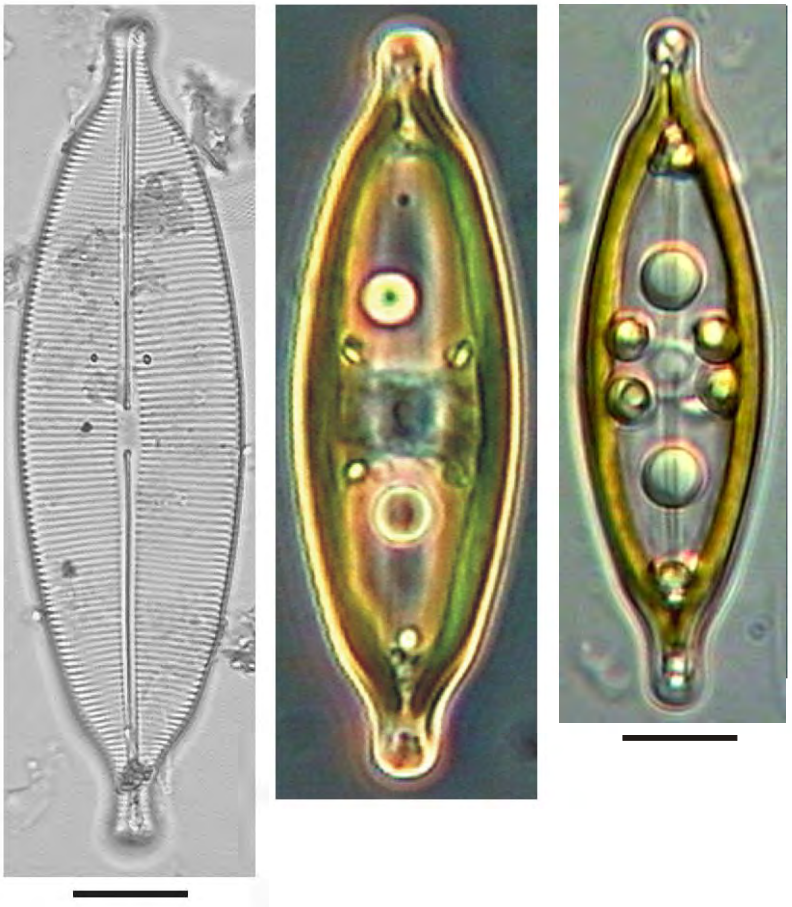
These taxa are characterised by ± parallel transverse striation

Craticula acidoclinata
Lange-Bertalot & Metzeltin



Dimensions:
Valve length = 60-130 µm
Valve breadth = 16-24 µm
Striae density = 13-15.5 /10 µm
Comments: Valves lanceolate with obtuse to broadly rounded, slightly or never protracted apices. Central area never concerve in the middle as is sometimes the case with *C. cuspidata.*
Ecology: A cosmopolitan species found in oligotrophic, usually dystrophic, electrolyte poor acidic waters.

***Craticula ambigua* (Ehrenberg) DG Mann**
Syn. *Navicula ambigua* Ehrenberg



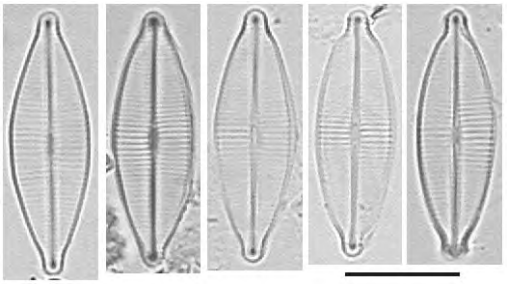
Dimensions:
Valve length = 42-95 µm
Valve breadth = 13-24 µm
Striae density = 15-18 /10 µm
Comments: Valves elliptic-lanceolate with protracted rostrate to weakly sub-capitate apices. Central area absent or only very slightly widened.
Ecology: A cosmopolitan usually epipelic species found in moderately to very electrolyte rich, eutrophic waters, resistant to critical and strong levels of pollution.

BIRAPHIDEAE

Taxa with a raphe on both valves

These taxa are characterised by ± parallel transverse striation

***Craticula accomoda* (Hustedt) DG Mann**
Syn. *Navicula accomoda* Hustedt

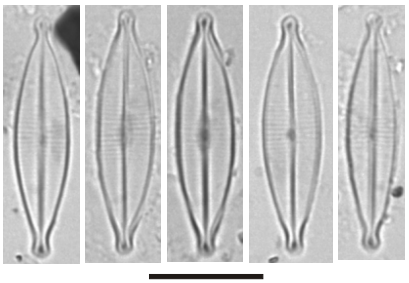


Dimensions:
Valve length = 17-25 (usually 20) µm
Valve breadth = 5-8 µm
Striae density = 20-28 /10 µm
Comments: Valves are elliptical to elliptic-lanceolate with protracted rostrate apices. Striae parallel, becoming more dense towards the apices. Central area is indistinct.
Ecology: A common characteristic indicator species for high levels of pollution. Found in strongly organically polluted waters, in particular effluent from sewage treatment works. It has a scattered occurrence in oligo- to eutrophic waters.

***Craticula accomodiformis* Lange-Bertalot**

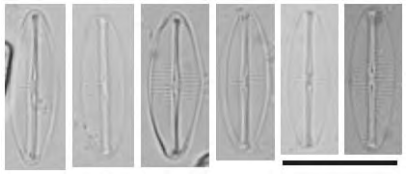
Dimensions:
Valve length = (24?)28-37 µm
Valve breadth = 8-11.5 µm
Striae density = 20-28 /10 µm
Comments: Valves elliptic-lanceolate with short-rostrate apices.
Ecology: Cosmopolitan in the tropics, subtropics and warmer regions. Found in eutrophic, electrolyte rich waters but not in waters with more than moderate levels of pollution.

***Craticula vixnegligenda* Lange-Bertalot**



Dimensions:
Valve length = 20-25 µm
Valve breadth = 5.5-6.5 µm
Striae density = 25 /10 µm
Comments: Valves elliptic-lanceolate with short-subcapitate apices. Striae become more dense towards the poles.
Ecology: Distribution uncertain, associated with electrolyte poor, meso- to eutrophic waters.

***Craticula molestiformis* (Hustedt) Lange-Bertalot**
Syn. *Navicual molestiformis* Hustedt, *Navicula twymaniana* Archibald, *Navicula hariola* Cholnoky



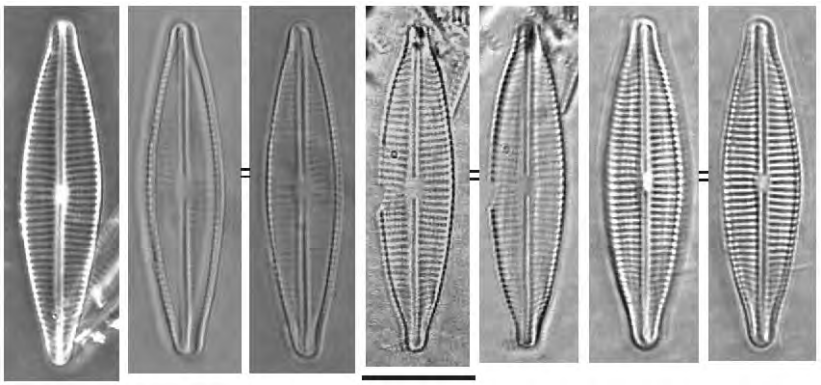
Dimensions:
Valve length = 9.5-22 µm
Valve breadth = 3-5 µm
Striae density = 23-40 /10 µm
Comments: Valves elliptic to linear-elliptic with broadly rounded apices. Striae only resolvable in the middle of the valve.
Ecology: A cosmopolitan species occurring electrolyte rich, often heavily polluted water including sewage effluent.

BIRAPHIDEAE

Taxa with a raphe on both valves

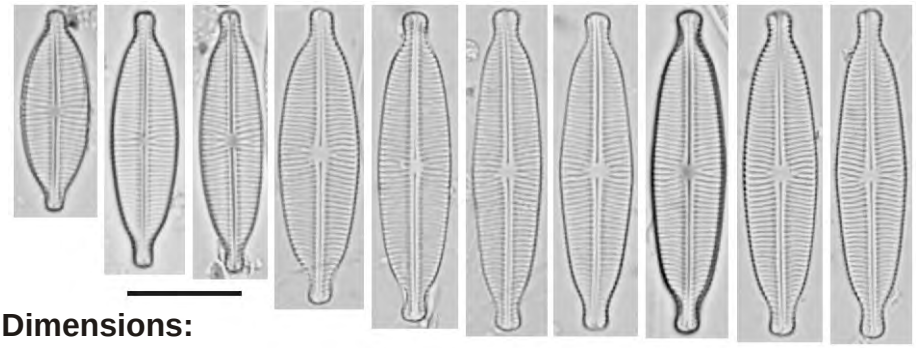
These taxa are characterised by ± parallel transverse striation

***Craticula halophila* (Grunow) DG Mann**
Syn. *Navicula halophila* (Grunow) Cleve

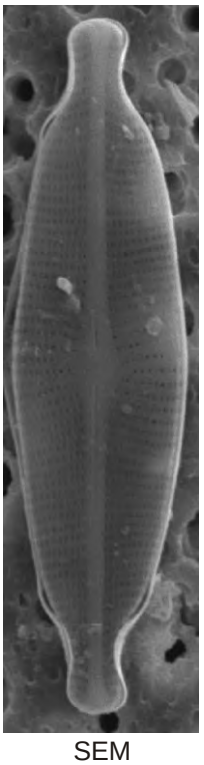


Dimensions:
Valve length = 20-90(140) µm
Valve breadth = (5?)8-18 µm
Striae density = 15-20 /10 µm
Comments: Valves rhombic, rhombic-lanceolate to linear-lanceolate. Apices slightly protracted and acutely rounded. Puncta usually resolvable in LM varying from 28-40 /10 µm.
Ecology: A cosmopolitan species commonly occurring in salt springs and standing waters with a high to very high electrolyte content.

***Craticula buderi* (Hustedt)**
***Syn. Navicula pseudohalophila* Cholnoky**



Dimensions:
Valve length = 10-40 µm
Valve breadth = 5-8 µm
Striae density = (17)19-24 /10 µm
Comments: Valves elliptic-lanceolate, lanceolate, linear-lanceolate or elliptical (small forms) with rostrate to subcapitate protracted apices. Striae radial in the centre of the cell becoming convergent and strongly curved (arcuate) towards the apices.
Ecology: Cosmopolitan distribution, common in fresh waters with moderate to elevated electrolyte content (e.g. calcareous streams). Found in a wide range of trophic conditions and occurs in mine effluent.



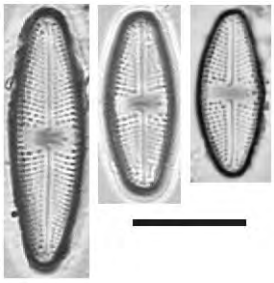
SEM

BIRAPHIDEAE

Taxa with a raphe on both valves

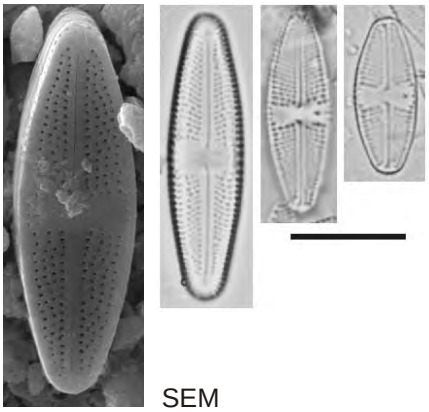
These taxa are characterised by coarse pore structure and the presence of a stigma

Luticola mutica (Kützing) DG Mann
Syn. *Navicula mutica* Kützing



Dimensions:
Valve length = 6-30(40) µm
Valve breadth = 4-9(12) µm
Striae density = 14-20(25) /10 µm
Comments: Valves rhombic-elliptical, broad-elliptical to rhombic-lanceolate with broad bluntly rounded apices.
Ecology: A cosmopolitan species very common in brackish conditions and in waters which are prone to drying out. Less tolerant of pollution than *L. goeppertiana.*

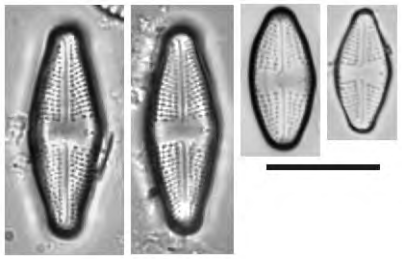
Luticola goeppertiana (Bleish) DG Mann
Syn. *Navicula goeppertiana* (Bleish) HL Smith



SEM

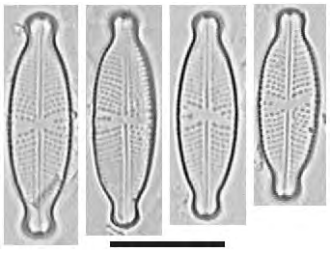
Dimensions:
Valve length = 10-65(144) µm
Valve breadth = 6-15(36) µm
Striae density = 18-24 /10 µm
Comments: Valves elliptic-lanceolate, rhombic-lanceolate to linear elliptical with sharply or bluntly rounded apices. Slightly denser striation than *L. mutica.*
Ecology: A cosmopolitan species commonly occurring in electrolyte rich, subaerial environments as well as in heavily polluted waters.

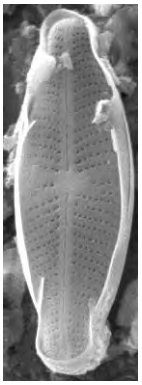
Luticola acidoclinata Lange-Bertalot



Dimensions:
Valve length = 9-25(40) µm
Valve breadth = 4.5-7.5 µm
Striae density = 20-24 /10 µm
Comments: Valves rhombic-lanceolate, rhombic-elliptical to broad-elliptical with acutely rounded apices. Characterised by a slight unilateral central inflation.
Ecology: A cosmopolitan species found in oligo- to dystrophic, circumneutral to slightly acidic, electrolyte poor waters.

Luticola kotschyi (Grunow)
Syn. *Navicula kotschyi* Grunow





SEM

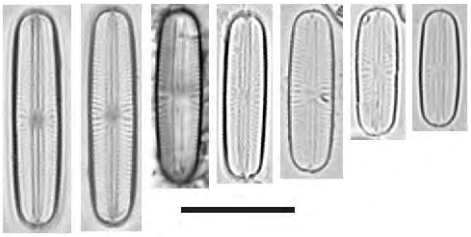
Dimensions:
Valve length = 15-26(40) µm
Valve breadth = 5-7 µm
Striae density = 20-26 /10 µm
Comments: Valves elliptical, elliptic-lanceolate to linear-elliptical with protracted sub-capitate apices. No stigma present.
Ecology: Found in thermal waters, as well as waters with elevated electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

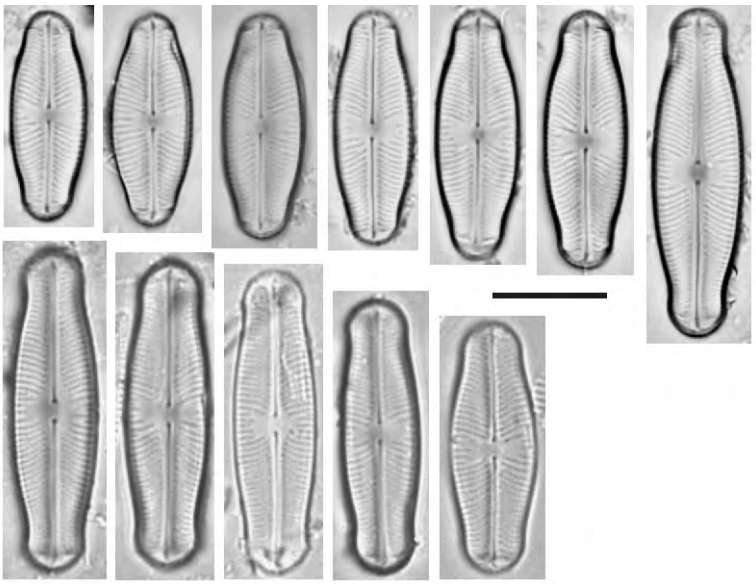
These taxa often have a transapical thickened rib near the poles

Sellaphora stroemii (Hustedt) DG Mann
Syn. _Navicula stroemii_ Hustedt

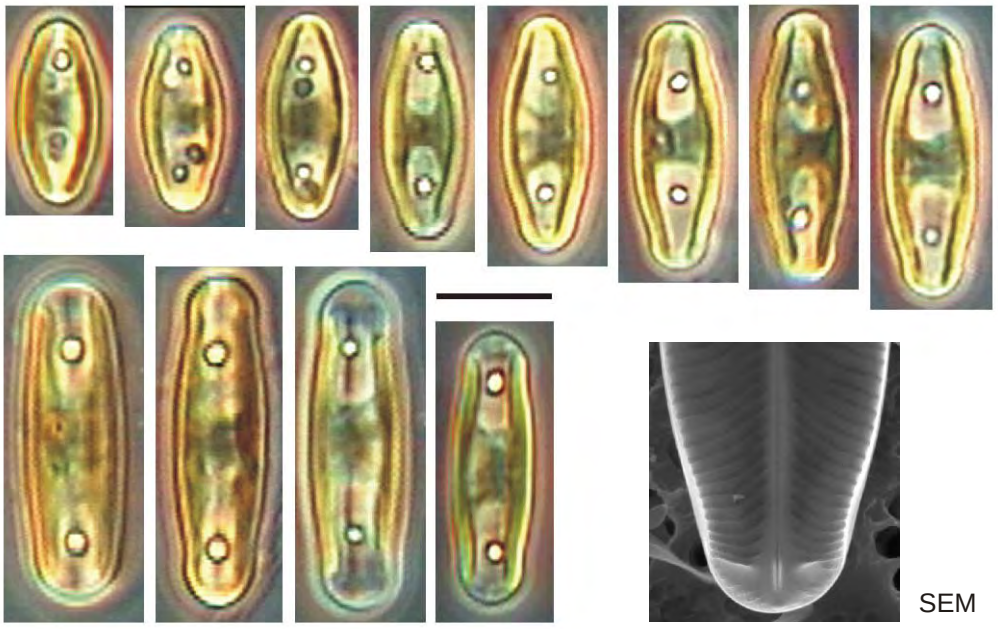


Dimensions:
Valve length = 10-90 µm
Valve breadth = 4.2-21 µm
Striae density = 16-26 /10 µm
Comments: Valves linear with slightly convex margins and bluntly rounded apices.
Ecology: A cosmopolitan species found in cold, electrolyte rich waters, such as springs and waterfalls.

Sellaphora pupula (Kützing) Mereschkowsky sensu lato
Syn. _Navicula pupula_ Kützing



Dimensions:
Valve length = 10-90 µm
Valve breadth = 4.2-21 µm
Striae density = 16-26 /10 µm
Comments: Valves extremely variable; elliptical, linear-elliptical to linear with bluntly rounded or weakly protracted subcapitate apices. Striae fine, composed of a single row of round puncta. Striae strongly radiate and curved at the centre of the cell. This large species complex has recently been revised (Mann *et al.*, 2004) resulting in the description of several new species.



Ecology: A cosmopolitan species found in a broad spectrum of electrolyte rich waters with some populations found under strongly polluted conditions.

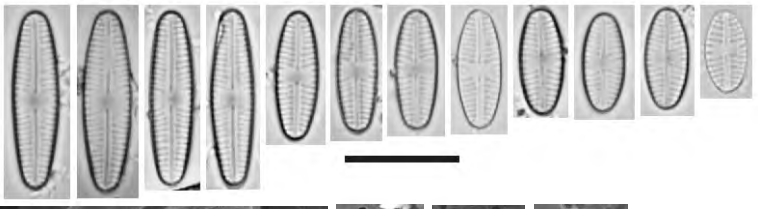
SEM

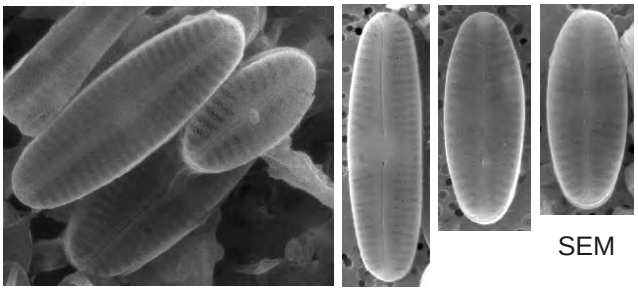
BIRAPHIDEAE

Taxa with a raphe on both valves

Small taxa previously belonging to Navicula *sensu lato*

***Sellaphora seminulum* (Grunow) DG Mann**
Syn. *Navicula seminulum* Grunow

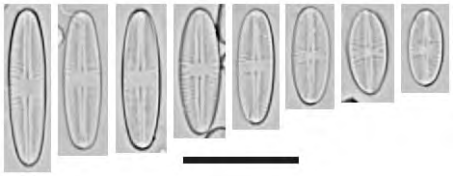


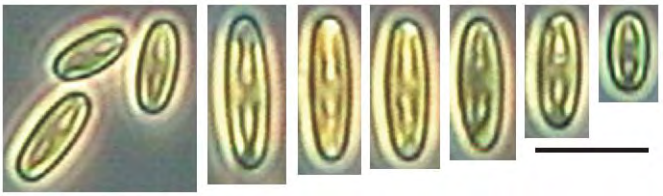


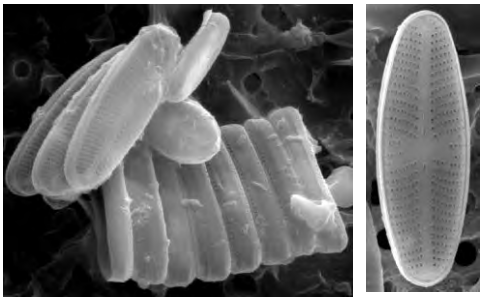
SEM

Dimensions:
Valve length = 3-21 µm
Valve breadth = 2-5 µm
Striae density = 18-22 /10 µm
Comments: Valves linear-elliptical, smaller valves elliptical. Striae coarser than *E. minima* and composed of a double row of puncta (see SEM images).
Ecology: A cosmopolitan species found in range of waters, including eutrophic, electrolyte rich and extremely polluted waters.

***Eolimna minima* (Grunow) Lange-Bertalot**
Syn. *Navicula minima* Grunow



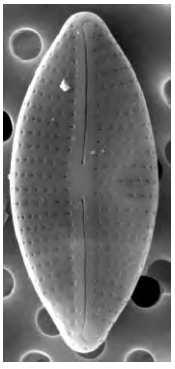




SEM

Dimensions:
Valve length = 5-18 µm
Valve breadth = 2-4.5 µm
Striae density = 25-30 /10 µm
Comments: Valves similar in outline to *S. seminulum* but with denser striation.
Ecology: Cosmopolitan, found in a wide range of waters including heavily polluted biotopes. May possibly be associated with organic detritus.

***Eolimna subminuscula* (Manguin) Lange-Bertalot**
Syn. *Navicula subminuscula* Manguin



SEM

Dimensions:
Valve length = 7.8-24 µm
Valve breadth = 3.2-5.1µm
Striae density = 15-26(34) /10 µm

Comments: Valves elliptical to rhombic-elliptical with rounded or acutely rounded, rarely weakly protracted apices. Striae density very variable.
Ecology: A cosmopolitan species common in electrolyte rich, strongly polluted rivers and flowing waters.

BIRAPHIDEAE

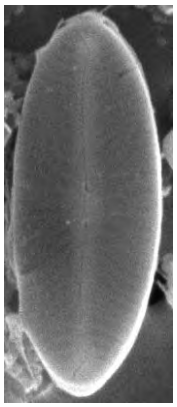
Taxa with a raphe on both valves
Small taxa previously belonging to Navicula *sensu lato*

***Mayamaea atomus* (Kützing) Lange-Bertalot**
Syn. *Navicula atomus* Kützing

Dimensions:
Valve length = 8.5-13 µm
Valve breadth = 4-5.5 µm
Striae density = 19-22 /10 µm

Comments: Valves elliptical to linear-elliptical with bluntly rounded apices. Raphe enclosed in a more or less silicified raphe sternum with prominent central and terminal nodules. Radial striae visible throughout the valve, alternately long and short around the central area.
Ecology: See *M. atomus* var. *permitis*

***Mayamaea atomus* var. *permitis* (Hustedt) Lange-Bertalot**
Syn. *Navicula atomus* var. *permitis* (Hustedt) Lange-Bertalot

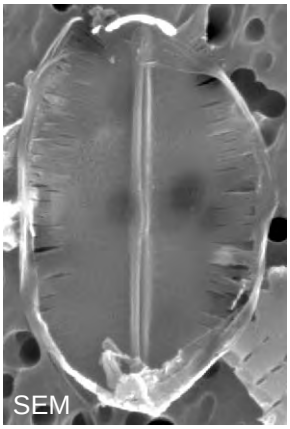


SEM

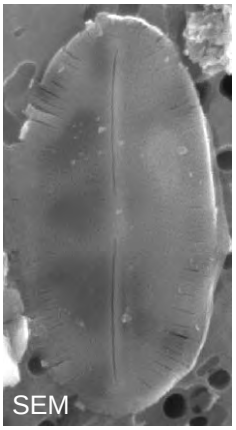
Dimensions:
Valve length = 6-9 µm
Valve breadth = 3-4 µm
Striae density = (25)30-36 /10 µm

Comments: Differs from nominate variety by denser striation and overall size. The raphe sternum is narrower but still with prominent polar and central nodules.
Ecology: A cosmopolitan aerophilous species, found in alkaline, heavily polluted waters with a high electrolyte content. One of the most pollution resistant diatoms, but also occurring in moderate quality waters probably associated with a micro-habitat e.g. organic detritus.

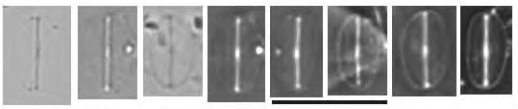
***Fistulifera saprophila* (Lange-Bertalot & Bonik) Lange-Bertalot**
Syn. *Navicula saprophila* Lange-Bertalot & Bonik

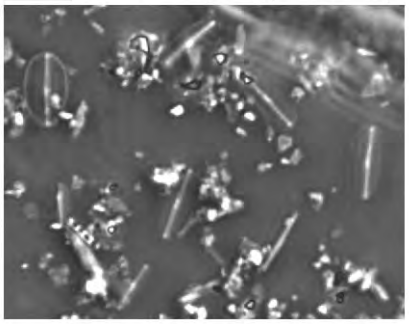


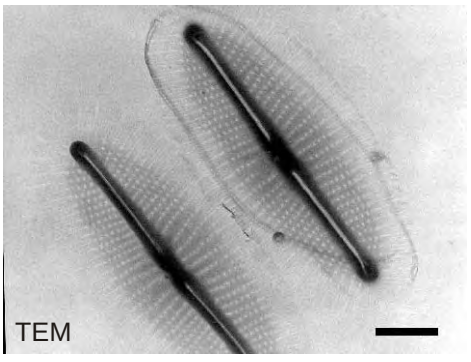
SEM



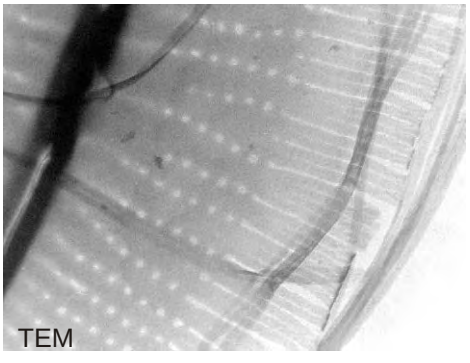
SEM







TEM



TEM

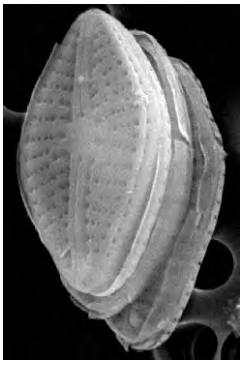
Dimensions:
Valve length = (3.8) 4.5-7.6 µm
Valve breadth = 2-4 µm
Striae density = 48-81 /10 µm
Comments: Valves elliptical with broadly rounded apices. Often only the strongly silicified raphe sternum is visible in LM, if the girdle bands are absent. The valve margin is indistinct, due to its fimbriate nature.
Ecology: A cosmopolitan species found in highly eutrophic, anthropogenically impacted, highly polluted waters. Belongs to the species poor group of the most resistant diatoms of all.

BIRAPHIDEAE

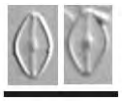
Taxa with a raphe on both valves

Small taxa previously belonging to, or awaiting transfer from, Navicula *sensu lato*

***Eolimna archibaldii* Taylor & Lange-Bertalot**



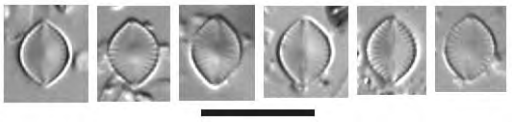
SEM



Dimensions:
Valve length = 5.5-6.5 µm
Valve breadth = 2.8-3.5 µm
Stria density = 32-36 striae /10 µm
Comments: Valves rhombic-lanceolate to rhombic-elliptic with acutely rounded never protracted apices. Only the median striae are visible under special illumination, other wise valves appear hyaline. Raphe located in thickened sternum with a prominent central nodule.
Ecology: This endemic South African species occurs in alkaline, eutrophic waters with elevated electrolyte content.

***Navigiolum adamantiforme* (Archibald) Taylor & Lange-Bertalot**
Syn. *Navicula adamantiformis* Archibald

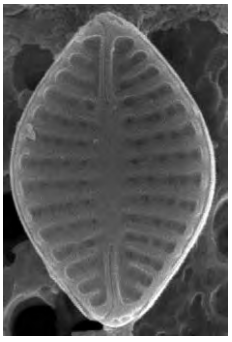
SEM



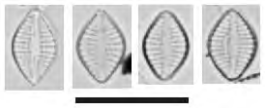
Dimensions:
Valve length = 6-7 µm
Valve breadth = 4.5-5.4 µm
Striae density = 20-26 /10 µm

Comments: Valves broadly-elliptical with narrow, acutely rounded apices. Charaterised by very short striae and short raphe branches.
Ecology: This endemic South African species occurs in alkaline, eutrophic waters with elevated electrolyte content.

***Navicula microrhombus* (Cholnoky) Schoeman & Archibald**



SEM



Dimensions:
Valve length = 6-7 µm
Valve breadth = 4.4-5 µm
Striae density = 22-30 /10 µm
Comments: Valves rhomic to rhombic-elliptical with acutely round apices. Characterised by short raphe branches which are not always clearly visible. The weakly radial striae have clearly discernable puncta.
Ecology: Not precisely known, but thought to occur in polluted, alkaline waters with elevated electrolyte content.

***Navicula arvensis* var. *maior* Lange-Bertalot**

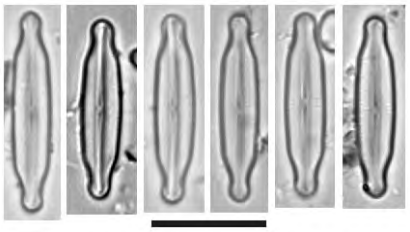
Dimensions:
Valve length = 5-17 µm
Valve breadth = 2.5-4 µm
Striae density = 34-40 /10 µm
Comments: Valves linear with more or less shortly protracted, subcapitate apices. Striae not resolvable in LM.
Ecology: A cosmopolitan species found in waters with moderate to elevated electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

Small taxa previously belonging to, or awaiting transfer from, Navicula *sensu lato*

Adlafia bryophila **(Petersen) Lange-Bertalot**
Syn. *Navicula bryophila* Petersen

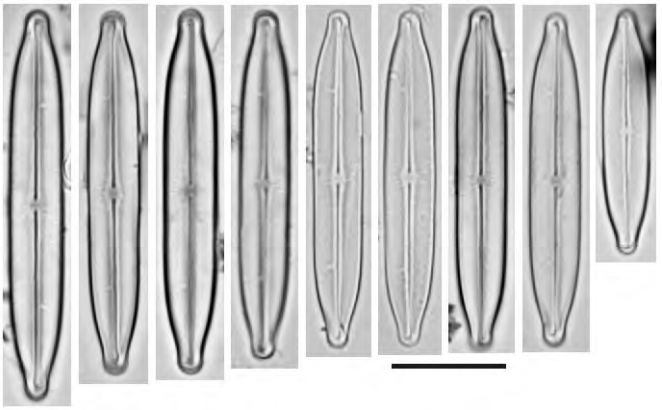


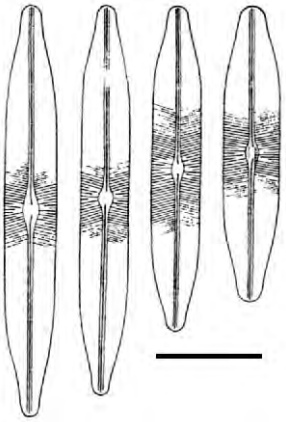
Dimensions:
Valve length = 10-20(25) µm
Valve breadth = (2.5)3-4 µm
Striae density = 29-36(38) /10 µm
Comments: Valves linear with straight or slightly convex margins. Apices variable, from non-protracted and rounded to subrostrate, rostrate or sub-capitate. Central striae strongly radiate.
Ecology: Uncertain, predominantly in clean waters but not necessarily oligotrophic. Aeorophilous, frequently found on intermittently wet bryophytes.

Kobayasiella subtillissima **(Cleve) Lange-Bertalot**
Syn. *Navicula subtillissima* Cleve

Dimensions:
Valve length = 18-38 µm
Valve breadth = 3.5-6 µm
Striae density = 40-42 /10 µm
Comments: Valves linear to linear-lanceolate with more or less protracted capitate apices. Central area elliptical, transapically expanded.
Ecology: A cosmopolitan species found in acidic, electrolyte poor waters.

Navicula dutoitana **Cholnoky**





Iconotype
Cholnoky (1959)

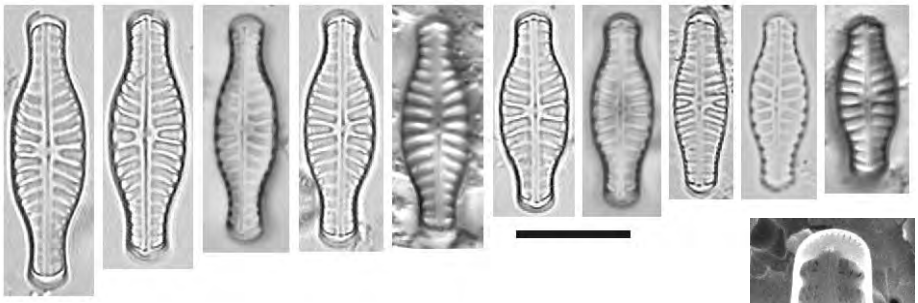
Dimensions:
Valve length = 28-45 µm
Valve breadth = 4-5 µm
Striae density = 38-40 /10 µm
Comments: Valves linear with weakly protracted, rounded to acutely rounded apices. Slightly enlarged central area surrounded by radial striae, alternatively longer and shorter.
Ecology: Unknown, until now only recorded from South Africa.

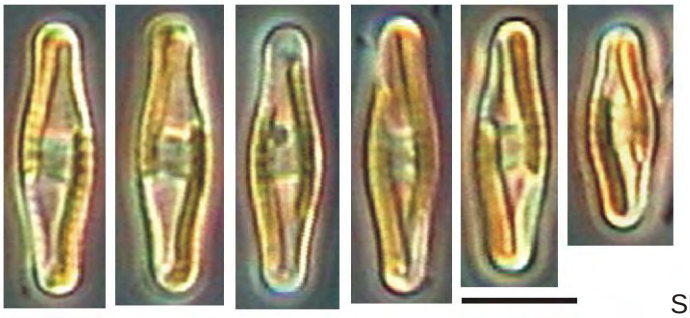
BIRAPHIDEAE

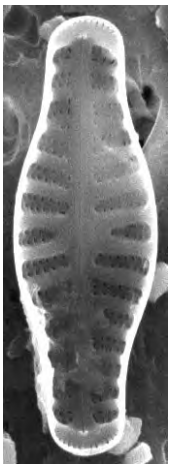
Taxa with a raphe on both valves

Taxa previously belonging to Navicula *sensu lato*

Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski
Syn. *Navicula capitata* Ehrenberg



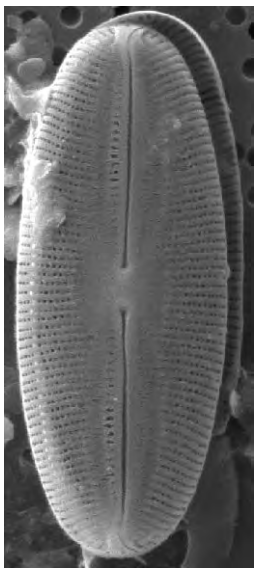




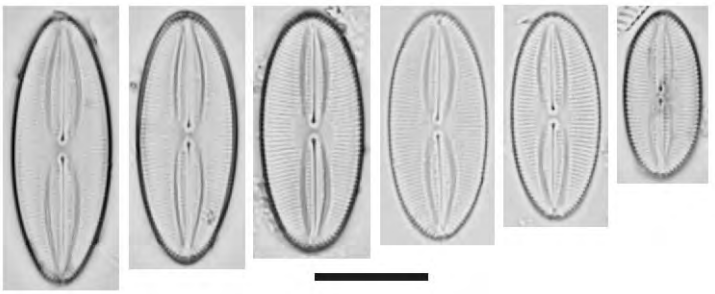
SEM

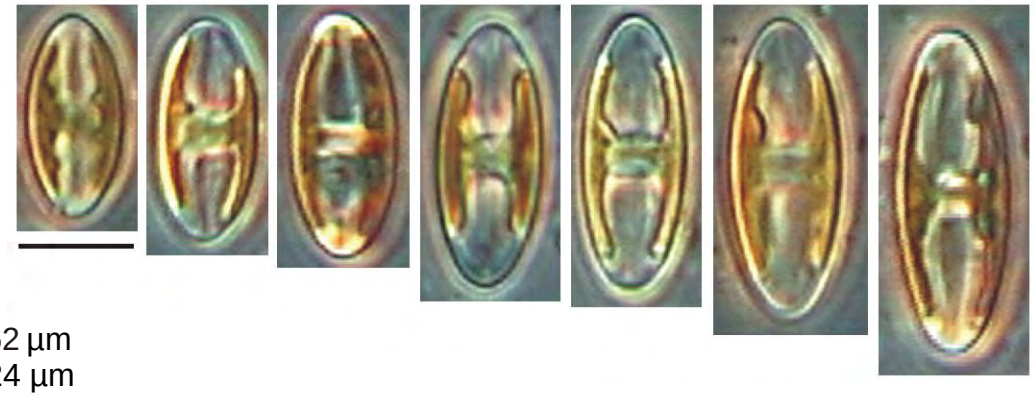
Dimensions:
Valve length = (13) 20-30 µm
Valve breadth = 5-7 µm
Striae density = 8-10 /10 µm
Comments: Valves elliptic-lanceolate with subcapitate to capitate protracted apices. Characterised by very broad striae and broad, transversely thickened polar nodules (see SEM image).
Ecology: Cosmopolitan, found in eutrophic waters with a moderate to high electrolyte content, occasionally brackish. Tolerant of critical pollution levels.

Fallacia pygmaea (Kützing) Sickle & Mann
Syn. *Navicula pygmaea* Kützing



SEM images showing the external structure of *F. pygmaea*. Note the that the H-shaped hyaline area visible in LM is covered by a structure known as a conopeum.





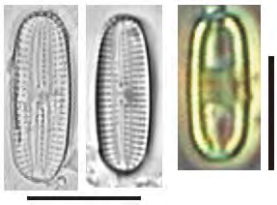
Dimensions:
Valve length = 10-62 µm
Valve breadth = 6-24 µm
Striae density = 22-28 /10 µm
Comments: Valve shape variable, ranging from linear-elliptical, elliptic-lanceolate, narrow-elliptical to broad elliptical. Characterised by distinct curved, H-shaped hyaline area running parallel to the raphe.
Ecology: A cosmopolitan epipelic species occurring in waters with elevated electrolyte content, tolerant to critical levels of pollution.

Plate 56

BIRAPHIDEAE

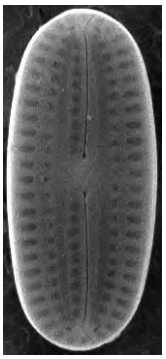
Taxa with a raphe on both valves
Taxa previously belonging to Navicula *sensu lato*

Fallacia tenera (Hustedt) DG Mann
Syn. *Navicula tenera* Grunow

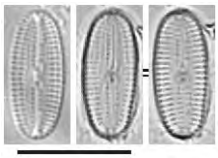


Dimensions:
Valve length = 9-27 µm
Valve breadth = 4-9 µm
Striae density = 13-22 /10 µm
Comments: Valves elliptical, linear-elliptical to linear with broadly rounded apices. Striae coarser than *F. pygmaea*. H-shaped hyaline area present. Characterised by a single row of puncta running parallel to the raphe on the concave side only.
Ecology: A cosmopolitan species found in waters with high to very high electrolyte content (i.e. brackish waters).

SEM



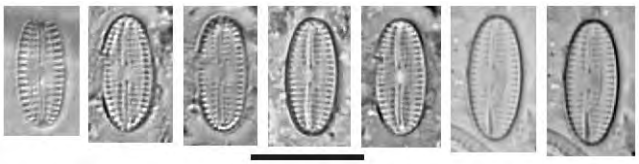
Fallacia insociabilis (Krasske) DG Mann
Syn. *Navicula insociabilis* Krasske, *Navicula natalensis* Cholnoky



Dimensions:
Valve length = 7-22 µm
Valve breadth = 4.5-7 µm
Striae density = 20-25 /10 µm

Comments: Valves elliptical to rhombic-elliptical with broadly rounded apices. Characterised by a single row of puncta running parallel to the raphe on both sides of the raphe.
Ecology: A cosmopolitan aerophilic species found in range of waters.

Fallacia umpatica (Cholnoky) DG Mann
Syn. *Navicula umpatica* Cholnoky

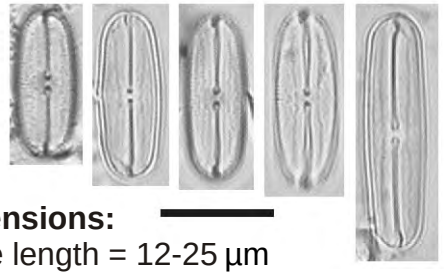


Iconotype
Cholnoky (1968a)

F. umpatica sensu
Archibald (1983)

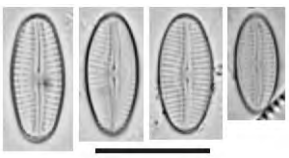
Dimensions:
Valve length = 7.5-16.1 µm
Valve breadth = 3.9-5 µm
Striae density = 17-22 /10 µm
Comments: Valves linear-elliptical with bluntly rounded apices. Characterised by a single row of puncta running parallel to the raphe on one side of the raphe and a double row on the other.
Ecology: A South African species described from brackish waters.

Sellaphora subhamulata (Grunow) DG Mann
Syn. *Navicula subhamulata* Grunow



Dimensions:
Valve length = 12-25 µm
Valve breadth = 4-7 µm
Striae density = 26-30 /10 µm
Comments: Valves linear-elliptic with a weakly visible H-shaped hyaline area. Striae have an irregular appearance.
Ecology: A cosmopolitan species found in a wide range of waters.

Fallacia monoculata (Hustedt) DG Mann
Syn. *Navicula monoculata* Hustedt, *Navicula parvipendata* Cholnoky



Dimensions:
Valve length = 8-22 µm
Valve breadth = 3-6.5 µm
Striae density = 18-22 /10 µm

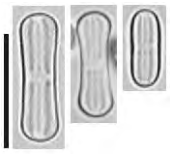
Comments: Valves elliptical to rhombic-elliptical with bluntly rounded apices. The longitudinal line (hyaline area) crossing the striae is distinct, but does not interrupt the striae.
Ecology: A cosmopolitan species found in a wide variety of waters with moderate to elevated electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

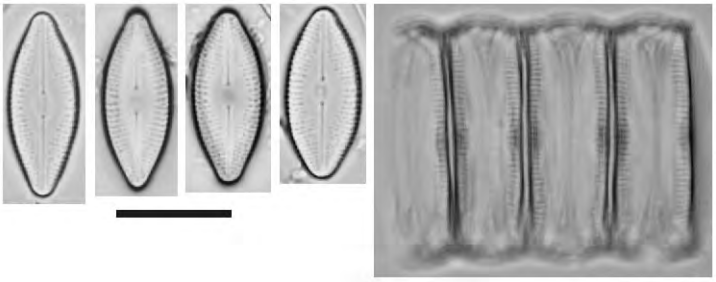
Taxa previously belonging to Navicula *sensu lato*

***Diadesmis contenta* (Grunow in Van Heurk) DG Mann**
Syn. *Navicula contenta* Grunow in Van Heurk

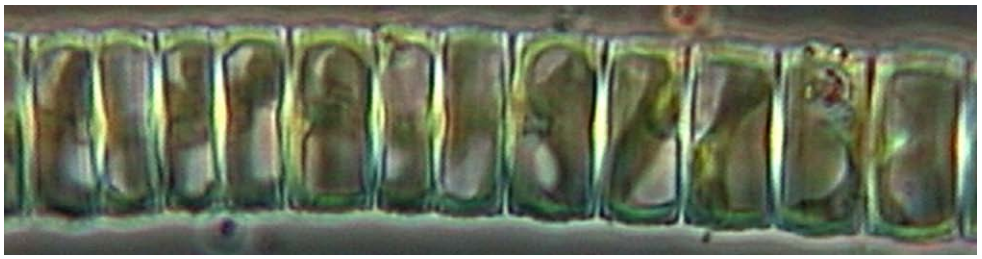


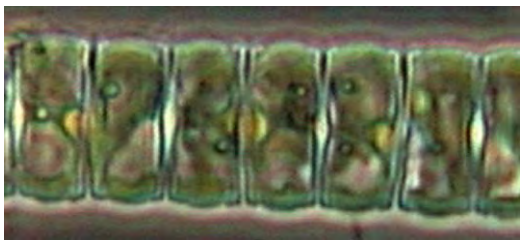
Dimensions:
Valve length = 4-30 µm
Valve breadth = 2-6 µm
Striae density = 25-40 /10 µm
Comments: Valves variable, elliptical to linear more or less constricted in the centre of the valve. Striae short and indistinct.
Ecology: A cosmopolitan species found in small bodies of oligotrophic acidic water such as morasses, vleis and small streams. Also found in biotopes with greatly reduced light intensity.

***Diadesmis confervacea* (Kützing) DG Mann**
Syn. *Navicula confervacea* Kützing



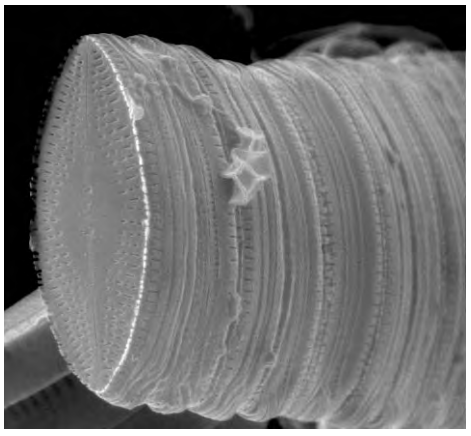
Dimensions:
Valve length = 9-28 µm
Valve breadth = 4-10 µm
Striae density = 15-26 /10 µm

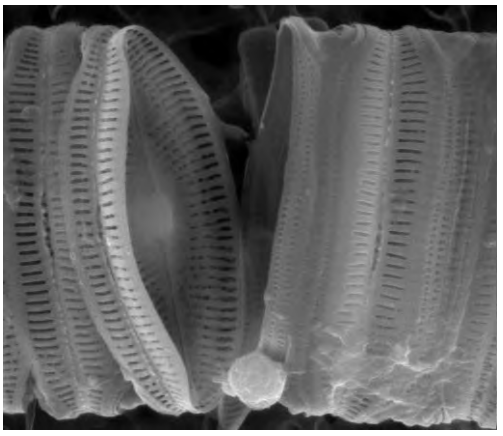




LM images showing cells linked forming long ribbon-shaped colonies.

Comments: Valves elliptical with rounded slightly protracted apices. Characterised by short striae with easily discernible puncta and a very broad lanceolate axial area.
Ecology: A cosmopolitan species found in range of waters, including eutrophic, electrolyte rich and extremely polluted waters.





SEM images showing the external and internal structure of *D. confervacea*. Note the typical slit-like puncta on the valve mantle.

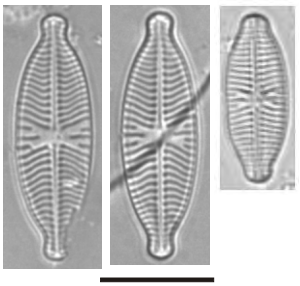
Plate 58

BIRAPHIDEAE

Taxa with a raphe on both valves

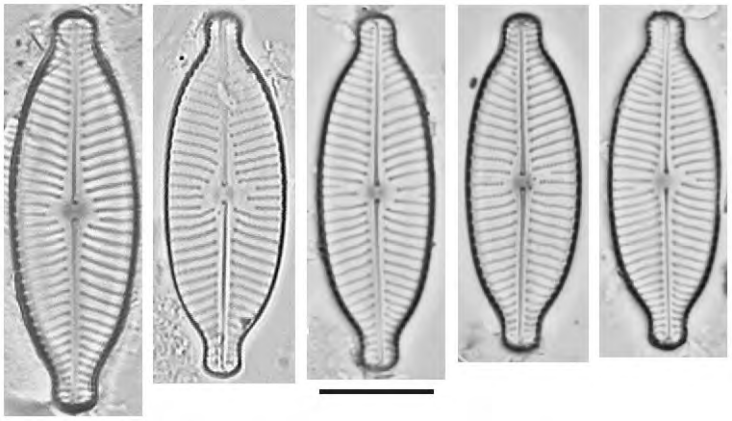
Taxa previously belonging to Navicula *sensu lato*

Geissleria decussis (Hustedt) Lange-Bertalot
Syn. _Navicula decussis_ Østrup

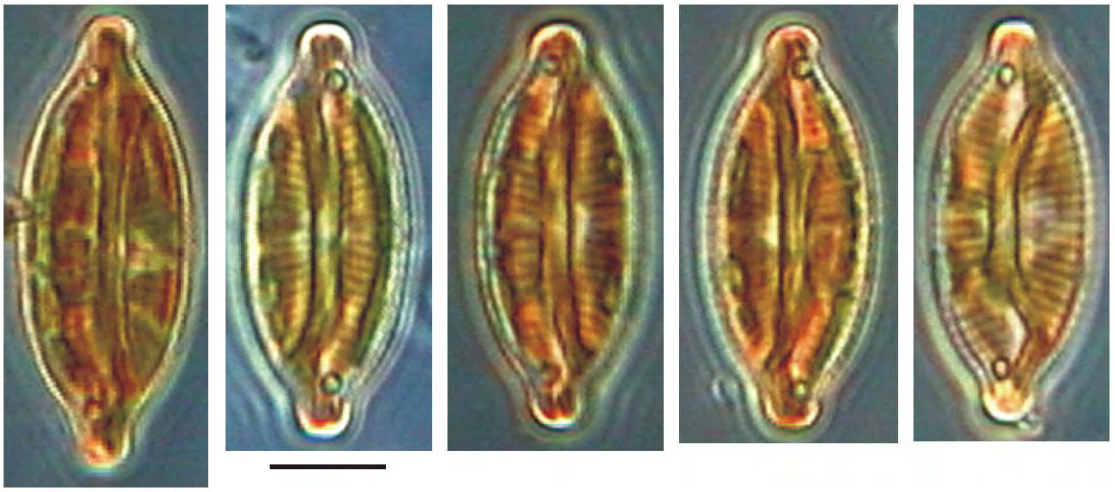


Dimensions:
Valve length = 15-33 µm
Valve breadth = 6-9 µm
Striae density = 14-18 /10 µm
Comments: Valve outline very variable ranging from elliptical to linear-elliptical, lanceolate-elliptical to lanceolate. Apices are protracted and vary from subrostrate to capitate. Single stigma usually present to one side of the central area. Central striae strongly radiate and sinuous.
Ecology: A cosmopolitan species found in eutrophic, unpolluted or moderately polluted waters with average or slightly elevated electrolyte content.

Placoneis placentula (Ehrenberg) Heinzerling
Syn. _Navicula placentula_ (Ehrenberg) Kützing



Dimensions:
Valve length = 30-70 µm
Valve breadth = 12-28 µm
Striae density = 6-9 /10 µm
Comments: Valves elliptic-lanceolate with protracted rostrate apices. Central area small, individual puncta not distinguishable under LM.
Ecology: A cosmopolitan species found in unpolluted or slightly polluted waters with moderate to high electrolyte content.

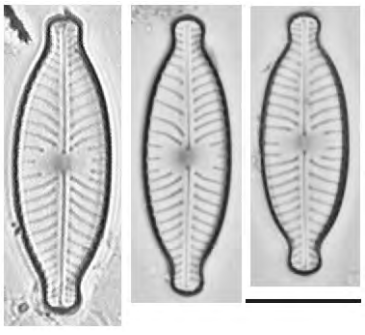


BIRAPHIDEAE

Taxa with a raphe on both valves

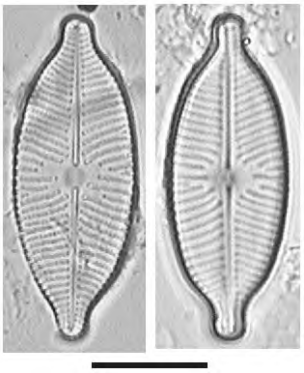
Taxa previously belonging to Navicula *sensu lato*

***Placoneis elginensis* (Gregory) EJ Cox**
Syn. *Navicula elginensis* Gregory



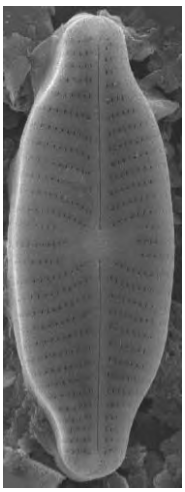
Dimensions:
Valve length = 20-40 µm
Valve breadth = 8-15 µm
Striae density = 8-12 /10 µm
Comments: Valves elliptic-lanceolate with protracted, rostrate or capitate apices. Central area broad, elliptical and transapically widened.
Ecology: A cosmopolitan species found in range of waters, especially unpolluted to slightly polluted dystrophic waters.

***Placoneis clementis* (Grunow) EJ Cox**
Syn. *Navicula clementis* Grunow

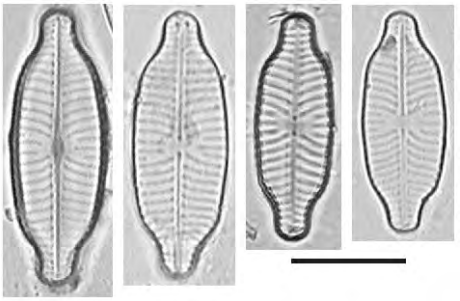


Dimensions:
Valve length = 15-50 µm
Valve breadth = 7-18 µm
Striae density = 8-15 /10 µm
Comments: Valves elliptical with more or less protracted, bluntly rounded apices. Central area slightly transapically expanded surrounded by alternate long and short striae. Puncta unclear and mostly indistinguishable.
Ecology: Found in electrolyte rich to brackish waters.

***Placoneis dicephala* (W Smith) Mereschkowsky**
Syn. *Navicula dicephala* Ehrenberg



SEM



Dimensions:
Valve length = 20-40 µm
Valve breadth = 8-13 µm
Striae density = 9-11 /10 µm
Comments: Valves linear-elliptic, sometimes valve margin is slightly triundulate. Apices protracted and cuneate in shape. Central area narrow surrounded by alternate long and short, curved striae.
Ecology: A cosmopolitan species found on sediments in a range of waters, tolerant of moderate pollution.

BIRAPHIDEAE

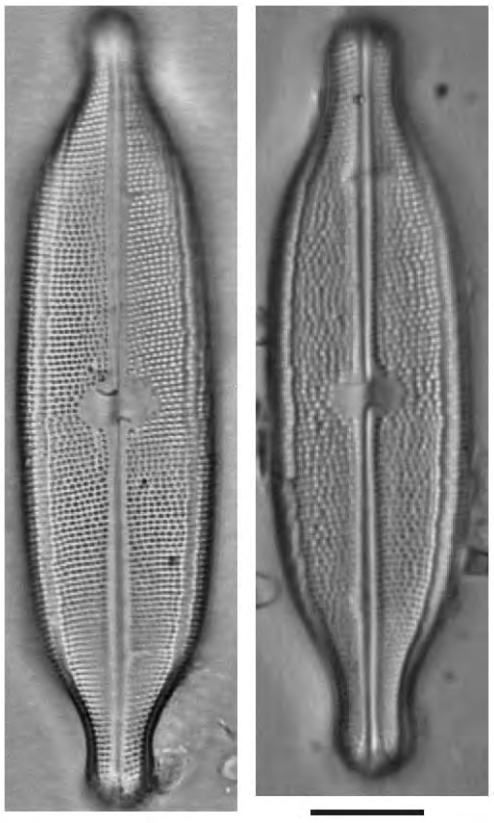
Taxa with a raphe on both valves

Taxa with longitudinal canals along each margin

Neidium affine (Ehrenberg) Pfitzer

Dimensions:
Valve length = 39-68 µm
Valve breadth = 8-26 µm
Striae density = 22-26 /10 µm
Comments: Valves linear to linear-elliptical with rostrate apices. Proximal raphe endings both hooked or one hooked and one deflected.
Ecology: A cosmopolitan species found in clean waters with moderate electrolyte content.

Neidium productum (W Smith) Cleve



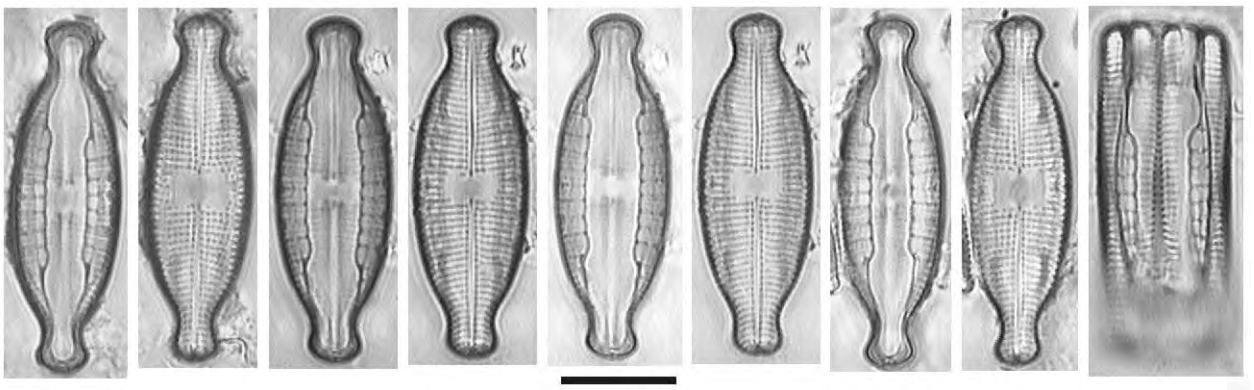
Dimensions:
Valve length = 40-100 µm
Valve breadth = 12-32 µm
Striae density = 18-22 /10 µm
Comments: Valves linear, linear-elliptical to elliptical with protracted capitate apices. Proximal raphe endings hooked and deflected in opposite directions. Striae clearly punctate.
Ecology: A cosmopolitan species found in dystrophic, electrolyte poor waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

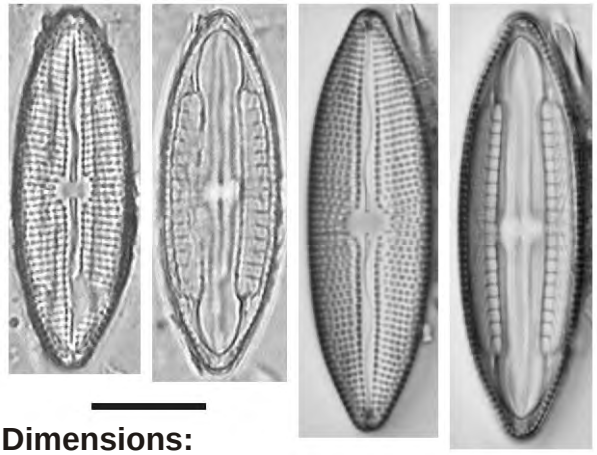
Taxa with chambered girdle bands

Mastogloia smithii **Thwaites**



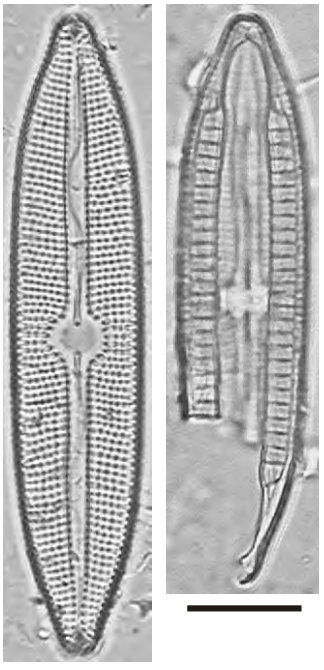
Dimensions:
Valve length = 20-60 µm
Valve breadth = 8-14 µm
Striae density = 18-22 /10 µm
Comments: Valves elliptic-lanceolate to linear-lanceolate. Apices protracted, either narrow-capitate or broad-capitate. Central area rectangular, transapically enlarged.
Ecology: A brackish water species, but may also occur in waters with a moderate to high electrolyte content.

Mastogloia elliptica **(Agardh) Cleve**



Dimensions:
Valve length = 20-80 µm
Valve breadth = 9-18 µm
Striae density = 15-18 /10 µm
Comments: Valves linear, elliptical or elliptic-lanceolate, with acute, cuneate or bluntly rounded apices. Path of external raphe slit markedly sinuous. Central area is small and rounded.
Ecology: A cosmopolitan brackish water species.

Mastogloia dansei **(Thwaites) Thwaites**



Dimensions:
Valve length = 20-80 µm
Valve breadth = 9-18 µm
Striae density = 15-18 /10 µm
Comments: Valves linear with parallel margins. Slightly protracted cuneate apices. As in *M. elliptica* the raphe is markedly sinuous. Central area elliptical and transapically enlarged.
Ecology: A cosmopolitan species, rarely abundant, epiphytic or epipelic, found in waters with moderate to high electrolyte content.

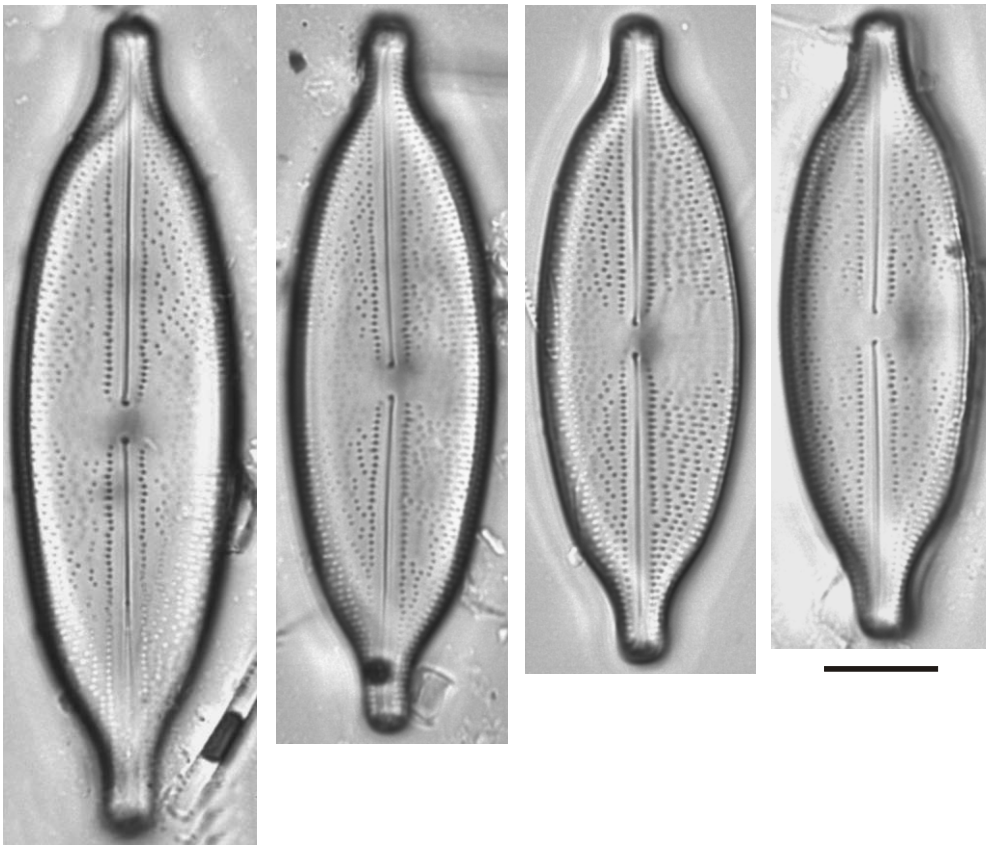
Plate 62

BIRAPHIDEAE

Taxa with a raphe on both valves

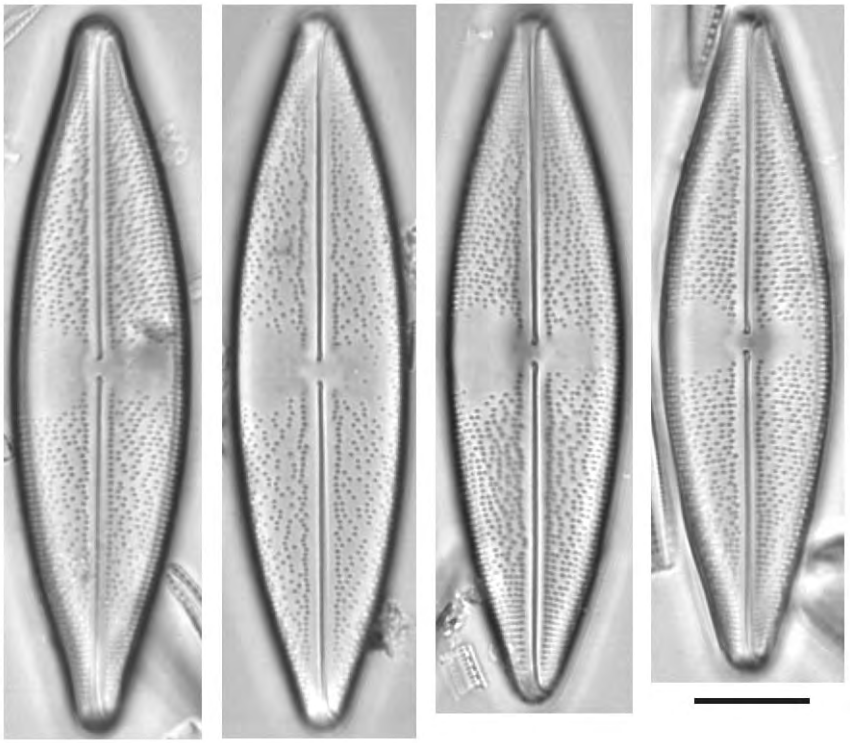
Taxa with striae in irregular undulating longitudinal lines

***Anomoeneis sphaerophora* (Ehrenberg) Pfitzer**



Dimensions:
Valve length = 25-80 µm
Valve breadth = 13-22 µm
Stria density = 15-20 striae /10 µm
Comments: Valves linear-elliptical, elliptic-lanceolate to rhombic-lanceolate. Apices protracted, rostrate to capitate. Characterised by large latera hyaline area.
Ecology: A common littoral diatom species occurring in water with moderate to high electrolyte content, extending to brackish coastal waters and saline inland biotopes. Tolerant to critical levels of pollution.

***Anomoeneis sphaerophora* f. *costata* (Kützing) Schmid**



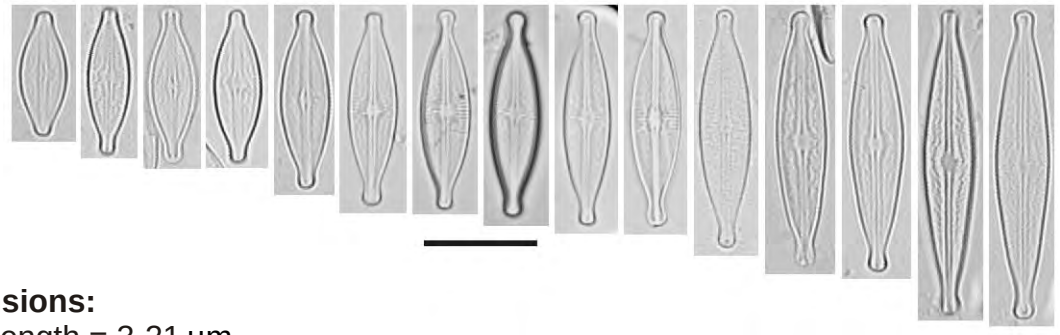
Dimensions:
Valve length = 3-21 µm
Valve breadth = 2-5 µm
Striae density = 18-22 /10 µm
Comments: Valves elliptical to rhombic elliptical, with rounded, never protracted apices. Lateral hyaline area absent.
Ecology: Similar to the nominate variety but occurring mainly in waters with high electrolyte content and in saline inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

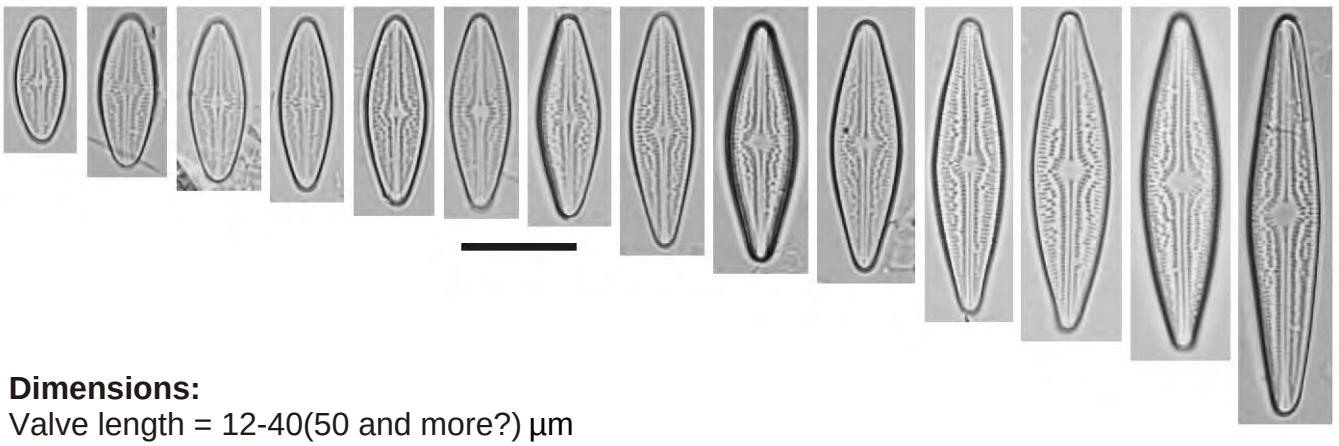
Taxa with striae in irregular undulating longitudinal lines

***Brachysira neoexilis* (Grunow) DG Mann**
***Brachysira vitrea* (Grunow) Ross**
***Anomoeneis vitrea* (Grunow) Ross**



Dimensions:
Valve length = 3-21 µm
Valve breadth = 2-5 µm
Striae density = 18-22 /10 µm
Comments: Valves lanceolate, elliptic- to rhombic-lanceolate, but mostly narrow-lanceolate. Apices protracted, rostrate in shape to weakly capitate. Polar raphe fissures not discernible. Central area elliptical to rhombic, very small but still differentiated from the axial area.
Ecology: A cosmopolitan species found in clean, olig- to mesotrophic waters. Occurs in acidic, electrolyte poor waters as well as in calcareous, alkaline biotopes.

***Brachysira brebissonii* Ross**
Syn. *Anomoeneis brachysira* (Brébisson ex Rabenhorst) Grunow



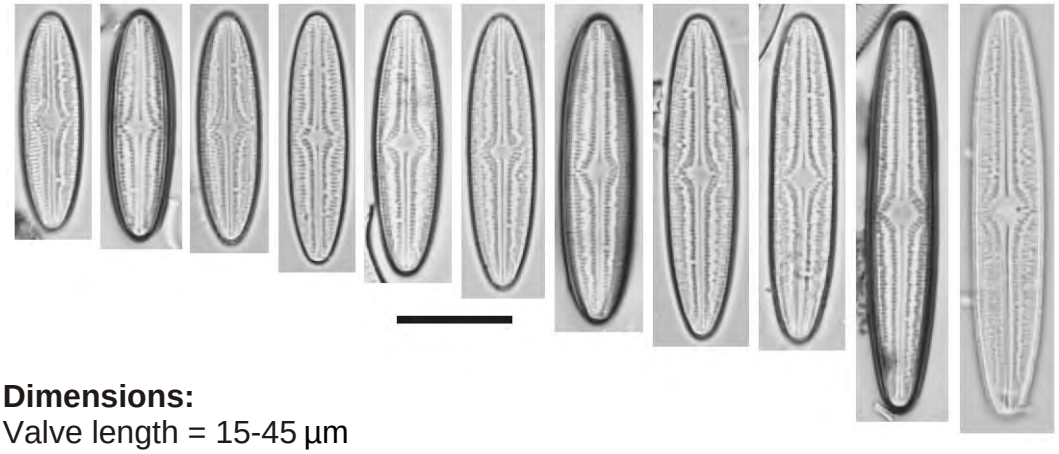
Dimensions:
Valve length = 12-40(50 and more?) µm
Valve breadth = 4.5-8 (10?) µm
Striae density = 24-27 /10 µm
Comments: Valves rhombic-lanceolate to elliptic-lanceolate with bluntly rounded apices. Rhombic central area clearly defined.
Ecology: A cosmopolitan species found in acidic, oligotrophic, electrolyte-poor waters. A good indicator for naturally acidic water with no anthropogenic impacts.

BIRAPHIDEAE

Taxa with a raphe on both valves

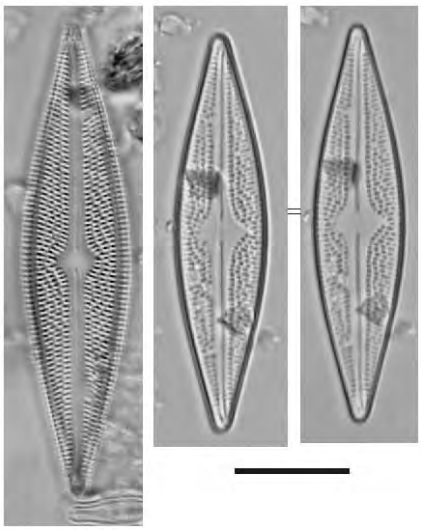
Taxa with striae in irregular undulating longitudinal lines

Brachysira zellensis **(Grunow) Round & Mann**
Syn. *Anomoeneis brachysira* var. *zellensis* (Grunow) Krammer

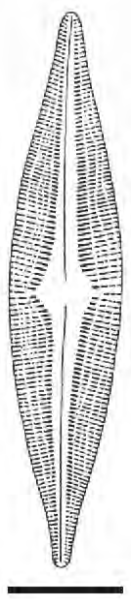


Dimensions:
Valve length = 15-45 µm
Valve breadth = 4-7 µm
Striae density = 26-30 /10 µm
Comments: Valves linear with parallel margins and protracted, rounded apices. Central area elliptical. Voigt-discordance pronounced and clearly visible.
Ecology: A cosmopolitan species found in oligotrophic waters with low electrolyte content.

Brachysira wygaschii **Lange-Bertalot**
Syn. *Anomoeneis serians* sensu Cholnoky (1955)



Dimensions:
Valve length = 30-65 µm
Valve breadth = 7-12 µm
Striae density = 20-24 /10 µm
Comments: Valves lanceolate to rhombic-lanceolate with narrow, acutely rounded, never protracted apices. Broad asymmetrical central area.
Ecology: A cosmopolitan species occurring in oligotrophic, electrolyte-poor waters.



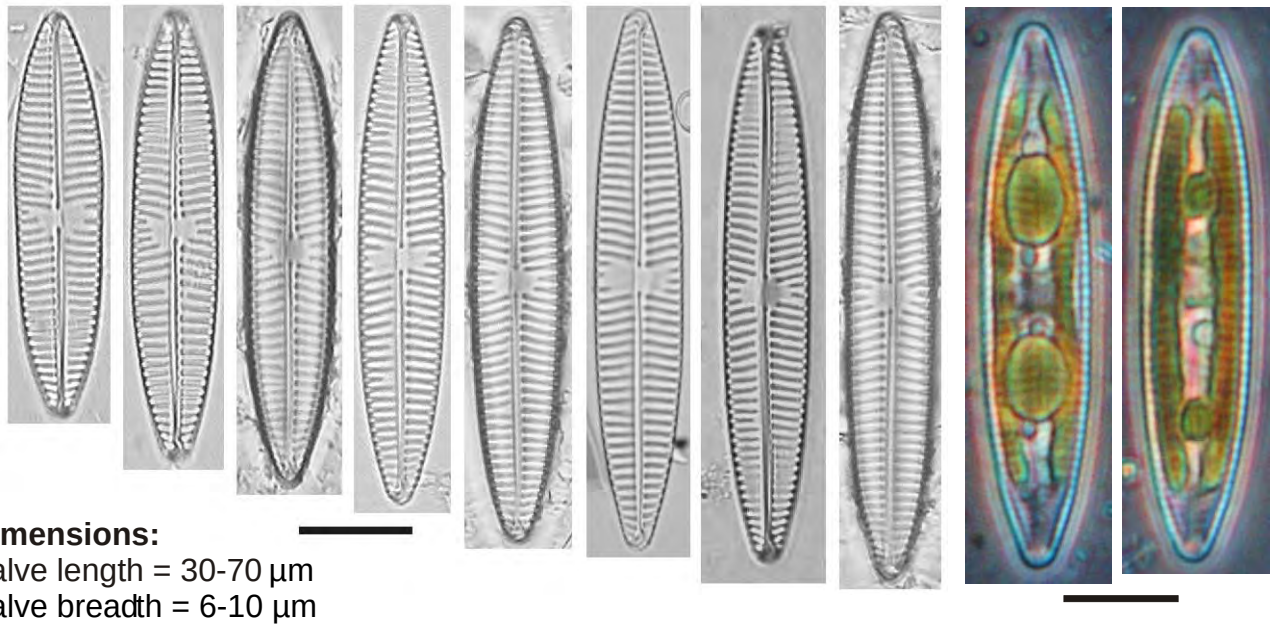
Anomoeneis serians
sensu Cholnoly (1955b)

BIRAPHIDEAE

Taxa with a raphe on both valves

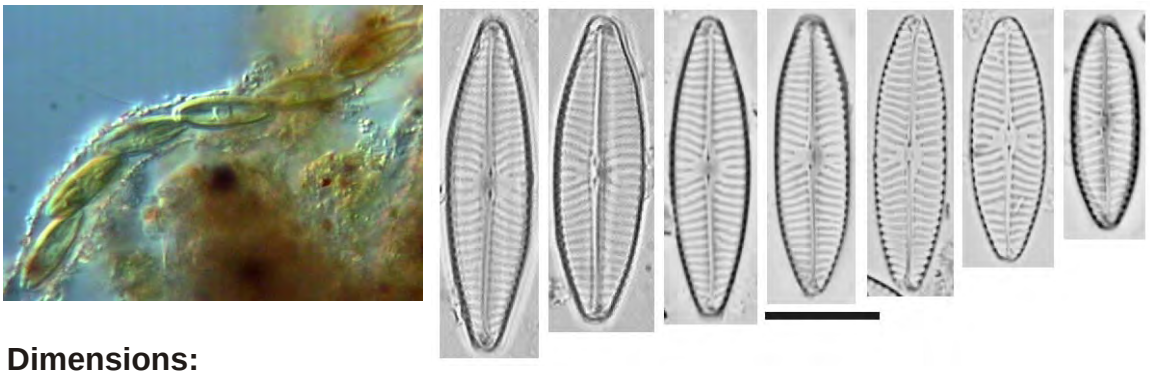
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

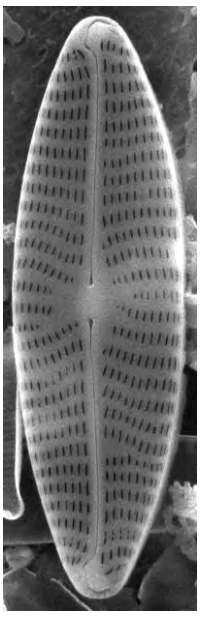
***Navicula tripunctata* (OF Müller) Bory**



Dimensions:
Valve length = 30-70 µm
Valve breadth = 6-10 µm
Striae density = 9-12 /10 µm
Comments: Valves linear-lanceolate or linear, apices not protracted rounded, poles cuneate. Axial area very narrow, central area almost rectangular, 2-3 irregularly shortened striae on each side. Striae radiate, becoming parallel then weakly radiate towards the poles.
Ecology: Cosmopolitan, free living and in mucilage tubes. A good indicator of eutrophic waters with moderate to high electrolyte content. Tolerant to critical levels of pollution.

***Navicula recens* (Lange-Bertalot) Lange-Bertalot**





SEM

Dimensions:
Valve length = 16-51 µm
Valve breadth = 5.5-9 µm
Striae density = 28-32 /10 µm
Comments: Valves elliptic-lanceolate to linear-lanceolate. Poles cuneate or wedge-shaped, apices acutely to bluntly rounded. Axial area very narrow, central area variable in size, more or less round. Striae variable, radiate, becoming parallel and then convergent towards the poles.
Ecology: Cosmopolitan species, found in large eutrophic rivers with elevated electrolyte content, also found in brackish waters. Tolerant to critical levels of pollution. Free living or in mucilage tubes.

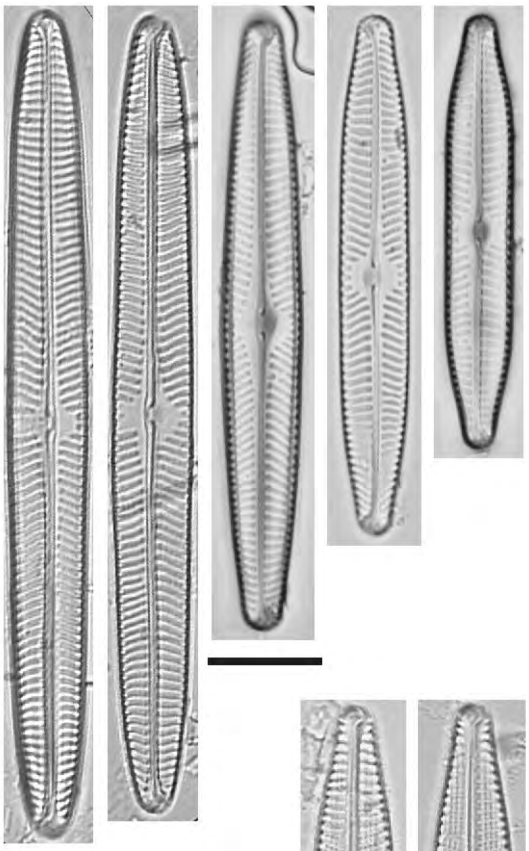
Plate 66

BIRAPHIDEAE

Taxa with a raphe on both valves

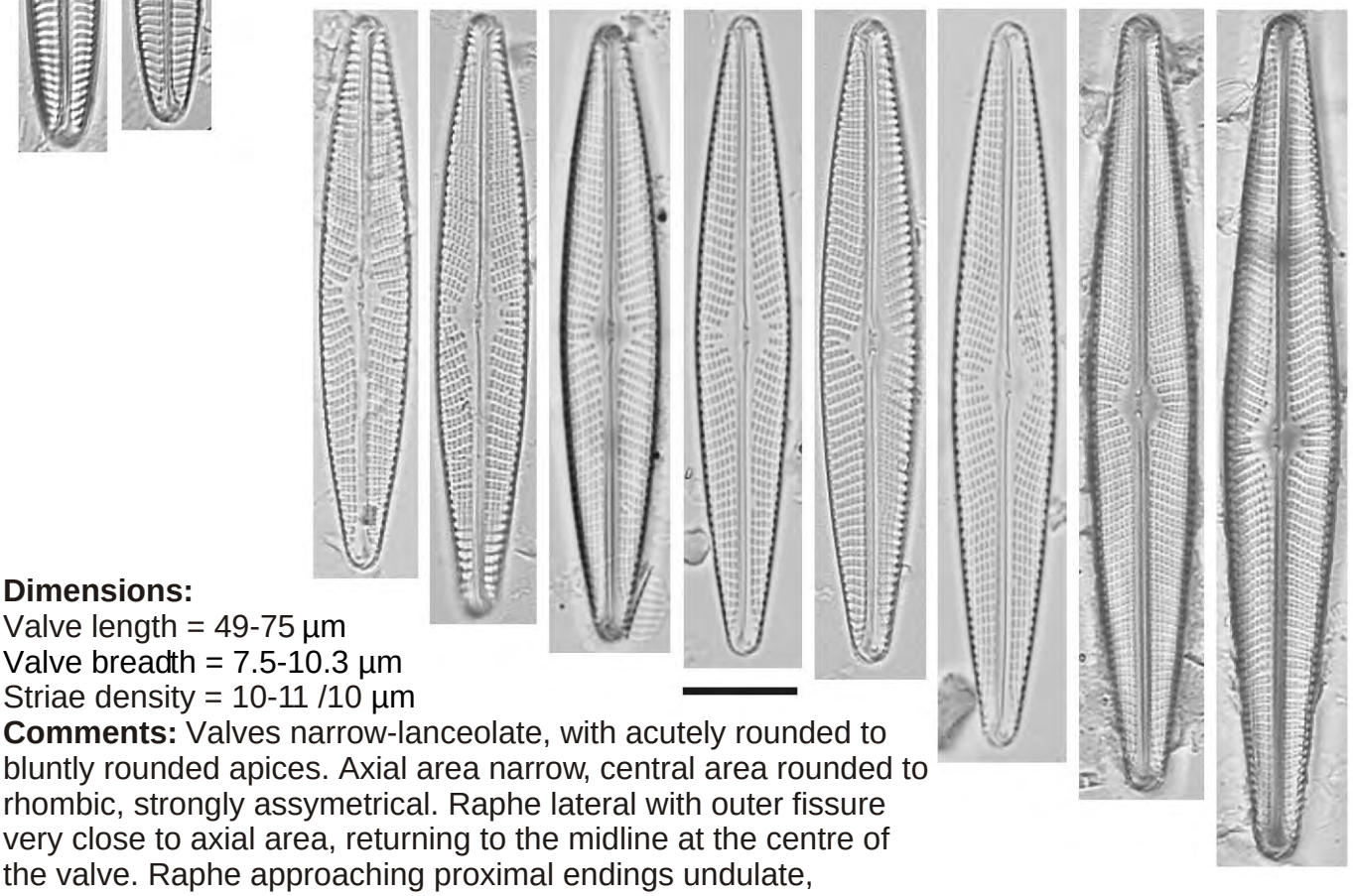
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula angusta* Grunow**



Dimensions:
Valve length = 30-78 µm
Valve breadth = 5-8 µm
Striae density = 11-12 /10 µm
Comments: Valves linear, poles cuneate, apices broadly rounded, sometimes slightly protracted. Raphe lateral, outer fissure running very close to the axial area returning to the midline towards the centre of the valve. Central area broadened, shape variable but always larger on one side. Striae radiate becoming convergent towards the poles.
Ecology: A cosmopolitan species, found in weakly acidic, oligotrophic, clean, un-impacted, electrolyte-poor waters. A good indicator for these conditions.

Navicula ranomafenensis
(Manguin) Metzeltin & Lange-Bertalot



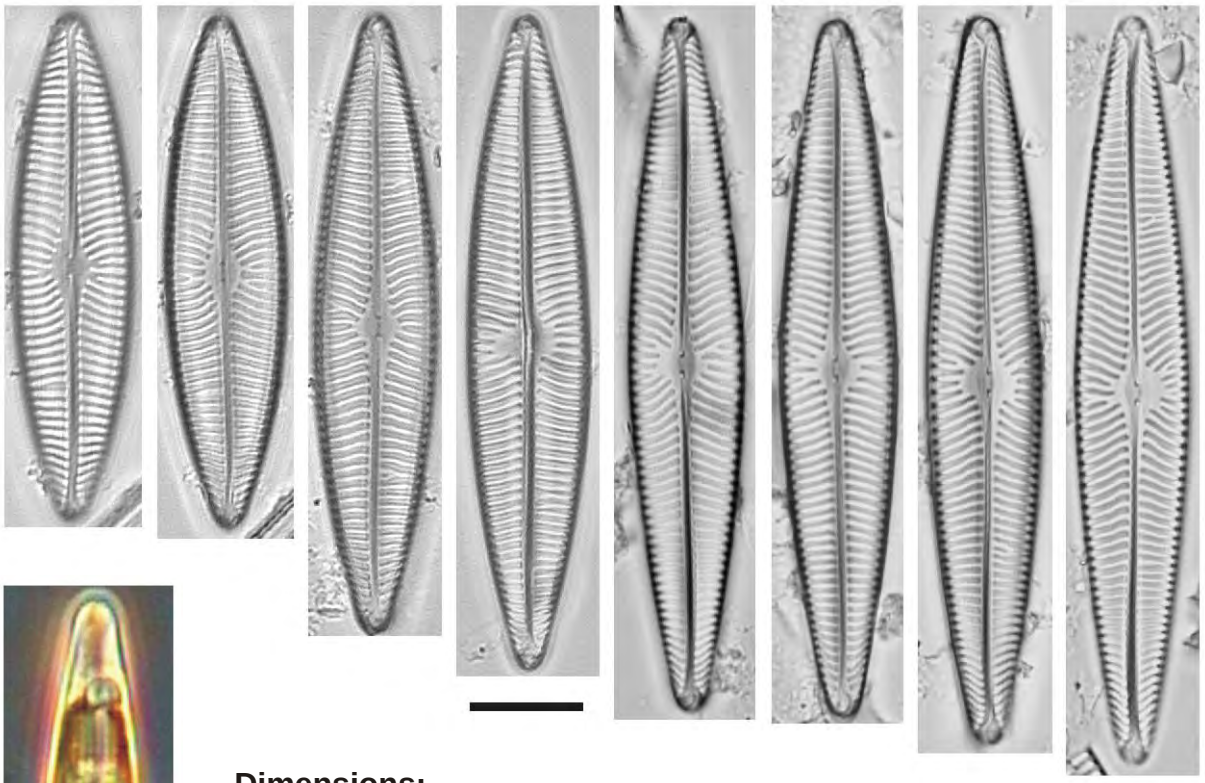
Dimensions:
Valve length = 49-75 µm
Valve breadth = 7.5-10.3 µm
Striae density = 10-11 /10 µm
Comments: Valves narrow-lanceolate, with acutely rounded to bluntly rounded apices. Axial area narrow, central area rounded to rhombic, strongly assymetrical. Raphe lateral with outer fissure very close to axial area, returning to the midline at the centre of the valve. Raphe approaching proximal endings undulate, proximal raphe endings rounded and deflected to the same side. Striae strongly radial to weakly convergent. Cannot be identified from international or South African literature.
Ecology: Common species in acidic, oligotrophic, clean waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula radiosa* Kützing**



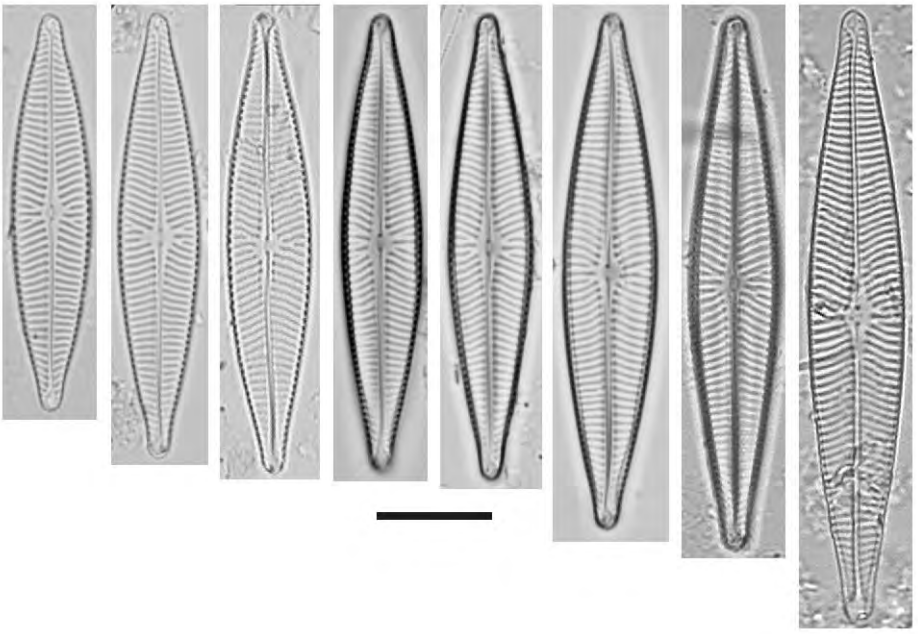
Dimensions:
Valve length = 40-120 µm
Valve breadth = 8-12 µm
Striae density = 10-12 /10 µm
Comments: Valves narrow-lanceolate with acutely rounded apices. Axial area very narrow, central area rhombic, asymmetrical. Central nodule often appears to be more thickened on one side. Striae strongly radiate becoming convergent towards the poles.
Ecology: A cosmopolitan species occuring in a wide variety of waters ranging from humic, weakly acidic, oligotrophic, electrolyte poor waters to strongly alkaline, eutrophic, calcareous waters. This species is however, very sensitive to organic pollution.

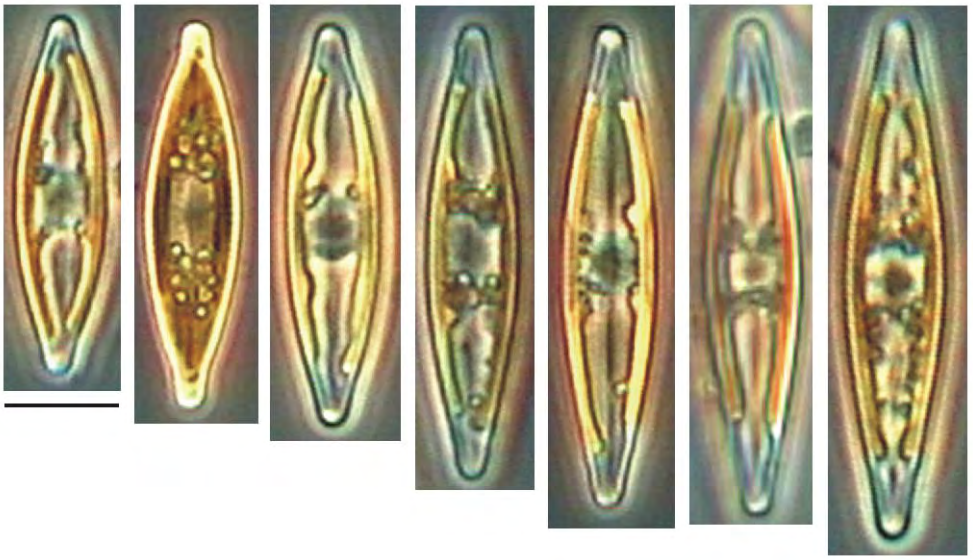
BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula zanonii* Hustedt**





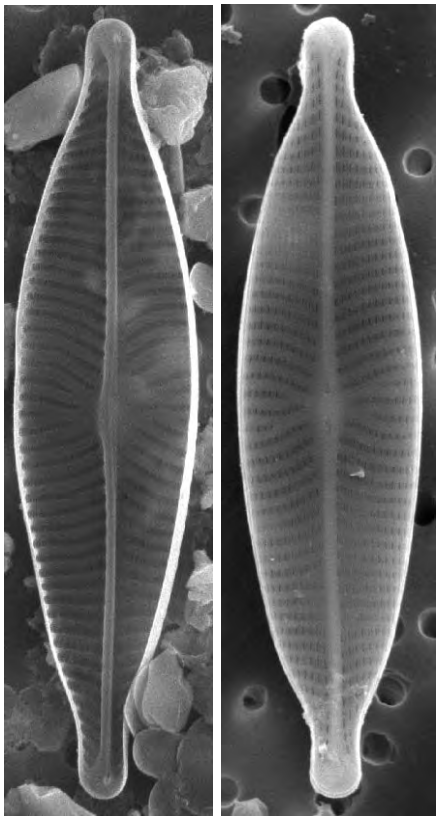
Dimensions:
Valve length = 14-26 µm
Valve breadth = 4-5 µm
Striae density = 14-16 /10 µm
Comments: Valves lanceolate with slightly protracted rostrate, sometimes acutely rounded apices. Raphe lateral, axial area linear, narrow. Central area small, rhombic. Striae radial, curved, alternately longer and shorter in the valve centre becoming convergent towards the poles.
Ecology: A tropical to sub-tropical species, found commonly in alkaline waters in South Africa.

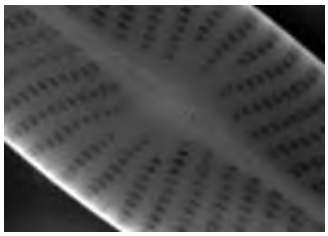
BIRAPHIDEAE

Taxa with a raphe on both valves

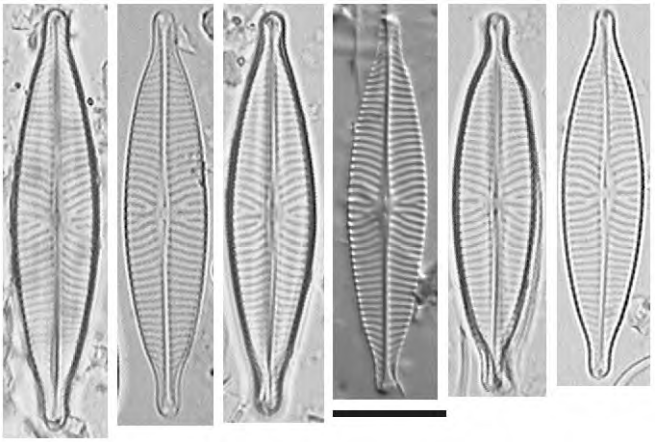
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula capitatoradiata* Germain**





SEM



Dimensions:
Valve length = 24-42 µm
Valve breadth = 8.5-10 µm
Striae density = 5-6 /10 µm
Comments: Valves lanceolate to elliptic-lanceolate with protracted rostrate apices. Raphe filiform, axial area very narrow. Central area small with an irregular border. Striae radiate, convergent at the poles, alternately long and short around the central area.
Ecology: Cosmopolitan, found in eutrophic waters, fresh waters with a high electrolyte content as well as in brackish waters. Tolerant of critical levels of pollution.

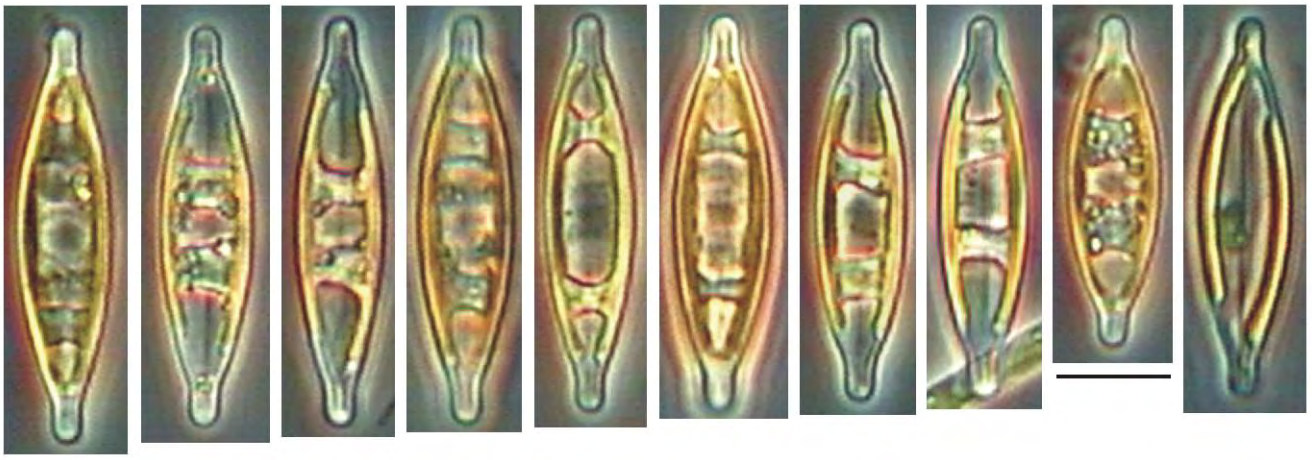


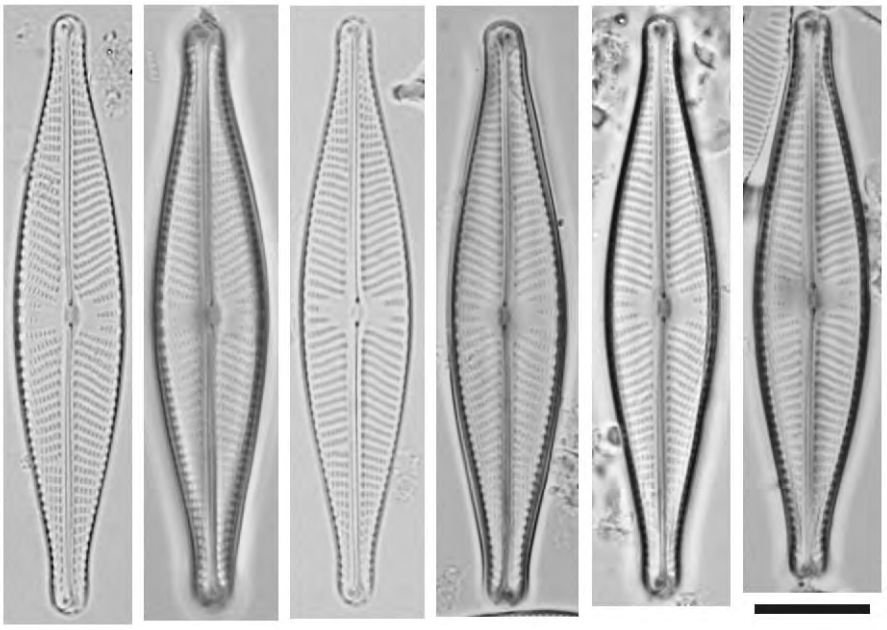
Plate 70

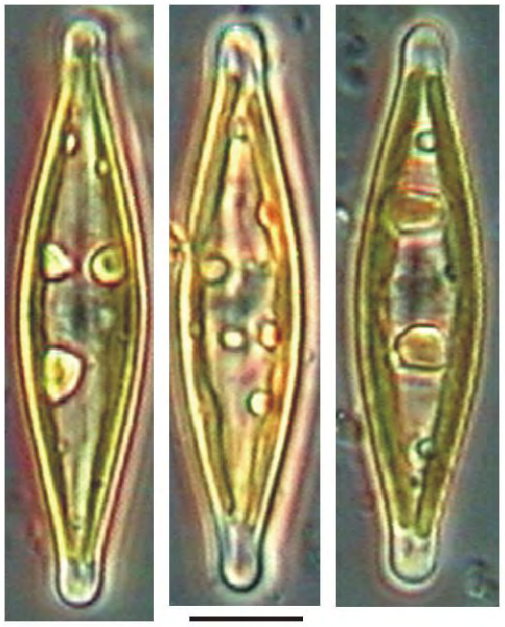
BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula rhynchocephala* Kützing**





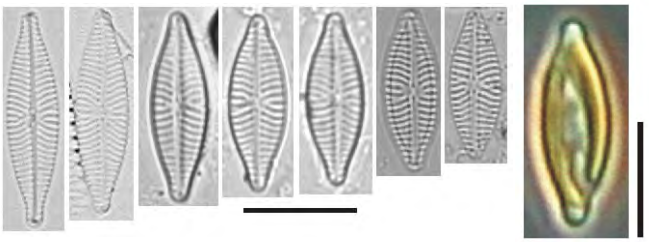
Dimensions:
Valve length = 40-ca. 60 µm
Valve breadth = 8.5-10 µm
Striae density = 10-12 /10 µm
Comments: Valves narrow-lanceolate, apices protracted, rostrate to subcapitate. Raphe weakly lateral, inner and outer fissures parallel up to the proximal endings. Axial area narrow, central area eliptical to transversely rectangular. Striae strongly radiate to convergent at the poles.
Ecology: Cosmopolitan, found in oligo- to eutrophic freshwaters with low to moderate electrolyte content. Tolerant of critical levels of pollution, but living preferentially in clean waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

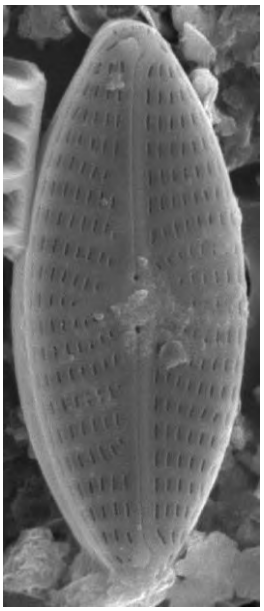
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

Navicula reichardtiana **Lange-Bertalot**

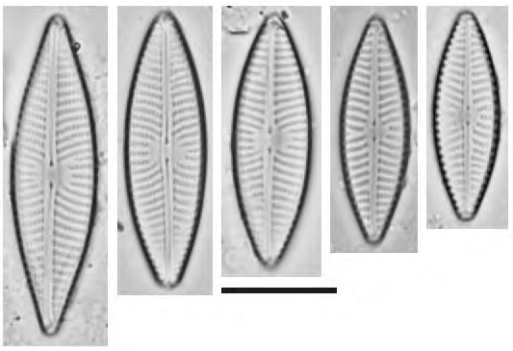


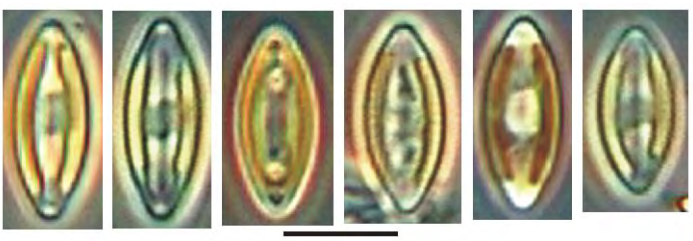
Dimensions:
Valve length = 12-22(26) µm
Valve breadth = 6-6 µm
Striae density = 14-16 /10 µm
Comments: Valves lanceolate, apices obtusely rounded, more or less protracted. Raphe filiform, axial area narrow, linear, central area small with an irregular border. Striae curved, radiate at the centre to convergent at the poles.
Ecology: A cosmopolitan species common in eutrophic, moderately electrolyte rich and particularly in calcareous waters. Tolerant of critical levels of pollution, a good indicator of these conditions.

Navicula antonii **Lange-Bertalot**
Navicula menisculus **var. *grunowii* Lange-Bertalot**



SEM





Dimensions:
Valve length = 11-30 µm
Valve breadth = 6-7.5 µm
Striae density = 10.5-15 /10 µm
Comments: Valves broadly lanceolate, apices not or only very slightly protracted, cuneate or acutely to obtusely rounded. Raphe filiform, axial area narrow, central area small and irregular in shape.

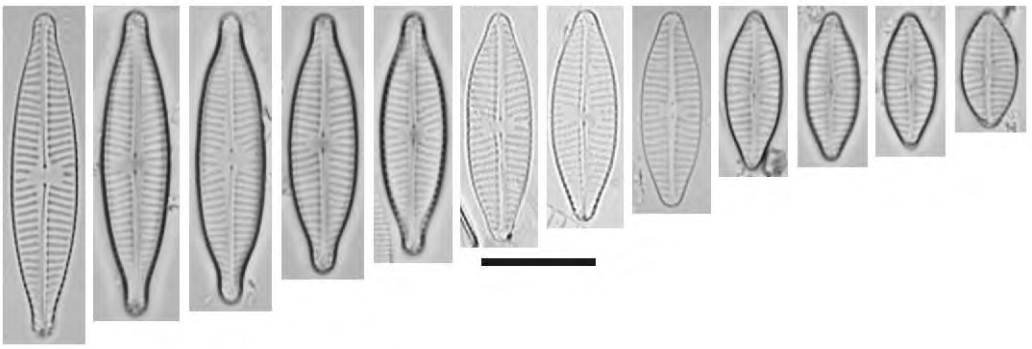
Ecology:
Cosmopolitan, found in eutrophic to hypereutrophic waters with moderate to high electrolyte content. Tolerant of strongly polluted conditions. A good indicator for such anthropogenically impacted waters.

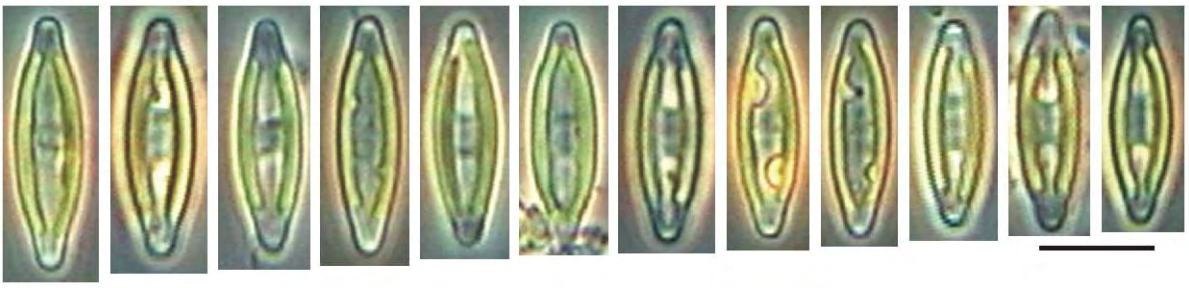
BIRAPHIDEAE

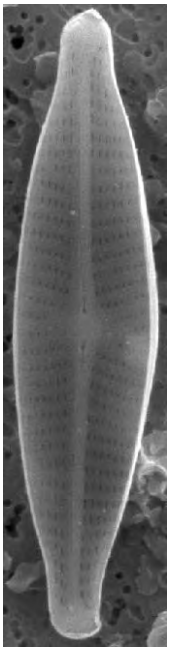
Taxa with a raphe on both valves

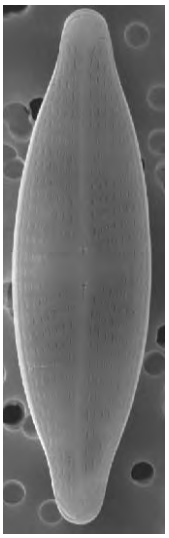
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula veneta* Kützing**

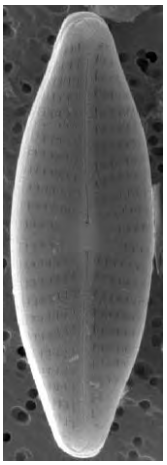








SEM



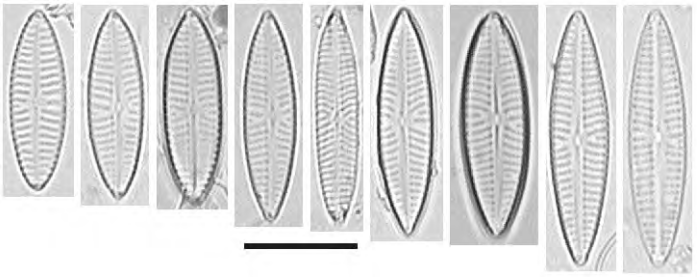
Dimensions:
Valve length = 13-30 µm
Valve breadth = 5-6 µm
Stria density = 13.5-15 striae /10 µm
Comments: Valves linear-lanceolate to rhombic-lanceolate, apices protracted, slightly cuneate. Raphe filiform, proximal raphe endings distinct. Axial area narrow, linear. Central area small, transversely widened into a rectangle, bordered by two shortened striae. Striae weakly radiate to convergent at the poles.
Ecology: Cosmopolitan, common in heavily eutrophied, electrolyte-rich to brackish water. Very pollution tolerant, often the dominant species in industrially impacted waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

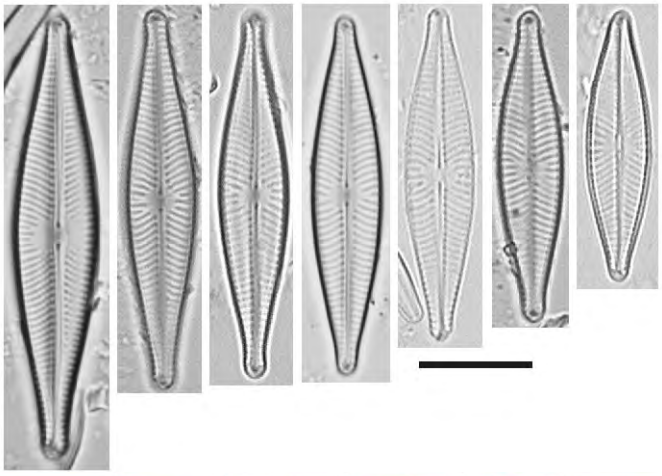
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

Navicula cryptotenelloides **Lange-Bertalot**

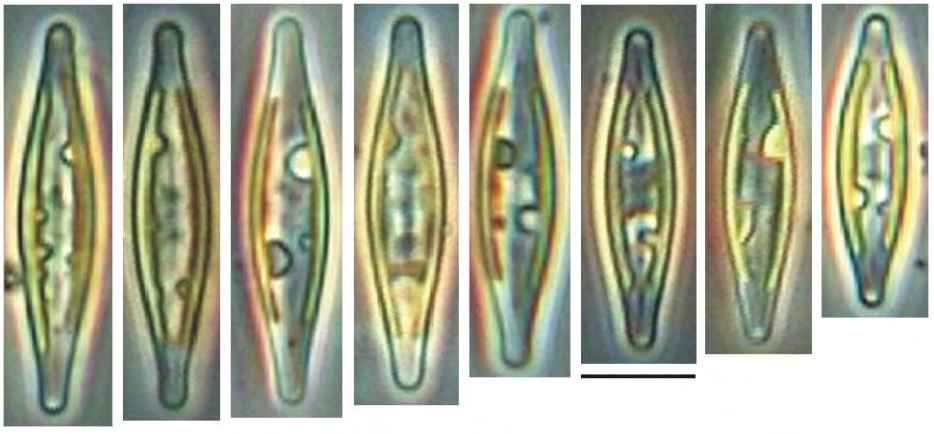


Dimensions:
Valve length = 9-18 µm
Valve breadth = 3.7-4.2 µm
Striae density = 16-18 /10 µm
Comments: Valves lanceolate, apices (very) acutely rounded, never protracted. Raphe filiform, difficult to resolve in LM, proximal raphe endings very delicate. Axial area narrow, linear, central area absent or very small. Striae direction variable, more or less radiate becoming weakly convergent towards the poles.
Ecology: A cosmopolitan species found in meso- to eutrophic calcareous streams and lakes.

Navicula cryptocephala **Kützing**



Dimensions:
Valve length = 24-42 µm
Valve breadth = 8.5-10 µm
Striae density = 5-6 /10 µm
Comments: Valves lanceolate to narrowly lanceolate, poles gradually narrowing , apices weakly rostrate, subcapitate or obtusely rounded. Raphe filiform, axial area narrow, central area small to moderately large, rounded to transversely elliptical, a little asymmetrical. Striae strongly radiate to weakly convergent at the poles.



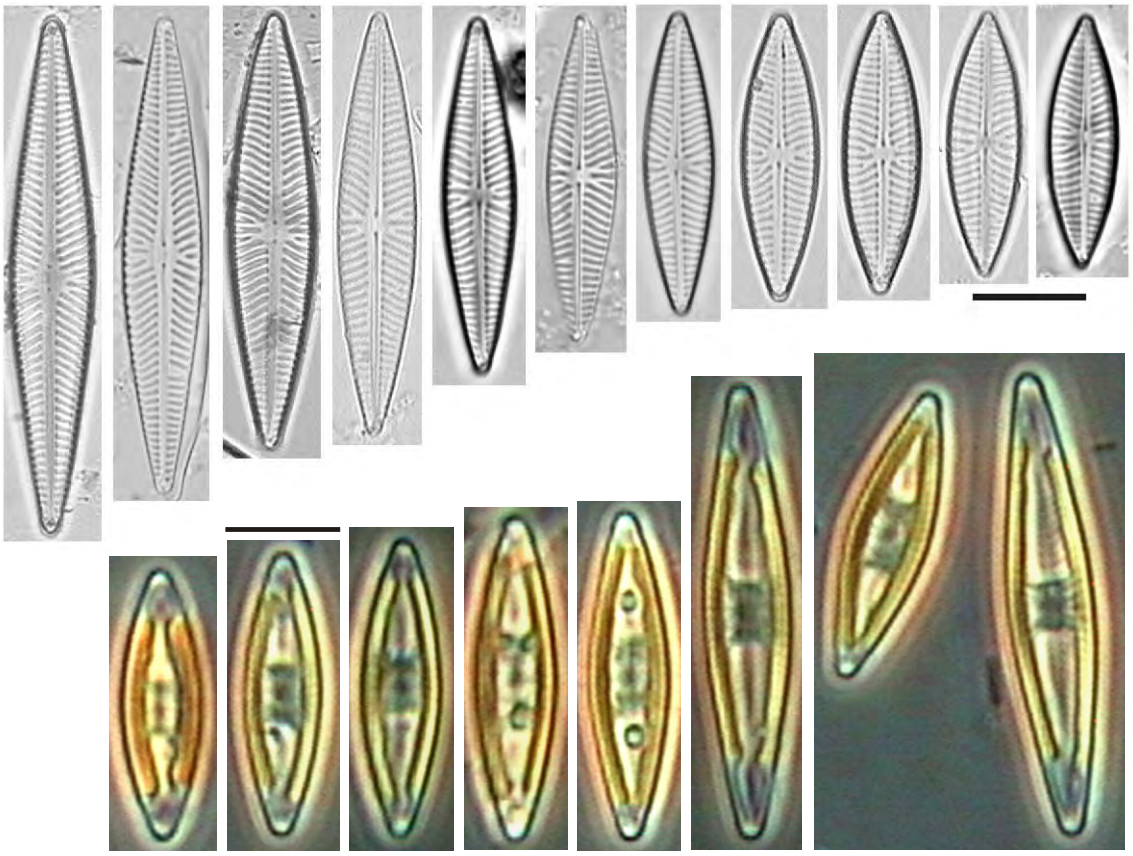
Ecology: A cosmopolitan species with a very wide ecological amplitude. Occurring in weakly acidic, oligotrophic, electrolyte poor waters and also in weakly alkaline, eutrophic, moderately electrolyte-rich waters. Tolerant to critical levels of pollution.

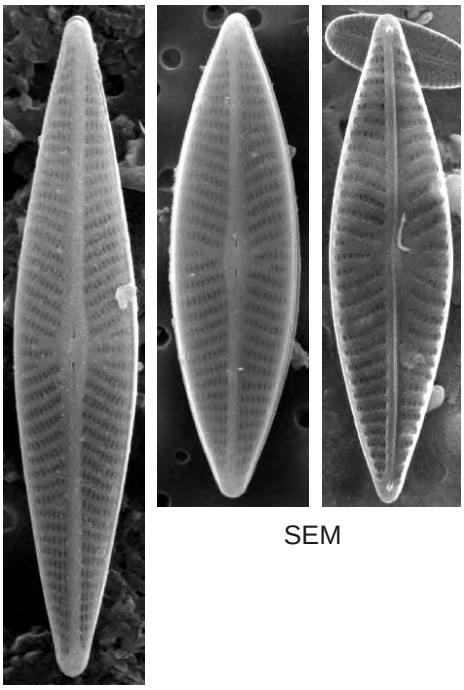
BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula cryptotenella* Lange-Bertalot**





SEM

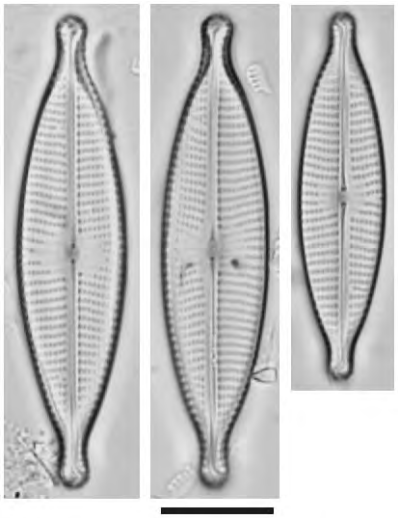
Dimensions:
Valve length = 12-40 µm
Valve breadth = 5-7 µm
Striae density = 14-16 /10 µm
Comments: Valves narrow to broadly lanceolate, apices acutely rounded. Raphe filiform to weakly lateral, axial area narrow, linear. Central area small with an irregular border. Striae radiate and slightly curved at valve centre becoming convergent towards the poles.
Ecology: A cosmopolitan species, very common in South Africa. Occurs in all freshwater biotopes which range between oligo- to eutrophic, with the exception of those with very high or very low electrolyte content. Tolerant only of moderately polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

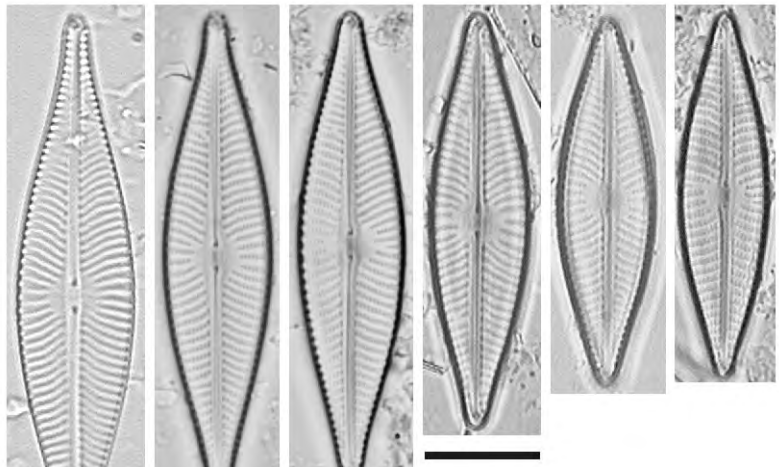
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula subrhynchocephala* Hustedt**
***Navicula towutiensis* Cholnoky**

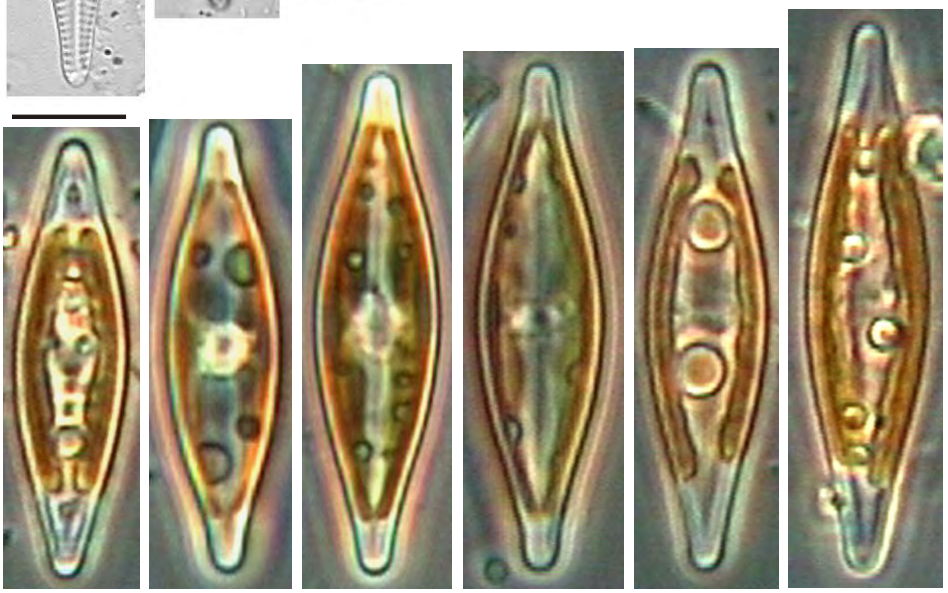


Dimensions:
Valve length = 30-45 µm
Valve breadth = 6-9 µm
Striae density = 12-15 /10 µm
Comments: Valves lanceolate, apices strongly protracted, rostrate to subcapitate. Raphe weakly lateral, axial area narrow, linear. Central area moderately large, circular or transversely, elliptically widened, ghost striae visible. Striae weakly radiate to weakly convergent at the poles, lineolae distinct.
Ecology: A Common species in electrolyte-rich waters of warmer climatic regions.

***Navicula trivialis* Lange-Bertalot**



Dimensions:
Valve length = 25-65 µm
Valve breadth = 9-12.5 µm
Striae density = 11-13 /10 µm
Comments: Valves broadly lanceolate, apices weakly protracted, acutely rounded. Raphe filiform to weakly lateral. Axial area narrow, central area moderately large and rounded. Striae radiate almost throughout, parallel or only weakly convergent very close to the poles.



Ecology: A cosmopolitan epipelic species. Occurs in eutrophic waters with moderate electrolyte content. Tolerant of dessication and strongly polluted conditions.

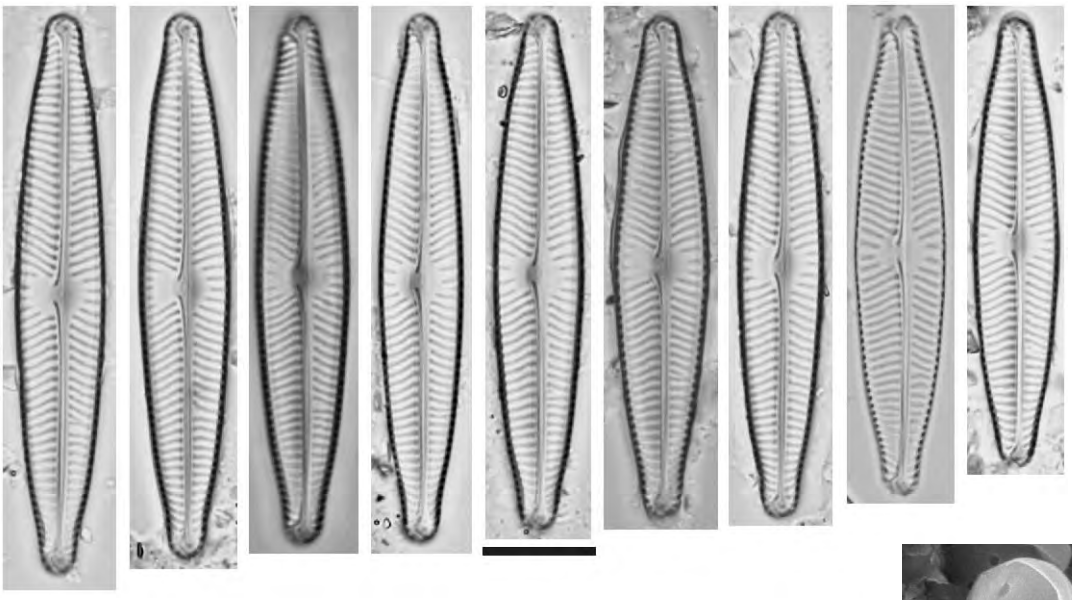
Plate 76

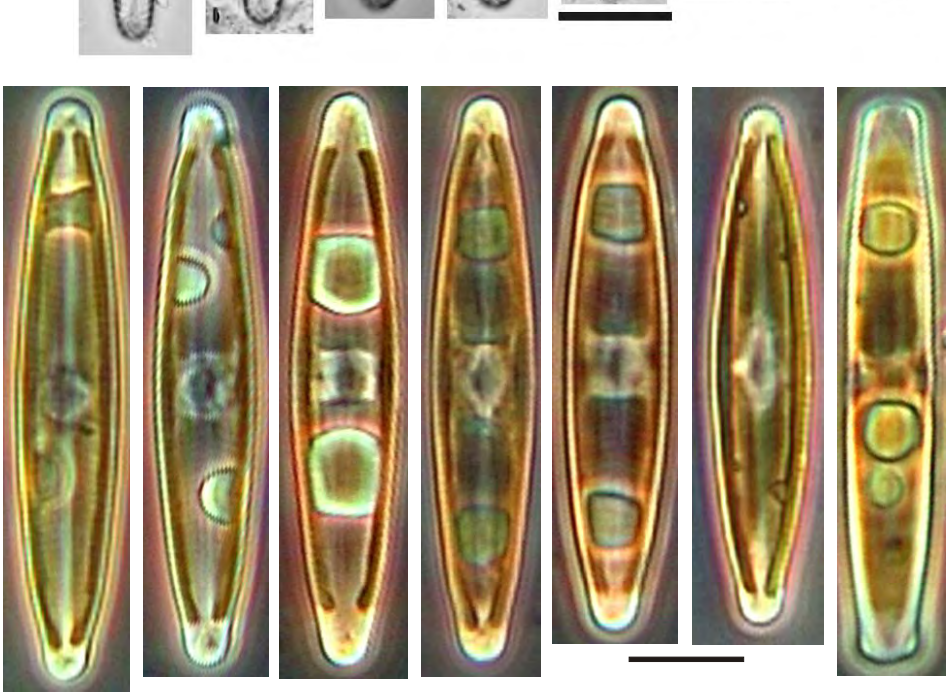
BIRAPHIDEAE

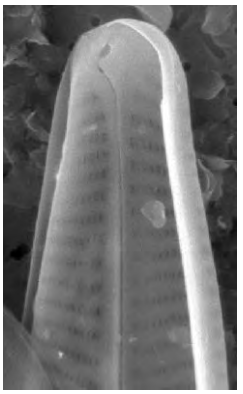
Taxa with a raphe on both valves

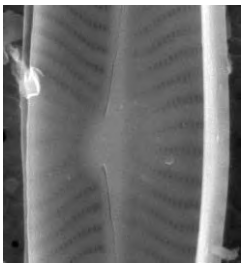
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula riediana* Lange-Bertalot & Rumrich**









SEM

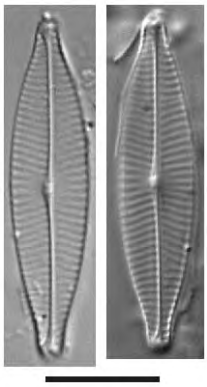
Dimensions:
Valve length = 35-50 µm
Valve breadth = 6.5-7.5 µm
Striae density = 10.5-11.5 /10 µm
Comments: Valves linear-lanceolate, narrow, apices weakly-cuneate, obtusely rounded. Raphe filiform, proximal endings strongly deflected. Axial area very narrow, central area large, elliptical or broadened transapically and rectangular. Striae strongly radiate in the centre to convergent near the poles.
Ecology: A common species in South Africa found in alkaline, eutrophic, electrolyte-rich waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

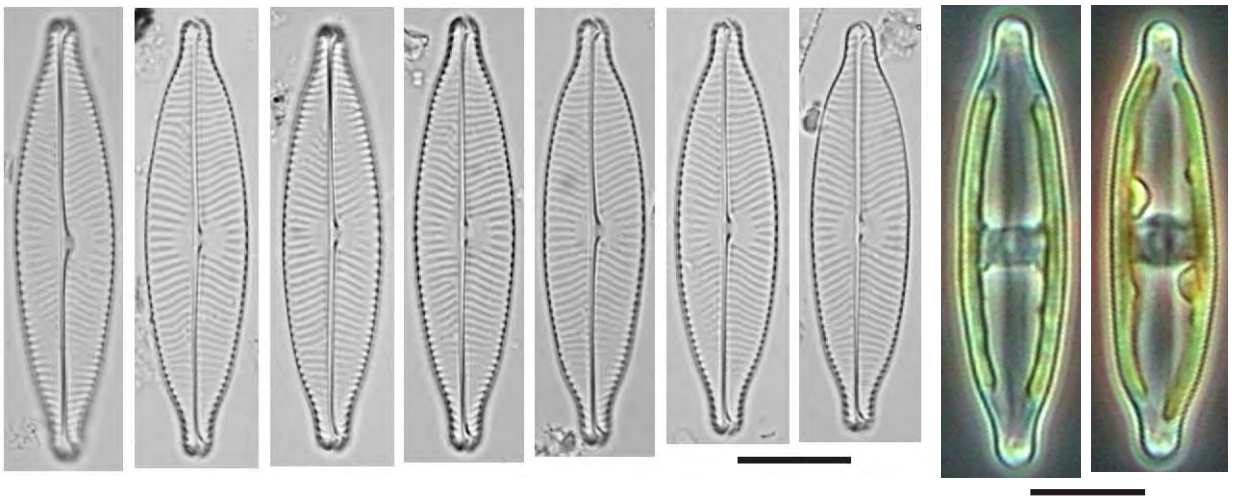
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

Navicula germainii Wallace
***Navicula viridula* var. *germainii* (Wallace) Lange-Bertalot**



Dimensions:
Valve length = 26-40 µm
Valve breadth = 5-8 µm
Striae density = 13-15 /10 µm
Comments: Valves lanceolate with weakly protracted, acutely rounded apices. Raphe filiform, proximal endings strongly deflected. Axial area very narrow, central area small to moderately large, elliptical or expanded transversely and rectangular. Central nodule thickening asymmetrical. Striae weakly radiate becoming weakly convergent towards the apices.
Ecology: Cosmopolitan, found in eutrophic waters, tolerant of critical levels of pollution.

***Navicula rostellata* Kützing**
***Navicula viridula* var. *rostellata* (Kützing) Cleve**



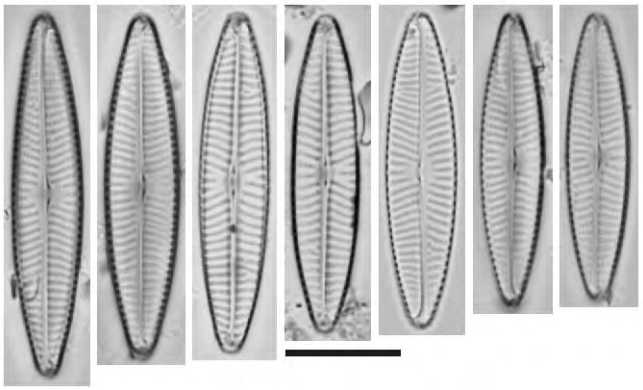
Dimensions:
Valve length = 34-50 µm
Valve breadth = 8-10 µm
Striae density = 11-14(15) /10 µm
Comments: Valves lanceolate to weakly linear-lancelate with protracted rostrate apices. Axial area narrow, central area moderately large and rounded, symmetrical. Central nodule thickened on one side. Striae radial at the centre becoming convergent near the poles.
Ecology: A cosmopolitan eutrophic species. Tolerant of critical levels of pollution.

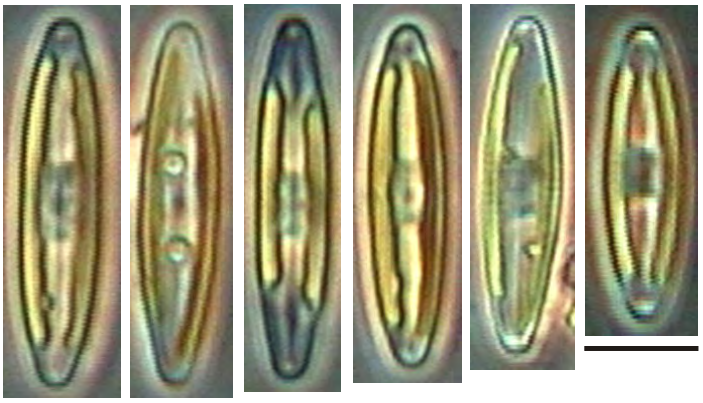
BIRAPHIDEAE

Taxa with a raphe on both valves

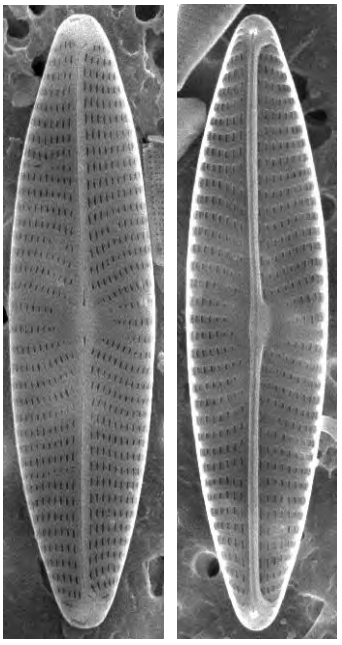
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula erifuga* (OF Müller) Bory**
***Navicula cinctaeformis* Hustedt sensu Cholnoky**

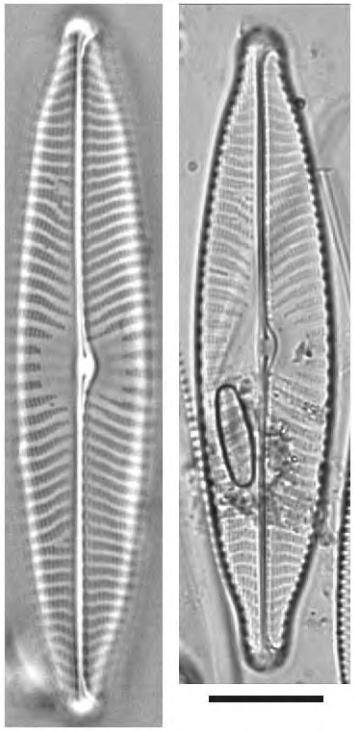




Dimensions:
Valve length = 20-45 µm
Valve breadth = 5-7 µm
Striae density = 5-6 /10 µm
Comments: Valves lanceolate, elliptic-lanceolate to linear-lanceolate. Apices acute, rarely obtuse. Raphe branches filiform, with the outer branch curved to the deflected proximal endings. Central area narrow, asymmetric, rectangular on the side where the pores are deflected, elliptical on the other side. Striae weakly radiate to convergent near the poles. Lineolae visible in LM.
Ecology: A cosmopolitan species found in eutrophic, brackish waters or those with very high electrolyte content. Tolerant of critical levels of pollution.



SEM



***Navicula viridula* (Kützing) Ehrenberg**

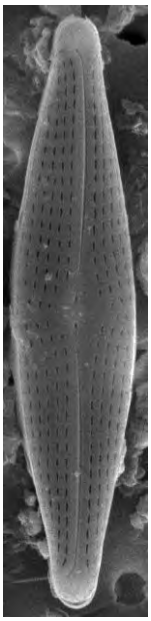
Dimensions:
Valve length = 40-100 µm
Valve breadth = 10-15 µm
Striae density = 8-11/10 µm
Comments: Valves lanceolate to weakly linear-lanceolate. Apices strongly protracted and obtusely rounded. Axial area narrow, central area large, rounded or transversely rectangular, usually asymmetrical. Central nodule strongly asymmetrical, lineolae distinct. Voigt-discordance particularly pronounced.
Ecology: Cosmopolitan but infrequent. Epilithic, epipelic, as well as on detritus and macrophytes. Occurring in eutrophic waters and tolerant of critical levels of pollution.

BIRAPHIDEAE

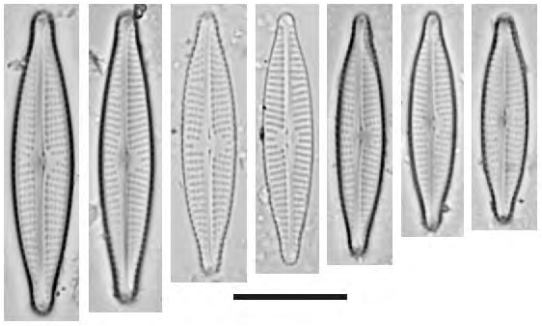
Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula vandamii* Schoeman & Archibald**

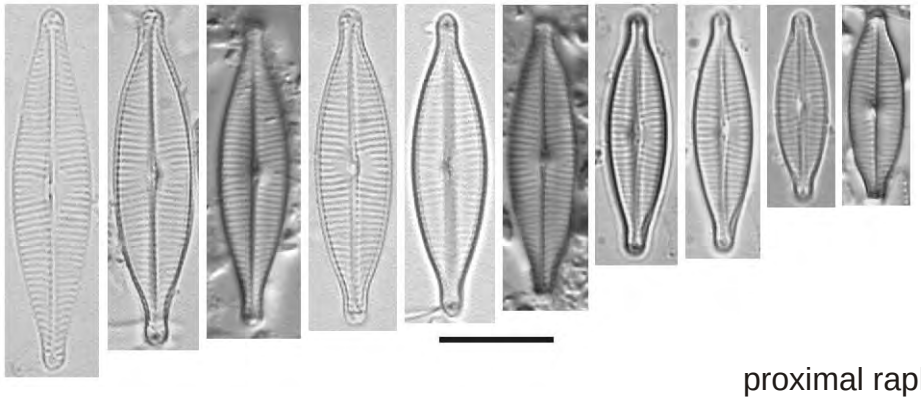


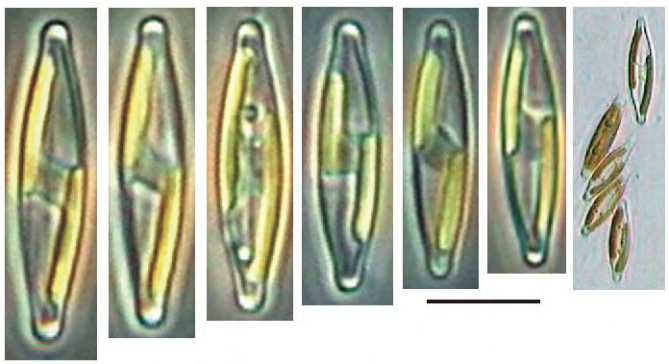
SEM



Dimensions:
Valve length = 18.5-30.5 µm
Valve breadth = 4.6-5.8 µm
Striae density = 14-17 /10 µm
Comments: Valves narrow-lanceolate, apices protracted, rostrate, rounded. Raphe filiform, straight, proximal raphe endings small, distinct and deflected. Axial area narrow, linear. Central area asymmetric, striae shortened on one side of the central nodule to form a relatively long, semi-lanceolate region while on the other side the central striae are more or less shortened forming a rhombic region. Striae weakly radiate to convergent at the poles. Lineolae coarse.
Ecology: A cosmopolitan found in alkaline, eutrophic and electrolyte-rich waters.

***Navicula gregaria* Donkin**
***Navicula gregalis* Cholnoky**





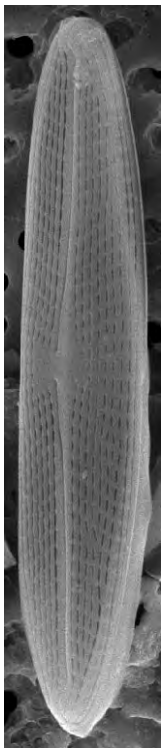
Dimensions:
Valve length = 13-44 µm
Valve breadth = 4-5 µm
Striae density = 25-33 /10 µm
Comments: Valves lanceolate to elliptic-lanceolate with highly variable protracted apices, rostrate, sometimes subcapitate. Raphe filiform, proximal raphe endings distinct, slightly deflected. Axial area narrow, linear, central area variable in size, widened transapically, asymmetric. Striae weakly radiate at the centre of the valve becoming convergent towards the poles.
Ecology: Cosmopolitan, very common in eutrophic to hypereutrophic fresh waters with moderate to high electrolyte content. Also found in brackish waters. Tolerant of strongly polluted conditions. A good indicator species for these conditions.

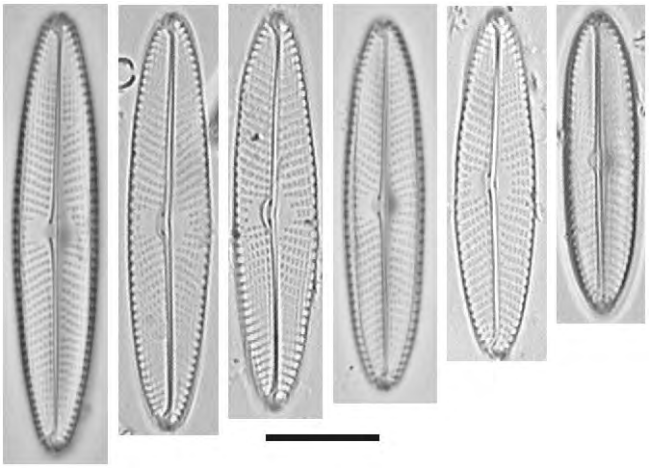
BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula schroeteri* Meister**

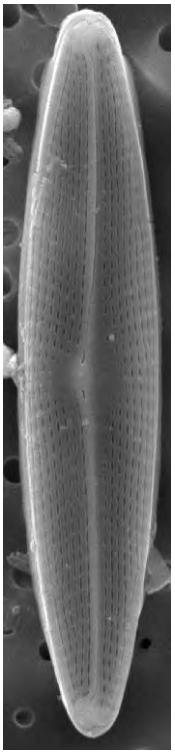


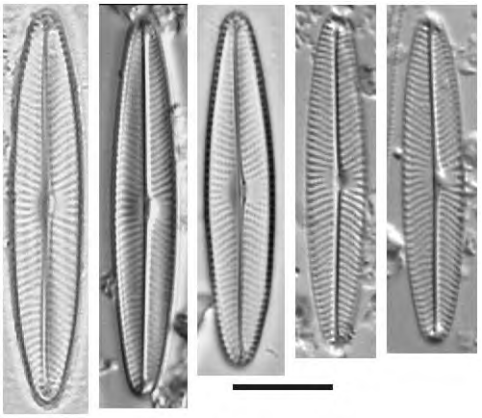


SEM

Dimensions:
Valve length = 30-55 µm
Valve breadth = 5-9 µm
Striae density = 12-15 /10 µm
Comments: Valves linear-elliptical to linear-lanceolate. Apices narrowed slightly cuneate to bluntly rounded, never protracted. Raphe filiform, proximal raphe endings deflected in the same direction as the asymmetrically enlarged central nodule. Axial area very narrow, central area varying from rounded to elliptical to rectangular, more or less longitudinally expanded on one side, lanceolate in shape. Striae radiate to weakly convergent at the poles. Distinct lineolae 20-23/ 10 µm.
Ecology: Cosmopolitan in eutrophic, electrolyte-rich waters. Tolerant of strongly polluted conditions.

***Navicula symmetrica* Patrick**
Syn. *Navicula schroeteri* var. *symmetrica* (Patrick) Lange-Bertalot





SEM

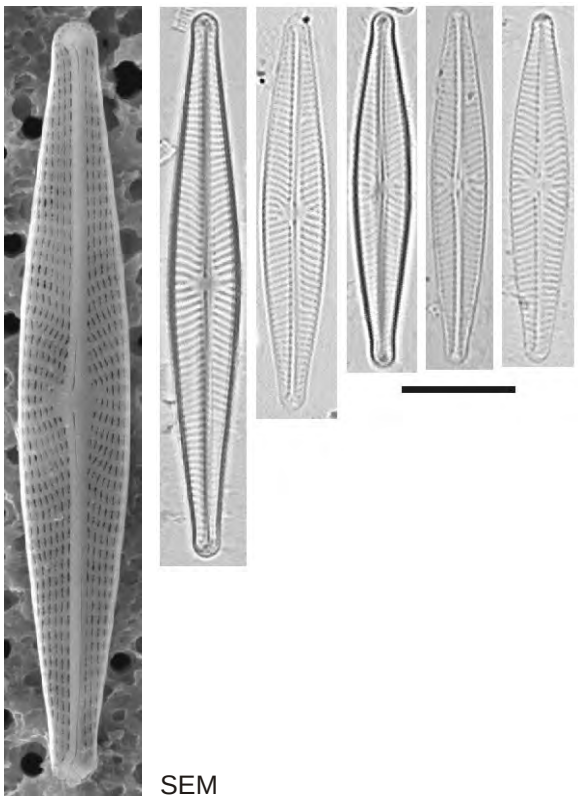
Dimensions:
Valve length = 30-55 µm
Valve breadth = 5-9 µm
Striae density = 14-16 /10 µm
Comments: As for *N. schroeteri* except for somewhat denser lineolae - 24-28/ 10 µm.
Ecology: As for *N. schroeteri.*

BIRAPHIDEAE

Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

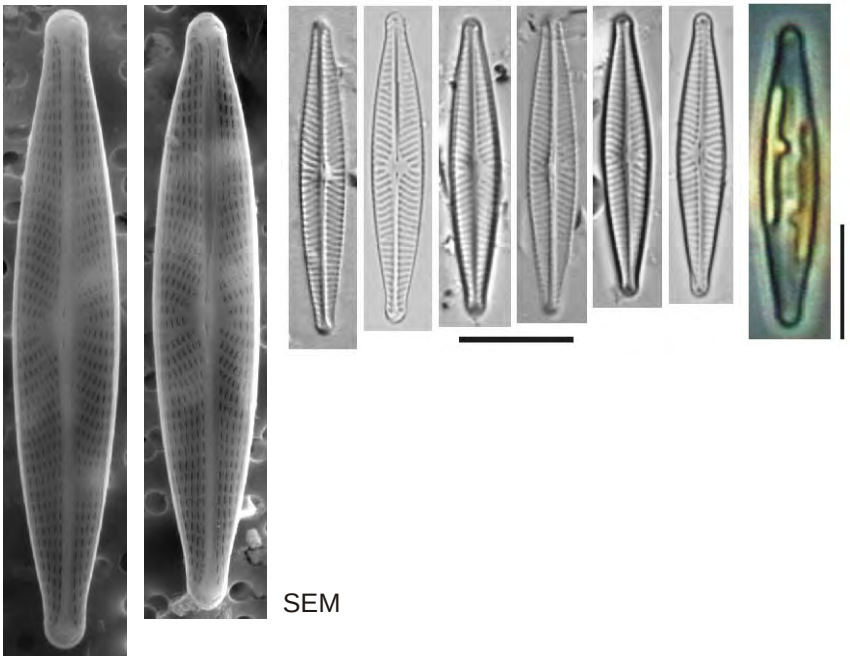
Navicula heimansioides **Lange-Bertalot**



SEM

Dimensions:
Valve length = 30-50 µm
Valve breadth = 5-6 µm
Striae density = 14-16 /10 µm
Comments: Valves narrow-lanceolate, gradually tapering from the valve centre to the bluntly rounded apices. Raphe filiform. Proximal raphe endings inconspicuous and slightly deflected. Central area rhombic to lanceolate in shape. Striae strongly radiate in the centre to strongly convergent at the poles.
Ecology: Cosmopolitan, occurring in weakly acid to circumneutral, oligotrophic, electrolyte-poor waters.

Navicula notha **Wallace**



SEM

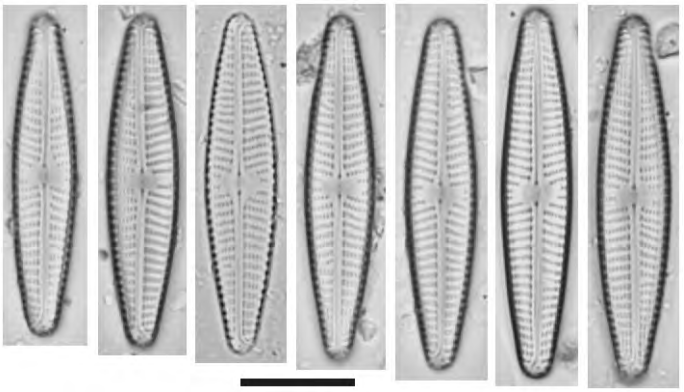
Dimensions:
Valve length = 19-32 µm
Valve breadth = 4-5.5 µm
Striae density = 15-17 /10 µm
Comments: Valves narrow-lanceolate, apices slightly protracted, acutely to obtusely rounded. Raphe filiform, proximal endings slightly deflected. Axial area very narrow, central area narrow, shape indistinct. Striae radiate at centre of the valve, convergent towards the poles.
Ecology: Cosmopolitan, found in acidic or circumneutral, oligotrophic, electrolyte-poor waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

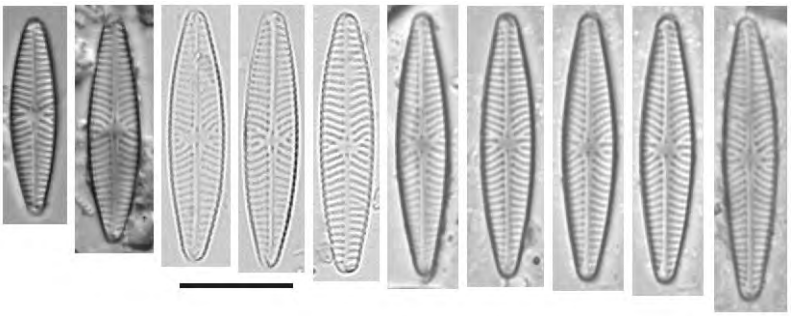
Navicula *sensu stricto - taxa with linear puncta (lineolae)*

***Navicula libonensis* Schoeman**
***Navicula schubartii* var. *africana* Archibald**



Dimensions:
Valve length = 25-40 µm
Valve breadth = 5.5-8 µm
Striae density = 12-13.5 /10 µm
Comments: Valves lanceolate with obtusely rounded, rarely slightly protracted apices. Raphe filiform to weakly lateral. Axial area narrow, linear. Central area variable, more or less transversely rectangular, occupying approximately half the width of the valve. Striae weakly radiate at the valve centre to weakly convergent towards the poles. Lineolae more or less distinct.
Ecology: A cosmopolitan species, found in eutrophic, electrolyte-rich waters and able to tolerate critical, or occasionally even heavier pollution levels.

***Navicula microcari* Lange-Bertalot**



Dimensions:
Valve length = 14-26 µm
Valve breadth = 4-5 µm
Striae density = 14-16 /10 µm
Comments: Valves elliptic-lanceolate to lanceolate, apices very weakly protracted, cuneate and bluntly rounded. Raphe filiform, axial area narrow, variable in shape, bordered by irregularly shortened, curved striae. Striae strongly radiate to weakly convergent.
Ecology: This diatom prefers waters with a moderate to high electrolyte content.

BIRAPHIDEAE

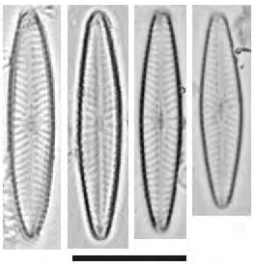
Taxa with a raphe on both valves

Navicula *sensu stricto - taxa with linear puncta (lineolae)*

Navicula cincta **(Ehrenberg) Ralfs**

Dimensions:
Valve length = 14-45 µm
Valve breadth = 5.5-8 µm
Striae density = 8-12 /10 µm
Comments: Valves variable, elliptical, lanceolate to linear-elliptic-lanceolate. Apices bluntly rounded, never protracted. Raphe filiform, axial area narrow. Central area small and irregular, due to variable positioning and lengths of the surrounding striae. Striae strongly radiate changing to weakly convergent at the Voigt-discordance.
Ecology: A (possibly) cosmopolitan species found in oligotrophic, calcareous waters.

Navicula tenelloides **Hustedt**



Dimensions:
Valve length = 14-21 µm
Valve breadth = 2.5-4 µm
Striae density = 15-17 /10 µm
Comments: Valves narrow, lanceolate to linear-lanceolate. Apices acutely to bluntly rounded, often protracted. Raphe filiform, axial area narrow, linear. Central area small and irregularly bordered. Striae strongly radiate, becoming convergent at the Voigt-discordance.
Ecology: A comopolitan, aerophilic species, found in waters with a wide range of electrolyte content and varied trophic status. Tolerant of extremely polluted conditions.

Navicula longicephala **Hustedt**

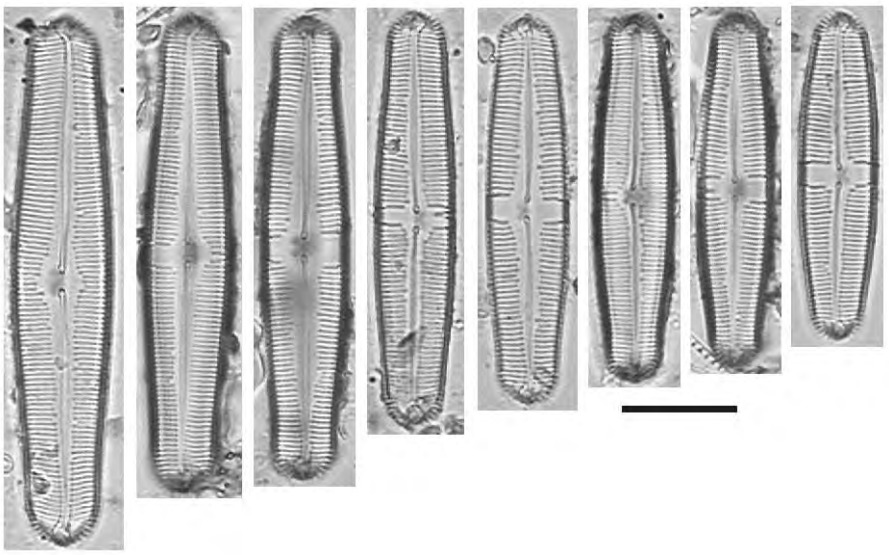
Dimensions:
Valve length = 12.5-18 µm
Valve breadth = 2.5-3.5 µm
Striae density = 18-21 /10 µm
Comments: Valves narrow, linear-lanceolate, apices abruptly rostrate, subcapitate to capitate. Raphe filiform, proximal raphe endings distinct, very close together. Central area variable due to the irregularly shortened bordering striae, narrowly lanceolate to transversely rectangular. Striae strongly radiate to convergent near the poles.
Ecology: Cosmopolitan in eutrophic, electrolyte rich to brackish waters. Tolerant of critical levels of pollution.

BIRAPHIDEAE

Taxa with a raphe on both valves

Taxa with alveoli, usually with a distinct central area reaching both margins

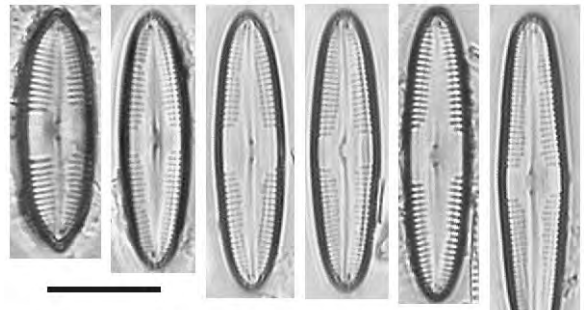
Caloneis aequatorialis Hustedt



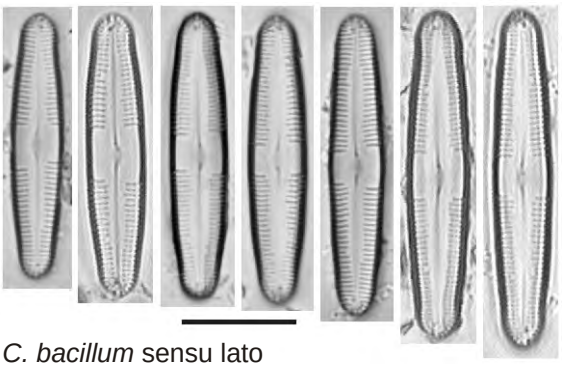
Dimensions:
Valve length = 25-50 µm
Valve breadth = 6-8 µm
Striae density = 24 /10 µm
Comments: Valves lanceolate with a slight bilateral swelling in the central region. The weakly protracted apices are bluntly rounded. Axial area lanceolate, central area usually reaching both margins.
Ecology: A tropical to sub-tropical diatom species found in alkaline waters.

Caloneis bacillum (Grunow) Cleve

Dimensions:
Valve length = 15-48 µm
Valve breadth = 4-9 µm
Striae density = 20-30 /10 µm
Comments: Valves linear, linear-lanceolate to lanceolate with parallel to convex margins. Apices are rounded and never protracted. Proximal raphe endings are slightly deflected to one side. Axial area varies from linear to lanceolate in shape. Wide central area reaching both margins may often occupy up to one third of the length of the valve.
Ecology: A cosmopolitan littoral species found in a range of waters with moderate electrolyte content, as well as in damp mosses.

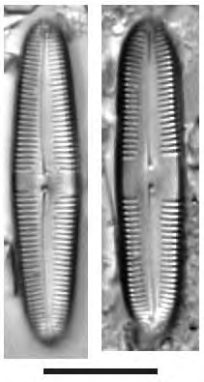


C. bacillum sensu stricto



C. bacillum sensu lato

Caloneis molaris (Grunow) Krammer



Dimensions:
Valve length = 26-65 µm
Valve breadth = 5-10 µm
Striae density = 18-22 /10 µm
Comments: Valves linear-lanceolate with weakly convex margins. Apices not protracted, bluntly rounded. Raphe bowed or arcuate, proximal raphe endings deflected to one side. Central area of variable width, reaching both margins.
Ecology: Cosmopolitan, ecology uncertain.

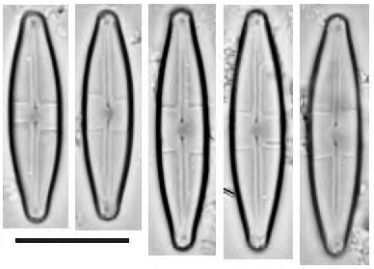
BIRAPHIDEAE

Taxa with a raphe on both valves
Taxa previously belonging to Navicula *sensu lato*

***Caloneis silicula* (Ehrenberg) Cleve**

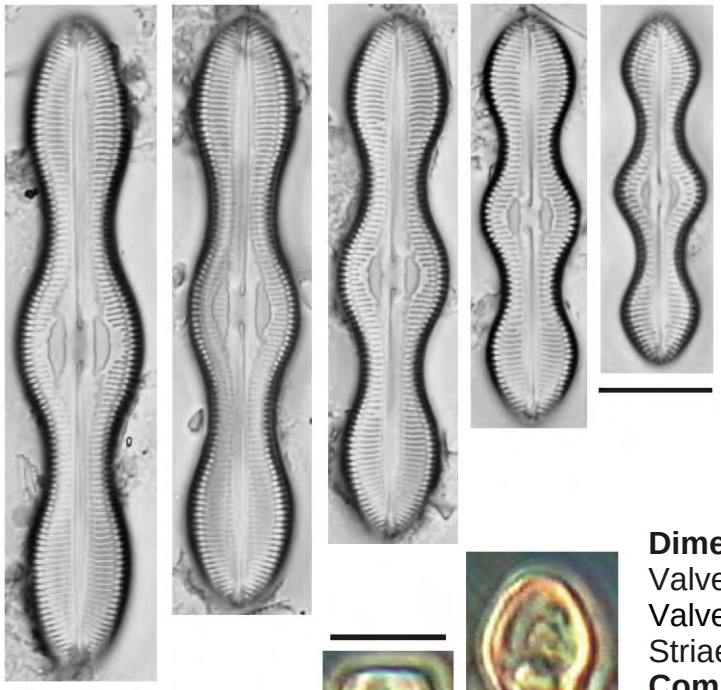
Dimensions:
Valve length = 13-120 µm
Valve breadth = 5-20 µm
Striae density = 15-20 /10 µm
Comments: Valves variable ranging from linear, linear-lanceolate to broad-elliptical. Margins parallel, triundulate, slightly convex or centrally expanded. Proximal raphe endings large. Axial area lanceolate. Central area often ornamented with slight depressions in the valve face.
Ecology: A cosmopolitan littoral species found in waters with moderate electrolyte content.

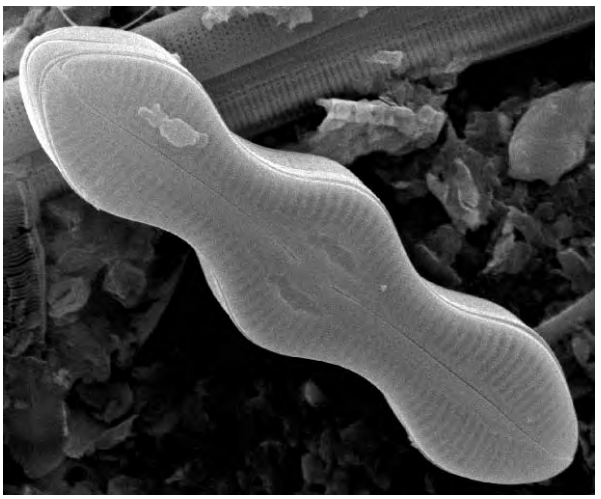
***Caloneis hyalina* Hustedt**
***Caloneis chasei* Cholnoky**

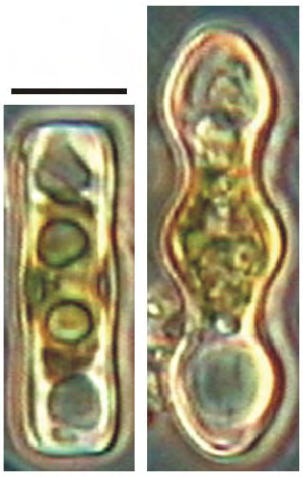


Dimensions:
Valve length = 12-30 µm
Valve breadth = 4-6 µm
Striae density = 34-38 /10 µm
Comments: Valves lanceolate to linear lanceolate, apices weakly protracted and rounded. Raphe slightly bowed. Central area very broad, up to half the area of the valve.
Ecology: A cosmopolitan aerophilic species found mainly in the tropics and sub-tropics.

***Caloneis schumanniana* (Grunow) Cleve**







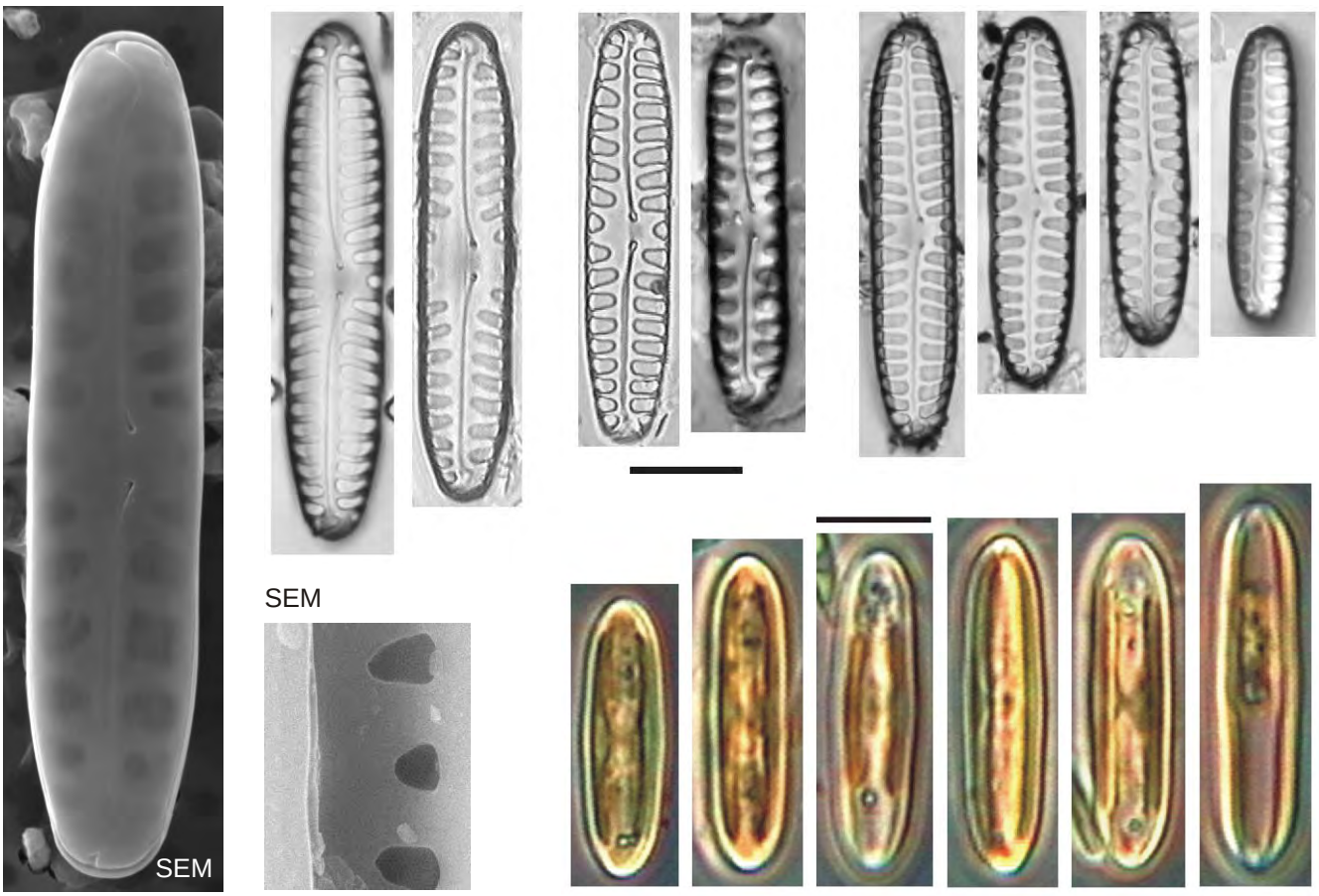
Dimensions:
Valve length = 22-85 µm
Valve breadth = 8-14 µm
Striae density = 17-20 /10 µm
Comments: Valves vary from linear to linear-lanceolate to lanceolate. Margins usually tri-undulate, seldom convex. Apices rounded or cuneate. Crescent moon-shaped depressions are found on the valve face in central area. Longitudinal line running parallel to margins.
Ecology: Cosmopolitan littoral species found in oligotrophic waters with moderate electrolyte content, also found in calcareous streams.

BIRAPHIDEAE

Taxa with a raphe on both valves

Striae formed by smooth tubular formations - alveoli

Pinnularia borealis **Ehrenberg sensu lato**



Dimensions:
Valve length = 24-42 µm
Valve breadth = 8.5-10 µm
Striae density = 5-6 /10 µm
Comments: Valves linear and linear-elliptical, margins parallel to weakly convex. Apices bluntly rounded. Proximal endings of raphe strongly deflected to one side. Terminal fissures sickle-shaped. Central area large and rounded sometimes reaching to the margins, 1-2 central striae often absent. Striae very broad and distant.
Ecology: A cosmopolitan aerophilic species, found on rocks, walls soils and moss. Also found in rivers and lakes.

Pinnularia joculata **(Manguin) Krammer**

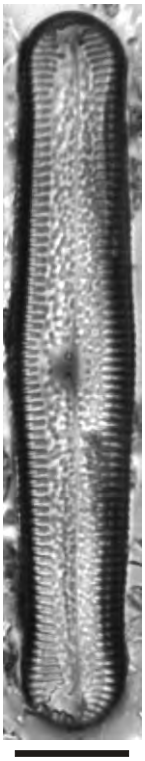
Dimensions:
Valve length = 14-26 µm
Valve breadth = 4-5 µm
Striae density = 14-16 /10 µm
Comments: Valves linear with nearly straight to weakly convex margins, apices broadly-capitate. Proximal raphe endings distinct, raphe indistinct. Axial area lanceolate, fascia broad and commonly symmetric.
Ecology: A tropical species, possibly preferring acidic waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Striae formed by smooth tubular formations - alveoli

***Pinnularia acrosphaeria* W Smith**

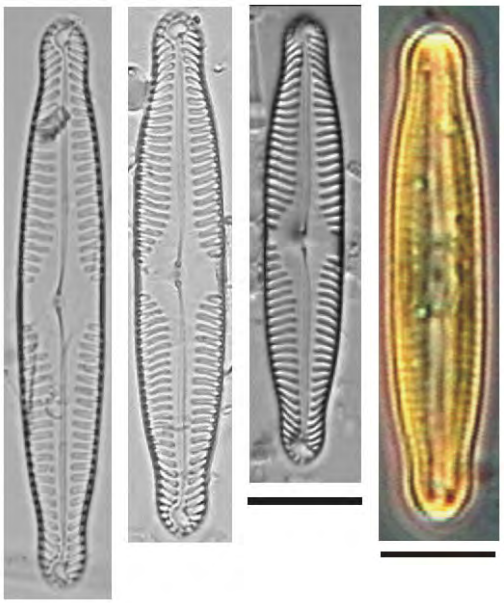


Dimensions:
Valve length = 60-116 µm
Valve breadth = 11.5-15 µm
Striae density = 10-12 /10 µm
Comments: Valves linear, margins parallel, slightly convex, triundulate or weakly expanded in the centre. Apices rounded or weakly capitate. Proximal raphe endings strongly deflected to one side. Terminal fissures large and sickle-shaped . Axial area broad, linear. Central area often asymmetrical. Both axial area and central area have a characteristic irregular surface structure.
Ecology: Cosmopolitan, but mostly in the tropics. Epipelic in circumneutral waters with a moderate electrolyte content.

***Pinnularia microstauron* var. *rostrata* Krammer**

Dimensions:
Valve length = 30-50 µm
Valve breadth = 6-7 µm
Striae density = 10-11 /10 µm
Comments: Valves linear with slightly convex or concave margins. Apices protracted, rostrate in shape. Axial area narrow, linear, central area rhombic, widening into a broad fascia. Proximal endings of raphe change dramatically with depth of focal plane - from distinct tear-drop shaped to indistinct.
Ecology: A cosmopolitan species found in clean, circumneutral, oligotrophic waters with a low electrolyte content.

***Pinnularia subcapitata* Gregory**



Dimensions:
Valve length = 17-57 µm
Valve breadth = 4.6-8 µm
Striae density = 10-14 /10 µm
Comments: Valves linear with parallel, weakly convex or concave margins. Apices protracted, rounded or capitate. Proximal raphe endings deflected, very close, terminal fissures semi-circular. Axial area linear, somewhat widened. Central area broad and rounded or extending into a fascia.
Ecology: Cosmopolitan, found in oligotrophic electrolyte poor waters.

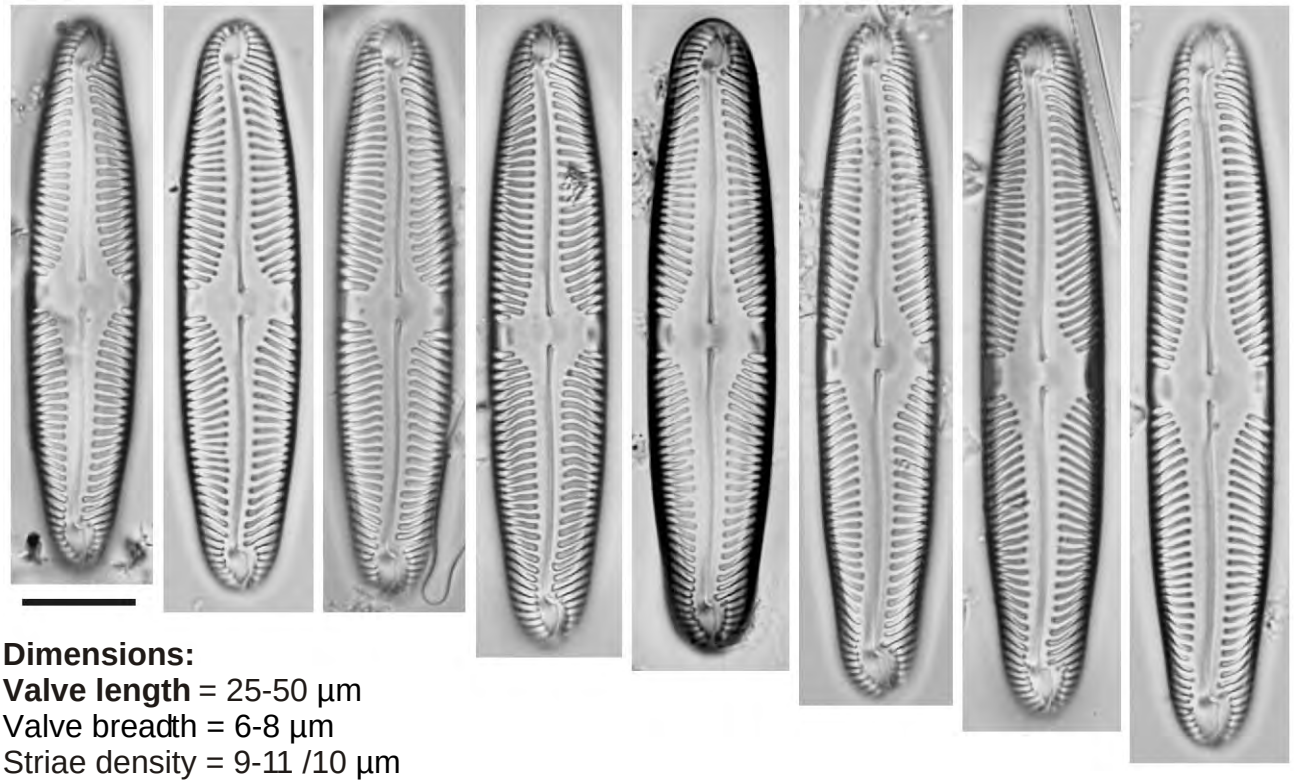
Plate 88

BIRAPHIDEAE

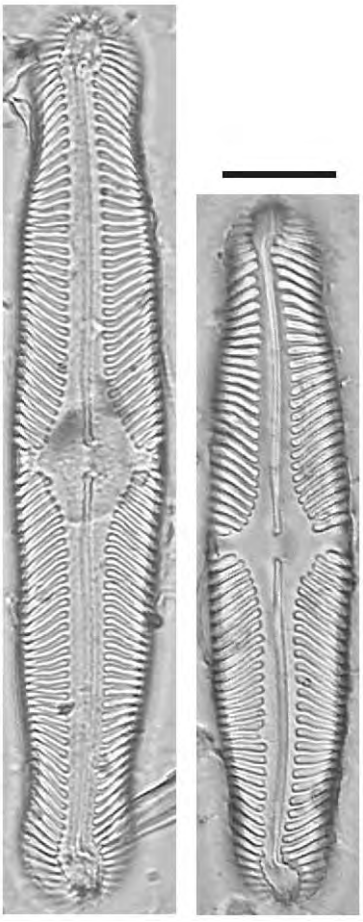
Taxa with a raphe on both valves

Striae formed by smooth tubular formations - alveoli

***Pinnularia divergens* W Smith**



Dimensions:
Valve length = 25-50 µm
Valve breadth = 6-8 µm
Striae density = 9-11 /10 µm



Comments: Valves lanceolate with capitate to sub-capitate, weakly protracted apices. Fascia has characteristic conical wall thickenings. Striae radial at the valve centre, convergent towards the poles.
Ecology: A montane species occurring in acidic, oligotrophic, electrolyte-poor waters.

***Pinnularia divergens* var. *undulata* (Péragallo & Heribaud)**

Dimensions:
Valve length = 15-48 µm
Valve breadth = 4-9 µm
Striae density = 20-30 /10 µm
Comments: Valves triundulate, apices broadly sub-capitate or capitate. Shares other characteristics with the nominate variety including characteristic conical wall thickenings of the fascia.
Ecology: Isolated distribution occuring in acidic, oligotrophic, electrolyte poor waters.

BIRAPHIDEAE

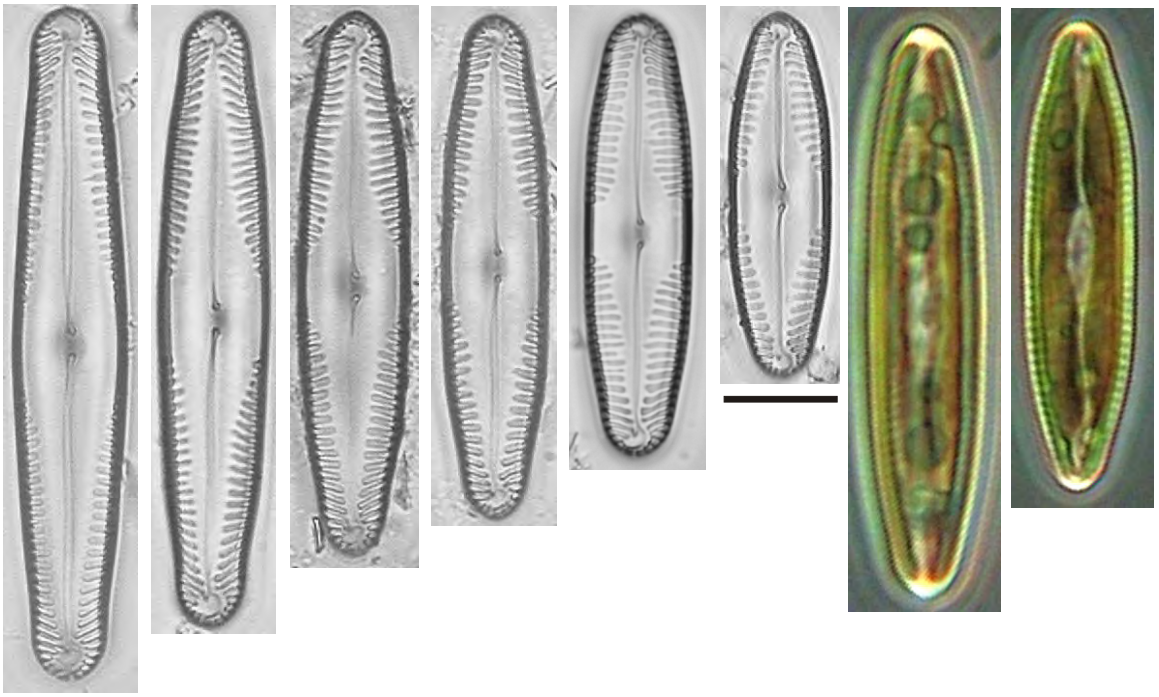
Taxa with a raphe on both valves

Striae formed by smooth tubular formations - alveoli

***Pinnularia gibba* Ehrenberg**

Dimensions:
Valve length = 60-110 µm
Valve breadth = 10-13.5 µm
Striae density = 8-11 /10 µm
Comments: Valves rhombic-lanceolate with weakly undulate margins. Apices broadly rounded, capitate. Proximal raphe endings rounded, terminal fissures large ?-shaped. Axial area broad, rhombic. Central area not clearly differentiated. Fascia small, symmetric or asymmetric. Central area with large markings on the valve surface, different on each side.
Ecology: A cosmopolitan species found in waters with low to moderate electrolyte content, especially in springs and small streams.

***Pinnularia subbrevistriata* Krammer**



Dimensions:
Valve length = (30)46-54(60) µm
Valve breadth = 10-11 µm
Striae density = 8-10 /10 µm
Comments: Valves lanceolate with convex margins. Apices broadly rostrate. Raphe lateral, outer fissure weakly undulate. Proximal endings rounded, terminal fissures ?-shaped. Axial area very broad occupying ½ to two thirds of the width of the valve, widens from the poles to the cental area which is not differentiated. The central and axial areas together have a rhombic shape.
Ecology: A tropical to sub-tropical diatom species occurring in moderately polluted waters.

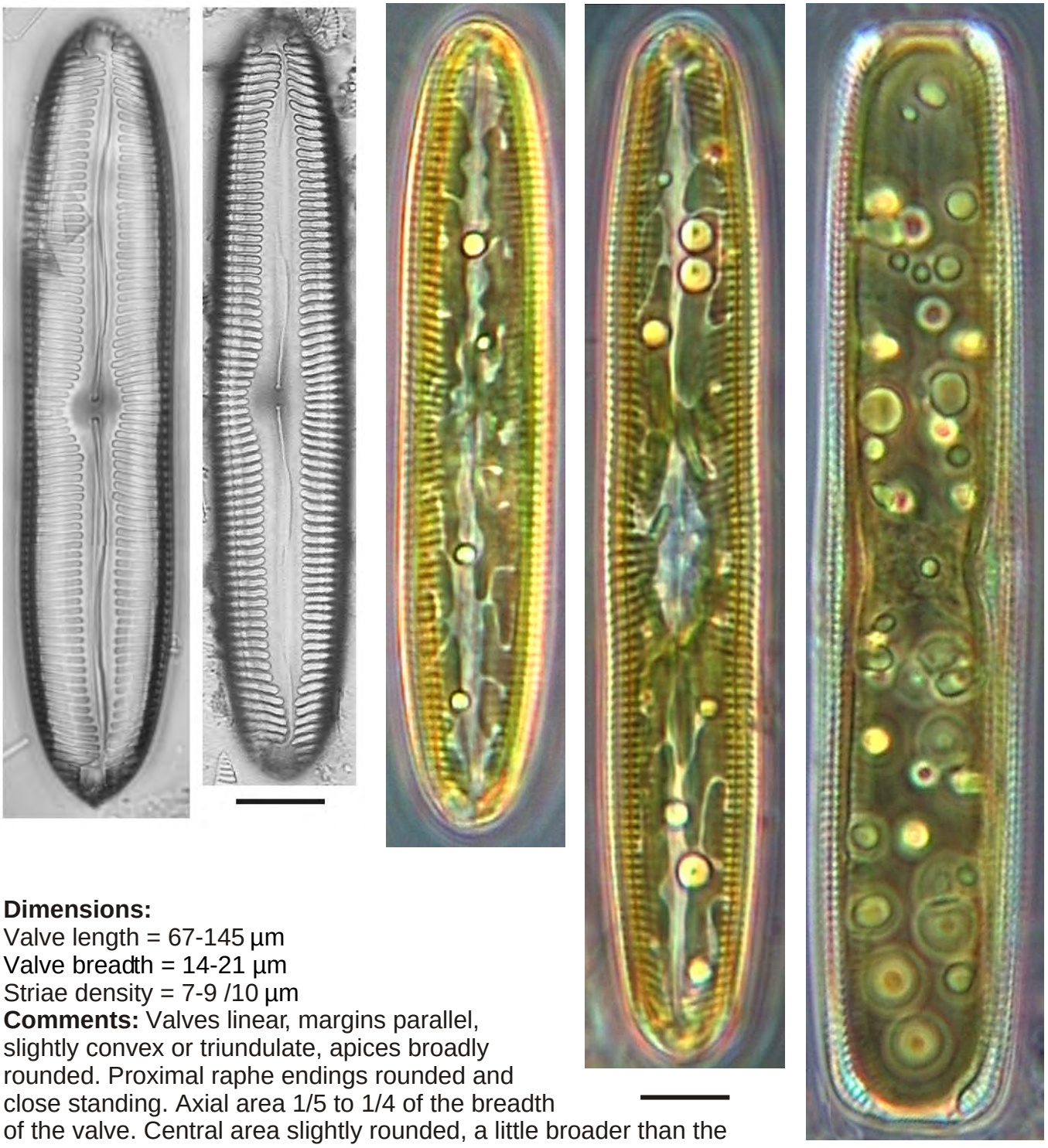
Plate 90

BIRAPHIDEAE

Taxa with a raphe on both valves

Striae formed by smooth tubular formations - alveoli

***Pinnularia viridiformis* Krammer**

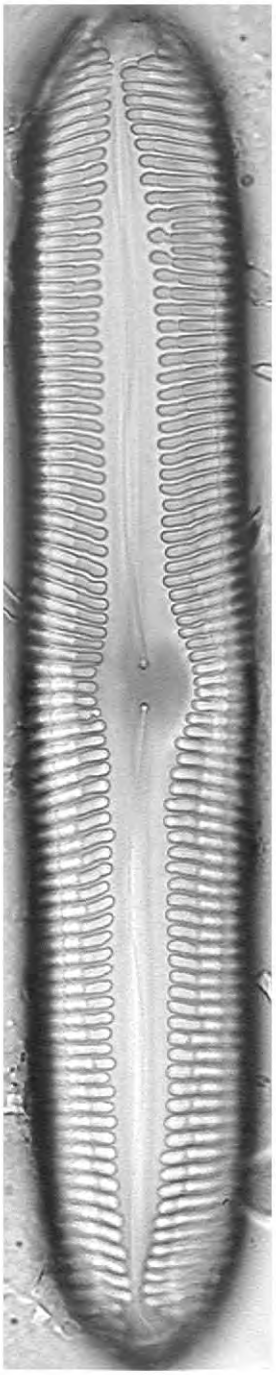


Dimensions:
Valve length = 67-145 µm
Valve breadth = 14-21 µm
Striae density = 7-9 /10 µm
Comments: Valves linear, margins parallel, slightly convex or triundulate, apices broadly rounded. Proximal raphe endings rounded and close standing. Axial area 1/5 to 1/4 of the breadth of the valve. Central area slightly rounded, a little broader than the axial area, commonly asymmetrical. Distinct longitudinal bands are present. Distinguished from *P. viridis* by outline, size and striae /10 µm.
Ecology: Cosmopolitan, one of the most common *Pinnularia* in oligo- to mesotrophic waters with low to moderate electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves
Striae formed by smooth tubular formations - alveoli

***Pinnularia viridis* (Nitzsch) Ehrenberg**



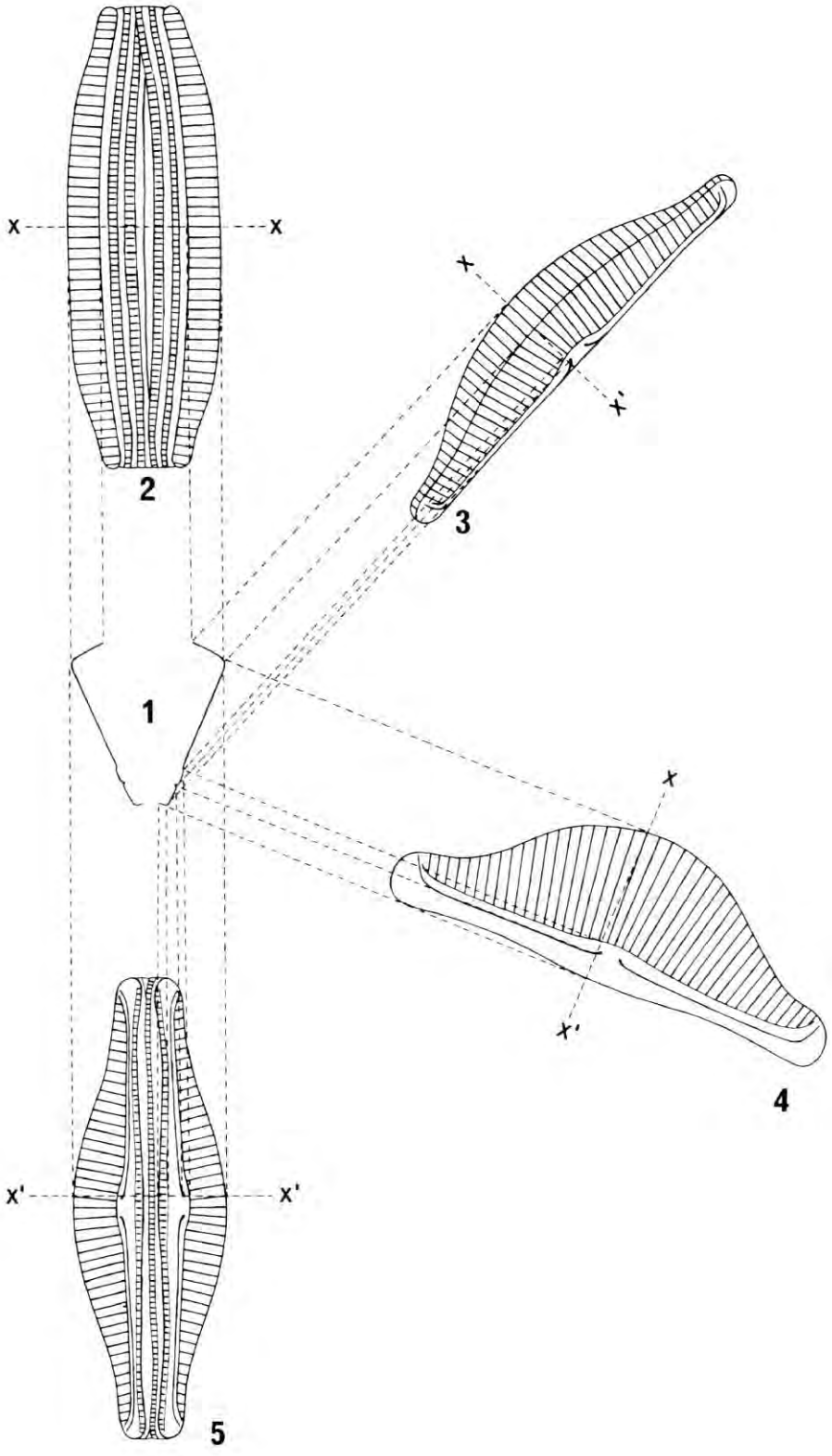
Dimensions:
Valve length = 100-182 µm
Valve breadth = 21-30 µm
Striae density = 6-7 /10 µm
Comments: Valves linear, margins parallel, slightly convex or triundulate narrowing towards rounded apices. Raphe lateral, undulating, three longitudinal lines visible. Proximal raphe endings are round and deflected to the same side. Axial area 1/5 to 1/4 of the valve breadth, linear, becoming lanceolate towards the poles. Central area irregular or rounded, a little wider than the axial area, commonly asymmetrical. Distinct longitudinal bands are visible.
Ecology: A cosmopolitan species found in circumneutral, oligo- to mesotrophic waters with low to moderate electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

Frustule in girdle view elliptic, showing the raphe system of both valves on the same side

The general frustule morphology of *Amphora*



Adapted from Schoeman & Archibald (1976-80)

Figure 1 shows the frustule of *Amphora* sectioned along the transapical plane (X-X'). The two valves are seen to lie at an angle to each other, the dorsal part of the frustule being much wider than the ventral part. This is one of the main taxonomic characters distinguishing the genus *Amphora* from the genus *Cymbella* sensu lato, whose opposite valves are parallel to each other.

When the frustule is observed from above (the dorsal side), the only parts of the frustule visible are the girdle bands and the dorsal valve mantles (**Figure 2**).

If a single valve is observed, obliquely from above, then as illustrated in **Figure 3** , the dorsal mantle may be seen as well as an oblique view of the valve face. In this view the valve face appears very narrow, and the raphe appears to be very close to the ventral margin.

The full valve view (or lateral view) is shown in **Figure 4**. In this view the dorsal striation, the axial area with the raphe system and the ventral striate region may be seen. The valve face may be either flat or curved.

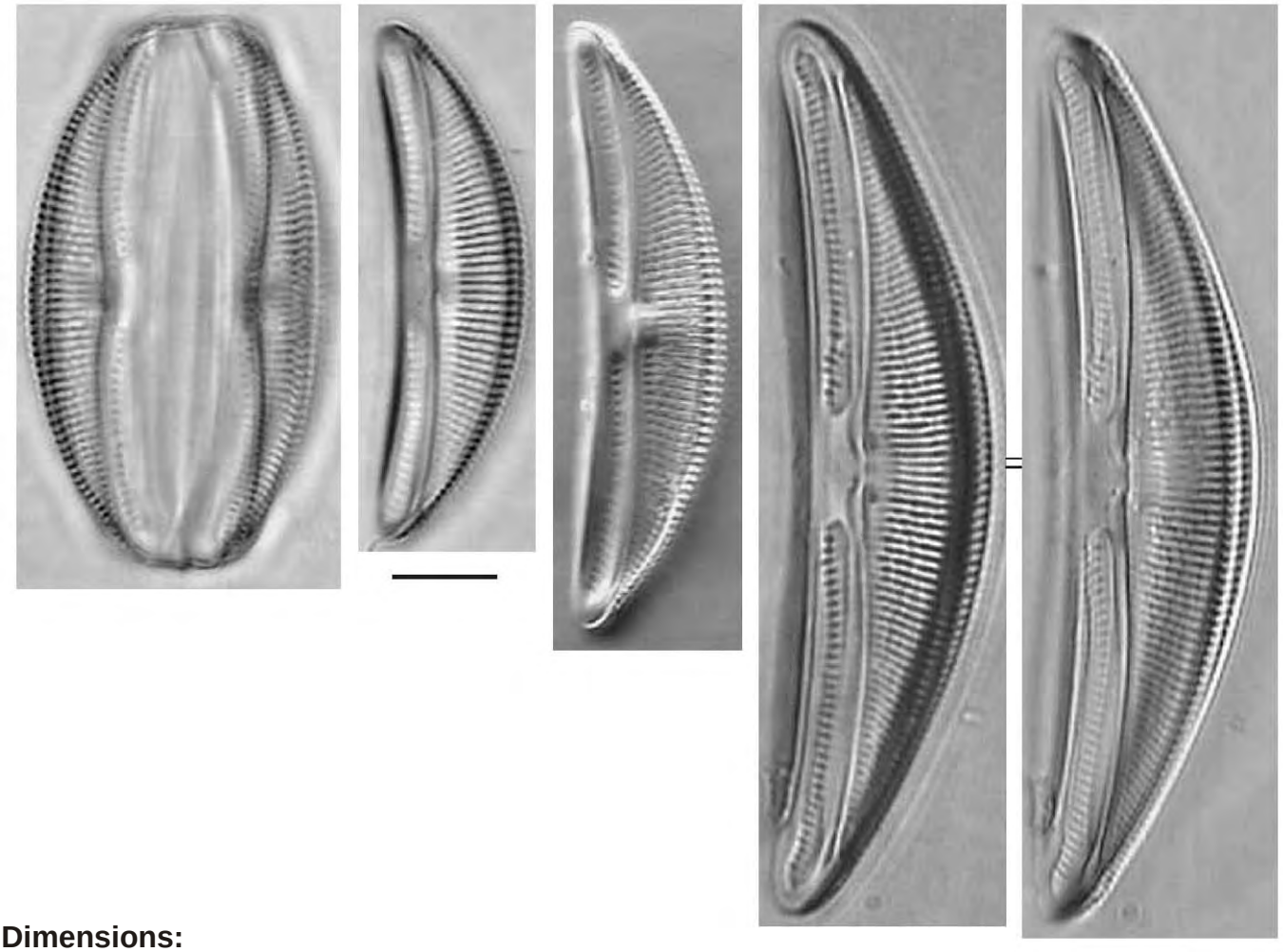
Figure 5 illustrates the ventral view of the frustule i.e. when the frustule is seen from directly below. In this view each valve lies at an oblique angle, but all the structures of the valve face may still be seen. The ventral mantle is seen in its entirety in this view, together with the narrow ventral girdle bands.

BIRAPHIDEAE

Taxa with a raphe on both valves

Frustule in girdle view elliptic, showing the raphe system of both valves on the same side

***Amphora ovalis* (Kützing) Kützing**



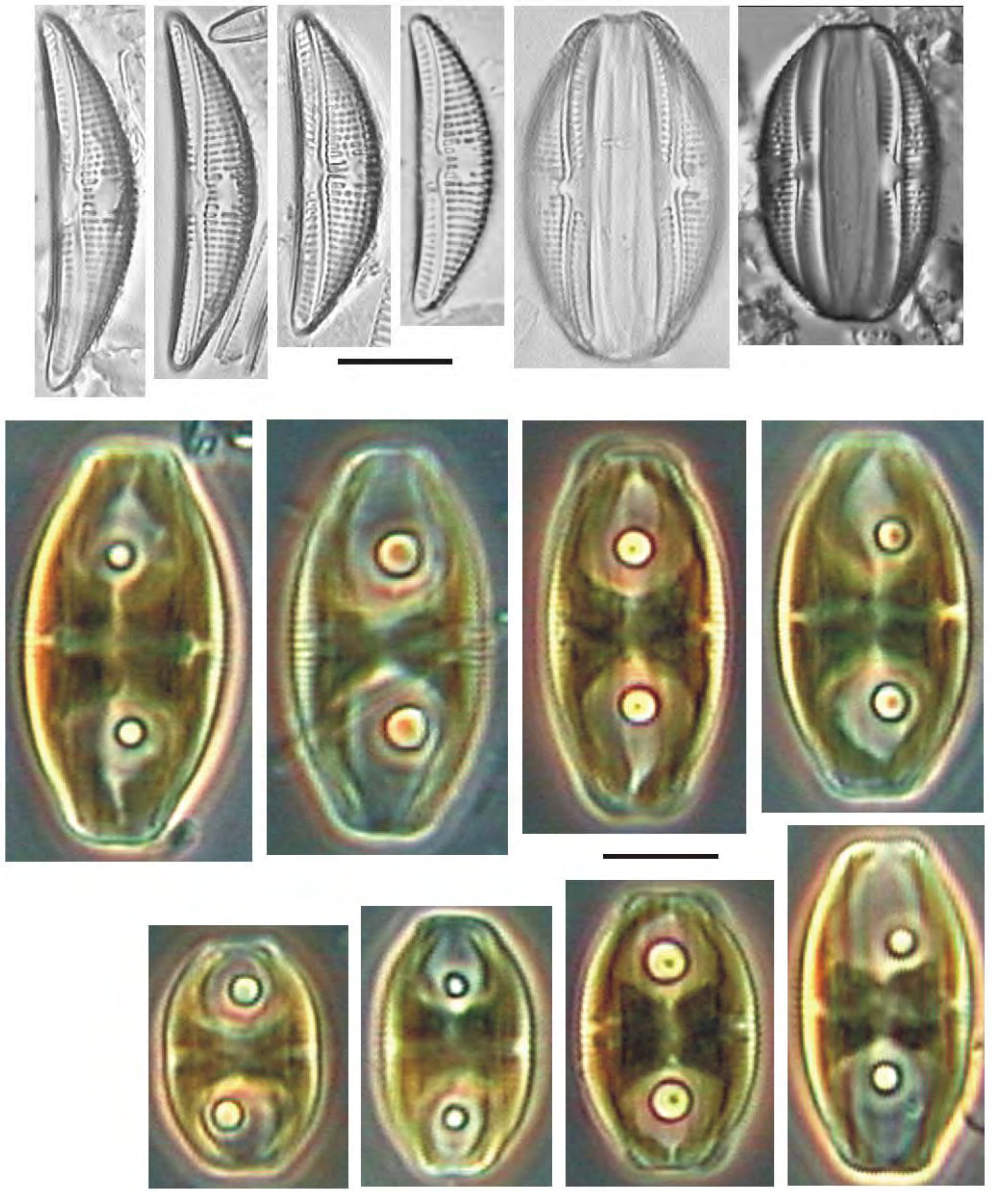
Dimensions:
Valve length = 30-105 µm
Valve breadth = 17-50 µm
Striae density = 10-13 /10 µm
Comments: Valves crescent moon-shaped, dorsal margin strongly convex, ventral margin weakly concave. Apices not protracted, bluntly rounded. Girdle bands without visible ornamentation. Raphe strongly arched, apical endings deflected to the ventral side, proximal endings strongly deflected to the dorsal margin.
Ecology: A cosmopolitan species found in waters with a moderate electrolyte content, extending into brackish and saline inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Frustule in girdle view elliptical, showing the raphe system of both valves on the same side

***Amphora copulata* (Kützing) Schoeman & Archibald**
Syn. *Amphora libyca* Ehrenberg



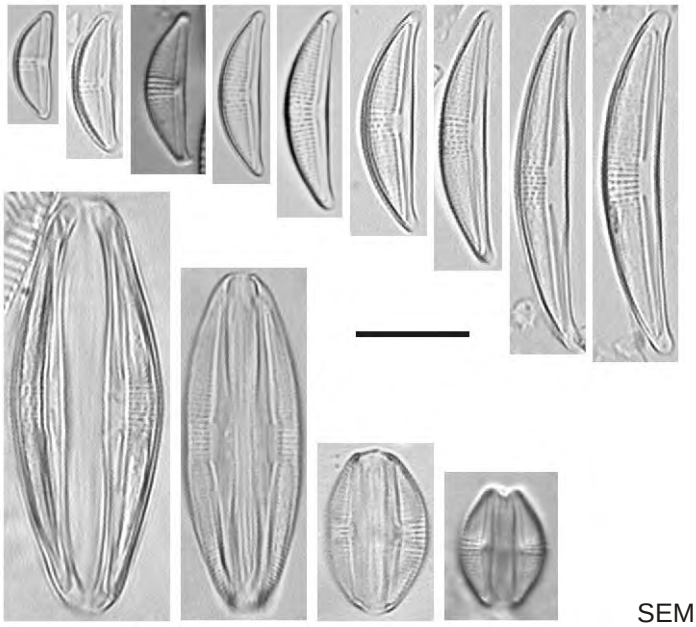
Dimensions:
Valve length = 20-80 µm
Valve breadth = 14-35 µm
Striae density = 11-15 /10 µm
Comments: Valves crescent moon-shaped, dorsal margin strongly convex, ventral margin weakly concave. Apices not protracted, sharply rounded. Girdle bands without visible ornamentation. Raphe strongly arched, apical endings deflected to the ventral side, proximal endings strongly deflected to the dorsal margin. Dorsal striae characteristically interrupted in the central region.
Ecology: A cosmopolitan species found in waters with moderate electrolyte content, sometimes occurring in brackish habitats.

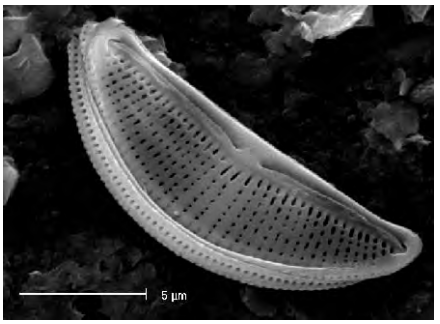
BIRAPHIDEAE

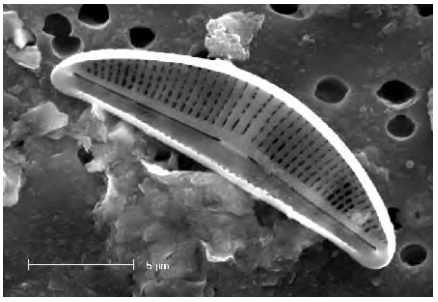
Taxa with a raphe on both valves

Frustule in girdle view elliptical, showing the raphe system of both valves on the same side

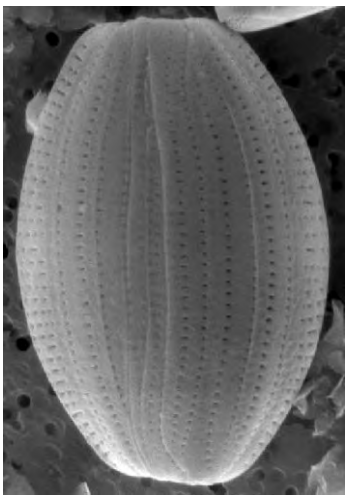
***Amphora veneta* Kützing**



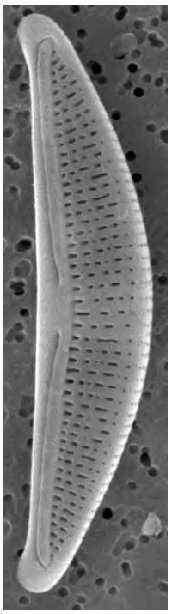


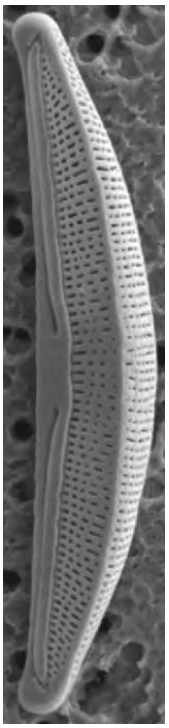


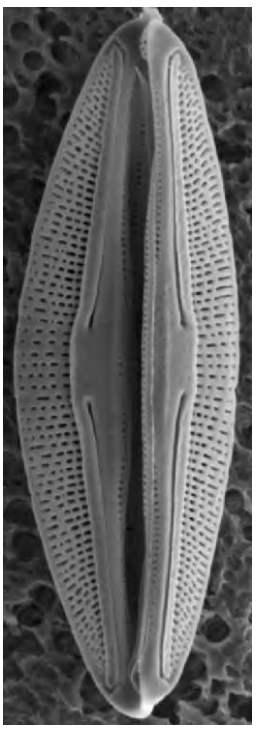
SEM



SEM







Dimensions:
Valve length = 50-60 µm
Valve breadth = 7-18 µm
Striae density = 19-30 (central region: 16-26) /10 µm
Comments: Valves crescent moon-shaped, with bluntly rounded sometimes weakly protracted apices. Girdle bands have well defined lineolae. Dorsal margin strongly convex, ventral margin straight or only slightly concave, sometimes expanded in the centre. Proximal raphe endings deflected to the dorsal side, widely spaced in large specimens, less so in smaller valves. Characterised by coarser striation in the central region.
Ecology: A cosmopolitan species found in waters with an elevated electrolyte content, tolerating critical to very heavy pollution.

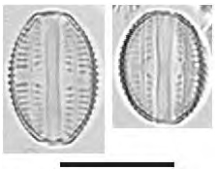
Plate 96

BIRAPHIDEAE

Taxa with a raphe on both valves

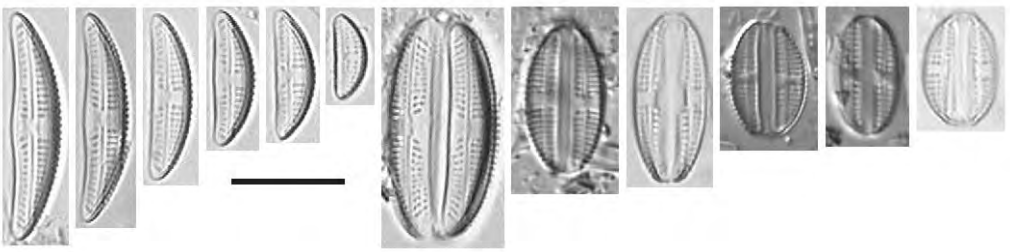
Frustule in girdle view elliptical, showing the raphe system of both valves on the same side

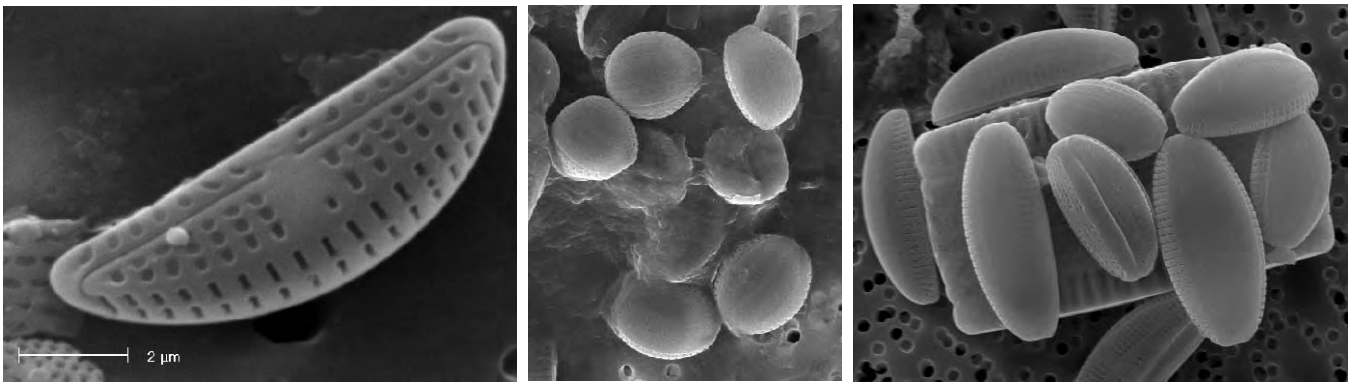
***Amphora inariensis* Krammer**



Dimensions:
Valve length = 10-28 µm
Valve breadth = 3.4-6 µm
Striae density = 15-17 /10 µm
Comments: Dorsal valve margin strongly convex, ventral margin straight with a very slight central inflation. Apices rounded and weakly deflected to the ventral side. No central area but a broad hyaline fascia. Proximal raphe endings not deflected. Striae composed of a single lineolae, as opposed to *A. pediculus* where striae are composed of several lineolae clearly visible in LM.
Ecology: Probably cosmopolitan, occurring in oligotrophic waters with moderate electrolyte content.

***Amphora pediculus* (Kützing) Grunow**





SEM image showing *A.pediculus* colonising *Diatoma vulgaris*

Dimensions:
Valve length = 5-18 µm
Valve breadth = 2-4 µm
Striae density = 18-25 /10 µm
Comments: Valves half-elliptical with rounded apices, sometimes slightly deflected towards the ventral side. No central area but a hyaline fascia which is slightly broader on the ventral side. Dorsal striae composed of 2-3 puncta.
Ecology: A cosmopolitan species found in waters with a moderate electrolyte content and tolerating critical levels of pollution. This species may be epiphytic on other algae, including diatoms.

BIRAPHIDEAE

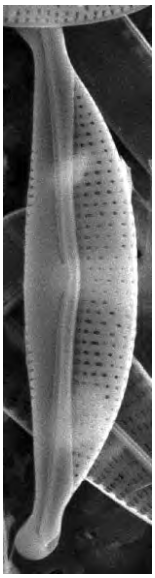
Taxa with a raphe on both valves

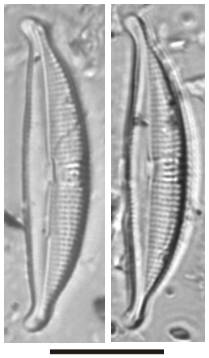
Taxa with dorsiventral valve symmetry (half-circle)

***Amphora normannii* Rabenhorst**

Dimensions:
Valve length = 15-40 µm
Valve breadth = 9-14µm
Striae density = 16-18 (20) /10 µm
Comments: Valves lanceolate, apices protracted, capitate. Central nodule clearly visible, raphe more or less straight with proximal endings strongly deflected towards the dorsal margin. Dorsal striae composed of clearly visible puncta (24-30 /10 µm)
Ecology: A cosmopolitan aerophilic species found in mountain regions and associated with wetland biotopes.

***Amphora fontinalis* Hustedt**

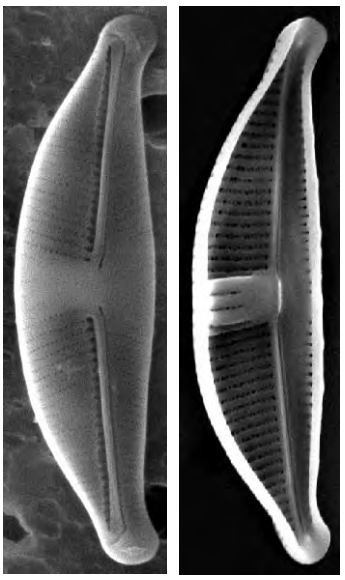




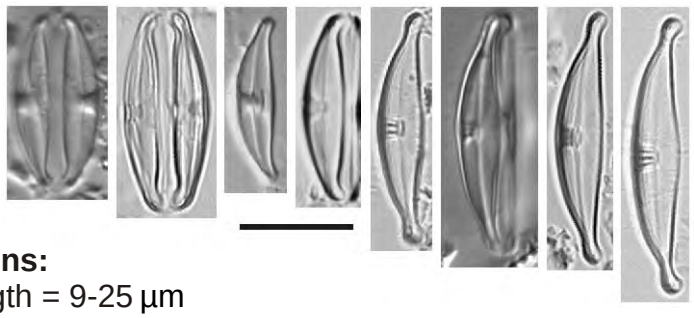
SEM

Dimensions:
Valve length = 20-33 µm
Valve breadth = 8-13 µm
Striae density = 20-24 /10 µm
Comments: Frustules linear elliptical in girdle view, valves half-lanceolate with strongly convex dorsal and weakly convex ventral margins. Apices protracted, capitate and ventrally deflected. Proximal raphe endings are weakly deflected towards the dorsal margin. The central area is strongly thickened with a semi-stauros. Very broad ventral axial area. Striae composed of clearly visible puncta.
Ecology: A rare species, possibly associated with acidic waters.

***Amphora montana* Krasske**
Syn. *Amphora submontana* Hustedt



SEM



Dimensions:
Valve length = 9-25 µm
Valve breadth = 7-10 µm
Striae density = 27-36 (40 near apices) /10 µm
Comments: Valves dorsiventral, dorsal margin convex, ventral margin weakly convex. Apices strongly protracted, capitate and ventrally deflected. Characterised by a thickened dorsal semi-stauros with 2 (1-4) clearly visible striae.
Ecology: A cosmopolitan species found in alkaline waters, rarely becoming dominant.

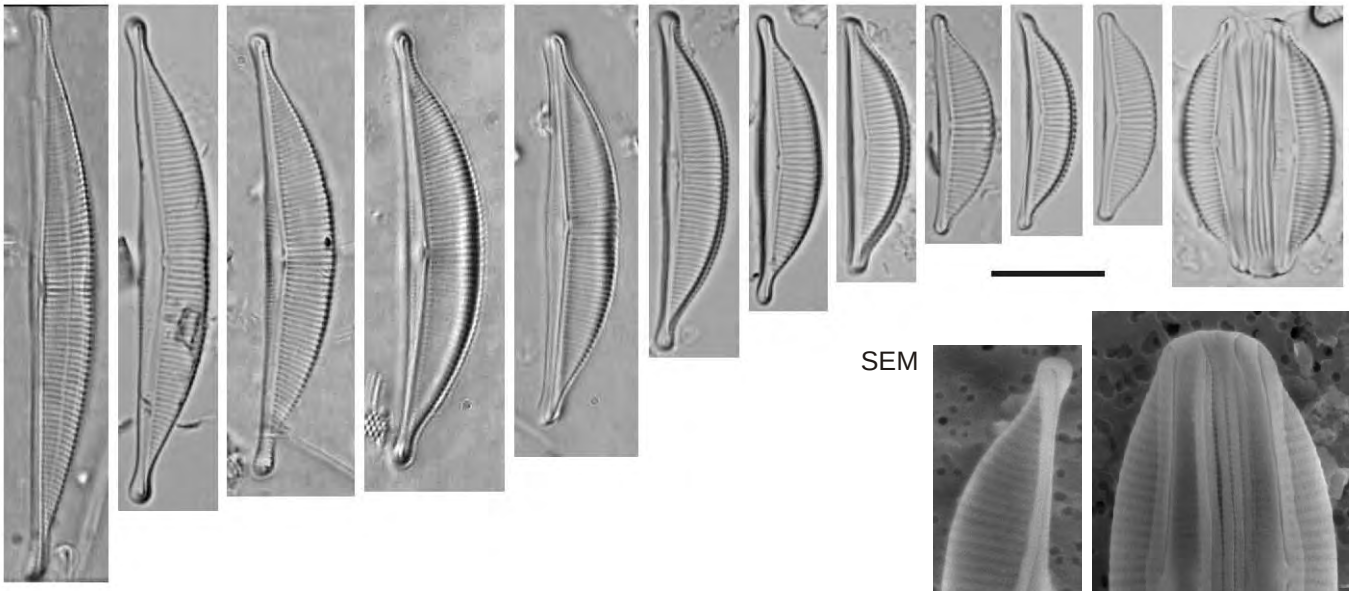
Plate 98

BIRAPHIDEAE

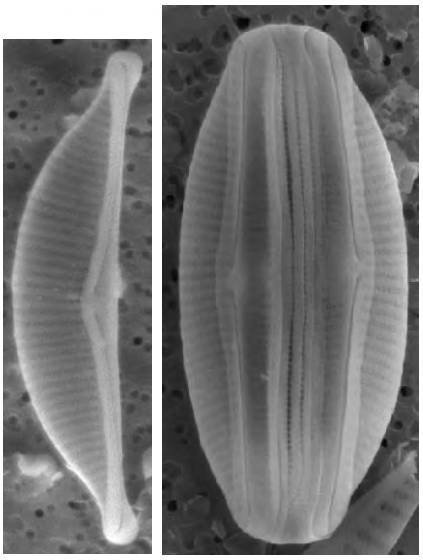
Taxa with a raphe on both valves

Taxa with dorsiventral valve symmetry (half-circle)

***Amphora coffeaeformis* (Agardh) Kützing**

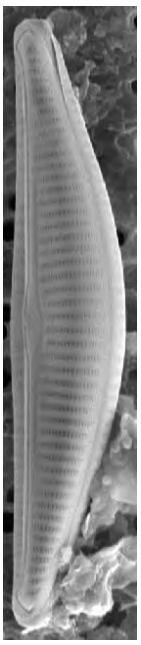


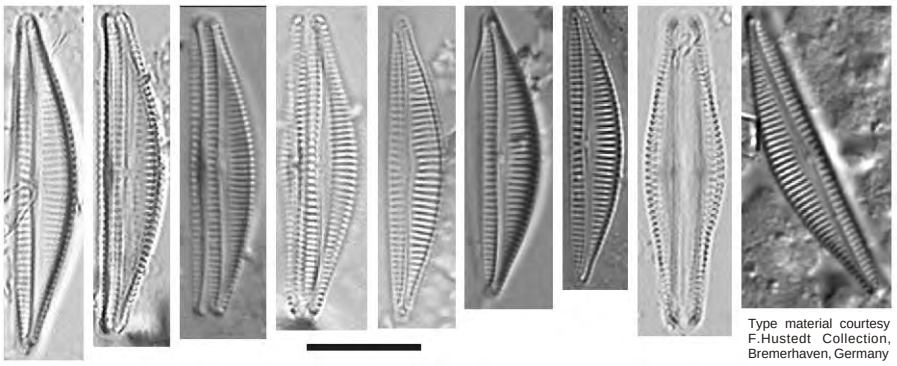
SEM



Dimensions:
Valve length = 13-60 µm
Valve breadth = 10-19 µm (frustule), 4-9 µm (valve)
Striae density = 16-24 /10 µm
Comments: Valves narrow half-lanceolate, dorsal margin convex, ventral margin weakly concave. Apices narrow, protracted, capitate. Raphe slightly arcuate, very close to the ventral margin. Proximal raphe endings slightly deflected to the dorsal side. Ventral striae very short, dorsal striae parallel in the middle becoming radiate. Puncta not visible in LM.
Ecology: A cosmopolitan species found waters with high electrolyte content and in brackish and saline inland waters.

***Seminavis strigosa* (Hustedt) Danieledis & Economou-Amilli**
***Syn. Amphora strigosa* Hustedt**





Type material courtesy F.Hustedt Collection, Bremerhaven, Germany

Dimensions:
Valve length = 23-27 µm
Valve breadth = 9.5-11 µm
Striae density = 18-20 /10 µm

Comments: Valves half-elliptical, dorsal margin strongly convex, ventral margin straight to weakly convex. Apices acutely rounded. Raphe slightly arcuate, proximal endings not deflected. Striae, without visible puncta, parallel in the middle of the valve becoming radiate towards the apices.
Ecology: A cosmopolitan species abundant in saline habitats.

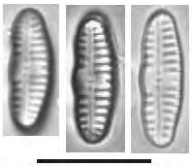
SEM

BIRAPHIDEAE

Taxa with a raphe on both valves

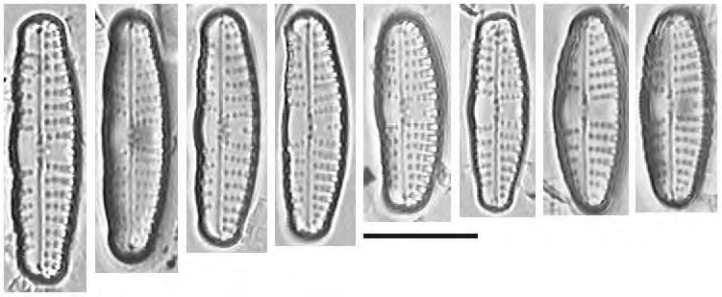
Weakly dorsiventral cells characterised by a ventral swelling

Reimeria sinuata **(Gregory) Kociolek & Stoermer**
Syn. *Cymbella sinuata* Gregory



Dimensions:
Valve length = 9-40 µm
Valve breadth = 3.5-9 µm
Striae density = 8-14 (16 near apices) /10 µm
Number of stigmata = 1
Comments: Valves moderately dorsiventral, elliptic-lanceolate, dorsal margin convex, ventral margin weakly convex. Apices weakly protracted, bluntly rounded to capitate. Axial area narrow, linear. Central area large and well defined, reaching the ventral margin, bordered by a single stria on the dorsal side. Raphe weakly lateral, proximal endings small, rounded. Distal endings bowed and ventrally deflected. Puncta not clearly discernible in LM.
Ecology: A cosmopolitan aerophilic species found montane biotopes, mosses, springs and streams.

Reimeria uniseriata **Sala, Guerrero & Ferrario**
Syn. *Cymbella sinuata* sensu Schoeman & Archibald



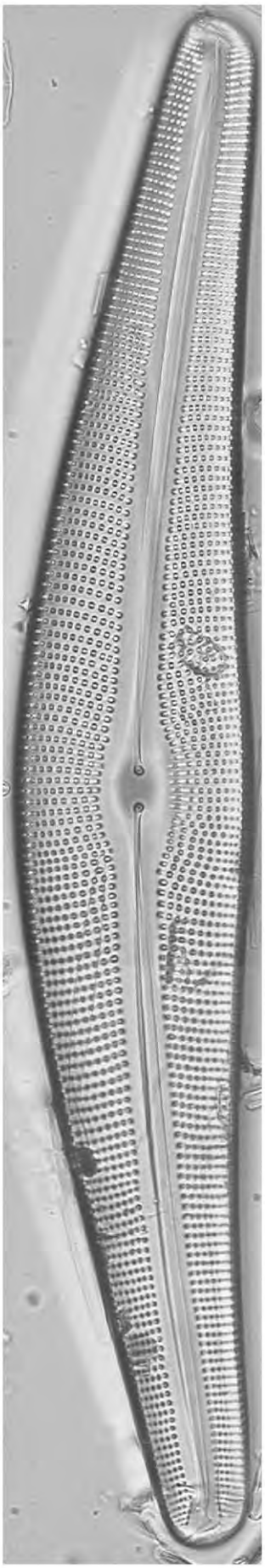
SEM

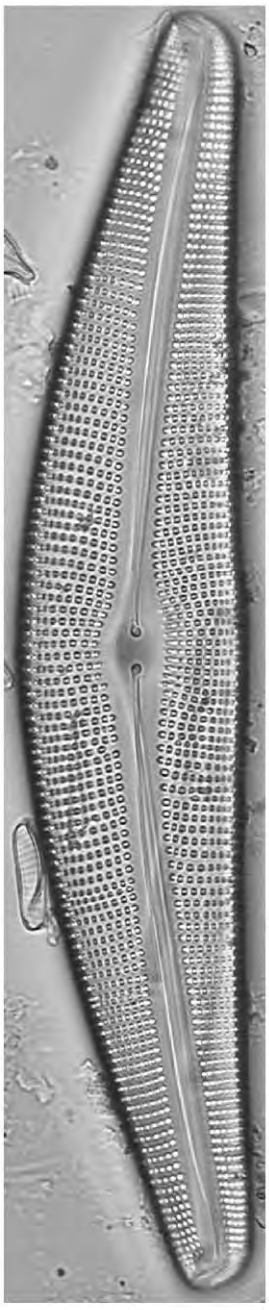
Dimensions:
Valve length = 15-40 µm
Valve breadth = 4-9 µm
Striae density = 7-14 /10 µm
Comments: Valves moderately dorsiventral, dorsal margin convex, ventral margin weakly convex, more or less triundulate. Apices not protracted, bluntly rounded. Axial area narrow, central area large and well defined, extending to the ventral margin. Raphe lateral, straight, proximal endings slightly ventrally deflected, polar or distal raphe endings ventrally curved. Striae composed of a single row of puncta (uniseriate). One apical pore field at each pole located on the ventral margin and extending onto the valve face.
Ecology: This species is found in alkaline, meso- to eutrophic waters with a moderate electrolyte content. *R. uniseriata* seems to be able to grow in conditions of reduced light penetration (i.e. high turbidity).

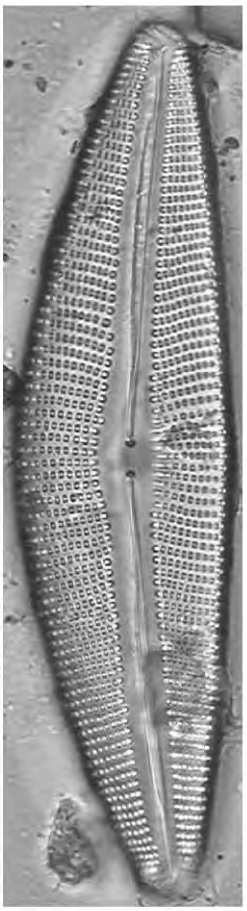
BIRAPHIDEAE

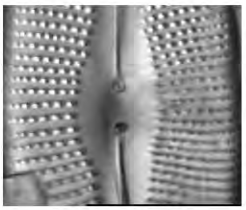
Taxa with a raphe on both valves

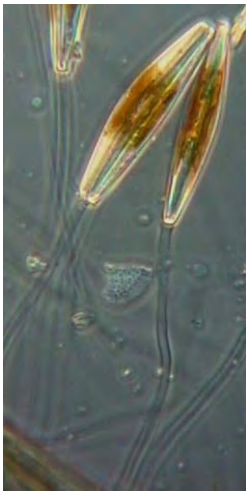
Half-circle shaped cells with dorsally deflected polar raphe endings











***Cymbella aspera* (Ehrenberg) H Peragallo**

Dimensions:
Valve length = 110-200 µm
Valve breadth = 26-35 µm
Striae density = 6.5-8 (10 near apices) /10 µm
Number of stigmata = 7-10

Comments: Valves moderately to distinctly dorsiventral, dorsal margin evenly arched, ventral margin with a slight central swelling. Raphe strongly lateral, proximal endings appear round and are slightly deflected to the ventral side, polar raphe endings sickle shaped and deflected dorsally at an angle of 45°. Puncta distinct, more or less round.

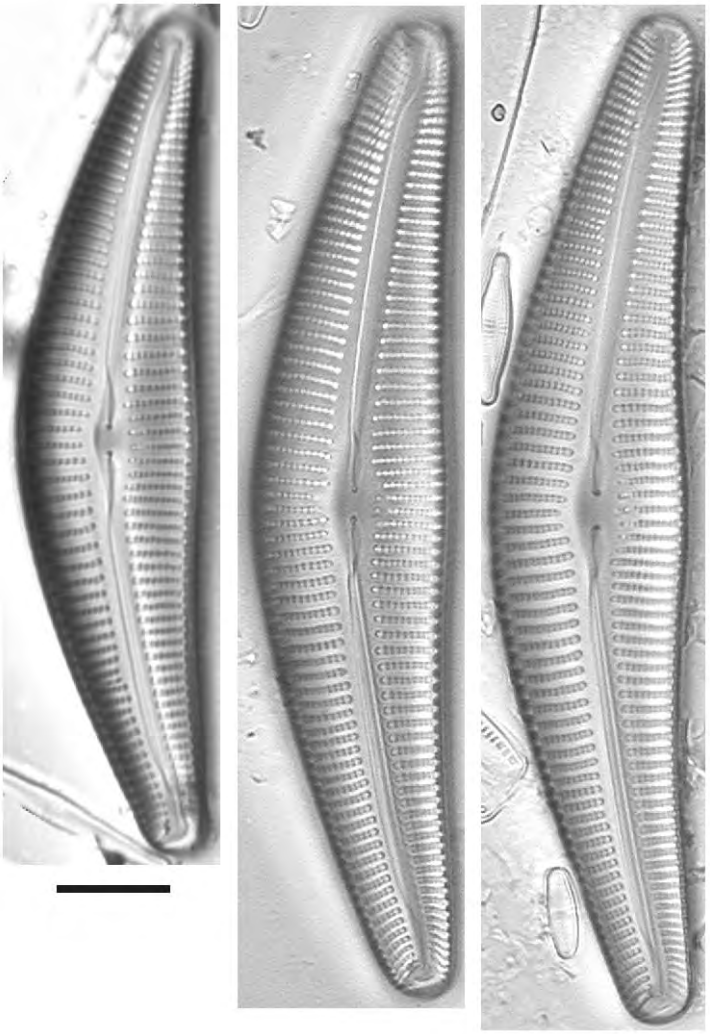
Ecology: A cosmopolitan species found in oligotrophic waters with moderate electrolyte content. Attached to the substratum by dichotomous mucilage stalks.

BIRAPHIDEAE

Taxa with a raphe on both valves

Half-circle shaped cells with dorsally deflected polar raphe endings

Cymbella simonsenii Krammer



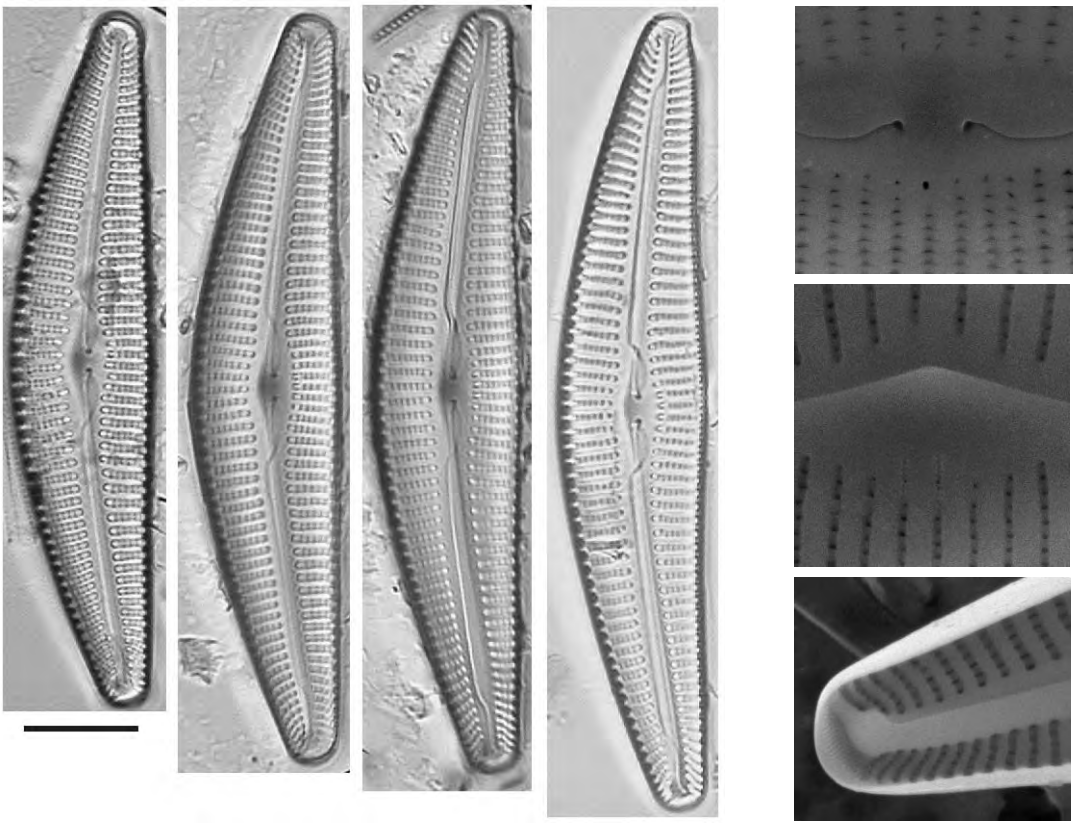
Dimensions:
Valve length = 56-125 µm
Valve breadth = 14-17.4 µm
Striae density = 6.5-9 (11 near apices) /10 µm
Number of stigmata = 1-3
Comments:
Valves moderately dorsiventral, dorsal margin arched, ventral margin straight or only slightly convex with a slight central swelling. Apices not protracted, bluntly rounded. Axial area linear, narrow and slightly tapering towards the apices. Central area absent on the dorsal side and ventrally only a slight widening of the axial area. Raphe lateral, proximal raphe endings small, polar (distal) raphe endings dorsally deflected. Striae finely, but distinctly, punctate.
Ecology:
A cosmopolitan species found in oligotrophic, calcareous waters with a moderate electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves

Half-circle shaped cells with dorsally deflected polar raphe endings

***Cymbella cymbiformis* Agardh**



SEM

Dimensions:
Valve length = 40-105 µm
Valve breadth = 13-17 µm
Striae density = 7-10 (25 near apices) /10 µm
Number of stigmata = 1 (2-3)

Comments:
Valves moderately dorsiventral, apices not protracted and bluntly rounded. Dorsal margin strongly arched, ventral margin straight in smaller specimens to slightly concave in larger specimens except in the midregion where it is slightly swollen or tumid. Axial area linear, central area absent on the dorsal side, consisting of a slight broadening of the axial area on the ventral side. Raphe strongly lateral, proximal endings distinct and rounded. Striae slightly radiate in the midregion becoming strongly radiate towards the apices.

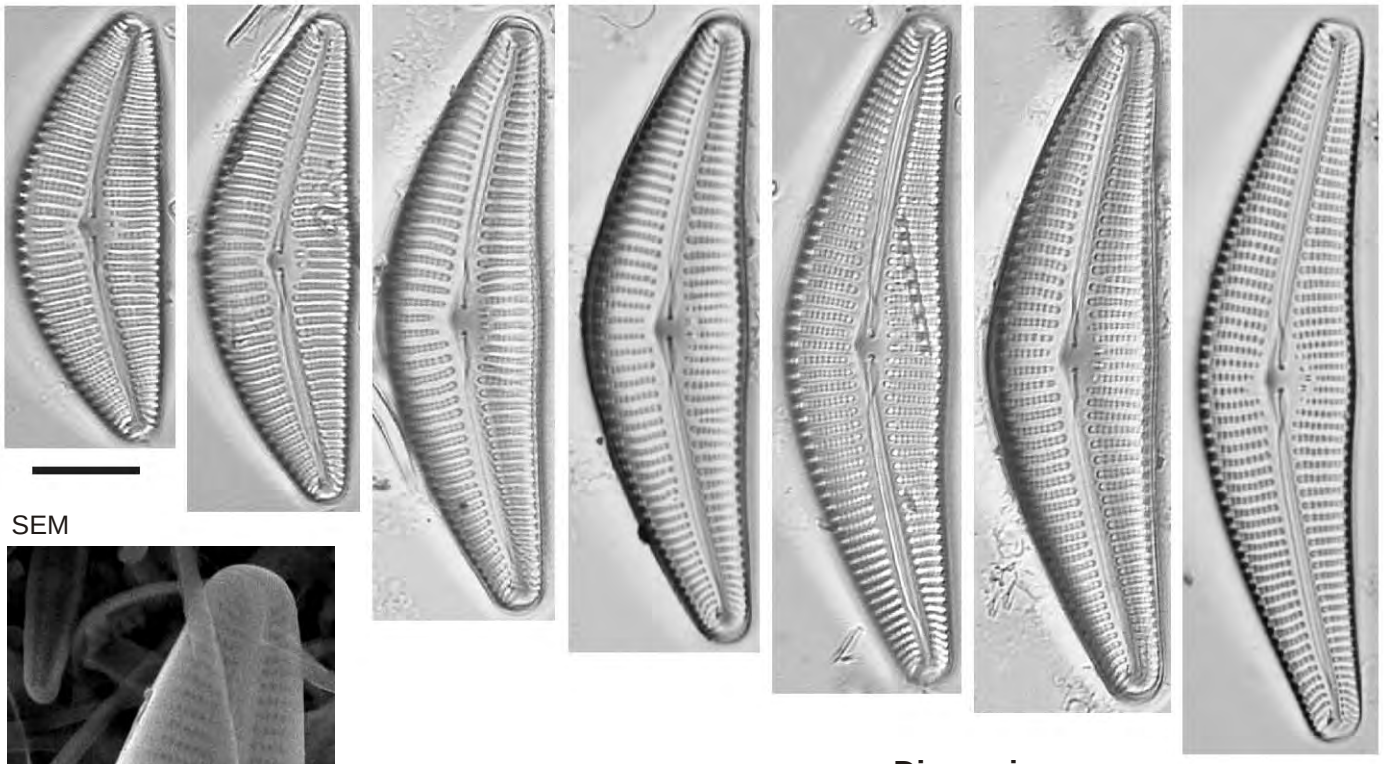
Ecology:
A cosmopolitan species found the littoral region of both lakes and streams, also found in smaller watercourses and puddles. Common in oligotrophic waters with low to very low electrolyte content.

BIRAPHIDEAE

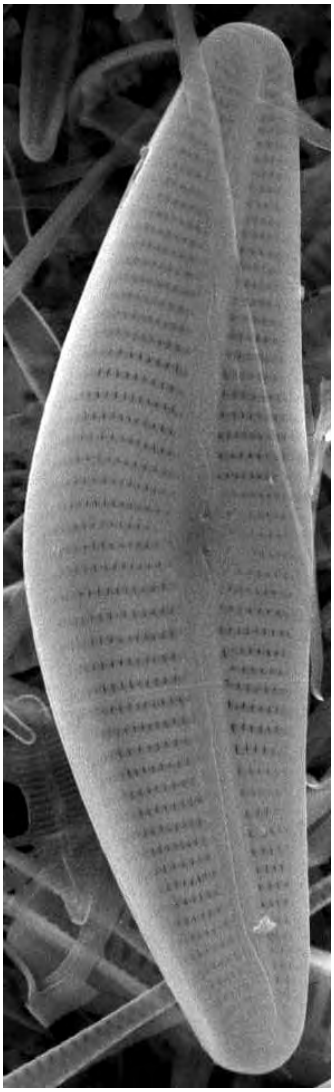
Taxa with a raphe on both valves

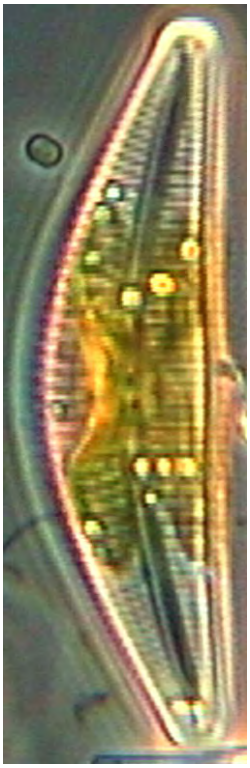
Half-circle shaped cells with dorsally deflected polar raphe endings

Cymbella neocistula Krammer
Syn. _Cymbella cistula_ (Ehrenberg) Kirchner sensu Krammer & Lange-Bertalot 1986



SEM



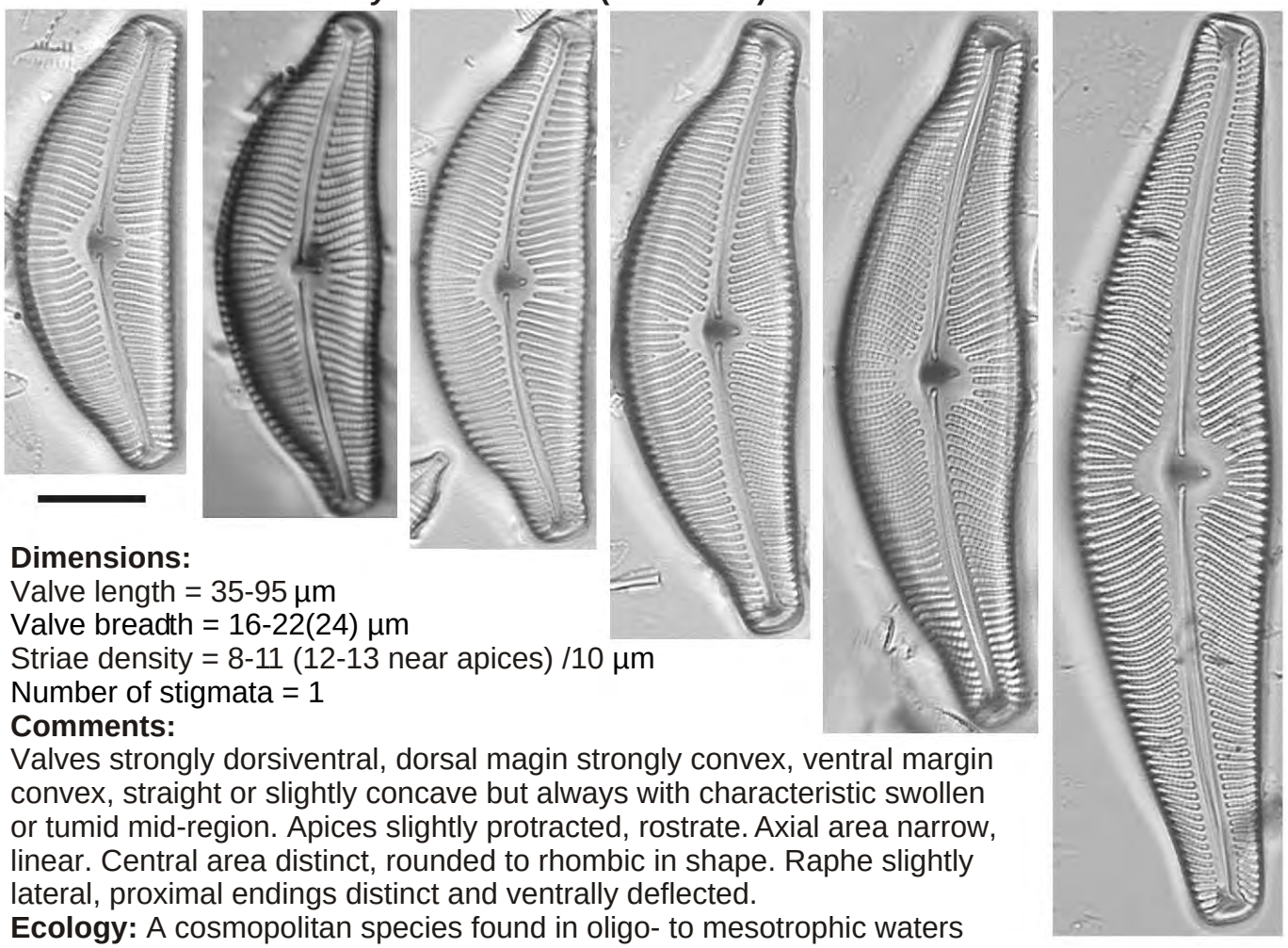


Dimensions:
Valve length = 34-110 µm
Valve breadth = 12-19 µm
Striae density = 7-9 (12 near the apices) /10 µm
Number of stigmata = 3-5
Comments: Valves strongly dorsiventral. Dorsal margin strongly arched (more so in smaller specimens). Ventral margin straight in smaller specimens to slightly convex with a central swelling in larger specimens. Axial area narrow, central area small and rounded. Raphe moderately lateral, proximal endings small. Distinguished from *C. cymbiformis* by the valve outline, the distinct dorsal central area and the 3 or more stigmata.
Ecology: A cosmopolitan epiphytic and epilithic species found in circumneural to slightly alkaline, mesotrophic waters with moderate to high electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves
Half-circle shaped cells with dorsally deflected polar raphe endings

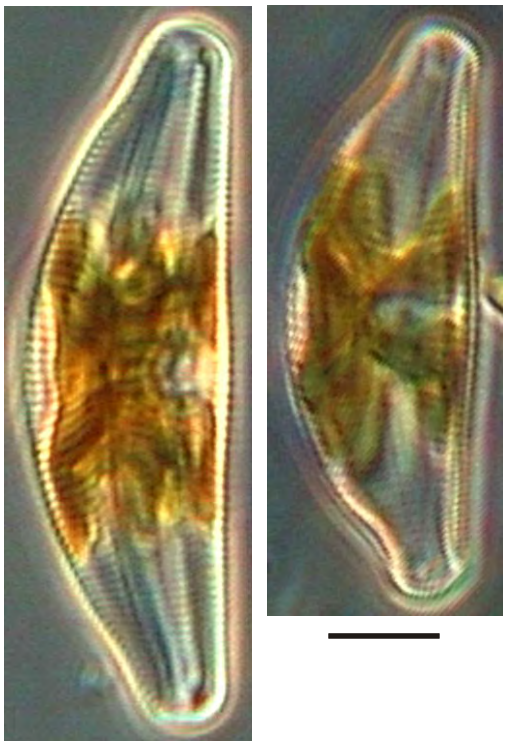
***Cymbella tumida* (Brébisson) Van Heurck**

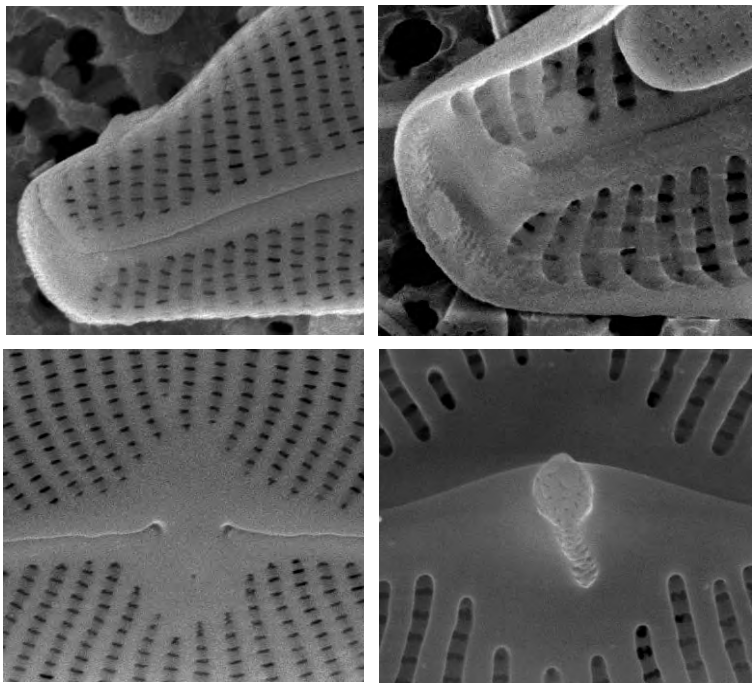


Dimensions:
Valve length = 35-95 µm
Valve breadth = 16-22(24) µm
Striae density = 8-11 (12-13 near apices) /10 µm
Number of stigmata = 1

Comments:
Valves strongly dorsiventral, dorsal magin strongly convex, ventral margin convex, straight or slightly concave but always with characteristic swollen or tumid mid-region. Apices slightly protracted, rostrate. Axial area narrow, linear. Central area distinct, rounded to rhombic in shape. Raphe slightly lateral, proximal endings distinct and ventrally deflected.

Ecology: A cosmopolitan species found in oligo- to mesotrophic waters with moderate electrolyte content. Occurs in the littoral zone of standing and flowing waters.





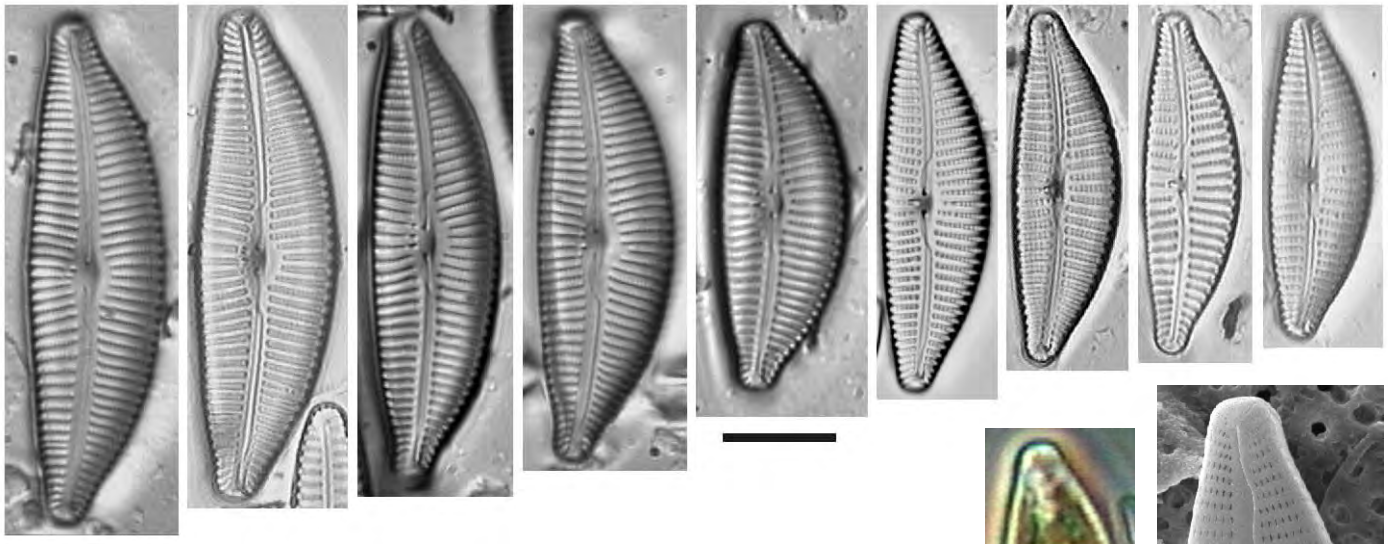
SEM

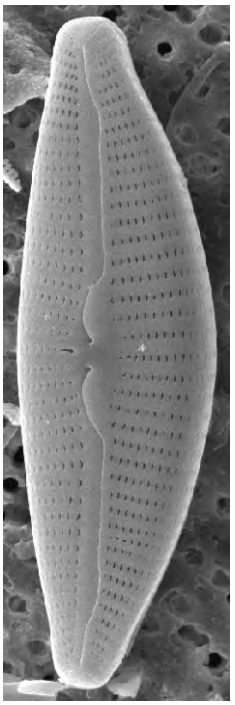
BIRAPHIDEAE

Taxa with a raphe on both valves

Half-circle shaped cells with dorsally deflected polar raphe endings

***Cymbella turgidula* Grunow**

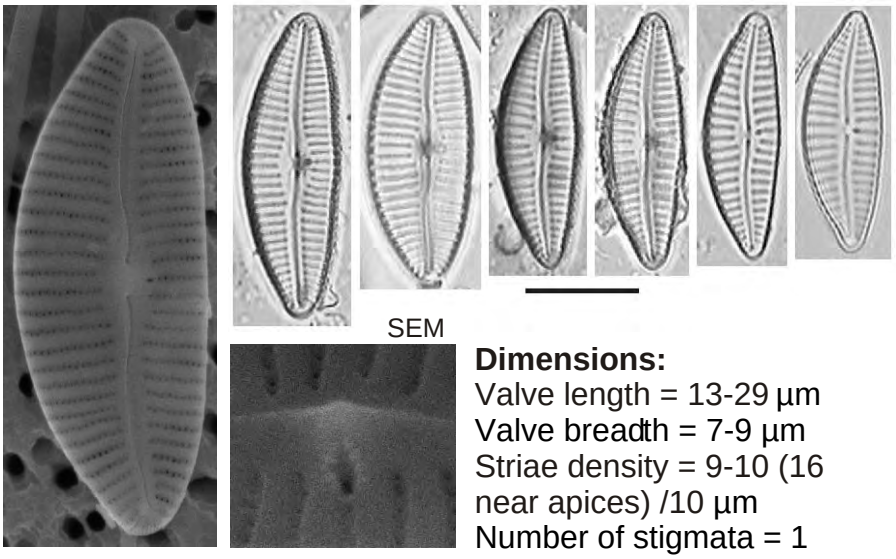




SEM

Dimensions:
Valve length = 30-50 µm
Valve breadth = 11-14 µm
Striae density = 8-11 (12-14 near apices) /10 µm
Number of stigmata = 1-3
Comments: Valves dorsiventral, dorsal margin strongly arched, ventral margin weakly convex. Apices short and blunt, sub-rostrate to rostrate-truncate, weakly protracted in larger specimens. Axial area narrow, central area small and rounded, more developed on the dorsal side, sometimes absent in smaller specimens. Raphe weakly lateral, proximal endings rounded.
Ecology: A cosmopolitan species found in oligo- to mesotrophic, alkaline waters with moderate electrolyte content.

***Cymbella kolbei* Hustedt**



SEM

Dimensions:
Valve length = 13-29 µm
Valve breadth = 7-9 µm
Striae density = 9-10 (16 near apices) /10 µm
Number of stigmata = 1

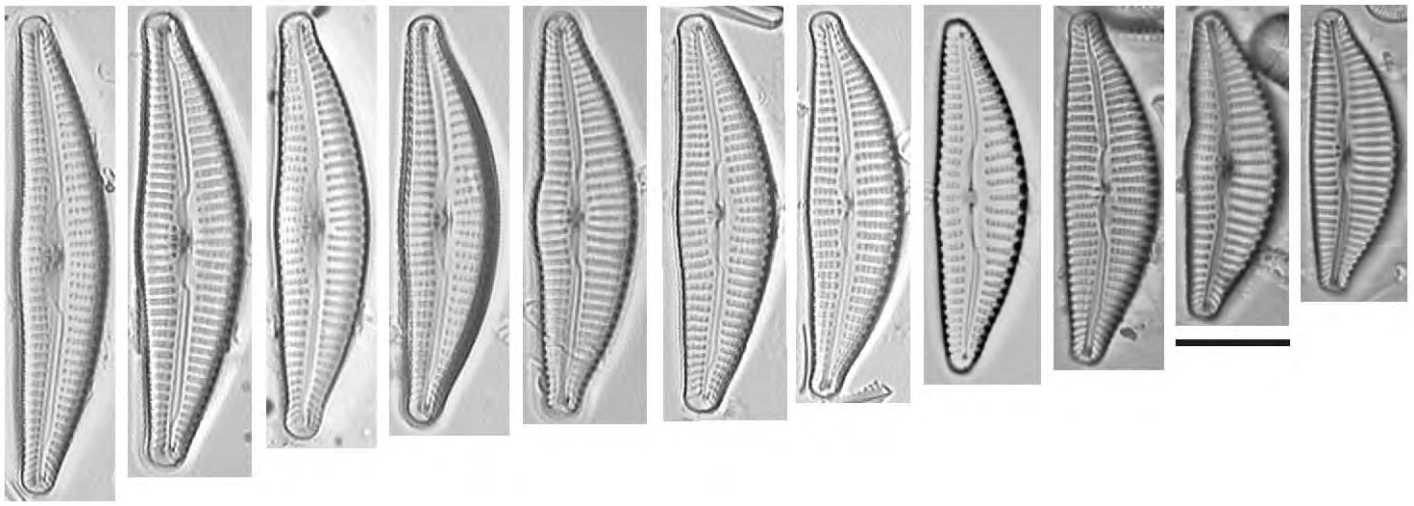
Comments: Valves moderately dorsiventral, dorsal margin strongly convex, ventral margin weakly convex. Apices not, or only very slightly protracted. Axial area very narrow, central area small, sometimes absent. Raphe very weakly lateral.
Ecology: A cosmopolitan species found in oligotrophic, alkaline waters.

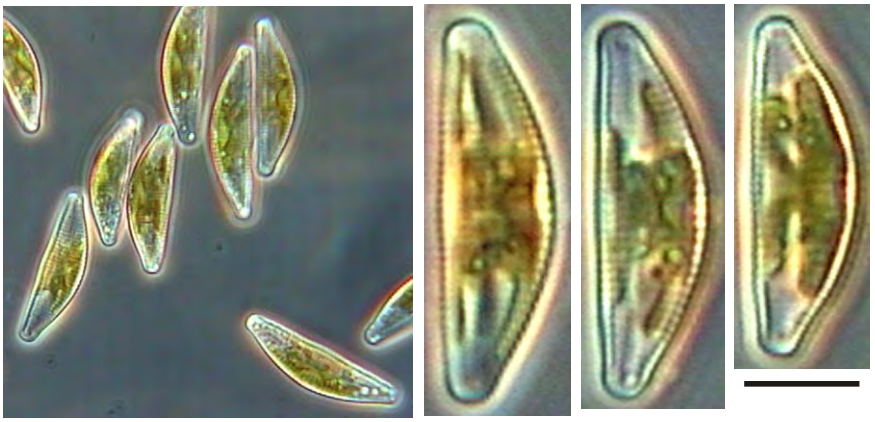
BIRAPHIDEAE

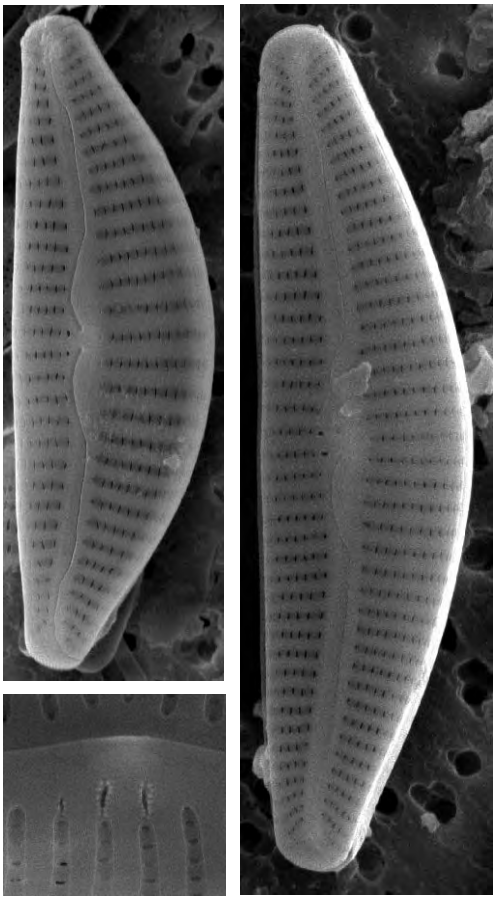
Taxa with a raphe on both valves

Half-circle shaped cells with dorsally deflected polar raphe endings

***Cymbella kappii* (Cholnoky) Cholnoky**
Syn. *Cymbella turgidula* var. *kappii* Cholnoky







SEM

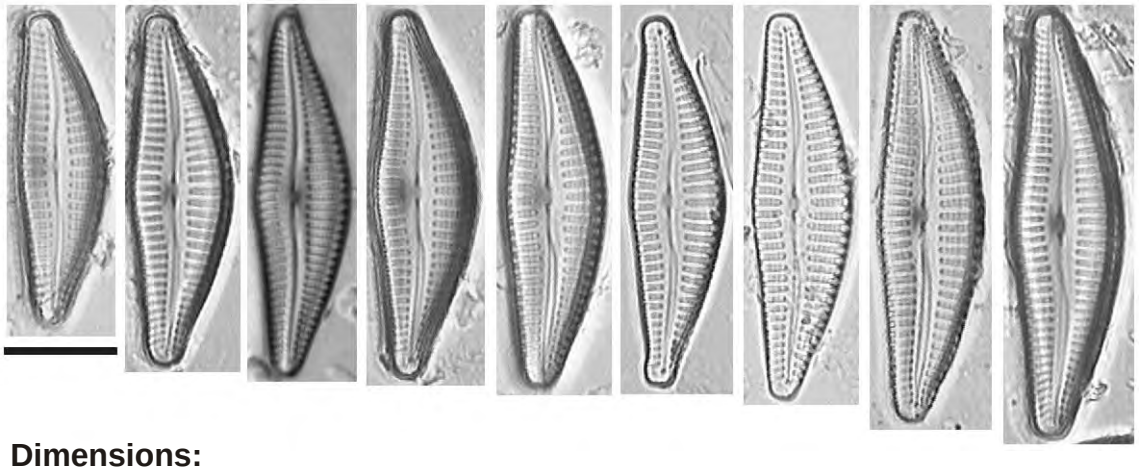
Dimensions:
Valve length = 22-58 µm
Valve breadth = 7-10.5 µm
Striae density = 8-12 (11-15 near apices) /10 µm
Number of stigmata = 2-4
Comments: Valves dorsiventral, dorsal margin strongly convex, ventral margin straight to slightly covex sometimes with a central swelling. Apices weakly protracted, sub-rostratre and rounded. Axial area narrow, sometimes slightly expanded at the central nodule. Central area absent. Raphe distinctly lateral, proximal endings very small and rounded. Striae indistinctly punctate.
Ecology: Distributed and very common throughout South Africa with a limited distribution in Europe and other parts of the world. Found in weakly alkaline, oligo- to mesotrophic waters with low to moderate electrolyte content.

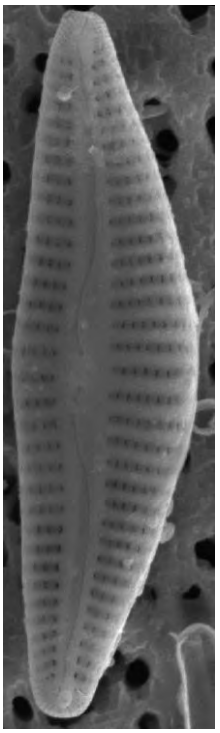
BIRAPHIDEAE

Taxa with a raphe on both valves

Half-circle shaped cells with dorsally deflected polar raphe endings

***Cymbella subleptoceros* Krammer**
Syn. *Cymbella leptoceros* (Ehrenberg) Kützing sensu Krammer & Lange-Bertalot 1986

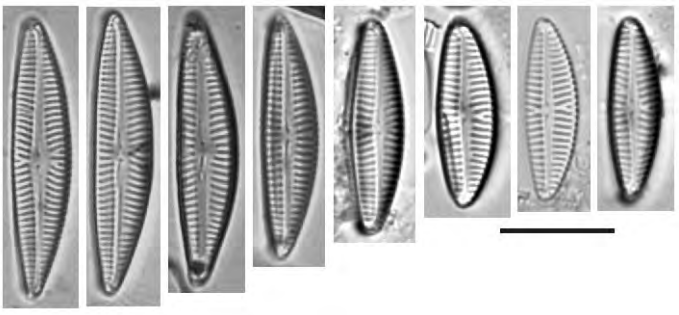




SEM

Dimensions:
Valve length = 17-45 µm
Valve breadth = 7.5-10 µm
Striae density = 9-11 (13 near apices)
Number of stigmata = 0
Comments: Valves dorsiventral, dorsal margin strongly arched, ventral margin slightly convex with a more or less pronounced central swelling. Apices narrow to acutely rounded. Axial area narrow in small specimens, slightly wider in larger specimens. The axial area broadens slightly towards the central nodule especially on the ventral side. Raphe slightly lateral with very small proximal endings. Striae indistinctly punctate with 22-25 puncta /10 µm.
Ecology: A cosmopolitan species found in mesotrophic waters with moderate electrolyte content.

***Navicymbula pusilla* (Grunow) Krammer**
Syn. *Cymbella pusilla* Grunow



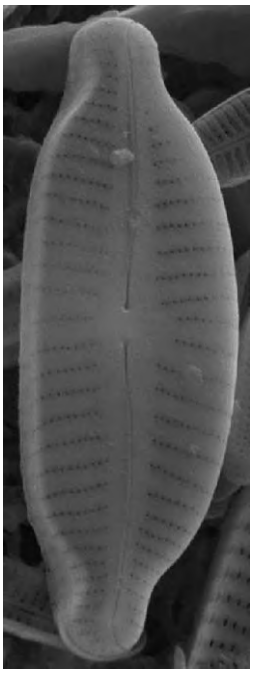
Dimensions:
Valve length = 14-42 µm
Valve breadth = 3.9-7.2 µm
Striae density = 15-18 (20 near the apices) /10 µm
Comments: Valves moderately dorsiventral, dorsal margin convex, ventral margin weakly convex or more or less straight. Axial area narrow becoming lanceolate near the central area. Central area absent or poorly defined. The central nodule is surrounded by one or more distinctly shortened striae. Raphe filiform, the proximal endings are small and slightly dorsally deflected. The polar fissures are dorsally deflected ?-shaped.
Ecology: Cosmopolitan, found oligo- to eutrophic waters with a moderate to high electrolyte content, especially waters with higher Ca- and Cl-salinity.

BIRAPHIDEAE

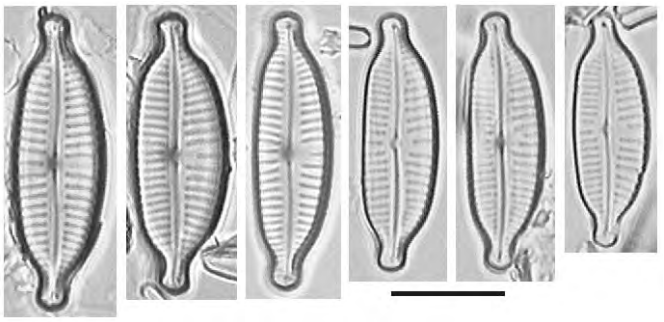
Taxa with a raphe on both valves

Weakly dorsiventral cells with dorsally deflected polar raphe endings

***Cymbopleura amphicephala* (Naegeli) Krammer**
Syn. *Cymbella amphicephala* Naegeli



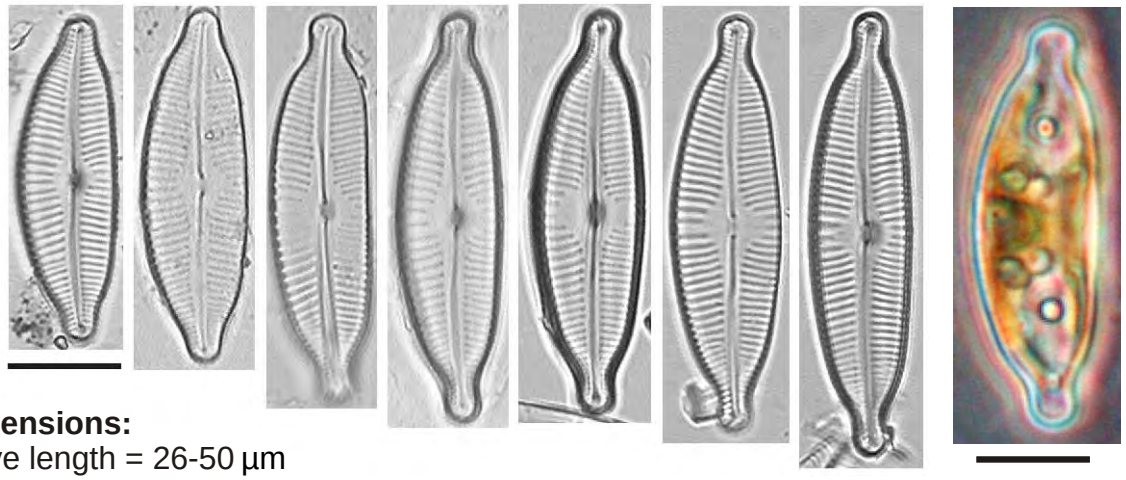
SEM



Dimensions:
Valve length = 22-34 µm
Valve breadth = 7.2-8.7 µm
Striae density = 12-15 (-18 near the apices) /10 µm

Comments: Valves slightly dorsiventral, broadly elliptical, dorsal and ventral margin both convex. Apices protracted, capitate or rostrate in smaller specimens. Axial area linear, narrow and slightly tapering towards the apices. Central area absent or poorly defined, often asymmetrical. Raphe filiform, proximal raphe endings small, polar (distal) raphe endings dorsally deflected. Striae finely punctate, not visible in LM. Striae radiate throughout.
Ecology: A cosmopolitan species found in oligo- to mesotrophic waters with a low to moderate electrolyte content.

***Cymbopleura naviculiformis* (Auerswald) Krammer**
Syn. *Cymbella naviculiformis* Auerswald

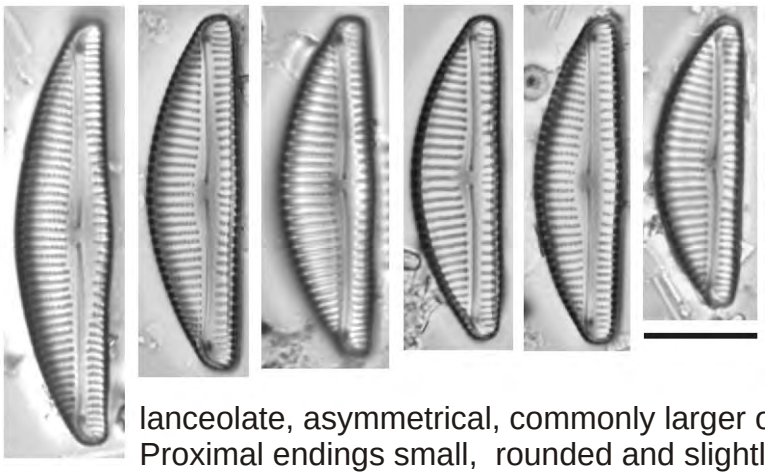


Dimensions:
Valve length = 26-50 µm
Valve breadth = 9-13 µm
Striae density = 12-14 (18 near apices) /10 µm
Comments: Valves moderately dorsiventral, elliptic-lanceolate, dorsal margin convex, ventral margin weakly convex. Apices protracted, rostrate to capitate. Axial area narrow, linear or broadening slightly towards the central area. Central area large and well defined, rounded or rhombic, sometimes asymmetrical. If asymmetrical commonly larger on the dorsal side. Raphe lateral becoming filiform towards the proximal and distal endings. Proximal endings small, rounded and deflected ventrally. Distal endings comma-shaped, dorsally deflected. Striae radiate throughout.
Ecology: A cosmopolitan species found in oligo- to mesotrophic waters with a low to moderate electrolyte content.

BIRAPHIDEAE

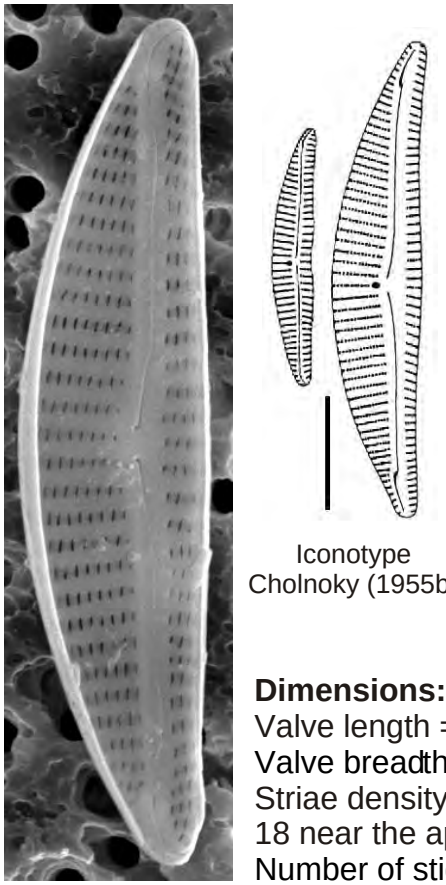
Taxa with a raphe on both valves
Strongly dorsiventral cells with ventrally deflected polar raphe endings

***Encyonema silesiacum* (Bleisch) DG Mann**
Syn. *Cymbella silesiaca* Bleisch

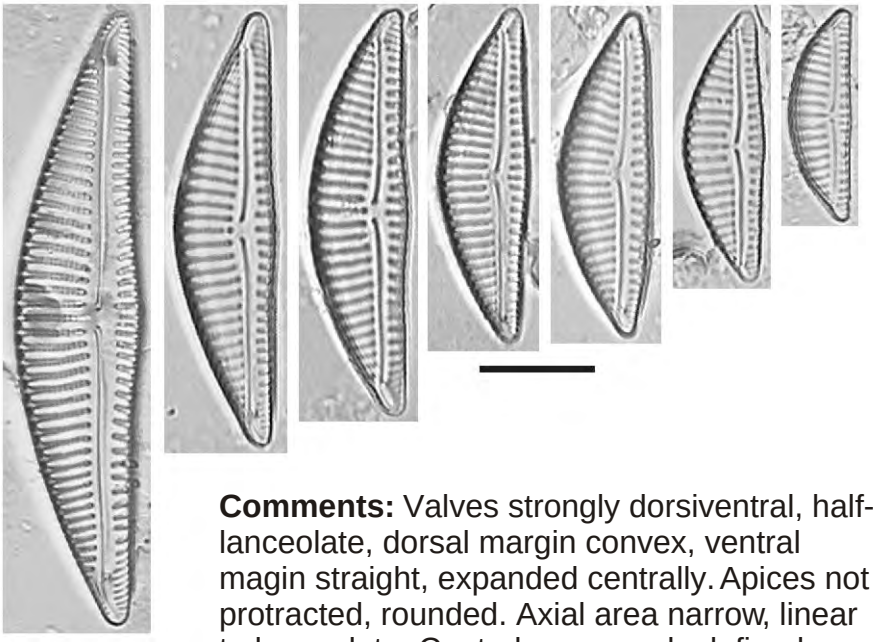


Dimensions:
Valve length = 15-46 µm
Valve breadth = 6.5-14.2 µm
Striae density = 10.5-15 (14-20 near apices) /10 µm
Comments:
Valves strongly dorsiventral, half-elliptical to half-lanceolate, dorsal margin convex, ventral straight with a slight central expansion. Apices not protracted, rounded. Axial area narrow, linear, central area lanceolate, asymmetrical, commonly larger on the dorsal side. Raphe lateral, bowed. Proximal endings small, rounded and slightly deflected dorsally. Distal endings curved, dorsally deflected.
Ecology: A cosmopolitan species found in standing and flowing oligo- to eutrophic waters and may tolerate strongly polluted conditions.

***Encyonema mesianum* (Cholnoky) DG Mann**
Syn. *Cymbella mesiana* Cholnoky



Iconotype
Cholnoky (1955b)



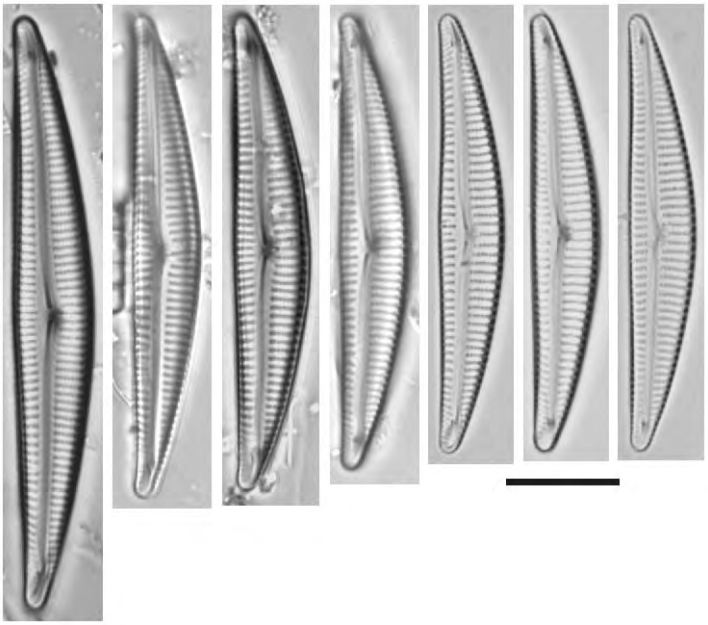
Dimensions:
Valve length = (19)30-70 µm
Valve breadth = 9-14 µm
Striae density = 7-9(11) (15-18 near the apices) /10 µm
Number of stigmata = 1

Comments: Valves strongly dorsiventral, half-lanceolate, dorsal margin convex, ventral magin straight, expanded centrally. Apices not protracted, rounded. Axial area narrow, linear to lanceolate. Central area poorly defined. Raphe slightly lateral, proximal raphe endings small, dorsally deflected, polar (distal) raphe endings curved. Striae finely punctate. Striae radiate throughout.
Ecology: A cosmopolitan montane species found in weakly acidic waters.

BIRAPHIDEAE

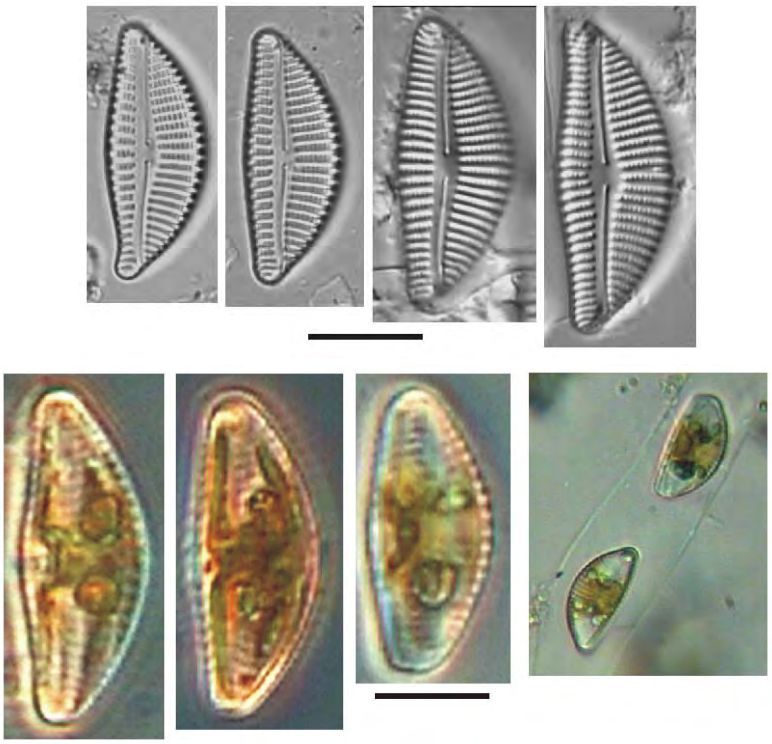
Taxa with a raphe on both valves
Strongly dorsiventral cells with ventrally deflected polar raphe endings

***Encyonema neogracile* Krammer**
Syn. *Cymbella gracilis* (Ehrenberg) Kützing pro parte



Dimensions:
Valve length = 22-57 µm
Valve breadth = 4.5-9 µm
Striae density = 4-14 (16-18 near apices) /10 µm
Comments: Valves strongly dorsiventral, lanceolate, dorsal margin convex, ventral margin weakly convex, often slightly expanded in the mid-region. Apices slightly protracted, sharply rounded. Axial area narrow, linear or broadening slightly towards the central area. Central area small, asymmetrical, larger on the dorsal side. Raphe lateral, proximal endings slightly enlarged and deflected dorsally. Distal endings comma-shaped, ventrally deflected.
Ecology: A cosmopolitan species found in oligotrophic, electrolyte-poor waters.

***Encyonema caespitosum* Kützing**
Syn. *Cymbella caespitosa* (Kützing) Brun



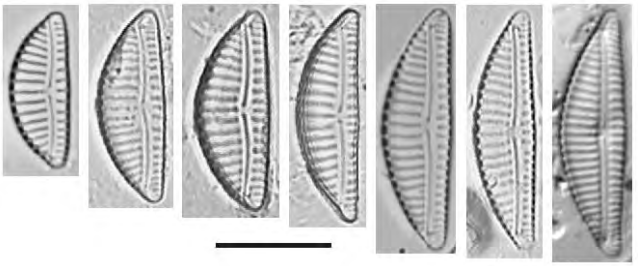
Dimensions:
Valve length = 18-58 µm
Valve breadth = 8-13 µm
Striae density = 9.5-12.5 (11-15 near apices) /10 µm
Comments: Valves strongly dorsiventral, half-elliptical to half-lanceolate, dorsal margin strongly convex, ventral margin weakly convex, often expanded in the mid-region. Apices broadly to sharply rounded, sometimes protracted then slightly ventrally deflected. Axial area narrow, linear. Central area small and rounded or a slight expansion mainly on the dorsal side of the valve. Raphe lateral, proximal endings small, rounded and deflected dorsally. Distal endings curved, dorsally deflected.
Ecology: A cosmopolitan species found in oligo- to eutrophic waters favouring those with a high electrolyte content. Tolerating critical levels of pollution. Cells found within a mucilage tube.

BIRAPHIDEAE

Taxa with a raphe on both valves

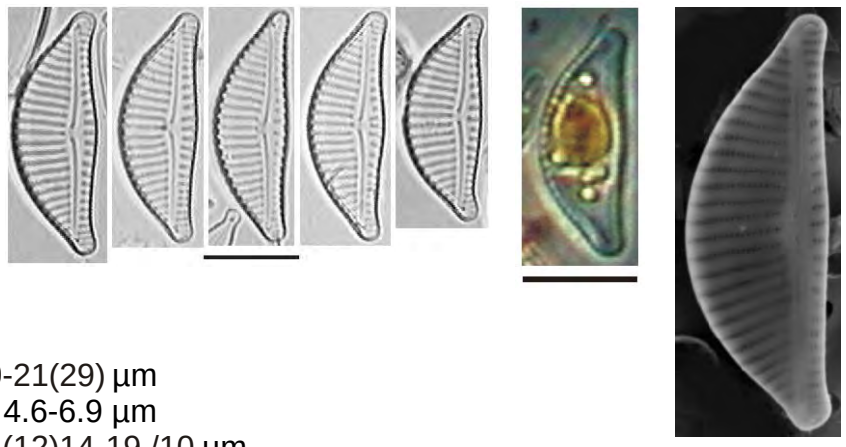
Strongly dorsiventral cells with ventrally deflected polar raphe endings

***Encyonema minutum* (Hilse) DG Mann**
Syn. *Cymbella minuta* Hilse



Dimensions:
Valve length = 7-32 µm
Valve breadth = 3.9-7 µm
Striae density = 10.5-15 (14-20 near apices) /10 µm
Comments: Valves strongly dorsiventral, half-elliptic to half-lanceolate, dorsal margin convex, ventral margin weakly convex, sometimes with a slight central swelling. Apices not protracted, bluntly to sharply rounded. Axial area narrow, linear, central area absent. Raphe filiform, curved. Proximal endings very small, rounded and deflected dorsally. Distal endings comma-shaped, ventrally deflected. Striae radiate throughout.
Ecology: A cosmopolitan species found in oligotrophic waters with moderate electrolyte content.

***Encyonema ventricosum* (Agardh) Grunow**
Syn. *Cymbella ventricosa* Agardh



Dimensions:
Valve length = 9-21(29) µm
Valve breadth = 4.6-6.9 µm
Striae density = (12)14-19 /10 µm
Comments: Valves strongly dorsiventral, semi-lanceolate, dorsal margin strongly convex, ventral margin weakly convex, slightly expanded in the central region. Apices protracted, subcapitate, rounded, ventrally deflected. Axial area in ventral region, narrow, linear. Central area absent. If asymmetrical commonly larger on the dorsal side. Raphe filiform, distal endings ventrally curved, proximal endings small, ill defined in LM and dorsally deflected.
Ecology: A cosmopolitan species found in alkaline well-oxygenated waters.

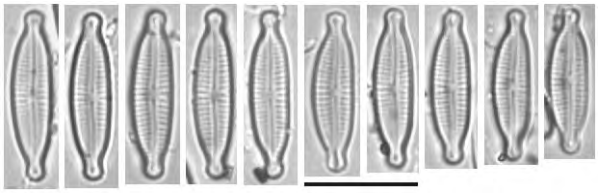
BIRAPHIDEAE

Taxa with a raphe on both valves

Weakly dorsiventral cells with ventrally deflected polar raphe endings

The taxa illustrated below were all previously considered to be part of Cymbella microcephala *s.l., for details see Krammer (1997)*

***Encyonopsis microcephala* (Grunow) Krammer**
Syn. *Cymbella microcephala* Grunow pro parte

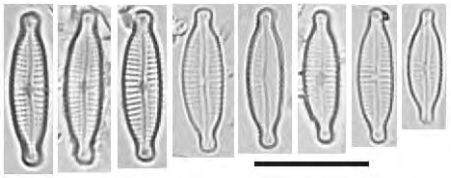


Dimensions:
Valve length = 10-23 µm
Valve breadth = 3.5-4.2 µm
Striae density = 23-24(25) /10 µm

Comments: Valves only slightly dorsiventral, dorsal margin convex, ventral margin straight or only slightly convex. Apices protracted, capitate. Axial area linear, narrow and slightly tapering towards the apices. Central area variable, usually very small and formed by the shortening of 1-3 dorsal transapical striae. Raphe slightly bowed, proximal raphe endings small and deflected dorsally, polar (distal) raphe endings unclear in LM, ventrally deflected. Puncta not discernable in LM.
Ecology: A cosmopolitan species found in calcareous waters with a moderate electrolyte content.

***Encyonopsis minuta* Krammer & Reichardt**
Syn. *Cymbella microcephala* Grunow pro parte

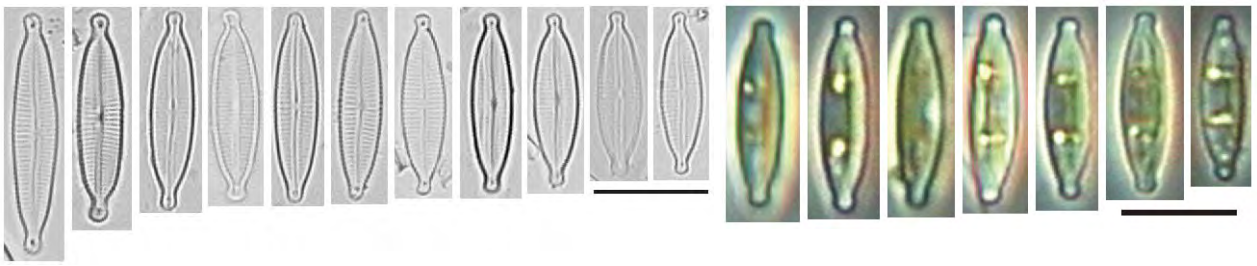
SEM

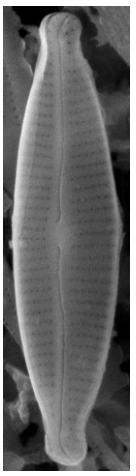


Dimensions:
Valve length = 8-17 µm
Valve breadth = 2.8-3.5 µm
Striae density = 24-25 /10 µm

Comments: Valves weakly dorsiventral, dorsal margin convex, ventral margin weakly convex. Apices protracted, capitate. Axial area narrow, linear. Central area absent. Raphe filiform, arched, proximal endings dorsally deflected. Transapical striae regular throughout the frustule, not shortened in the central region as in *E. microcephala*.
Ecology: Cosmopolitan, similar to *E. microcephala.* Requires an oxygen rich environment.

***Encyonopsis subminuta* Krammer & Riechart**
Syn. *Cymbella microcephala* Grunow pro parte





SEM

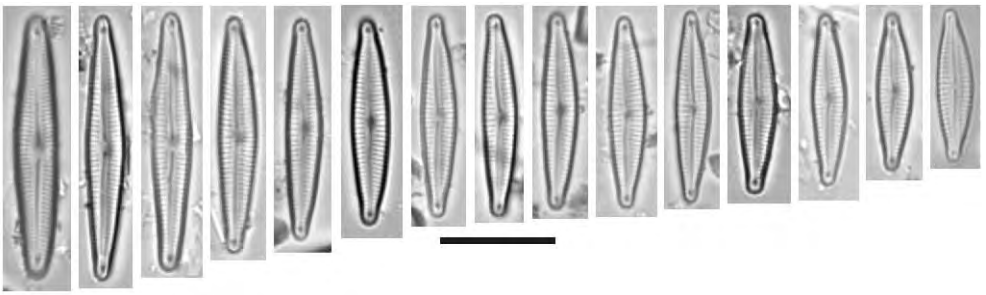
Dimensions:
Valve length = 10-25 µm
Valve breadth = 3.4-4.5 µm
Striae density = 23-26 /10 µm

Comments:
Valves only slightly dorsiventral, dorsal margin convex, ventral margin weakly convex. Apices protracted, narrow, capitate. Axial area narrow, linear. Central area absent. Raphe weakly filiform, proximal endings dorsally deflected, polar endings weakly ventrally deflected.
Ecology: Cosmopolitan, similar to *E. microcephala.* Requires an oxygen rich environment.

BIRAPHIDEAE

Taxa with a raphe on both valves
Weakly dorsiventral cells with ventrally deflected polar raphe endings

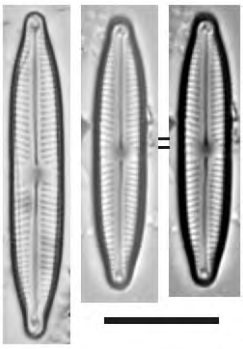
***Encyonopsis krammeri* Reichardt**
Syn. *Cymbella microcephala* Grunow pro parte



Dimensions:
Valve length = 11.5-23.5 µm
Valve breadth = 2.6-3.8 µm
Striae density = (27)28-30 (32) /10 µm

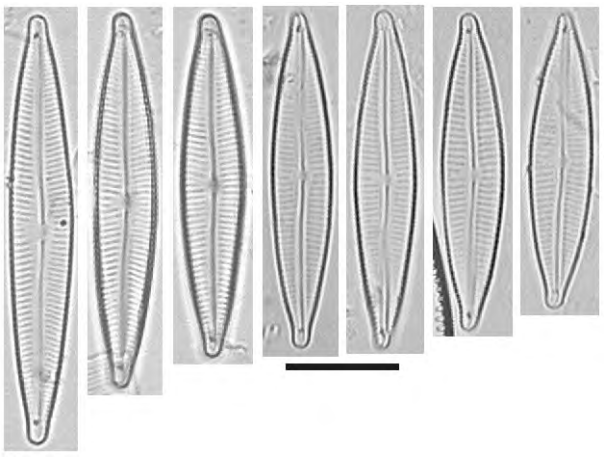
Comments: Valves weakly dorsiventral, both dorsal and ventral margin convex. Apices protracted, capitate, narrow rounded, slightly ventrally dflected. Axial area linear, narrow. Central area absent. Raphe weakly lateral, proximal and distal portions filiform. Polar (distal) raphe endings first dorsally then ventrally deflected. Striae weakly radial in the central region becoming strongly radial towards the apices.
Ecology: Found in oligotrophic, slightly acidic water with a low electrolyte content.

***Encyonopsis falaisensis* (Grunow) Krammer**
Syn. *Cymbella falaisensis* (Grunow) Krammer & Lange-Bertalot



Dimensions:
Valve length = 18-32 µm
Valve breadth = 3-7 µm
Striae density = 18-20 (21-23 near apices) /10 µm
Comments: Valves symmetrical, naviculoid, narrow linear-lanceolate. Ventral valve margin slightly more convex than the dorsal margin. Apices slightly protracted, rounded, sub-capitate. Axial area linear, central area widened, round or elliptical, often asymmetrical. Raphe slightly lateral, proximal endings slightly expanded, distal endings comma-shaped. Striae in central region radial, becoming parallel towards the apices.
Ecology: A cosmopolitan montane species found in oligotrophic, oxygen rich waters with low to moderate electrolyte content.

***Encyonopsis cesatii* (Rabenhorst) Krammer**
Syn. *Cymbella cesatii* (Rabenhorst) Grunow

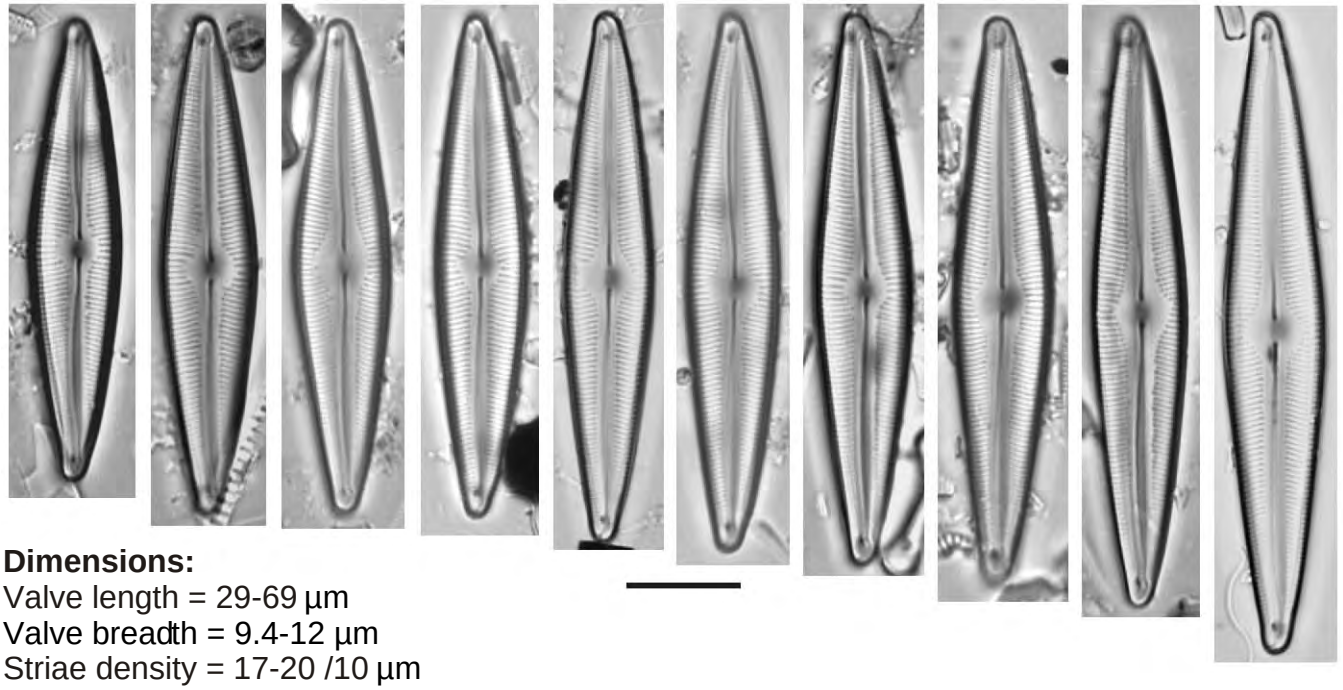


Dimensions:
Valve length = 18-60 µm
Valve breadth = 4-8 µm
Striae density = 18-22 (23-25 near apices) /10 µm
Comments: Valves weakly dorsiventral, linear-lanceolate. Apices weakly protracted, sharply rounded, weakly sub-capitate. Axial area linear, central area small, rounded, often asymmetrical. Raphe weakly lateral, proximal endings very small, polar endings comma-shaped. Striae radial throughout.
Ecology: A cosmopolitan montane species found in well oxygenated biotopes e.g. rock faces, mosses, springs and streams.

BIRAPHIDEAE

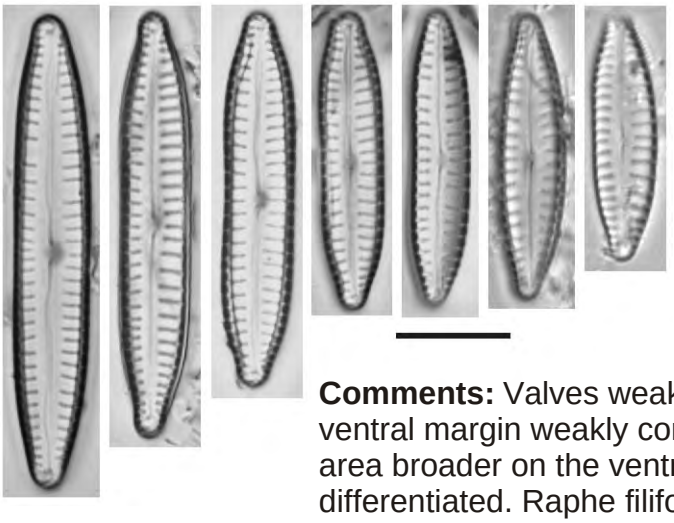
Taxa with a raphe on both valves
Weakly dorsiventral cells with ventrally deflected polar raphe endings

***Encyonopsis budelii* Krammer**

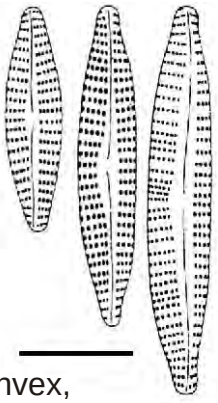


Dimensions:
Valve length = 29-69 µm
Valve breadth = 9.4-12 µm
Striae density = 17-20 /10 µm
Comments: Valves slightly dorsiventral. Large forms are rhombic-lanceolate, medium are lanceolate and the smaller forms are more linear with slightly convex dorsal and ventral margins. Apices are slightly protracted, weakly sub-rostrate and rounded. Axial area wide and lanceolate in larger specimens. Raphe weakly lateral, proximal endings slightly dorsally deflected, distal endings comma-shaped.
Ecology: Described from Golden Gate National Park, 2050m. Also found in oligotrophic, slightly acidic waters on the Mont-Aux-Sources Plateau (3000m).

***Encyonopsis raytonensis* (Cholnoky) Krammer**
Syn. *Cymbella raytonensis* Cholnoky



Dimensions:
Valve length = 20-35 µm
Valve breadth = 3.5-6 µm
Striae density = 10-11 /10 µm



Iconotype Cholnoky (1955b)

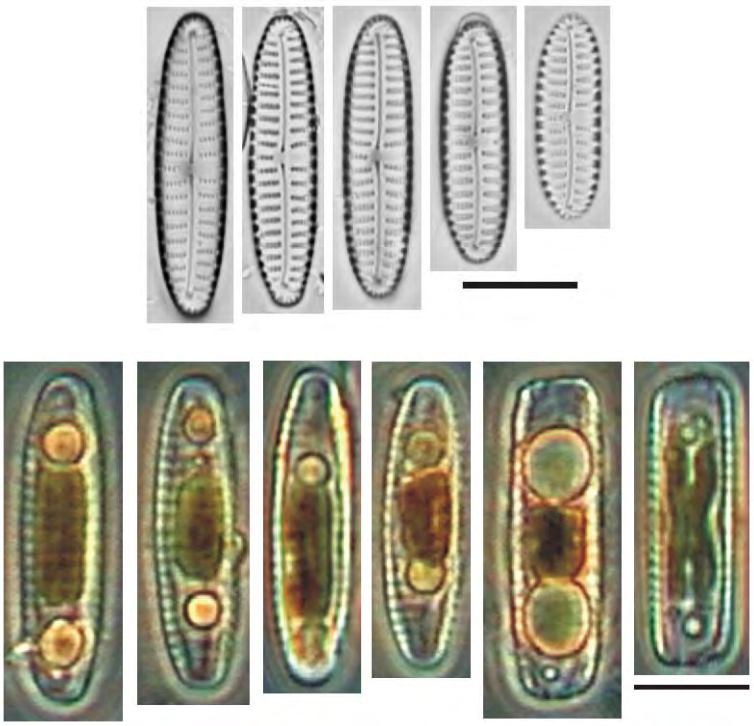
Comments: Valves weakly dorsiventral, dorsal margin convex, ventral margin weakly convex. Apices protracted, capitate. Axial area broader on the ventral side, lanceolate. Central area not clearly differentiated. Raphe filiform, arched, proximal endings dorsally deflected. Striae radiate in the central region, becoming convergent at the poles. Striae very clearly punctate, 30 /10 µm.
Ecology: This species has only been recorded from South Africa, found in acidic, well oxygenated waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Weakly dorsiventral cells with dorsally deflected polar raphe endings

***Encyonopsis leei* var. *sinensis* Metzeltin & Krammer**

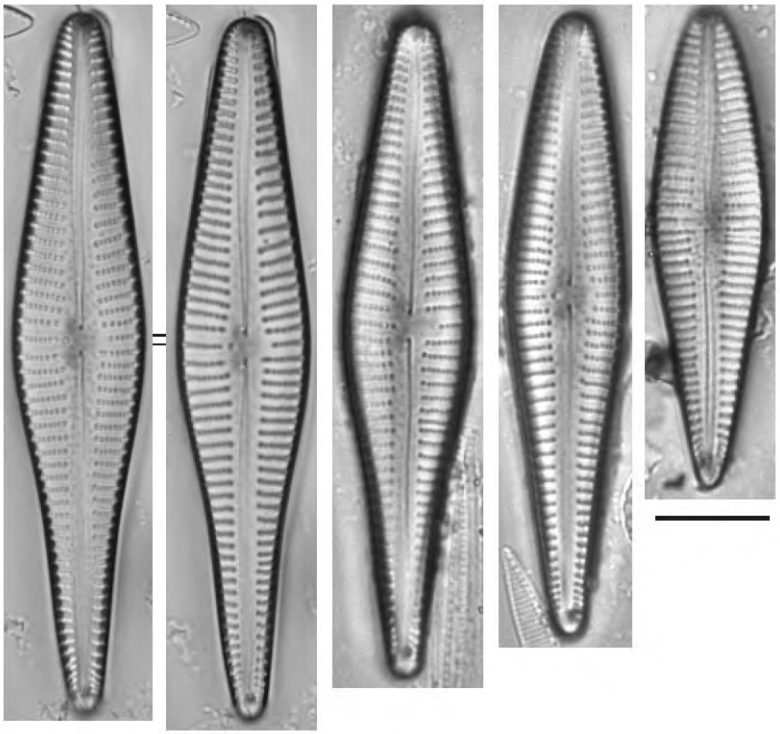


Dimensions:
Valve length = 20-44 µm
Valve breadth = 6-8.6 µm
Striae density = 9-10 (12 near apices) /10 µm
Comments: Valves nearly symmetrical, elliptical, dorsal and ventral margins convex. Apices not protracted, broadly rounded. Axial area narrow, linear. Central area small, formed by shortening, or lack of central ventral striae. Raphe filiform, arched, proximal endings small, rounded and deflected dorsally. Distal endings curved, ventrally deflected. Striae parallel in the mid-region becoming radiate towards the apices. Striae clearly punctate, 25-29 puncta /10 µm
Ecology: This taxon was described from a single site in China, but is known from numerous localities in South Africa. It occurs in slightly acidic, oligo- to mesotrophic waters with low to moderate electrolyte content.

BIRAPHIDEAE

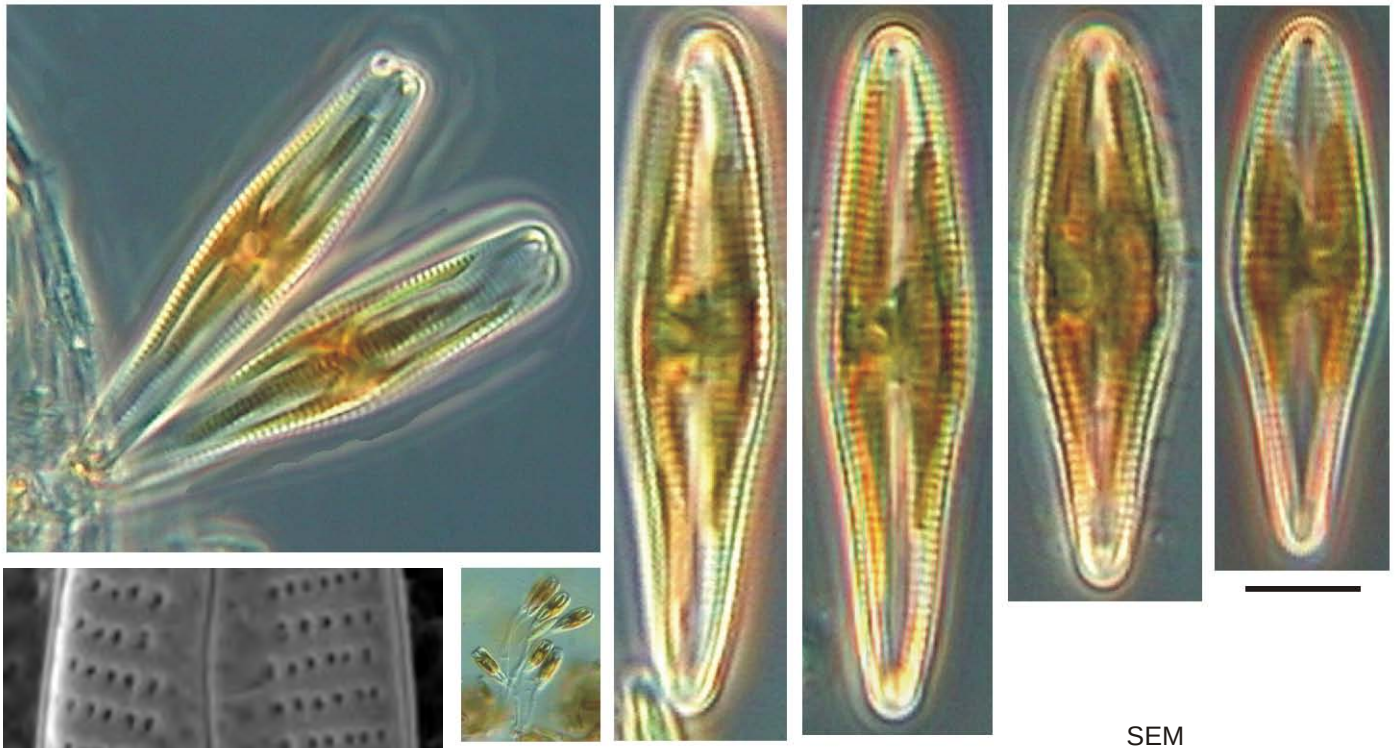
Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region



***Gomphonema affine* Kützing**

Dimensions:
Valve length = 36-88 µm
Valve breadth = 9-13.6 µm
Striae density = 8-11(12) /10 µm
Comments: Valves heteropolar, club-shaped with bluntly and sharply rounded apices, in girdle view broad and weakly cuneate (wedge-shaped). Characterised by depressions in the valve surface. Axial area linear narrowing slightly towards the apices. Central area small, formed by shortening of the central striae. Raphe lateral, proximal endings small and rounded, distal endings comma-shaped. Striae radial throughout, becoming strongly radial at the apices.
Ecology: A tropical/sub-tropical species tolerant of elevated electrolyte concentrations.



SEM

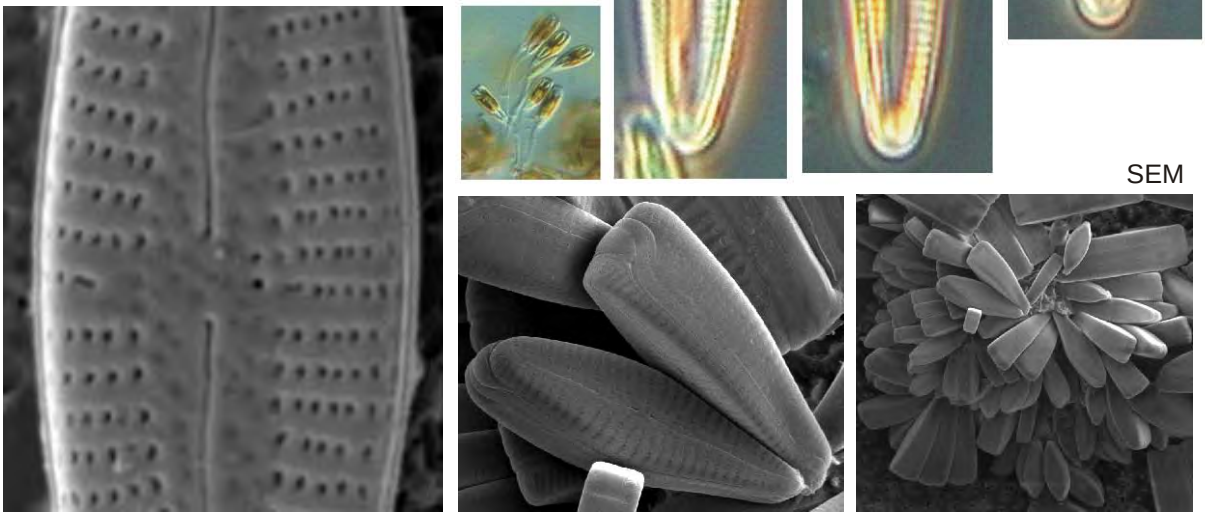


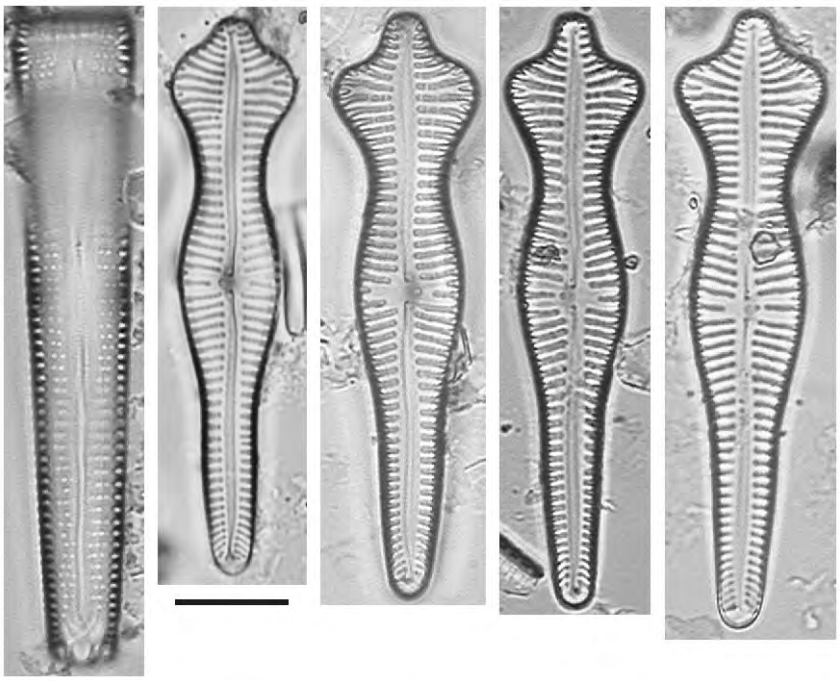
Plate 117

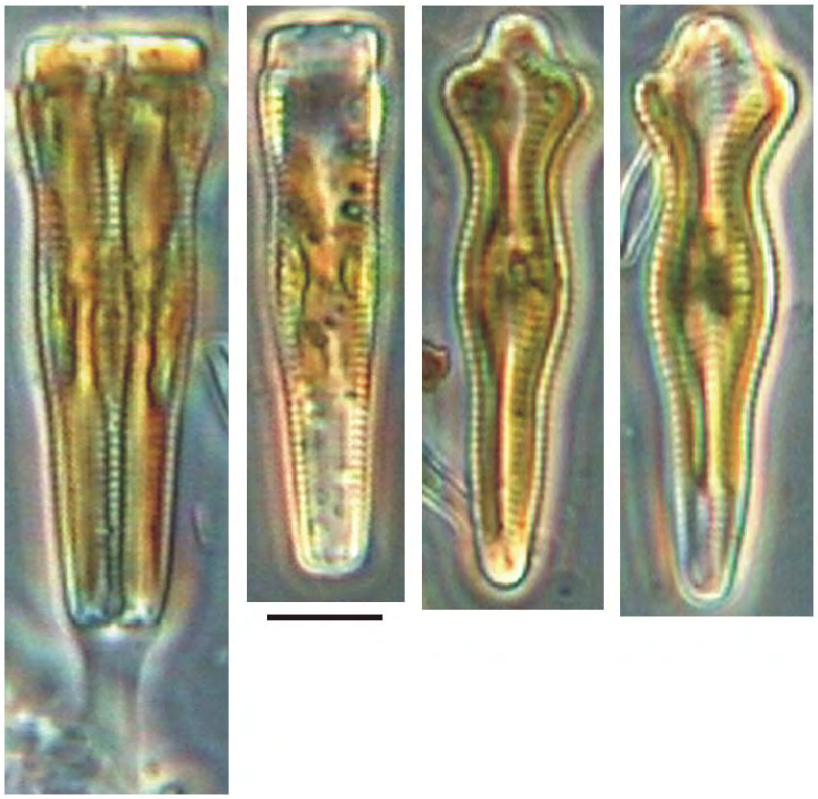
BIRAPHIDEAE

Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region

***Gomphonema acuminatum* Ehrenberg**



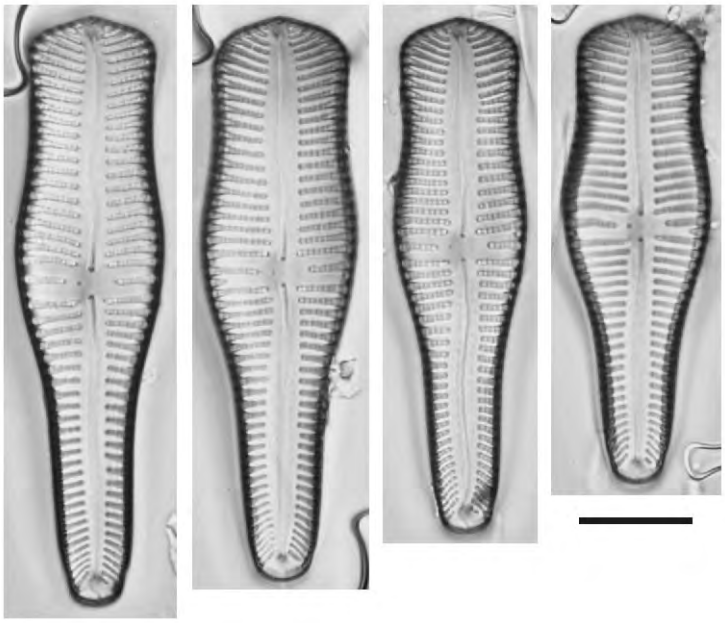


Dimensions:
Valve length = 17.5-57 µm
Valve breadth = 6.7-10.8 µm in the middle,
head pole 8-14 µm
Striae density = 9-11 /10 µm
Comments: Valves strongly heteropolar, easily distinguished by the characteristic valve outline, prominent expansion of the head pole, and a much narrowed basal pole. Valves in girdle view cuneate (wedge-shaped), girdle bands clearly punctate. Axial area linear narrowing slightly towards the apices. Central area very small, rounded and commonly asymmetrical. Raphe lateral, endings ill defined in LM.
Ecology: A cosmopolitan species found circumneutral to weakly alkaline waters. Tolerant of slight or moderate pollution. Attached to the substratum by a mucilage stalk.

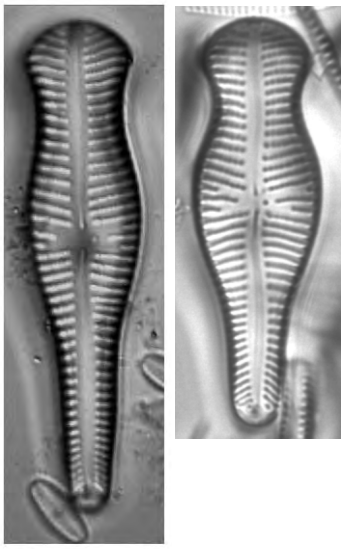
BIRAPHIDEAE

Taxa with a raphe on both valves
Heteropolar cells often with one or more stigmata in the central region

***Gomphonema truncatum* Ehrenberg**



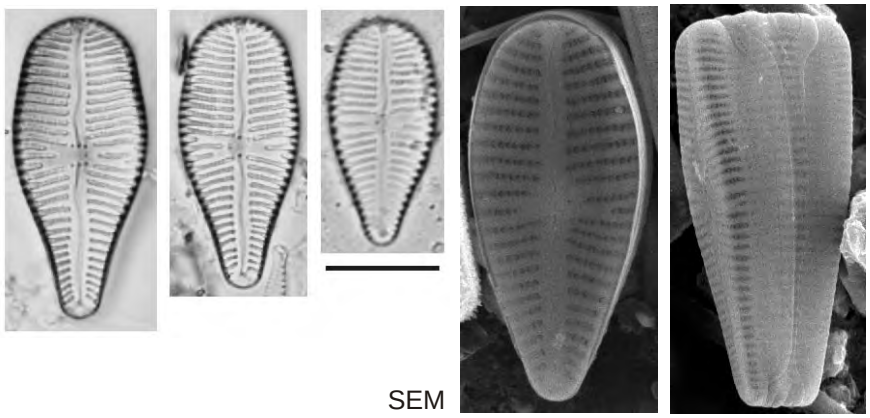
Dimensions:
Valve length = 17-48 µm
Valve breadth = 8.5-13.5 µm
Striae density = 10-15 /10 µm
Comments: Valves strongly heteropolar, easily distinguished by the charateristic valve outline, prominant expansion of the bluntly rounded head pole, and rounded foot pole. Valves in girdle view cuneate. Striae clearly punctate. Axial area linear narrowing slightly towards the apices. Central area very small, rounded. Raphe strongly lateral, proximal endings small, distal endings comma-shaped.
Ecology: A cosmopolitan species found in oligotrophic waters with elevated electrolyte content but not tolerant of more than moderate pollution.



***Gomphonema capitatum* Ehrenberg**
Syn. *Gomphonema truncatum* Ehrenberg pro parte

Dimensions:
Valve length = 18-55 µm
Valve breadth = 8.3-12.6 µm
Striae density = 9-13 (15 near poles) /10 µm
Comments: Valves more strongly constricted below the head pole than *G. truncatum* sensu stricto.
Ecology: Similar to *G. truncatum.*

***Gomphonema italicum* Kützing**
Syn. *Gomphonema truncatum* Ehrenberg pro parte



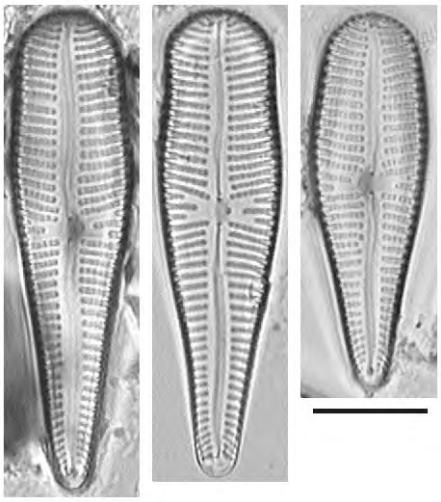
Dimensions:
Valve length = 19-53.5 µm
Valve breadth = 9.3-14 µm
Striae density = 10-16 /10 µm
Comments: Valves only very weakly constricted below the head pole than *G. truncatum* sensu stricto.
Ecology: Similar to *G. truncatum,* but also found in slightly eutrophic habitats.

BIRAPHIDEAE

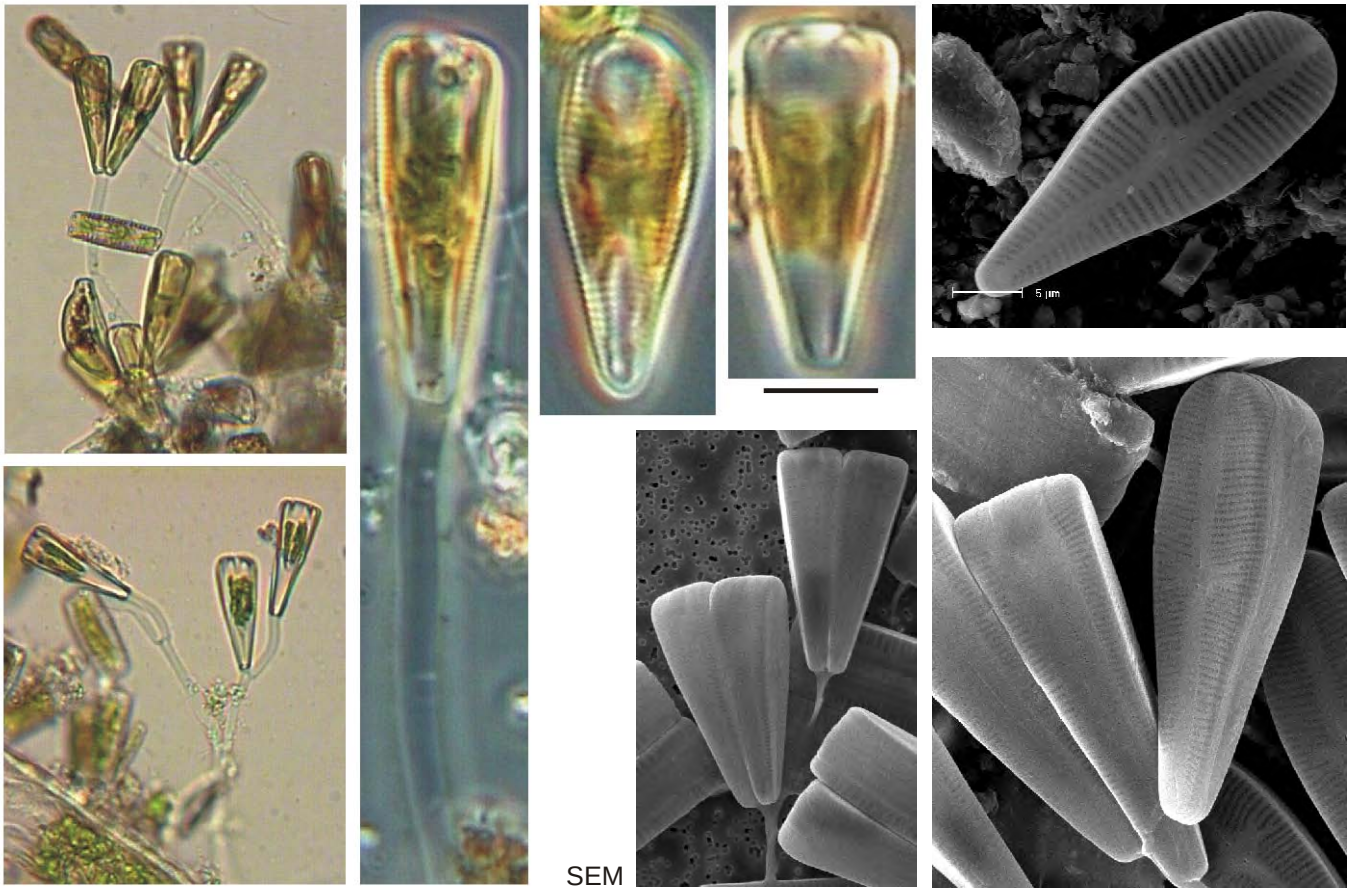
Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region

***Gomphonema laticollum* Reichart**
Syn. *Gomphonema truncatum* Ehrenberg pro parte



Dimensions:
Valve length = 26-57 µm
Valve breadth = 9.6-13.3 µm
Striae density = 10-12 /10 µm
Comments: Valves only slightly constricted below the head pole, but more elongate than *G. italicum.*
Ecology: A subcosmopolitan species, found in slightly eutrophic habitats. In common with the other species belonging to *G. truncatum* sensu lato, cells of *G. laticollum* are attached to substrata by dichotomous mucilage stalks.

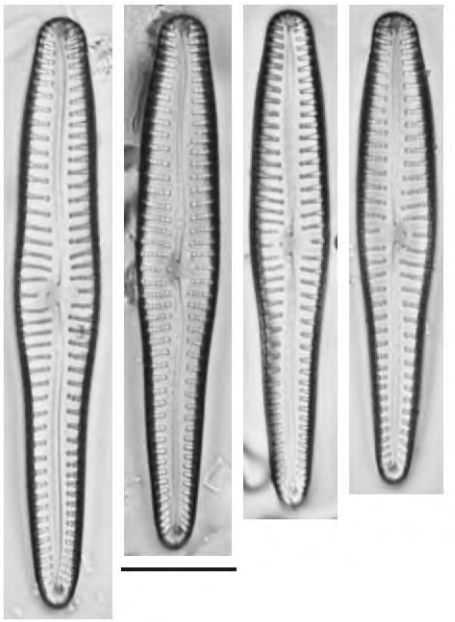


BIRAPHIDEAE

Taxa with a raphe on both valves

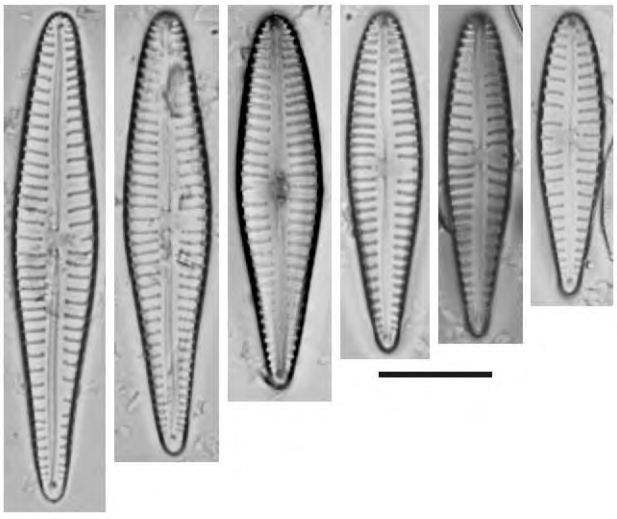
Heteropolar cells often with one or more stigmata in the central region

***Gomphonema clavatum* Ehrenberg**



Dimensions:
Valve length = 20-95 µm
Valve breadth = 6-14 µm
Striae density = 9-15 /10 µm
Comments: Valves heteropolar, cuneate in girdle view (wedge-shaped). Valve outline commonly tri-undulate. Head pole bluntly rounded, foot pole rounded. Axial area linear narrowing slightly towards the apices. Central area variable small, rhombic to rounded and commonly asymmetrical. Raphe lateral, proximal endings small and rounded, distal endings not clearly defined in LM.
Ecology: A cosmopolitan montane species found in oligotrophic waters but tolerating a high electrolyte content.

***Gomphonema insigne* Gregory**



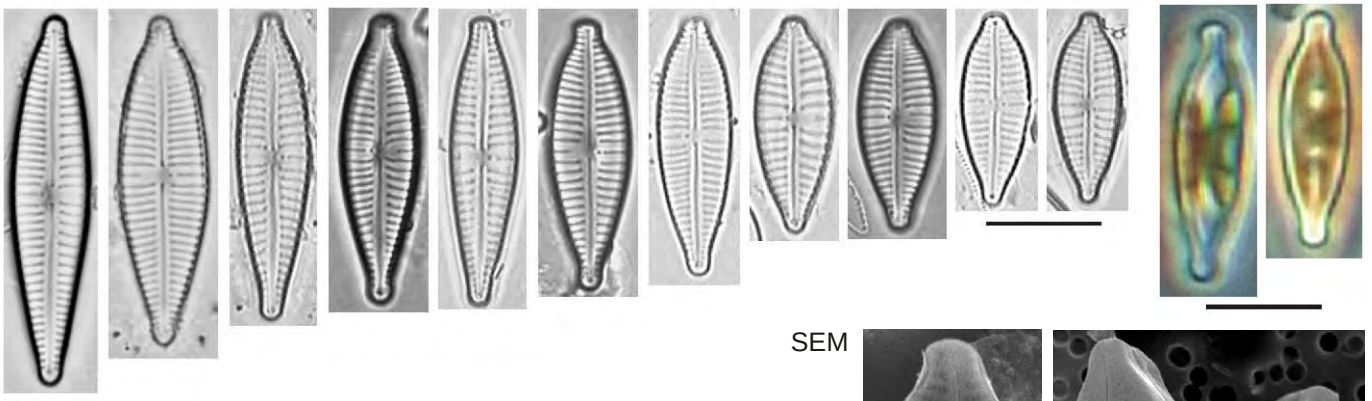
Dimensions:
Valve length = (20)29-84 µm
Valve breadth = (8.6)9-12.8 µm
Striae density = 6.5-10 /10 µm
Comments: Valves strongly heteropolar, laceolate. Head pole broadly rounded, foot pole sharply rounded. Axial area moderately broad, linear. Central area small, rounded, formed by the shortening of the central striae. Raphe lateral, proximal endings small and rounded, distal endings comma-shaped. Striae, parallel to radiate near the poles, density variable
Ecology: A cosmopolitan species found in electrolyte-rich waters.

BIRAPHIDEAE

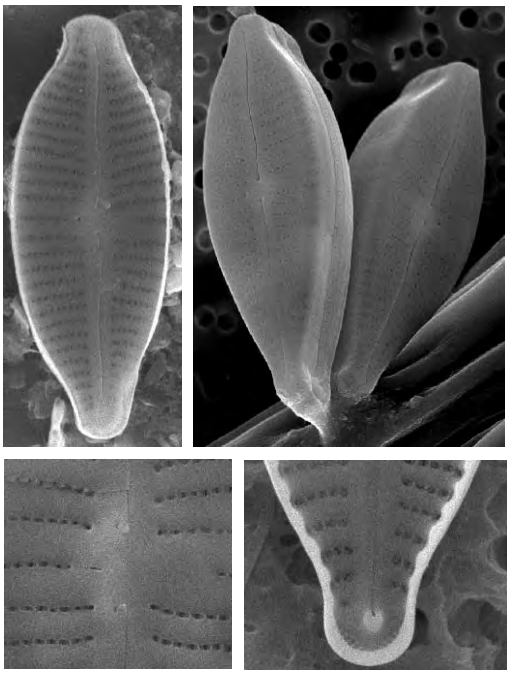
Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region

Gomphonema parvulum (Kützing) Kützing sensu stricto



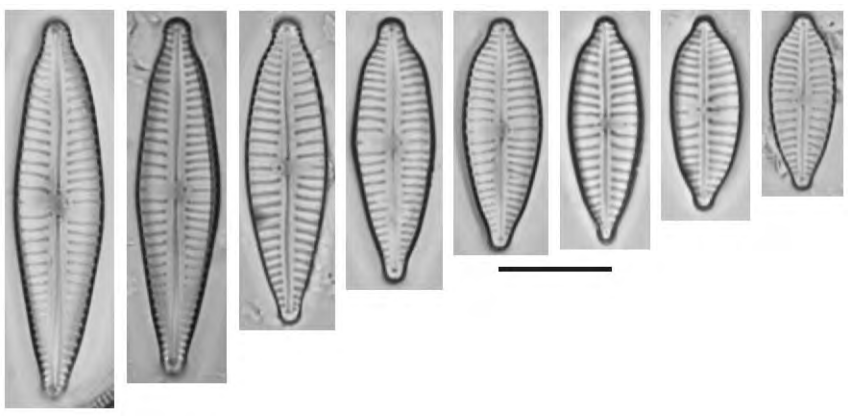
SEM



Dimensions:
Valve length = 10-36 µm
Valve breadth = 4-8 µm
Striae density = 7-20 /10 µm
Comments: Valves weakly heteropolar club-shaped, lancolate to elliptical to oval. In valve view weakly cuneate to rectangular. Apices protracted, weakly capitate. Axial area narrow, linear, central area small formed by the shortening of the central striae. Stigmata closely associated with the longer of the central striae. Raphe weakly lateral. Striae parallel to weakly radial, indistinctly punctate.
Ecology: A cosmopolitan species which is very widespread in a range of waters, from small pools to lakes and rivers and generally considered to be tolerant of extremely polluted conditions.

The following taxa, below and on the next plate, previously formed part of G. parvulum *s.s. However, because of both morphological and ecological differences these taxa have been split from the nominate variety and described either as species or forms.*

Gomphonema parvulum f. *saprophilum* Lange-Bertalot & Reichardt



Comments: Valves have slightly triundulate margins.
Ecology: Tolerant of extremely polluted conditions.

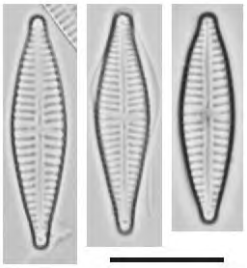
Plate 122

BIRAPHIDEAE

Taxa with a raphe on both valves

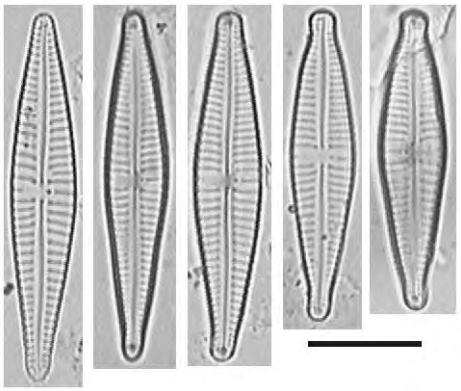
Heteropolar cells often with one or more stigmata in the central region

***Gomphonema parvulius* Lange-Bertalot & Reichardt**
Syn. *Gomphonema parvulum* var. *parvulius* Lange-Bertalot & Reichardt



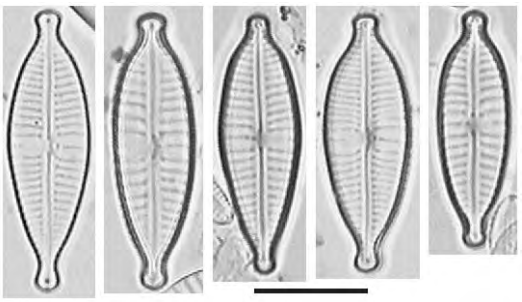
Comments: Valves lanceolate to rhombic-lanceolate with narrow rounded apices.
Ecology: Found in acidic, oliotrophic, electrolyte poor waters.

***Gomphonema exilissimum* Lange-Bertalot & Reichardt**
Syn. *Gomphonema parvulum* var. *exilissimum* Grunow



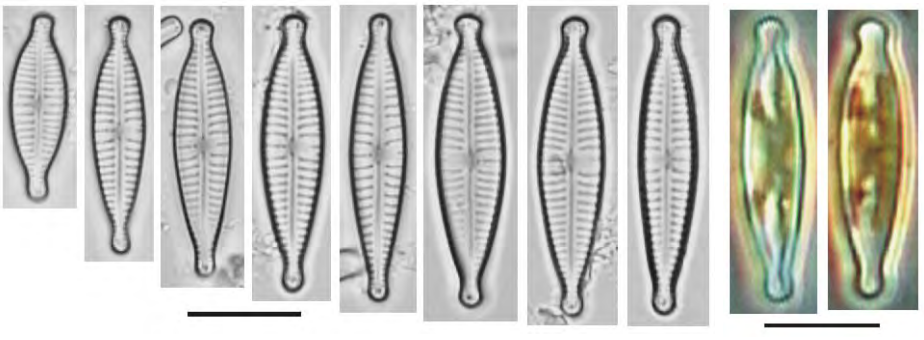
Comments: Valves lanceolate to rhombic-lanceolate with narrow rounded apices.
Ecology: Found in circumneutral, oliotrophic, electrolyte poor waters.

***Gomphonema lagenula* Kützing**
***Syn. Gomphonema parvulum* var. *lagenula* (Kützing) Frenguelli**



Comments: Valves broadly elliptical with strongly protracted capitate apices.
Ecology: A poorly delineated form, thus little is known of the ecology.

Gomphonema* aff. *lagenula



Comments: Valves narrow-lanceolate with strongly protracted capitate apices.
Ecology: Unknown.

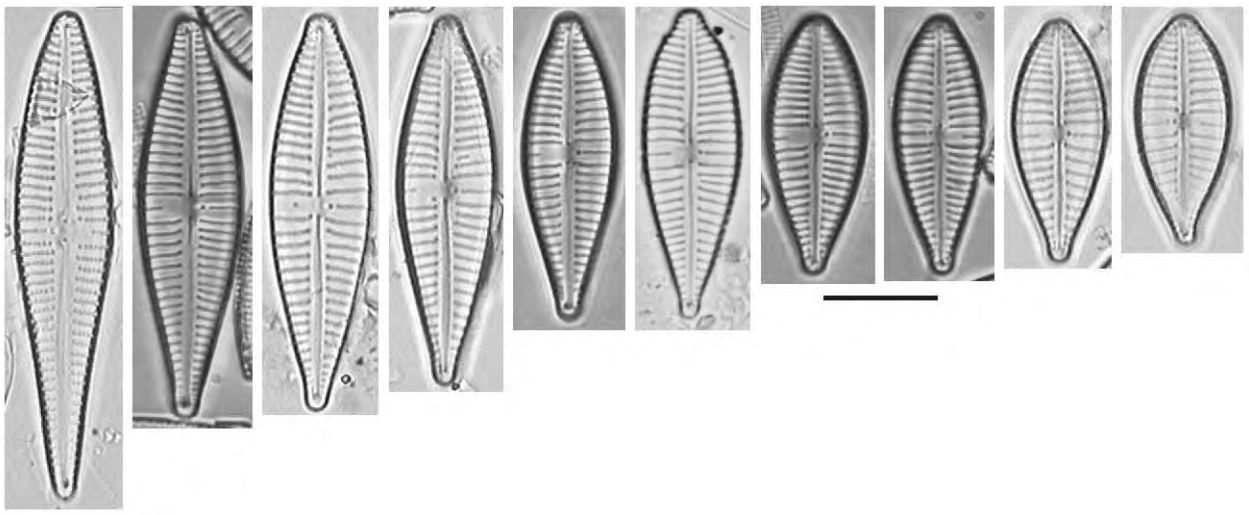
Plate 123

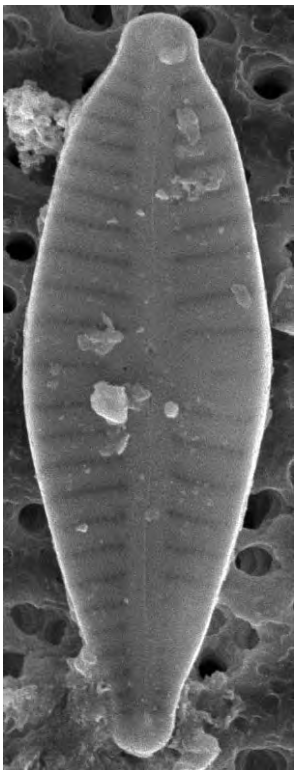
BIRAPHIDEAE

Taxa with a raphe on both valves

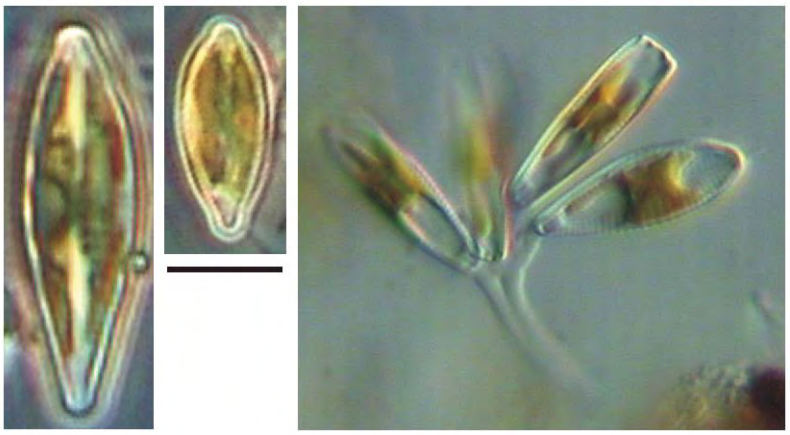
Heteropolar cells often with one or more stigmata in the central region

***Gomphonema pseudoaugur* Krammer**





SEM

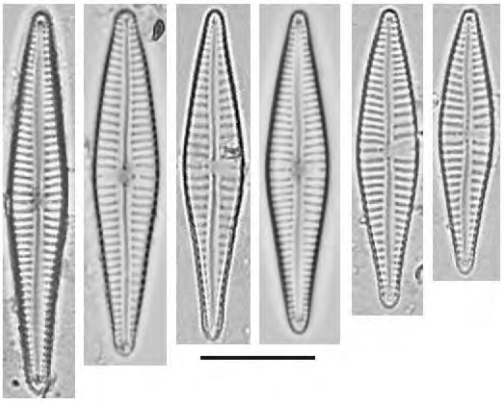


Dimensions:
Valve length = 25-55 µm
Valve breadth = 7-10 µm
Striae density = 9-12 /10 µm
Comments: Valves strongly heteropolar, oval to lancolate club-shaped. Weakly protracted, bluntly rounded head-pole, sharply rounded basal pole. Axial area narrow, linear, central area small formed by the shortening of the central striae. Stigmata closely associated with the longer of the central striae. Raphe weakly lateral. Striae weakly radial throughout, indistinctly punctate.
Ecology: A cosmopolitan species found in meso- to eutrophic waters but not tolerant of more than critical levels of pollution. Attached to the substratum by dichotomous mucilage stalks.

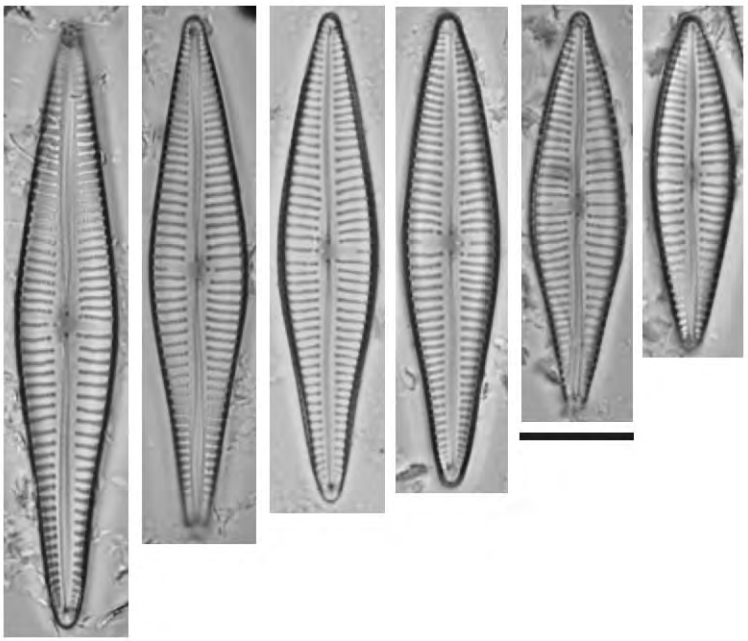
BIRAPHIDEAE

Taxa with a raphe on both valves
Heteropolar cells often with one or more stigmata in the central region

***Gomphonema gracile* Ehrenberg sensu stricto**



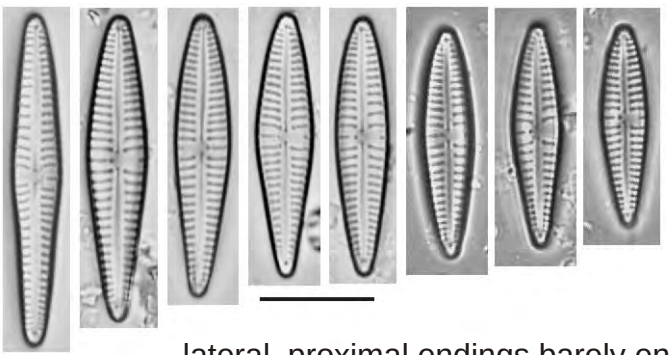
Dimensions:
Valve length = 20-30 µm
Valve breadth = 4-6 µm
Striae density = 9-17 /10 µm
Comments: Valves weakly heteropolar, clavate, lanceolate to rhombic lanceolate. Valves in girdle view narrow, weakly cuneate (wedge-shaped). Axial area linear narrowing slightly towards the apices. Central area rounded and commonly asymmetrical, formed by the shortening of the central striae. Raphe weakly lateral, endings ill defined in LM. Striae weakly radial throughout, indistinctly punctate.
Ecology: A cosmopolitan species and may be found in electrolyte rich waters but not tolerant to more than moderate levels of pollution.



Gomphonema* aff. *gracile

Dimensions:
Valve length = 29-54 µm
Valve breadth = 7.3-8.6 µm
Striae density = 10-12 /10 µm
Comments: Although morphologically simmilar to *G.. gracile* sensu stricto the cells are much larger and have distinctive slightly protracted, acutely rounded apices.
Ecology: This taxon is able to tolerate extremely polluted conditions and is found in abundance in mining effluent.

***Gomphonema angustatum* (Kützing) Rabenhorst**



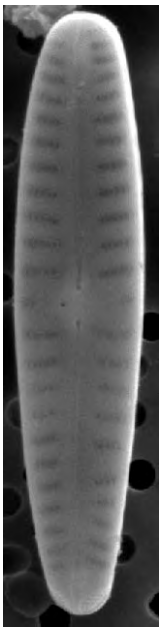
Dimensions:
Valve length = 16-48 µm
Valve breadth = 5.3-6.7 µm
Striae density = 10-14 /10 µm
Comments: Valves weakly heteropolar, narrow-lanceolate to rhombic-lanceolate. Valves in girdle view weakly cuneate to rectangular. Apices bluntly to sharply rounded. Axial area formed by shortening of the central striae. Raphe weakly lateral, proximal endings barely enlarged, distal endings difficult to discern in LM.
Ecology: A cosmopolitan species, but only common in oligotrophic waters. Found over a range of pH and electrolyte cencentrations, including calcium rich waters.

BIRAPHIDEAE

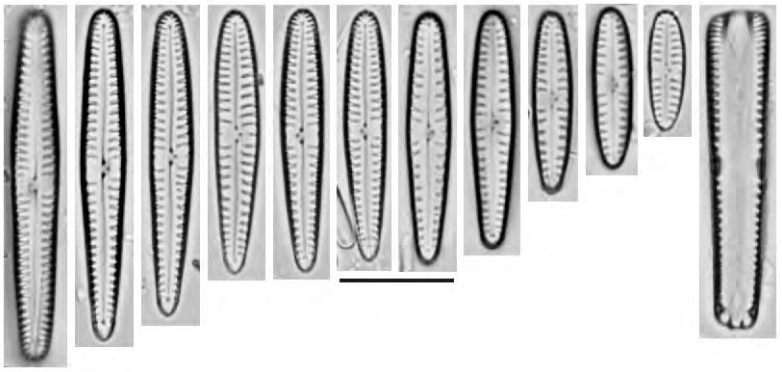
Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region

***Gomphonema pumilum* var. *rigidum* Reichardt & Lange-Bertalot**
***Syn. Gomphonema pumilum* (Grunow) Reichart & Lange-Bertalot pro parte**



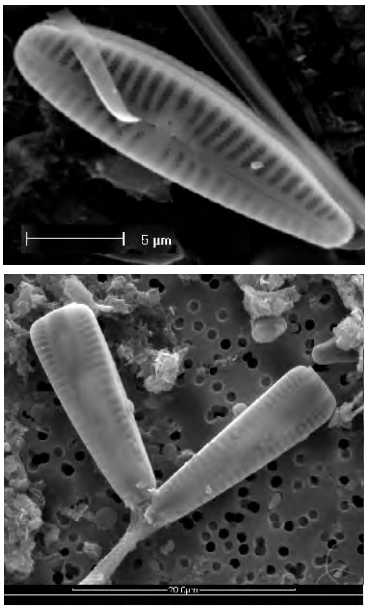
SEM



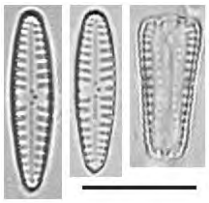
Dimensions:
Valve length = 12-36 µm
Valve breadth = (3)3.5-5.3 µm
Striae density = 9-12 /10 µm

Comments: Valves weakly heteropolar, linear to linear-lanceolate. Weakly clavate in girdle view. Apices not protracted, head pole bluntly rounded, foot pole sharply rounded. Axial area narrow linear, central area large, rectangular bordered by one shortened central stria on each side. Raphe weakly lateral, proximal endings rounded, distal endings not clearly distinguishable in LM. Striae radial to parallel, slightly curved in the central region. Distinguished from other varieties of *G. pumilum* by the valve outline.
Ecology: A cosmopolitan species found in meso- to eutrophic waters with moderate electrolyte content. Not tolerant of more than critical levels of pollution.

***Gomphonema minutum* (Agardh) Agardh**



SEM



Dimensions:
Valve length = 10-35 µm
Valve breadth = 4-8 µm
Striae density = 8-18 /10 µm

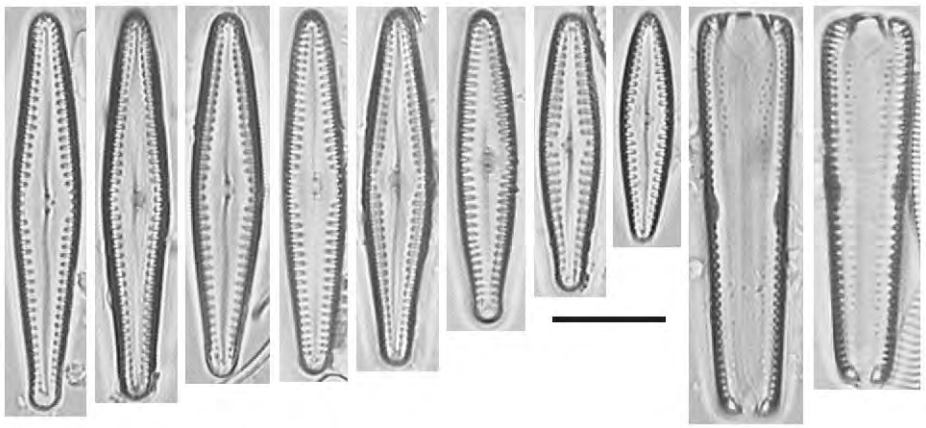
Comments: Valves weakly heteropolar, oval to lancolate club-shaped. In girdle view broadly clavate, with clearly punctate girdle bands. Apices not protracted, bluntly rounded head-pole, sharply rounded basal pole. Axial area very narrow, linear, central area relatively large, formed by the shortening of the central striae. Stigmata isolated from the striae. Raphe weakly lateral. Striae relatively broad, weakly radial to parallel. In SEM it can be seen that the striae are composed of two rows of puncta.
Ecology: A cosmopolitan species found in eutrophic waters but not tolerant to more than moderate levels of pollution. Attached to a substratum by dichotomous mucilage stalks.

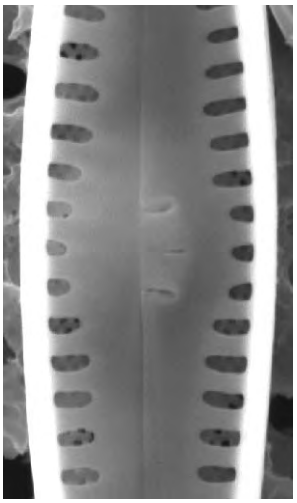
BIRAPHIDEAE

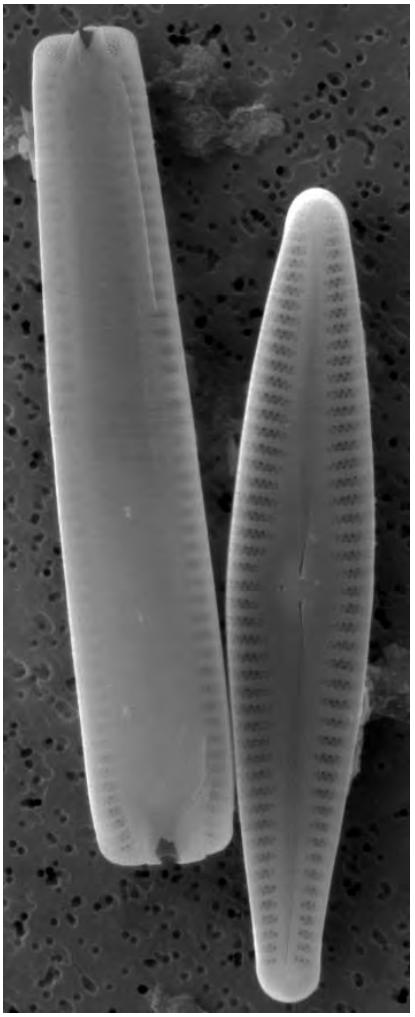
Taxa with a raphe on both valves

Heteropolar cells often with one or more stigmata in the central region

***Gomphonema venusta* Passy, Kociolek & Lowe**







SEM

Dimensions:
Valve length = (19)30-45 µm
Valve breadth = (4.6)5-7 µm
Striae density = 10-13 /10 µm

Comments: Valves weakly heteropolar, linear lanceolate, clavate. Head pole acutely to narrowly rounded, basal or foot pole rounded. The raphe is lateral, the proximal endings are enlarged and teardrop-shaped, the distal endings are curved in the opposite direction to the stigma, but are not clearly discernable in LM. The striae are shortened, forming a broad axial area. Central are not differentiated. The striae are radiate at the centre becoming parallel at the head pole and slightly radiate to parallel at the foot pole. The striae appear broad, being composed of two alternating rows of puncta. Both poles bear a pseudoseptum. The girdle bands or copulae bear well defined puncta near the head pole which become indistinct towards the foot pole. The single stigmata is small and round with a slit-like internal opening.

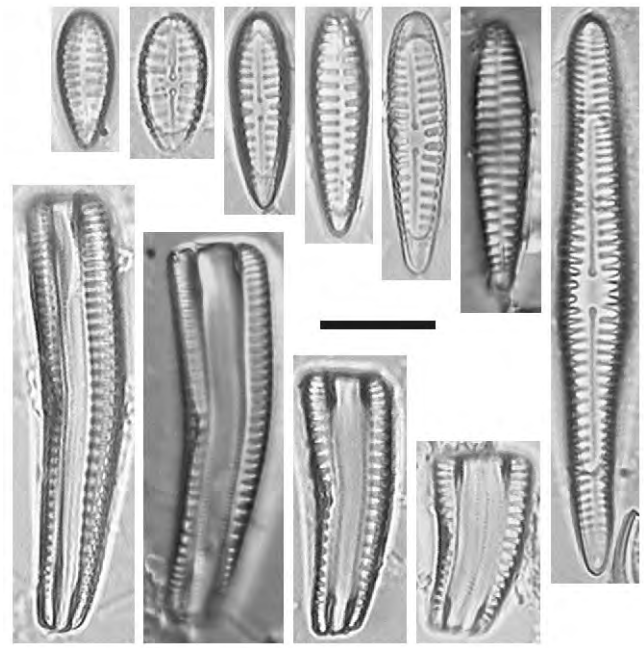
Ecology: This species was described from South Africa and occurs very commonly in the northern and central parts of the country. Found in circumneutral to weakly alkaline, oligo- to mesotrophic waters with a low to moderate electrolyte content.

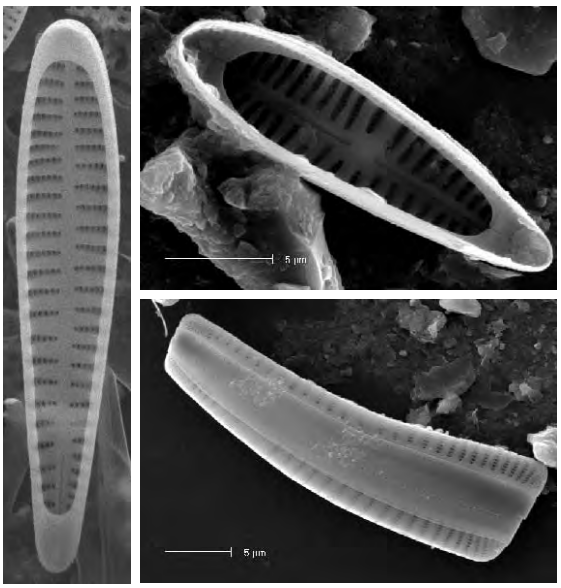
BIRAPHIDEAE

Taxa with a raphe on both valves

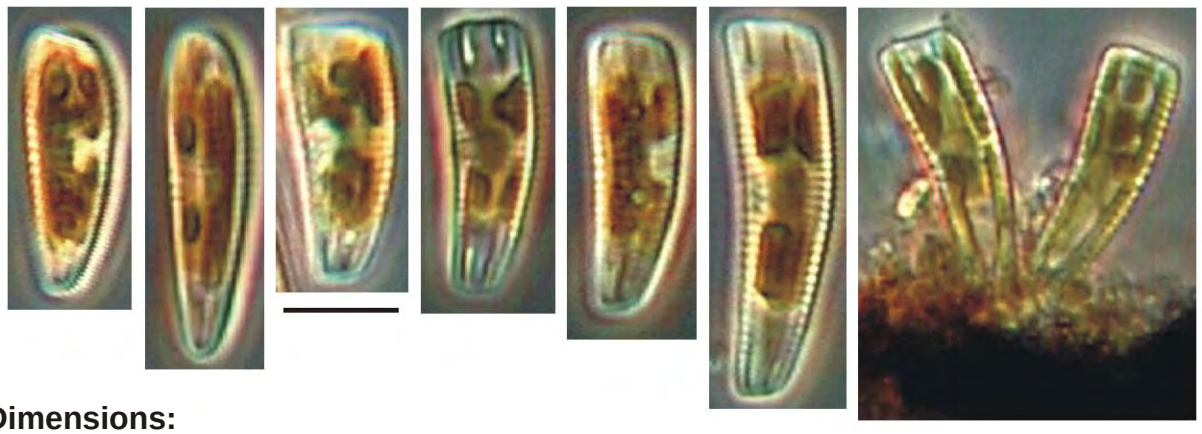
Heteropolar cells often with one or more stigmata in the central region

***Rhoicosphenia abbreviata* (Agardh) Lange-Bertalot**





SEM



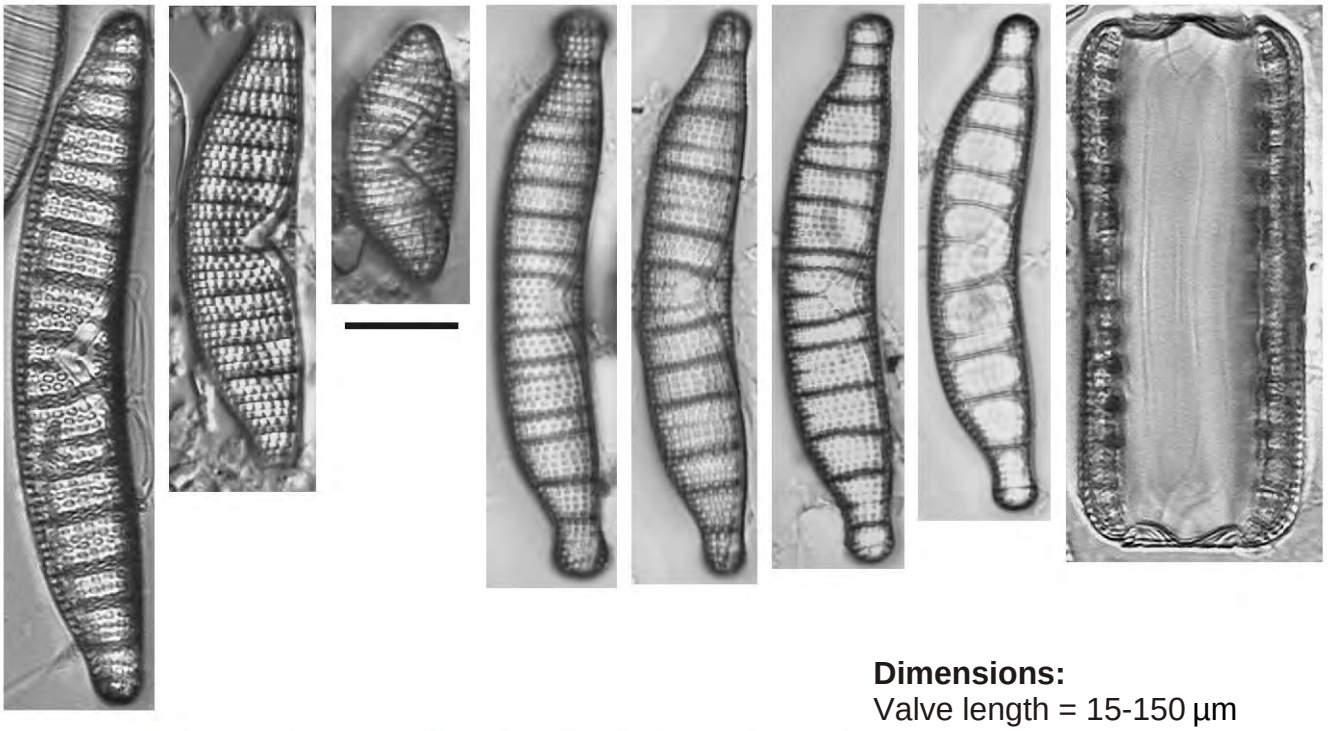
Dimensions:
Valve length = 10-75 µm
Valve breadth = 3-8 µm
Striae density = 15-20 /10 µm
Comments: Valves weakly heteropolar, linear lanceolate, clavate. Head pole bluntly rounded, basal or foot pole sharply rounded. Pseudospeta can clearly be seen, associated with each pole. In girdle view the frustule is club-shaped and flexed (bent). The raphe is filiform on the concave valve with well defined, large, rounded proximal endings. The axial area is very narrow, the central area is small, almost indistinguishable. The convex valve has clearly shortened raphe branches with indistinct proximal ends. The axial area is narrow and the central area absent. The striae are parallel throughout the valve.
Ecology: This species is found in electrolyte-rich as wellas in brackish inland waters and is tolerant of critical levels of pollution. The cells are attached to the substratum by mucilage stalks at the basal pole.

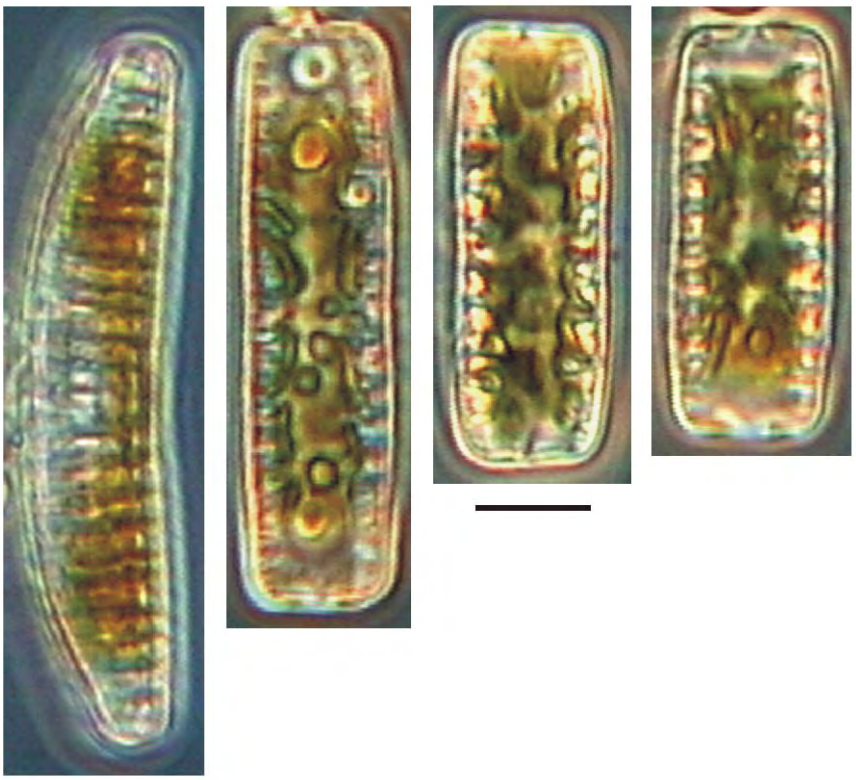
BIRAPHIDEAE

Taxa with a raphe on both valves

Cells dorsiventral with transapical costae and a v-shaped raphe system

***Epithemia adnata* (Kützing) Brébisson**





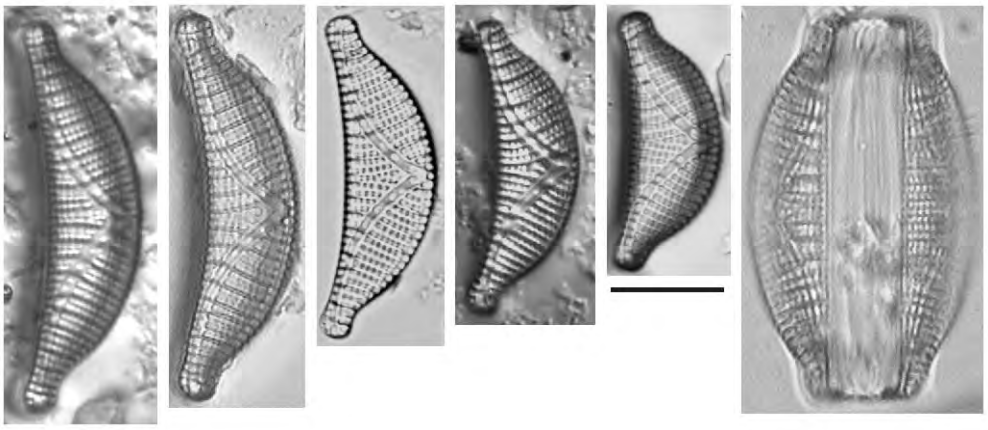
Dimensions:
Valve length = 15-150 µm
Valve breadth = 7-14 µm
Striae density = 11-14 /10 µm
Fibulae density = 2-8 /10 µm
Comments: Valves more or less dorsiventral, dorsal margin convex, straight in the middle. Ventral margin either straight or weakly concave. Apices braodly rounded, either not protracted or protracted, if protracted then capitate. Raphe branches curve from the poles inwards (biarcuate) towards the dorsal side and ending approximately in the centre of the valve. Raphe supported by fibulae.
Ecology: A cosmopolitan species found in both flowing and standing waters of moderate to high electrolyte content. Also extending into brackish biotopes. Tolerant to elevated water temperatures.

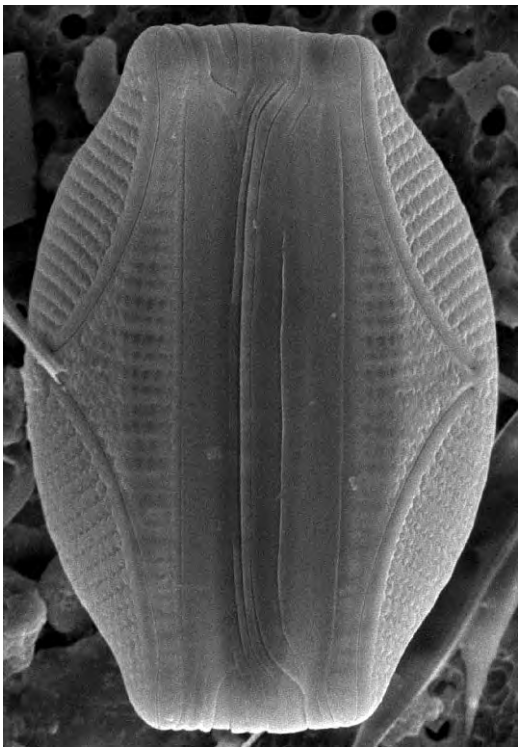
BIRAPHIDEAE

Taxa with a raphe on both valves

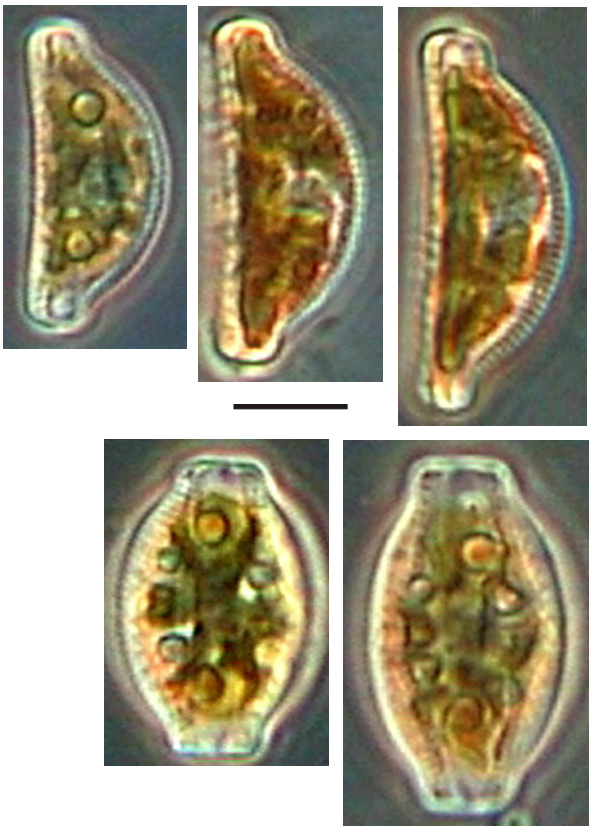
Cells dorsiventral with transapical costae and a v-shaped raphe system

***Epithemia sorex* Kützing**





SEM

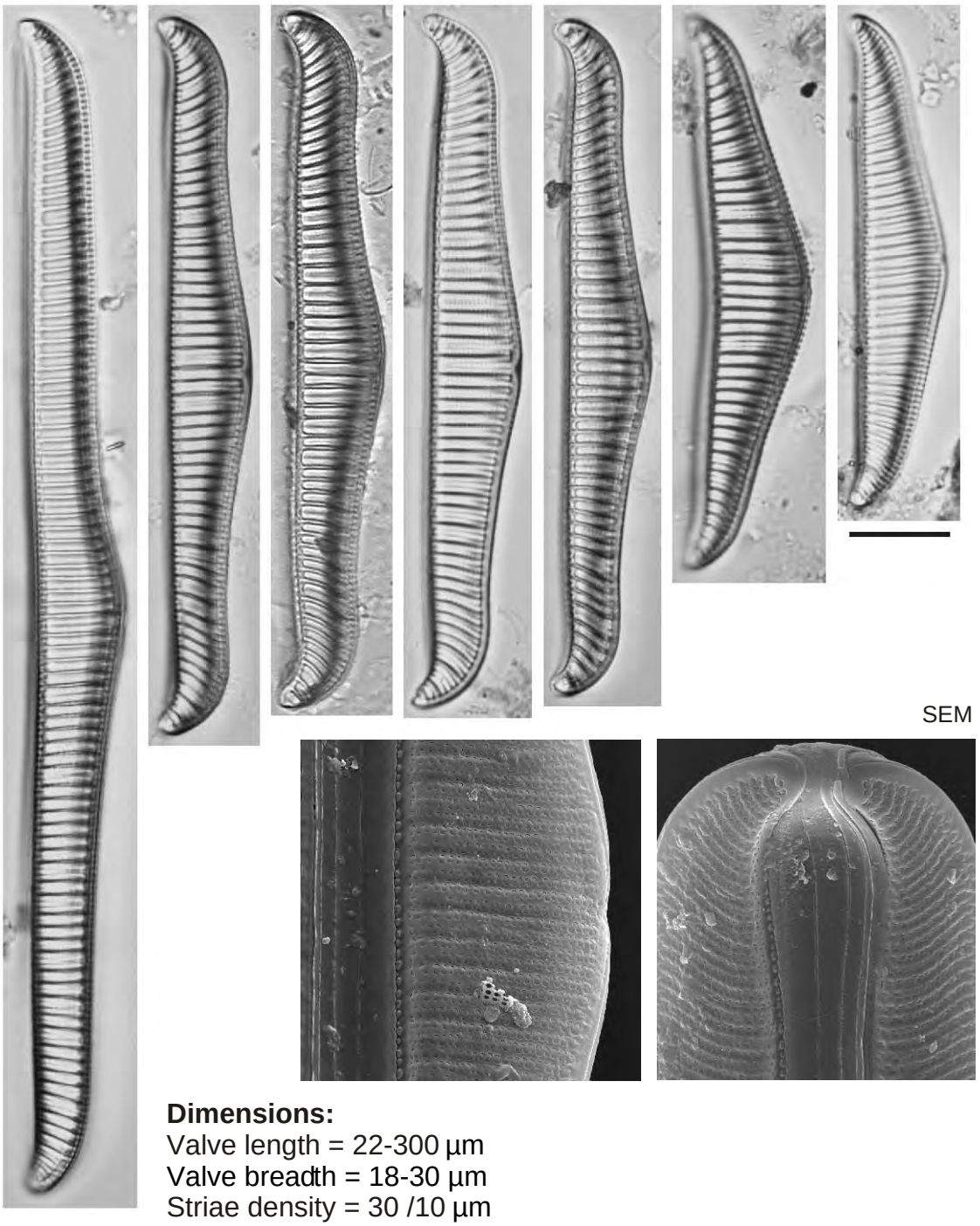


Dimensions:
Valve length = 8-70 µm
Valve breadth = 6.5-16 µm
Striae density = 10-15 /10 µm
Fibulae density = 5-7.5 /10 µm
Comments: Valves strongly dorsiventral, dorsal margin strongly convex, ventral margin weakly concave. Apices braodly rounded protracted, capitate. Raphe branches curve from the poles inwards (biarcuate) towards the dorsal side ending very close to the dorsal margin. Raphe supported by fibulae, round or oval holes known as portulae lie between the fibulae.
Ecology: A cosmopolitan species found in both flowing and standing waters of moderate to high electrolyte content. Also extending into brackish biotopes.

BIRAPHIDEAE

Taxa with a raphe on both valves
Cells dorsiventral with transapical costae

***Rhopalodia gibba* (Ehrenberg) O Müller**



SEM

Dimensions:
Valve length = 22-300 µm
Valve breadth = 18-30 µm
Striae density = 30 /10 µm
Fibulae density = 5-8 /10 µm
Costae density = 12-17 /10 µm

Comments: Valves strongly dorsiventral, talon or claw-like in shape, dorsal margin strongly convex with a slight but noticeable indentation in the middle, ventral margin more or less straight. Apices rounded ventrally deflected. Raphe branches follow the shape of the dorsal margin. Raphe supported by fibulae, round or oval holes known as portulae lie between the fibulae.
Ecology: A cosmopolitan species found in standing and slow flowing waters, especially springs, of moderate to high electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves
Cells dorsiventral with transapical costae

***Rhopalodia gibba* (Ehrenberg) O Müller**

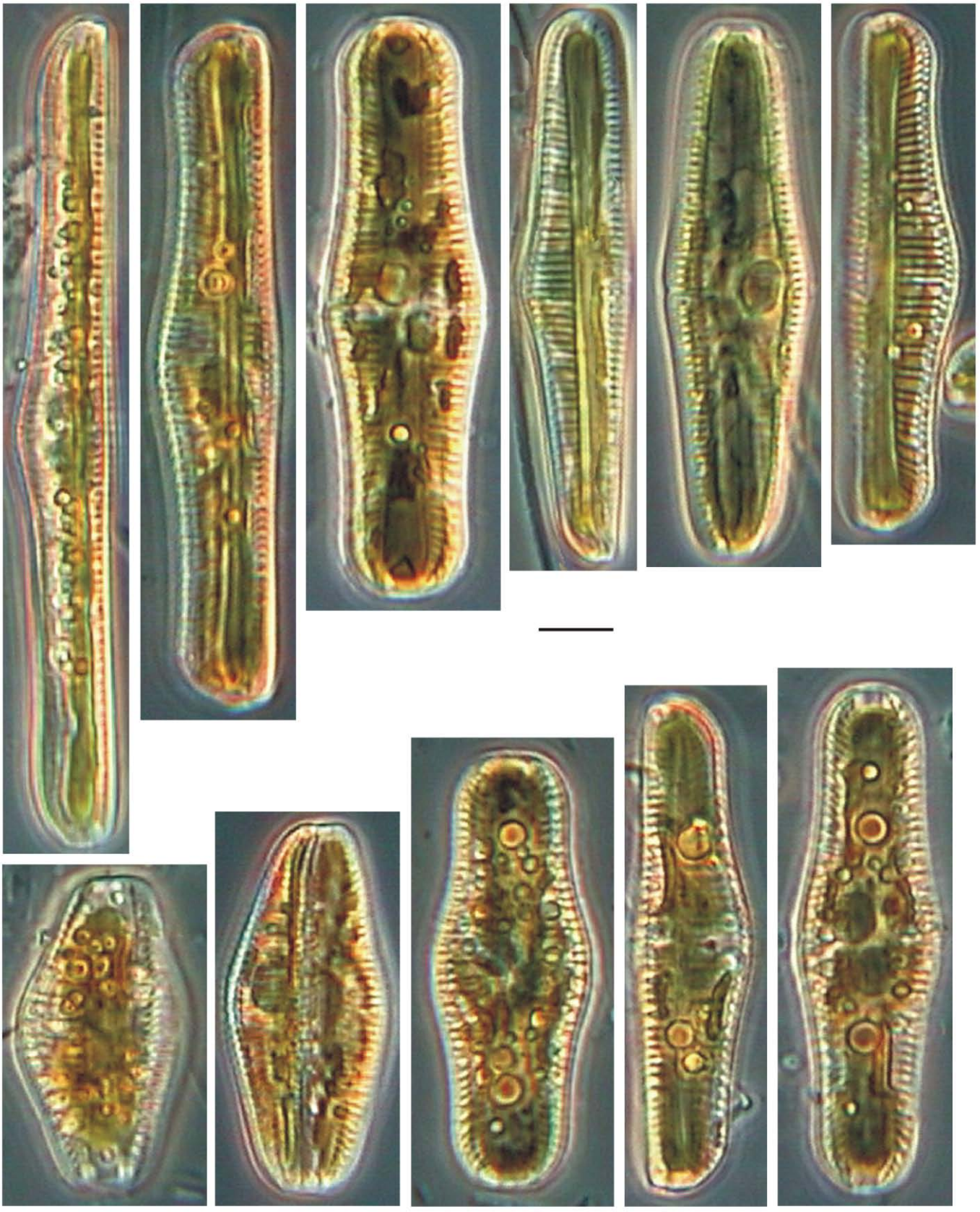


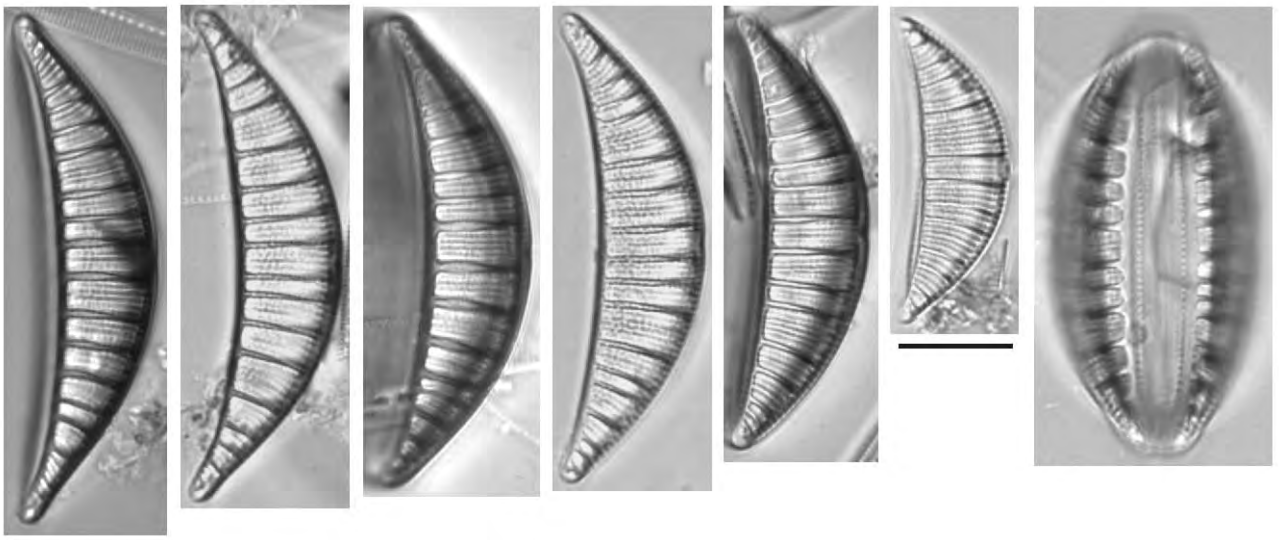
Plate 132

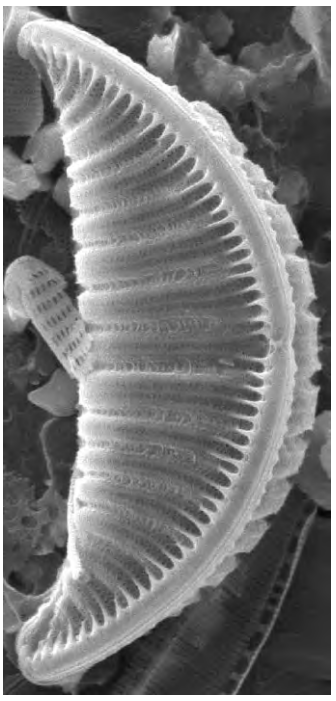
BIRAPHIDEAE

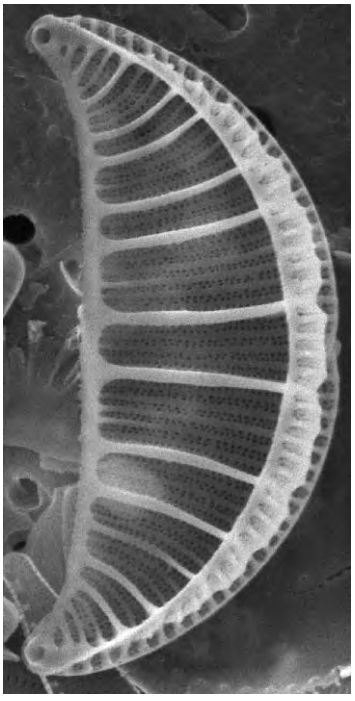
Taxa with a raphe on both valves

Cells dorsiventral with transapical costae

***Rhopalodia gibberula* (Ehrenberg) O Müller**







SEM

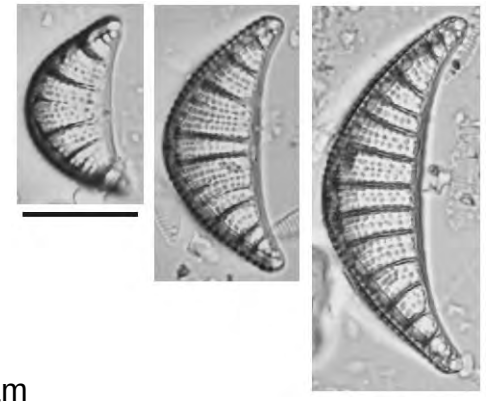
Dimensions:
Valve length = 25-100 µm
Valve breadth = 5-12 µm
Striae density = 15-19 /10 µm
Fibulae density = 3-10 /10 µm
Costae density = 15-19 /10 µm
Comments: Valves strongly dorsiventral, dorsal margin strongly convex with a slight indentation in the middle, ventral margin convex or more or less straight. Apices slightly protracted, rounded and ventrally deflected. Raphe branches follow the shape of the dorsal margin, interrupted in the centre. Raphe supported by fibulae.
Ecology: A cosmopolitan species found in waters of moderate to high electrolyte content. Tolerant of elevated water temperatures.

BIRAPHIDEAE

Taxa with a raphe on both valves

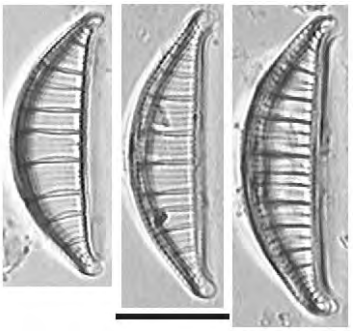
Cells dorsiventral with transapical costae

Rhopalodia musculus (Kützing) O Müller



Dimensions:
Valve length = 12-80 µm
Valve breadth = (7)10-16 µm
Striae density = 15-20 /10 µm
Fibulae/coastae density = 3-5 /10 µm
Comments: Valves strongly dorsiventral, sickle to half moon-shaped, dorsal margin strongly convex, ventral margin moderately to weakly concave. Apices sharply rounded, not protracted, ventrally deflected. Striae formed by 2-4 rows of areolae between the costae. Raphe branches follow the shape of the dorsal margin.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish waters.

Rhopalodia operculata (Agardh) Håkansson

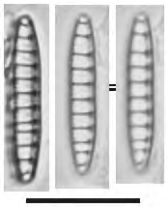


Dimensions:
Valve length = 18-52 µm
Valve breadth = 5-10 µm
Striae density = 16-18 /10 µm
Fibulae/costae density = 3-6 /10 µm
Comments: Valves strongly dorsiventral, dorsal margin strongly convex, ventral margin more or less straight. Apices protracted, capitate and ventrally deflected. Raphe supported by costae which act as fibulae beneath the raphe. 2-7 rows of striae between costae. Striae weakly punctate in LM.
Ecology: A cosmopolitan species found in waters of moderate to high electrolyte content. Also found in thermal mineral springs.

BIRAPHIDEAE

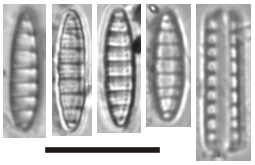
Taxa with a raphe on both valves
Cells with transapical fibulae extending from margin to margin

***Denticula subtilis* Grunow**



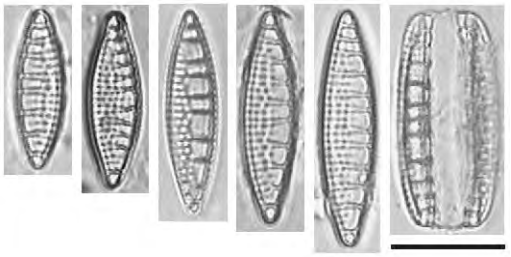
Dimensions:
Valve length = 7-20 µm
Valve breadth = 2-3 µm
Striae density = 28-30 /10 µm
Fibulae density = 6-10 /10 µm
Comments: Valves narrow linear-lanceolate, margins slightly convex, apices sharply rounded. The cells are characterised by the clearly visible fibulae, the striae are difficult to discern in LM.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish waters.

***Denticula sundayensis* Archibald**



Dimensions:
Valve length = (9.5)10.5-14.5 µm
Valve breadth = 2.3-3 µm
Striae density = 19-20 /10 µm
Fibulae density = 8-10 /10 µm
Comments: Similar to *D. subtilis* with the exception of lower striae density.
Ecology: A cosmopolitan species found in brackish waters.

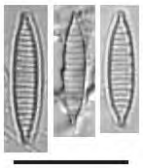
***Denticula kuetzingii* Grunow**

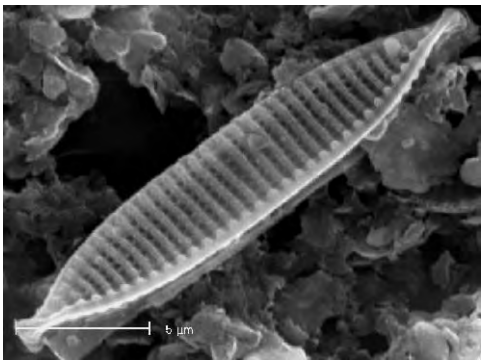


Dimensions:
Valve length = 10-120 µm
Valve breadth = 3-8 µm
Striae density = (13)14-18(20) /10 µm
Fibulae density = 5-8 /10 µm
Comments: Valves lanceolate, elliptic-lanceolate to linear-lanceolate, apices cuneate, sharply or bluntly rounded. Distinguished by clearly visible fibulae extending across the valve face and striae with clearly discernible puncta.
Ecology: A cosmopolitan species found in waters with moderate to high electrolyte content.

Cells with a canal raphe, but without fibulae

***Simonsenia delognei* Lange-Bertalot**
Syn. *Nitzschia chasei* Cholnoky





SEM

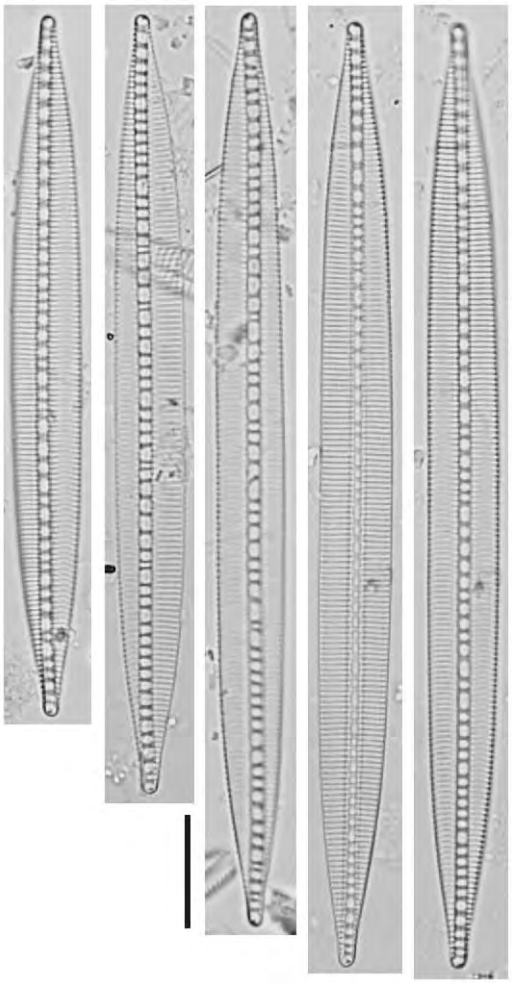
Dimensions:
Valve length = 7-15 µm
Valve breadth = 1.5-2 µm
Comments: Valves lanceolate to linear lanceolate with protracted acutely rounded rostrate apices. Distinguished by clearly discernible external transapical costae.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish waters. Also found in soils and is tolerant of osmotic fluctuations.

BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with a central (or nearly central) raphe system

***Bacillaria paradoxa* Gmelin**



Living material showing the two phases of colony locomotion, linear arrays (left) and tabular arrays (right top).

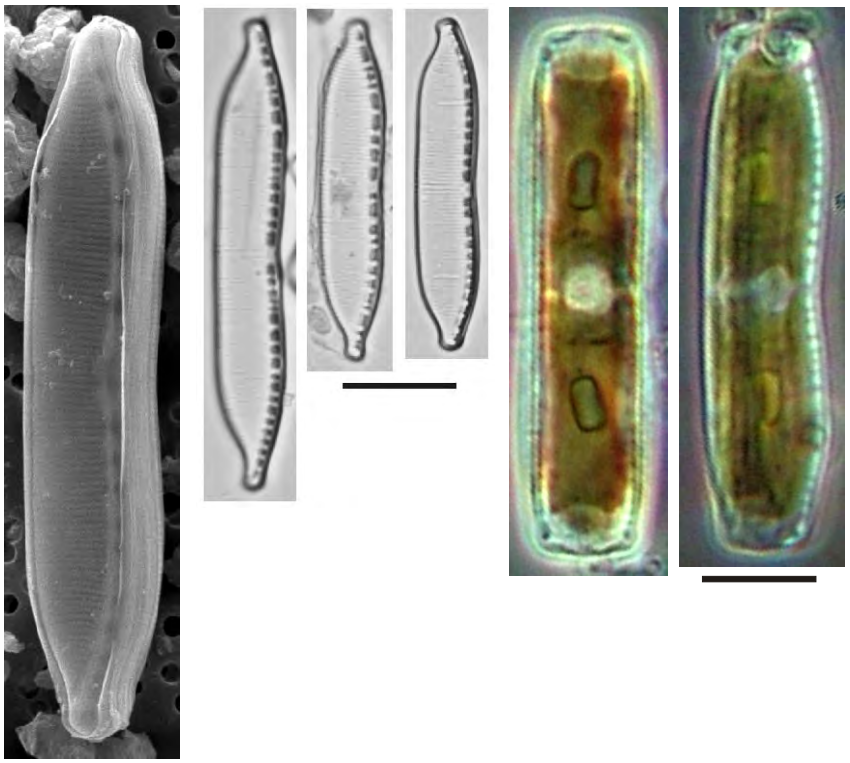
Dimensions:
Valve length = 60-150 µm
Valve breadth = 4-8 µm
Striae density = 20-25 /10 µm
Fibulae density = 5-9 /10 µm
Comments: Valves linear to linear-lanceolate with narrow rostrate or capitate apices. Canal-raphe central or nearly central, supported by irregularly spaced fibulae. Striae regular, parallel throughout, sometimes appearing curved.
Ecology: A cosmopolitan species widespread in very electrolyte-rich and brackish waters particularly near the coast. The cells form a unique type of motile colony, in which individual cells slide to and fro with respect to each other. They are held together by interlocking grooves on the raphe-sterna. The colony extends to form a linear array, where only the poles of the cells are touching then retracts to form a tabular array, with all the cells side by side.

BIRAPHIDEAE

Taxa with a raphe on both valves

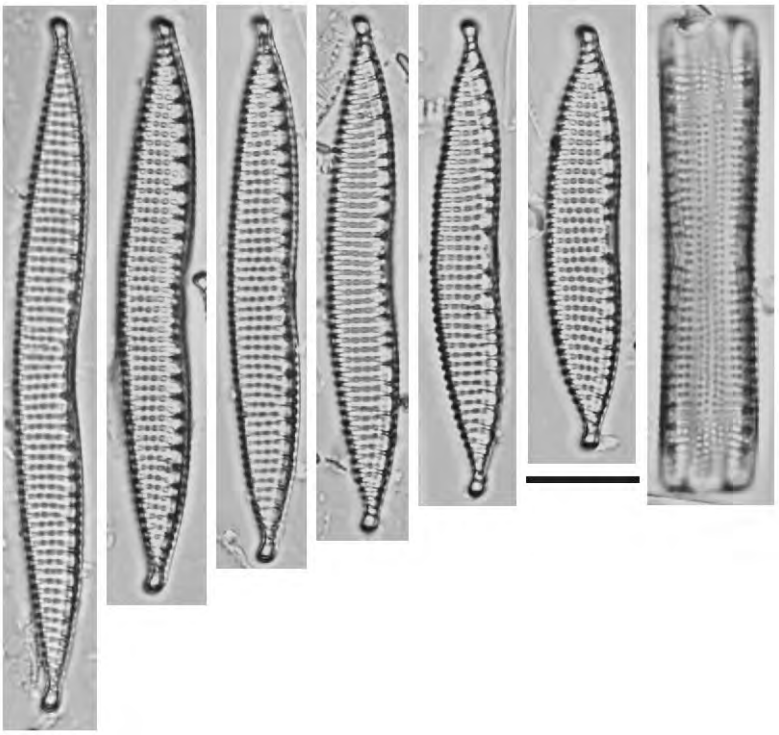
Dorsiventral cells, both raphes on the same side

Hantzschia amphioxys **(Ehrenberg) Grunow**



Dimensions:
Valve length = 20-210(300) µm
Valve breadth = 5-15(25) µm
Striae density = 11-28 /10 µm
Fibulae density = 4-11 /10 µm
Comments: Valves dorsiventral, margins linear, concave in the middle. Apices protracted, rostrate. Striae slightly radial. The short, irregularly shaped fibulae are interrupted in the middle.
Ecology: A cosmopolitan species favouring periodically dry habitats, including soils and rock crevices. Widespread in a range of rivers, but probably washed in from soils.

Hantzschia distinctepunctata **Hustedt**



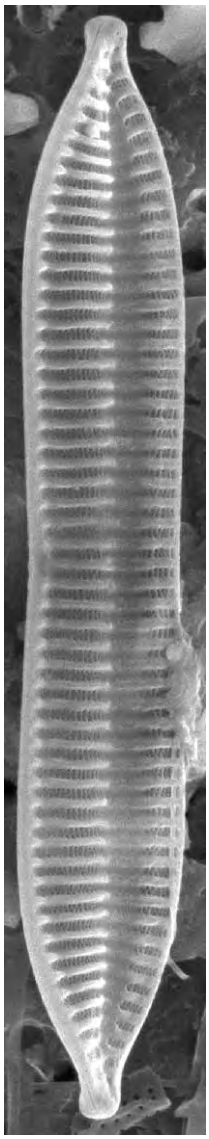
Dimensions:
Valve length = 40-85 µm
Valve breadth = 5-8.5 µm
Striae density = 8.5-18 /10 µm
Comments: Valves dorsiventral, lanceolate, valve margin bearing the raphe distinctly concave. Apices protracted, narrow-rostrate. As the name of the species would imply the transapical striae are composed of large, easily discernible puncta.
Ecology: A cosmopolitan species found in waters with a very high electrolyte content as well as in brackish waters.

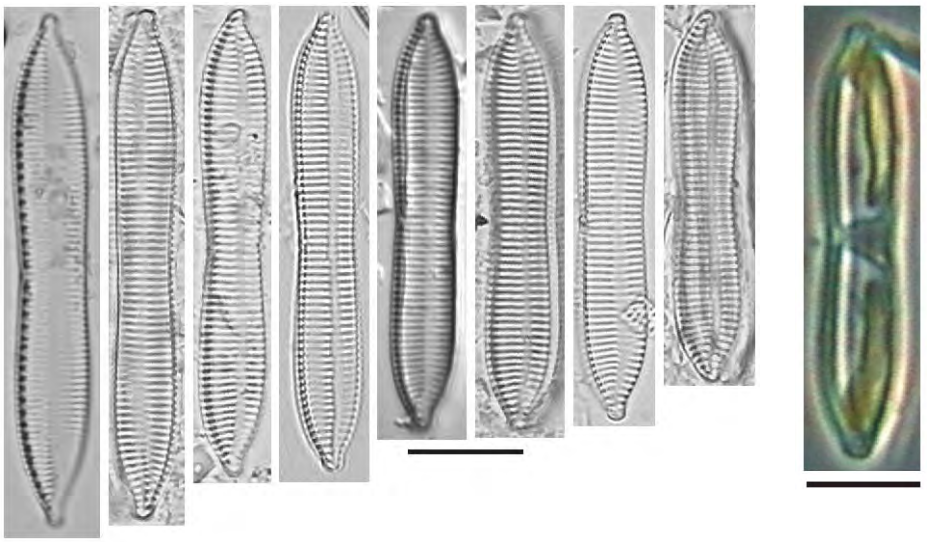
BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with an undulate valve face ornamented with transapical ridges

***Tryblionella apiculata* Gregory**
Syn. *Nitzschia constricta* (Kutzing) Ralfs





SEM

Dimensions:
Valve length = 20-58 µm
Valve breadth = 4.5-8.5 µm
Striae density = (14)15-20 /10 µm
Fibulae density = (14)15-20 /10 µm

Comments:
Valves linear, weakly concave in the middle. Apices protracted, narrow rostrate. Striae interrupted by a single more or less broad longitudinal sternum. The fibulae are short and stubby, interrupted in the middle.

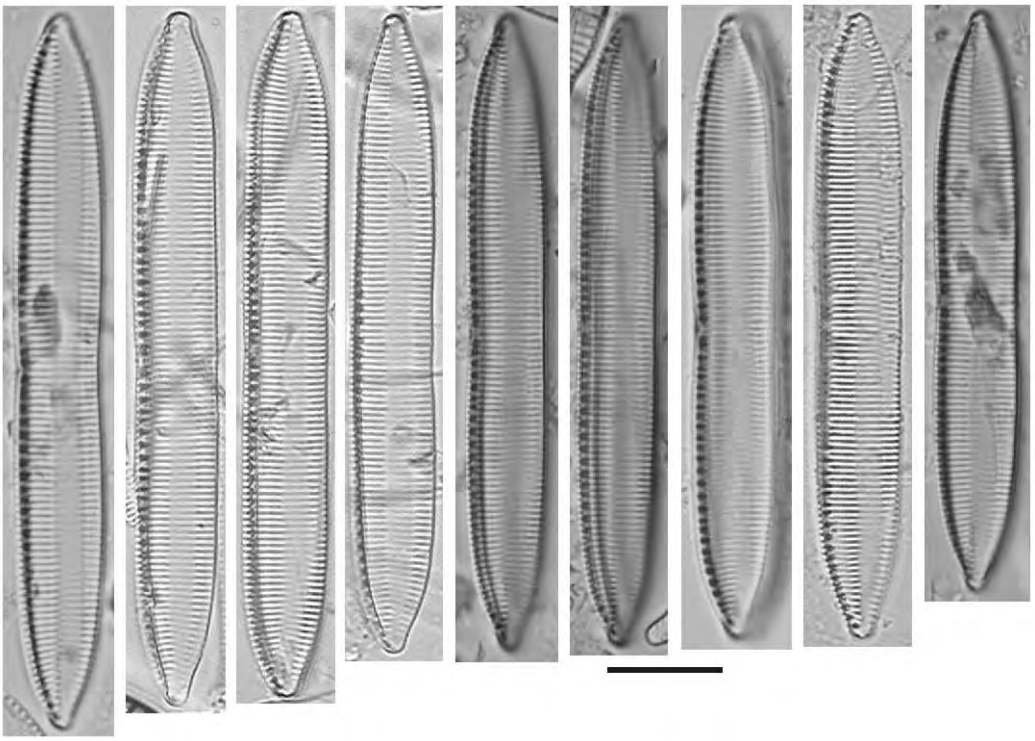
Ecology:
A cosmopolitan species found in electrolyte-rich waters. Tolerant of strongly polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with an undulate valve face ornamented with transapical ridges

***Tryblionella hungarica* (Grunow) DG Mann**
Syn*. Nitzschia hungarica* Grunow



SEM

Dimensions:
Valve length = (20)35-130 µm
Valve breadth = (4.5)5-9 µm
Striae density = 16-20(22) /10 µm
Fibulae density = 7-10(12)

Comments:
Valves linear becoming cuneate at the poles, only very slightly concave in the middle. Apices weakly protracted, rostrate. Striae interrupted by a longitudinal, internal sternum. Fibulae are interrupted at the mid-region.

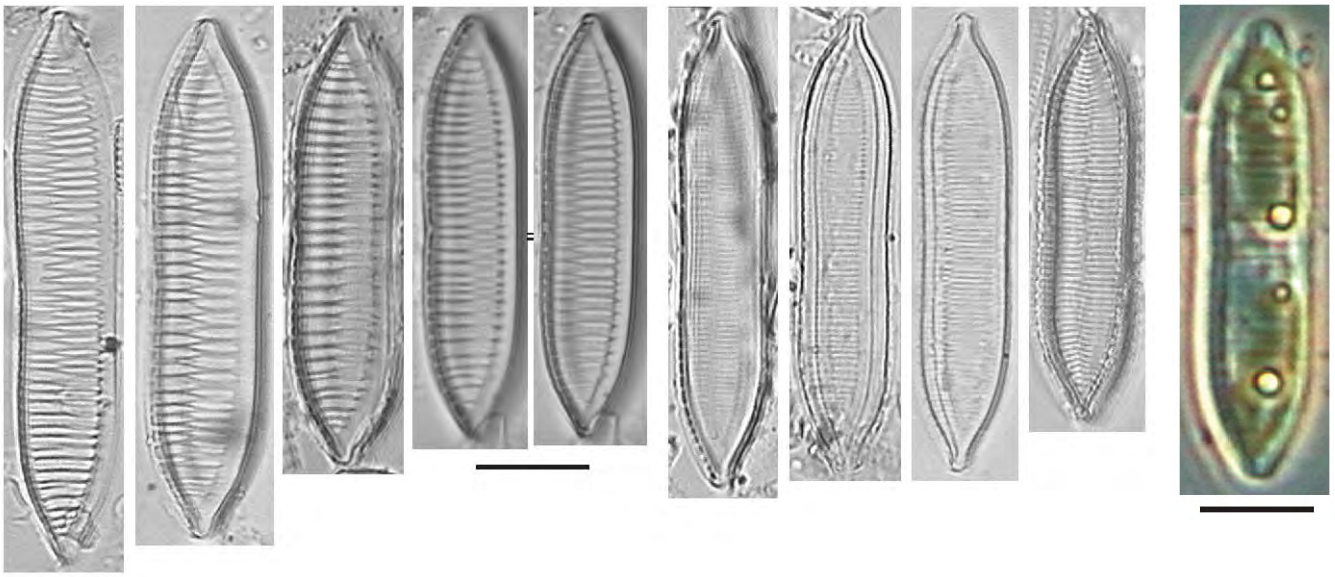
Ecology:
A cosmopolitan species found in waters with high electrolyte content to brackish waters. Tolerant of strongly polluted conditions.

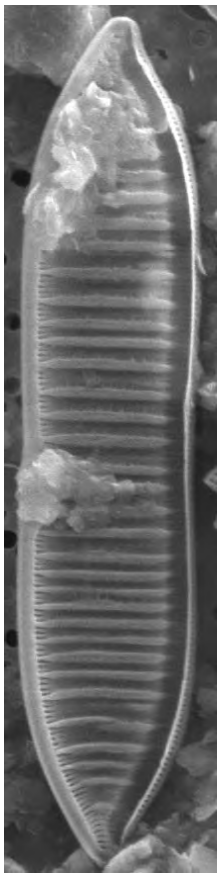
BIRAPHIDEAE

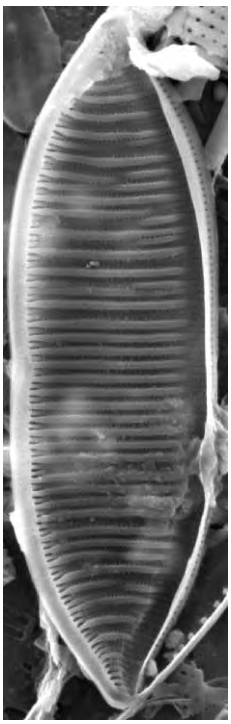
Taxa with a raphe on both valves

Cells with an undulate valve face ornamented with transapical ridges

***Tryblionella calida* (Grunow) DG Mann**
Syn. *Nitzschia calida* Grunow







SEM

Dimensions:
Valve length = 27-70 µm
Valve breadth = (6)8-11 µm
Striae density = 9-12 /10 µm
Fibulae density = 7-10 /10 µm
Transapical ridges = 9-17(22) /10 µm

Comments:
Valves linear, very weakly concave in the middle. Apices cuneate, weakly protracted, narrow-rostrate. Striae difficult to resolve in LM. Short, broad fibulae interrupted in the centre.

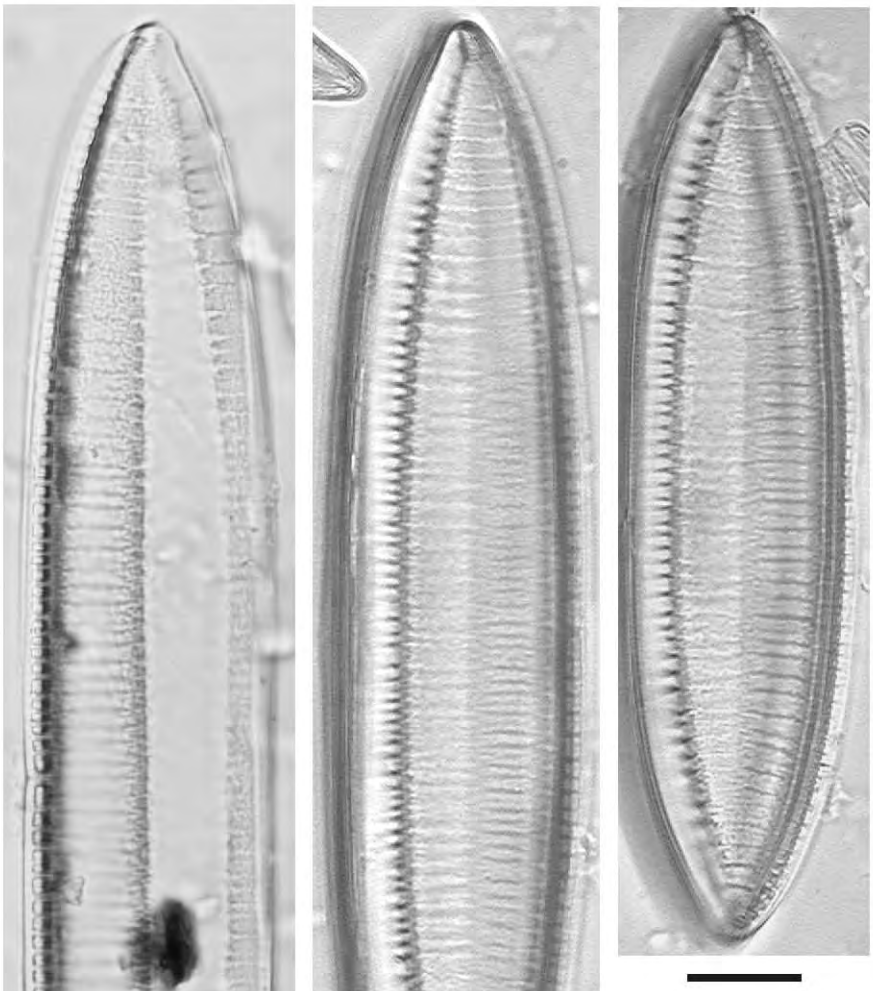
Ecology:
A cosmopolitan species commonly occurring in eutrophic waters with elevated electrolyte content. Favours standing waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with an undulate valve face ornamented with transapical ridges

***Tryblionella gracilis* W Smith**
Syn. *Nitzschia tryblionella* Hantzsch



Dimensions:
Valve length = (50)60-180 µm
Valve breadth = 16-30(35) µm
Striae density = 30-35 /10 µm
Fibulae density = 5-9 /10 µm
Transapical ridges = 6-10(22) /10 µm

Comments:
Valves linear-elliptical to linear-lanceolate becoming cuneate at the poles. Apices not protracted, narrowly rounded. Transapical ridges interrupted in the centre of the cell. Striae difficult to discern in LM. Block-shaped fibulae interrupted in the centre

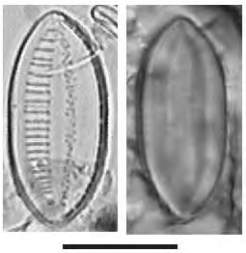
Ecology:
A cosmopolitan species brackish waters and also sometimes in electrolyte-rich waters. Tolerant of osmotic fluctuations.

BIRAPHIDEAE

Taxa with a raphe on both valves

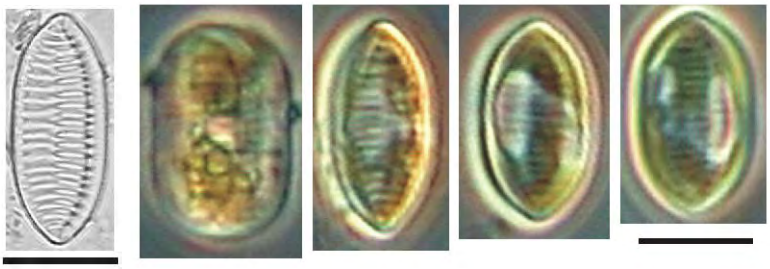
Cells with an undulate valve face ornamented with transapical ridges

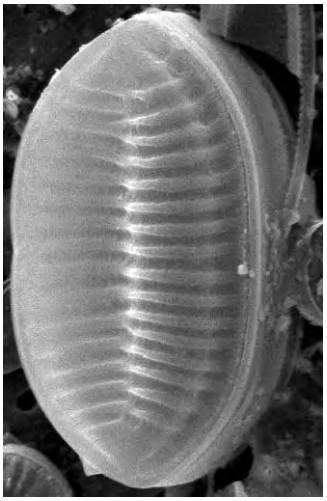
Tryblionella debilis **Arnott**
Syn. *Nitzschia debilis* (Arnott) Grunow



Dimensions:
Valve length = 13-26(31) µm
Valve breadth = 7-10 µm
Striae density = 40 /10 µm
Fibulae density = (6?)8-10
Transapical ridges = ca.15 /10 µm
Comments: Valves elliptical to broad linear-elliptical. Apices cuneate narrowed, bluntly rounded. Striae not visible in LM. The trybionelloid transapical ridges are variably spaced and sometimes not clearly discernible. Fibulae very broad, widely separated in the middle.
Ecology: A cosmopolitan species, rarely abundant. Favouring biotopes subject to osmotic fluctuation, including mosses, rock crevices and damp soil.

Tryblionella levidensis **W Smith**
Syn. *Nitzschia levidensis* (W Smith) Grunow





Dimensions:
Valve length = 18-65(82) µm
Valve breadth = 8-23(26) µm
Striae density = 35-36 /10 µm
Fibulae density = 6-12
Transapical ridges = 10 /10 µm
Comments: Valves linear with cuneate, narrowed, bluntly rounded apices. Sometimes weakly concave in the middle. Striae difficult to resolve in LM. Transapical ridges are strongly undulate, giving the impression of zig zags in LM.
Ecology: A cosmopolitan species found in waters ranging from those with moderate electrolyte content to electrolyte-rich and brackish waters. Tolerant of strongly polluted conditions.

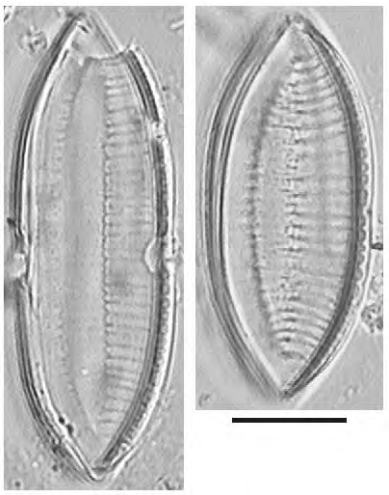
Plate 142

BIRAPHIDEAE

Taxa with a raphe on both valves

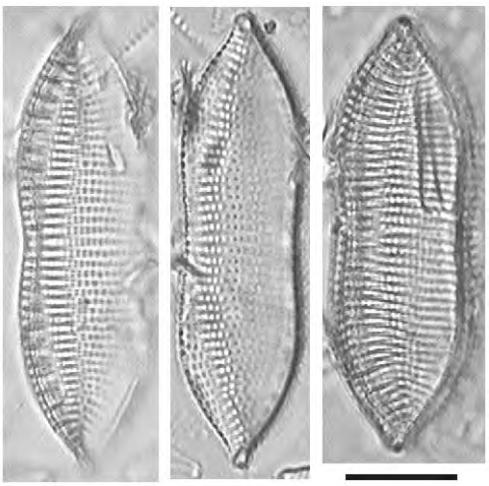
Cells with an undulate valve face ornamented with transapical ridges

***Tryblionella littoralis* (Grunow) DG Mann**
Syn. *Nitzschia littoralis* Grunow, *Nitzschia natalensis* Cholnoky



Dimensions:
Valve length = 30-100 µm
Valve breadth = 12-30 µm
Striae density = 30-38 /10 µm
Comments: Valves broadly elliptical-lanceolate to linear-elliptical, with a very slight central constriction of the keel. Apices cuneate, narrowed and rounded. Striae difficult to resolve in LM.
Ecology: A cosmopolitan species found in tidal zones and biotopes influenced by brackish water.

Tryblionella coarctata (Grunow) DG Mann
Syn. *Nitzschia coarctata* Grunow



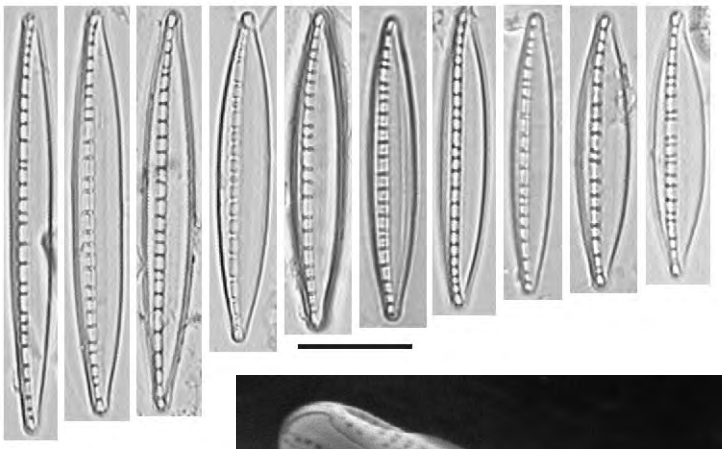
Dimensions:
Valve length = µm
Valve breadth = µm
Striae density = /10 µm
Comments: Valves panduriform, constricted in the middle. Poles cuneate, apices slightly protracted and rounded. Distinguished by the coarse pucta and the relatively weakly visible transapical ridges.
Ecology: A cosmopolitan species found in brackish waters.

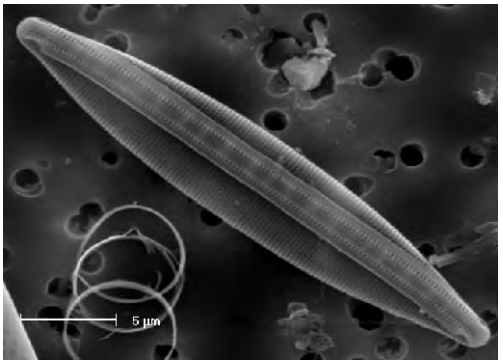
BIRAPHIDEAE

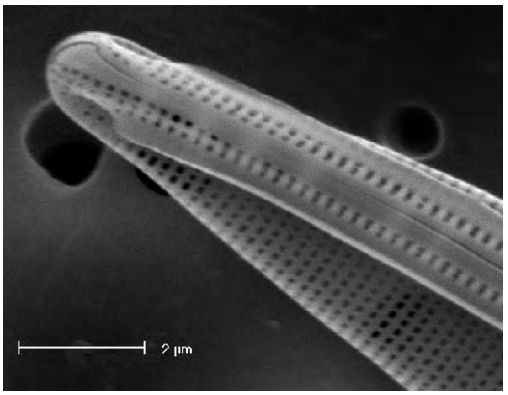
Taxa with a raphe on both valves

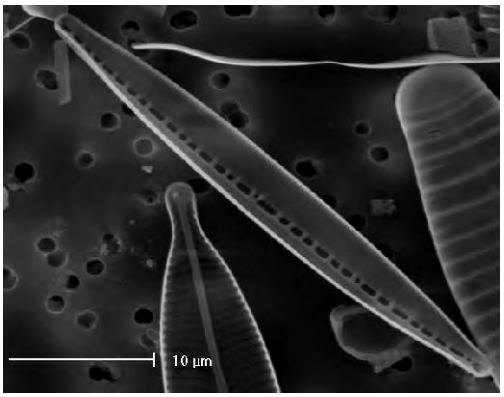
Raphe systems of two valves on opposite sides of the frustule

Nitzschia dissipata (Kützing) Grunow

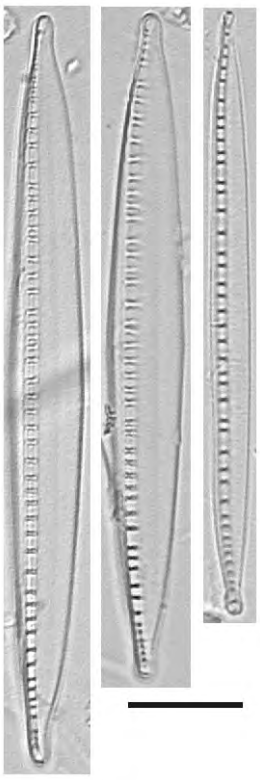








Note the external covering of the raphe or conopeum visible in SEM.



Dimensions:
Valve length = (3)3.5-7(8) µm
Valve breadth = 12.5-85 µm
Striae density = (32?)39-50 /10 µm
Fibulae density = 5-11 /10 µm
Comments: Valves lanceolate, seldom linear-lanceolate. Apices often protracted, rostrate to capitate, if not protracted acutely rounded. Raphe slightly to moderately excentric, never marginal. Fibulae unevenly spaced, becoming denser towards the apices. Striae not visible in LM. In SEM the raphe is covered by a structure known as a conopeum.
Ecology: A cosmopolitan species found in waters of moderate to high electrolyte content, not present in waters of low electrolyte content.

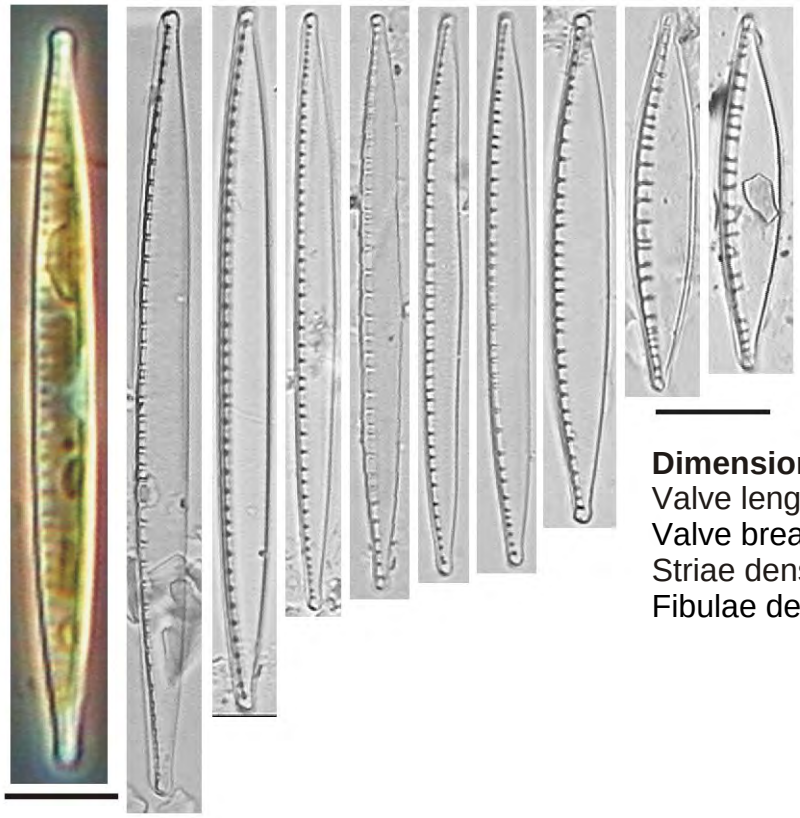
Nitzschia dissipata var. *media* (Hantzsch) Grunow

Comments: Raphe distinctly more excentric (i.e. closer to the margin) than the nominate variety.

BIRAPHIDEAE

Taxa with a raphe on both valves
Raphe systems of two valves on opposite sides of the frustule

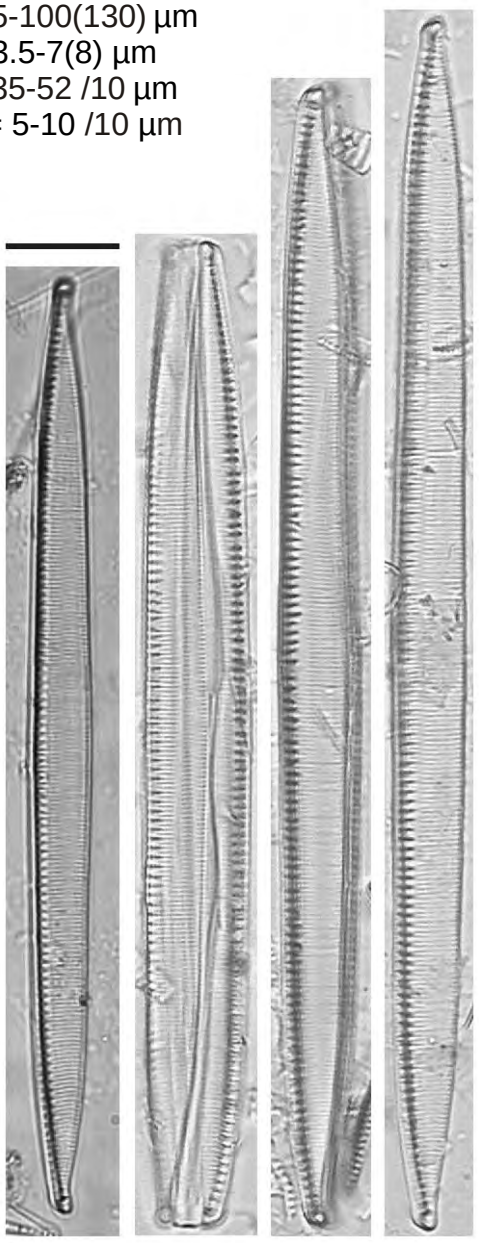
Nitzschia recta **Hantzsch**



Comments:
Valves linear, linear-lanceolate to lanceolate. Poles narrow cuneate, apices more or less protracted slightly capitate or acutely rounded. Raphe marginal. Fibulae narrow, long and irregularly spaced. Striae not discernible in LM.
Ecology: A cosmopolitan species common in a variety of water types but not tolerating more than moderately polluted conditions

Dimensions:
Valve length = 35-100(130) µm
Valve breadth = 3.5-7(8) µm
Striae density = 35-52 /10 µm
Fibulae density = 5-10 /10 µm

Nitzschia heufleriana **Grunow**



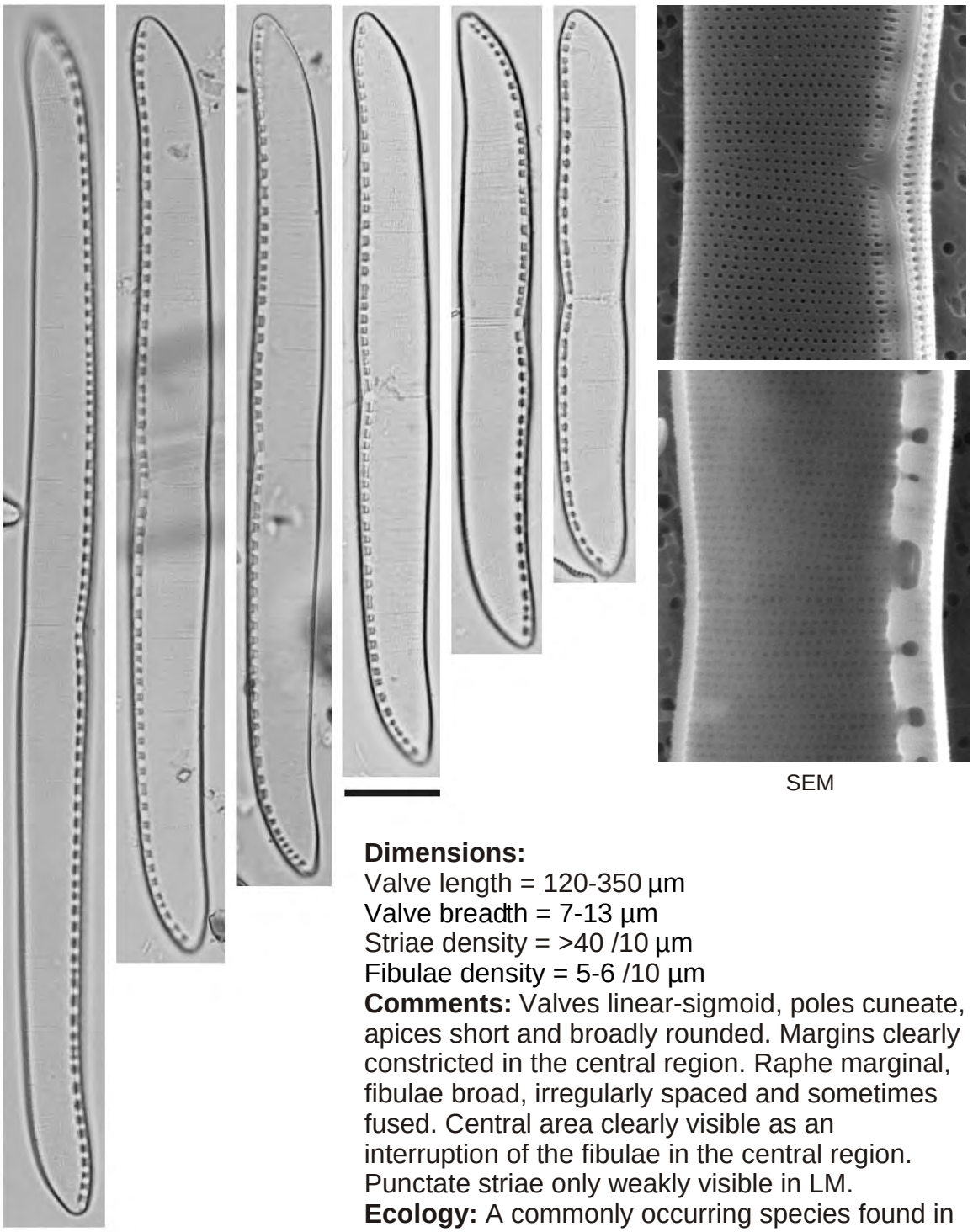
Dimensions:
Valve length = 70-190 µm
Valve breadth = 4-7 µm
Striae density = 20-24(26) /10 µm
Fibulae density = 10-11(14) /10 µm
Comments: Valves linear to linear-lanceolate with narrow cuneate poles and capitate apices. Fibulae narrow, irregularly spaced seeming to extend into the striae. The striae have a characteristic “wavy” appearance due the transapical undulation of the valve face.
Ecology: A common species found in waters with moderate to slightly elevated electrolyte content. Not tolerant of more than moderately polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

Nitzschia obtusa var. _kurzii_ Rabenhorst



SEM

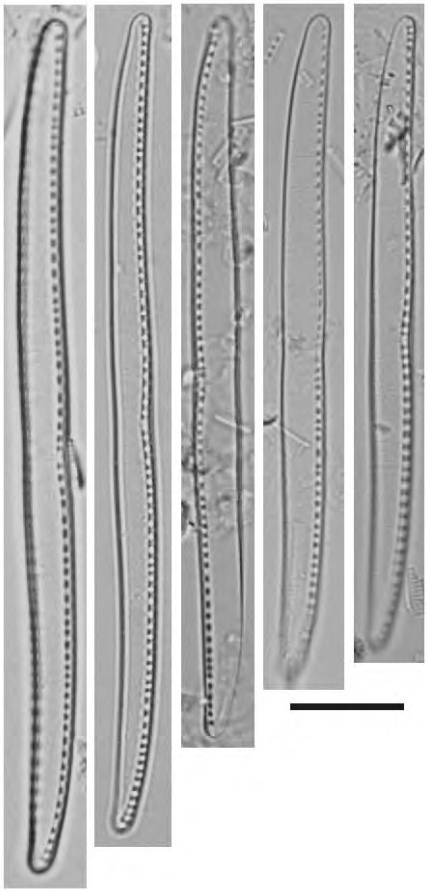
Dimensions:
Valve length = 120-350 µm
Valve breadth = 7-13 µm
Striae density = >40 /10 µm
Fibulae density = 5-6 /10 µm
Comments: Valves linear-sigmoid, poles cuneate, apices short and broadly rounded. Margins clearly constricted in the central region. Raphe marginal, fibulae broad, irregularly spaced and sometimes fused. Central area clearly visible as an interruption of the fibulae in the central region. Punctate striae only weakly visible in LM.
Ecology: A commonly occurring species found in brackish coastal and inland waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

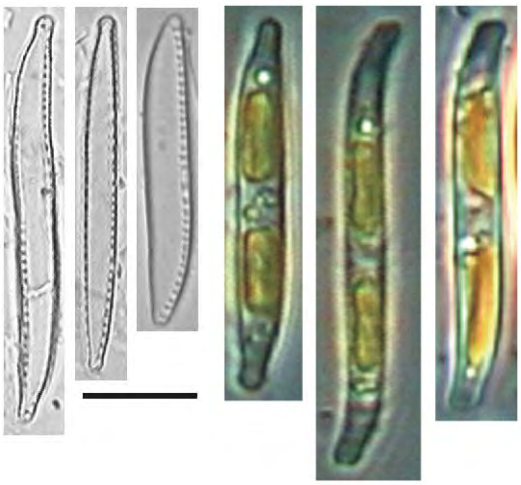
Raphe systems of two valves on opposite sides of the frustule

Nitzschia nana **Grunow**



Dimensions:
Valve length = 35-120 µm
Valve breadth = 3-4.5 µm
Striae density = 30-36 /10 µm
Fibulae density = 7-11 /10 µm
Comments: Valves linear-sigmoid, apices bluntly rounded. Raphe marginal, fibulae short, block-like, interrupted at the central region.
Ecology: A cosmopolitan species found in brackish and electrolyte-rich waters, able to tolerate changes in osmotic pressure but found in moderately polluted waters only.

Nitzschia clausii **Hantzsch**

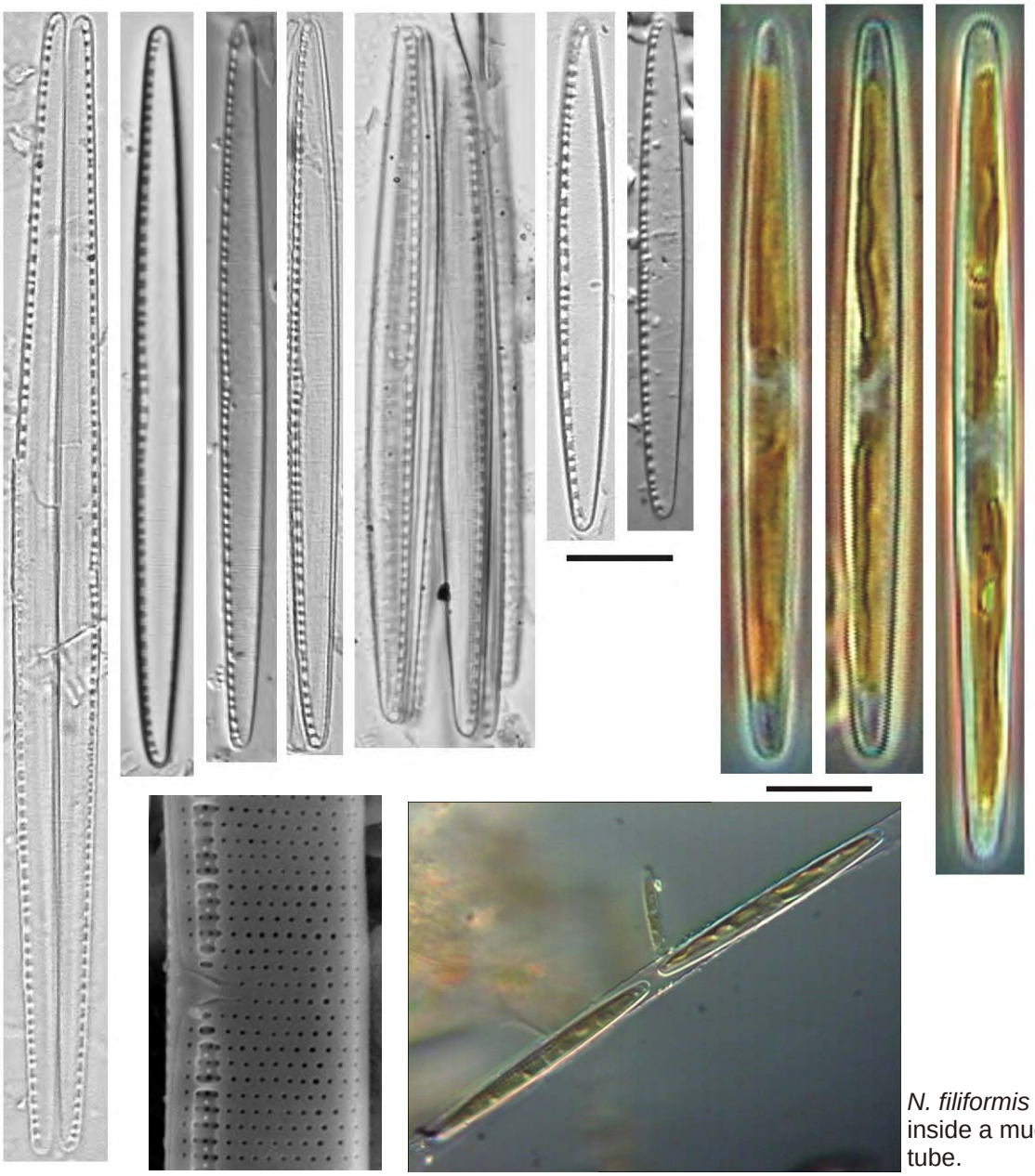


Dimensions:
Valve length = 20-55 µm
Valve breadth = 3-5 µm
Striae density = (32)38-42 /10 µm
Fibulae density = 10-13 /10 µm
Comments: Valves linear sigmoid, slightly concave near the centre. Poles abruptly narrow, apices weakly capitate to rostrate.
Ecology: A cosmopolitan species found in brackish coastal waters as well as in electrolyte-rich inland waters. In large rivers systems this species may be associated with industrial effluents and is tolerant of strongly polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves
Raphe systems of two valves on opposite sides of the frustule

***Nitzschia filiformis* (W Smith) Van Heurk**



SEM

N. filiformis cells inside a mucilage tube.

Dimensions:
Valve length = 40-100 µm
Valve breadth = 4-6 µm
Striae density = 27-36 /10 µm
Fibulae density = 7-11 /10 µm
Comments: Valves linear-lanceolate, valve margins slightly concave in the middle. Apices bluntly rounded. Raphe marginal, supported by irregularly arranged fibulae. Striae weakly visible in LM.
Ecology: A cosmopolitan species found in waters of moderate to high electrolyte content also extending into brackish waters. Tolerant of strongly polluted conditions, but not of critical levels of pollution. Often found occurring in mucilage tubes.

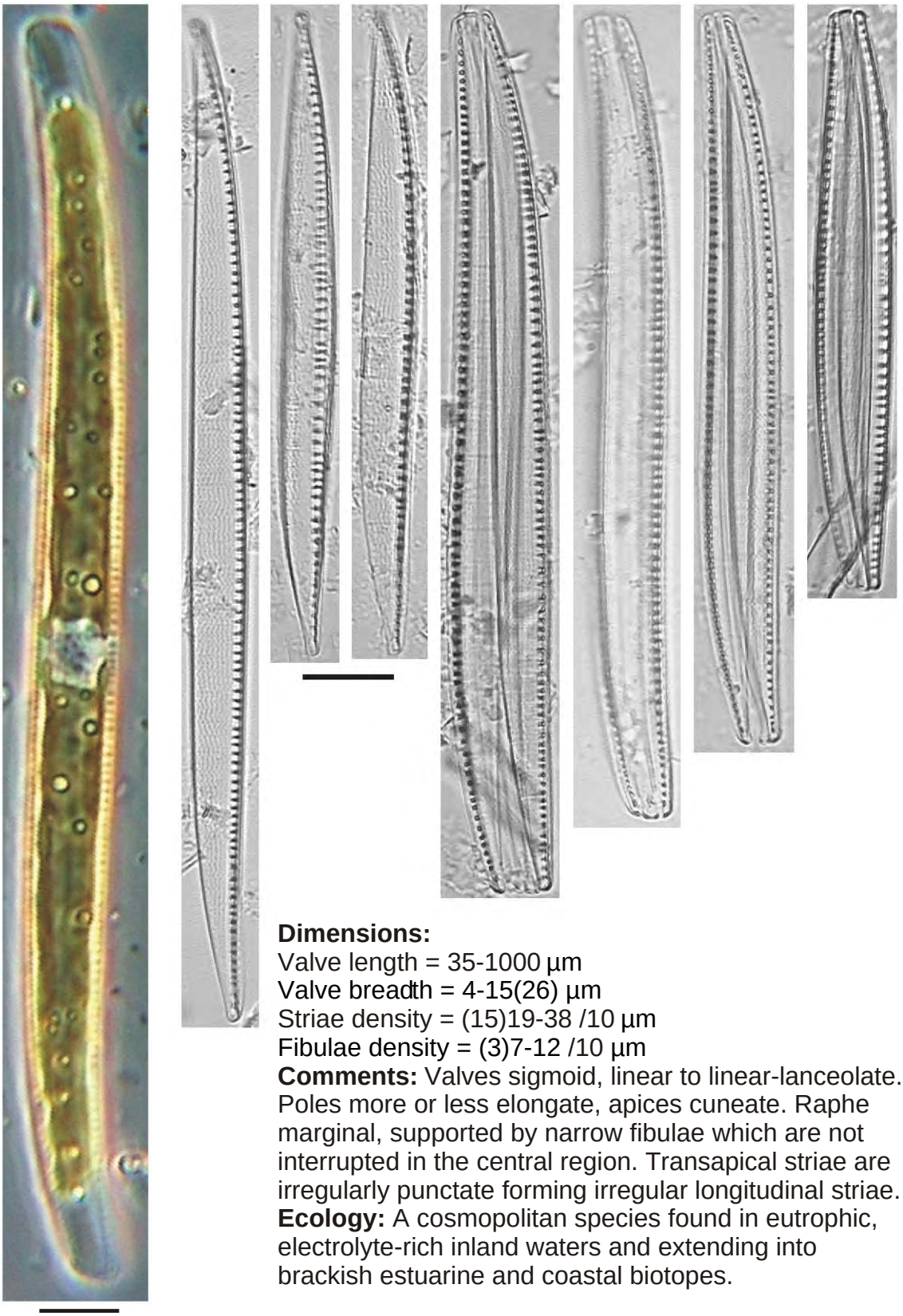
Plate 148

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia sigma* (Kützing) W Smith**



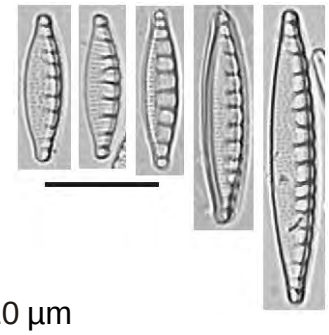
Dimensions:
Valve length = 35-1000 µm
Valve breadth = 4-15(26) µm
Striae density = (15)19-38 /10 µm
Fibulae density = (3)7-12 /10 µm
Comments: Valves sigmoid, linear to linear-lanceolate. Poles more or less elongate, apices cuneate. Raphe marginal, supported by narrow fibulae which are not interrupted in the central region. Transapical striae are irregularly punctate forming irregular longitudinal striae.
Ecology: A cosmopolitan species found in eutrophic, electrolyte-rich inland waters and extending into brackish estuarine and coastal biotopes.

BIRAPHIDEAE

Taxa with a raphe on both valves

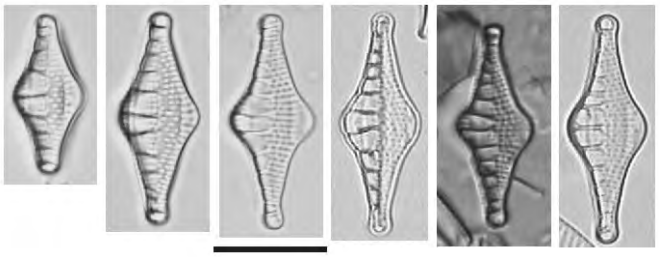
Raphe systems of two valves on opposite sides of the frustule

Nitzschia sinuata var. *delognei* (Grunow) Lange-Bertalot



Dimensions:
Valve length = 10-50 µm
Valve breadth = 3-4 µm
Striae density = 18-25 /10 µm
Fibulae density = 5-8 /10 µm
Comments: Valves lanceolate with acutely rounded to slightly protracted, weakly capitate apices. Raphe marginal, supported by irregularly spaced fibulae up to half the width of the valve. Striae with large, clearly distinguishable puncta. Valve face angled.
Ecology: A cosmopolitan species found in alkaline, meso- to eutrophic waters. Occurring in waters with moderate to high electrolyte content. Tolerant of moderately polluted conditions.

Nitzschia sinuata var. *tabellaria* (Grunow) Grunow

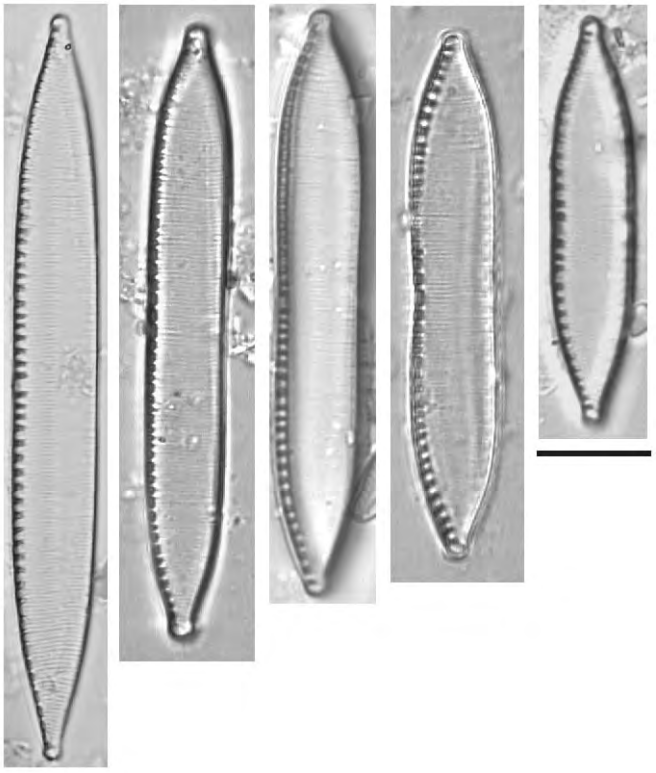


Dimensions:
Valve length = 10-30 µm
Valve breadth = 3-8 µm
Striae density = 18-25 /10 µm
Fibulae density = 6.5-8 /10 µm
Comments: Valves rhombic, strongly inflated in the centre. Apices capitate. Fibulae extend almost half way across the valve. Striae with clearly visible large puncta.
Ecology: A cosmopolitan species found in circumneutral, mesotrophic waters of moderate electrolyte content and tolerating critical levels of pollution.

BIRAPHIDEAE

Taxa with a raphe on both valves
Raphe systems of two valves on opposite sides of the frustule

***Nitzschia umbonata* (Ehrenberg) Lange-Bertalot**
Syn. *Nitzschia thermalis* (Ehrenberg) Auerswald



Dimensions:
Valve length = 8-70 µm
Valve breadth = 8-30 µm
Striae density = (16)17-19(20) /10 µm
Fibulae density = 3.5-6(7) /10 µm
Comments: Valves linear, margins sometimes weakly concave in the middle. Poles cuneate, apices protracted, either weakly capitate or short-rostrate. Raphe marginal, supported by irregularly spaced fibulae interrupted in the middle of the valve. Striae undulating, clearly visible in LM.
Ecology: A common species in eutrophic electrolyte rich waters and tolerating extremely polluted conditions.

SEM

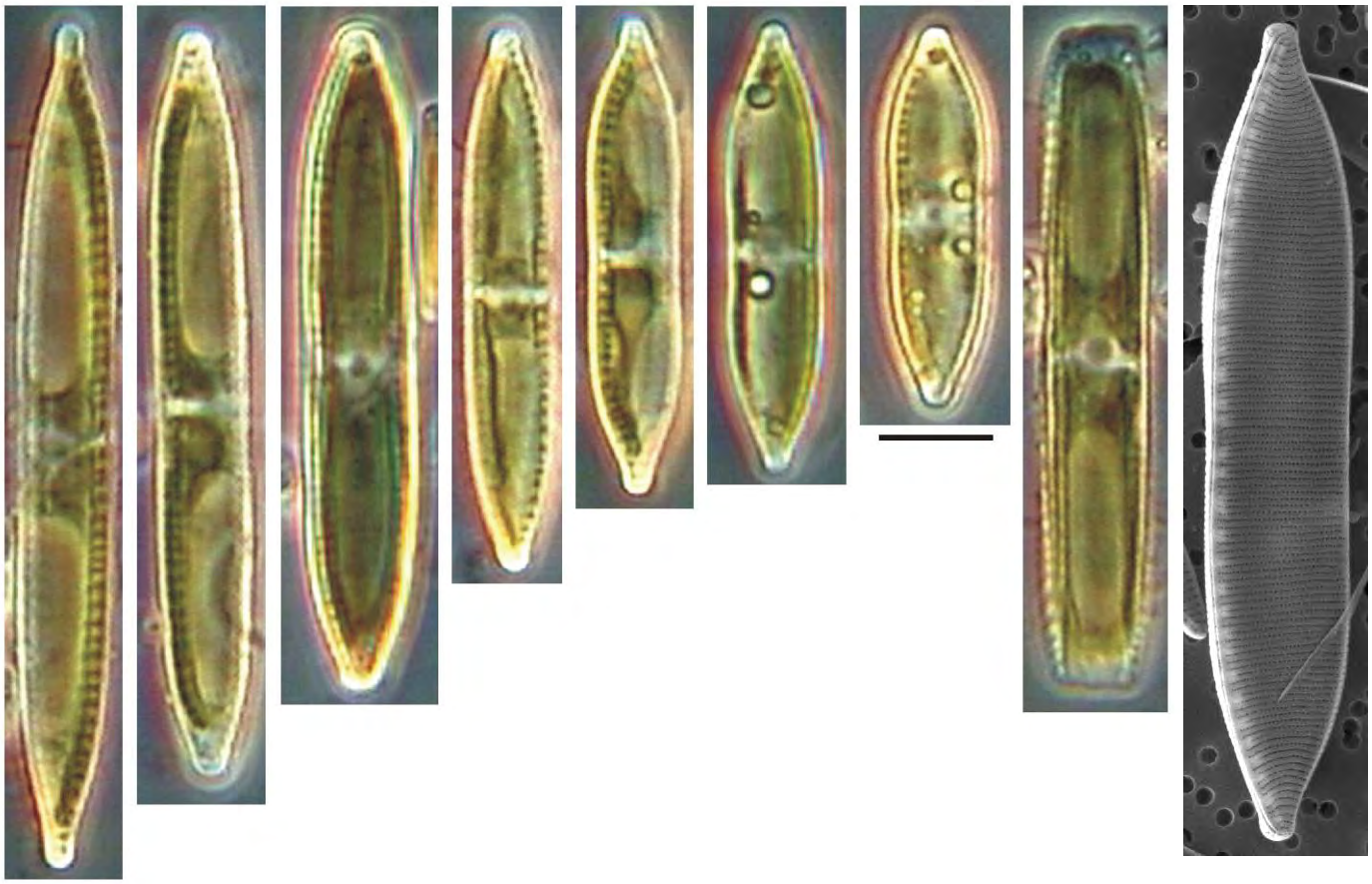


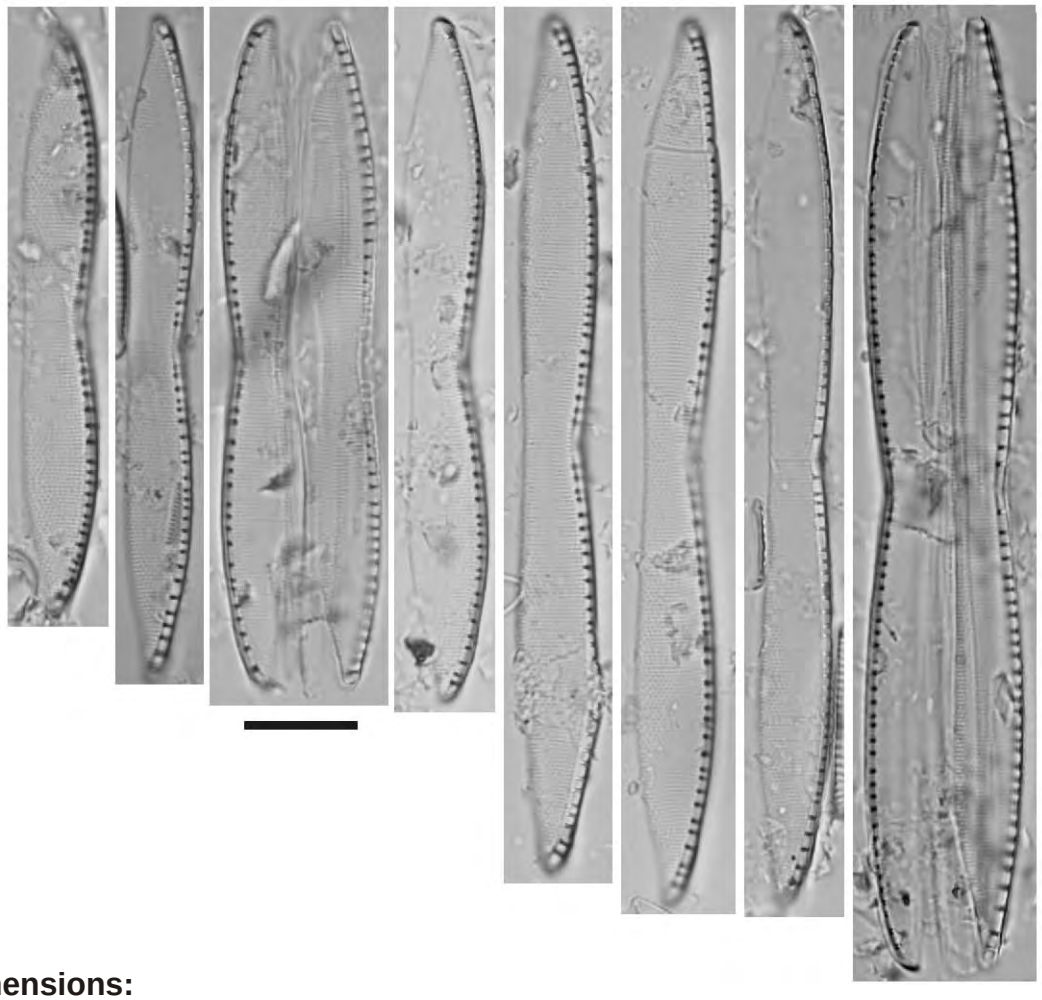
Plate 151

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia littorea* Grunow**

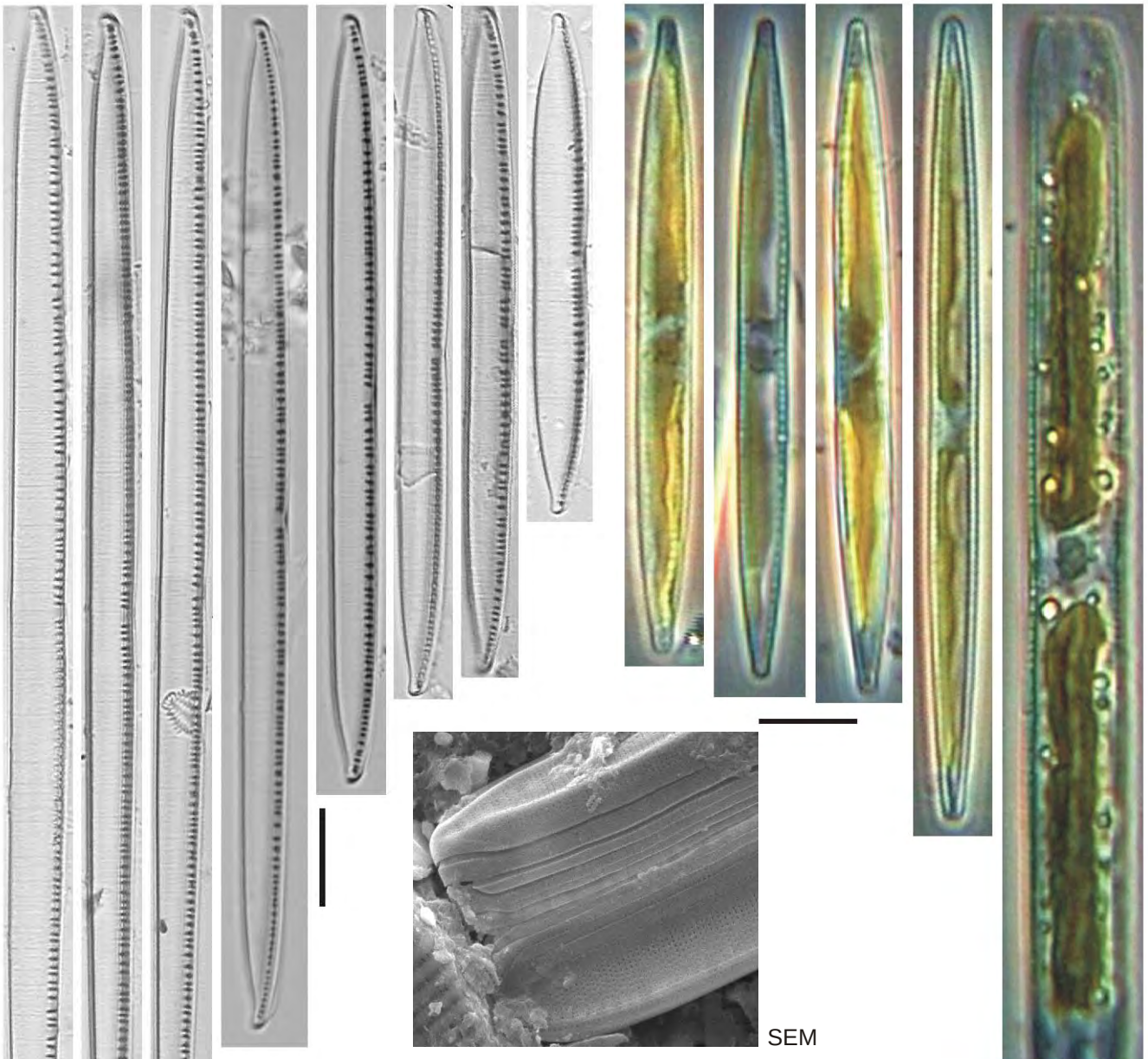


Dimensions:
Valve length = 60-100 µm
Valve breadth = 5-9 µm
Striae density = 30 /10 µm
Fibulae density = 7-10(14) /10 µm
Comments: Valves linear, margins strongly constricted in the middle. Poles cuneate, apices protracted, weakly rostrate. Marginal raphe supported by narrow unevenly spaced fibulae interrupted in the middle. Striae visible in LM, puncta less dense than striae, approximately 20 /10 µm.
Ecology: A cosmopolitan species usually found in coastal waters but also occurring in brackish inland biotopes influenced by mining effluent.

BIRAPHIDEAE

Taxa with a raphe on both valves
Raphe systems of two valves on opposite sides of the frustule

***Nitzschia linearis* (Agardh) W Smith**



SEM

Dimensions:
Valve length = 34-228 µm
Valve breadth = 2.5-7.5 µm
Striae density = 28-41 /10 µm
Fibulae density = 8-17 /10 µm

Comments: Valves linear to linear-lanceolate to narrow-lanceolate. Poles cuneate, apices capitate to rostrate. The margin bearing the raphe is slightly concave. Raphe marginal, central area distinct. at some focal depths it would seem as though the narrow irregularly spaced fibulae merge into the striae. Striae indistinct to weakly visible.

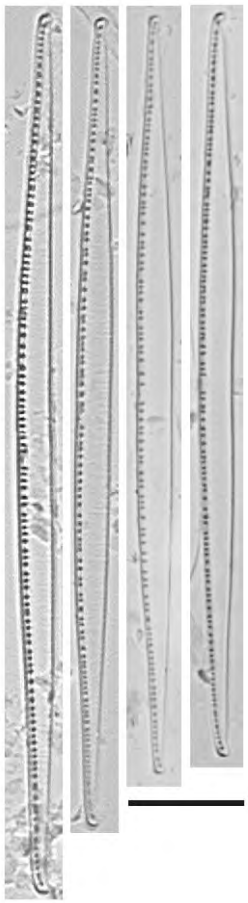
Ecology: A cosmopolitan species with a wide ecological range, favouring circumneutral, oxygen rich waters of moderate to high electrolyte content. Tolerant of moderately polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

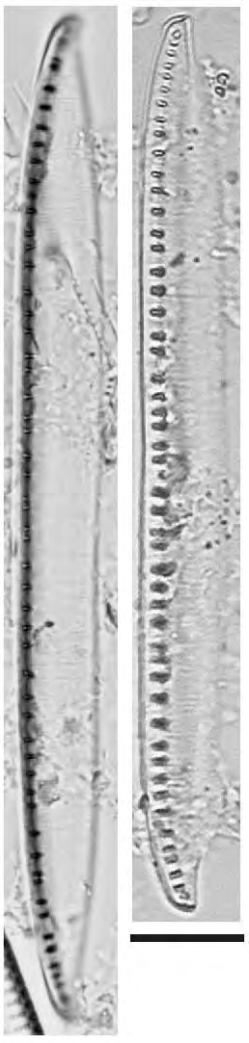
***Nitzschia linearis* var. *subtilis* Grunow**



Dimensions:
Valve length = 34-228 µm
Valve breadth = 2.5-7.5 µm
Striae density = 33-37 /10 µm
Fibulae density = 8-17 /10 µm
Comments: Valves narrow-linear to linear-lanceolate to narrow-lanceolate. Valves bowed. Poles narrow-cuneate, apices capitate. The margin bearing the raphe is slightly concave.
Ecology: A cosmopolitan species with a wide ecological range, favouring circumneutral, oxygen rich waters of moderate to high electrolyte content. Tolerant of moderately polluted conditions.

***Nitzschia tsarenkoi* Lange-Bertalot**

Dimensions:
Valve length = 70-80(85) µm
Valve breadth = 6-8 µm
Striae density = 30-35 /10 µm
Fibulae density = 5-6 /10 µm
Comments: Valves linear, margins slightly concave in the middle. Poles cuneate, apices bluntly rounded. Fibulae marginal, unevenly spaced, no central nodule. Striae difficult to discern in LM.
Ecology: Described from Israel from alkaline waters with a moderate electrolyte content.

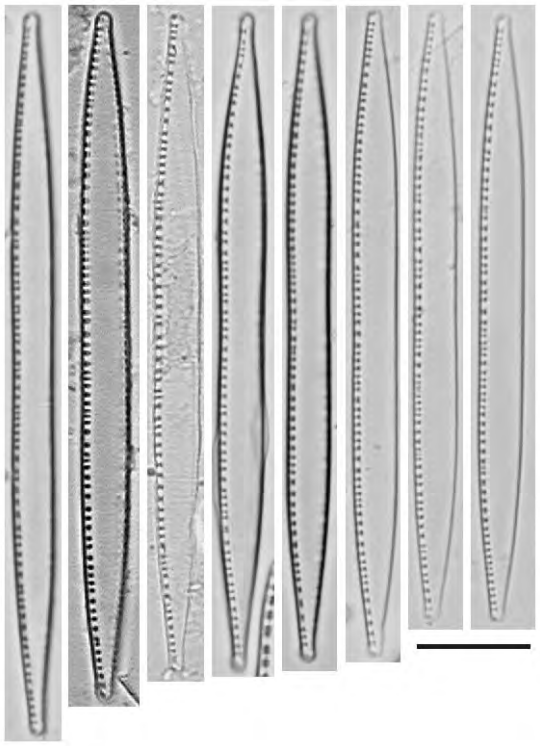


BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

Nitzschia pura Hustedt

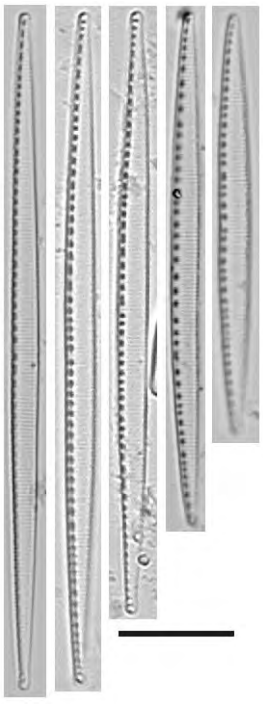


Dimensions:
Valve length = 35-50 µm
Valve breadth = 4-5 µm
Striae density = >40 /10 µm
Fibulae density = (14)16-20(24) /10 µm
Comments: Valves lanceolate with more or less protracted, capitate apices. Striae difficult to discern in LM.
Ecology: Found in weakly to moderately polluted waters with moderate electrolyte content.

Nitzschia sublinearis Hustedt

Dimensions:
Valve length = (20)30-90 µm
Valve breadth = 4-6 µm
Striae density = 34-38 /10 µm
Fibulae density = 13-17 /10 µm
Comments: Valves linear sometimes lanceolate in smaller specimens. Poles narrow-cuneate with rounded or weakly capitate apices. Fibulae narrow, long and unevenly spaced, not interrupted at the centre of the valve.
Ecology: Found in slightly to moderately polluted, electrolyte-rich waters.

Nitzschia radicula Hustedt



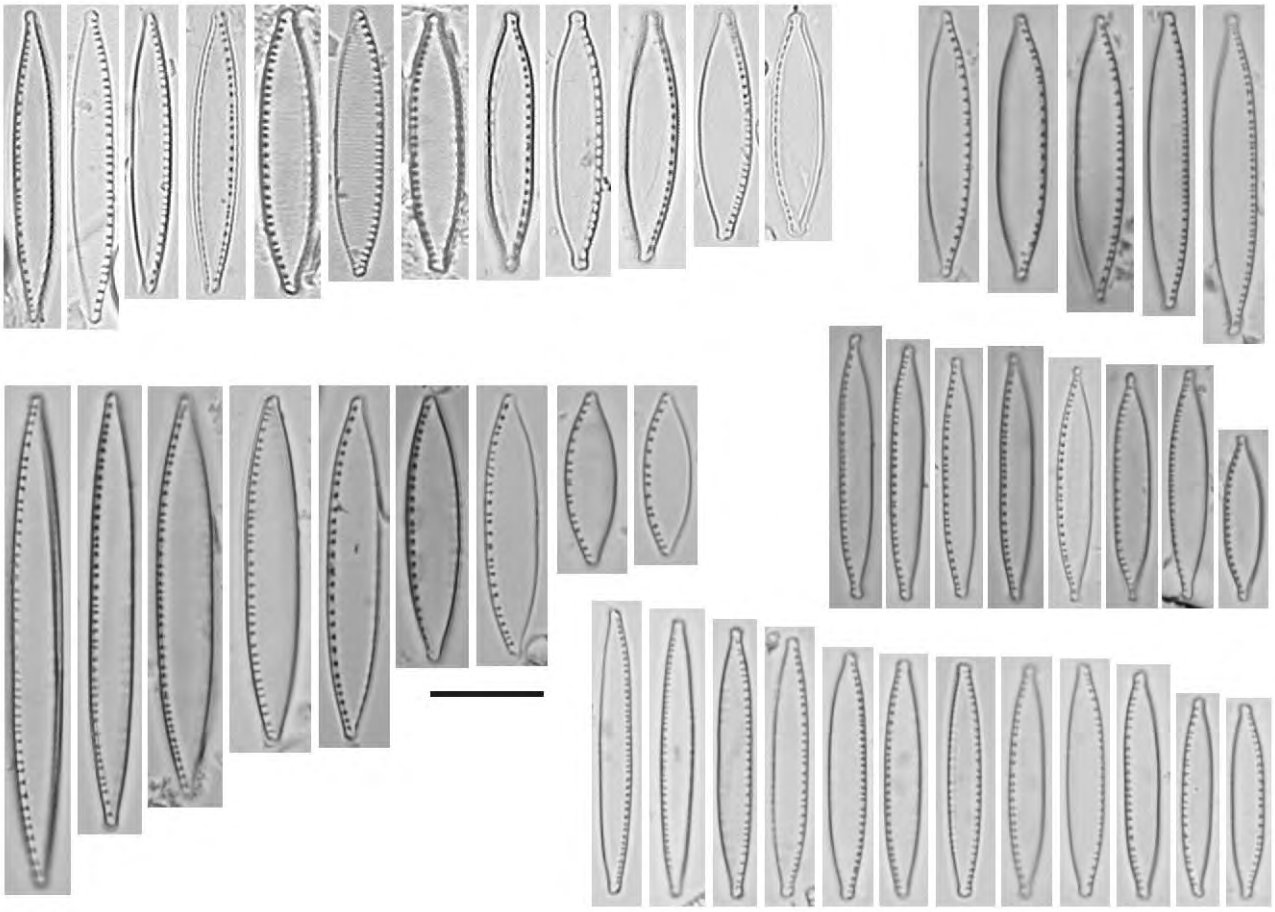
Dimensions:
Valve length = 33-70 µm
Valve breadth = 2.5-3 µm
Striae density = 28-30 /10 µm
Fibulae density = 10-13 /10 µm
Comments: Valves narrow-lanceolate with acutely rounded or protracted capitate apices. Fibulae short and broad. Striae visible in LM.
Ecology: Found in slightly to moderately polluted, electrolyte-rich waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia palea* (Kützing) W Smith**



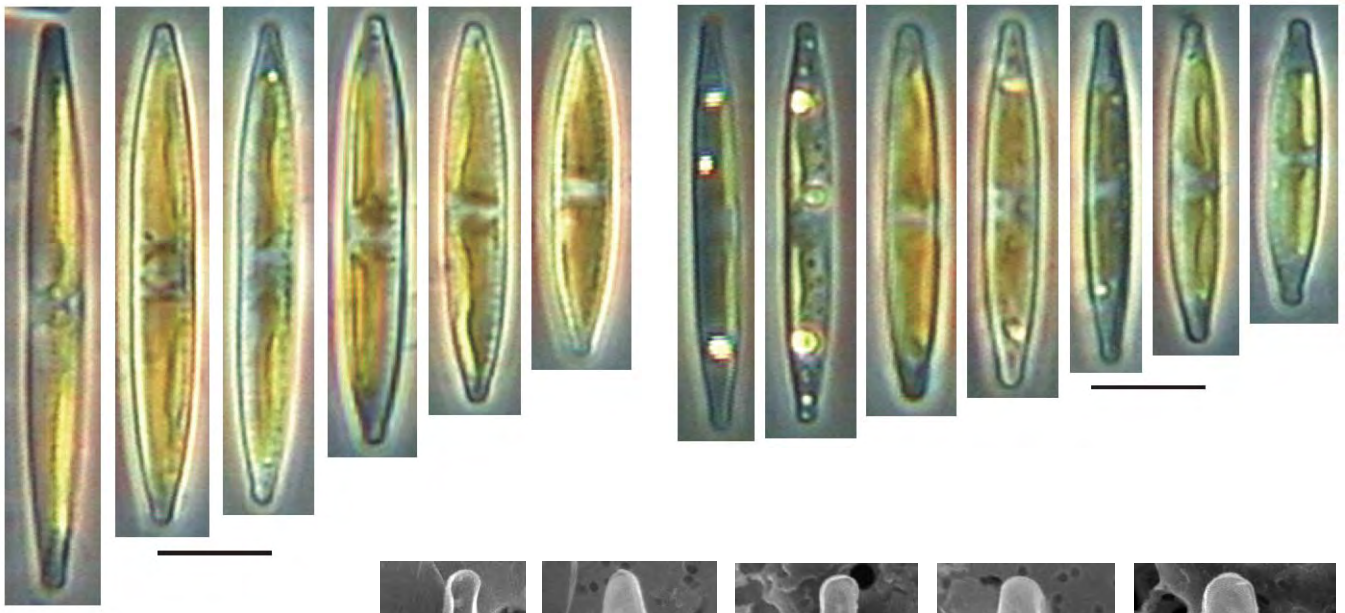
Dimensions:
Valve length = 15-70 µm
Valve breadth = 2.5-5 µm
Striae density = 28-40 /10 µm
Fibulae density = 9-17 /10 µm
Comments: Valves linear-lanceolate to linear sometimes lanceolate. Poles narrowed, cuneate, apices acutely rounded or weakly capitate. Marginal raphe supported by short block like, more or less evenly spaced fibulae. The striae are usually difficult to discern in LM without the use of special lighting techniques. As can be seen from the illustrations this is a morphologically very variable species, but on examination under SEM no good grounds can be found for splitting the forms of *N. palea* into species.
Ecology: A cosmopolitan and very commonly occurring species found in eutrophic and very heavily polluted to extremely polluted waters with moderate to high electrolyte content.

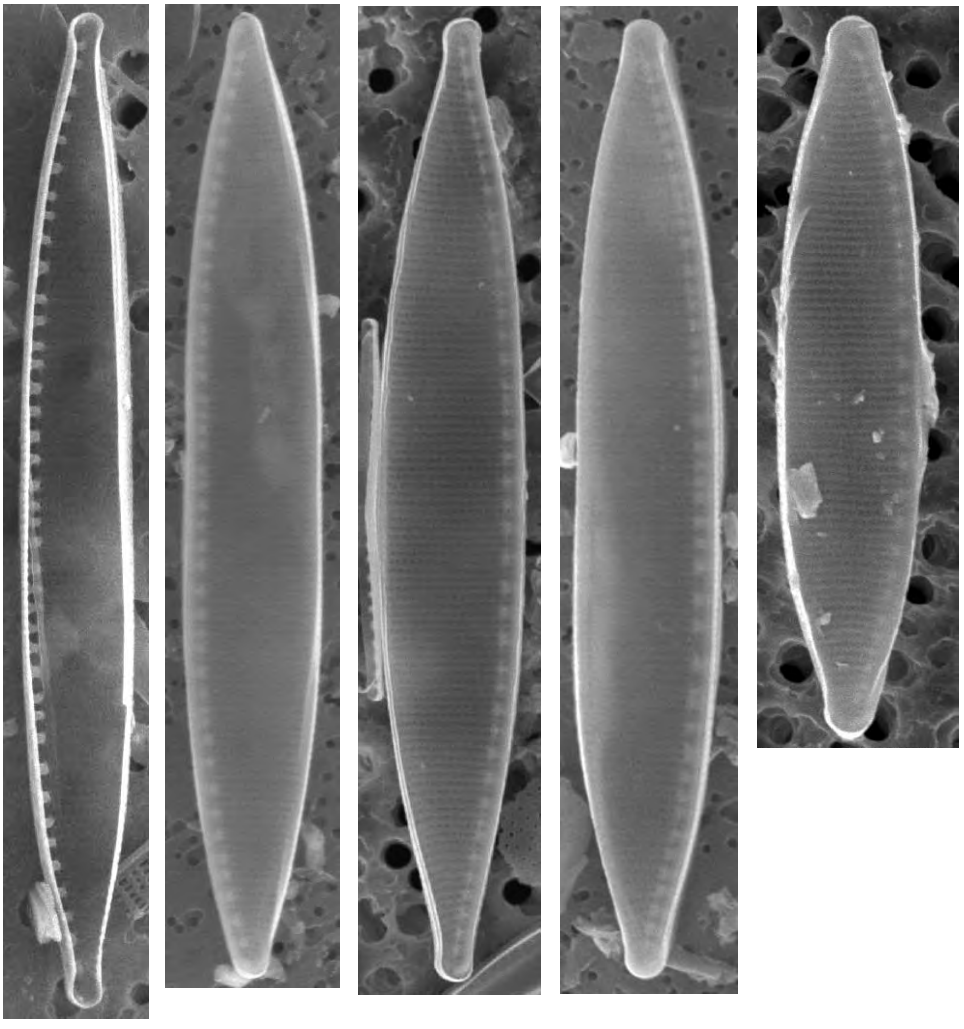
BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia palea* (Kützing) W Smith**





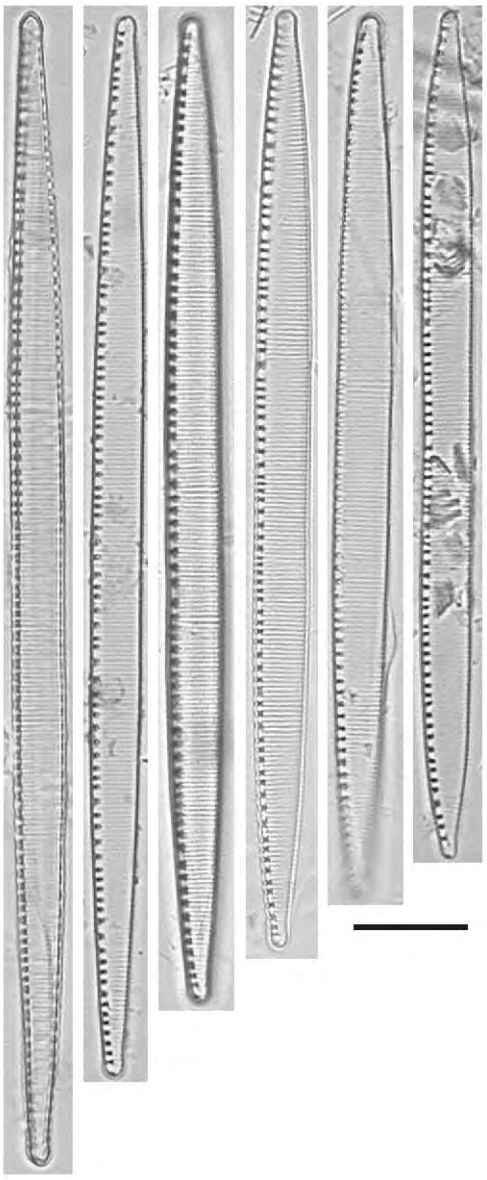
SEM

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia intermedia* Hantzsch**



SEM

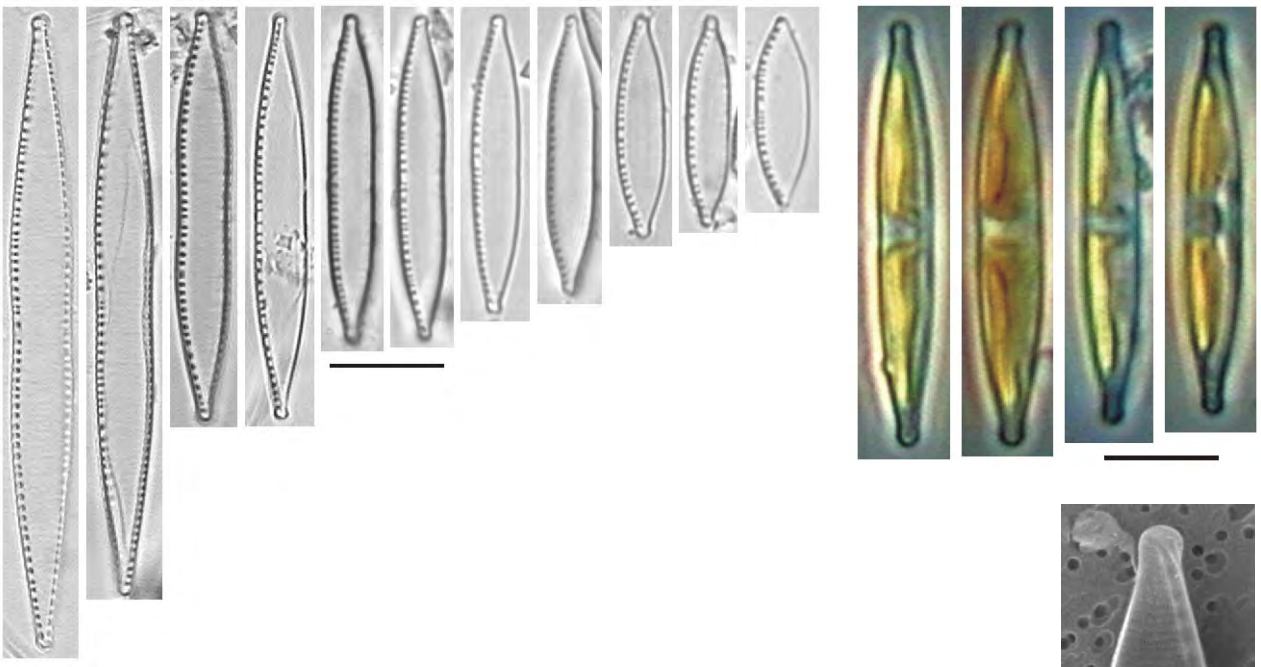
Dimensions:
Valve length = 60-100 µm
Valve breadth = 4-7 µm
Striae density = 20-33 /10 µm
Fibulae density = 7-13 /10 µm
Comments: Valves linear to linear-lanceolate. Poles long-cuneate, apices narrow-rounded, rounded to weakly capitate. Raphe supported by small narrow fibulae, no central area. Striae puncate, density variable. The fine structure of this species as revealed by SEM is similar to *N. palea* with the exception of the larger puncta.
Ecology: Found in the littoral zone of large eutrophic rivers and lakes with moderate to high electrolyte content. This species does not tolerate more than critical levels of pollution.

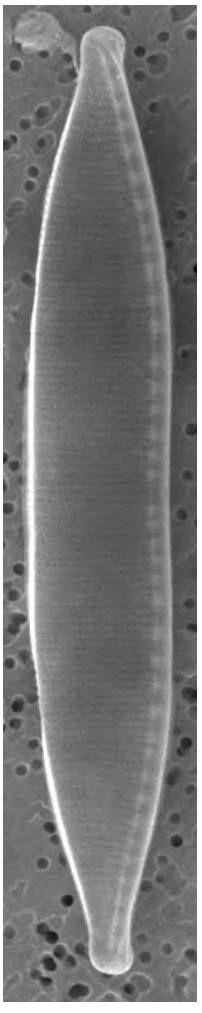
BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia capitellata* Hustedt**





SEM

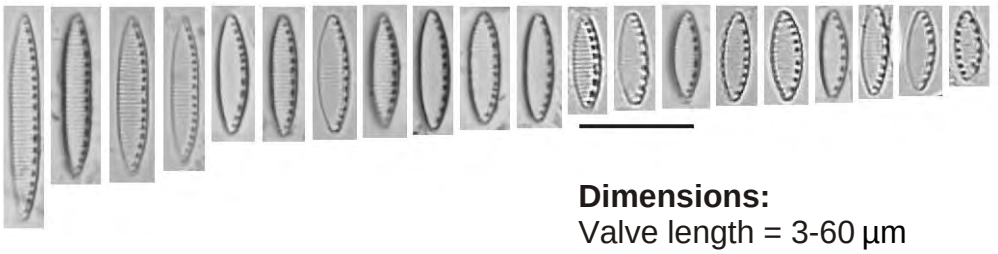
Dimensions:
Valve length = 20- ca. 70 µm
Valve breadth = 3.5-6.5 µm
Striae density = 23-40 µm
Fibulae density = 10-18 /10 µm
Comments: Valves linear to linear-lanceolate, margins are more or less concave in the middle. The poles are cuneate and the apices mostly capitate. The raphe is supported by small block-shaped fibulae, the two central fibulae are more widely spaced than the others forming an easily discernable gap.
Ecology: A widespread species occurring in electrolyte rich and brackish waters. Tolerant of extremely polluted conditions.

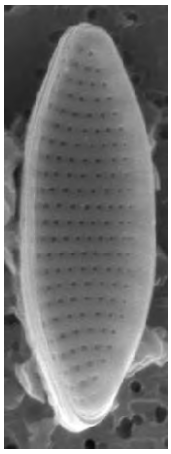
BIRAPHIDEAE

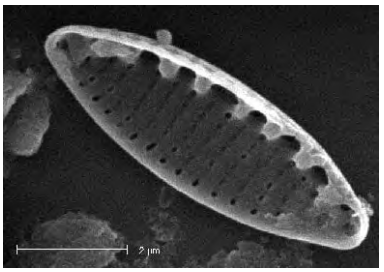
Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

Nitzschia frustulum (Kützing) Grunow



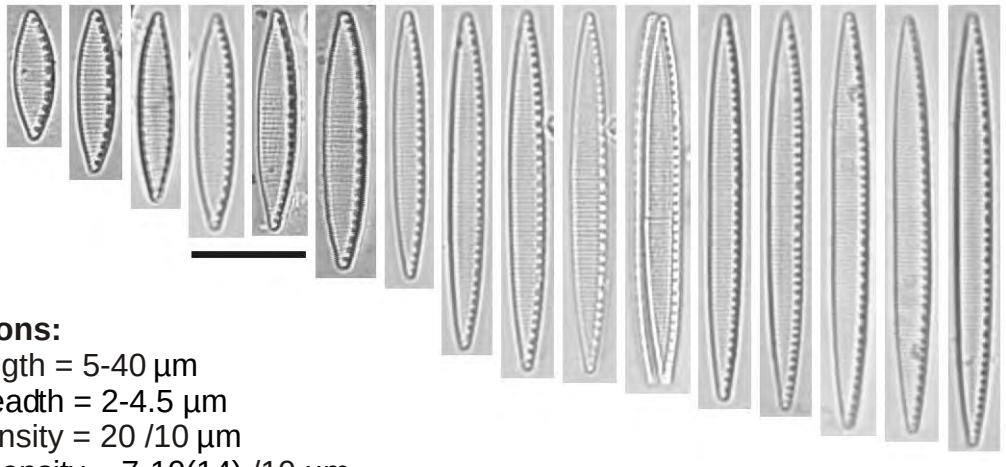




SEM

Dimensions:
Valve length = 3-60 µm
Valve breadth = 2-4.5 µm
Striae density = 19-32 /10 µm
Fibulae density = 8-16 /10 µm
Comments: Valves elliptical, lanceolate, linear-lanceolate to linear. Poles cuneate, apices seldom protracted, acutely or bluntly rounded to weakly capitate. Small block-shaped fibulae support the raphe. Striae are clearly visible in LM, parallel in the middle becoming radial towards the poles.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish waters . Tolerant of fluctuations in osmotic pressure and of critical levels of pollution.

Nitzschia liebertruthii Rabenhorst



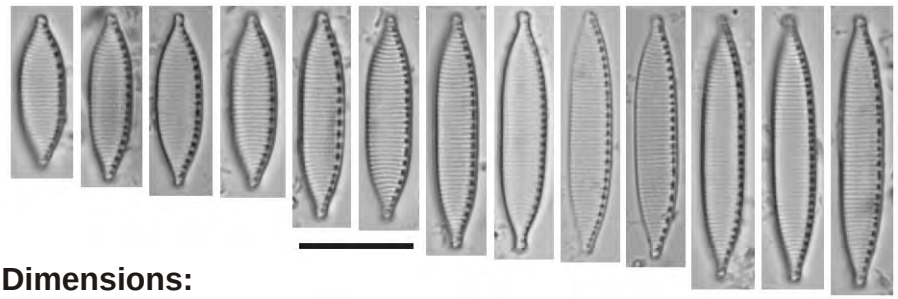
Dimensions:
Valve length = 5-40 µm
Valve breadth = 2-4.5 µm
Striae density = 20 /10 µm
Fibulae density = 7-10(14) /10 µm
Comments: Valves lanceolate, linear lanceolate to linear with narrow-cuneate poles and acutely rounded apices. Small block-shaped fibulae support the raphe. Striae are clearly visible in LM, parallel throughout the length of the valve.
Ecology: A cosmopolitan species occurring in very electrolyte-rich to brackish waters.

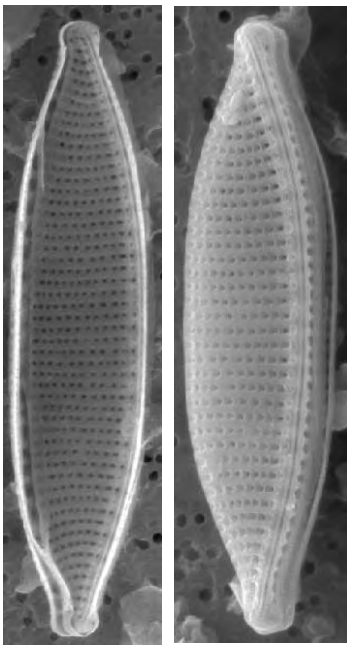
BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia desertorum* Hustedt**

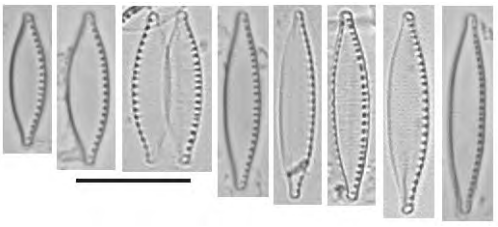




SEM

Dimensions:
Valve length =(13)17-20(24) µm
Valve breadth = 4-5 µm
Striae density = 25(26) /10 µm
Fibulae density = 10-15 /10 µm
Comments: Valves elliptic-lanceolate with protracted short-rostrate apices. Marginal raphe supported by narrow evenly spaced fibulae, equidistant in the middle. Striae visible in LM, clearly punctate.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish inland waters.

***Nitzschia supralitorea* Lange-Bertalot**
Syn. *Nitzschia fonticola* sensu Cholnoky



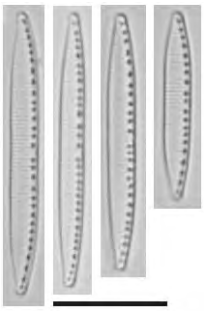
Dimensions:
Valve length = 10-25 µm
Valve breadth = 2.5-4 µm
Striae density = 25-34 /10 µm
Fibulae density = 14-18(20) /10 µm
Comments: Valves lanceolate to linear-lanceolate with weakly protracted slightly capitate apices. Small fibulae more or less equidistant, with no gap in the centre. Striae weakly discernible or not visible in LM.
Ecology: A cosmopolitan species found in eutrophic waters with moderate to moderately high electrolyte content. Also occurring in supralitoral sites, tolerant of osmotic fluctuations and strongly polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

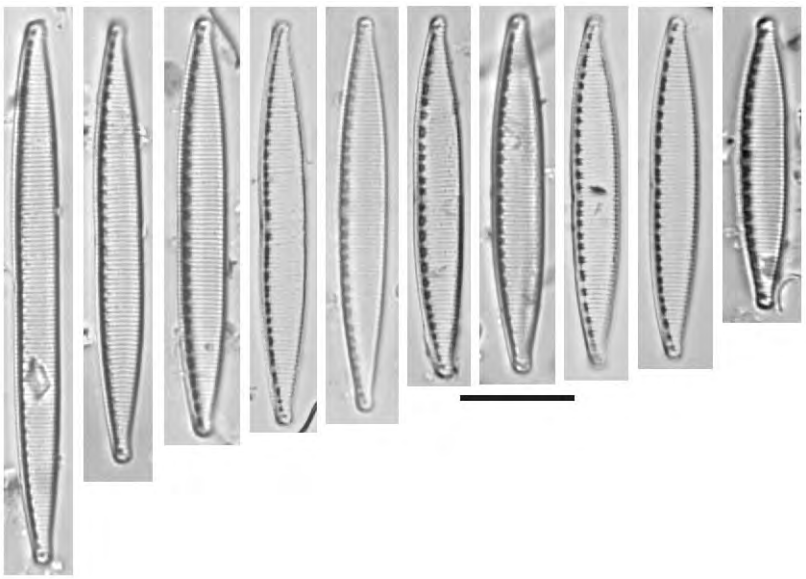
Raphe systems of two valves on opposite sides of the frustule

Nitzschia acidoclinata Lange-Bertalot



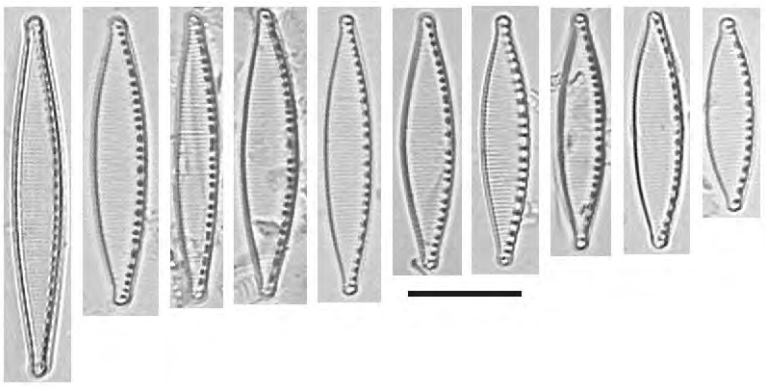
Dimensions:
Valve length = 8-50 µm
Valve breadth = 3-4 µm
Striae density = 27-34 /10 µm
Fibulae density = 7-12.5 /10 µm
Comments: Valves linear, poles cuneate, apices rounded or weakly capitate. Marginal raphe supported by block-like unevenly spaced fibulae, interrupted in the middle. Striae visible in LM.
Ecology: A common species found in acidic, oligotrophic, electrolyte poor, small water bodies.

Nitzschia hantzschiana Rabenhorst



Dimensions:
Valve length = 8-50 µm
Valve breadth = 3-4(5) µm
Striae density = 20-26 /10 µm
Fibulae density = 7-12.5 /10 µm
Comments: Valves linear-lanceolate to elliptic-lanceolate with cuneate poles and rounded or weakly capitate apices. A clear gap (central nodule) may be seen between the central fibulae. Punctate striae visible in LM.
Ecology: A cosmopolitan species found in acidic, electrolyte-poor, cool and clean waters. Commonly occurring in montane biotopes in the Drakensberg.

Nitzschia fonticola Grunow



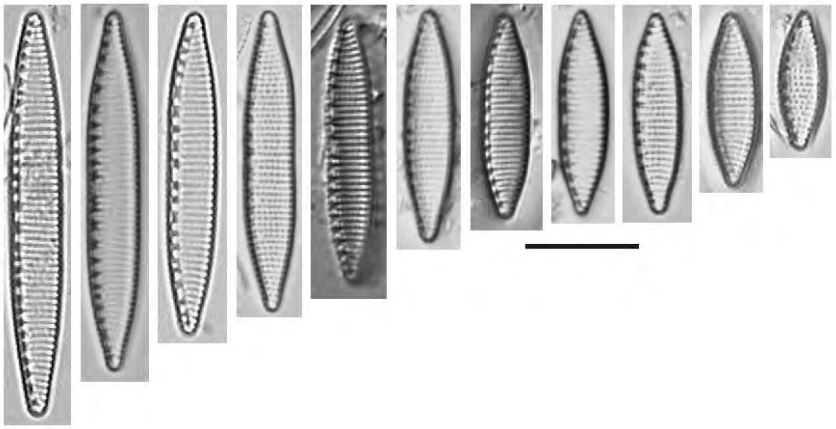
Dimensions:
Valve length = 10-65 µm
Valve breadth = 2.5-5 µm
Striae density = 23-33 /10 µm
Fibulae density = 9-16 /10 µm
Comments: Valves narrow-lanceolate with slightly protracted weakly capitate or acutely rounded apices. Fibulae with a clear gap in the middle of the valve. Striae (usually) clearly discernible in LM.
Ecology: A cosmopolitan species in waters with moderate to high electrolyte content. Found in slightly or moderately polluted conditions. A good indicator of clean water.

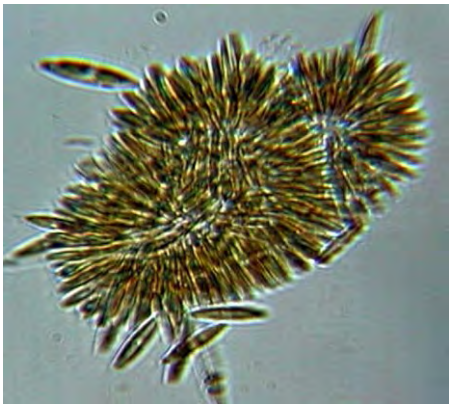
BIRAPHIDEAE

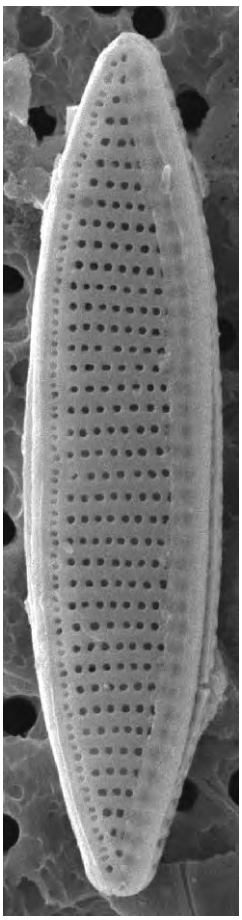
Taxa with a raphe on both valves

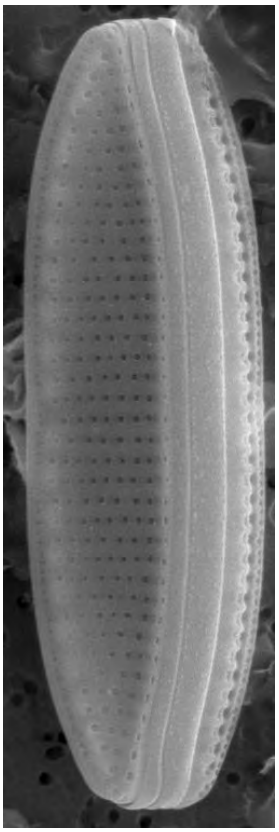
Raphe systems of two valves on opposite sides of the frustule

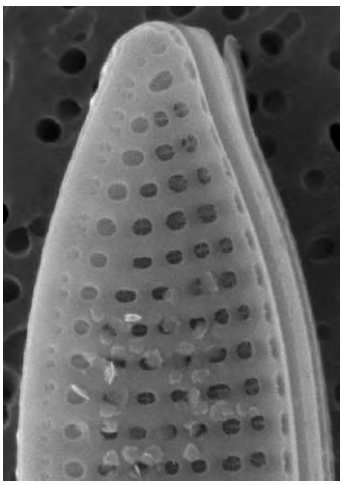
***Nitzschia amphibia* Grunow**

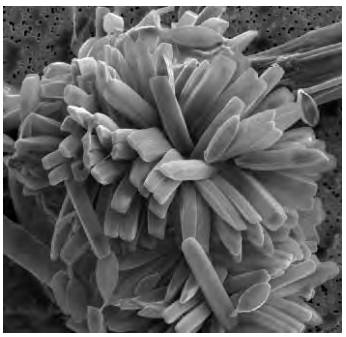












SEM

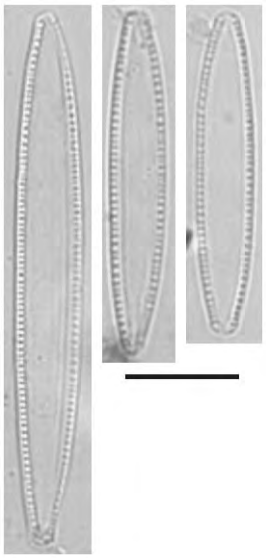
Dimensions:
Valve length = 6-50 µm
Valve breadth = 4-6 µm
Striae density = 13-18 /10 µm
Fibulae density = 7-9/10 µm
Comments: Frustules strongly silicified. Valves elliptical, lanceolate, linear-lanceolate to linear with variably shaped apices, mostly sharply rounded. At some focal depths the fibulae seem to merge with the striae. Striae clearly punctate in LM.
Ecology: Found in eutrophic waters over a range from electrolyte-poor to electrolyte-rich waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

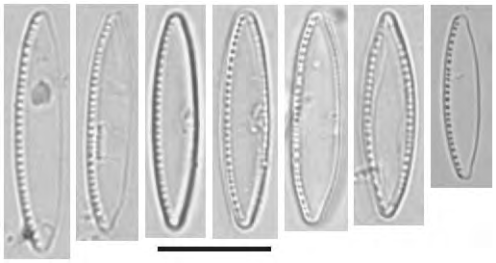
Raphe systems of two valves on opposite sides of the frustule

***Nitzschia etoshensis* Cholnoky**



Dimensions:
Valve length = 20-60 µm
Valve breadth = 4-5.5 µm
Striae density = >40 /10 µm
Fibulae density = 15-18 /10 µm
Comments: Frustules weakly silicified. Valves lanceolate to linear-lanceolate with rounded, never protracted apices. Raphe marginal, fibulae small, narrow. Striae not visible in LM.
Ecology: Occurs in electrolyte-rich to saline waters.

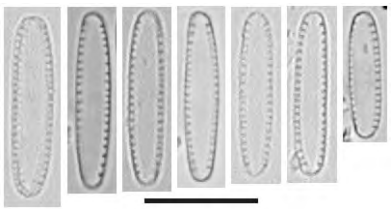
***Nitzschia perspicua* Cholnoky**

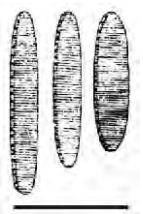


Iconotype, Cholnky (1960b)

Dimensions:
Valve length = 17-25(36) µm
Valve breadth = 3-4 µm
Striae density = 50 /10 µm
Fibulae density = 15-17(20) /10 µm
Comments: Frustules weakly silicified. Valves narrow-elliptical with bluntly rounded or slightly sub-rostrate apices. Marginal raphe supported by small fibulae. Striae not discernable in LM.
Ecology: A species commonly occurring in saline waters.

***Nitzschia aurariae* Cholnoky**
Syn. *Nitzschia elliptica* var. *alexandrina* Cholnoky





Iconotype, Cholnky (1966)

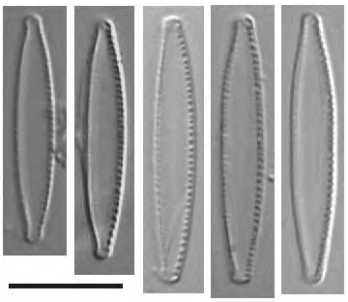
Dimensions:
Valve length = 6.5-18 µm
Valve breadth = 2.5-3.5(4) µm
Striae density = 46-53 /10 µm
Fibulae density = (13)25-18 /10 µm
Comments: Frustules weakly silicified. Valves linear-elliptical with broadly rounded, never protracted apices. Fibulae equidistant, no gap in the centre of the valve. Striae not visible in LM except with special lighting.
Ecology: A cosmopolitan species occurring in electrolyte-rich waters and sporadically in other types of waters. Found commonly in effluent waters from gold mines.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia pusilla* Grunow**



Dimensions:
Valve length = 8-33 µm
Valve breadth = 2.5-5 µm
Striae density = (40)43-55 /10 µm
Fibulae density = 14-20(24) /10 µm
Comments: Frustules weakly silicified. Valves linear-lanceolate, seldom elliptical. Apices bluntly rounded or weakly protracted in larger specimens. Fibulae equidistant with no central area. Striae not discernable in LM, except with special lighting.
Ecology: A cosmopolitan species found in a variety of eutrophic waters as well as on damp earth. Not tolerant of pollution.

***Nitzschia communis* Rabenhorst**

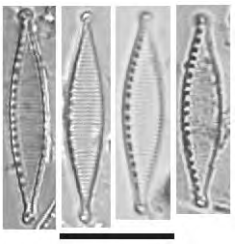
Dimensions:
Valve length = 6-40(60) µm
Valve breadth = 4-5.8 µm
Striae density = 28-38 /10 µm
Fibulae density = (8)10-14 /10 µm
Comments: Valves elliptical, linear-elliptical to linear, never lanceolate. Broadly rounded, seldom weakly protracted bluntly rounded apices. Striae supported by small block-shaped fibulae which may be fused, with no gap in the centre of the valve. Striae usually discernable in LM.
Ecology: A cosmopolitan species usually found in electrolyte-rich and brackish waters. Tolerant of extremely polluted conditions

BIRAPHIDEAE

Taxa with a raphe on both valves

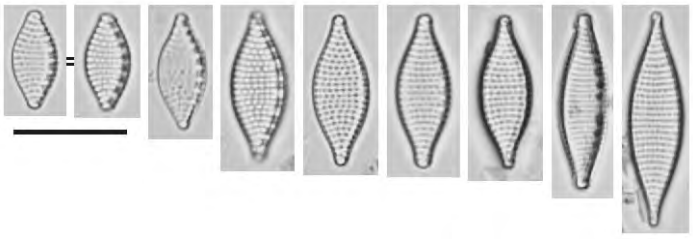
Raphe systems of two valves on opposite sides of the frustule

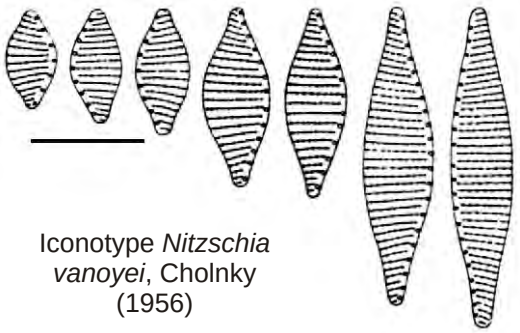
***Nitzschia bacillum* Hustedt**



Dimensions:
Valve length = 12-20(24) µm
Valve breadth = 2-3.5(5?) µm
Striae density = 27-32 /10 µm
Fibulae density = 12-16 /10 µm
Comments: Valves strictly lanceolate with more or less protracted acutely rounded or weakly capitate apices. No central area present. Striae clearly visible in LM.
Ecology: A cosmopolitan species usually found in oligotrophic, electrolyte-rich waters.

***Nitzschia lancettula* O Müller**
Syn. *Nitzschia vanoyei* Cholnoky





Iconotype *Nitzschia vanoyei*, Cholnky (1956)

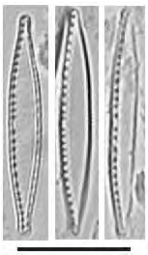
Dimensions:
Valve length = (8)10-25 µm
Valve breadth = 4.5-5.5 µm
Striae density = 18-20 /10 µm
Fibulae density = 7-9 /10 µm
Comments: Valves lanceolate usually with sharply rounded slightly protracted apices. The smaller specimens have more bluntly rounded apices. Striae parallel in the middle becoming strongly curved towards the apices. The large round puncta comprising the striae are easily visible in LM.
Ecology: A tropical to sub-tropical species preferring alkaline waters.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

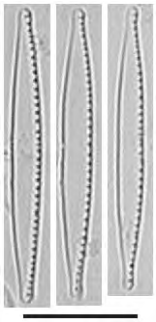
Nitzschia paleacea (Grunow) Grunow



SEM

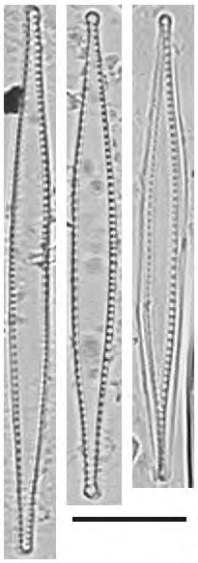
Dimensions:
Valve length = 8-55(80) µm
Valve breadth = 1.5-4 µm
Striae density = 44-55 µm
Fibulae density = (12)14-19 /10 µm
Comments: Valves rhombic-lanceolate to narrow linear-lanceolate. Poles narrow, apices sharply rounded. There is a clear gap between the two fibulae at the valve centre. Striae not discernable in LM.
Ecology: A cosmopolitan common species occurring in more or less eutrophic waters of moderate to high electrolyte content. Tolerant of very heavy levels of pollution.

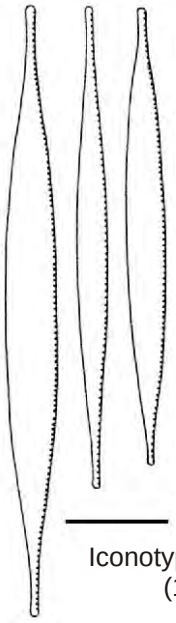
Nitzschia archibaldii Lange-Bertalot



Dimensions:
Valve length = 15-40 µm
Valve breadth = 2-3 µm
Striae density = 46-55 /10 µm
Fibulae density = 14-19 /10 µm
Comments: Valves narrow lanceolate, apices rounded sometimes protracted, weakly capitate. Raphe supported by short equidistant fibulae with no gap in the centre, central nodule absent. Striae not visible in LM.
Ecology: A cosmopolitan species found in circumneutral, slightly to moderately polluted waters with moderate electrolyte content. Reported to be tolerant of Pb and Zn.

Nitzschia iremissa Cholnoky





Iconotype, Cholnky (1959)

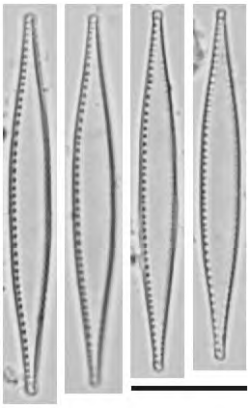
Dimensions:
Valve length = (33)45-65 µm
Valve breadth = 3-5 µm
Striae density = >40 /10 µm
Fibulae density = 18 /10 µm
Comments: Valves linear narrowing towards the apices. Poles elongate (3-8 µm), apices rounded or slightly capitate. Raphe marginal, supported by small round evenly distributed fibulae with no gap in the centre. Striae not visible in LM.
Ecology: Little is known about the ecology of this species, but it is thought to be tolerant of elevated levels of pollution.

BIRAPHIDEAE

Taxa with a raphe on both valves

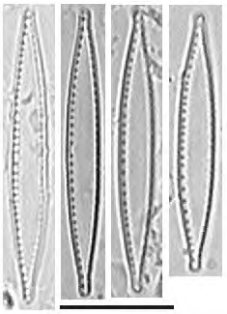
Raphe systems of two valves on opposite sides of the frustule

Nitzschia agnita **Hustet**



Dimensions:
Valve length = 25-40 µm
Valve breadth = 3-3.5 µm
Striae density = >35 /10 µm
Fibulae density = 13-20 /10 µm
Comments: Valves lanceolate, poles narrowly protracted with small capitate apices. Marginal raphe with equidistant fibulae. Striae not visible in LM. Cholnoky distinguished *N. iremissa* (see previous page) from *N. agnita* on the basis of the more linear valve margins and greater length of the valves of *N. iremissa*. Whether this is valid distinction or not is unclear. See discussion in Archibald (1983).
Ecology: A cosmopolitan species found in electrolyte rich to brackish waters.

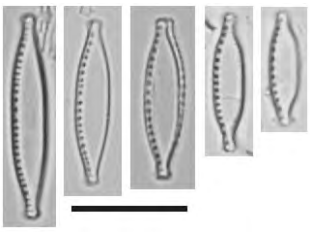
Nitzschia agnewii **Cholnoky**



Cholnky (1968b)

Dimensions:
Valve length = (11)15-20(26) µm
Valve breadth = 2-2.5 µm
Striae density = >40 /10 µm
Fibulae density = 16-19(14) /10 µm
Comments: Valves narrow lanceolate with more or less elongated thin poles and more or less capitate apices. Raphe supported by small fibulae, equidistant in the centre. Striae not visible in LM.
Ecology: This species occurs in South Africa in eutrophic waters.

Nitzschia microcephala **Grunow**



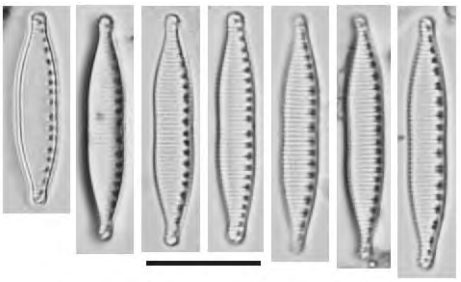
Dimensions:
Valve length = 7-19 µm
Valve breadth = 2.3-4 µm
Striae density = 30-41 /10 µm
Fibulae density = 9-19 /10 µm
Comments: Valves lanceolate, elliptical to linear-elliptical with abruptly protracted short rostrate or capitate apices. Marginal raphe supported by small fibulae of variable density, equidistant in the centre. Striae difficult to resolve using LM.
Ecology: A cosmopolitan species usually found in electrolyte-rich waters with critical levels of pollution. Tolerant of changes in osmotic pressure

BIRAPHIDEAE

Taxa with a raphe on both valves

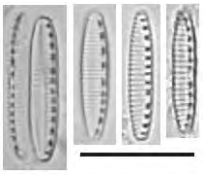
Raphe systems of two valves on opposite sides of the frustule

***Nitzschia elegantula* Grunow**



Dimensions:
Valve length = 10-29 µm
Valve breadth = 2.5-4 µm
Striae density = 23-32 /10 µm
Fibulae density = 10-15 /10 µm
Comments: Valves lanceolate to linear with abruptly protracted, short rostrate to capitate apices. Valve margins concave near the centre, the raphe-less margin being somewhat more so. Marginal raphe with equidistant fibulae. Striae with fine puncta usually visible in LM.
Ecology: A cosmopolitan species found in electrolyte rich waters.

***Nitzschia valdecostata* Lange-Bertalot & Simonsen**



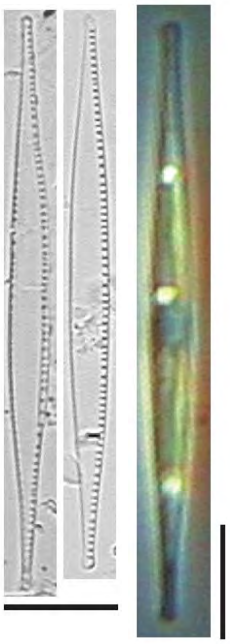
Dimensions:
Valve length = 10-25 µm
Valve breadth = 3-4.5 µm
Striae density = 17-20 /10 µm
Fibulae density = 7-9 /10 µm
Comments: Valves linear-elliptical, the smallest specimens are elliptical with bluntly rounded, never protracted apices. Marginal raphe supported by broad fibulae, central area absent. Striae easily discernible in LM.
Ecology: A cosmopolitan species found in electrolyte rich waters, favouring waters with high concentrations of sulphates and carbonates.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

Nitzschia gracilis **Hantzsch**



Dimensions:
Valve length = 30-110 µm
Valve breadth = 2.5-4 µm
Striae density = 38-42 µm
Fibulae density = 12-18 /10 µm
Comments: Valves narrow linear-lanceolate, poles narrowed (acicularoid) and protracted, apices weakly capitate or weakly rostrate. Raphe marginal with small irregular fibulae, central area absent. Striae not discernible in LM without special illumination.
Ecology: A cosmopolitan species found in eutrophic, electrolyte-rich waters but not tolerating more than moderately polluted conditions.

Nitzschia pumila **Hustedt**

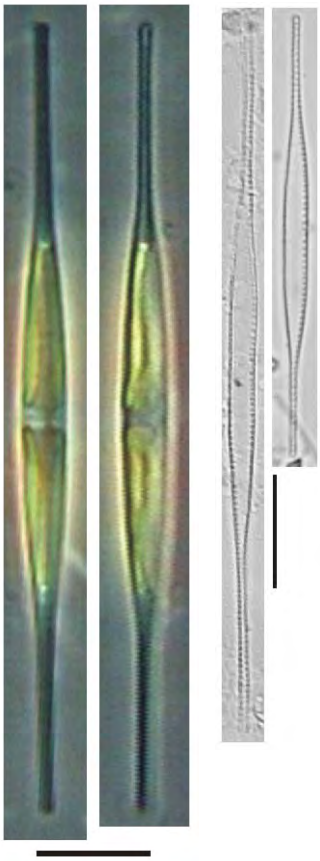
Dimensions:
Valve length = (26)30-37 µm
Valve breadth = 2.5-3 µm
Striae density = >40 /10 µm
Fibulae density = 14-18 /10 µm
Comments: Valves narrow lanceolate with long narrow poles ending in capitate or acutely rounded apices. Marginal raphe supported by very small fibulae, equidistant in the middle. Striae not visible in LM without special illumination.
Ecology: Little is known of this species except that it it occurs in alkaline lakes.

BIRAPHIDEAE

Taxa with a raphe on both valves

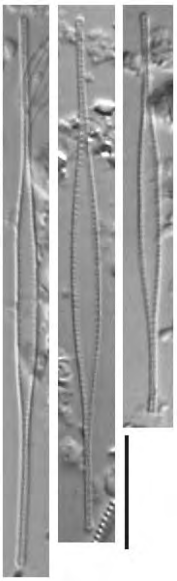
Raphe systems of two valves on opposite sides of the frustule

Nitzschia draveillensis Coste & Ricard



Dimensions:
Valve length = 40-110 µm
Valve breadth = 3-4.5 µm
Striae density = 55-64 /10 µm
Fibulae density = 18-21 /10 µm
Comments: Valves spindle-shaped with long narrow poles and narrow rostrate apices. The central fibulae are widely spaced and this differentiates *N. draviellensis* from *N. acicularis* which has equidistant central fibulae. Striae not visible in LM.
Ecology: A cosmopolitan species usually in the plankton of eutrophic waters.

Nitzschia acicularis (Kützing) W Smith



Dimensions:
Valve length = 30-150 µm
Valve breadth = 2.2-5 µm
Striae density = 60-72 /10 µm
Fibulae density = 15-22 /10 µm
Comments: Frustules very weakly silicified and may be easily damaged during preparation. Valves spindle-shaped with long thin poles, rounded at the apex. Marginal raphe with very small, equidistant fibulae. No central area. Striae not visible in LM.
Ecology: A planktonic as well as epipelic species found in eutrophic waters with moderate to high electrolyte content. Tolerant of strong pollution but not of extremely polluted conditions.

BIRAPHIDEAE

Taxa with a raphe on both valves

Raphe systems of two valves on opposite sides of the frustule

***Nitzschia reversa* W Smith**

Dimensions:
Valve length = 40-180 µm
Valve breadth = 5-9 µm
Striae density = 30 /10 µm
Fibulae density = 7-10(14) /10 µm
Comments: Valve shape similar to *N. draviellensis* with the exception of the poles which are deflected in opposite directions. As with *N. draveillensis* the central fibulae are widely spaced forming a gap.
Ecology: A cosmopolitan species usually found in coastal waters but also occurring in saline inland biotopes.

***Nitzschia closterium* (Ehrenberg) W Smith**

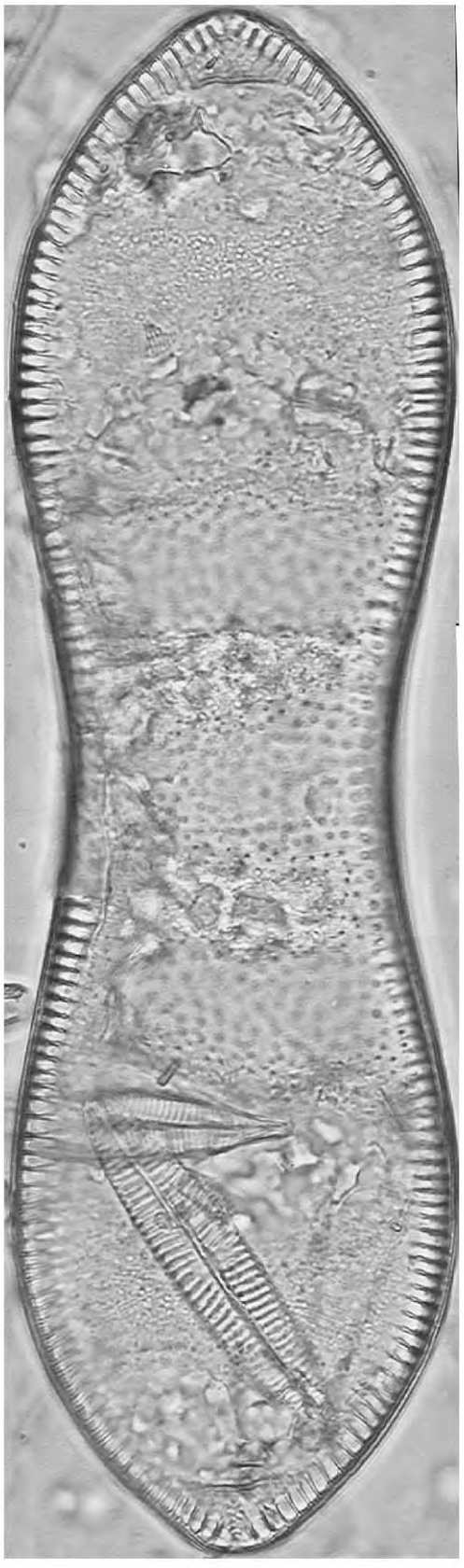
Dimensions:
Valve length = 30-400µm
Valve breadth = (1)2-6 µm
Striae density = Not discernable
Fibulae density = 12-37 /10 µm
Comments: Frustules exceptionally weakly silicified. Valves spindle-shaped with very long, narrow, hair-like poles. The poles are often bent, curved or twisted, even in living specimens.
Ecology: A cosmopolitan species usually found in the plankton of brackish waters but extending into other brackish biotopes such as wetlands. Also found in saline inland waters.

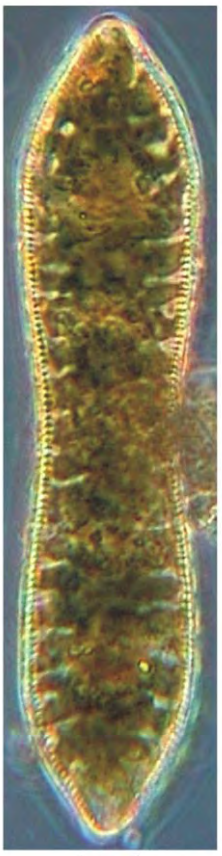
BIRAPHIDEAE

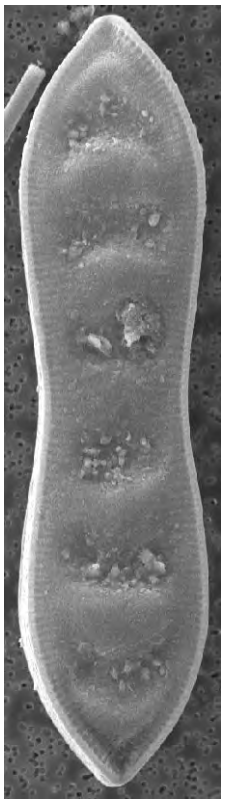
Taxa with a raphe on both valves

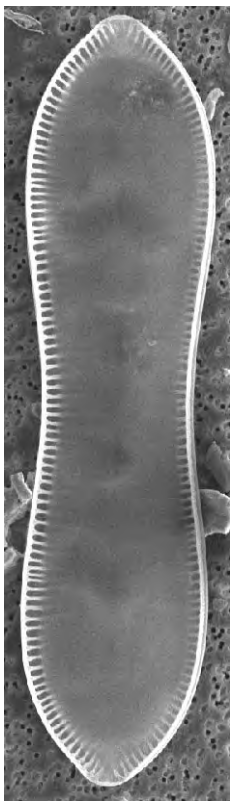
Cells with a fibulate raphe system around the whole circumference of the valve

***Cymatopleura solea* (Brébisson) W Smith**









SEM

Dimensions:
Valve length = 30-300 µm
Valve breadth = 10-45 µm
Striae density = 25-32 /10 µm
Fibulae density = 6-9 /10 µm

Comments:
Valves narrow to broadly linear, margins weakly to strongly panduriform, very seldom parallel. Apices slightly cuneate, broadly rounded. Valve face strongly longitudinally undulate, 4-6 “waves” per valve. These undulations are most clearly visible in girdle view. Longer forms can also be seen to have warts ornamenting the valve face.

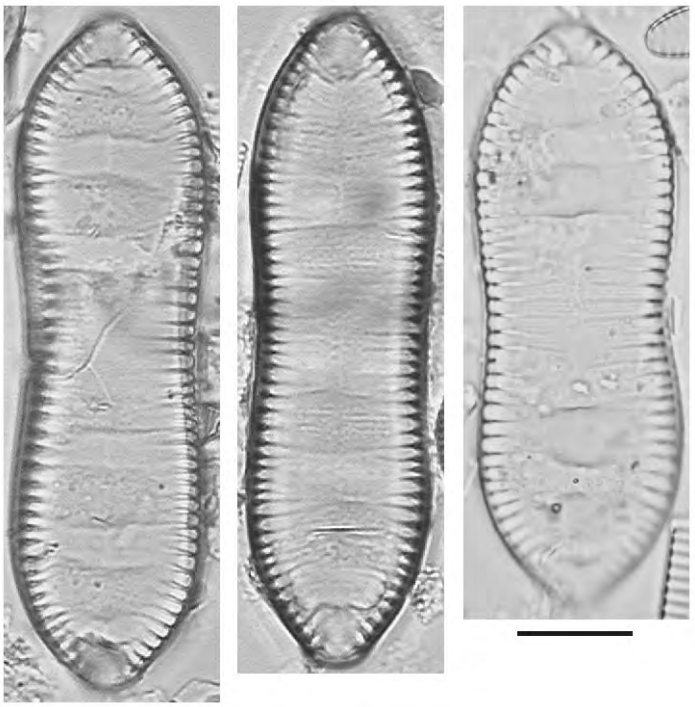
Ecology:
A cosmopolitan species found in eutrophic waters with moderate to high electrolyte content sometimes found in brackish biotopes. Favouring alkaline waters. An epipelic and epiphytic species found in the littoral zone.

BIRAPHIDEAE

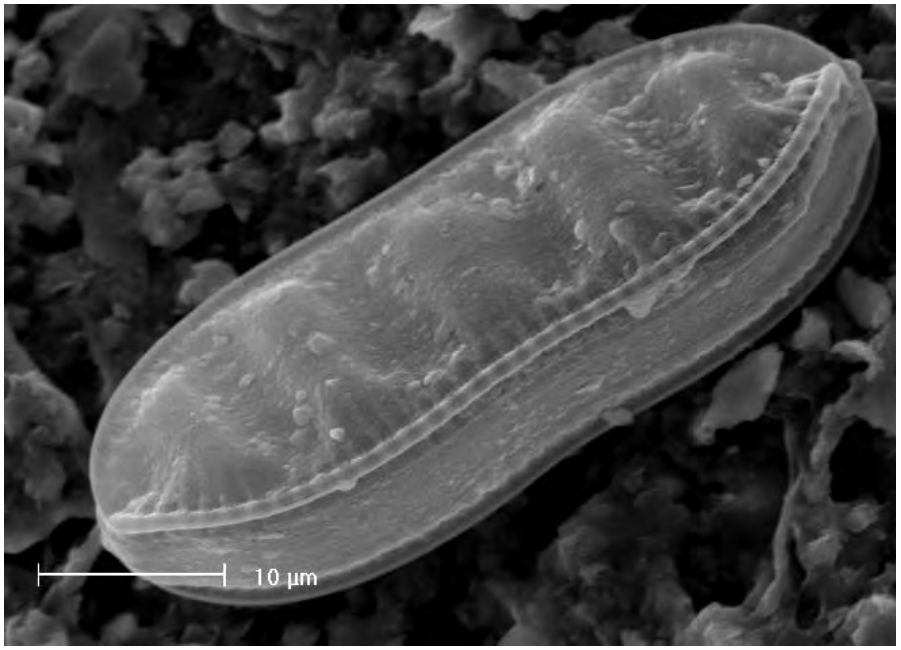
Taxa with a raphe on both valves

Cells with a fibulate raphe system around the whole circumference of the valve

***Cymatopleura solea* var. *apiculata* (W Smith) Ralfs**



Dimensions:
Valve length = 30-300 µm
Valve breadth = 10-45 µm
Striae density = 25-32 /10 µm
Fibulae density = 6-9 /10 µm
Comments: See *C. solea.* Valves smaller than the nominate variety but with much more prominent longitudinal undulations of the valve face.
Ecology: Similar to the nominate variety.



SEM

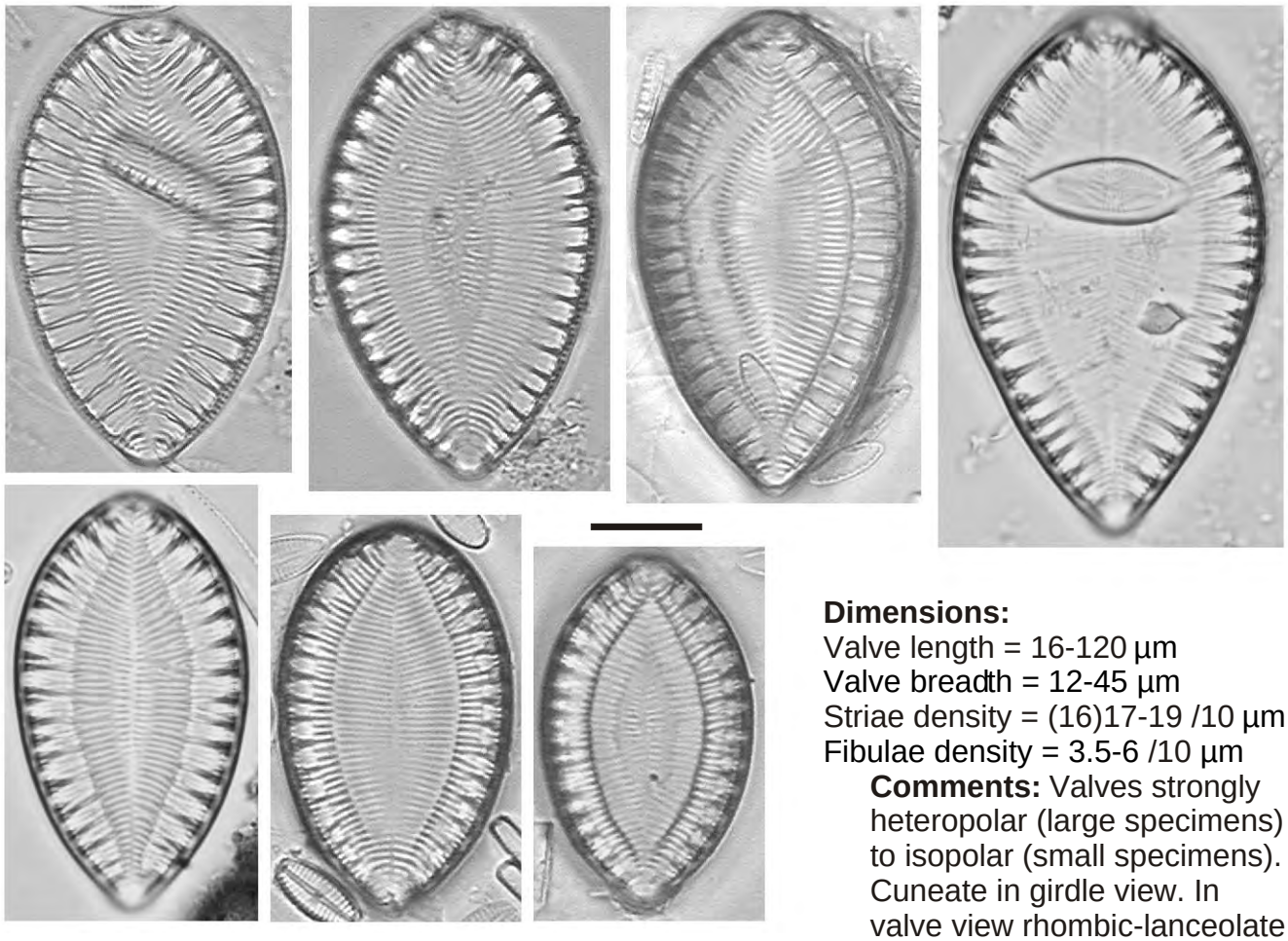
Plate 174

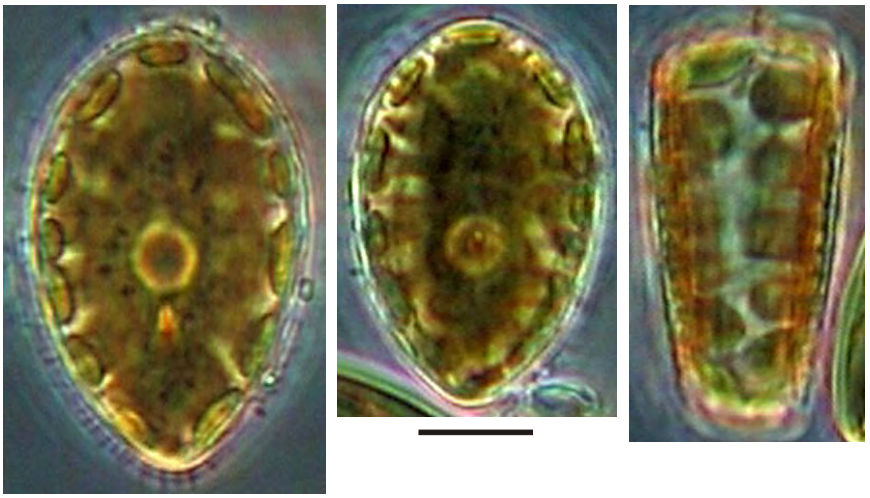
BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with a fibulate raphe system around the whole circumference of the valve

***Surirella ovalis* Brébisson**





Dimensions:
Valve length = 16-120 µm
Valve breadth = 12-45 µm
Striae density = (16)17-19 /10 µm
Fibulae density = 3.5-6 /10 µm

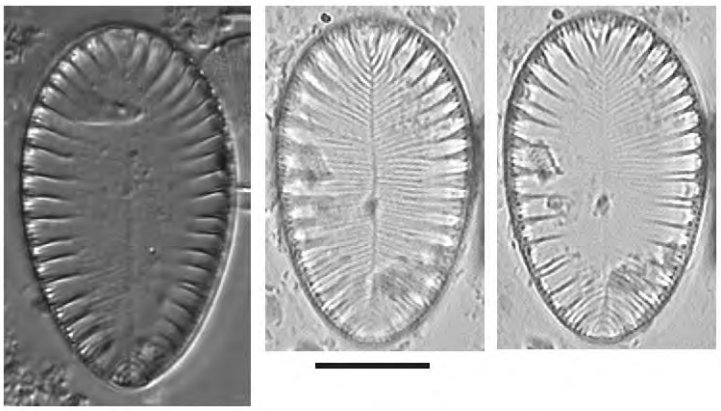
Comments: Valves strongly heteropolar (large specimens) to isopolar (small specimens). Cuneate in girdle view. In valve view rhombic-lanceolate to broad-lanceolate. Apices rounded. Valve concentrically undulate, this can be seen in LM by some portions of the valve being in focus when others are out of focus. The striae are interrupted by a clear longitudinal line where the fibulae end.

Ecology: A cosmopolitan species found in waters of high electrolyte content.

BIRAPHIDEAE

Taxa with a raphe on both valves
Cells with a fibulate raphe system around the whole circumference of the valve

Surirella brebissonii Krammer & Lange-Bertalot

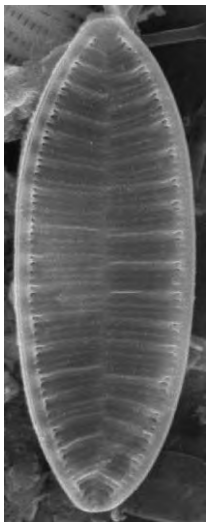


Dimensions:
Valve length = 8-70 µm
Valve breadth = 8-30 µm
Striae density = (16)17-19(20) /10 µm
Fibulae density = 3.5-6(7) /10 µm
Comments: Valves elongate-oval, oval, broad-elliptical to round. Apices bluntly rounded. Valve ornamentation concentrically undulate, less so than *S. ovalis*. Striae meet in the middle forming a fault line along the middle of the valve.
Ecology: A cosmopolitan species found in waters of moderate to high electrolyte content also extending into brackish waters.

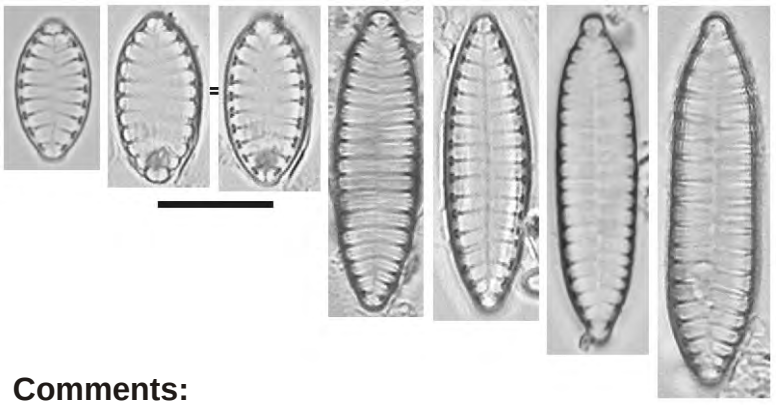
Surirella crumena Brébisson

Dimensions:
Valve length = 30-65 µm
Valve breadth = 27-31 µm
Striae density = 12-21 /10 µm
Fibulae density = 3.5-8 /10 µm
Comments: Valves oval-lanceolate to round (smaller specimens). Larger specimens are clearly concentrically undulate, smaller specimens not so.
Ecology: A cosmopolitan species found in electrolyte-rich and brackish waters. More common in coastal waters than in inland waters.

Surirella angusta Kützing



SEM



Dimensions:
Valve length = 12.5-70 µm
Valve breadth = 6-15 µm
Striae density = (20)22-28 /10 µm
Fibulae density = 5.5-8 /10 µm

Comments:
Valves isopolar to weakly heteropolar, linear. Apices cuneate, rounded sometimes very slightly protracted. The fibulae are extended from the valve margin to the centre of the valve.
Ecology: A cosmopolitan species found in eutrophic waters with moderate electrolyte content.

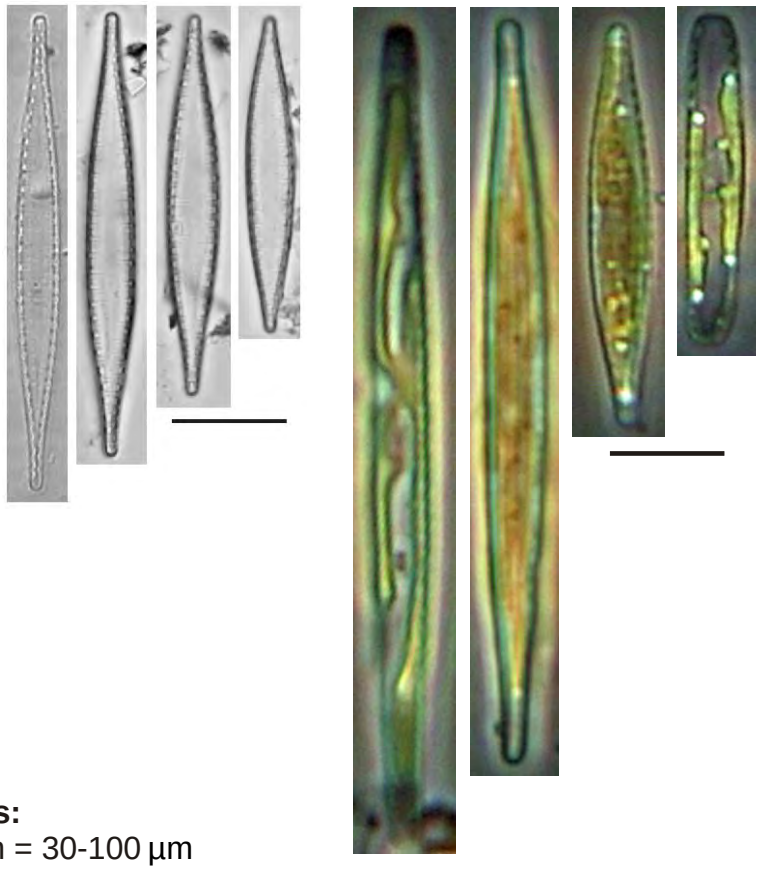
Plate 176

BIRAPHIDEAE

Taxa with a raphe on both valves

Cells with a fibulate raphe system around the whole circumference of the valve

***Stenopterobia delicatissima* (Lewis) Brébisson**



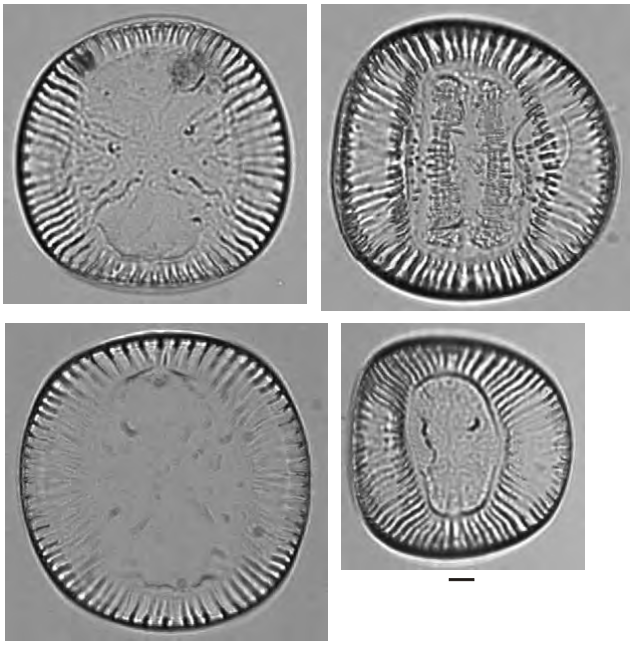
Dimensions:
Valve length = 30-100 µm
Valve breadth = 3.5-9 µm
Striae density = 18-27 /10 µm
Fibulae density = 4-7.5 /10 µm
Comments: Valves isopolar, elongate-linear to linear-lanceolate, margins parallel or slightly convex. Apices sharply rounded, often distinctly protracted. The striae are interrupted in the mid-line by a hylaline area which is broad-lanceolate to linear-lanceolate in shape and may occupy up to one third of the valve area. Fibulae not well developed.
Ecology: A cosmopolitan species occurring in acidic, oliotrophic (sometimes dystrophic) upland waters with low to moderate electrolyte content.

BIRAPHIDEAE

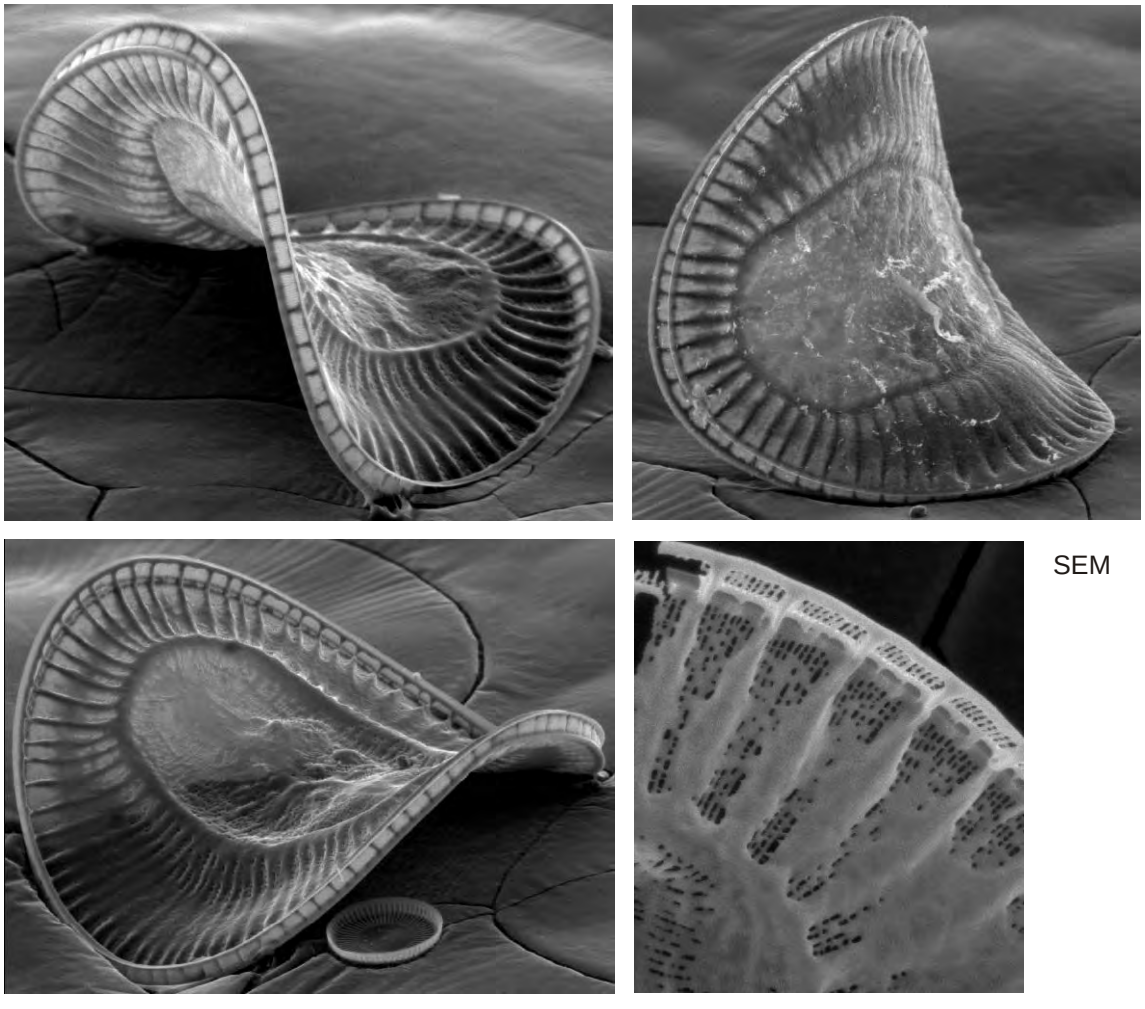
Taxa with a raphe on both valves

Cells with a fibulate raphe system around the whole circumference of the valve

***Campylodiscus clypeus* Ehrenberg**



Dimensions:
Valve diameter = 80-200 µm
Striae density = 15-19 /10 µm
Fibulae density = 1.5 /10 µm
Costae density = 15-19 /10 µm
Comments: Valves saddle-shaped, the fibulae are interrupted by a continuous hayaline ring (sternum) leaving a roughly rectangular area in the middle of the valve
Ecology: A cosmopolitan species found in saline waters, especially in coastal regions. This species may be found in inland salt pans in the Freestate.



SEM

Plate 178