

Diatoms of the Mystery Lake, Taiwan (I)

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ABSTRACT: Mystery Lake is a slightly acidic, oligotrophic subalpine lake situated within a hardwood nature preserve in northeastern Taiwan. This lake is rich in diatoms, with a total of 76 diatom species found in the surface sediments. As the first part of reporting these diatoms, 36 species, belonging to 16 genera and six families, are described in this article, basing on the morphology observed under the scanning electron microscope. Of the species described here, 17 are newly recorded in Taiwan. They are: *Achnanthes renei*, *A. rupestoides*, *A. subhudsonis*, *Achnantheiopsis frequentissima* var. *magna*, *Actinella brasiliensis*, *Eunotia intermedia*, *E. minor*, *E. septentrionalis*, *E. soleirolii*, *E. zygon*, *Fragilaria bidens*, *Psammothidium marginulatum*, *Pseudostaurosira brevistriata*, *Punctastriata linearis*, *Staurosira construens*, *Staurosira elliptica*, and *Synedra lanceolata*. In addition, six genera, namely *Achnantheiopsis*, *Actinella*, *Psammothidium*, *Pseudostaurosira*, *Punctastriata*, and *Staurosira*, are newly recorded in Taiwan. These results provide basic information for further study in the lake.

KEY WORDS: Taiwan, Mysterious Lake, Diatom, New record, SEM.

INTRODUCTION

Mystery Lake (E121°43', N24°26') is located within the Nanao Hardwood Nature Reserve in northeastern Taiwan. The lake occurs at an altitude of 1,100 m a.s.l. in a prevalent fog belt, and it covers an area of ca. 1.5 ha. It is a shallow lake, with depth less than 2 m, and it is in the late phase in its development. The forest surrounding the lake was comprised primarily of well-preserved hardwoods (Su *et al.*, 1988). The soils in the Mystery Lake watershed were studied by Chen (1992, 1994). However, there are no past records of the lake's algae.

Due to the resistant cell wall, which is composed of siliceous compounds, diatoms are well preserved in the sediments of lakes. Therefore, they are commonly used as indicators for studying the anthropogenic effects (Schmidt and Simola, 1991), eutrophication of water (Stockner, 1972; Whitmore, 1989; Christie and Smol, 1993), and acidification of the environment (Davis, 1987; Steinberg *et al.*, 1989; Whiting *et al.*, 1989). In Taiwan, diatoms have been used to study changes in the paleolimnological environment (Wu and Chang, 1996; Wu *et al.*, 1997; Chen and Wu, 1999). Until recently, Mystery Lake was virtually undisturbed by human activity, and as a result, diatoms are well preserved in the lake's sediments. Thus, it provides a unique record of paleoenvironmental changes in its surrounding area. Before conducting such a study, the floristic data about diatoms in the lake should be well

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understood. For this purpose, the taxa of diatoms occurring in the sediments were identified on the basis of fine structure observed under a scanning electron microscope (SEM). In the present article, a part of these results is presented.

MATERIALS AND METHODS

Six surface sediment samples from different localities of the lake were collected with a plastic pipe (6 cm in diameter). They were treated with an acid solution in the laboratory, as described by Chen and Wu (1999). A part of the acid treated samples was stored in the mixture of glycerol and formalin (3:1) in eppendorff tubes. The rest of the sample was dehydrated through an alcohol series, and dried by the critical point dryer (Hitachi HCP-2). Dried diatoms were mounted on aluminum stubs and coated with gold by a sputter coater (Edwards S150A). Coated stubs were viewed on a Zeiss DSM 950 SEM. The materials examined in this study were stored in the Phycological Laboratory, Institute of Botany, Academia Sinica, Taipei, Taiwan.

RESULTS

A total of 76 diatom species were identified from the samples of the lake sediments. In this article, the taxa belonging to Achnanthes, Eunotiales, Fragillariales, Rhopalodiales, Tabellariales are described. Their morphology was based on the observations under the SEM. The taxonomic designations of the genera are listed in Table 1.

Table 1. Summaries of the diatom genera and their taxonomic positions described in the present article.

Class FRAGILLARIOPHYCEAE Round 1990

Fragillariales Silva 1962

Fragilarioaceae Greville 1833

Fragilaria, *Pseudostaurosira*; *Punctastriata*; *Staurosira*; *Synedra*

Tabellariales Round 1990

Tabellariaceae Kützing 1844

Tabellaria

Class BACILLARIOPHYCEAE Haeckel 1878

Eunotiales Silva 1962

Eunotiaceae Kützing 1844

Eunotia, *Actinella*

Achnanthes Silva 1962

Achnantheaceae Kützing 1844

Achnanthes; *Achnantheiopsis*; *Achnantheidium*; *Lemnicola*; *Psammothidium*; *Rossithidium*

Cocconeidaceae Kützing 1844

Cocconeis

Rhopalodiales D.G. Mann 1990

Rhopalodiaceae (Karsten) Topachevs'kyj & Oksiyuk 1960

Epithemia

Descriptions of the taxa

Order Achnanthes
 Family Achnantheaceae
 Genus *Achnanthes* Bory 1822

Valves mostly lanceolate or linear-lanceolate, sometimes linear-elliptical or elliptical, valves maybe moderately convex, but more often only slightly convex to essentially flat surfaces. Opposing valves usually with similar striae pattern but some maybe markedly different. Raphe and pseudoraphe straight and median, marginal or submarginal, diagonal and/or sigmoid. Striae mostly radiate or parallel, coarsely to finely, uniseriately to multiseriately punctate. There were five species in the Mystery Lake.

Key to the species

- 1A. The valve twice concave, with gibbous center *A. inflata*
 1B. The valve not twice concave, without gibbous center 2
 2A. The raphe valve with transversally central space 3
 2B. The raphe valve without transversally central space *A. subhudsonis*
 3A. The central spaces stauroid and reaching to both margins in the raphe valve *A. exigua*
 3B. The central space rectangular and not reaching to both margins in the raphe valve 4
 4A. The central area broad-oval in the raphe valve *A. rupestoides*
 4B. The central area rectangular in the raphe valve *A. renei*

1. *Achnanthes exigua* Grunow

Fig. 1. A

Archibald and Schoeman, 1987, p. 79, Fig.5 & 6; Cassie, 1989, p. 235, pl. 3, figs. 2, 4. Fungladda & Kaczmarska, 1983, p. 59, pl. 1, figs. 12-13; Güttinger, 1994c, Plate 2.04.01-13; John, 1983, p. 69, pl. 30, figs. 5-6; Krammer & Lange-Bertalot, 1991b, p. 295, pl. 23, figs. 1-19; Lange-Bertalot & Krammer, 1989, p. 259, pl. 46, figs. 1-2. Patrick & Reimer, 1966, p. 287, pl. 16, figs. 21-22; Podzorski, 1985, p. 155, pl. 33, figs. 4-5; Toledo *et al.*, 1997, p. 370, figs. 2-6.

Synonym: *Achnanthes exigua* var. *constricta* (Torika) Hustedt; *Achnanthes exigua* var. *heterovalva* Krasske.

Valves linear to linear-elliptical, with central quadratic portions and distinctly set off; ends suddenly drawn out, bulbous, rostrate. Raphe valve with narrow and linear axial area, abruptly funnel-shaped widening near the central area; central area rectangular, extending to the margins of the valve; raphe filiform, proximal ends broader than the raphe branch, not extending to the central area, distal ends subtly curved in opposite directions; striae radiate, becoming slightly radiate or parallel towards the ends. Pseudoraphe valve with a narrow, axial area, slightly wider in the center than towards the end; central area a smaller flattened rectangle caused by shortening of one or two striae at the center; striae slightly radiate. Dimension: 5-6 × 15-16 μm, striae 22-25 in 10 μm (PRV), 30-35 in 10 μm (RV).

2. *Achnanthes inflata* (Kützing) Grunow

Fig. 1. C

Foged, 1979, p. 21, pl. 15, figs. 9-12; Fungladda & Kaczmarska, 1983, p. 59, pl. 1, figs. 1, 9; Güttinger, 1994d, Plate 2.04.01-21, 22; Krammer & Lange-Bertalot, 1991b, p. 253, pl. 2, figs. 9-12; Lange-Bertalot & Krammer, 1989, p. 193, pl. 13, figs. 20-22; Patrick & Reimer, 1966, p. 293, pl. 19, figs. 15-16; Podzorski, 1985, p. 97, pl. 4, figs. 13-15; Toledo *et al.*, 1997, p. 371, figs. 22-27.

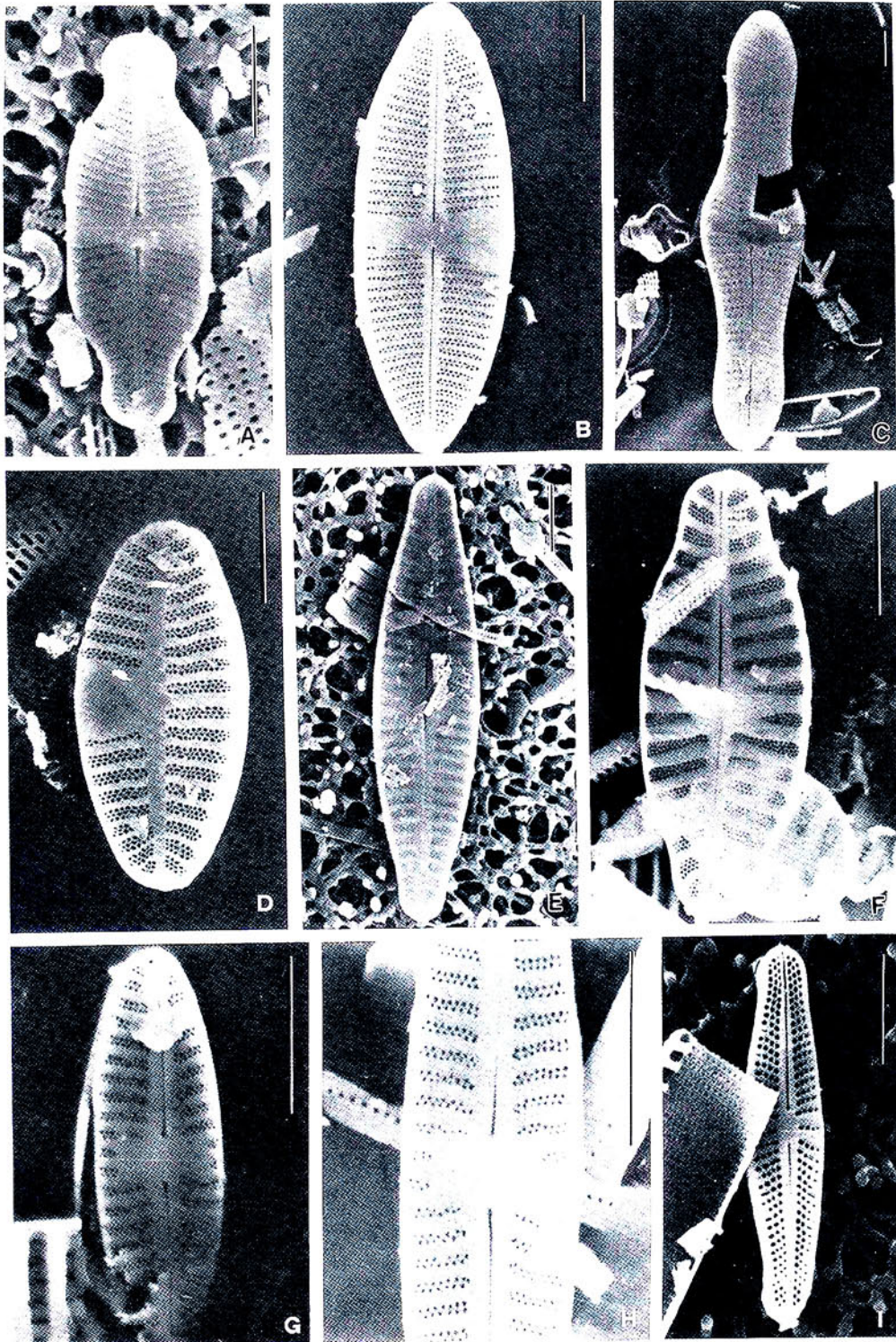


Fig. 1. A. *Achnanthes exigua* raphid valve. B. *Lemnicola hungarica* raphid valve. C. *Achnanthes inflata* raphid valve. D. *Achnantheiopsis lanceolata* pseudoraphid valve. E. *Achnantheiopsis frequentissima* raphid valve. F. *Achnantheiopsis rostrata* raphid valve. G & H. *Rossithidium linearis* var. *pusilla* raphid valve. H. Part of the raphid valve showing raphe ends, central area and striae arrangement. I. *Achnantheidium minutissima* raphid valve. Bar = 4 μ m.

Valve twice concave, forming a gibbous center, and two capitate or subcapitate ends, valve surface arched and longitudinally undulate. Raphe valve with linear, slightly sinuous axial area flaring into widening stauros central area; raphe filiform, proximal ends rounded, not protruding into the central area, distal ends curving in the same direction; striae slightly radiate, uniseriately punctate. Pseudoraphe valve with narrow and linear pseudoraphe, submarginal; no central area; striae parallel except at the ends becoming slightly curved. Dimension: 10-13 × 36-54 μm, striae 10-12 in 10 μm.

3. *Achnanthes renei* Lange-Bertalot et Schmidt

Fig. 2. D

Oppenheim, 1994, p. 1741, figs. 67-70.

Valves linear-elliptical; ends obtusely rounded. Raphe valve with linear axial area; central area rectangular according to the length of two central striae; raphe filiform, proximal ends not protruding into the central area, distal ends straight; striae slightly radiate, biseriately punctate. Dimension: 3-4 × 8-10 μm, striae 20-22 in 10 μm.

4. *Achnanthes rupestoides* Hohn

Figs. 3. A & B

Fungladda & Kaczmarzka, 1983, p. 59, pl. 1, figs. 6-8; Krammer & Lange-Bertalot, 1991b, p. 283, pl. 17, figs. 35-42; Patrick & Reimer, 1966, p. 264, pl. 17, figs. 9-10. Podzorski, 1985, p. 97, pl. 4, figs. 7-8.

Synonym: *Cocconeis hustedtii* Krasske; *Achnanthes hustedtii* (Krasske) Reimer; *Achnanthes krasskei* Kobayasi et Sawatari

Valves oblong-elliptical; ends broadly rounded. Raphe valve: linear axial area; central area broad-oval; raphe straight, becoming slightly broader toward the valve center, proximal ends distant, rounded, distal ends slightly curved in opposite direction; striae radiate, biseriately punctate. Pseudoraphe valve with lanceolate or narrowly rhomboidal space; striae radiate, biseriately punctate, shorter, interrupted by lanceolate or narrowly rhomboidal space. Dimension: 4.5-6 × 12-16 μm, striae 14-16 in 10 μm (PRV), 18-20 in 10 μm (RV).

5. *Achnanthes subhudsonis* Hustedt

Figs. 3. C & D

Gasse, 1986, p. 21, pl. 7, figs. 14-18; Lange-Bertalot & Krammer, 1989, p. 303, pl. 68, figs. 28-38.

Valve linear-lanceolate or lanceolate; ends obtuse or obtusely rounded. Raphe valve: axial and central areas united into a linear-lanceolate space; no central area differentiated; raphe filiform, proximal ends closed, distal ends curving slightly in the same direction; striae in the middle part almost parallel, radiate towards the poles, becoming denser at the poles. Pseudoraphe valve: axial and central areas united into a linear-lanceolate space; striae less radial than on the raphe valve, those in the middle part almost parallel, increasing in density towards the pole; striae punctate, interrupted by a longitudinal space on both sides. Dimension: 4-4.5 × 14-17 μm, striae 20 in 10 μm (PRV), 16-18 in 10 μm (RV).

Genus *Achnantheiopsis* Lange-Bertalot 1997

Valves elliptical to elliptical lanceolate, ends sometimes drawn out. Raphe valve: narrow, linear axial area; central area lacking; raphe filiform, distal ends curved in the same direction; Pseudoraphe valve interrupted by a horseshoe-shaped clear area centrally on one side, horseshoe-shaped area more complicated, partly roofed over by a thin silica hood. Striae multiseriate punctate, slightly radiate. There were three species in the Mystery Lake.

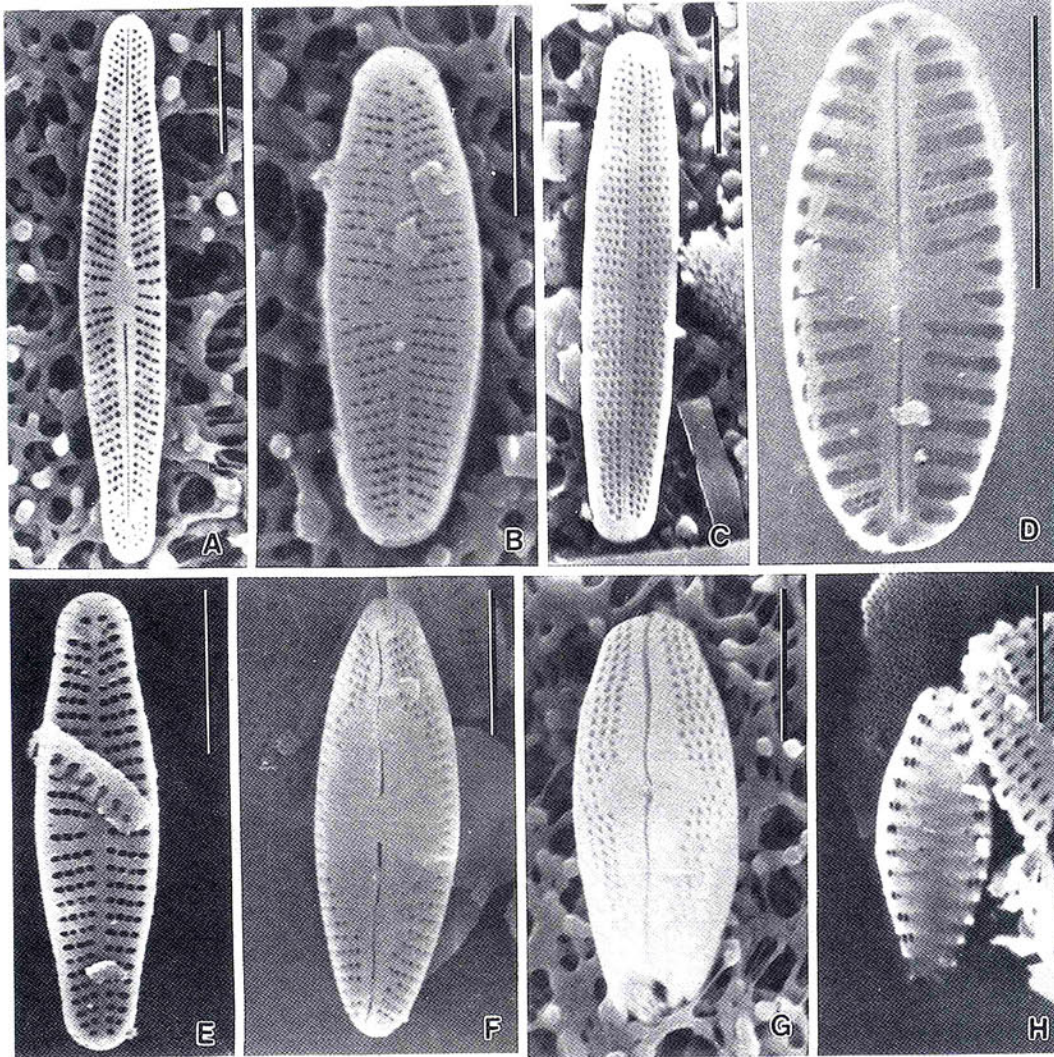


Fig. 2. A. *Achnantheidium exilis* raphid valve. B-C & E. *Achnantheidium minutissima* pseudoraphid valve. D. *Achnanthes renei* raphid valve. F-G. *Psammothidium marginulatum* raphid valve. H. *Pseudostaurosira brevistriata* external valve, showing wide sternum and marginal striae. Bar = 4 μ m.

Key to the species

- 1A. Valves without differentiated ends *A. lanceolata*
 1B. Valves with differentiated ends 2
 2A. The valves are shorter, elliptical to broadly elliptical and the ends rounded rostrate *A. rostrata*
 2B. The valves are longer, narrowly elliptical to elliptical lanceolate and the ends rostrate to subrostrate
 *A. frequentissima* var. *magna*

1. *Achnantheiopsis frequentissima* (Lange-Bertalot) Lange-Bertalot var. *magna* (Straub) Lange-Bertalot

Krammer & Lange-Bertalot, 1991b, p. 337, pl. 44, figs. 7-9, 24-38; Toledo *et al.*, 1997, p. 370, figs. 18-19.

Synonym: *Achnanthes lanceolata* (Brébisson) Grunow subsp. *frequentissima* Lange-Bertalot var. *magna* (Straub) Lange-Bertalot; *Achnanthes lanceolata* (Brébisson) Grunow var. *dubia* f. *minuta* Grunow; *Achnanthes lanceolata* (Brébisson) Grunow var. *dubia* Grunow sensu Van Heurck; *Planothidium lanceolata* (Brébisson) Round et Bukhtiyarova subsp. *frequentissima* Lange-Bertalot var. *magna* (Straub) Lange-Bertalot

Valves narrowly elliptical to elliptical-lanceolate; ends well differentiated, rostrate to subrostrate. Raphe valve: narrow, linear axial area; central area rectangular; raphe filiform, proximal ends rounded, distal ends curved in the same direction; striae multiseriate punctuate, slightly radiate. Pseudoraphe valve interrupted by a horseshoe-shaped clear area centrally on one side, horseshoe-shaped area more complicated, partly roofed over by a thin silica hood. Dimension: 6-7 × 26-28 μm, striae 13 in 10 μm.

2. *Achnantheiopsis lanceolata* (Brébisson) Lange-Bertalot

Fig. 1. D

Archibald and Schoeman, 1987, p. 79, figs. 7-10; Foged, 1979, p. 22, pl. 14, figs. 19-20; Foged, 1981, p. 49, pl. 12, figs. 11-12; Güttinger, 1994, plate 2.04.01-7; John, 1983, p. 73, pl. 31, figs. 13-16; Krammer & Lange-Bertalot, 1991b, p. 331, pl. 41, figs. 1-8; Lange-Bertalot & Krammer, 1989, p. 335, pl. 84, figs. 1-16; Patrick & Reimer, 1966, p. 291, pl. 18, figs. 1-10; Toledo *et al.*, 1997, p. 370, figs. 9-10.

Synonym: *Achnanthes lanceolata* (Brébisson) Grunow subsp. *lanceolata*; *Achnanthidium lanceolatum* Brébisson ex Kützing; *Planothidium lanceolata* (Brébisson) Round et Bukhtiyarova subsp. *lanceolata*.

Valves elliptical to elliptical-lanceolate; ends undifferentiated, broadly rounded. Raphe valve: narrow and linear axial area; central area wide, rectangular; raphe filiform, becoming slightly broader toward rounded proximal ends, distal ends curving in the same direction; striae slightly radiate, multiseriate punctate, center striae short, marginal, irregular in number and occasionally lacking on one side. Pseudoraphe valve: interrupted centrally on one side by a horseshoe-shaped clear area, horseshoe-shaped area partly roofed over by a thin silica hood; axial and central areas forming a narrowly linear-lanceolate space. Striae slightly radiate, multiseriate punctate. Dimension: 4-7 × 11-26 μm, striae 12-15 in 10 μm.

3. *Achnantheiopsis rostrata* (Oestrup) Lange-Bertalot

Fig. 1. F

Archibald and Schoeman, 1987, p. 79, figs. 11-15; Krammer & Lange-Bertalot, 1991b, p. 335, pl. 43, figs. 1-14; Lange-Bertalot & Krammer, 1989, p. 337, pl. 85, figs. 3-6; Toledo *et al.*, 1997, p. 370, figs. 13-14.

Synonym: *Achnanthes lanceolata* (Brébisson) Grunow subsp. *rostrata* (Oestrup) Hustedt; *Achnanthes rostrata* Oestrup; *Achnanthidium rostrata* Oestrup; *Achnanthes piasica* Carter; *Planothidium rostrata* (Oestrup) Round et Bukhtiyarova.

Valves elliptical to broadly elliptical; ends well differentiated, rather wide, rounded rostrate to broadly rostrate. Raphe valve: narrow, linear axial area; central area lacking; raphe filiform, proximal raphe ends closed, distal ends curved in the same direction; striae multiseriate punctuate, slightly radiate. Pseudoraphe valve interrupted by a horseshoe-shaped clear area centrally on one side, horseshoe-shaped area more complicated, partly roofed over by a thin silica hood. Dimension: 4-6 × 11-14 μm, striae 13-15 in 10 μm.

Genus *Achnanthidium* Kützing 1844

Valves linear lanceolate to lanceolate elliptical. Raphe valve with a fine central raphe, hardly protruding towards the center and straight or turned to one side at the ends. Axial area narrow at the ends, widening to the center. Pseudoraphe valve with striae usually more even and often slightly more spaced than on the raphe valve. Striae mostly radiate or parallel, uniseriately punctate. There were two species in the Mystery Lake.

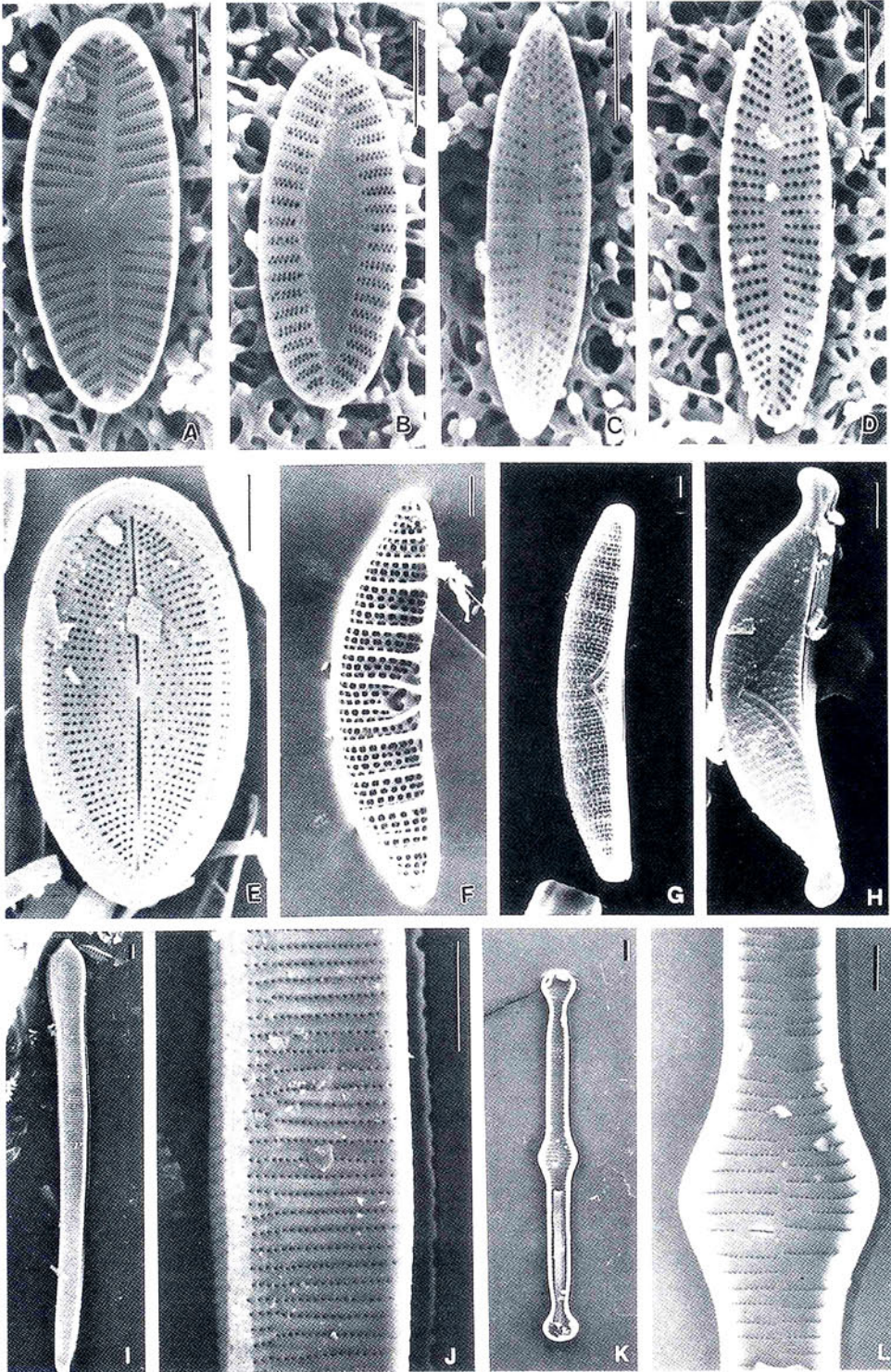


Fig. 3. A-B. *Achnanthes rupestoides* Raphid valve (A); pseudoraphid valve (B). C-D. *Achnanthes subhudsonis*, raphid valve (C); pseudoraphid valve (D). E. *Cocconcis placentula* var. *placentula* internal valve. F-G. *Epithemia adnata* external valve. H. *Epithemia sorex* external valve. I-J. *Actinella brasiliensis*. K-L. *Tabellaria fenestrata*, internal valve (K); detail of inflated center (L). Bar = 4 μ m.

Key to the species

- 1A. The valve length to breadth ratio is more than 6:1, and its eight to ten striae in the central area are spaced more farther apart than the remaining striae in the raphe valve *A. exilis*
 1B. The valve length to breadth ratio is less than 5.5:1, and its three striae in the central area are spaced slightly farther apart them *A. minutissima*

1. *Achnantheidium exilis* (Kützing) Round et Bukhtiyarova Fig. 2. A
 Gasse, 1986, p. 19, pl. 8, figs. 4-6; Krammer and Lange-Bertalot, 1991b, p. 315, pl. 33, figs. 23-33; Lange-Bertalot and Krammer, 1989, p. 275, pl. 54, figs. 1-10.

Synonym: *Achnanthes exilis* Kützing; *Achnanthes leibleinii* Agardh.

Valves linear-lanceolate; ends rounded subrostrate, tapering from the center. Raphe valve: axial area narrow, flaring into the central area; central area longitudinally rectangular; raphe filiform, proximal ends not protruding into the central area, distal ends straight; striae radiate, uniseriately punctuate, becoming more numerous toward the ends, eight to ten striae in the central area spaced more farther apart than the remaining striae. Dimension: 3-4 × 19-20 μm, striae 25-30 in 10 μm.

2. *Achnantheidium minutissima* Kützing Figs. 1. I; 2. B, C & E
 Archibald and Schoeman, 1987, p. 79, Fig. 23-28; Güttinger, 1994, plate 2.04.01-3,4.
 Hein, 1990, p.17, pl. 2, fig. 1; John, 1983, p. 74, pl. 32, figs. 3-4; Krammer & Lange-Bertalot, 1991b, p. 313, pl. 32, figs. 1-24; Lange-Bertalot & Krammer, 1989, p. 271, pl. 52, figs. 1-13; Oppenheim, 1994, p. 1741, figs. 60-62; Patrick & Reimer, 1966, p. 287, pl. 16, figs. 9-10.

Synonym: *Achnanthes minutissima* Kützing; *Achnantheidium microcephalum* Kützing; *Achnantheidium lineare* W. Smith; *Achnanthes minutissima* Kützing var. *cryptocephala* Grunow.

Valves narrowly elliptical; ends with rounded rostrate to broadly rostrate, subtile protracted. Raphe valve with narrow, linear axial area and narrow, somewhat irregularly shaped, central area occupying up to about one-half the total width of the valve in the middle portion; raphe filiform, proximal ends rather close, digital ends curving subtilely in the same direction; striae slightly to moderately radiate, becoming more numerous toward the ends; three shorter striae on either side of the central area sometimes spaced slightly farther apart than the remaining striae. Pseudoraphe valves with narrow, linear axial areas, slightly broadened in the middle portion of the valve, but with no distinct central area as much; striae character and direction as on the raphe valve. Dimension: 2.5-4 × 9-16 μm, striae 28-32 in 10 μm in the center, becoming 36-40 in 10 μm near the ends (both valves).

Genus *Lemnicola* Round et Basson 1997

Valves linear elliptical to linear lanceolate, narrowing to rounded ends. Raphe valve with filiform raphe and asymmettically stauros-like central area. Axial area narrow, linear. Pseudoraphe valve similar to the raphe valve, with very weak central area. Striae mostly radiate or parallel, biseriately punctate. Only one species was found in the Mystery Lake.

1. *Lemnicola hungarica* (Grunow) Round et Basson Fig. 1. B
 Foged, 1979, p. 21, pl. 14, figs. 15-18; Gasse, 1986, p. 19, pl. 8 figs. 1-3; Güttinger, 1994, plate 2.04.01-5, 6; John, 1983, p. 71, pl. 30, figs. 11-14; Krammer & Lange-Bertalot, 1991b, p.

287, pl. 19, figs.1-15; Lange-Bertalot & Krammer, 1989, p. 235, pl. 34, fig. 8; Patrick & Reimer, 1966, p. 287, pl. 16, figs. 27-28.

Synonym: *Achnanthes hungarica* (Grunow) Grunow; *Achnanthes andicola* (Cleve) Hustedt; *Achnanthes pseudohungarica* Cholnoky-Pfannkiche; *Schizostauron andicolum* Cleve.

Valves broadly linear-elliptical to linear-lanceolate; ends obtusely rounded or subcuneate. Raphe valve with narrow, linear axial area; central area a broad, widening stauros-like space reaching both margins, one side of the central area broader than the opposite side; raphe filiform, proximal ends rather close, rounded, distal ends curving slightly in opposite directions; striae slightly radiate, biserially punctate. Pseudoraphe valve: shorter striae in the middle portion from a very weak central area; striae slightly radiate. Dimension: 6-9 × 13-39 μm, striae 20-24 in 10 μm.

Genus *Psammothidium* Bukhtiyarova et Round 1996

Valves elliptical, lanceolate, lanceolate-elliptical or linear-lanceolate; ends rounded; Raphe valve: axial area narrowly linear to narrowly triangular; central area variable; raphe straight; proximal and distal ends variably developed; striae radiate, uniseriately punctate. Pseudoraphe valve: axial area alike or dissimilar the raphe valve. There was one single species in the Mystery Lake.

1. *Psammothidium marginulatum* (Grunow) Bukhtiyarova et Round Figs. 2. F & G Bukhtiyarova & Round, 1996, p. 6, figs. 2-7.

Valves elliptical; ends obtusely rounded. Raphe valve: axial and central area uniting to a large elliptical, lanceolate or somewhat rhomboidal space; raphe sinuous at the axial area, twice recurved, proximal ends not protruding into the central area, distal ends curving in the same direction; striae radiate, uniseriately punctate, shorter, interrupted by elliptical, lanceolate or somewhat rhomboidal space. Dimension: 4-7 × 12-13 μm, striae 28-30 in 10 μm.

Genus *Rossithidium* Round et Bukhtiyarova 1996

Valves linear or linear elliptical; ends rounded. Raphe valve with a straight central raphe, proximal ends rounded, distal ends turned to the same direction; central area rectangular. Axial area narrow, linear. Pseudoraphe valve with generally unbroken striae. Striae mostly radiate or parallel, uniseriately or biserially punctate. Only one species was found in the Mystery Lake.

1. *Rossithidium linearis* (W. Smith) Round et Bukhtiyarova var. *pusilla* Grunow Figs. 1. G & H

Patrick & Reimer, 1966, p. 287, pl. 16, figs. 5-6.

Synonym: *Achnanthes linearis* (W. Smith) Grunow var. *pusilla* Grunow; *Achnanthes pusilla* (Grunow) De Toni

Valves linear to linear-elliptical, with almost parallel sides and broadly rounded ends. Raphe valve: with linear axial area; central area rectangular according to the length of two central striae; raphe filiform, proximal raphe ends rounded, distal ends curved in the same direction; striae slightly radiate, biserially punctate. Dimension: 3-4 × 10-15 μm, striae 19-20 in 10 μm.

Family Cocconeidaceae
Genus *Cocconeis* Ehrenberg 1832

Valves more or less elliptical; without produced or protracted and distinct ends. Pseudoraphe valve in PRV mostly moderately to strong convex; raphe valve convex to more nearly flat. Opposing valves usually with different striae pattern and/or structure. Raphe in RV with marginal and/or submarginal hyaline area. In many cases noted a rather broad, more highly refractive band around the margin of the raphe valve correspond with the presence of an attached intercalary-like band. Occasionally maybe unattached to the valve; sometimes having rudimentary chamber-like projections. Valve length to breadth ratio usually about 2:1 or less and not appeared to exceed 2.5:1. There was one single species in the Mystery Lake.

- 1. *Cocconeis placentula* Ehrenberg var. *placentula* Ehrenberg** Fig. 3. E
Foged, 1979, p. 34, pl. 12, figs. 9-10; Foged, 1981, p. 61, pl. 12, figs. 13-14; Gasse, 1986, p. 33, pl. 7, fig. 6; Güttinger, 1994, plate 2.04.04-2; John, 1983, p. 79, pl. 34, figs. 11-12; Krammer & Lange-Bertalot, 1991b, p. 86, pl. 51, figs. 1-5; Patrick & Reimer, 1966, p. 240, pl. 15, fig. 7.

Synonym: *Cocconeis punctata* Ehrenberg; *Cocconeis elongata* Ehrenberg; *Cocconeis pumila* Kützing.

Valve elliptical to linear-elliptical; without produced or protracted and distinct ends. Raphe valve with very narrow axial area; central area oval; raphe filiform, proximal ends close, distal ends terminating at inner hyaline ring; striae curved radiate, finely punctate, interrupted submarginally by a hyaline ring. Second hyaline area encircled the valve at the margin. Pseudoraphe valve with very narrow, linear pseudoraphe; central area not well distinguished; striae curved-radiate, linearly punctate, puncta transversally arranged in longitudinal undulate rows by hyaline bands. Valve length to breadth ratio usually more than 1.5, often approximate 2. Dimension: 11-15 × 18-29 μm, striae 20-25 in 10 μm.

Order Eunotiales
Family Eunotiaceae
Genus *Actinella* Lewis 1864

Valve linear, with one apex much larger than the other; terminal nodules present; a jelly pore present near one or both apices; striae parallel. There was one single species in the Mystery Lake.

- 1. *Actinella brasiliensis* Grunow** Figs. 3. I & J
De Oliveira and Steinita-Kannan, 1992, p. 540, pl. 1, fig. 3; Foged, 1979, p. 24, pl. 12, fig. 12; Okuno, 1954, pl. 17, figs. 4, a-b.

Valves arcuate-clavate, with wedged-shaped or broad apiculate apices and narrowly rounded bases, gradually tapering from the apices to the bases; terminal nodules at both the apical and the basal ends; striae parallel, lineate, uniseriately punctate. Dimension: 7.5-11 × 88-125 μm, striae 12-13 in 10 μm.

Genus *Eunotia* Ehrenberg 1837

Valves asymmetrical to the longitudinal or apical axis; ventral margins straight or somewhat concave; dorsal margins usually more or less convex; terminal nodules located at the ends of the valve or on the ventral margin; striae parallel. Seven species were found in the Mystery Lake.

Key to species

- 1A. The valve swollen in the middle *E. formica*
 1B. The valve not swollen in the middle 2
 2A. The valve with four undulations on convex dorsal margins *E. zygodon* var. *elongata*
 2B. The valve without four undulations on convex dorsal margins 3
 3A. The valve more than 60µm long *E. monodon*
 3B. The valve less than 60µm long 4
 4A. The striae density more than 13 in 10 µm 5
 4B. The striae density less than 13 in 10 µm 6
 5A. The valve with two shallow undulations on the dorsal margins, its margins slightly setting off towards the ends *E. minor*
 5B. The valve without undulation on the dorsal margins, its margins gradually narrowed towards the ends *E. intermedia*
 6A. The valve arched, with rostrate-capitate ends *E. septentrionalis*
 6B. The valve lunate, with cut-off angular ends *E. soleirolii*

1. *Eunotia formica* Ehrenberg

Fig. 4. A

Cassie, 1984, p. 233, pl. 2, fig. 2; Foged, 1981, p. 86, pl. 6, fig. 5; Krammer & Lange-Bertalot, 1991a, p. 535, pl. 152, figs. 8-12a.

Valves linear, slightly swollen in the middle; ends rounded; terminal nodules prominent at the ventral margins of valve; striae parallel and coarsely punctuate.

Dimension: 7-8 × 38-40 µm, striae 12-13 in 10 µm.

Habitat: acid to circumneutral soft water, standing or usually slow-flowing water (Patrick and Reimer, 1966).

2. *Eunotia intermedia* (Krasske ex Hustedt) Nörpel et Lange-Bertalot

Fig. 4. K

Krammer & Lange-Bertalot, 1991a, p. 517, pl. 143, figs. 10-15.

Synonym: *Eunotia pectinalis* var. *minor* f. *intermedia* Krasske ex Hustedt; *Eunotia faba* var. *intermedia* Cleve-Euler; *Eunotia vanheurckii* var. *intermedia* Patrick.

Valves lunate, gradually narrowing towards the rounded ends; ventral margins straight; dorsal margins convex; terminal nodules distinctly, near the ends of the valve. Striae parallel. Dimension: 4-5 × 12 µm, striae 20 in 10 µm.

3. *Eunotia minor* (Kützing) Grunow

Fig. 4. B

Cox, 1996, p. 61, fig. 20.d; Krammer & Lange-Bertalot, 1991a, p. 515, pl. 142, figs. 7-15.

Synonym: *Himantidium minus* Kützing; *Eunotia pectinalis* var. *minor* (Kützing) Rabenhorst; *Eunotia pectinalis* var. *minor* (Kützing) Grunow.

Valves dorsiventral, somewhat narrower at the ends than at the center; ventral margin slightly concave; dorsal margin distinctly convex, with two shallow undulations; ends rounded, somewhat narrower, not distinctly set off from the valve; terminal nodules distinct, near but not at the ends of the valve; striae parallel. Dimension: 4-7 × 23-25 µm, striae 14-15 in 10 µm.

4. *Eunotia monodon* Ehrenberg

Figs. 4. E & F

Cassie, 1984, p. 233, pl. 2, fig. 4; Foged, 1981, p. 87, pl. 10, fig. 2; Krammer & Lange-Bertalot, 1991a, p. 547, pl. 158, figs. 2-3.

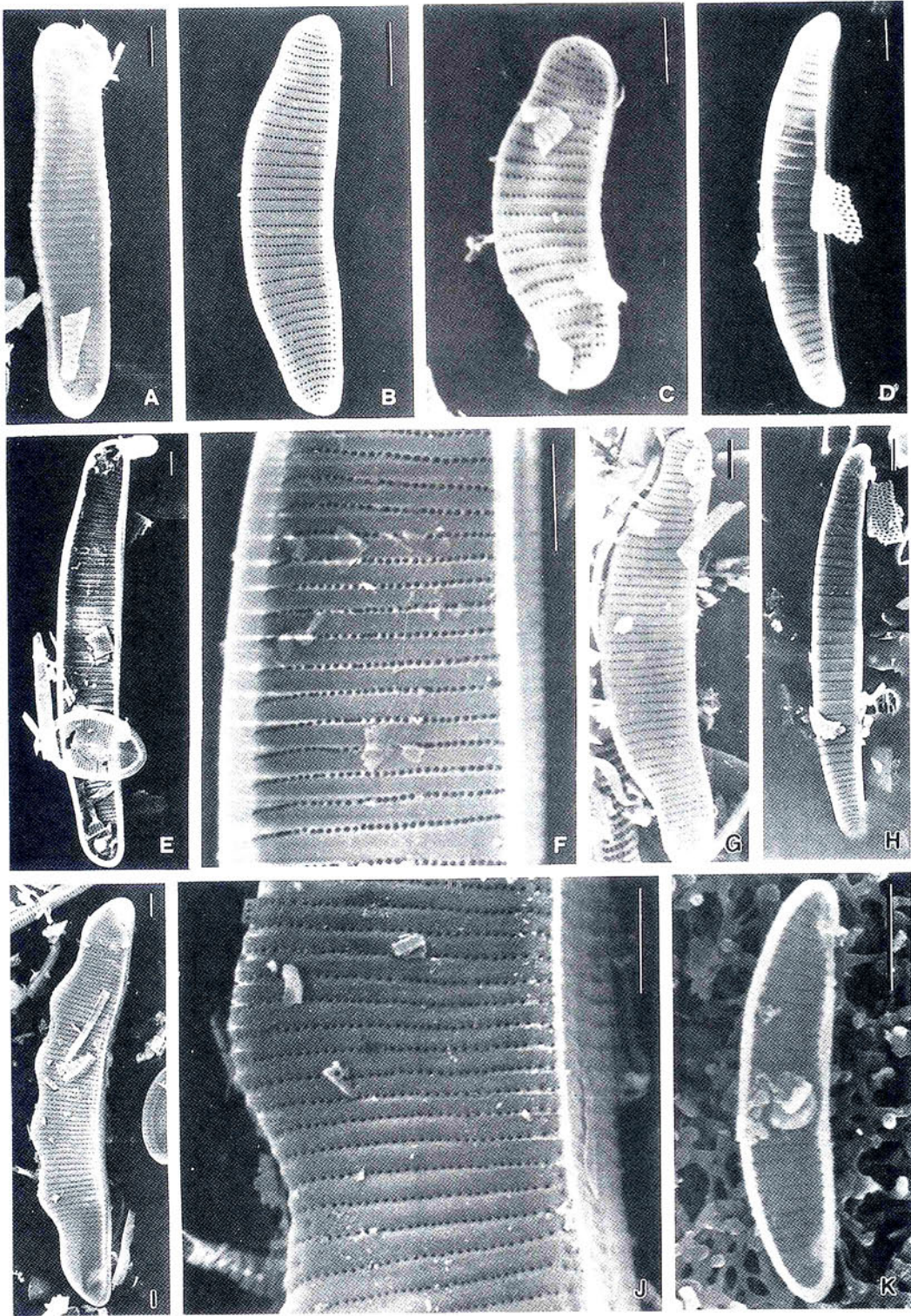


Fig. 4. A. *Eunotia formica* external valve. B. *Eunotia minor* external valve. C & G. *Eunotia septentrionalis* external valve. D & H. *Eunotia soleirolii* external valve. E-F. *Eunotia monodon* internal valve, internal valve (E); detail of the striae arrangement (F). I-J. *Eunotia zygodon* var. *elongata*, external valve (I); detail of the striae arrangement (J). K. *Eunotia intermedia* internal valve. Bar = 4 μ m.

Synonym: *Eunotia alpina* Ehrenberg; *Eunotia major* var. *ventricosa* A. Cleve; *Eunotia monodon* Ehrenberg. var. *major* (W. Smith) Hustedt.

Valves dorsiventral; ventral margins slightly concave; dorsal margins convex; valve slightly narrowed toward rounded, but not protracted or capitate ends; with distinctive terminal nodules; striae parallel. Dimension: 11-12 × 80 μm, striae 10 in 10 μm.

5. *Eunotia septentrionalis* Oestrup

Figs. 4. C & G

Alles *et al.*, 1991, p.201, pl. 6, figs. 1-12; Foged, 1981, p. 89, pl. 9, fig. 12; Krammer & Lange-Bertalot, 1991a, p. 545, pl. 157, figs. 13-18; Patrick & Reimer, 1966, p. 233, pl. 13, fig. 10.

Synonym: *Eunotia arcuata* var. *compacta* Steinecke.

Valves arched; ventral margin concave, gradually recurved toward ends, producing ends somewhat reflexed; dorsal margin strongly convex, usually not parallel to the ventral margin; ends of the valve slightly reflexed, rostrate-capitate in shape; terminal nodules on the ventral margin at ends of the valve; striae parallel. Dimension: 6-9 × 21-41 μm, striae 10-11 in 10 μm.

6. *Eunotia soleirolii* (Kützing) Rabenhorst

Figs. 4. D & H

Alles *et al.*, 1991, p.207, pl. 8, figs. 8-16; Cox, 1996, p. 61, fig. 20.f; Krammer & Lange-Bertalot, 1991a, p. 515, pl. 142, figs. 1-6.

Valves dorsiventral, broader at the center than towards the apices; ventral margins straight; dorsal margins slightly convex; ends cut off, angular, capitate; striae parallel. Dimension: 5-8 × 30-49 μm, striae 7-9 in 10 μm.

7. *Eunotia zygodon* Ehrenberg var. *elongata* Hustedt

Figs. 4. I & J

De Oliveira and Steinita-Kannan, 1992, p. 544, pl. 5, fig. 77; Krammer & Lange-Bertalot, 1991a, p. 549, pl. 159, fig. 3.

Valves dorsiventral; ventral margins concave, particularly at the center of the valve; dorsal margin convex with four undulations, suddenly recurved towards ends; ends wedge-shaped; terminal nodules large, located a short distance from the apices on the ventral margins; striae parallel. Dimension: 13-15 × 75-100 μm, striae 10-12 in 10 μm.

Order Rhopalodiales
Family Rhopalodiaceae
Genus *Epithemia* Kützing 1844

Cell solitary; valves dorsiventral, crossed by strong transverse costae, the raphe curved from the ventral side of the valve towards the center; in some species finger-like septa projected into the cell lumen. There were two species in the Mystery Lake.

Key to species

- 1A. The valve with strongly convex dorsal margins and dorsally deflected, bluntly subcapitate ends *E. sorex*
1B. The valve with more gently convex dorsal margin and bluntly rounded ends *E. adnata*

1. *Epithemia adnata* (Kützing) Brébisson

Figs. 3. F & G

Krammer & Lange-Bertalot, 1988, p. 431, pl. 107, figs. 1-6; Gasse, 1986, p. 51, pl. 30, fig. 12; Foged, 1979, p. 46, pl. 38, fig. 9; Hadi *et al.*, 1984, p.553, pl. 12, fig. 211. Güttinger, 1994d, Plate 2.07.01-2.

Synonym: *Epithemia zebra* (Ehrenberg) Kützing; *Frustulia adnata* Kützing; *Eunotia zebra* (Ehrenberg) Ehrenberg; *Epithemia kurzeana* Rabenhorst.

Valves lunate; dorsal margins more gently convex; ventral margin slightly concave; ends bluntly rounded; raphe running along ventral margin for most of its length, only located in a "V" shaped canal in the center, curved towards the dorsal margin; valve surface furnished with transverse costae, separated by three to five rows of distinct alveoli; costae, 3-4 in 10 μm . Dimension: 6-42 \times 20-85 μm , 10-12 striae in 10 μm .

2. *Epithemia sorex* Kützing

Fig. 3. H

Foged, 1979, p. 45, pl. 38, figs. 2, 6, 10-11; Foged, 1981, p. 82, pl. 55, fig. 12; Güttinger, 1994, plate 2.07.01-1; Krammer & Lange-Bertalot, 1988, p. 429, pl. 106, figs. 1-14.

Valves lunate; dorsal margin strongly convex; ventral margin slightly concave; ends bluntly subcapitate, dorsally deflected; raphe strongly curved, central raphe endings close to the dorsal margin; septa not obvious; alveoli radiate in arrangement. Costae, 5-7 in 10 μm . Dimension: 5-10 \times 39-45 μm , striae 10-12 in 10 μm .

Order Fragilariales

Family Fragilariaceae

Genus *Fragilaria* Lyngbye 1819

Valve linear, linear-lanceolate or elliptical; ends variously shaped, symmetrical to the transverse and apical axes; pseudoraphe present on both valves, perhaps narrow or formed a broad lanceolate space; central area variable in structure, may be absent; striae uniseriately punctate, alternate; spines around the mantle junction. Four species were found in the Mystery Lake.

Key to species

- 1A. The valve linear 2
- 1B. The valve linear-lanceolate to lanceolate 3
- 2A. The valve constricted at the central area *F. capucina* var. *mesolepta*
- 2B. The valve not constricted at the central area *F. capucina* var. *capucina*
- 3A. The valve shorter (less than 25 μm long) with bluntly rounded ends *F. bidens*
- 3B. The valve longer (more than 25 μm long) with rounded subrostrate ends *F. capucina* var. *rumpens*

1. *Fragilaria bidens* Heiberg

Fig 5. G

Foged, 1984, p. 93, pl. 3, fig. 15, 18-19; Krammer & Lange-Bertalot, 1991a, p. 453, pl. 111, figs. 18-32.

Synonym: *Synedra pulchella* var. *minuta* Hustedt; *Synedra rumpens* var. *fragilarioides* f. *constricta* Hustedt.

Valve linear-lanceolate; ends bluntly rounded; central area transversally rectangular; striae uniseriately punctate, alternate; spines around the mantle junction. Dimension: 3-4 \times 14-16 μm , striae 16-17 in 10 μm .

2. *Fragilaria capucina* Desmazières var. *capucina* Desmazières Figs. 5. A-C & E
Krammer & Lange-Bertalot, 1991a, p. 447, pl. 108, figs. 1-8; Williams & Round, 1987, p.270, fig. 4.

Valve linear, attenuated toward the ends; ends swollen, rounded rostrate to subcapitate; central area longitudinally rectangular; striae uniseriately punctate, alternate; spines around the mantle junction. Dimension: 3-4 × 28-44 μm, striae 12-20 in 10 μm.

3. *Fragilaria capucina* Desmazières var. *mesolepta* (Rabenhorst) Rabenhorst Fig. 5. D
Bateman & Rushforth, 1984, p. 69, pl. 11, fig. 144; Foged, 1981, p. 92, pl. 4, fig. 12. Foged, 1984, p. 91, pl. 2, fig. 18; Patrick & Reimer, 1966, p. 119, pl. 3, fig. 6.

Synonym: *Fragilaria mesolepta* Rabenhorst; *Fragilaria capucina* var. *mesolepta* Rabenhorst.

Valve linear, constricted in the middle of the valve; ends subcapitate; central area longitudinally rectangular; striae uniseriately punctate, alternate; spines around the mantle junction. Dimension: 3-4 × 37-40 μm, striae 17-20 in 10 μm.

4. *Fragilaria capucina* Desmazières var. *rumpens* (Kützing) Lange-Bertalot Fig. 5. F
Krammer & Lange-Bertalot, 1991a, p. 447, pl. 108, figs. 16-21.

Synonym: *Synedra rumpens* Kützing; *Fragilaria laevissima* Oestrup; *Fragilaria pseudolaevissima* Van Landingham; *Synedra puellaris* Messikommer.

Valve linear-lanceolate to lanceolate; ends rounded rostrate, somewhat attenuated; central area swollen, transversally rectangular; striae uniseriately punctate, alternate; spines around the mantle junction. Dimension: 3-4.5 × 30-35 μm, striae 14 in 10 μm.

Genus *Pseudostaurosira* (Grunow) Williams et Round 1987

Valves lanceolate to elliptical, sometimes with undulate margins or cruciform; sternum very wide; striae uniseriate with only a few areolae near edge of the valve face. There was one species in the Mystery Lake.

1. *Pseudostaurosira brevistriata* (Grunow) Williams et Round Fig. 2. H
Krammer & Lange-Bertalot, 1991a, p. 491, pl. 130, figs. 9-16; Foged, 1979, p. 52, pl. 7, fig. 24; Foged, 1981, p. 91, pl. 4, fig. 13; Gasse, 1986, p. 57, pl. 6, fig. 8; Güttinger, 1994, Plate 2.01.13-4; John, 1983, p. 42, pl. 16, figs. 2-3; Masahiko & Tamostu, 1995, p. 234, fig. 5, figs. a-e; Podzorski, 1985, p. 155, pl. 33, figs. 4-5; p. 91, pl. 1, figs. 4-5.

Synonym: *Fragilaria brevistriata* Grunow; *Fragilaria brevistriata* var. *subacuta* Grunow; *Fragilaria brevistriata* var. *pusilla* Grunow; *Fragilaria brevistriata* var. *subcapitata* Grunow.

Valve lanceolate; ends rounded; sternum very wide; striae marginal, very short, with 2-4 rectangular areolae in the striae; spines situated on the interstriae. Dimension: 3-4 × 8-10 μm, striae 15-18 in 10 μm.

Genus *Punctastriata* Williams et Round 1987

Valve elliptical to broadly elliptical, heteropolar with depression at one end; striae multiseriate; spines situated along the valve/mantle junction on the interstriae. There was one single species in the Mystery Lake.

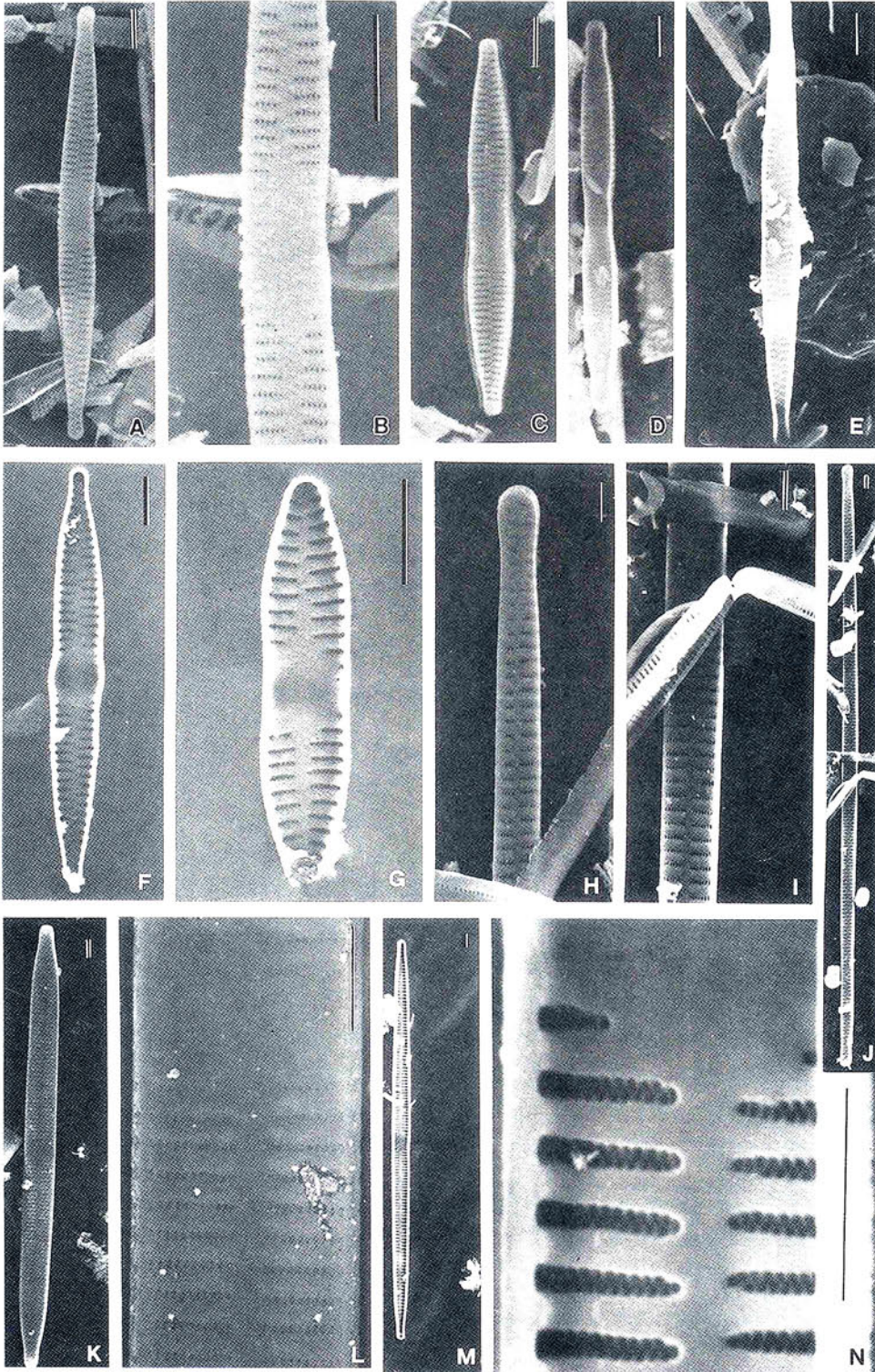


Fig. 5. A-C & E. *Fragilaria capucina* var. *capucina*, external valve (A & C); part of external valve, showing longitudinally rectangular central area and striae arrangement (B). D. *Fragilaria capucina* var. *mesolepta* internal valve. F. *Fragilaria capucina* var. *rumpens* internal valve. G. *Fragilaria bidens* internal valve. H-J. *Synedra ulna* var. *Danica*, external view of pole field and striae (H); external view of central area and striae (I); external valve (J). K-L. *Synedra ulna* var. *Unla*, external valve (K); external view of striae, with closing plate attached on puncta (L); M-N. *Synedra lanceolata*, internal valve (M); part of internal valve showing biserially punctate striae (N). Bar = 4 μ m.

1. *Punctastriata linearis* (Ehrenberg) Williams et Sound

Figs. 6. G-I.

Foged, 1981, p. 93, pl. 5, fig. 3; Gasse, 1986, p. 59, pl. 6, fig. 5; Krammer & Lange-Bertalot, 1991a, p. 497, pl. 133, figs. 1-18; Masahiko & Tamostu, 1995, p. 235, fig. 6.

Synonym: *Odontidium mutabile* W. Smith; *Fragilaria pinnata* Ehrenberg; *Fragilaria mutabilis* var. *subsoltaris* Grunow; *Fragilaria pinnata* var. *lancettula* (Schumann) Hustedt; *Fragilaria elliptica* Schumann; *Fragilaria pinnata* var. *subrotunda* Mayer; *Odontidium martyi* var. *polymorpha* (Jouravleva) Proschkina-Lavrenko.

Valve elliptical to broadly elliptical, sometimes with central inflation; ends rounded, sometimes heteropolar with depression at one end; striae level slightly depressed the valve surface; striae consisting of a distinctive, high silicified, regular net of transapical and apical bars; spines situated along the valve/mantle junction on the interstriae. Dimension: 3-4.5 × 5-15 μm, striae 9-12 in 10 μm.

Genus ***Staurosira*** (Ehrenberg) Williams et Round 1987

Valves oval, elliptical, cruciform or rarely triangular with widely spaced uniseriate rows of areolae; spines situated along the valve/mantle junction on the interstriae or across the striae. There was two species in the Mystery Lake.

Key to the species

- 1A. The valve elliptical to broadly elliptical *S. elliptica*
 1B. The valve cruciform *S. construens*

1. *Staurosira construens* Ehrenberg

Fig. 6. A

Krammer & Lange-Bertalot, 1991a, p. 495, pl. 132, figs. 1-24; Foged, 1979, p. 53, pl. 7, figs. 19-20; Foged, 1981, p. 92, pl. 5, fig. 2; Gasse, 1986, p. 57, pl. 6, figs. 2-4. Masahiko & Tamostu, 1995, p. 238, pl. 4, figs. a-d; Patrick & Reimer, 1966, p. 125, pl. 4, fig. 4; Güttinger, 1994, plate 2.01.13-3; Podzorski, 1985, p. 155, pl. 33, figs. 6-7; p. 91, pl. 1, figs. 4-5.

Synonym: *Fragilaria construens* (Ehrenberg) Grunow f. *construens* (Ehrenberg) Hustedt; *Staurosira construens* Ehrenberg var. *construens* Ehrenberg; *Odontidium tabellaria* W. Smith.

Valves cruciform, strongly expanded in the middle portion, often somewhat asymmetrical; valve surface ribbed; ends of the valve rounded; sternum wide centrally; striae extending over most of valve face, uniseriately punctuate; spines situated on the interstriae, tapered gradually outward from the valve face. Dimension: 6-10 × 8-14 μm, striae 14-20 in 10 μm.

2. *Staurosira elliptica* (Schumann) Williams et Round

Figs. 6. B-F

Krammer & Lange-Bertalot, 1991a, p. 491, pl. 130, figs. 31-42; Masahiko & Tamostu, 1995, p. 238, pl. 4, fig. e.

Synonym: *Fragilaria elliptica* Schumann; *Fragilaria construens* var. *pumila* Grunow; *Fragilaria construens* var. *subsalina* Hustedt.

Valves elliptical to broadly elliptical; ends bluntly rounded; striae uniseriately punctuate, slightly radiate throughout the valve; spines situated along the valve/mantle junction on the interstriae or across the striae, tapered gradually outward from the valve face. Cingulum of 6-10 open, ligulate, plain, copulae curved towards the poles. Copulae narrower than the valvocopula but morphologically identical. Dimension: 2-7 × 3.5-8 μm, striae 12-20 in 10 μm.

Genus *Synedra* Ehrenberg 1830

Valves narrowly linear or linear-lanceolate, elongate; without raphe system on either valve; with or without central area; striae parallel, lineate. There were three species in the Mystery Lake.

Key to the species:

- 1A. The valve with biserially punctate striae *S. lanceolata*
 1B. The valve with uniserially punctate striae 2
 2A. The valve with swollen ends and longitudinally rectangular central area *S. ulna* var. *danica*
 2B. The valve with rostrate or wedge-shaped ends and transversally rectangular central area *S. ulna* var. *ulna*

1. *Synedra lanceolata* Kützing

Figs. 5. M & N

Krammer & Lange-Bertalot, 1991a, p. 471, pl. 120, figs. 7-9; Williams, 1986, p. 146, figs. 37-45.

Synonym: *Fragilaria lanceolata* (Kützing) Reichardt; *Synedra ulna* var. *lanceolata* (Kützing) Grunow; *Synedra juliana* De Notaris; *Synedra ulna* var. *fonticola* Hustedt; *Synedra ulna* var. *oxyrhynchus* sensu Germain.

Valves needle-like; ends rostrate, valves constricted at the ends; axial area central, continuous end to end; central area longitudinally rectangular; striae parallel, biserially punctate; puncta alternately arranged within each striae. Dimension: 6-7 × 150 µm, striae 9-10 in 10 µm.

2. *Synedra ulna* (Nitzsch) Ehrenberg var. *danica* (Kützing) Van Heurck

Figs. 5. H-J

Cassie, 1989, p. 231, pl. 1, fig. 6; Krammer & Lange-Bertalot, 1991a, p. 475, pl. 122 fig. 9; Patrick & Reimer, 1966, p. 177, pl. 7, fig. 10.

Synonym: *Fragilaria ulna* (Nitzsch) Lange-Bertalot var. *danica* (Kützing) Lange-Bertalot; *Synedra danica* Kützing.

Valves linear, narrower than *S. ulna* var. *ulna*; ends of valve swollen, somewhat capitate, but not markedly constricted; axial area central, continuous end to end; central area longitudinally rectangular; striae parallel, uniserially punctate. Dimension: 5-7.5 × 196-230 µm, striae 7-8 in 10 µm.

3. *Synedra ulna* (Nitzsch) Ehrenberg var. *ulna* Ehrenberg

Figs. 5. K & L

Krammer & Lange-Bertalot, 1991a, p. 475, pl. 122, figs. 1-8; Foged, 1981, p. 171, pl. 5, figs. 12-13; Patrick & Reimer, 1966, p. 177, pl. 7, figs. 1-2; Güttinger, 1994, plate 2.01.30-1; Cassie, 1989, p. 231, pl. 1, fig. 8.

Synonym: *Fragilaria ulna* (Nitzsch) Lange-Bertalot var. *ulna*; *Bacillaria ulna* Nitzsch.

Valves narrowly linear-lanceolate, attenuated with a narrow rapheless area; ends rostrate or wedge-shaped; axial area central, continuous end to end; central area transversally rectangular; striae parallel, uniserially punctate. Dimension: 8-10 × 110-120 µm, striae 8-9 in 10 µm.

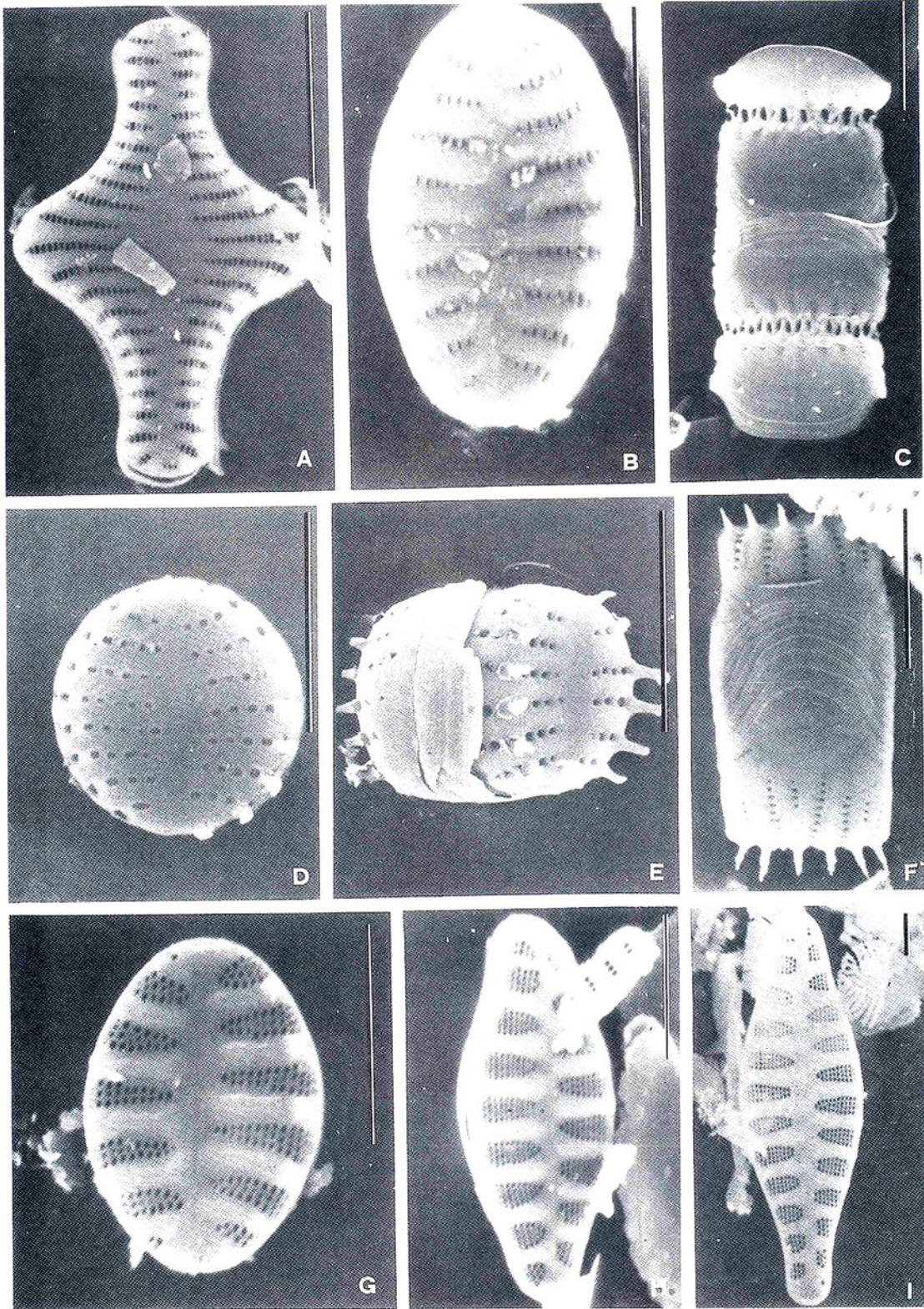


Fig. 6. A. *Staurosira construens* external valve. B-F. *Staurosira elliptica*, external valve (B & D-E); girdle view of colonies showing linking spines and curved copulae (C & F). G-I. *Punctastriata linearis*, external valve (G & I); internal valve (H). Bar = 4 μ m.

Order Tabellariales
 Family Tabellariaceae
 Genus *Tabellaria* Ehrenberg 1840

Valves bluntly linear, sometimes inflated at the center; intercalary bands and septa present; in valve view the septa extend at varying length under the surface of the valve; striae parallel; costae present. There was one single species in the Mystery Lake.

1. *Tabellaria fenestrata* (Lyngye) Kützing

Figs. 3. K & L

Cox, 1996, p. 40, fig. K; Foged, 1981, p. 172, pl. 4, fig. 4; Krammer & Lange-Bertalot, 1991a, p. 441, pl. 105, figs. 1-4; Patrick & Reimer, 1966, p. 165, pl. 1, figs. 1-2.

Synonym: *Diatoma fenestratum* Lyngye; *Tabellaria trinodos* Ehrenberg; *Striatella fenestrata* (Kützing) Kuntze.

Valves bluntly linear; inflated at the center of the valve and at the distinctly capitate apices, the width of the valve in the middle portion and at the apices is about the same; striae parallel, singly punctate. Dimension: 5-7 × 66-86 μm, striae 15-21 in 10 μm.

DISCUSSION

Mystery Lake is an acidic, oligotrophic lake. Under such conditions, the diatom assemblage was riched with Fragilariaceae (*Fragilaria*, *Pseudostaurosira*, *Punctastriata*, *Staurosira*, and *Synedra*), Achnantheaceae (*Achnanthes*, *Achnantheiopsis*, *Achnantheidium*, *Lemnicola*, *Psammothidium*, and *Rossithidium*), and Eunotiaceae (*Eunotia* and *Actinella*). Among these diatoms, genera such as *Pseudostaurosira*, *Punctastriata*, and *Staurosira* were formerly placed in *Fragilaria* (cf. Krammer and Lange-Bertalot, 1991a). They were treated as separated genera first by Williams and Round (1986 & 1987). About genera *Fragilaria* and *Synedra* there were some revisions and discussions (Le Chou, 1988 & 1989; Williams and Round, 1986 & 1987; Round, 1991; Masahiko and Tamostu, 1995 & 1997). The genus *Synedra* has been fused into *Fragilaria* by Lange-Bertalot (1980). But they were treated as separate genus by other authors (cf. Wang and Chen, 2000). In the present article, *Synedra* is separated from *Fragilaria*, adopting the opinion of the most of authors that *Fragilaria* is restricted to taxa that form colonies, whereas *Synedra* occurs as free-living or epiphytic taxa. Thus, in total, there are 11 taxa of *Fragilaria* sensu lato in the Mystery Lake.

Actinella is allied to *Eunotia* due to similarity in the position and structure of the raphe slits, rimportulae, stria pattern and overall form. However, the former genus differs from the latter in its heteropolarity with arcuate-clavate valve with wedge-shaped apice and narrowly rounded base. These genera are typical constituents of acid waters (Round *et al.*, 1990). In the Mystery Lake, there were seven species of *Eunotia* and one of *Actinella*. The occurrence of these diatoms agrees well with the most acidic environments ever measured for the lakes (pH 5.5 - 6.5).

Observations under SEM can provide information regarding the fine structure of cell wall. This allows for differentiation between certain taxa that have similar morphology under a light microscope. There are six genera in Mystery Lake under *Achnanthes* sensu lato, namely *Achnanthes*, *Achnantheiopsis*, *Achnantheidium*, *Lemnicola*, *Psammothidium*, and *Rossithidium*.

The taxa of latter five genera were designated under *Achnanthes* before 1995. A combination of some taxa of this genus was done by Czarnecki and Edlund (1995). The splitting of *Lemnicola* (Round and Basson, 1997), *Achnantheiopsis* (Lange-Bertalot, 1997), *Psammothidium* (Bukhtiyarova and Round, 1996), and *Rossithidium* (Round and Bukhtiyarova, 1996) from genus *Achnanthes* was basically done on the basis of fine structures observed under SEM. However, there still are some arguments about the taxonomy of *Achnanthes* sensu lato. In order to clarify this group of diatoms, a further study is necessary.

Round and Bukhtiyarova (1996) have revised the type species *Achnanthes lanceolata* and re-defined the genus *Achnanthidium*. They transferred this species to the new genus, *Planothidium*. Later, another revision of this species was done by Lange-Bertalot (1997). According to the fine structure observed under SEM, he proposed a new genus, *Achnantheiopsis*, for this species. The old genus *Achnanthes* sensu Hustedt (1931-59) was characterized by very discrete habitat selection of the various sections, both in terms of water type and micro-niche. It was noted that the „lanceolate“ section favours alkaline waters (Round and Bukhtiyarova, 1996). Nevertheless, the designated new genus for species of *Achnanthes* sensu lato seems to be based principally on the morphology of the fine structures. Accordingly, the taxonomic positions of *Planothidium* and *Achnantheiopsis* are still open for discussion.

In conclusion, among 36 species described here for Mystery Lake, 17 species were new to the checklist of diatoms published in the past for Taiwan (cf. Wang and Chen, 2000). In addition, genera such as *Achnantheiopsis*, *Actinella*, *Psammothidium*, *Pseudostaurosira*, *Punctastriata*, and *Staurosira* have never been reported in Taiwan. Therefore, they are of new record to Taiwan.

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神秘湖的矽藻(1)

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摘 要

神秘湖位於台灣東北部南澳闊葉林保護區內，屬於中海拔略酸性的貧養湖。此湖中滋長豐富的矽藻種類，在湖積物表面共發現有 76 種矽藻。本文針對其中分屬於 16 屬 36 種之形態特徵予以描述，其中 17 種為台灣的新紀錄種，即 *Achnanthes renei*, *A. rupestoides*, *A. subhudsonis*, *Achnantheiopsis frequentissima* var. *magna*, *Actinella brasiliensis*, *Eunotia intermedia*, *E. minor*, *E. septentrionalis*, *E. soleirolii*, *E. zygodon*, *Fragilaria bidens*, *Psammothidium marginulatum*, *Pseudostaurosira brevistriata*, *Punctastriata linearis*, *Staurosira construens*, *Staurosira elliptica* 和 *Synedra lanceolata* 等。此外，*Achnantheiopsis*, *Actinella*, *Psammothidium*, *Pseudostaurosira*, *Punctastriata* 和 *Staurosira* 等六個屬是新紀錄屬。本文為往後在該湖進行研究提供基礎資料。

關鍵詞：台灣、神秘湖、矽藻、新紀錄、掃描電子顯微鏡。

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