

On the occurrence of freshwater diatoms of Southern Himachal Pradesh, India

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Abstract

The present paper reports 29 freshwater diatoms from different regions of southern Himachal Pradesh. These are *Cyclotella meneghiniana* Kuetzing, *Melosira varians* Agardh, C. A., *Synedra* Ehrenberg (4 var.), *Fragilaria* Lyngbye (6 spp.), *Ulnaria contracta* (Østrup) Morales & Vis (1 sp.), *Diatoma* Bory (2 spp.), *Eunotia* Ehrenberg (1 sp., 1 var.), *Fragilariopsis doliolus* (Wall.) Medlin & Sims (1 sp.), *Achnanthis exile* (Kützing) Heiberg (1 sp.), *Planothidium* Round et Bukhtiyarova (2 spp.), *Achnanthis* Bory (3 spp., 1 var.), *Cocconeis* Ehrenberg (2 spp. 1 var.), *Pinnularia luculenta* (A. W. F. Schmidt) Cleve

Introduction

Himachal Pradesh is one of the northern states of India which is a part of Indo-western Himalaya. It shares its boundary with China and other states of India namely, Jammu and Kashmir, Punjab, Haryana, and Uttarakhand. Very little work has been done on the algal flora of the state particularly with reference to the diatoms. From the state, work on diatoms has been done by Srivastava and Gupta (2004) who have described diatoms from pond and wetlands of Himachal Pradesh. Seth *et al.* (2005) have published a checklist of algal flora of Himachal Pradesh. Misra *et al.* (2005), Misra and Shukla (2006), Misra *et al.* (2007) have reported some diatoms from Uttarakhand. Suxena and Venkateshwarlu (1970), Nautiyal (2002), Sharma *et al.* (2007) have worked on diatom biodiversity of the Garhwal region of Uttarakhand state.

Materials and methods

Algal samples were collected by Random Sampling Technique from different geographical localities of Southern Himachal during November 2003 to November 2006. All the collections were fixed in 3-4% formalin immediately in the field and the collection number and date were also marked. Diatoms were studied after cleaning their frustules following modified conc. H₂SO₄ – K₂Cr₂O₇ method of Patrick and Reimer (1966). A drop of DPX was put on the dried and cleaned diatom material as mountant and covered carefully with cover slip. Several permanent slides were made for each sample and some of them representing maximum taxa were chosen for the study. Photomicrographs of the studied taxa were made by Nikon Labophot- II microscope in Phycology Laboratory of Lucknow University.

Description of the species:

1. *Cyclotella meneghiniana* Kütz. (Pl. 1, fig. 1& 2)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.58, fig. 660, Pg. 218)

Valves 15 (fig. 1) and 23(fig. 2) µm in diameter, 14 striae in 10 µm. Outer zone broad; central zone smooth or finely radially punctuate.

Collection Number & Date: HP/MAN/14b, 25/5/2004; Locality: Satluj River, Tattapani, Mandi.

2. *Melosira varians* C. Agardh, C. A. (Pl. 1, fig. 3)

Tiffany, L.H. & Britton, M.E. (1952) (Pl. 59, fig. 673, Pg. 221)

Valve 26 µm long, 11 µm broad. Valves somewhat convex, finely punctuate, appearing nearly smooth, girdles very finely punctuate, appearing nearly smooth.

Collection Number & Date: HP/SOL/19b, 28/5/2004; Locality: Ashni River, Solan.

3. *S. ulna* (Nitz.) Ehr. var. *amphirhynchus* (Ehr.) Grunow (Pl. 1, fig. 14)

Gandhi (1955) (Pl. 311, fig. 4-5)

Valve 130 µm long, 5 µm broad, striae 9 in 10 µm, valves linear-lanceolate with abruptly constricted, large capitate ends. Pseudoraphe narrow, linear central area moderate, reaching the sides.

Collection Number & Date: HP/KIN/2g, 8/11/2006; Locality: Nako Lake, Kinnaur.

4. *S. ulna* (Nitz.) Ehr. var. *danica* (Kuetz.) Grunow (Pl. 1, fig. 15)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.63, fig. 715, Pg. 237)

Valve 100 µm long, 4 µm broad, striae 12-13 in 10 µm. Cells scarcely attenuated towards the slightly capitate ends.

Collection Number and Date: HP/UNA/4c, 1/6/2005; Locality: Swan River, Una.

5. *S. ulna* (Nitz.) Ehr. var. *fonticola* Hustedt (Pl. 1, fig. 8)

Hustedt, F. (1938) (Fig. 37, Plate 10, Pg. 156)

Valve 50 µm long, 10 µm broad, striae 9 in 10 µm.

Collection Number and Date: HP/MAN/5b, 20/5/3004; Locality: Byas River, Mandi.

6. *S. ulna* (Nitz.) Ehr. var. *impressa* Hustedt (Pl. 1, fig. 9)

Hustedt, F. (1959) (Fig. 691 A (i), Pg. 198)

Valve 49 µm long, 5 µm broad, striae 13 in 10 µm.

Collection Number & Date: HP/SIR/4d, 21/6/2005; Locality: Giri River, Dadahu, Sirmaur.

7. *F. construens* (Ehr.) Grunow (Pl. 1, fig. 12)

Hustedt, F. (1985) (Fig. 670 f, Pg. 146)

Valve 19 µm long, 8 µm broad, striae 18 in 10 µm. Cells rectangular in girdle view, bound into long tightly closed ribbon, girdle side crossed by broad band on account of transapical inflation.

Collection Number & Date: HP/MAN/9b, 22/5/2004; Locality: Suketi Khad, Mandi.

8. *F. intermedia* Grunow (Pl. 1, fig. 13)

Hustedt, F. (1959) (Fig.6, Pg.152)

Valve, 75 µm long and 7 µm broad striae 9 in 10 µm.

Collection Number & Date: HP/MAN/2b, 19/5/2004; Locality: Jarol Khad, Mandi.

9. *F. leptostauron* (Ehr.) Hustedt (Pl. 2, fig. 2)

Hustedt, F. (1959) (Fig.668-e, Pg.153)

Valve 18 µm long, 10 µm broad striae 9 in 10 µm. Valves strongly widened transapically in the middle, almost cross-shaped, bluntly rounded on the poles, not drawn out. Transapical striae very robust, pseudoraphe wide, lanceolate, without a specially delimited central area.

Collection Number & Date: HP/MAN/9b, 22/5/2004; Locality: Suketi Khad, Mandi.

10. *F. nitzschioides* Grunow (Pl. 2, fig. 1)

Hustedt, F. (1959) (Fig.675, Pg.167)

Valve 35 µm long, 4 µm broad striae 16 in 10 µm. Valves linear, slightly narrowed to wedge-shaped on the ends, slightly, drawn out, valve margin with small spines, transapical striae slightly radial near the ends. Central area absent.

Collection Number & Date: HP/UNA/4c, 1/6/2005; Locality: Swan River, Una.

11. *F. pinnata* Ehrenberg (Pl. 1, fig. 11)

Hustedt, F. (1985) (Fig. 671, Pg. 150)

Valve 13 µm long, 8 µm broad striae 13- 14 in 10 µm. Valves linear in outline, parallel or weakly convex sides and bluntly rounded ends. Transapical striae robust, rib-like, weakly radial towards ends. Pseudoraphe sharply delimited, linear or somewhat lanceolately widened in the middle.

Collection Number & Date: HP/SIR/4d, 21/6/2005; Locality: Giri River, Dadahu, Sirmaur.

12. *F. ulna* (Nitzsch) Lange-Bertalot [syn. *Synedra ulna* (Nitz.) Ehrenberg]

(Pl. 1, fig. 7)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.63, fig. 713, Pg. 237)

Valve 85µm long, 9.5 µm broad, striae 9.5 in 10 µm. Valves linear in girdle view, solitary; gradually narrowed towards the ends, with broadly rounded poles; pseudoraphe narrowly linear.

Collection Number & Date: HP/MAN/5b, 20/5/3004; Locality: Byas river, Mandi.

13. *Ulnaria contracta* (Østrup) Morales & Vis [syn. *S. ulna* var. *contracta* Østrup] (Pl. 1, fig. 10)

Prasad, B.N. & Srivastava, M.N. (1992) (Pl. 24, fig. 21, Pg. 172)

Valve 32 µm long, 5 µm broad, striae 13 in 10 µm.

Collection Number & Date: HP/SIR/4d, 21/6/2005; Locality: Giri River, Dadahu, Sirmaur.

14. *Diatoma heimalis* (Lyngbye) Heiberg (Pl. 2, fig. 4)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.61, fig. 684, Pg. 230)

Valves 59 µm long, 11 µm broad, Striae 9 in 10 µm. Valves linear-lanceolate, only slightly narrowed towards the rounded poles; costae prominent.

Collection Number & Date: HP/HAM/9c, 3/6/2005; Locality: Byas River, Nadaun, Hamirpur.

15. *D. vulgare* Bory (Pl. 2, fig. 3)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.61, fig. 686, Pg. 230)

Valves 45 µm long, 12 µm broad, Striae 7 in 10 µm. Valves elliptic-lanceolate, narrowed slightly towards the rounded poles, with very narrow pseudoraphe.

Collection Number & Date: HP/KIN/1g, 8/11/2006; Locality: Satluj River, Ribba, Kinnaur.

16. *Eunotia serrata* var. *diadema* (Ehrenberg) R.M. Patrick [syn. *Eunotia robusta* var. *tetraodon* (Ehr.) Ralfs] (Pl. 1, fig. 5)

Hustedt, F. (1959) (Fig. 740g, Pg. 273)

Valve 58 µm long, 20 µm broad striae 11 in 10 µm.

Collection Number & Date: HP/MAN/8b, 22/5/2004; Locality: Mandi Baodi, Mandi.

17. *E. valida* Hustedt (Pl. 1, fig. 4)

Hustedt, F. (1985) (Fig. 754, Pg. 261)

Valve 45 μm long, 5 μm broad striae 14 in 10 μm . Valves with convex ventral margin, slightly decreasing in width from the middle towards the ends with almost parallel margins. Dorsal line somewhat depressed only a short distance from ends. Ends slightly capitate and slightly bent dorsally.

Collection Number & Date: HP/MAN/8b, 22/5/2004; Locality: Mandi Baodi, Mandi.

18. *Fragilariopsis doliolus* (Wall.) Medlin & Sims [syn. *Pseudoeunotia doliolus* (Wall.) Grunow] (Pl. 1, fig. 6)
Hustedt, F. (1959) (Fig. 737b, Pg. 259)

Valves 31 μm long, 8 μm broad, Striae 10 in 10 μm .

Collection Number & Date: HP/MAN/7b, 21/5/2004; Locality: Gambar River between Rewalsar and Mandi.

19. *Achnanthes crenulata* Grunow (Pl. 2, fig. 6)

Hustedt, F. (1938) (Pl. 14, Fig. 7, Pg. 388)

Valves 40 μm long, 12 μm broad, Striae 10 in 10 μm .

Collection Number & Date: HP/HAM/9c, 3/6/2005; Locality: Byas River, Nadaun, Hamirpur

20. *A. inflata* (Kuetz.) Grunow (Pl. 2, fig. 5)
Hustedt, F. (1938) (Tafel 14, Fig. 11, Pg. 205)

Valves 40 μm long, 13 μm broad, Striae 10 in 10 μm .

Collection Number & Date: HP/MAN/8b, 22/5/2004; Locality: Mandi Baodi, Mandi.

21. *A. lanceolata* var. *rostrata* Hustedt (Pl. 2, fig. 9)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 725, Pg. 241)

Valve 15 μm long, 6 μm broad, Striae 12 in 10 μm . Valves broadly elliptic, abruptly narrowed towards poles.

Collection Number & Date: HP/UNA/4c, 1/6/2005; Locality: Swan River, Una.

22. *A. nodosa* Cleve (Pl. 2, fig. 8)
Hustedt, F. (1959) (Fig. 861, Pg. 407)

Valves 12 μm long, 7 μm broad, Striae 11 in 10 μm .

Collection Number & Date: HP/SIR/2d, 21/6/2005; Locality: Renuka Lake, Sirmaur.

23. *Achnantheidium exile* (Kützing) Heiberg [syn. *Achnanthes exilis* Kuetzing] (Pl. 2, fig. 10)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 723, Pg. 242)

Valves 18 μm long, 4 μm broad, Striae 18 in 10 μm . Valves linear-lanceolate gradually narrowed to rounded poles; hypovalves with thread like raphe, with wide central area and transverse striations somewhat radial; epivalve with linear pseudoraphe and striations only slightly radial.

Collection Number & Date: HP/SOL/10a, 8/11/2003; Locality: Mohan Baodi, Dharmapur, Solan.

24. *Planothidium hauckianum* (Grunow) Round & Bukhtiyarova [syn. *A. hauckiana* Grunow] (Pl. 2, fig. 11)
Hustedt, F. (1959) (Fig. 834, Pg. 388)

Valves 23 µm long, 6µm broad, Striae 10 in 10 µm.

Collection Number & Date: HP/SIR/4d, 21/6/2005; Locality: Giri River, Dadahu, Sirmaur.

25. *P. lanceolatum* (Brébisson ex Kützing) Lange-Bertalot [syn. *Achnanthes lanceolata* (Brebisson ex Kütz.) Grunow] (Pl. 2, fig. 7)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 724, Pg. 241)

Valve 13 µm long, 5 µm broad, Striae 5-7 in 10 µm. Valves elliptic-lanceolate with transverse striations; hypovalves with pronounced thread like raphe with central area broad, somewhat rectangular; hypovalves with slender pseudoraphe and with a U-shaped spot on one side.

Collection Number & Date: HP/MAN/8b, 22/5/2004; Locality: Mandi Baodi, Mandi.

26. *Cocconeis pediculus* Ehrenberg (Pl. 2, fig. 12)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 733, Pg. 241)

Valve 29 µm long, 20 µm broad, Striae 16 in 10 µm. Valves broadly elliptic; hypovalve with radially arranged transverse striae with round punctae, raphe thread-like, straight with small rounded central area; epivalve with striations crossed by irregularly longitudinal rows of larger punctae with narrow linear pseudoraphe scarcely medianly widened.

Collection Number & Date: HP/MAN/2b, 19/5/2004; Locality: Jarol Khad, Mandi.

27. *C. placentula* Ehrenberg (Pl. 2, fig. 13)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 735, Pg. 241)

Valve 35 µm long, 20 µm broad, Striae 16 in 10 µm.

Collection Number & Date: HP/MAN/4a, 4/11/2003; Locality: Tattapani drainage water, Mandi.

28. *C. placentula* var. *lineata* (Ehrenberg) van Heurck [syn. *C. placentula* var. *lineata* (Ehrenberg) Cleve] (Pl. 2, fig. 14)

Tiffany, L.H. & Britton, M.E. (1952) (Pl.64, fig. 736, Pg. 241)

Valve 32 µm long, 18 µm broad, Striae 23 in 10 µm. Striae in both transverse and longitudinal series with isolated punctae and hyaline areas appearing towards margin.

Collection Number & Date: HP/MAN/5a, 4/11/2003; Locality: Satluj River, Tattapani, Mandi.

29. *Pinnularia luculenta* (A. W. F. Schmidt) Cleve (Pl. 2, fig. 15)

Hustedt, F. (1938) (Pl. 23, Fig. 16, Pg 394.)

Valves 70 µm long, 12 µm broad, Striae 10 in 10 µm. Frustules biraphid, symmetrical to apical and transapical axes Valves usually constricted and linear. The external proximal ends usually dilated and bent slightly in the same direction, distal ends deflected

Collection Number & Date: HP/UNA/4c, 1/6/2005; Locality: Swan River, Una.

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PLATE-1

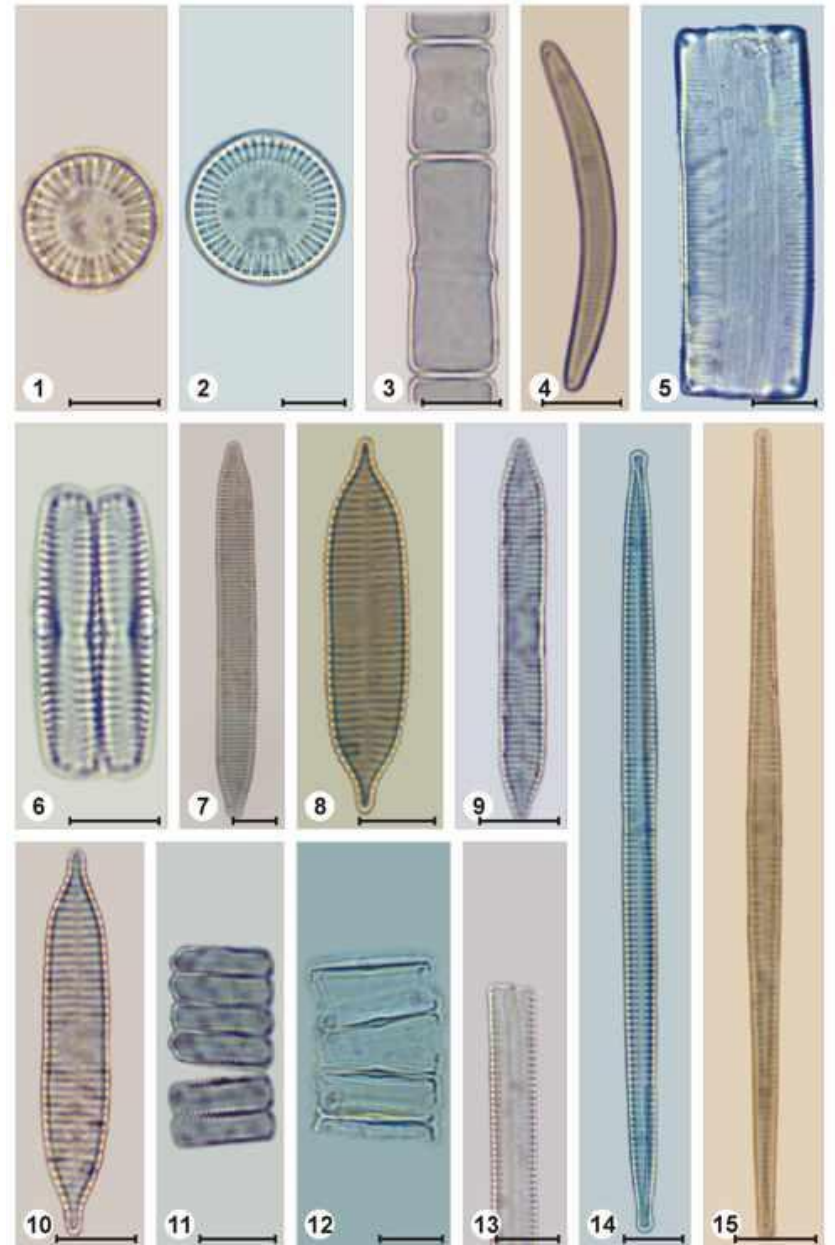


Plate – 1

1 . & 2. *Cyclotella meneghiniana* Kuetzing. 3. *Melosira varians* Agardh 4. *Eunotia valida* Hustedt 5. *E. serrata* var. *diadema* (Ehr.) R.M. Patrick 6. *Fragilariopsis doliolus* (Wall.) Medlin & Sims 7. *Fragilaria ulna* (Nitz.) Lange-Bertalot 8. *Synedra ulna* (Nitz.) Ehr. var. *fonticola* Hustedt 9. *S. ulna* (Nitz.) Ehr. var. *impressa* Hustedt 10. *S. ulna* (Nitz.) Ehr. var. *contracta* Østrup. 11. *Fragilaria pinnata* Ehrenberg 12. *F. construens* (Ehr.) Grunow 13. *F. intermedia* Grunow 14. *Synedra ulna* (Nitz.) Ehr. var. *amphirhynchus* (Ehr.) Grunow 15. *S. ulna* (Nitz.) Ehr. var. *danica* (Kütz.) Grunow

PLATE-2

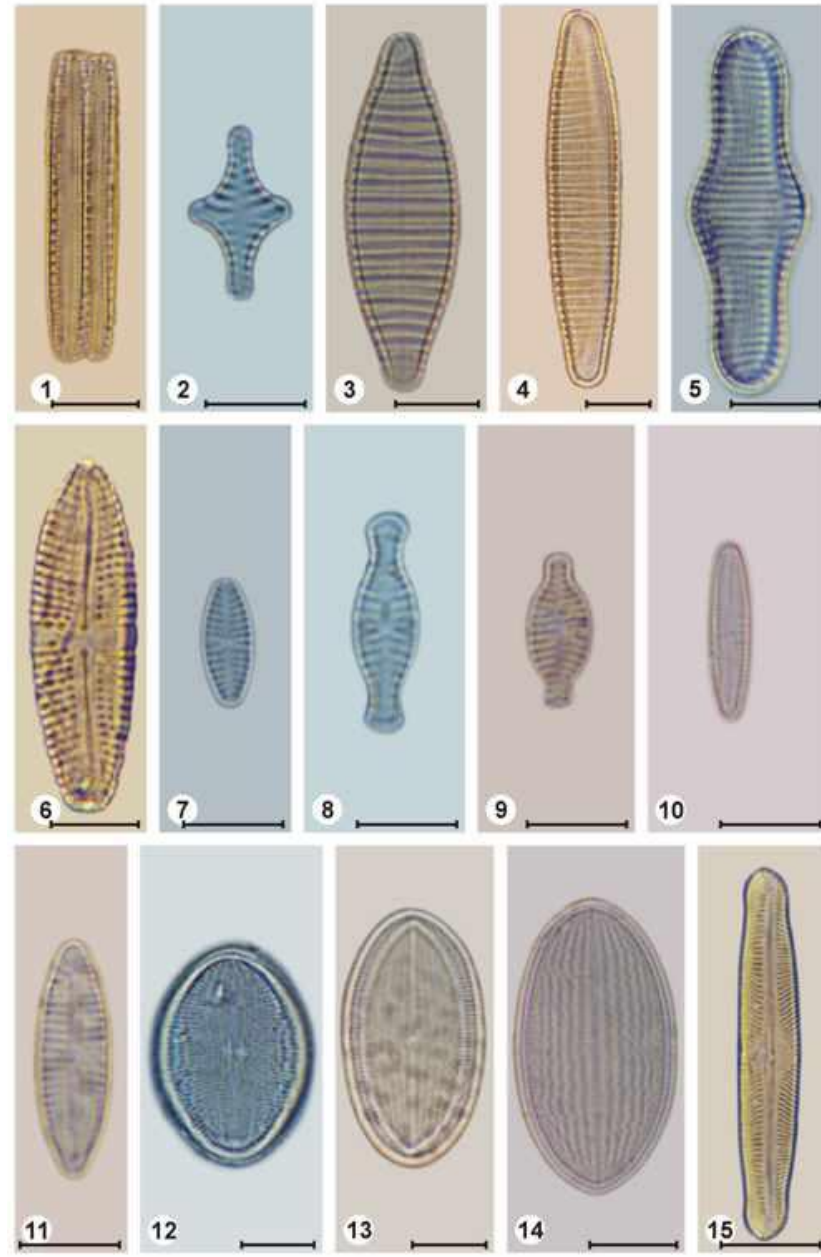


Plate – 2

1. *Fragilaria nitzschioides* Grunow 2. *F. leptostauron* (Ehr.) Hustedt 3. *Diatoma vulgare* Bory 4. *D. heimalis* (Lyngbye) Heiberg 5. *Achnanthes inflata* (Kuetz.) Grunow 6. *A. crenulata* Grunow 7. *Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot 8. *A. nodosa* Cleve 9. *A. lanceolata* var. *rostrata* Hustedt 10. *Achnantheidium exile* (Kützing) Heiberg 11. *Planothidium hauckianum* (Grunow) Round & Bukhtiyarova 12. *Cocconeis pediculus* Ehrenberg 13. *C. placentula* Ehrenberg 14. *C. placentula* var. *lineata* (Ehrenberg) van Heurck 15. *Pinnularia luculenta* (A. W. F. Schmidt) Cleve