Environ. Sci. Hokkaido	5 (2)	221～282	Dec. 1982

Phytoplankton in Lake Abashiri

Yuko Nakamura-Niiyama
Laboratory of Systematic Botany, Division of Environmental Structure, Graduate School of Environmental Science, Hokkaido University, Sapporo, Japan, 060

網走湖の植物プランクトン

新山優子
北海道大学大学院環境科学研究科植物分類学講座

Introduction

Lake Abashiri is located in the northeast of Hokkaido and connected with the Sea of Okhotsk by River Lower Abashiri[1] with the length of 7 km. This lake is eutrophic and had been investigated on the various aspects of the fishery (Tokui & Kawai, 1967).

Until now total 58 phytoplankton taxa were identified by the previous authors in Lake Abashiri (Motoda & Ishida, 1948; Hirose, 1950; Motoda, 1950; Kurohagi & Kuroda, 1965; Tsuda *et al.*, 1966; Kurohagi, 1970). Recently the water bloom of the blue-green algae caused trouble in fishery of the lake (Kuroda, 1977), and the detailed water analysis was made (Aoi *et al.*, 1978). The present writer with Aoi & Kurogi (1980) reported on the seasonal change of dominant phytoplankton and the environmental factors of this lake from 1978 to 1979. This paper enumerates all species collected during 1978 to 1979 and describes their seasonal occurrence and morphological characters.

Methods

Phytoplankton samples were taken once or twice a month from May in 1978 to September in 1979, except the freezing season. Three stations were visited periodically. St. 1 was located near the mouth of River Upper Abashiri, St. 2 was in the center of the Lake and St. 3 was near the entrance of River Lower Abashiri (Fig. 1). Samples were obtained by making vertical and horizontal hauls with a plankton net (NXXX 25). Diatoms were burned and fixed with Mountmedia (Wako-jyunyaku-kogyo Co., Ltd.).

Received 27 Aug. 1982
1982年8月27日受理

1) River Abashiri is divided into two portions by Lake Abashiri. In this Study, River Upper Abashiri means the inflow to the Lake and River Lower Abashiri does the outflow from the Lake.

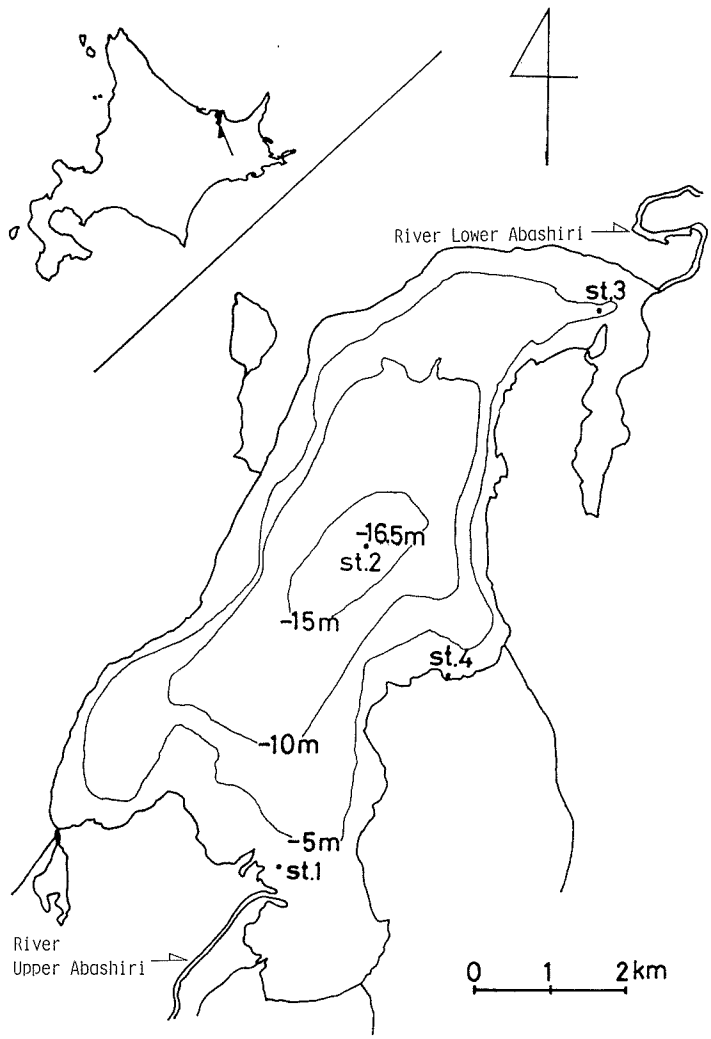


Fig. 1. Lake Abashiri.

Periphytic algae were collected only once on July 26 in 1979 (St. 4 in Fig. 1).

All samples were investigated under the light microscope. Primary taxonomic references used for algal identification were Geitler (1932), Hirose & Yamagishi ed. (1977), Huber-Pestalozzi (1938), Hustedt (1930), Patrick & Reimer (1966, 1975), Prescott (1951) and Uherkovich (1966).

Results

Total 189 taxa of phytoplankton were identified by this study, including Cyanophyceae 9, Chrysophyceae 1, Bacillariophyceae 161 and Chlorophyceae 18. Compared with the investgations of the previous authors, newly found phytoplankton in Lake Abashiri were Cyanophyceae 7, Chrysophyceae 1, Bacillariophyceae 154, Chlorophyceae 13 and total 175 taxa. In addition to these, three periphytic algae were identified, 1 Cyanophyceae and 2 Chlorophyceae.

The phytoplankton species occurred in the lake is listed on Table 1. The bar in the table indicates the relative abundance of each species. The thicker the bar is, the more abundant species is. The dotted line indicates that species is very rare.

Morphological description of all the identified algae are described in the following. According to Hirose & Yamagishi ed. (1977), Hustedt (1930), Geitler (1923), Patrick & Reimer (1966, 1975) and Prescott (1951), halophilous species were about 30% of all the species[2].

Cyanophyceae

1. *Dactylococcopsis acicularis* Lemmermann (Pl. I, fig. 1)

Prescott, 1951, p. 464, Pl. 105-figs. 1, 2; Hirose & Yamagishi (ed.), 1977, p. 13. Pl. 4-fig. 2.

Cells solitaly, needle-like shaped with acute apices, straight or somewhat arched, 2-3 μm in diameter, 50-70 μm long, light bluegreen to pale green. F.

2. *Merismopedia glauca* (Ehr.) Nägeli (Pl. I, fig. 2)

Huber-Pestalozzi, 1938, p. 160 , fig. 59; Prescott, 1951, p. 459, Pl. 101-figs. 2-4.

Colony quadrangular plate of 16-64 cells. Cells ovoid to elliptical, 3-4 μm in diameter, 4-5 μm long, bright blue-green. F, B.

3. *Merismopedia tenuissima* Lemmermann (Pl. I, fig. 3)

Huber-Pestalozzi, 1938, p. 160, fig. 57; Prescott, 1951, p. 459, Pl. 100-fig. 17.

Colony rectangular plate of 4, 8, 16, 32, 64 cells within a gelatinous envelope. Cells minute ovoid to elliptical, 1.3-2 μm in diameter, blue-green to pale green. F, B.

4. *Microcystis* sp. (Pl. I, fig. 4)

Colony of numerous spherical cells sparsely and irregularly arranged within mucilage. Cells spherical with pseudovacuoles, 2-3 μm in diameter. F.

5. *Anabaena flos-aquae* var. *treleasi* Bornet et Flahault (Pl. I, fig. 5)

Geitler, 1932, p. 891, fig. 571 c; Huber-Pestalozzi, 1938, p. 214, fig. 134; Prescott, 1951, p. 515. Pl. 120-fig. 134; Watanabe, M., 1971, p. 271, fig. 18.

Trichomes contorted or coiled in a somewhat regular spiral, solitary or entangled in a group. Cells ellipsoid to subcylindrical, about 4 μm in diameter, 4-10 μm long. Heterocyst ellipsoid, 4-5 μm in diameter, 7-8 μm long. Akinete cylindrical, 4 μm in diameter, ca. 10 μm long, very rare. F.

6. *Anabaena flos-aquae* var. *intermedia* f. *spiroides* Woronich (Pl. I, fig. 6)

Huber-Pestalozzi, 1938, p. 241, fig. 131; Watanabe, M., 1971, p. 273, fig. 20.

Trichome planktonic with thick gelatinous sheath, coiled in regular or irregular spiral. Cells spherical to broadly ellipsoid, sometimes barrel-shaped with pseudovacuoles, 4-6 μm in diameter. Heterocyst spherical, 6-7 μm in diameter. Akinete

2) At the end of the each description, F means fresh water algae, B does brackish and M does marine algae.

Table 1. Seasonal occurrence of phytoplankton in Lake Abashiri (1).

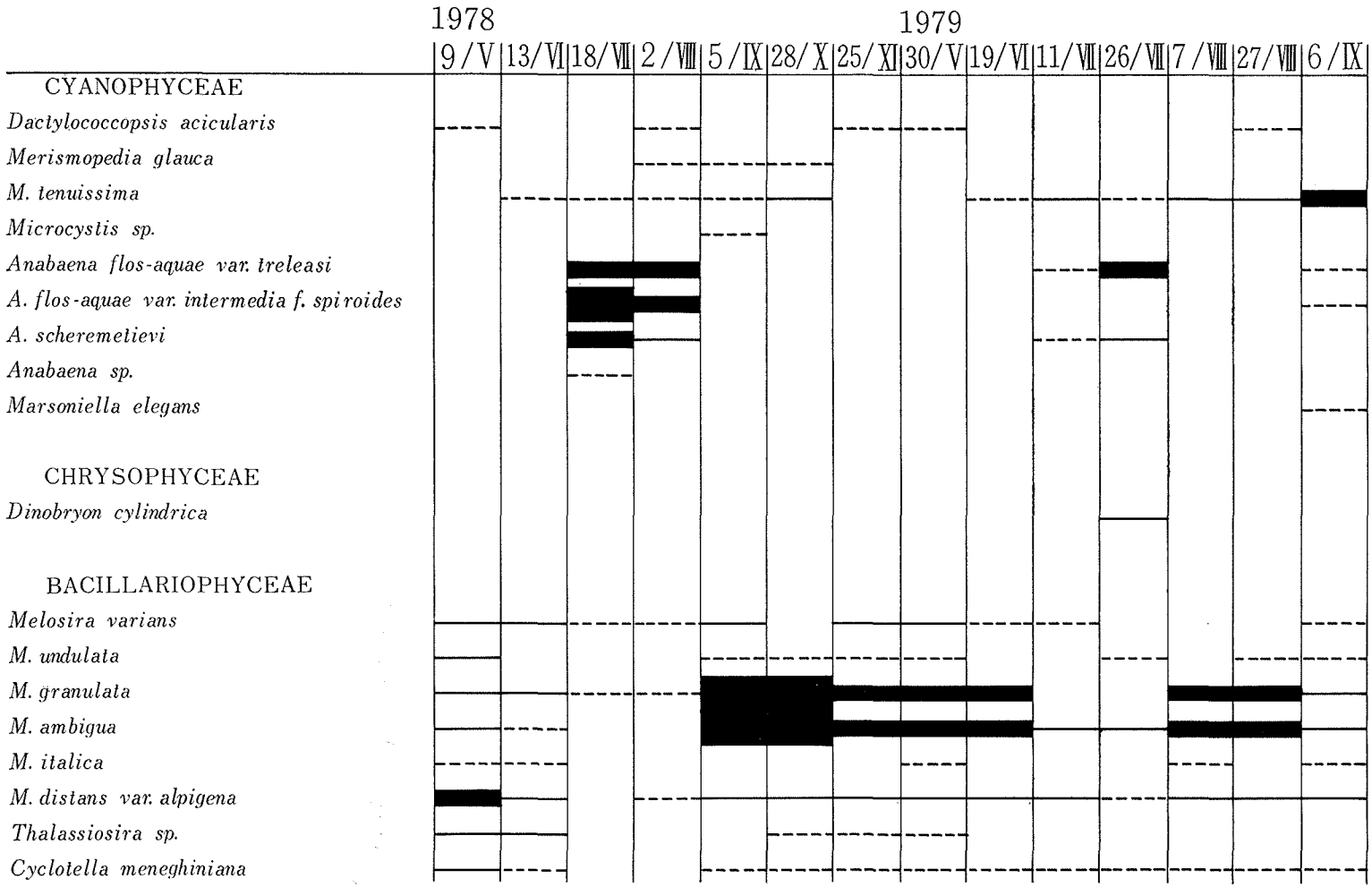


Table 1 Continued (2).

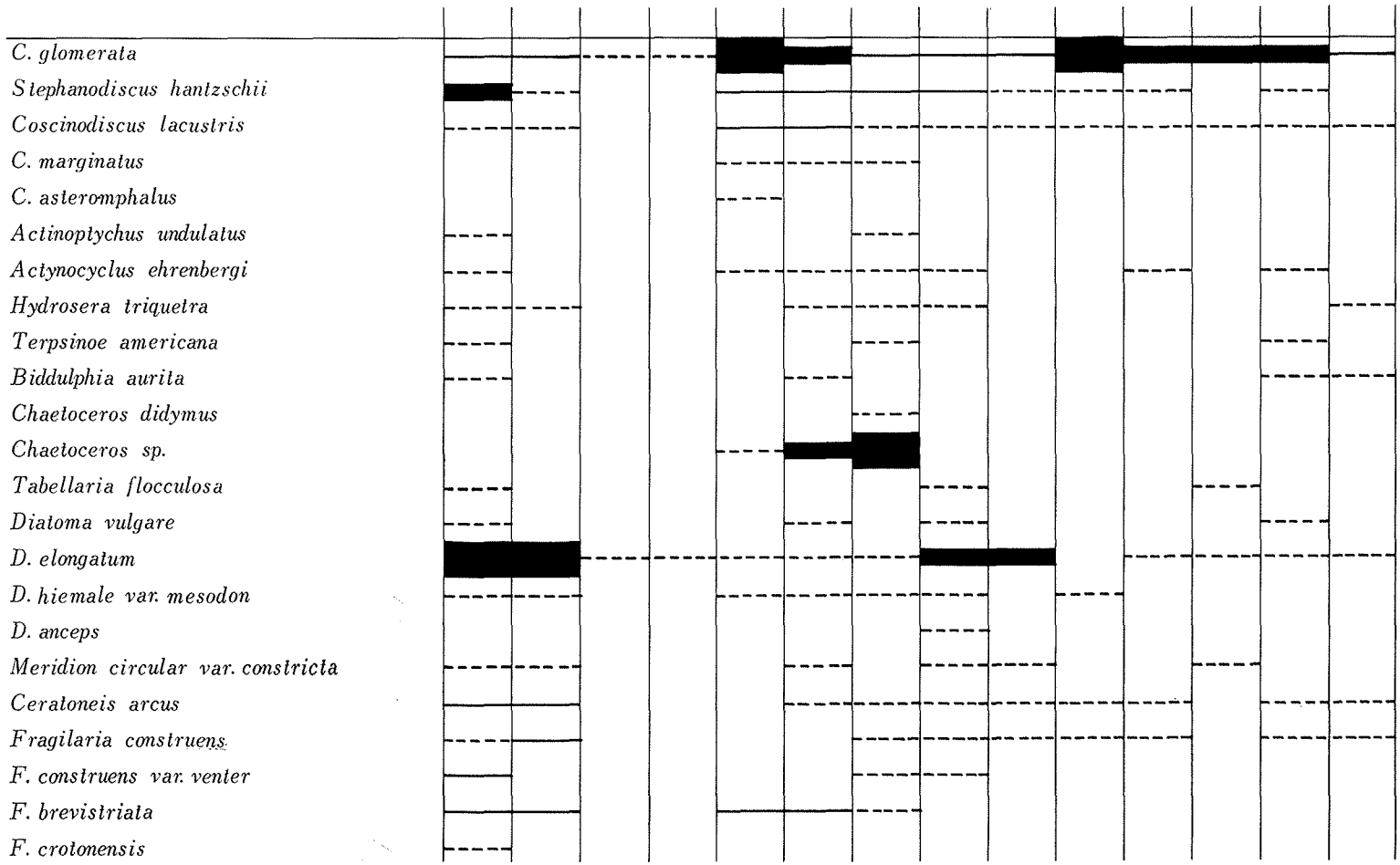


Table 1 Continued (3).

	1978							1979						
	9/V	13/VI	18/VII	2/VIII	5/IX	28/X	25/XI	30/V	19/VI	11/VII	26/VII	7/VIII	27/VIII	6/IX
F. leptostauron	- - - -													
F. lapponica	- - - -				- - - -									
F. vaucheriae	- - - -	- - - -												
Asterionella gracillima	- - - -					- - - -								
Synedra ulna		■	- - - -		■	■	■			- - - -	- - - -	- - - -		- - - -
S. inaequalis	- - - -	- - - -				- - - -	- - - -	- - - -	- - - -	- - - -		- - - -	- - - -	
S. acus		■			■			■	■	- - - -	- - - -	- - - -		
S. rumpens		- - - -	- - - -			- - - -	- - - -	■	- - - -		- - - -			
S. rumpens var. fragilarioides	- - - -													
S. tabulata								- - - -						
S. pulchella	- - - -					- - - -		- - - -				- - - -		
Eunotia veneris	- - - -				- - - -									
E. lunaris	- - - -													
E. praerupta var. bidens	- - - -													
Cocconeis placentula	- - - -								- - - -				- - - -	- - - -
C. placentula var. euglypta	- - - -	- - - -					- - - -							
C. diminuta	- - - -						- - - -							
C. scutellum		- - - -					- - - -							
C. scutellum var. parva	- - - -						- - - -							
Achnanthes lanceolate						- - - -	- - - -	- - - -			- - - -	- - - -	- - - -	- - - -

Table 1 Continued (4).

A. lanceolate f. capitata	-													
A. lanceolata var. elliptica	-													
A. peragallis	-													
Navicura seminulum								-						
Rhoicosphenia curvata	—	—			—	-	-	-	-		-	-	-	-
Frustria rhomboides	-						-	-						
F. vulgaris								-						
Gyrosigma acuminatum	-				-	-	—	-						
G. terryanum		-												
Caloneis brevis	-													
C. ventricosa	-						-							
C. ventricosa var. truncatula	-													
Diploneis interrupta					-									
D. finnica	-						-							
D. smithii	-						-	-						
Neidium bisulcatum var. baicalense	-													
Stauroneis phoenicenterom	-				-									
S. anceps	-													
Stauroneis acula	-													
Navicula gregaria	-	-				-	-	-	-			-		-
N. crucicula	-													
N. punctulata							-							
N. cryptocephala														-

Table 1 Continued (5).

	1978							1979						
	V	VI	VII	VIII	IX	X	XI	V	VI	VII	VII	VIII	VIII	IX
N. lanceolata	—	—			—	—	—	—	—	—		—	—	—
N. radiosa						—								
N. viridvla var. rostellata	—													
N. peregrina	—					—								
N. cuspidata	—													
N. sp.								—	—				—	
N. integra	—													
N. rynchocephala	—													—
N. clementis	—							—					—	
N. tuscula	—							—						
N. alpha var. longistris	—				—	—	—						—	—
N. viridula var. slevicensis	—						—							
Pimularia alpina								—						
P. borealis								—						
P. brebissonii								—						
P. gibba	—							—						
P. gibba var. parva	—													
P. viridis var. commutata								—						
P. divergens var. parallela	—													
P. gentilis	—													
P. mesolepta	—													
P. nobilis							—							
P. streptoraphe						—								

Table 1 Continued (6).

P. viridis	----													
Gomphonema sp.	----													
Amphiprora paludosa		----					----	----				----	----	
A. alata							----							
A. ovalis var. affinis	----				----	----		----				----	----	
Amphora perpusilla	----					----		----					----	
A. coffeaeformis						----		----					----	
A. arenicola	----	----				----		----						
Cymbella minuta var. silesiaca	----													
C. gracilis	----													
C. cistula	----													
C. ehrenbergii	----													
C. minuta		----			----		----	----	----			----	----	
C. naviculiformis	----	----					----	----						
C. cymbiformis	----													
C. aspera	----					----		----			----			
C. tumida	----	----				----	----	----	----				----	----
Gomphonema acuminatum	----					----								
G. truncatum var. capitatum	----													
G. sphaerophorum	----					----		----						
G. olivaceum	----					----	----							
G. olivaceoides	----													
G. angustatum	----													

Table 1 Continued (7).

	1978							1979						
	V	VI	VII	VIII	IX	X	XI	V	VI	VII	VII	VIII	VIII	IX
Epithemia adnata								-						-
E. turgida	-					-	-	-						
E. sorex	-	-				-	-	-					-	-
Rhopalodia gibba	-					-	-	-						-
R. gibba var. ventricosa	-					-	-	-					-	
R. gibberula							-	-						
Hantzschia amphioxys	-	-					-							
H. amphioxys var. major	-					-								
H. elongata	-													
Bacillaria paradoxa	-					—	-	-		-				
Nitzschia trybionella	-					-	-	-					-	
N. trybionella var. levidensis	—					-	-	-						-
N. trybionella var. debilis	-													
N. circumsuta	-						-	-						
N. punctata var. peragalli	-													
Nitzschia apiculata	-													-
N. hungrica	-													
N. dubia	—				-	-	-	-					-	
N. commutata	-													
N. gracilis	-													
N. sp. 1	■	-	-	-	-	-	—	■	—					
N. frustulum	-	-						-						
N. sp. 2	-						-	-						

Table 1 Continued (8).

N. amphibia	- - - -													
N. actinastroides	- - - -					- - - -	- - - -	- - - -	—					
N. obtusa var. scalpelliformis	- - - -					- - - -		- - - -	- - - -			- - - -	- - - -	
N. sigma	- - - -						- - - -	- - - -						
N. parvula	- - - -							- - - -						
N. lorenziana var. subtilis	- - - -						- - - -							
N. acicularis	- - - -	- - - -		- - - -				—						
Cymatopleura solea	- - - -					- - - -								
Stenopterobia intermedia	- - - -					- - - -								
Surirella biseriata						- - - -								
S. linearis	- - - -					- - - -								
S. moelleriana	- - - -													
S. robusta var. splendida	—				- - - -	- - - -	- - - -	- - - -			- - - -		- - - -	
S. inducta							- - - -	- - - -						
S. ovata var. pinnata	- - - -													
Campylodiscus echneis	- - - -					- - - -	- - - -	- - - -						

Table 1 Continued (9).

	1978 9/V	13/VI	18/VII	2/VIII	5/IX	28/X	25/XI	1979 30/V	19/VI	11/VII	26/VII	7/VIII	27/VIII	6/IX
CHLOROPHYCEAE														
Eudorina elegans			- - - -						- - - -	- - - -			- - - -	
Elakatothrix gelatinosa						- - - -	- - - -							- - - -
Planctonema lauterbornii	- - - -	- - - -			—	- - - -	■	- - - -	- - - -	- - - -				
Dictyosphaerium ehrenbergianum				- - - -			- - - -		- - - -					- - - -
Micractinium pusillum					- - - -		- - - -							
Westella botryoides		- - - -		- - - -	- - - -	- - - -	—	- - - -	—	- - - -			- - - -	
Oocystis sp.						- - - -	- - - -	- - - -	- - - -				- - - -	- - - -
Closteriopsis longissima var. tropica					- - - -	- - - -	—						- - - -	
Pediastrum duplex		- - - -	- - - -	- - - -	—	- - - -	- - - -		- - - -					
P. boryanum	- - - -	—	- - - -		- - - -		- - - -		- - - -					
Scenedesmus acuminatus	- - - -	- - - -	- - - -	- - - -		—	- - - -			- - - -		- - - -	- - - -	—
S. quadricauda		- - - -		- - - -	- - - -	—			- - - -			- - - -	- - - -	
S. intermedius		- - - -	- - - -			- - - -		- - - -	- - - -	- - - -			- - - -	- - - -
S. spinosus						- - - -				- - - -			- - - -	- - - -
Closterium moniliferum			- - - -	- - - -										

ellipsoid, near the heterocyst, sometimes adjoining, 8-10 μm in diameter, 13-15 μm long. F.

7. *Anabaena scheremetievi* Elenkin (Pl. I, fig. 7)

Prescott, 1951, p. 518, Pl. 117-figs. 11, 12; *A. scheremetievi* var. *recta* f. *ovaspora* in Geitler, 1932, p. 880, fig. 561; in Watanabe, M., 1971, p. 266, figs. 6, 7.

Trichomes planktonic, straight with thin gelatinous sheath. Cells spherical or barrel-shaped with pseudovacuoles, 8-9 μm in diameter, 5-10 μm long. Heterocyst spherical, 8-10 μm in diameter. Akinete spherical to elliptical with acute ends, not adjacent to the heterocyst, 13-17 μm in diameter, 15-20 μm long, rare. F.

8. *Anabaena* sp.

Trichome closely coiled in an irregular spiral. Cells spherical with pseudovacuoles, 6-8 μm in diameter. Heterocyst spherical, about 8 μm in diameter. Akinete not to be seen.

9. *Marsoniella elegans* (Roth) Agardh (Pl. I, fig. 9)

Geitler, 1932, p. 247, fig. 120; Prescott, 1951, p. 471, Pl. 107-fig. 12.

Colony of 6-16 pyriform cells arranged in radiate with their narrow ends directed outward. Cells 2-3 μm in diameter, 5-6 μm long, pale green. F.

10. *Calothrix* sp. (Pl. XIX, fig. 2)

Filaments clustered to form stellate and compact tufts, forming dark green patches on submerged rock or stone surfaces, with false branched from the midregion. Trichomes gradually tapering from the base. Vegetative cells 4-7 μm in diameter at the base, 2-4 μm long, sometimes constricted at the cross wall, light blue-green to blue-green. Heterocyst 5-6 μm in diameter, basal, ellipsoid to hemispherical. Sheath 8-10 μm in diameter at the base, colorless.

Chrysophyceae

1. *Dinobryon cylindrica* Imhof (Pl. I, fig. 10)

Prescott, 1951, p. 378, Pl. 107-fig. 1; Hirose & Yamagishi (ed.), 1977, p. 191, Pl. 66-fig. 8.

Colony of conical loricas arranged in forked chains. Loricas smooth with flaring mouth, irregularly tapering to a blunt base, swollen just above the cone-shaped posterior portion and concave above the swelling, about 10 μm in diameter at the mouth, 40-50 μm long. F.

Bacillariophyceae

1. *Melosira varians* Agardh (Pl. II, fig. 1)

Hustedt, 1930, p. 240, fig. 100.

Cells cylindrical, united to form chains. Valves circuler with almost flattened and hyaline surface. Without sulcus and spines. Numerous small plate-like chromatophores arranged around the cell wall. Auxospores almost globular. Diameter 10-30 μm. Height 10-12 μm. F.

2. *Melosira undulata* (Ehr.) Kützing (Pl. II, fig. 2)

Hustedt, 1930, p. 243, fig. 102.

Cells cylindrical, united to form close chains. Valve surface punctate in radiating dichotomous lines with central hyaline area. Valve mantle thicker as it approaches the suture. Girdle surface punctate parallel to the pervalver axis. Diameter ca. 50 μm. Height ca. 20 μm. F.

3. *Melosira granulata* (Ehr.) Ralfs (Pl. II, fig. 3)

Hustedt, 1930, p. 248, fig. 104.

Cells cylindrical, united to form close chains. Girdle surface with coarse granules, arranged in longitudinal lines, 8-9 in 10 μm. With clear sulcus, pseudosulcus and spines. Diameter ca. 10 μm. Height 15-20 μm. F, eutrophic.

4. *Melosira ambigua* (Grun.) Müller

Hustedt, 1930, p. 256, fig. 108.

Cells cylindrical, united to form chains, with distinct sulcus. Girdle surface punctate in spiral lines, ca. 20 in 10 μm. Puncta ca. 20 in 10 μm. Diameter 3-5 μm, hight 15-20 μm.

5. *Melosira italica* (Ehr.) Kützing (Pl. II, fig. 5)

Hustedt, 1930, p. 257, fig. 109.

Cells cylindrical, united to form chains, with clear sulcus, pseudosulcus and short spines. Girdle surface punctate with small granules. Diameter 10-20 μm. Height 10-15 μm. F.

6. *Melosira distans* var. *alpigena* Grunow (Pl. II, fig. 6)

Hustedt, 1930, p. 263, fig. 110 g.

Cells drum shaped, united to form short chains, with deep sulcus, marginal short spines. Diameter 4-5 μm. Height 3-5 μm. F.

7. *Thalassiosira* sp. (Pl. II, fig. 7)

Cells discoid, rectangular in girdle view, circular and slightly convex in valve view. Valve surface punctate with areolate structure in curved lines. Margine of the valve furnished with a ring of spines. Cells united by central mucilage filament. Diameter 18-25 μm. Height 10-15 μm.

8. *Cyclotella meneghiniana* Kützing (Pl. II, fig. 8)

Hustedt, 1930, p. 341, fig. 174.

Cells solitary, sometimes united in short chains, discoid, undulate in girdle view. Valve circular, middle area almost smooth, marginal area striate, striae 8-9 in 10 μm. Diameter 18-22 μm. F.

9. *Cyclotella glomerata* Bachmann (Pl. II, fig. 9)

Hustedt, 1930, p. 362, fig. 189.

Cells very small, drum shaped, united to form loose chains, somewhat undulate in girdle view. Valve circular, middle area smooth or punctate, marginal area

striate. Diameter 3-7 μm. F.

10. *Stephanodiscus hantzschii* Grunow (Pl. II, fig. 10)

Hustedt, 1930, p. 370, fig. 194.

Cells discoid, solitary or united to form short chains. Valve surface furnished with radiating rows of small puncta, somewhat irregularly at the center, with marginal spines. Diameter 6-10 μm. F.

11. *Coscinodiscus lacustris* Grunow (Pl. III, fig. 1)

Hustedt, 1930, p. 432, fig. 235.

Cells solitary, drum shaped. Valve circular, undulate with marginal small spines. Puncta arranged in radiating rows, divided dichotomously. Diameter 25-40 μm. M, B, F.

12. *Coscinodiscus marginatus* Ehrenberg (Pl. II, fig. 11)

Hustedt, 1930, p. 416, fig. 223.

Cells solitary, discoid. Valve circular with somewhat convex surface. Valve covered with strong and large areolation. Areolae polygonal, arranged somewhat irregularly radiated, central areolae 1.5-2 in 10 μm, peripheral areolae smaller, 3 in 10 μm. Without central hyaline area. Diameter 100-120 μm. M.

13. *Coscinodiscus asteromphalus* Ehrenberg

Hustedt, 1930, p. 452, fig. 250.

Cells discoid, large, solitary. Valve circular, slightly convex. Valve surface covered with areolation, large central rosette enclosing a small hyaline area. Areolae sub-hexagonal, arranged in radiating lines, 3-4 in 10 μm. Diameter 120-140 μm. M.

14. *Actinoptychus undulatus* (Bailey) Ralfs (Pl. III, fig. 2)

Hustedt, 1930, p. 475, fig. 264.

Cells solitary, discoid. Valve divided in six sections, alternately raised and depressed. Sectors covered with sub-hexagonal areolae and fine puncta. There is a small hexagonal hyaline area at the center of the valve. Diameter 60-80 μm. M.

15. *Actynocyclus ehrenhergi* Ralfs (Pl. III, fig. 3)

Hustedt, 1930, p. 525, fig. 298.

Cells solitary, discoid. Valve circular convex. When viewed with a low power objective, valve appears to be colored—blue, green, brown, pink, yellow etc. Valve surface covered with punctate, radiate striae. Valve surface divided into radial compartment with varying number of striae which parallel to the middle striae. Puncta 7-9 in 10 μm. Diameter 50-100 μm. M.

16. *Hydrosera triquetra* Wollich (Pl. IV, fig. 1)

Kato, Kobayashi & Nagumo, 1977, p. 72, Pl. 1-fig. 14.

Cells large, solitary. Quadrangular and areolate in girdle view. In valve view, valve appears to be composed of two triangles with the broadly rounded apices.

Diameter ca. 100 μm. B.

17. *Terpsinoe americana* (Bail.) Ralfs

Hustedt, 1930, p. 900, fig. 541.

Cells large, solitary. Rectangular in girdle view. Valve furnished with two transverse costae and with three inflations. Finely punctate. Diameter 45-50 μm. M.

18. *Biddulphia aurita* (Lyngb.) Brébisson et Godey (Pl. IV, fig. 2)

Hustedt, 1930, p. 846, fig. 501.

Cells irregularly quadrangular. Valve elliptical, slightly inflated at the center with two long spines. From the angles of the valve arise conical horns. Puncta arranged almost parallel to pervalver axis in girdle view. Diameter ca. 120 μm. M.

19. *Chaetoceros didymus* Ehrenberg (Pl. XVII, fig. 1)

Hustedt, 1930, p. 688, fig. 390

Cells united to form straight chains. Valve surface slightly concave with a prominant semicircular median inflation. From the angles of the valve arise two elongated bristles (setae) which cross those of the neighbouring cells a short distance beyond the cell margin. Diameter 10-12 μm. M.

20. *Chaetoceros* sp. (Pl. XVII, fig. 2)

Cells united to form short curved chains. Cells elliptical in valve view, rectangular in girdle view with somewhat concave surface. Terminal bristle not different from the others. Setae arise from the apices of the valve and appear to be bent toward the same side of the chains, slender. Chromatophore plate-like, one or two. Diameter 7-10 μm. Pervalver axis 10-30 μm. M.

21. *Tabellaria flocculosa* (Roth) Kützing (Pl. V, fig. 1)

Knudson, 1952, p. 421-440; Patrick & Reimer, 1966, p. 104, Pl, 1-figs. 4, 5; *Tabellaria fenestrata* var. *intermedia* Grunow in Hustedt, 1931, p. 27, fig. 555.

Cells rectangular with four or more septa in girdle view, united in zigzag filaments. Rudimentary septa present. Valve linear with median inflation, a little greater than the apices. Apical inflation somewhat capitate. Pseudoraphe narrow. Striae fine, 12-16 in 10 μm. Length 23-80 μm. Width of median inflation about 5 μm. F.

22. *Diatoma vulgare* Bory (Pl. V, fig. 2)

Hustedt, 1931, p. 96, fig. 628

Cells rectangular with intercalary bands in girdle view. Valve elliptical with rounded or somewhat attenuated, rostrate apices. Coastae 6-8 in 10 μm. Length ca. 50 μm. Breadth 8-10 μm. F.

23. *Diatoma elongatum* (Lyngb.) Agardh (Pl. V, fig. 3)

Hustedt, 1931, p. 99, fig. 629; Cleve-Euler, 1953, p. 22, fig. 330; *Diatoma tenue* var. *elongatum* Lyngby in Patrick & Reimer, 1966, p. 109, Pl. 2-fig. 6.

Cells linear, rectangular in girdle view, without intercalary bands. Valve linear

with capitate apices. Pseudoraphe indistinct. Coastae 6-11 in 10 μm. Striae very fine, almost indistinct. Cells formed zigzag filaments united by their ends to form irregularly branching colonies. Colonies composed utmost 3,000-5,000 cells. Many small, discoid chromatophores contained. Length 15-80 μm, mostly 25-30 μm. Breadth 2-4 μm. F, B.

24. *Diatoma hiemale* var. *mesodon* (Ehr.) Grunow (Pl. V, fig. 4)

Hustedt, 1931, p. 103, fig. 631.

Cells rectangular with clear intercalary bands in girdle view. Valve elliptical, somewhat rhombic. Costae 3-4 in 10 μm. Striae ca. 20 in 10 μm. Length ca. 15 μm. Breadth ca. 6 μm. F.

25. *Diatoma anceps* (Ehr.) Grunow

Hustedt, 1931, p. 130, fig. 117.

Valve linear, constricted toward the capitate ends. Costae 4-5 in 10 μm. Striae 17-20 in 10 μm. Length ca. 35 μm. Breadth ca. 5 μm. F.

26. *Meridion cricular* var. *constricta* (Ralfs) Van Heurck (Pl. V, fig. 5)

Hustedt, 1931, p. 93, fig. 627 g, h.

Cells wedge-shaped in girdle view. In valve view, the broader apex capitate, another rounded and somewhat rostrate. Costae 6-8 in 10 μm. Length ca. 15 μm. F.

27. *Ceratoneis arcus* Kützing (Pl. V, fig. 6)

Hustedt, 1930, p. 134, fig. 122; *Hannaea arcus* (Ehr.) Patrick in Patrick & Reimer, 1966, p. 132, Pl. 4-fig. 20.

Valve curved with convex dorsal margin and concave ventral margin, swolen at the center. Apices attenuate, capitate. Central area swollen only on the ventral side of the valve. Pseudoraphe narrow. Striae almost parallel, 13-16 in 10 μm. Length 40-50 μm. Breadth ca. 6 μm. F.

28. *Fragilaria construens* (Ehr.) Grunow (Pl. V, fig. 7)

Hustedt, 1930, p. 156, fig. 670 a-c.

Cells rectangular in girdle view. Valve strongly swollen in the middle portion, with rounded, slightly capitate apices. Pseudoraphe distinct, linear-lanceolate in shape. Striae radiate ca. 13 in 10 μm. Length ca. 15 μm. Breadth ca. 7 μm. F.

29. *Fragilaria brevistriata* Grunow (Pl. V, fig. 12)

Hustedt, 1930, p. 145, fig. 151.

Cells linear-rectangular in girdle view, united in band to form chains. Valve linear to linear-lanceolate with rostrate ends. Pseudoraphe linear-lanceolate. Striae marginal, slightly radiate, 13-14 in 10 μm. Length 20-30 μm. Breadth ca. 7 μm. F.

30. *Fragilaria crotonensis* Kitton (Pl. V, fig. 9)

Hustedt, 1930, p. 137, fig. 125.

Cells linear and swollen at the center in girdle view, attached in the middle

portion to form filaments. Striae 15-16 in 10 μm. Length ca. 65 μm. F.

31. *Fragilaria leptostauron* (Ehr.) Hustedt (Pl. V, fig. 10)

Patrick & Reimer, 1966, p. 124, Pl. 4; fig. 2; *F. harrisonii* W. Smith in Hustedt, 1930, p. 139, fig. 132.

Valve strongly swollen in the middle portion with attenuated and rounded apices. Pseudoraphe linear-lanceolate. Striae coarse, somewhat radiate, ca. 7 in 10 μm. Length ca. 25 μm. Breadth in the middle of the valve ca. 12 μm. F.

32. *Fragilaria construens* var. *venter* (Ehr.) Grunow (Pl. V, fig. 11)

Hustedt, 1930, p. 158, fig. 670 h-m.

Cells rectangular in girdle view, united to form chains. Valve elliptical, broad-lanceolate or rhombic with rounded ends. Pseudoraphe lanceolate in shape. Striae radiate, 12-14 in 10 μm. Length 10-20 μm. Breadth 5-7 μm. F.

33. *Fragilaria lapponica* Grunow

Hustedt, 1931, p. 170, fig. 678.

Cells linear-rectangular in girdle view, united in band to form chains. Valve linear to lanceolate with rounded apices. Pseudoraphe large, lanceolate in shape. Striae marginal, 6-8 in 10 μm. Length 10-20 μm. Breadth ca. 4 μm. F.

34. *Fragilaria vaucheriae* (Kütz.) Peters (Pl. V, fig. 13)

Patrick & Reimer, 1966, p. 120, Pl. 3-figs. 14, 15; *Ceratoneis arcus* var. *recta* Cleve et Kraßke in Kobayashi, 1965, p, 126, figs. 1-5.

Cells in short or fairly long chains. Valve linear-lanceolate, slightly narrowed toward the rostrate, rounded, sometimes capitate apices. Pseudoraphe narrow, linear. Central area on only one side of the valve, somewhat inflated. Striae almost parallel, slightly shortened opposite the central area, 13-14 in 10 μm. Length 25-90 μm. Breadth 4-6 μm. F.

35. *Asterionella gracillima* (Hantz.) Heiberg (Pl. V, fig. 14)

Hustedt, 1930, p. 147, fig. 157; *A. formosa* var. *gracillima* (Hantz.) Grunow in Patrick & Reimer, 1966, p. 160, Pl. 9-fig. 9.

Valve linear with capitate ends which are more or less similar in size. Cells forming star-shaped colonies. Striae fine, 22-25 in 10 μm. Length 50-90 μm. Breadth 2-3 μm. F.

36. *Synedra ulna* (Nitzsch.) Ehrenberg (Pl. V, fig. 15)

Hustedt, 1930, p. 151, figs. 158, 159.

Cells solitary, linear-rectangular in girdle view. Valve linear, very gradually attenuated to the rostrate ends. Striae distinct, parallel, 10-12 in 10 μm. Pseudoraphe narrow, linear. Central area almost square or somewhat elliptical. Length 110-400 μm. Breadth 5-6 μm. F, eutrophic.

37. *Synedra inaequalis* H. Kobayashi (Pl. V, fig. 16)

Kabayashi, 1964, p. 67, Pl. 3-figs. 7, a-k.

Valve linear-lanceolate to lanceolate with attenuated, rostrate apices. Striae

distinct, parallel, 14-16 in 10 μm. Pseudoraphe narrow, linear. Central area almost square or elliptical. Length 40-90 μm. Breadth 7-8 μm. F.

38. *Synedra acus* Kützing (Pl. V, fig. 17)

Hustedt, 1930, p. 155, fig. 170.

Cells linear in girdle view. Valve linear-lanceolate, tapering to rounded or slightly capitate apices. Striae parallel, 12-16 in 10 μm. Pseudoraphe narrow, linear. Central area a little longer than broad. Length 90-160 μm. Breadth 4-5 μm. F.

39. *Synedra rumpens* Kützing (Pl. V, fig. 18)

Hustedt, 1930, p. 156, fig. 179.

Valve linear-lanceolate, undulated in the middle portion, attenuated toward the ends. Apices rostrate or somewhat capitate. Pseudoraphe narrow. Central area rectangular, undulated. Striae 16-20 in 10 μm. Length 20-45 μm. Breadth 2-3 μm. F.

40. *Synedra rumpens* var. *fragilarioides* Grunow (Pl. V, fig. 19)

Patrick & Reimer, 1966, p. 144, Pl. 6-fig. 1.

Valve linear, attenuated to the rostrate apices. Pseudoraphe narrow. Central area longer than broad, reaching both margin of the valve and sowewhat swollen. Striae parallel, ca. 13 in 10 μm. Length 50-60 μm. The number of striae is more in this specimens than that of the textbook (10-12 in 10 μm), but other is as same. F.

41. *Synedra tabulata* (Ag.) Kützing (Pl. V, figs. 8, 20)

Hustedt, 1932, p. 218, fig. 710 a-d.

Cells in fan-shaped clusters. Valve linear-lanceolate, tapering to capitate apices. Striae marginal, 12-13 in 10 μm. Pseudoraphe central, linear-lanceolate. Length 70-100 μm. Breadth 4-5 μm. F, B.

42. *Synedra pulchella* Kützing (Pl. V, fig. 21)

Hustedt, 1930, p. 160, fig. 187.

In girdle view, linear rectangular, somewhat narrowed toward the ends. Valve linear-lanceolate with attenuated, rounded or slightly capitate apices. Striae distinctly punctate, parallel, 13-18 in 10 μm. Pseudoraphe narrow, linear. Central area rectangular to elliptical, slightly swollen. Length 80-100 μm. Breadth 6-7 μm. B.

43. *Eunotia veneris* (Kütz.) Müller (Pl. V, fig. 22)

Hustedt, 1932, p. 300, fig. 766.

Valve arcuate, narrower at the ends than at the center, with rounded apices. Ventral margin slightly concave or almost straight, dorsal margin convex. Terminal nodules near the ends of the valve. Striae straight, almost perpendicular to ventral margin, 13-15 in 10 μm. Length 20-55 μm. Breadth ca. 5 μm. F.

44. *Eunotia lunaris* (Ehr.) Grunow (Pl. V, fig. 23)

Hustedt, 1932, p. 302, fig. 769.

Valve arcuate with rounded apices. Dorsal and ventral margin parallel. Terminal nodules small. Striae ca. 14 in 10 μm. Length ca. 90 μm. Breadth ca. 4 μm. F.

45. *Eunotia praerupta* var. *bidens* (W. Sm.) Grunow

Hustedt, 1932, p. 281, figs. 747 i-m.

Ventral margin slightly concave. Dorsal margin with two swellings. Ends of the valve broadly rostrate and rounded. Terminal nodules on ventral margin at the apices. Striae almost parallel, 10-12 in 10 μm at the center, ca. 14 in 10 μm at the ends. Length 40-50 μm. Breadth ca. 9 μm.

46. *Cocconeis placentula* Ehrenberg

Hustedt, 1930, p. 189, fig. 260.

Valve elliptical. Raphe valve; axial area very narrow, central area small, striae curved radiate, finely punctate, interrupted near the margin by a hyaline area. Pseudoraphe valve; pseudoraphe linear, striae curved and radiate to the margin, finely punctate, 21-23 in 10 μm. Length 15-30 μm. Breadth 9-16 μm. F.

47. *Cocconeis placentula* var. *euglypta* (Ehr.) Cleve (Pl. VI, fig. 1, 2)

Hustedt, 1930, p. 190, fig. 261.

Valve elliptical. Striae on pseudoraphe valve interrupted by a few longitudinal hyaline spaces which are linear and somewhat undulated. Striae radiate, coarser than the type form, 18-19 in 10 μm. Length 15-30 μm. Breadth 9-15 μm. F.

48. *Cocconeis diminuta* Pantocsek (Pl. VI, fig. 3)

Hustedt, 1930, p. 190, fig. 265.

Valve elliptical, pseudoraphe valve with linear-lanceolate pseudoraphe. Striae radiate, coarse dotted lines, 13-14 in 10 μm. Length 10-15 μm. Breadth ca. 8 μm. F.

49. *Cocconeis scutellum* Ehrenberg (Pl. VI, fig. 5)

Hustedt, 1930, p. 191, fig. 267; Hendey, 1964, p. 180, Pl. XXVII-fig. 8.

Valve broadly elliptical. Pseudoraphe valve; pseudoraphe linear, coarse puncta arranged in transverse lines, 5-7 in 10 μm. Raphe valve; raphe straight, axial area vary narrow, central area small, striae finely punctate, radiate, 8-9 in 10 μm. Length 40-100 μm. Breadth 30-70 μm. M.

50. *Cocconeis scutellum* var. *parva* Grunow (Pl. VI, fig. 4)

Hustedt, 1930, p. 192, fig. 268; Hendey, 1964, p. 180.

Valve elliptical or somewhat rhombic, small. Puncta on pseudoraphe valve 9-10 in 10 μm. Otherwise similer to the type form. Length 15-30 μm. Breadth 10-20 μm. M.

51. *Achnanthes lanceolata* Brébisson (Pl. VI, fig. 6)

Hustedt, 1930, p. 207, fig. 306 a.

Valve elliptical-lanceolate with broad, rounded ends. Pseudoraphe valve; pseudoraphe linear-lanceolate, interrupted centrally on one side by a horseshoe-shaped clear area, striae radiate. Raphe valve; raphe straight with narrow, linear axial area, central area broad, rectangular, striae radiate, at the center shorter. Striae 13-14 in 10 μm on both valve. Length 13-18 μm. Breadth 6-7 μm. F.

52. *Achnanthes lanceolate* f. *capitata* Müller (Pl. VI, fig. 7)

Hustedt, 1933, p. 410, fig. 863 g, h.

Valve elliptical with protracted, rostrate apices. Pseudoraphe lanceolate, otherwise similer to the type form. Length 11-15 μm. Breadth 5-6 μm. F.

53. *Achnanthes lanceolate* var. *elliptica* Cleve (Pl. VI, fig. 8)

Hustedt, 1930, p. 208, fig. 306 c.

Valve elliptical. Striae radiate, 14-15 in 10 μm on both valve. Otherwise similer to the type form. Length 8-13 μm. Breadth 5-7 μm. F.

54. *Achnanthes peragalli* Brun et Héribaud (Pl. Vi, fig. 9)

Hustedt, 1930, p. 207, fig. 300.

Valve broadly elliptical with protracted, rostrate apices. Pseudoraphe valve with lanceolate pseudoraphe, striae radiate, 16-17 in 10 μm, interrupted on one side by a horseshoe-shaped clear area. Length ca. 15 μm. Breadth ca. 8 μm. F.

55. *Navicula seminulum* Grunow (Pl. VI, fig. 10)

Hustedt, 1930, p. 272, fig. 443.

Valve linear-elliptical with broadly rounded ends. Axial area narrow with a stauroid central area, almost reaching to the margins. Raphe straight, striae slightly radiate, 18-20 in 10 μm, length 10-17 μm. Breadth 3-4 μm. F, B.

56. *Rhoicosphenia curvata* (Kütz.) Grunow (Pl. VI, fig. 11)

Hustedt, 1930, p. 211, fig. 311

Valve clavate with rounded ends. In girdle view wedge-shaped and bent. Raphe valve concave with narrow, linear axial area and small central area. Rudimentary raphe valve convex with narrow, linear axial area. Rudimentary raphe short, extending from foot pole. Striae parallel or somewhat radiate, 15-16 in 10 μm. Length 19-30 μm. Breadth ca. 8 μm. F, eutrophic.

57. *Frustria rhomboides* (Ehr.) De Toni (Pl. VI, fig. 12)

Hustedt, 1930, p. 220, fig. 324.

Valve rhombic-lanceolate with broad rounded apices. Transverse striae almost perpendicular to longitudinal striae, 25-30 in 10 μm. Raphe straight, enclosed between two ribs. Terminal nodule swollen and then abruptly attenuated, pen point like shaped. Length ca. 120 μm. Breadth ca, 25 μm. F.

58. *Frustria vulgrais* Thwaites (Pl. VI, fig. 13)

Hustedt, 1930, p. 221, fig. 327; Patrick & Reimer, 1966, p. 309, Pl. 22-fig. 3.

Valve linear elliptical with subrostrate, rounded ends. Central area rounded. Raphe straight. Striae very fine. Length ca. 50 μm. Breadth ca. 7 μm. F.

59. *Gyrosigma acuminatum* (Kütz.) Rabenhorst (Pl. VII, fig. 1)

Hustedt, 1930, p. 222, fig. 329.

Valve sigmoid with gradually tapering to obtusely rounded apices. Raphe sigmoid, central area and axial area small. Striae arranged in transverse and longitudinal rows, 18-20 in 10 μm. Longitudinal striae curving outward on either side of the central area. Length 110-120 μm. Breadth 15-20 μm. F, eutrophic.

60. *Gyrosigma terryanum* (Perag.) Cleve (Pl. VII, fig. 2)

Patrick & Reimer, 1966, p. 325, Pl. 25-fig. 3.

Valve large, sigmoid, linear-lanceolate with symmetrically attenuated ends. Axial area and raphe undulate, eccentric. Central area small, elliptical, diagonal. Transverse and longitudinal striae arranged almost equally, 13-14 in 10 μm. Length 250-350 μm. Breadth 30-45 μm. B.

61. *Caloneis brevis* (Greb.) Cleve (Pl. VI, fig. 14)

Cleve-Euler, 1955, p. 89, fig. 1123.

Valve elliptical-lanceolate with broad, rostrate apices. Axial area narrow, dilated toward the proximal to form a large circular area. Striae fine, radiate, 14-16 in 10 μm. Length 50-80 μm. Breadth 18-20 μm. M, B.

62. *Caloneis ventricosa* (Ehr.) Meister (Pl. VI, fig. 15)

Patrick & Reimer, 1966, p. 583, Pl. 54-fig. 3; *C. silicula* (Ehr.) Cleve in Hustedt, 1930, p. 236, fig. 362.

Valve linear-lanceolate, biconstricted, triundulated, with rounded and somewhat cuneate apices. Axial area linear lanceolate with widened and rounded central area. Striae almost parallel but slightly radiate at the ends, 16-17 in 10 μm. Length 50-90 μm. Breadth 10-15 μm. F.

63. *Caloneis ventricosa* var. *truncatula* (Grun.) Meister (Pl. VI, fig. 16)

Patrick & Reimer, 1966 p. 585, Pl. 54, fig. 5; *C. silicula* v. *truncatula* (Grun.) Cleve in Hustedt, 1930, p. 238, figs. 363, 364.

Valve linear elliptical with rostrate ends. The transverse fascia is about 1/7 of the length. Striae slightly radiate, 20-22 in 10 μm. Length ca. 30 μm. Breadth ca. 7 μm. F, B.

64. *Diploneis interrupta* (Kütz). Cleve (Pl. VII, fig. 3)

Hustedt, 1937, p. 602, fig. 1019.

Valve panduriform, producing two broadly elliptical portions, with rounded ends. Central area quadrate, elongated slightly in the apical axis. Siliceous rib parallel, enclosing the straight raphe. Longitudinal canals narrow with a single

row of process. Costae distinct, convergent near the center of the valve to radiate toward the ends, absent at the center, 11-12 in 10 μm. Length 30-40 μm. Breadth at the widest part, 12-20 μm. M.

65. *Diploneis finnica* (Ehr.) Cleve (Pl. VII, fig. 4)

Hustedt, 1937, p. 669, fig. 1064.

Valve elliptical. Central area rounded quadrate, elongated in the apical axis. Longitudinal canals linear-lanceolate, about one third the breadth of the valve. Costae radiate, 6-7 in 10 μm. Between the costae is a double row of alveoli. Length 30-80 μm. Breadth 20-40 μm. M, B.

66. *Diploneis smithii* (Breb.) Cleve (Pl. VII, fig. 5)

Hustedt, 1937, p. 647, fig. 1057.

Valve elliptical. Central area small, rounded quadrate. Siliceous rib parallel, enclosing the raphe. Longitudinal canals narrow, same width throughout the valve, swollen around the central area. Costae radiate, 8-9 in 10 μm. Between the costae a row of alveoli. Length 37-30 μm. Breadth 15-20 μm. F.

67. *Neidium bisulcatum* var. *baicalense* (Skv. & Meyer) Reimer (Pl. VII, fig. 6)

Partick & Reimer, 1966, p. 297, Pl. 36-fig. 6.

Valve linear-elliptical with broadly rounded ends. Axial area straight, narrow. Raphe straight, proximal ends curved in opposite directions. Central area diagonally elliptical. Primary longitudinal band marginal. Striae almost parallel, 20-22 in 10 μm. Length ca, 50 μm. Breadth ca. 12 μm.

68. *Stauroneis phoenicenteron* Ehrenberg (Pl. VIII, fig. 1)

Hustedt, 1930, p. 255, fig. 404.

Valve rhombic-lanceolate with broadly rounded ends. Raphe straight, slightly broad, tapering toward the proximal and the distal ends. Axial area broadly linear. Central area dilated to form a stauros which reaches the valve margin. Striae radiate, punctate, 15-18 in 10 μm. Length ca. 160 μm. Breadth ca. 35 μm. F.

69. *Stauroneis anceps* Ehrenberg (Pl. VIII, fig. 2 b)

Hustedt, 1930, p. 256, fig. 405.

Valve lanceolate with protracted capitate ends. Axial area linear. Fascia broading toward the valve margin. Raphe straight. Striae finely punctate ca. 20 in 10 μm. Length ca. 70 μm. Breadth ca. 15 μm. F.

70. *Stauroneis phoenicenteron* f. *capitata* Gonzalves et Gandhi (Pl. VIII, fig. 2 a)

Valve lanceolate with protracted capitate ends. Striae finely punctate, radiate, 15-18 in 10 μm. Length ca. 85 μm. Breadth. ca. 20 μm.

71. *Stauroneis acuta* W. Smith (Pl. VIII, fig. 3)

Hustedt, 1930, p. 259, fig. 415!

Valve rhombic-lanceolate with rounded ends. Pseudosepta present. Axial area broad linear. Fascia broading toward the valve margin. Raphe straight, ca. 2 μm

at the widest point. Striae finely punctate, ca. 13 in 10 μm. Length ca. 150 μm. Breadth ca. 22 μm. F.

72. *Navicula gregaria* Donkin (Pl. IX, fig. 1)

Hustedt, 1937, p. 269, fig. 437.

Valve small, lanceolate with rostrate ends. Axial area very narrow. Central area small. Striae parallel, slightly radiate in the middle portion of the valve, 16-18 in 10 μm. Length 15-20 μm. Breadth 5-6 μm. M, B.

73. *Navicula crucicula* (W. Smith) Donkin (Pl. IX, fig. 2)

Hustedt, 1930, p. 284, fig. 471.

Valve elliptical-lanceolate with rounded or slightly protracted and rounded ends. Axial area narrow. Central area small. Striae radiate, coaser in the middle portion, 12-14 in 10 μm, 16-18 in 10 μm at the ends. Length 52-62 μm. Breadth 15-16 μm. B, F.

74. *Navicula punctulata* W. Smith (Pl. IX, fig. 3)

Patrick & Reimer, 1966, p. 449, Pl. 41-fig. 1.

Valve elliptical. Raphe straight. Axial area narrow. Central area circular. Striae radiate, distinctly punctate, 12-13 in 10 μm at the center of the valve, 14 in 10 μm at the ends. Length 30-35 μm. Breadth 16-18 μm. B.

75. *Navicula cryptocephala* Kützing (Pl. IX, fig. 4)

Hustedt, 1930, p. 295, fig. 496 ; Patrick & Reimer, 1966, p. 503, Pl. 48-fig. 3.

Valve lanceolate with protracted, subacute ends. Axial area narrow. Central area rounded. Striae radiate at the center of the valve, 14-15 in 10 μm, convergent at the ends, 16-17 in 10 μm. Length 32-50 μm. Breadth 8-10 μm. F, B.

76. *Navicula lanceolata* (Ag.) Kützing (Pl. IX, fig. 5)

Patrick & Reimer, 1966, p. 511, Pl. 48-figs. 19, 20.

Valve lanceolate with rounded ends. Axial area narrow. Central area large, orbicular. Striae radiate throughout most of the valve, convergent at the ends, regularly shortened about the central area, 10 in 10 μm, 13 in 10 μm at the ends. Length 42-45 μm. Breadth 11-12 μm. F, B.

77. *Navicula radiosa* Kützing (Pl. IX, fig. 6)

Hustedt, 1930, p. 299, fig. 513 ; Patrick & Reimer, 1966, p. 509, Pl. 48-fig. 15.

Valve linear-lanceolate with acute, rounded ends. Axial area narrow. Central area somewhat rhombic. Striae radiate, convergent at the ends, 9-11 in 10 μm. Length 55-80 μm. Breadth 10-1 μm. F.

78. *Navicula viridula* var. *rostellata* (Kütz.) Cleve (Pl. IX, fig. 7)

Patrick & Reimer, 1966, p. 507, Pl. 48-fig. 12.

Valve lanceolate with wedge-shaped and rounded ends. Axial area narrow. Central area irregular oval. Striae radiate at the center of the valve, convergent at the ends, 10-12 in 10 μm. Length 26-35 μm. Breadth 8-11 μm. F, B.

79. *Navicula peregrina* (Ehr.) Kützing (Pl. IX, fig. 8)

Hustedt, 1930, p. 300, fig. 516; Cleve-Euler, 1953, p. 149, fig. 803; Hendey, 1964, p. 201, Pl. XXX-figs. 12, 13.

Valve lanceolate, narrowed toward the rounded ends. Axial area narrow. Central area rounded. Striae radiate, convergent at the ends, distinctly punctate, 5-7 in 10 μm at the center of the valve, 7-8 in 10 μm at the ends. Length 70-80 μm. Breadth 13-20 μm. B, M.

80. *Navicula cuspidata* (Kütz.) Kützing (Pl. IX, fig. 9)

Partick & Reimer, 1966, p. 464, Pl. 43-figs. 9, 10.

Valve lanceolate, gradually tapering toward the rostrate ends. Axial area linear with very slightly widened central area. Raphe straight. Striae composed of puncta forming transverse and longitudinal lines. Transverse striae 13-16 in 10 μm. Longitudinal lines 22-24 in 10 μm. Length ca. 110 μm. Breadth ca. 25 μm. F.

81. *Navicula* sp. (Pl. IX, fig. 10)

Valve lanceolate with slightly protracted and rounded ends. Axial area narrow. Central area lanceolate. Striae radiate at the center of the valve to convergent at the ends, 10-12 in 10 μm. Length 24-32 μm. Breadth 6-7 μm. B.

82. *Navicula integra* (W. Smith) Ralfs (Pl. IX, fig. 11)

Partick & Reimer, 1966, p. 473, Pl. 45-fig. 6.

Valve lanceolate with undulate margin and rostrate ends. Pseudospetum present at each end of the valve. Axial area narrow. Central area small. Striae radiate, distinctly separated from each other in the middle portion of the valve, 12-14 in 10 μm, finer toward the ends, 18-20 in 10 μm. Length 25-30 μm. Breadth 7-8 μm. F, B.

83. *Navicula rhynchocephala* Kützing (Pl. IX, fig. 12)

Patrick & Reimer, 1966, p. 505, Pl. 48-fig. 6.

Valve lanceolate with protracted, somewhat capitate ends. Axial area narrow. Central area transverse, rounded. Striae finely punctate, radiate in the middle portion of the valve, 8 in 10 μm, convergent at the ends, 12 in 10 μm. Length ca. 60 μm. Breadth ca. 12 μm. F.

84. *Navicula clementis* Grounow (Pl. IX, fig. 13)

Patrick & Reimer, 1966, p. 521, Pl. 49-fig. 22.

Valve elliptical-lanceolate with shortly protracted, rostrate ends. Axial area narrow. Central area irregular in shape. Two isolated puncta are present. Striae radiate, alternately longer and shorter at the central area, 12-14 in 10 μm. Length 17-35 μm. Breadth 9-12 μm. F.

85. *Navicula tuscula* Ehrenberg (Pl. IX, fig. 14)

Hustedt, 1930, p. 308, fig. 552; Patrick & Reimer, 1966, p. 539, Pl. 52-fig. 7.

Valve elliptical-lanceolate with protracted rostrate ends. Axial area narrow. Central area transverse. Raphe straight. Striae radiate, 12-13 in 10 μm, broken up into the punctate segments. Length 45-60 μm. Breadth 15-20 μm. F.

86. *Navicula alpha* var. *longistris* H. Kobayashi (Pl. IX, fig. 15)

Kato, Kobayashi & Nagumo, 1977, p. 91, P. 11-figs. 151-152.

Valve elliptical to rectangular, producing long rostrate apices. Raphe straight with triangular central nodules. Striae radiate, distinctly punctate, 10-11 in 10 μm. Central area X-form by striae which are alternately longer and shorter, and the median striae much longer than the others. Length 30-40 μm. Breadth 15-20 μm. B.

87. *Navicula viridula* var. *slevicensis* (Grun.) Cleve (Pl. IX, fig. 16)

Hustedt, 1930, p. 297; Van Heurck, 1885, p. 84, Pl. VII, figs. 28, 29.

Valve lanceolate with rostrate ends. Axial area narrow. Central area transversely widened. Striae radiate, but almost parallel at the center of the valve, 7-8 in 10 μm, slightly convergent at the ends, 10-11 in 10 μm. Length 32-36 μm. Breadth 11-12 μm. F, B.

88. *Pinnularia alpina* W. Smith (Pl. X, fig. 1)

Hustedt, 1938, p. 324, fig. 594; Patrick & Reimer, 1966, p. 618, Pl. 58-figs. 11, 12.

Valve elliptical-lanceolate with broadly rounded ends. Axial area lanceolate. One side of the central area somewhat rounded. Raphe filamentous, terminal fissures sinuous, median ends of the raphe turned slightly to one side. Striae radiate, parallel or convergent at the ends, ca. 3 in 10 μm. Length ca. 100 μm. Breadth ca. 35 μm. F.

89. *Pinnularia borealis* Ehrenberg (Pl. X, fig. 2)

Hustedt, 1930, p. 326, fig. 597; Patrick & Reimer, 1966, p. 618, Pl. 58-fig. 13.

Valve linear-elliptical. Axial area narrow but somewhat rounded at the center of the valve. Median ends of the raphe turned slightly to one side. Striae parallel, 4-5 in 10 μm. Length 10 μm. Breadth ca. 10 μm. F.

90 *Pinnularia brebissonii* (Kütz.) Rabenhorst

Patrick & Reimer, 1966, p. 614, Pl. 58-fig. 6; *P. microstauron* var. *brebissonii* (Kütz.) Hustedt in Hustedt, 1930, p. 320, fig. 6.

Valve linear-elliptical, gradually narrowing to rounded ends. Axial area narrow, graduallly widening toward the central fascia. Striae radiate at the center of the valve, convergent toward the ends, 12-13 in 10 μm. Length 35-40 μm. Breadth 7-8 μm. F,

91. *Pinnularia gibba* Ehrenberg (Pl. X, fig. 3)

Hustedt, 1930, p. 327, fig. 600.

Valve linear with somewhat attenuated, slightly cuneate apices. Axial area narrow, widening into the central area which forms a broad transverse fascia.

Striae radiate at the center of the valve, convergent at the ends, 9–11 in 10 μm. Length 58–65 μm. Breadth 8–11 μm. F.

92. *Pinnularia gibba* var. *parva* (Ehr.) Grunow (Pl. X, fig. 4)

Hustedt, 1930, p. 327, fig. 602.

Valve lanceolate with somewhat attenuated apices. Axial area broadly lanceolate with transverse fascia. Striae almost parallel to slightly convergent at the ends, 9–10 in 10 μm. Length ca. 50 μm. Breadth ca. 17 μm.

93. *Pinnularia viridis* var. *commutata* (Grun.) Cleve

Patrick & Reimer, 1966, p. 640, Pl. 64-fig. 6.

Valve linear with rounded slightly narrower toward the apices. Axial area uniting with the central area to form linear-lanceolate. The ends of the raphe turned to the one side. Striae almost parallel, 9–11 in 10 μm. Length 43–85 μm. Breadth 11–15 μm. F.

94. *Pinnularia divergens* var. *parallela* (Brun.) Patrick (Pl. X, fig. 6)

Patrick & Reimer, 1966, p. 605, Pl. 56-fig. 4.

Valve linear with rounded ends. Raphe straight. Axial area linear, about 1/4 the width of the valve, widening toward the central area to form a transverse fascia with hemispherical thicknings on each margin. Striae radiate at the center of the valve, convergent toward the ends, 7–8 in 10 μm. Length 85–100 μm. Bredth 16–22 μm. This specimen is smaller than that of Patrick, but other description is the same. F.

95. *Pinnularia mesolepta* (Ehr.) W. Smith (Pl. X, fig. 9)

Hustedt, 1930, p. 319, fig. 575 a.

Valve linear with triundulate margine and attenuated, rostrate-capitate ends. Axial area linear with transverse fascia. Striae strongly radiate at the center of the valve, convergent at the ends, 10–11 in 10 μm. The central ends of raphe turned to the one side. Length ca. 50 μm. Breadth ca. 10 μm. F.

96. *Navicula oblonga* (Kütz.) Kützing (Pl. X, fig. 8)

Hustedt, 1930, p. 307, fig. 550; Patrick & Reimer, 1966, p. 534, Pl. 51-fig. 6.

Valve linear, swollen in the middle portion of the valve with rounded, somewhat cuneate ends. Axial area about one forth the breadth of the valve. Central area rounded. Raphe complex. Striae radiate and convergent at the ends of the valve, 6–7 in 10 μm. Length ca. 135 μm. Breadth ca. 20 μm. F.

97. *Pinnularia nobilis* Ehrenberg (Pl. XI, fig. 1)

Hustedt, 1930, p. 337, fig. 619; Cleve-Euler, 1955, p. 81, fig. 1113.

Valve broadly linear with rounded ends, slightly swollen in the middle portion. Raphe complex, terminal fissures "question mark" shaped. Axial area linear, about one third the breadth of the valve. Central area asymmetrically rounded. Striae radiate at the center of the valve, convergent toward the ends, crossed by a broad band, 5–6 in 10 μm. Length 255–340 μm. Breadth 20–45 μm. F.

98. *Pinnularia streptoraphe* Cleve (Pl. X, fig. 7, Pl. XI, fig. 2)

Hustedt, 1930, p. 337, fig. 620.

Valve broadly linear with rounded ends. Raphe complex, terminal fissures "question mark" shaped. Axial area about one third the breadth of the valve. Central area asymmetrically rounded. Striae almost parallel throughout the valve, slightly radiate at the center of the valve, crossed by a broad band, about 5 in 10 μm. Length 180–220 μm. Breadth 32–34 μm. F.

99. *Pinnularia viridis* (Nitz.) Ehrenberg (Pl. XI, fig. 3)

Hustedt, 1930, p. 334, fig. 620.

Valve linear with rounded ends. Raphe complex with "question mark" shaped terminal fissures. Axial area about one fifth the breadth of the valve. Central area asymmetrically rounded. Striae somewhat radiate at the center of the valve, slightly convergent toward the ends, crossed by a narrow band, 7–10 in 10 μm. Length 110–160 μm. Breadth 15–27 μm. F.

100. *Gomphonema* sp. (Pl. X, fig. 10)

Valve linear-lanceolate with rostrate-capitate ends. Axial area linear with transverse fascia. Striae slightly radiate at the center of the valve, somewhat convergent at the ends, 12–13 in 10 μm. Length ca. 28 μm. Breadth ca. 5 μm. F.

101. *Amphiprora paludosa* W. Smith (Pl. XII, fig. 1)

Hustedt, 1930, p. 339, fig. 625; *Entomoneis paludosa* (W. Smith) Reimer Patrick & Reimer, 1975, p. 4, Pl. 1-figs. 3, 4.

Cells somewhat rectangular in girdle view, constricted in the middle and twisted in a figure of eight pattern. Girdle composed of some longitudinal segments. Valve lanceolate with acute apices. Axial area raised to form a sigmoid keel, enclosing the raphe. Valve surface striate. Striae finely lineate, 20–22 in 10 μm. Chromatophore only one. Length 35–70 μm. B.

102. *Amphiprora alata* Kützing (Pl. XII, fig. 2)

Hustedt, 1930, p. 340, fig. 624; *Entomoneis alata* (Ehr.) Ehrenberg in Patrick & Reimer, 1975, p. 3, Pl. 1-fig. 2.

Cells somewhat rectangular in girdle view, constricted in the middle. Axial area raised to form a sigmoid keel, enclosing the raphe. Valve surface striate. Striae ca. 12 in 10 μm. Girdle composed of numerous longitudinal segments. Length ca. 90 μm. B.

103. *Amphora ovalis* var. *affinis* (Kütz.) De Toni (Pl. XII, fig. 3)

Patrick & Reimer, 1975, p. 69, Pl. 13-figs. 3, 4.

Cells broadly elliptical with flat, truncate apices in girdle view. Valve arcuate at dorsal margin, concave at ventral margin. Raphe inflected, lying close to the ventral margin. Striae coarsely punctate, 12–13 in 10 μm, radiate at the dorsal portion, leaving a hyaline space in the middle of the ventral portion. Length 25–40 μm. Breadth 15–25 μm. F.

104. *Amphora perpusilla* (Grun.) Grunow (Pl. XII, fig. 4)

Patrick & Reimer, 1975, p. 70, Pl. 13-figs. 8 a–11 b.

Cells broadly elliptical with truncate apices in girdle view. Raphe almost straight, lying closer to the ventral margin. Striae almost parallel, somewhat radiate at the ends of the valve, ca. 16 in 10 μm. Length 10–18 μm. Breadth 6–9 μm. F.

105. *Amphora coffeaeformis* Agradh (Pl. XII, fig. 5)

Cleve-Euler, 1953, p. 97, fig. 685.

Cells elliptical, tapering toward the truncate apices in girdle view. Valve arcuate at dorsal margin, almost straight at ventral margin, with somewhat rostrate apices. Ventral portion narrow. Striae almost parallel on dorsal part, 16–17 in 10 μm at the center of the valve, 20–22 in 10 μm at the ends. Length 20–20 μm. Breadth ca. 15 μm. B.

106. *Amphora arenicola* Grunow (Pl. XII, figs. 6 a, b)

Celve, 1965, p. 104, Pl. IX-fig. 19, 20

Cells broadly elliptical to almost rectangular in girdle view. Raphe gently bi-arcuate. Axial area indistinct on dorsal part. Central area elliptical. Striae on ventral side punctate and convergent at the center of the valve, radiate at the ends, 9–11 in 10 μm, sometimes interrupted by a hyaline space in the middle portion. Striae on dorsal side radiate, 9–10 in 10 μm. Length 25–52 μm. Breadth 19–30 μm. M.

107. *Cymbella minuta* var. *sileslaca* (Bleish ex Rabh.) Reimer (Pl. XIII, fig. 1)

Patrick & Reimer, 1975, p. 49, Pl. 8, figs. 7 a–10 b.

Valve lunate with convex dorsal margin and almost straight ventral margin, which is somewhat inflated at the middle portion. Raphe straight, near the ventral margin slightly bent at the proximal. Dorsal striae radiate, ventral striae radiate at the center of the valve, becoming slightly convergent at the ends. Striae 8–9 in 10 μm at the center of the valve, ca. 12 in 10 μm at the ends. Length ca. 28 μm. Breadth ca. 10 μm. F.

108. *Cymbella gracilis* (Rabh.) Cleve (Pl. XIII, fig. 2)

Hustedt, 1930, p. 359, fig. 663.

Valve linear-lunate with convex dorsal margin and almost straight ventral margin. Axial area linear. Central area linear-lanceolate. Raphe almost straight, proximal ends dorsally deflected. Striae silightly radiate, but convergent at the ends of the ventral portion, 10–11 in 10 μm at the center of the valve, 12–13 in 10 μm at the ends. Length ca. 50 μm. Breadth ca. 9 μm. F.

109. *Cymbella cistula* (Hemprich) Grunow (Pl. XIII, fig. 3)

Hustedt, 1930, p. 363, fig. 676 a.

Valve dorsi-ventral with convex dorsal and concave ventral margin, in the middle of the latter somewhat inflated. Axial area narrow. Central area small. Raphe slightly arcuate. Striae almost parallel, 7–8 in 10 μm, becoming radiate at

the ends of the valve, 11-12 in 10 μm. Striae punctate, puncta 18-20 in 10 μm. Isolated stigma in ventral portion of central area. Length 50-60 μm. Breadth 15-20 μm. F.

110. *Cymbella ehrenbergii* Kützing (Pl. XIII, fig. 4)

Hustedt, 1930, p. 365, fig. 656; Cleve-Euler, 1955, p. 147, fig. 1218.

Valve asymmetric, broadly lanceolate with slightly rostrate apices. Raphe almost straight. Axial area rather broad, linear-lanceolate, enlarged near the central nodules. Striae radiate, 8-9 in 10 μm, clearly punctate, puncta 15-17 in 10 μm. Length ca. 150 μm. Breadth ca. 40 μm. F.

111. *Cymbella minuta* Rabenhorst (Pl. XIII, fig. 5)

Patrick & Reimer, 1975, p. 47, Pl. 8, figs. 1 a-4 b.

Valve lunate with convex dorsal margin and almost straight ventral margin which is somewhat inflated at the mediate portion. Raphe straight. Axial area narrow, not inflated round the central nodules. Striae radiate to almost parallel, 14-18 in 10 μm. Raphe near the ventral margin, slightly bent at the proximal. Length 20-35 μm. Breadth 6-7 μm. F.

112. *Cymbella naviculiformis* Auerswald (Pl. XIII, fig. 6)

Hustedt, 1930, p. 366. fig. 653.

Valve asymmetrical linear-elliptical with rostrate-capitate apices. Axial area narrow. Central area circular. Striae radiate, 11-12 in 10 μm the middle of the valve, becoming 16-18 in 10 μm toward the ends. Length 30-47 μm. Breadth 8-11 μm. F.

113. *Cymbella cymbiformis* Agardh (*Pl. XIII, fig. 7*)

Hustedt, 1930, p. 362, fig. 672; Patrick & Reimer, 1975, p. 54, Pl. 10-figs. 3, 4.

Valve dorsi-ventral, gradually tapering to the rounded ends. Ventral margin slightly concave except at the middle where it is inflated. Axial area linear, arched. Central area slightly broading at the ventral. Single isolated stigma on the ventral side of the central area. Striae radiate, punctate, about 7-8 in 10 μm, becoming 10-12 in 10 μm at the ends. Length 60-100 μm. Breadth 14-15 μm. F.

114. *Cymbella aspera* (Ehr.)Cleve (Pl. XIII, fig. 8)

Hustedt, 1930, p. 365, fig. 680.

Valve lunate with rounded ends, dorsal margin arcuate, ventral margin very slightly concave and inflated in the middle. Raphe slightly arcuate. Axial area broad, swollen round the central nodules. Striae radiate, 9-12 in 10 μm, punctate, puncta 12-15 in 10 μm. Length 150-165 μm. Breadth 26-30 μm. F.

115. *Cymbella tumida* (Bréb.) Van Heurck (Pl. XIII, fig. 9)

Hustedt, 1930, p. 366, fig. 677.

Valve lunate with broadly rostrate apices, dorsal margin arcuate, ventral margin concave and inflated in the middle. Raphe arcuate. Axial area linear, inflated round the central nodules. One isolated granule on the ventral central area. Striae

radiate, clearly punctate, 9-10 in 10 μm. Length 40-66 μm. Breadth 12-20 μm. F.

116. *Gomphonema acuminatum* Ehrenberg (Pl. XIV, fig. 1)

Patrick & Reimer, 1975, p. 112, Pl. 15-figs. 2, 4, 7; *G. acuminatum* var. *coronata* (Ehr.) W. Smith in Hustedt, 1930, p. 370, fig. 684.

Valve clavate with triangular dilated and shortly rostrate upper apex and gradually attenuated lower apex, inflated in the middle portion. Raphe straight. Axial area narrow. Central area irregular in shape. Striae punctate, radiate, 8-10 in 10 μm. Length 60-100 μm. Breadth 8-16 μm. F,

117. *Gomphonema truncatum* var. *capitatum* (Ehr.) Patrick (Pl. XIV, fig. 2)

Patrick & Reimer, 1975, p. 119, Pl. 16, fig. 4.

Valve clavate, swollen at the center of the valve, with broadly rounded upper apex and narrow basis. Axial area linear. Central area broad, an isolated stigma on one side of the central area. Striae radiate, 11-12 in 10 μm, on each side of the central area irregularly longer and shorter. Length 38-40 μm. Breadth ca. 10 μm. F.

118. *Gomphonema sphaerophorum* Ehrenberg (Pl. XIV, fig. 3)

Hustedt, 1930, p. 372, fig. 695; Patrick & Reimer, 1975, p. 115, Pl. 15-fig. 11.

Valve clavate with rostrate-capitate apex and basis narrowed, sometimes capitate. Axial area narrow. An isolated punctum on one side of the central area. Middle striae are perpendicular to the raphe, becoming slightly radiate at the ends, 10-13 in 10 μm. Length 30-40 μm. Breadth 7-10 μm. F.

119. *Gomphonema olivaceum* (Lyngb.) Kützing (Pl. XIV, fig. 4)

Hustedt, 1930, p. 378, fig. 719.

Valve clavate with broadly rounded upper apex and attenuated to rounded lower apex. Raphe straight. Axial area narrow, inflated round the central nodules. Striae radiate, 13-14 in 10 μm. Cells cuneate in girdle view, forming fan-shaped colonies. Length 19-35 μm. Breadth 5-8 μm. F, B.

120. *Gomphonema olivaceoides* Hustedt (Pl. XIV, fig. 5)

Patrick & Reimer, 1975, p. 144, Pl. 18-fig. 21.

Valve clavate with broadly rounded apper apex and narrowly rounded lower apex. Axial area narrow, widening toward the center of the valve. Raphe straight, filamentous. Four puncta in the central area. Striae radiate, 13-14 in 10 μm. Length 25-30 μm. Breadth 8-9 μm. F.

121. *Gomphonema angustatum* (Kütz.) Rabenhorst (Pl. XIV, fig. 6)

Hustedt, 1930, p. 373, fig. 690.

Valve clavate with somewhat rostrate apices. Axial area narrow, widening at the central area. Striae at the center of the valve distantly placed, and striae on one side of the central area ending in a punctum. Stria opposite punctum short. Striae radiate, 10-14 in 10 μm. Length ca. 32 μm. Breadth ca. 9 μm. F.

122. *Epithemia adnata* (Kütz.) Brébisson (Pl. XIV, fig. 7)

Patrick & Reimer, 1975, p. 179, Pl. 24, figs. 3, 4; *E. Zebra* (Ehr.) Kützing in Hustedt, 1930, p. 384, fig. 729.

Valve with convex dorsal margin and straight or slightly concave ventral margin. Raphe curved toward the dorsal margin. Costae 4-5 in 10 μm. Alveoli 3-5 rows between the costae. Length 30-80 μm. Breadth 8-15 μm. F.

123. *Epithemia turgida* (Ehr.) Kützing (Pl. XIV, fig. 8)

Hustedt, 1930, p. 387, fig. 733.

Valve arcuate with rostrate, rounded apices, dorsal margin convex, ventral margin almost straight. Raphe running along the ventral margin like a widely spread V. Costae radiate, 4-5 in 10 μm, between which the structure is areolate, 7-9 in 10 μm. In girdle view, linear, inflated in the central portion. Length 100-140 μm. Breadth 15-20 μm. F, B.

124. *Epithemia sorex* Kützing (Pl. XIV, fig. 9)

Hustedt, 1930, p. 388, fig. 736.

Valve arcuate with rostrate-capitate apices, dorsal margin convex, ventral margin slightly concave. Raphe running along the ventral surface in the form of a flattend V. Costae radiate, 5-7 in 10 μm, between which areolate, 12-15 in 10 μm. Length 25-35 μm. Breadth 8-10 μm. F.

125. *Rhopalodia gibba* (Ehr.) O. Müller (Pl. XIV, fig. 10)

Hustedt, 1930, p. 390, fig. 740.

Cells linear with rounded apices in girdle view, somewhat inflated in the middle with a small inflection. Ventral margin straight, arcuate at the ends. Dorsal margin convex. Costae slightly radiate to parallel, 6-8 in 10 μm, between which finely striate. Length 120-200 μm. Breadth ca. 20 μm. F.

126. *Rhopalodia gibba* var. *ventricosa* (Ehr.) Grunow (Pl. XIV, fig. 11)

Hustedt, 1930, p. 391, fig. 741.

Cells short and strongly inflated at the median portion. Otherwise same as the type form. Length ca. 30 μm. Breadth ca. 20 μm. F.

127. *Rhopalodia gibberula* (Ehr.) O. Müller

Hustedt, 1930, p. 391, fig. 742; Patrick & Reimer, 1975, p. 191, Pl. 28-fig. 6.

Valve dorsi-ventral with convex dorsal margin and almost straight ventral margin. Apices bent ventrally and rounded. Costae radiate, 3-4 in 10 μm, between which finely striate. Length 35-40 μm. Breadth ca, 8 μm. F, B.

128. *Hantzschia amphioxys* (Ehr.) Grunow (Pl. XV, fig. 1)

Hustedt, 1930, p. 394, fig. 747.

Valve arcuate with rostrate-capitate apices, dorsal margin convex, ventral margin biarcuate and furnished with a marginal keel having coarse short dots, 5-8 in 10 μm. Striae almost parallel, 15-17 in 10 μm. Length 60-75 μm. Breadth 7-10 μm. F.

129. *Hantzschia amphioxys* var. *major* Grunow (Pl. XV, fig. 2)

Hustedt, 1930, p. 349, fig. 749; Cleve-Euler, 1952, p. 49, fig. 1419 y, z.

Valve longer, arcuate with rostrate-capitate apices, dorsal margin slightly convex, ventral margin slightly concave in the middle portion. Carinal dots 5-6 in 10 μm. Striae 11-13 in 10 μm. Length 150-185 μm. Breadth 10-18 μm. F.

130. *Hantzschia elongata* (Hantz.) Grunow

Hustedt, 1930, p. 395, fig. 751; *H. amphioxys* var. *elongata* (Hantz.) Grunow in Cleve-Euler, 1952, p. 51, fig. 1421.

Valve linear with rostrate apices, dorsal margin arcuate, ventral margin slightly concave. Carinal dots 8-9 in 10 μm, in the middle 7 in 10 μm. Striae almost parallel, 15-16 in 10 μm. Length ca. 230 μm. Breadth ca. 10 μm. F.

131. *Bacillaria paradoxa* Gmelin (Pl. XV, fig. 3)

Hustedt, 1930, p. 396, fig. 755.

Cells united valve to valve in stratum, sliding one cell over another. Cells narrowly rectangular in girdle view. Valve linear-lanceolate with slightly rostrate apices. Keel almost central, keel puncta 7-10 in 10 μm. Striae parallel, fine, 17-20 in 10 μm. Length 60-70 μm. Breadth ca. 6 μm. B.

132. *Nitzschia trybionella* Hantzsh (Pl. XV, fig. 4)

Hustedt, 1930, p. 399, fig. 757.

Valve elliptical-lanceolate with subacute apices. Valve surface striate, 8-12 in 10 μm, with a few folds in the apical axis. Keel eccentric. Carinal dots 7-8 in 10 μm. Length 60-88 μm. Breadth 13-15 μm. F, B.

133. *Nitzschia trybionella* var. *levidensis* (W. Smith) Grunow (Pl. XV, fig. 5)

Hustedt, 1930, p. 299, fig. 760.

Valve linear-lanceolate with cuneate apices, median portion somewhat constricted. Valve surface crossed by a few longitudinal folds. Keel eccentric. Carinal dots 10-12 in 10 μm. Striae 11-13 in 10 μm. Length 20-45 μm. Breadth 7-8 μm. F, B.

134. *Nitzschia trybionella* var. *debilis* (Arnott) A. Mayer (Pl. XV, fig. 6)

Hustedt, 1930, p. 400, fig. 795.

Valve elliptical-lanceolate with acute apices. Valve surface with a few folds in the apical axis. Keel eccentric. Striae 12-14 in 10 μm. Length 19-32 μm. Breadth 6-9 μm. F, B.

135. *Nitzschia circumsta* (Bailey) Grunow (Pl. XV, fig. 7)

Hustedt, 1930, p. 402, fig. 761.

Valve linear-elliptical with cuneate apices, in the middle portion slightly constricted. Valve surface with a few longitudinal folds. Striae finely punctate. Keel distinct, marginal carinal dots 5-8 in 10 μm. Length 65-120 μm. Breadth 30-35 μm. B.

136. *Nitzschia punctata* var. *peragalli* Halden (Pl. XV, fig. 8)

Cleve-Euler, 1952, p. 57, fig. 1429 f.

Valve elliptical-lanceolate with cuneate apices, in the middle portion strongly constricted. Striae parallel, coarsely punctate, 13-14 in 10 μm. Length ca. 23 μm. Breadth ca. 9 μm. B, M.

137. *Nitzschia apiculata* (Greg.) Grunow (Pl. XV, fig. 9)

Hustedt, 1930, p. 401, fig. 765.

Valve linear with cuneate apices, constricted in the middle portion. Keel puncta indistinct. Valve bearing longitudinal narrow hyaline line. Striae almost parallel, 16-18 in 10 μm. Length 30-40 μm. Breadth 6-8 μm. B.

138. *Nitzschia hungrica* Grunow (Pl. XV, fig. 10)

Hustedt, 1930, p. 401, fig. 766.

Valve linear with rostrate-cuneate apices, slightly constricted in the middle portion. Keel marginal. Keel puncta 7-9 in 10 μm. Valve bearing longitudinal distinct hyaline line. Striae almost parallel, 14-16 in 10 μm. Length 70-97 μm. Breadth 8-9 μm. B, F.

139. *Nitzschia dubia* W. Smith (Pl. XV, fig. 11)

Hustedt, 1930, p. 403, fig. 770; Cleve-Euler, 1952, p. 63, fig. 1441.

Valve asymmetrically linear with obliquely rostrate apices, constricted in the middle portion. In girdle view linear with truncate ends, constricted in the middle portion. Keel marginal. Keel puncta 8-10 in 10 μm. Striae fine, almost parallel, 20-22 in 10 μm. Length 90-140 μm. Breadth 10-17 μm. B.

140. *Nitzschia commutata* Grunow

Hustedt, 1930, p. 405, fig. 774.

Valve linear with protracted rostrate ends, somewhat constricted in the middle portion. Keel marginal. Keel puncta 6-8 in 10 μm. Striae almost parallel, 16-18 in 10 μm. Length ca. 75 μm. Breadth ca. 10 μm. B.

141. *Nitzschia gracilis* Hantzsch (Pl. XVI, fig. 1)

Hustedt, 1930, p. 416, fig. 794.

Valve linear, attenuated toward the somewhat capitate apices. Keel puncta 12-13 in 10 μm. Striae 24-26 in 10 μm. Length ca. 55 μm. Breadth ca. 25 μm. F.

142. *Nitzschia* sp. 1 (Pl. XVI, fig. 2)

Valve linear-lanceolate with almost parallel margin, attenuated toward the capitate ends. Keel puncta 10-13 in 10 μm. Striae indistinct. In girdle view linear-lanceolate with truncate ends. Length 25-50 μm, mostly 25-35 μm. Breadth 4-5 μm. F.

143. *Nitzschia frustulum* (Kütz.) Grunow (Pl. XVI, fig. 3)

Hustedt, 1930, p. 414, fig. 795.

Valve narrowly elliptical with rounded ends, very small. Keel puncta 12–14 in 10 μm. Striae indistinct. Length 5–8 μm. Breadth 2.5–3 μm. F.

144. *Nitzschia* sp. 2 (Pl. XVI, fig. 4)

Valve lanceolate with acute ends. Keel puncta 15–18 in 10 μm. Striae indistinct. Length 10–18 μm. Breadth 3–4 μm. F.

145. *Nitzschia amphibia* Grunow (Pl. XVI, fig. 5)

Hustedt, 1930, p. 414, fig. 793.

Valve linear-lanceolate with capitate ends. Keel puncta 7–10 in 10 μm. Striae 14–16 in 10 μm. Length 25–30 μm. Breadth 4–5 μm. F.

146. *Nitzschia actinastroides* (Lemm.) Von Goor

Cleve-Euler, 1952, p. 91, fig. 1507; *Nitzschia holsatica* Hustedt in Hustedt, 1930, p. 416, fig. 803.

Valve linear with attenuated and rostrate-capitate ends. In girdle view linear-rectangular. Cells united in a stellate form. Keel puncta 12–14 in 10 μm. Striae indistinct. Length 40–60 μm. Breadth 2–3 μm. F.

147. *Nitzschia obtusa* var. *scalpelliformis* Grunow (Pl. XVI, fig. 6)

Hustedt, 1930, p. 422, fig. 817, d.

Cells linear-sigmoid with parallel margin in girdle view. Valve linear, almost straight with cuneate apices. Keel puncta 7–8 in 10 μm. Striae indistinct. Length 108–400 μm. Breadth 8–10 μm. F.

148. *Nitzschia sigma* (Küz.) W. Smith (Pl. XVI, fig. 7)

Hustedt, 1930, p. 420, fig. 813.

Valve linear-lanceolate, gently sigmoid with slightly capitate apices. In girdle view linear, sigmoid with tapering ends. Keel eccentric. Keel puncta 15–17 in 10 μm. Striae very fine. Length 58–90 μm. Breadth 5–6 μm. M, B.

149. *Nitzschia parvula* Lewis (Pl. XVI, fig. 8)

Hustedt, 1930, p. 421, fig. 816.

Valve sigmoid with rostrate-capitate apices. Keel puncta in 10 μm. Striae indistinct. Length 20–40 μm. Breadth ca. 5 μm. B.

150. *Nitzschia lorenziana* var. *subtilis* Grunow (Pl. XVI, fig. 9)

Hustedt, 1930, p. 423, fig. 820; Cleve-Euler, 1952, p. 93, fig. 1510.

Valve narrowly lanceolate, gently sigmoid with elongated and rounded apices. Keel eccentric. Keel puncta 7–8 in 10 μm. Striae parallel, 18–20 in 10 μm. Length 60–70 μm. Breadth ca. 4 μm. M, B.

151. *Nitzschia acicularis* W. Smith (Pl. XVI, fig. 10)

Hustedt, 1930, p. 423, fig. 821.

Valve lanceolate with long rostrum which is shorter than the valve. Keel puncta 16–19 in 10 μm. Striae indistinct. Length 60–80 μm. Breadth 3–4.5 μm. F, B.

152. *Cymatopleura librile* (Ehr.) Pantocsek (Pl, XXI, fig. 1)

Schoeman & Archibald, 1980, The Diatom Flora of Southern Africa, No. 6 (18); *C. solea* (Bréb.) W. Smith in Hustedt, 1930, p. 425, fig. 823, a.

Valve broad-linear with cuneate ends, constricted in the middle portion of the valve. "Flugelkänale" and rippen 8-9 in 10 μm. Length ca. 140 μm. Breadth ca. 18 μm.

153. *Stenopterobia intermedia* (Lewis) Fricke

Hustedt, 1930, p. 428, fig. 830; Cleve-Euler, 1952, p. 100, fig. 1522.

Cells narrowly linear, sigmoid. Valve linear-sigmoid with tapering apices. Coarse marginal puncta about 4 in 10 μm. Striae very fine, 20-25 in 10 μm. Length 160-200 μm. Breadth 5-7 μm. F.

154. *Surirella biseriata* Brébisson

Hustedt, 1930, p. 432, figs. 831, 832.

Valve linear with parallel margin and somewhat cuneate ends. Costae ca. 10 in 100 μm. Isopolar. Length 250-400 μm. Breadth ca. 50 μm. F.

156. *Surirella linearis* W. Smith (Pl. XVI, fig. 11)

Husted, 1930, p. 434, figs. 837, 838.

Valve broadly lanceolate with somewhat cuneate ends. Isopolar. Pseudoraphe with hyaline area liner-lanceolate. Valve surface costate, costae 25-30 in 100 μm. In girdle view rectangular with rounded angles. Length 90-170 μm. Breadth 25-30 μm.

157. *Surirella moelleriana* Grunow (Pl. XVI, fig. 12)

Hustedt, 1930, p. 435, figs. 842.

Valve linear-lanceolate with somewhat cuneate ends. Apical axis isopole. Costae 28-30 in 100 μm. Striae fine, 15-16 in 10 μm. Length 30-35 μm. Breadth 7-16 μm. F.

158. *Surirella robusta* var. *splendida* (Ehr.) Van Heurck

Hustedt, 1930, p. 437, figs. 851, 852.

Valve ovoid, heteropolar in the apical axis, with straight median line. In girdle view wedge-shaped, with round angles. Robust costae, 17-20 in 100 μm. Length 110-200 μm. Breadth 30-35 μm. F.

159. *Surirella inducta* A. Schmidt

Kato *et al.*, 1977, p. 110, Pl. 20, fig. 319.

Valve ovoid. Central area narrow. Coastae about 20-30 in 100 μm. Striae 14-16 in 10 μm. In the girdle view wing-projection ramify. Length 45-60 μm. Breadth 30-40 μm. F, B.

160. *Surirella ovata* var. *pinnata* W. Smith (Pl. XVI, fig. 15)

Hustedt, 1930, p. 442, fig. 865.

Valve linear-obovate, small. Costae 6-7 in 10 μm. Striae 15-16 in 10 μm,

very fine. Length ca. 28 μm. Breadth ca. 7 μm. B.

161. *Campylodiscus echeneis* Ehrenberg (Pl. XXI, fig. 2)

Hustedt, 1930, p. 449, fig. 875; Cleve-Euler, 1952, p. 128, fig. 1580.

Cells solitary, saddle-shaped. Valve suborbicular. Valve surface with more or less radiate lines of coarse puncta, 2-4 in 10 μm, median portion of the valve with a few scattered puncta. Diameter 90-150 μm. M.

Chlorophyceae

1. *Eudorina elegans* Ehrenberg (Pl. XVIII, fig. 1)

Prescott, 1951, p. 76, Pl. 1-figs. 24-26; Huber-Pestalozzi, 1961, p. 690, fig. 889.

Colony spherical or ovoid with 16, 32 ovoid cells despread within a gelatinous envelope, about 50-60 μm in diameter. Cells 10-20 μm in diameter, with two flagella which diverge beyond the periphery of the colonial envelope. F.

2. *Elakatothrix gelatinosa* Wille (Pl. XVIII, fig. 2)

Prescott, 1951, p. 93, Pl. 3-figs. 13, 14; Hirose & Yamagishi (ed.), 1977, p. 289, Pl. 91-fig. 9.

Gelatinous, fusiform colony containing 2, 4 fusiform cells. Cells 3-5 μm in diameter, 20 μm long. Colony 10 μm in diameter, about 50 μm long. F.

3. *Planktonema lauterbornii* Schmidle (Pl. XVIII, fig. 3)

Haga, M., 1970, p. 134, figs. 1-3; Hirose & Yamagisgi (ed.), 1977, p. 301, Pl. 96-fig. 1.

Filaments planktonic, composed of uniseriately arranged cells. Cells ellipsoid, 2-3 μm in diameter, 5-8 μm long. Cells separated from one another and disposed in a gelatinous sheath. Chloroplast a peripheral plate. Filaments not tapering, the same diameter throughout. B.

4. *Dictyosphaerium ehrenbergianum* Nägeli (Pl. XVIII, fig. 4)

Prescott, 1951, p. 238, Pl. 51-figs. 3, 4; Hirose & Yamagishi (ed.), 1977, p. 345, Pl. 113-fig. 11.

Colony spherical or ovoid, composed of 32-64 cells. Cells elliptical with a cup-shaped chloroplast, attached in groupes of 2 at the ends of dichotomously branched strands, 3 μm in diameter, 4-5 μm long. F.

5. *Micractinium pusillum* Fresenius (Pl. XVIII, fig. 6)

Prescott, 1951, p. 287, Pl. 66, fig. 8.

Colony of spherical cells arranged in a pyramid. Cells 2.5-5 μm in diameter with long, needle-like setae, setae 10-14 μm. F.

6. *Westella botryoides* (W. West) De Wildemann (Pl. XVIII, fig. 5)

Prescott, 1951, p. 237, Pl. 53, fig. 14.

Colony composed of 4-40 cells, quadrately arranged in groups of 4 or 8, the groups loosely connected by the persistent old mother cell walls. Cells spherical,

3-7.5 μm in diameter, with one parietal chloroplast, one pyrenoid sometimes present. F.

7. *Oocystis* sp. (Pl. XVIII, fig. 7)

Colony of 2, 4, 8 cells enclosed in a gelatinous envelope. Cells elliptical to somewhat spherical. Sometimes colony consisted of the groups of 2 cells which are surrounded by a persistent mother cell walls. Chloroplasts 1-4, mostly 2, parietal plates, one pyrenoid sometimes present. Cells 4-8 μm in diameter, 6-12 μm long.

8. *Closteriopsis longissima* var. *tropica* W. et G. S. West (Pl. XVIII, fig. 10)

Prescott, 1951, p. 255, Pl. 57-figs. 2, 3; Hirose & Yamagishi (ed.), 1977, p. 351, Pl. 116-fig. 8; *Ankistrodesmus longissima* var. *tropicum* W. et G. S. West in Pascher, 1915, p. 191, fig. 303.

Cells long and needle-like shaped, tapering to bluntly tipped apices. Chloroplast one, parietal, long, containing a row of pyrenoids. F.

9. *Pediastrum duplex* Meyen (Pl. XVIII, fig. 8)

Pascher, 1915, p. 95, fig. 57; Prescott, 1951, p. 223, Pl. 48-fig. 4.

Colony composed of 16 cells with lens-shaped to triangular spaces between the inner cells. Inner cells quadrate with concave margin. Peripheral cells quadrate with outer margins extending into 2 tapering and bluntly tipped to somewhat truncate prosesses. Colony 60-80 μm in diameter. F.

10. *Pediastrum boryanum* (Turp.) Meneghini (Pl. XVIII, fig. 9)

Pascher, 1915, p. 100, Pl. 100-fig. 61 a; Prescott, 1951, p. 222, Pl. 47-fig. 9, Pl. 48-figs. 1, 3.

Colony circular with monostromatic disc of 8, 16, 32 continuous cells, 40-100 μm in diameter. Inner cells irregularly quadrate. Peripheral cells with outer margins extending into 2 bluntly tipped processes. F.

11. *Scenedesmus acuminatus* (Lag.) Chodat (Pl. XVIII, fig. 15)

Prescott, 1951, p. 275, Pl. 62-fig. 16; Uherkovich, 1966, p. 41, figs. 45-66; Hirose & Yamagishi (ed.), 1977, p. 369, Pl. 123-fig. 6.

Colony composed of 4 or 8 cells. Cells lunate, convex walls adjoined inwardly, concave walls directed outwardly, 2.25-5 μm in diameter, 20-30 μm long. F.

12. *Scenedesmus quadricauda* (Trup.) Brébisson (Pl. XVIII, fig. 16)

Prescott, 1951, p. 280, Pl. 64-fig. 2; Uhercovich, 1966, p. 78, figs. 446-460.

Colony consisting of 2, 4, 8 cells in one series. Cells oblong-cylindric, 3-5 μm in diameter, 8-20 μm long. Outer cells have a long spine at each pole, inner cells without spines but with very short processes at the apices. F.

15. *Closterium moniliferum* (Bory) Ehrenberg (Pl. XVIII, fig. 12)

Hirose & Yamagishi (ed.), 1977, p. 495, Pl. 168-fig. 2.

Cell lunate with rounded ends, dorsal margin convex, ventral margin concave

and somewhat inflated in the middle portion. Chloroplast containing a row of pyrenoids situated centrally. At the tip of each semicell is a small vacuole. Cell 40–45 μm in diameter, 250–300 μm long. F.

16. *Closterium* sp. (Pl. XVIII, fig. 11)

Cells long and needle-like shaped with bluntly tipped apices. Chloroplasts 2, each containing a row of pyrenoids. Cell 4–7.5 μm in diameter, 170–200 μm long.

17. *Spirogyra* sp. 1 (Pl. XVIII, fig. 13)

Filament long and unbranched. Cells cylindrical with plane end walls, about 30 μm in diameter, 150–250 μm long. Chloroplasts 3–4 in each cells, spirally twisted 3 turns, with many pyrenoids.

18. *Spirogyra* sp. 2 (Pl. XVIII, fig. 14)

Filament long and unbranched. Cells cylindrical with plane end walls, about 50 μm in diameter, 100–250 μm long. Chloroplasts 3 in each cells, spirally twisted 2 turns, with many pyrenoids.

19. *Chaetophora elegans* (Roth) Agardh (Pl. XIX, fig. 1)

Prescott, 1951, p. 118, Pl. 14-figs. 3, 4; Hirose & Yamagishi (ed.), 1977, p. 313, Pl. 101-fig. 1.

Thallus attached, flattened green masses of soft mucilage, consisted of highly branched filaments spread out from a common center. Filaments dichotomously branched, tapering to blunt or somewhat acute point. Cells cylindrical, 5–10 μm in diameter, 8–40 μm long. Chloroplast parietal band with one pyrenoid. F.

20. Cladophora crispata (Roth) Kützing (Pl. XX, fig. 1)

Prescott, 1951, p. 137, Pl. 19-figs. 9–11; Hirose & Yamagishi (ed.), 1977, p. 329, Pl. 109-fig. 1.

A repeatedly branched filamentous thallus with basal rhizoidal cells spread in sucker-shaped, attached on the aquatic plants or stones, forming feathery and delicate tufts, a few centimeter to more than 30 centimeters. Filaments dichotomously branched, gradually attenuated in the branches to narrowed apices. Cells long, cylindrical, 20–50 μm in diameter, 7–20 times their diameter in long, cell walls relatively thin. Chloroplast parietal reticulum with many pyrenoids. F.

13. *Scenedesmus intermedius* Chodat (Pl. XVIII, fig. 17)

Uherkovich, 1966, p. 93, figs. 560–578.

Colony composed of 4 cells arranged alternately. Cells elliptical 2.5–10 μm in diameter, 8–20 μm long. Outer cells have a spine at each pole, inner cells without spines. F.

14. *Scenedesmus spinosus* Chodat (Pl. XVIII, fig. 18)

Uherkovich, 1966, pp. 107–108, figs. 709–750.

Colony composed of 2, 4 cells in one series. Cells elliptical, 2.5–3 μm in diameter, 8–10 μm long. Outer cells have a spine at each pole and a short process at

the median portion. Inner cells smooth. F.

Acknowledgement

I am thanksful to Prof. Munenao Kurogi, the Graduate School of Environmental Science, Hokkaido University, for his valuable advices and critical reading of the manuscript; to Prof. Hiromu Kobayashi, Tokyo Gakugei University, for his kind advices in the identification of the diatoms; to Assistant Prof. Masaru Haga, Iwamizawa College, Hokkaido University of Education, for his helpful suggestions in the study. I also wish to thank Dr. Toshio Nakamura, Mr. Kazuo Ando, Mr. Takao Aoi and other staffs, the Hokkaido Research Institute for Environmental Pollution, for affording the great conveniences to conduct this work.

References

1) Aoi, T., K. Ando & T. Nakamura 1978: Studies on eutrophication part 3. The eutrophication of Abashiri Lake (in Japanese). Rep. Hokkaido Res. Inst. Environ. Poll. **5**: 131–147.
2) Cleve-Euler, A. 1951: Die Diatomeen von Schweden und Finnland. Kongl. Svensk. Ventensk. Akad. Handl. 2(1); 1–163. Stockholm.
3) Cleve-Euler, A. 1952: do. **3**(3); 1–153.
4) Cleve-Euler, A. 1953: do. **4**(1); 1–158.
5) Cleve-Euler, A. 1953: do. **4**(5); 1–255.
6) Cleve-Euler, A. 1955: do. **5**(4); 1–232.
7) Cleve, P. T. 1965: Synopsis of the naviculoid diatoms. Kongl. Svensk. Ventensl. Akad. Handl. bd. **26**(2, 3). Amsterdam.
8) Geitler, L. 1932: Cyanophyceae. in Rabenhorst's Kryptogamen Flora von Deutschland, Österreich und der Schweiz. **14**. Leipzig.
9) Haga, M. 1970: On three freshwater species of Ulotricaceae from Hokkaido (in Japanese with English summary). Bull. Jap. Soc. Phycol. **18**(3); 131–136.
10) Håkansson, H. 1981. *Stephanodiscus* Ehrenberg 1846, a revision of the species described by Ehrenberg. Nov. Hedw. **35**(1); 117–150.
11) Hendey, N. I. 1964: An introductory account of the smaller algae of British Coastal Waters. 5. Bacillariophyceae (Diatoms). London.
12) Hirose, H. 1950: Study on the phytoplankton of Lake Abashiri (in Japanese with English summary). Bull. Jap. Sci. Fish. **16**(1); 25–29.
13) Hirose, H. & T. Yamagish ed. 1977. Illustrations of the Japanese fresh-water algae (in Japanese with English summary). Uchida Rokakuho, Tokyo.
14) Huber-Pestalozzi, G. 1938: Das Phytoplankton des Süsswassers. **16**(1). Allgemeiner Teil. Blaualgen, Bakterien, Pilze. Stuttugart.
15) Hustedt, F. 1930: Bacillariophyta. in Pascher's Die Süsswasser Flora Mitteleulopas. Heft 10. Jena.
16) Hustedt, F. 1930: Die Kieselalgen in Rabenhorst's Kryptogamen Flora on Deutshland, Österreich und der Schweiz. 7. Teil **1**; 1–920.
17) Hustedt, F. 1931–1959: do Teil **2**; 1–845.
18) Kato, K., H. Kobayashi & T. Nagumo 1977: Diatoms in Hachirogata (in Japanese). Rep. of the investigation about the biota in Hachirogata; 64–137.
19) Knudson, B. M. 1952: The diatom genus *Tabellaria* I. taxonomy and morphology. Ann.

Bot. **16**; 421–440.

20) Kobayashi, H. 1964: Diatoms from River Arakawa (2). Bull. Chichibu Mus. Nat. Hist. **12**; 65–77, Pl. 1–11.

21) Kobayashi, H. 1965: Notes on the genus *Ceratoneis* (diatoms from River Arakawa 3). J. Jap. Bot. **40** (1); 125–128.

22) Kuroda, K. 1977: The cause of death of the fishes in River Abashiri (in Japanese). Mizu-shorigijutsu **18**; 861–864.

23) Kuroda, K. & T. Kurohagi 1965: The present condition and situation of foul water of Lake Abashiri (in Japanese). Hokusuishi-geppo. **22** (7); 437–459.

24) Kurohagi, T. 1970: The succession of plankton in Lake Abashiri, eastern Hokkaido (in Japanese with English summary). Sci. Rep. Hokkaido Sarmon Hatchery. **24**; 101–124.

25) Motoda, S. 1950: Researches of lakes in Hokkaido (in Japanese). Sci. Rep. Hokkaido Fish Hatchery. **5** (1); 77–82.

26) Motoda, S. & A. Ishida 1949: Study about Lake Abashiri, especially about the plankton (in Japanese with English summary). Sci. Rep. Hokkaido Fish Hatchery. **4**; 1–9.

27) Nakamura, Y., T. Aoi & M. Kurogi. 1980: The seasonal change of phytoplankton in Lake Abashiri (in Japanese with English summary). Environ. Sci., Hokkaido. **3** (1); 35–46.

28) Patrick, R. & W. Reimer 1966: The diatoms of the United States I. Philadelphia.

29) Patrick, R. & W. Reimer 1975: do. II (1).

30) Pasher, A. 1951: Die Süsswasser Flora Deutschland, Österreich und der Schweiz. Heft 4. Jena.

31) Prescott, G. M. 1951: Algae of the Western Great Lakes Area. Cranbrook Inst. Sci. Bull. 31. Michigan.

32) Smith, G. M. 1950: The freshwater algae of the United States. McGraw-Hill Book Co. New York.

33) Tokui, T. & T. Kawai 1967: Bibliography of limnology in Hokkaido (in Japanese). Sci. Rep. Hokkaido Sarmon Hatchery. **21**; 81–112.

34) Tsuda, M., T. Watanabe & K. Goze 1966: Biological investigation about River Abashiri and Lake Abashiri (in Japanese). Suisanchou Gyosei-bu Gyogyo-Shinkokai.

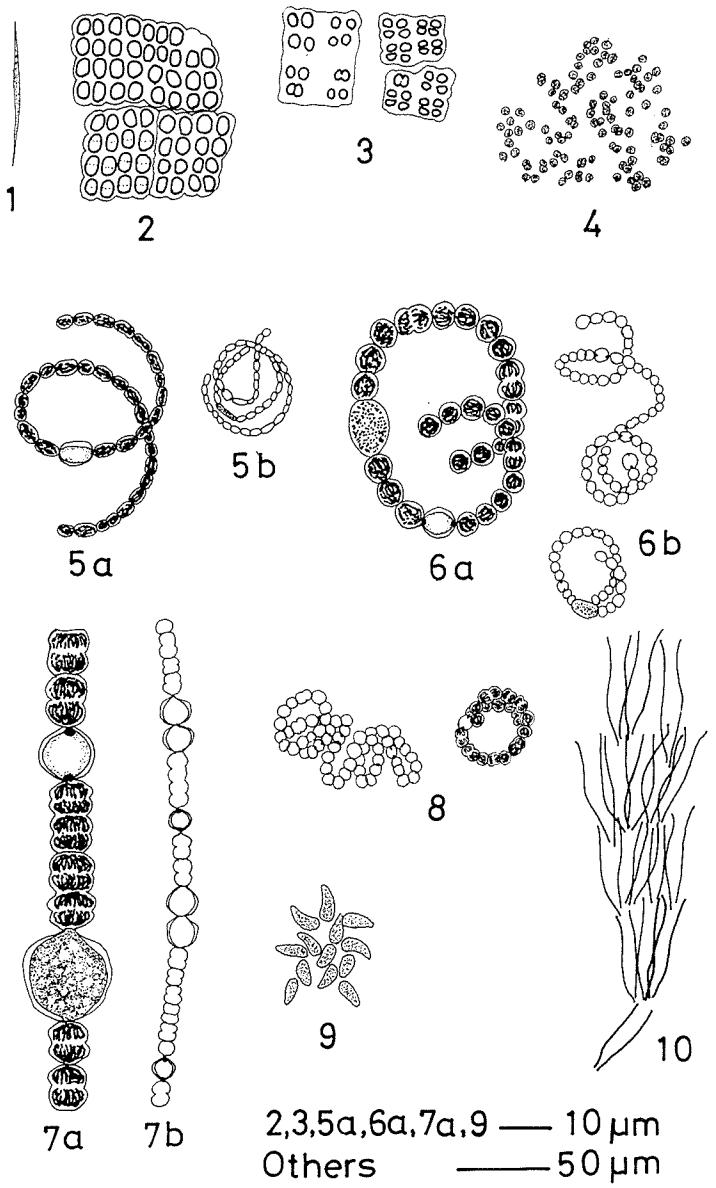
35) Uherkovich, G. 1966: Die *Scenedesmus*-Arten ungarns. Akdaémiai kiadó. Budapest.

36) Van Heurck, H. 1880–1881, 1855: Synopsis des Diatomees de Belgique. Anvers.

Summary

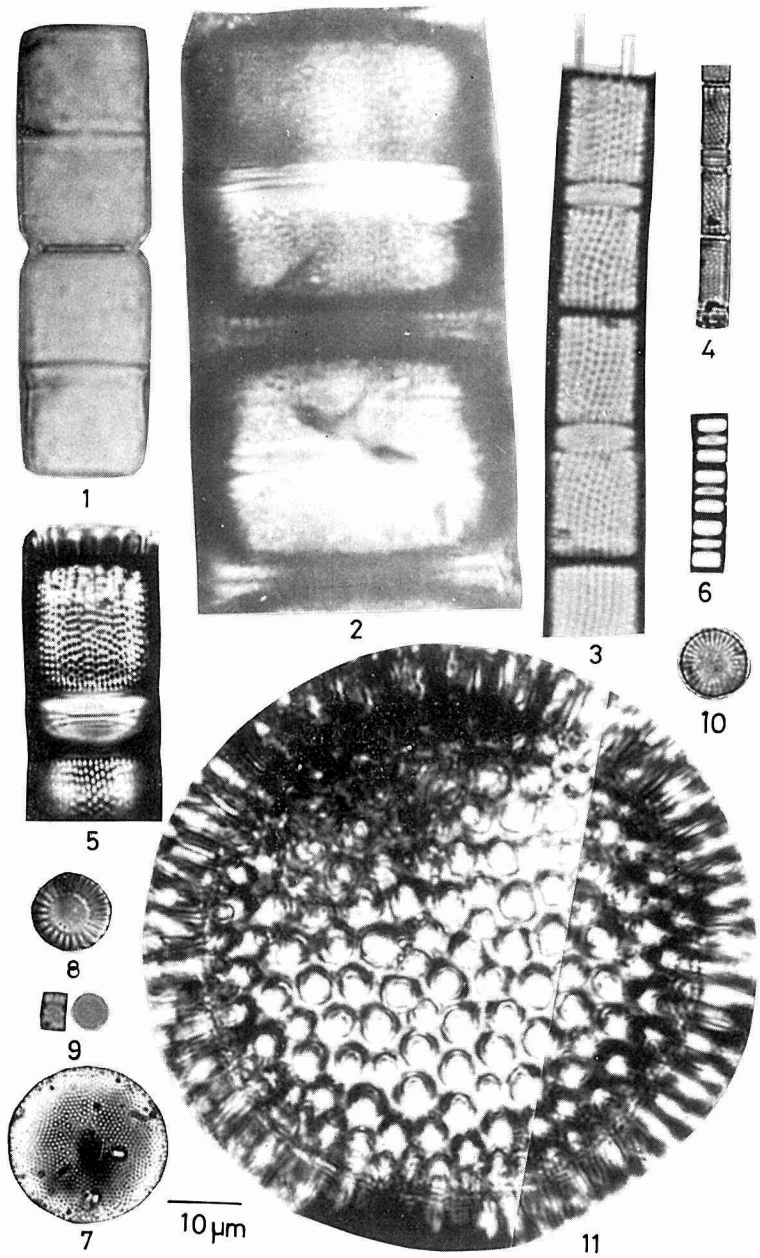
The author collected phytoplankton in Lake Abashiri during 1978 to 1979 and identified total 189 taxa of phytoplankton, including Cyanophyceae 9, Chrysophyceae 1, Bacillariophyceae 161 and Chlorophyceae 18. Among them newly found phytoplankton from Lake Abashiri were Cyanophyceae 7, Chrysophyceae 1, Bacillariophyceae 154, Chlorophyceae 13 and total 175 taxa. In addition to these, three periphytic algae were identified. This paper describes their seasonal occurrence and morphological characters.

PL. I



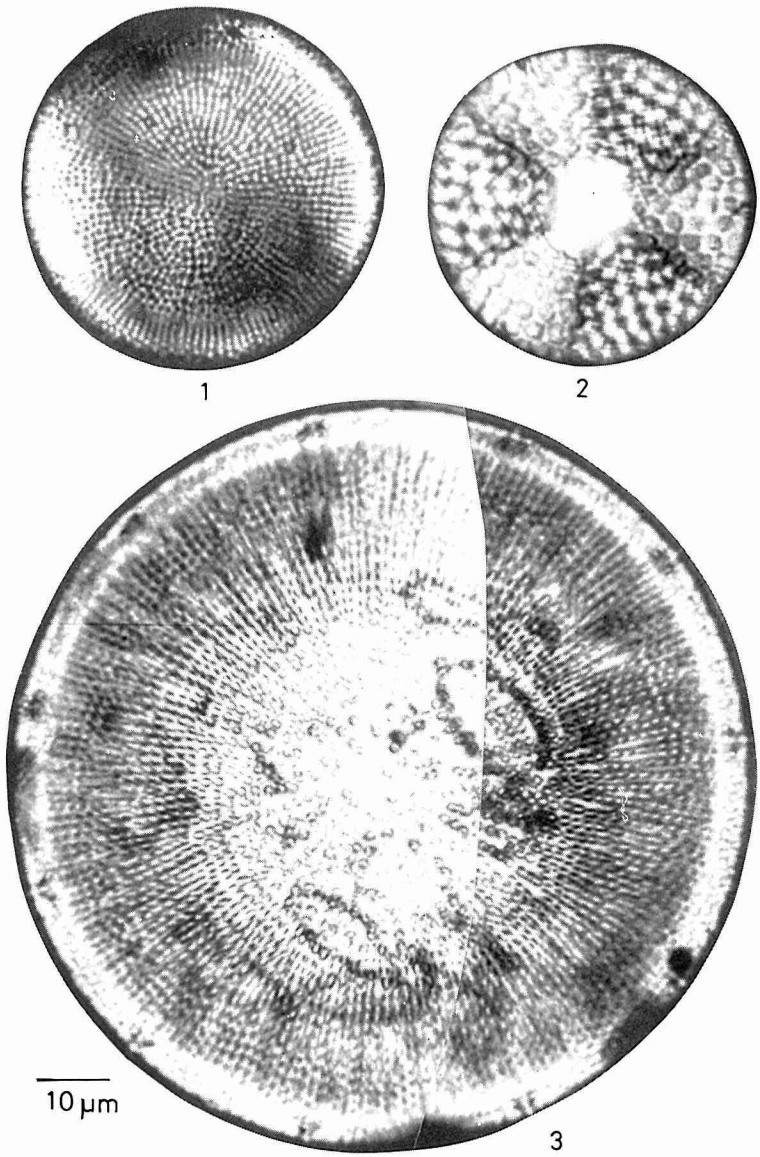
1. *Dactylococcopsis acicularis*, 2. *Merismopedia glauca*, 3. *Merismopedia tenuissima*, 4. *Microcystis* sp., 5. *Anabaena flos-aquae* var. *treleasi*, 6. *Anabaena flos-aquae* var. *intermedia* f. *spiroides*, 7. *Anabaena scheremetievi*, 8. *Anabaena* sp., 9. *Marsoniella elegans*, 10. *Dinobryon cylindrica*.

PL. II



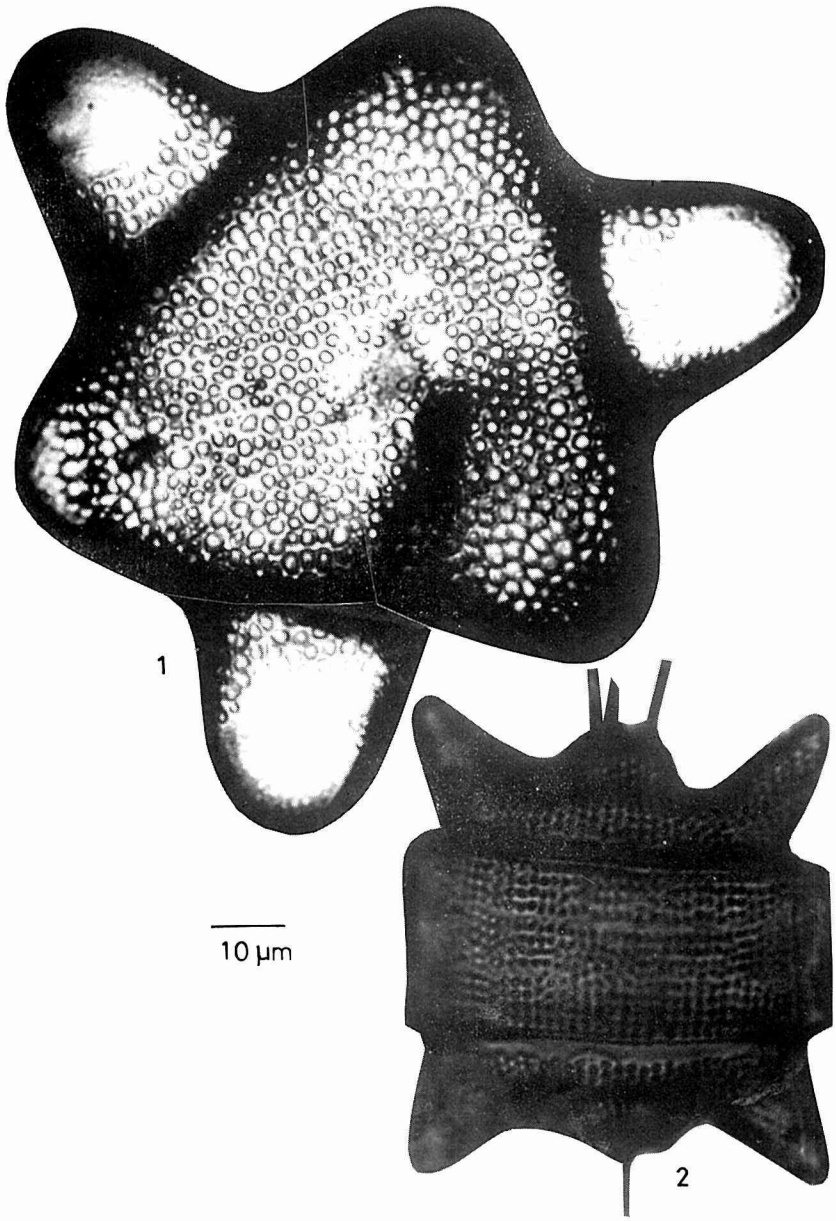
1. *Melosira varians*, 2. *M. undulata*, 3. *M. granulata*, 4. *M. ambigua*, 5. *M. italica*, 6. *M. distans* var. *alpigena*, 7. *Thalassiosira* sp., 8. *Cyclotella meneghiniana*, 9. *C. glomerata*, 10. *Stephanodiscus hantzschii*, 11. *Coscinodiscus marginatus*.

PL. III



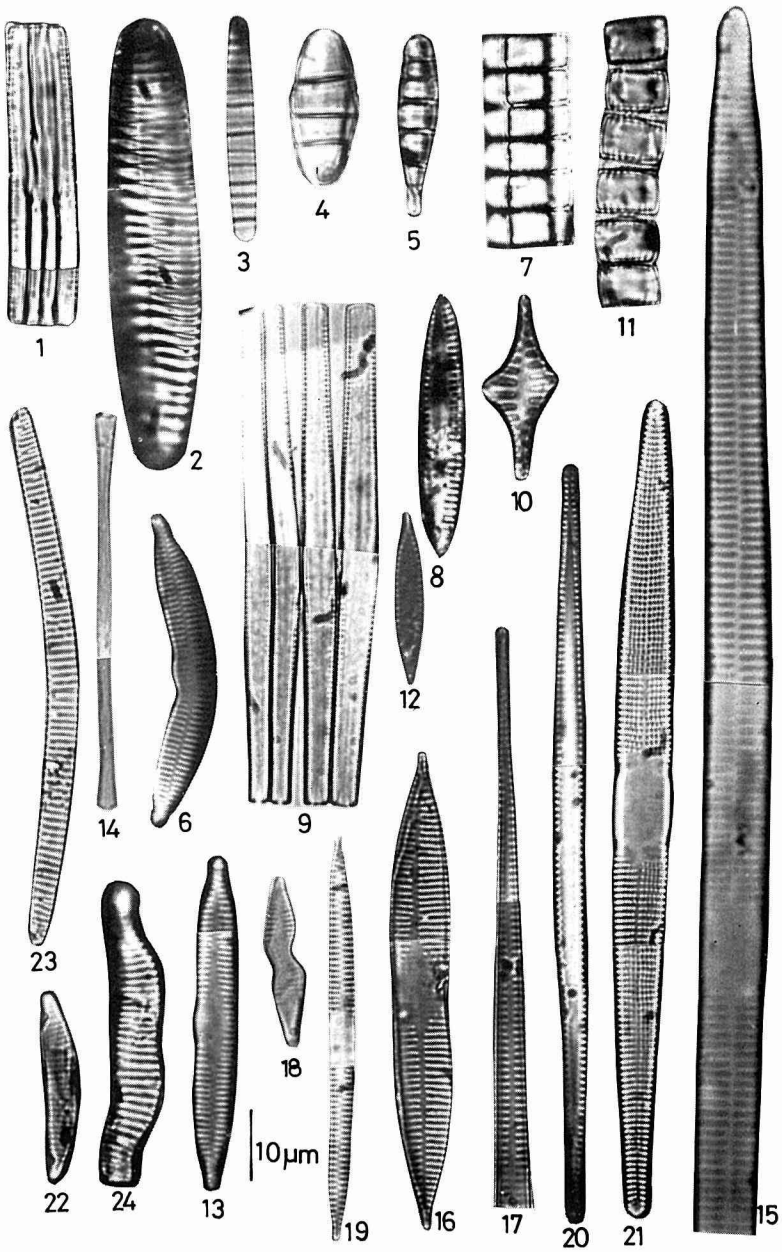
1. *Coscinodiscus lacustris*, 2. *Actinoptychus undulatus*,
3. *Actynocyclus ehrenbergi*.

PL. IV



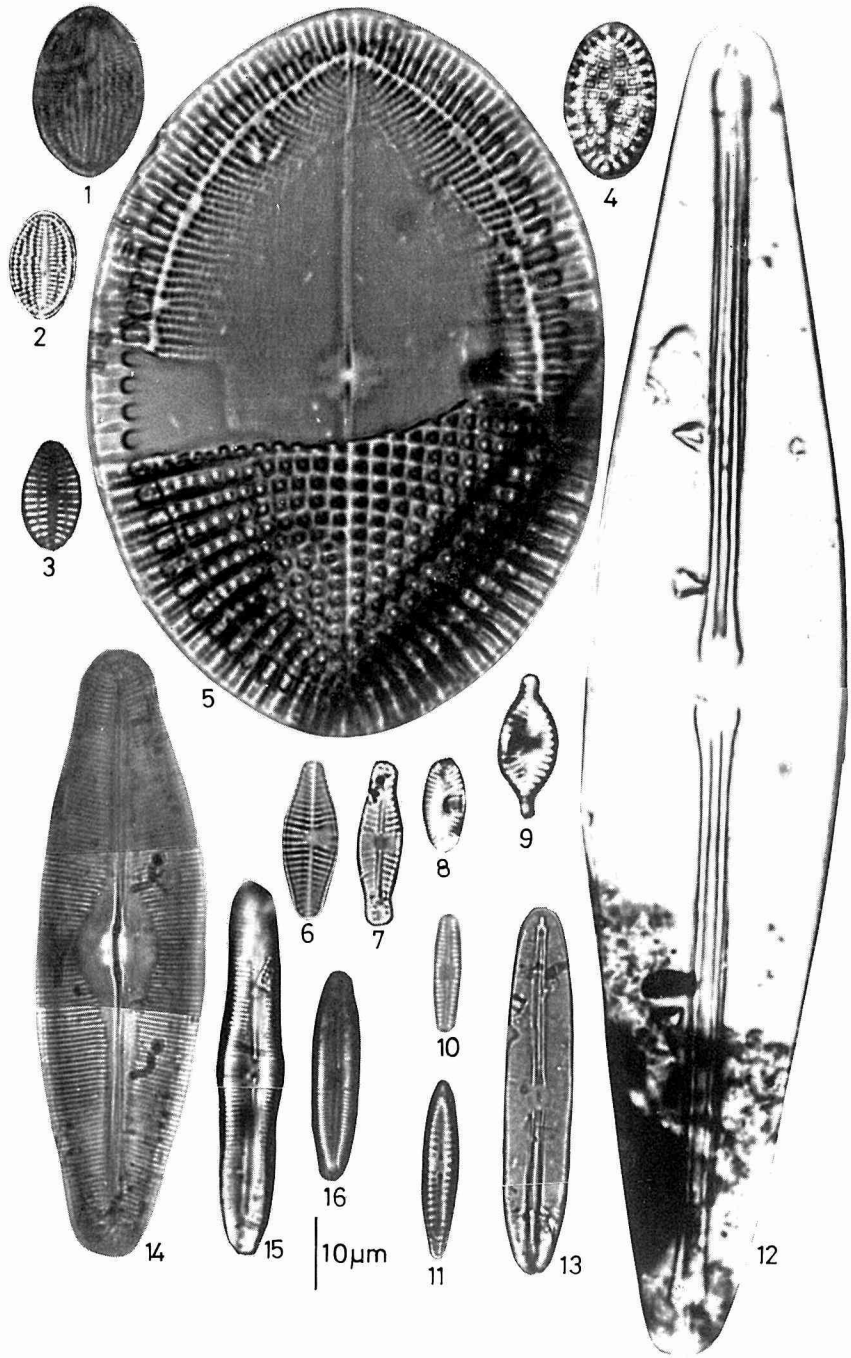
1. *Hydrosera triquetra*, 2. *Biddulphia aurita*.

PL. V



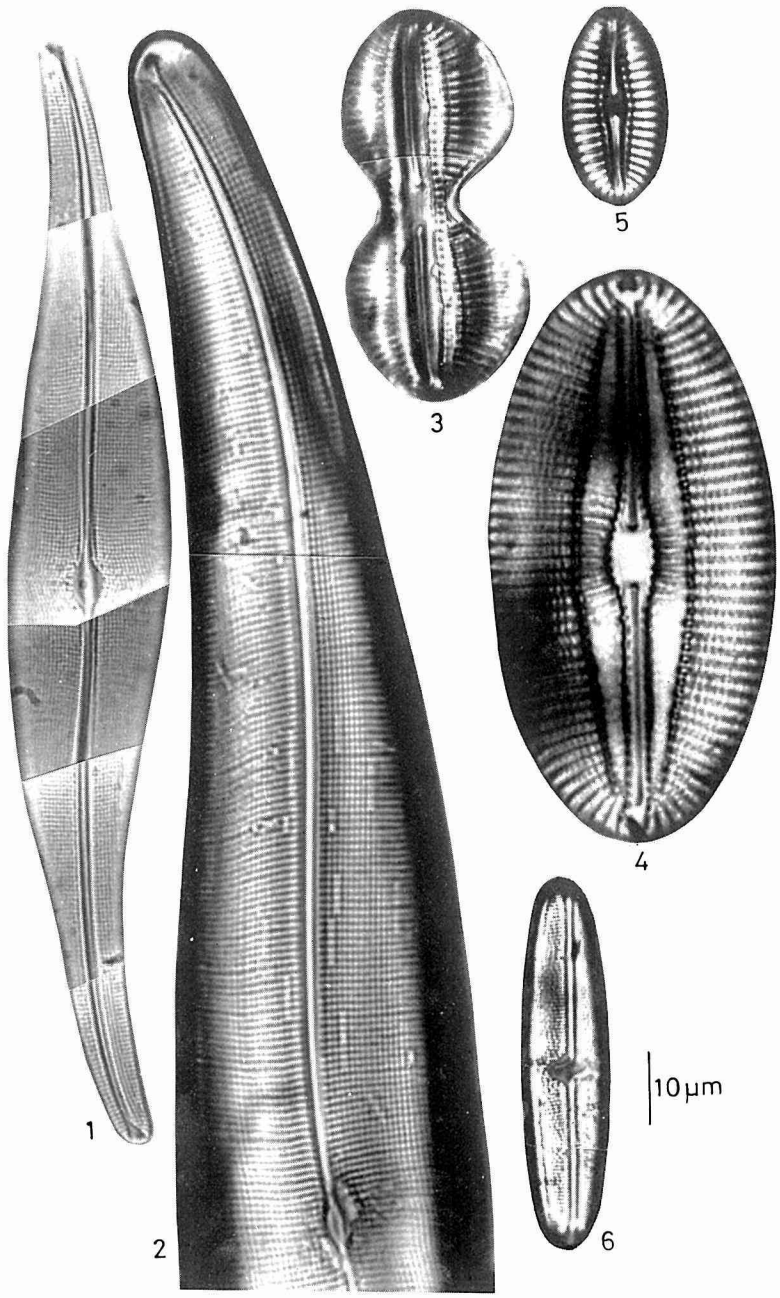
1. *Tabellaria flocculosa*, 2. *Diatoma vulgare*, 3. *D. elongatum*, 4. *D. hiemale* var. *mesodon*, 5. *Meridion circular* var. *constricta*, 6. *Ceratoneis arcus*, 7. *Fragilaria construens*, 8, 20. *Synedera tabulata*, 9. *Fragilaria crotonensis*, 10. *F. leptostauron*, 11. *F. construens* var. *venter*, 12. *F. brevistriata*, 13. *F. vaucheriae*, 14. *Asterionella gracillima*, 15. *Synedra ulna*, 16. *S. inaequalis*, 17. *S. acus*, 18. *S. rumpens*, 19. *S. rumpens* var. *fragilarioides*, 21. *S. pulchella*, 22. *Eunotia veneris*, 23. *E. lunaris*, 24. *E. praerupta* var. *bidens*.

PL. VI



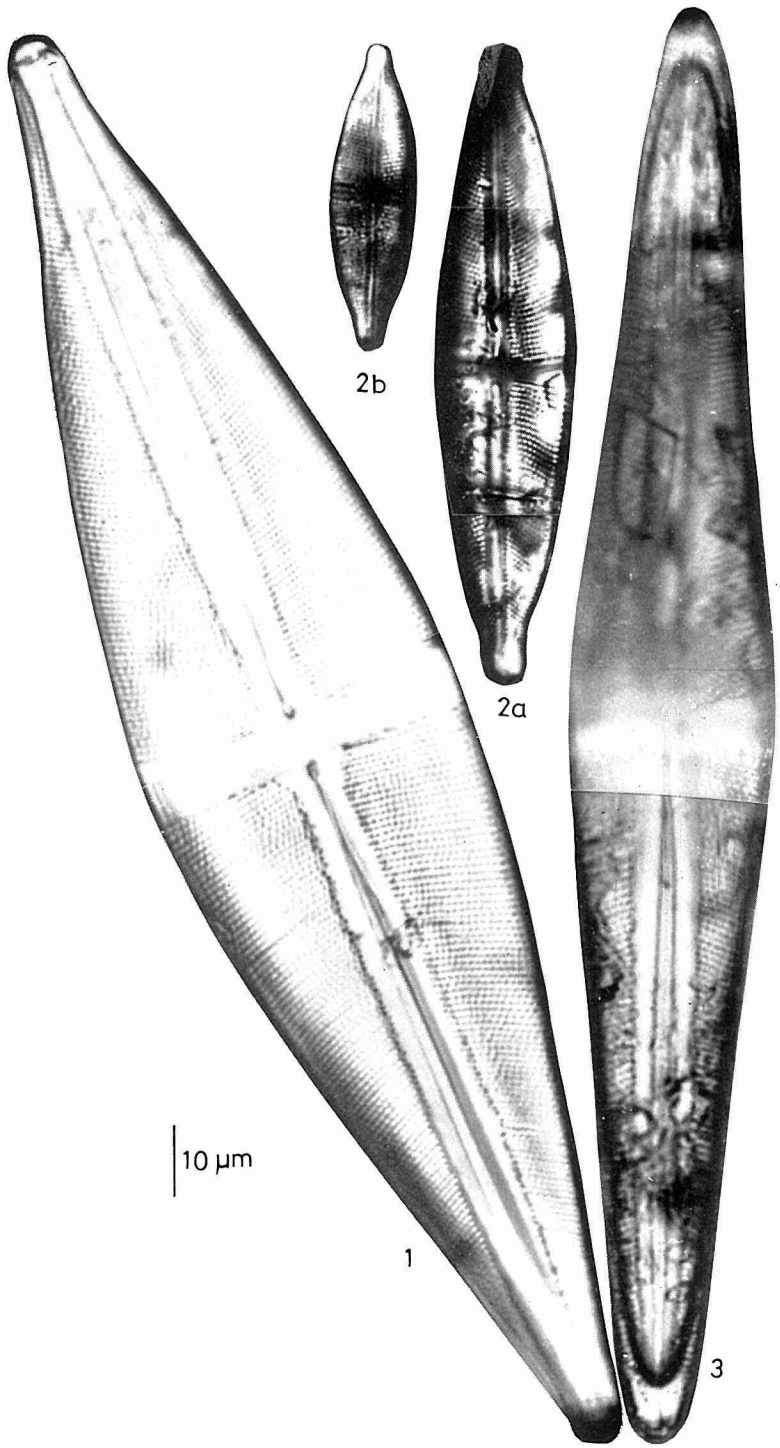
1, 2. *Cocconeis placentula* var. *euglypta*, 3. *C. diminuta*, 4. *C. scutellum* var. *parva*, 5. *C. scutellum*, 6. *Achnanthes lanceolata*, 7. *A. lanceolata* f. *capitata*, 8. *A. lanceolata* var. *elliptica*, 9. *A. peragalli*, 10. *Navicula seminulum*, 11. *Rhoicosphenia curvata*, 12. *Frustria rhomboides*, 13. *F. vulgaris*, 14. *Caloneis brevis*, 15. *C. ventricosa*, 16. *C. ventricosa* var. *truncatula*.

PL. VII



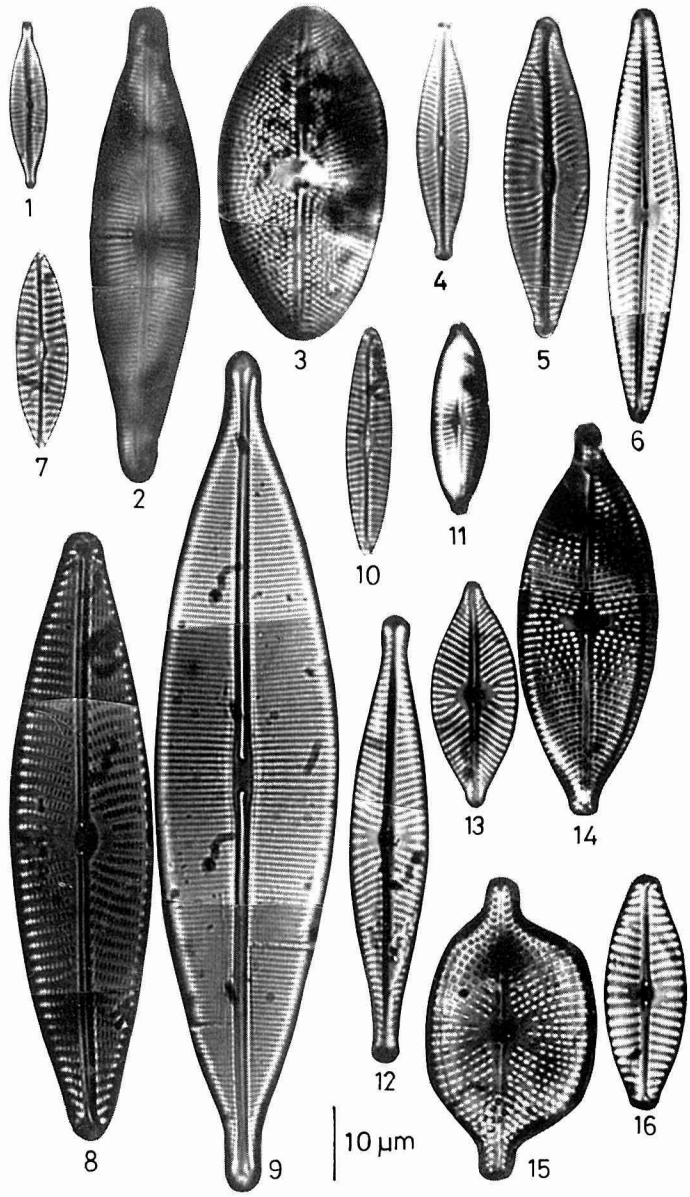
1. *Gyrosigma acuminatum*, 2. *G. terryanum*, 3. *Diploneis interrupta*, 4. *D. finnica*, 5. *D. smithii*, 6. *Neidium bisulcatum* var. *baicalense*.

PL. VIII



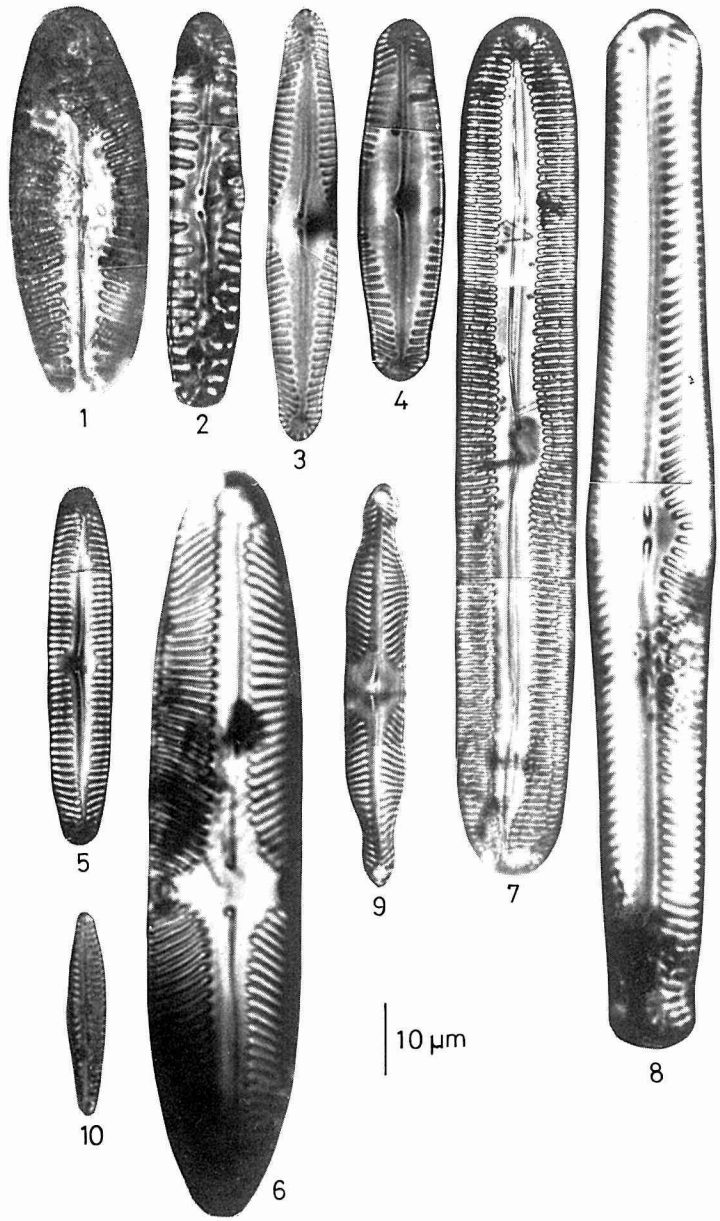
1. *Stauroneis phoenicenteron*, 2 a. *S. phoenicenteron* f. *capitata*, 2 b. *S. anceps*, 3. *S. acuta*.

PL. IX



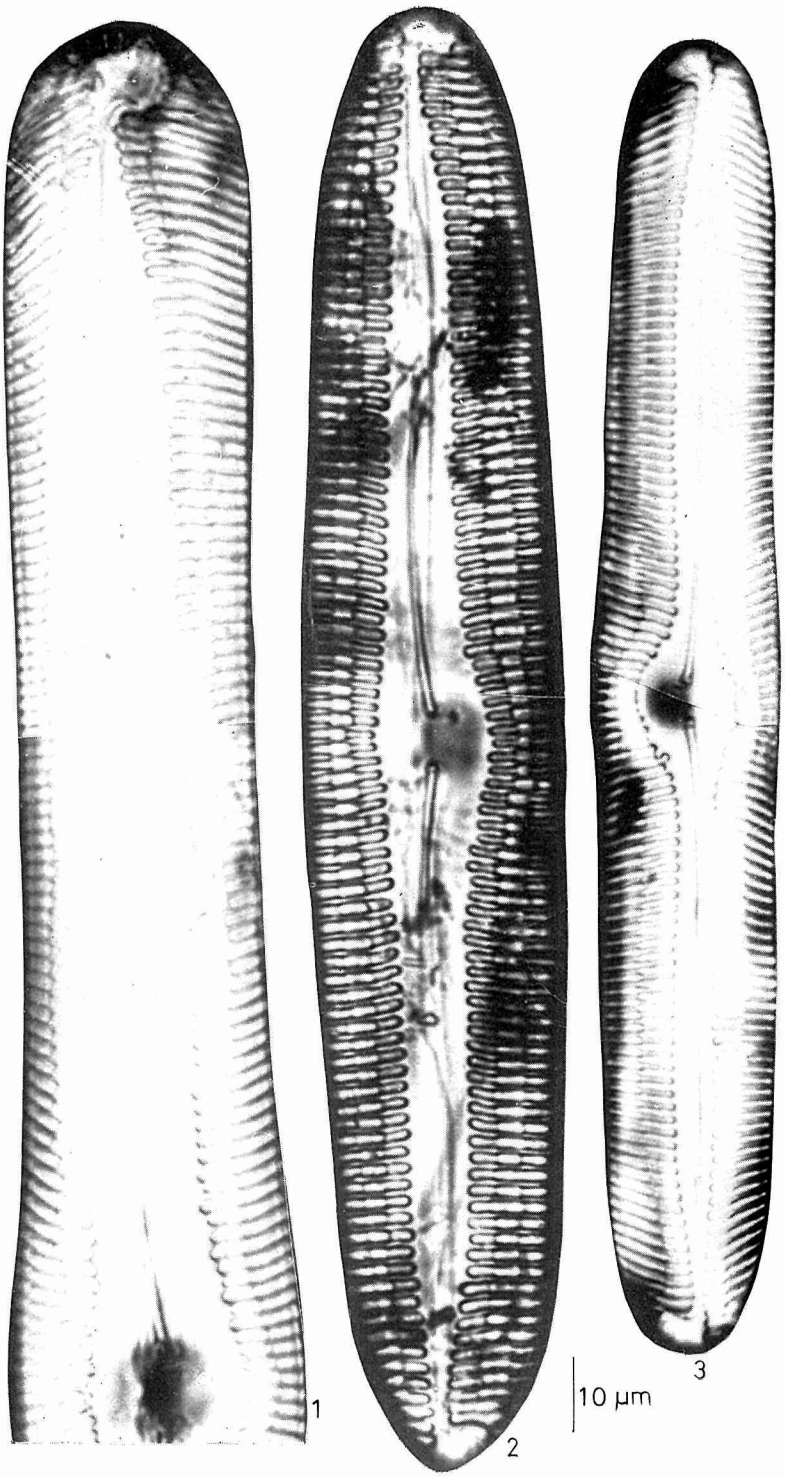
1. *Navicula gregaria*, 2. *N. crucicula*, 3. *N. punctulata*, 4. *N. cryptocephala*, 5. *N. lanceolata*, 6. *N. radiosa*, 7. *N. viridula* var. *rostrata*, 8. *N. peregrina*, 9. *N. cuspidata*, 10. *N.* sp., 11. *N. integra*, 12. *N. rhynchocephala*, 13. *N. clementis*, 14. *N. tuscula*, 15. *N. alpha* var. *longistris*, 16. *N. viridula* var. *slevicensis*.

PL. X



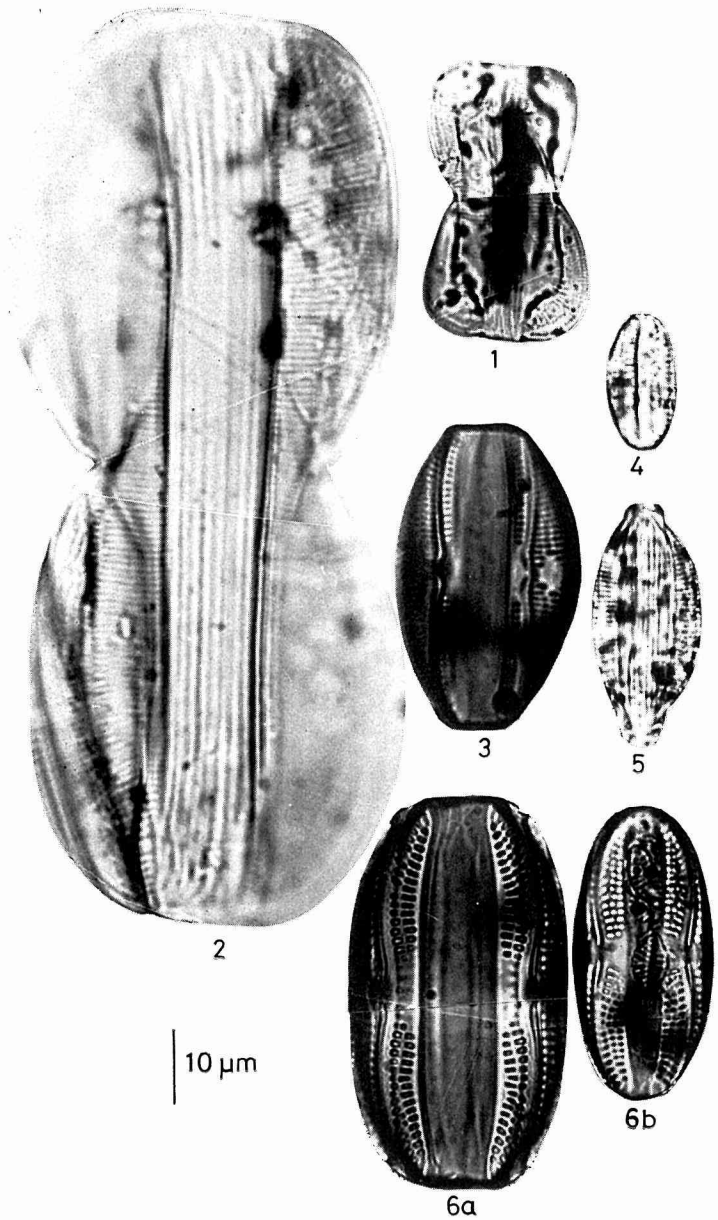
1. *Pinnularia alpina*, 2. *P. borealis*, 3. *P. gibba*, 4. *P. gibba* var. *parva*, 5. *P. viridis* var. *commutata*, 6. *P. divergens* var. *parallela*, 7. *P. streptoraphe*, 8. *Navicula oblonga*, 9. *Pinnularia mesolepta* 10. *Gomphonema* sp.
Notice; the scale should be read 20 μm for 10 μm in No. 7.

PL. XI



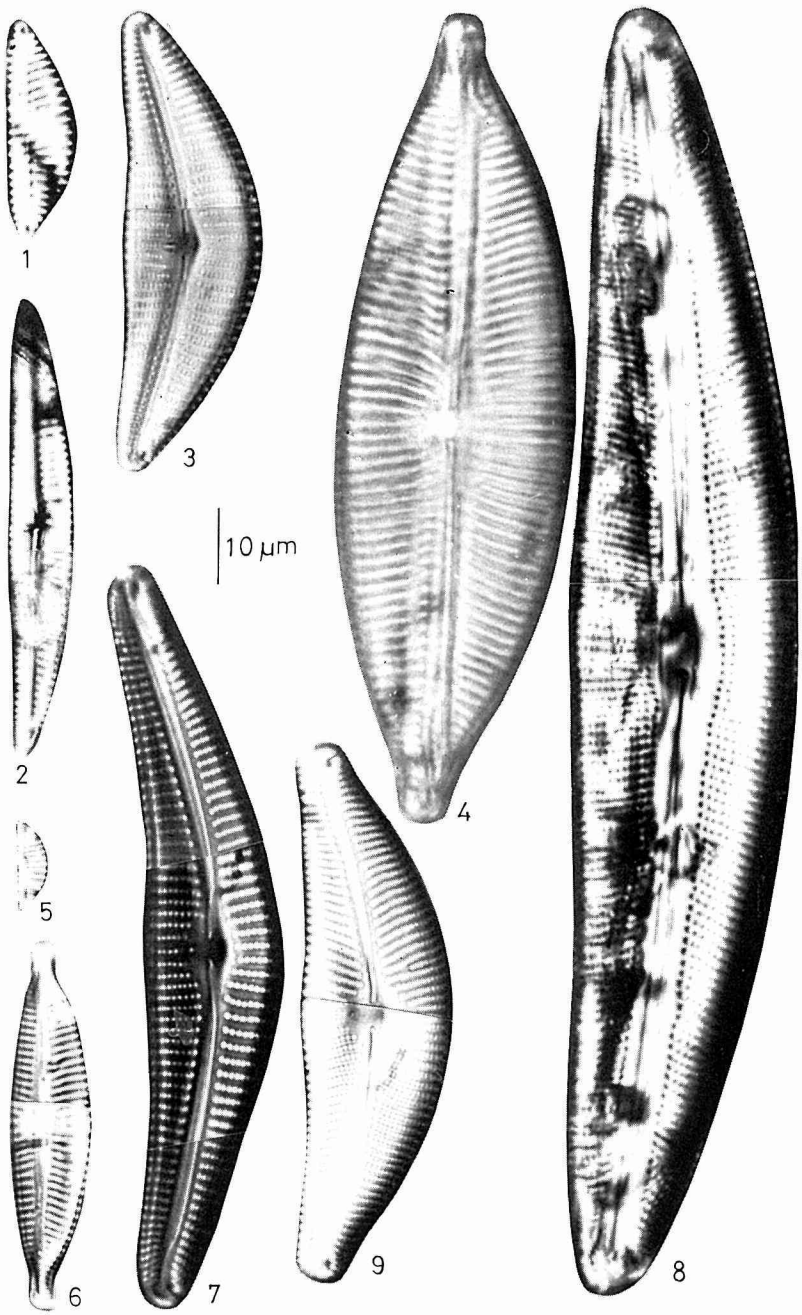
1. *Pinnularia nobilis*, 2. *P. streptoraphe*, 3. *P. viridis*.

PL. XII



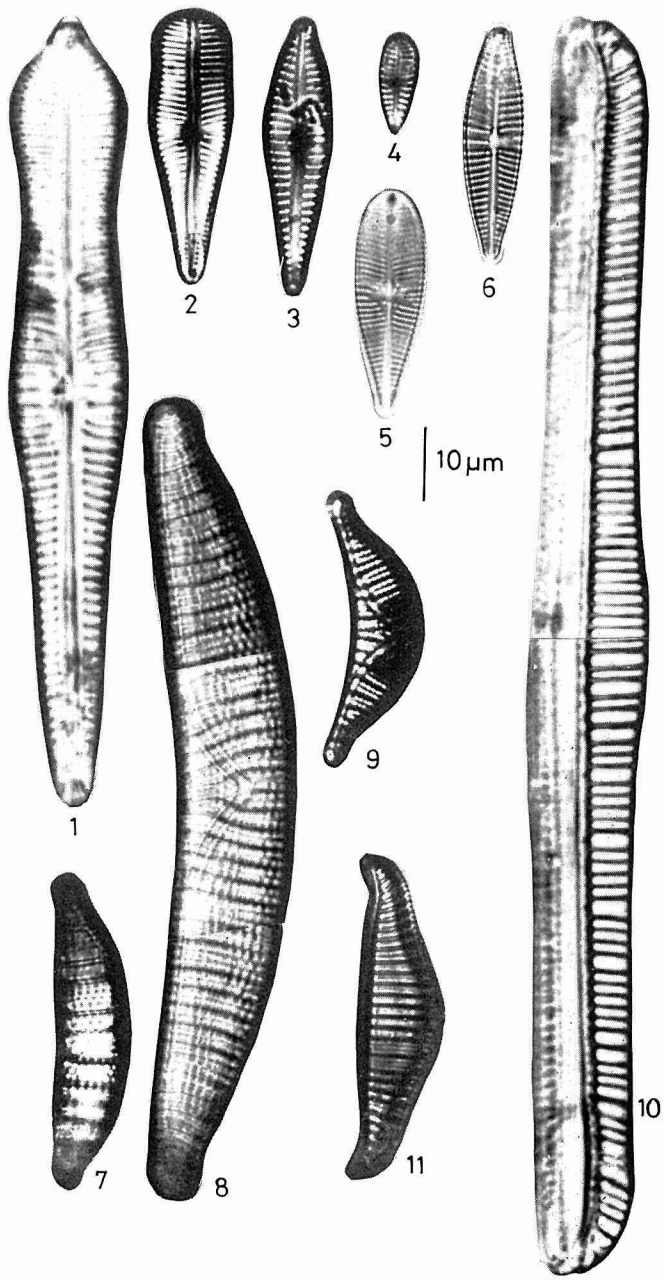
1. *Amphiplora paludosa*, 2. *A. alata*, 3. *Amphora ovalis* var. *affinis*, 4. *A. perpusilla*, 5. *A. coffeaeformis*, 6. *A. arenicola*.

PL. XIII



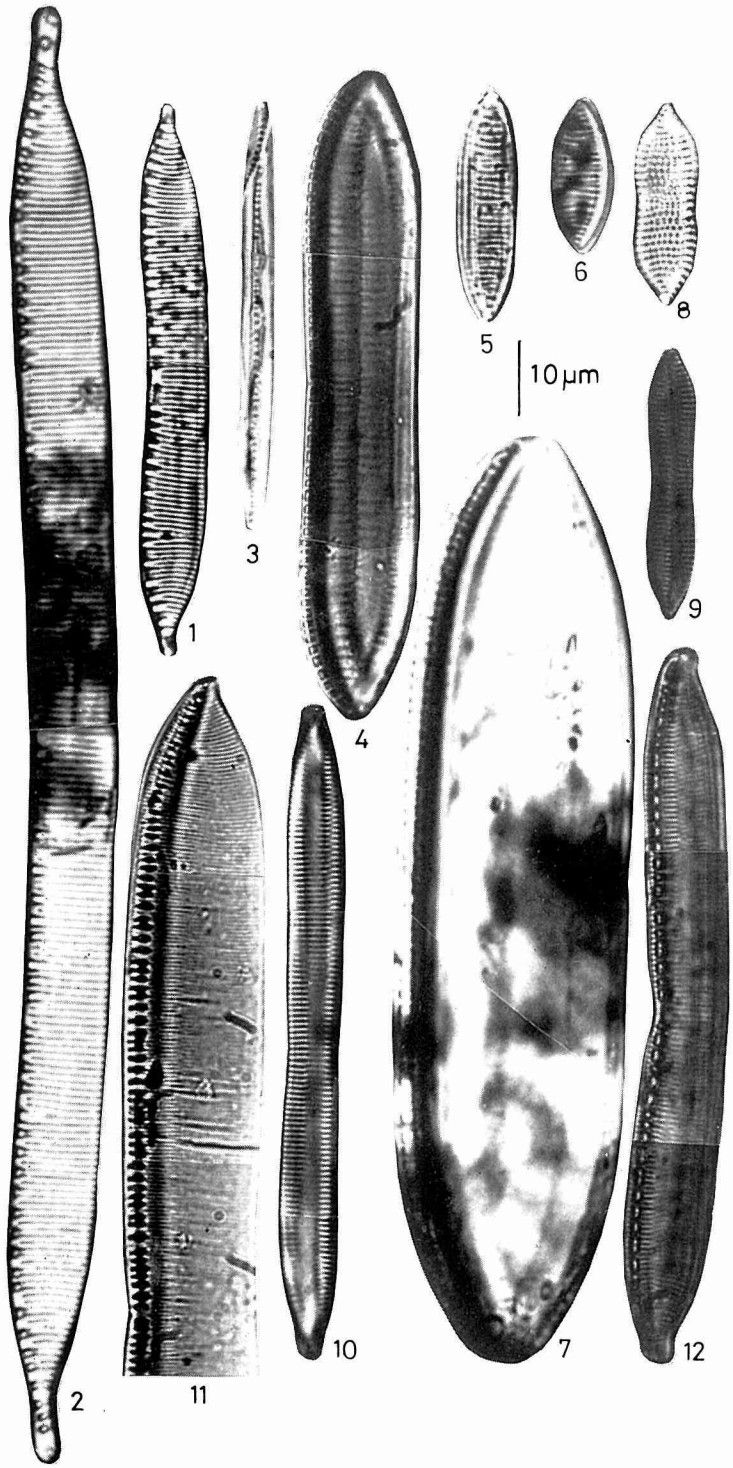
1. *Cymbella minuta* var. *silesiaca*, 2. *C. gracilis*, 3. *C. cistula*, 4. *C. ehrenbergii*, 5. *C. minuta*, 6. *C. naviculiformis*, 7. *C. cymbiformis*, 8. *C. aspera*, 9. *C. tumida*.

PL. XIV



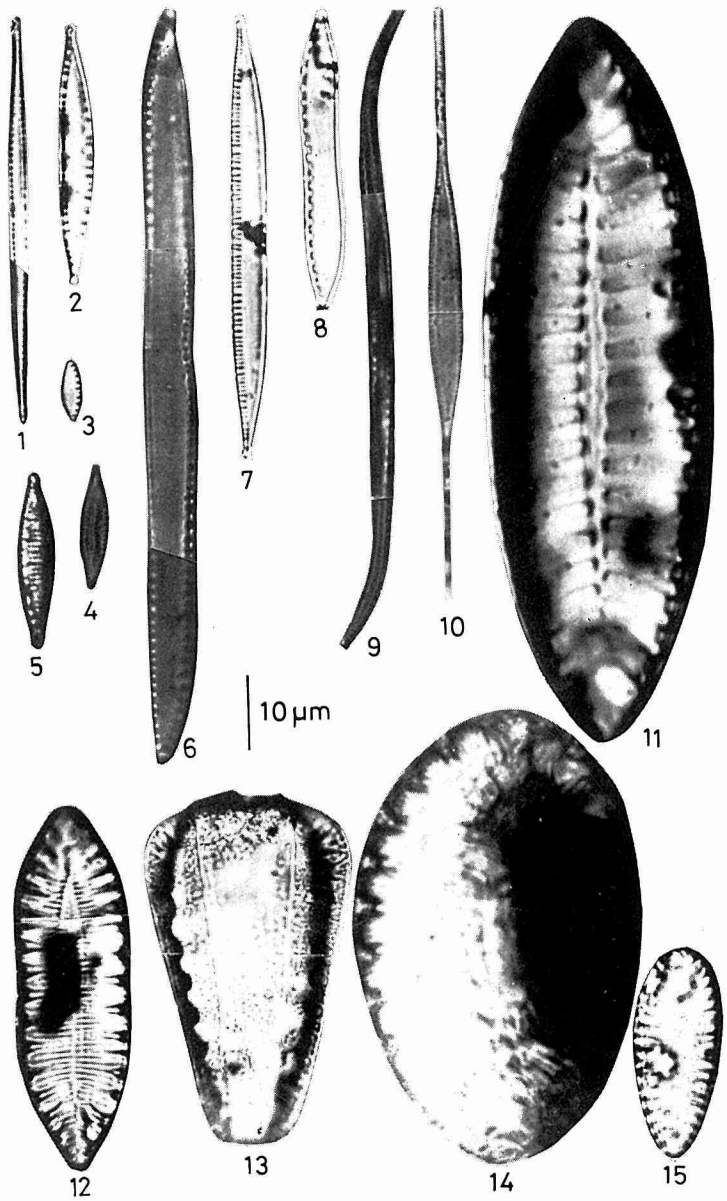
1. *Gomphonema acuminatum*, 2. *G. truncatum* var. *capitatum*, 3. *G. sphaerophorum*, 4. *G. olivaceum*, 5. *G. olivaceoides*, 6. *G. angustatum*, 7. *Epithemia adnata*, 8. *E. turgida*, 9. *E. sorex*, 10. *Rhopalodia gibba*, 11. *Rhopalodia gibba* var. *ventricosa*.

PL. XV



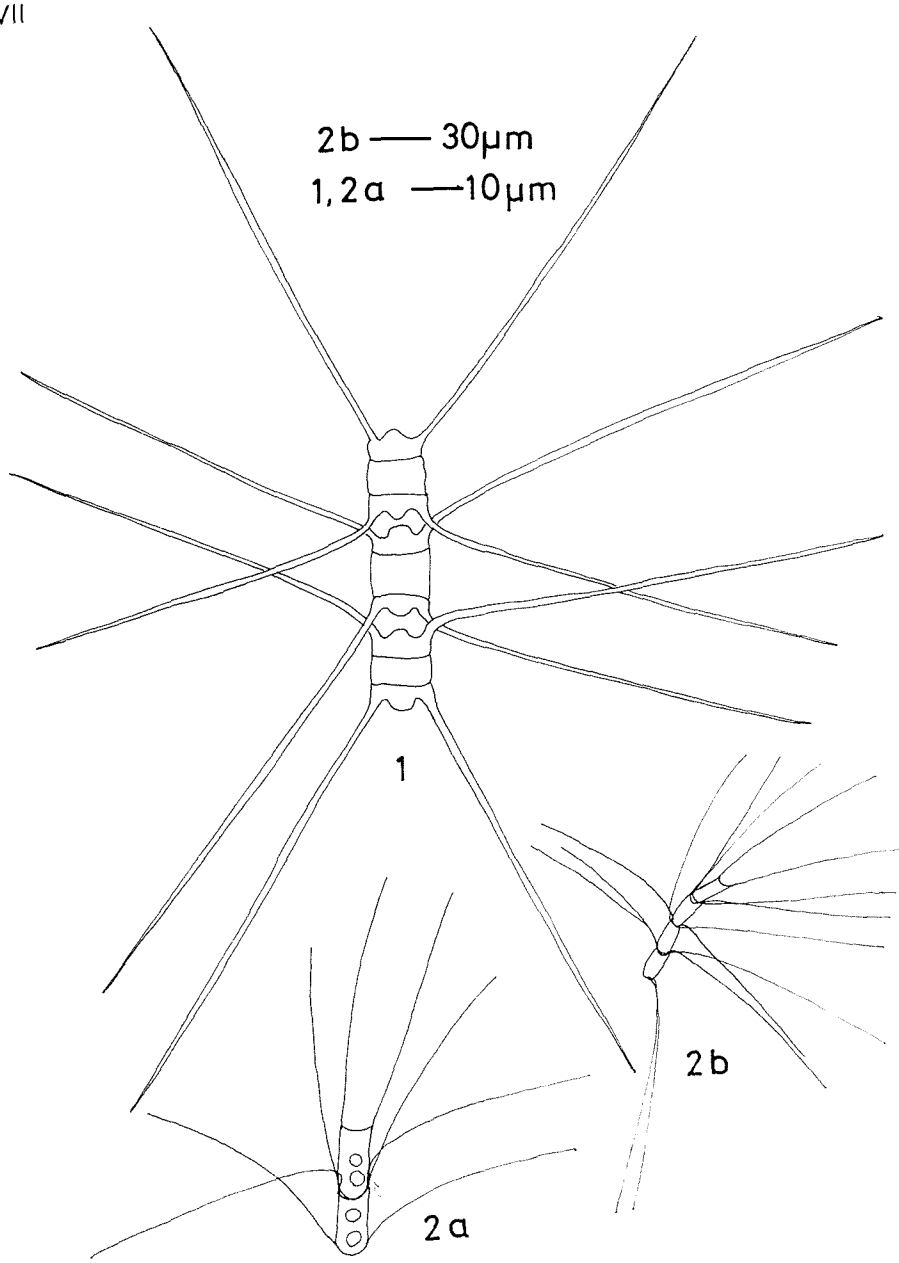
1. *Hantzschia amphioxys*, 2. *H. amphioxys* var. *major*, 3. *Bacillaria paradoxa*, 4. *Nitzschia trybionella*, 5. *N. trybionella* var. *levidensis*, 6. *N. trybionella* var. *debilis*, 7. *N. circumsta*, 8. *N. punctata* var. *peragalli*, 9. *N. apiculata*, 10. *N. hungrica*, 11. *N. dubia*, 12. *H. amphioxys*.

PL. XVI



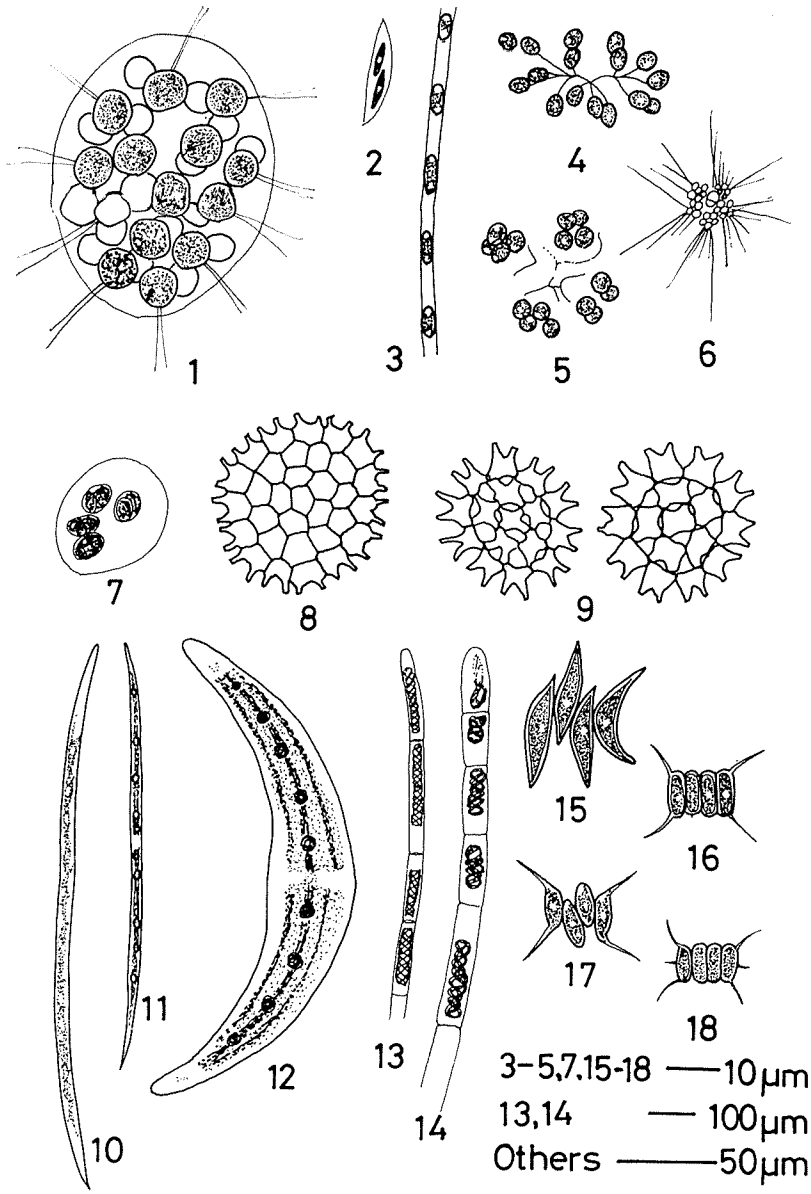
1. *Nitzschia gracilis*, 2. *N.* sp. 1., 3. *N. frustulum*, 4. *N.* sp. 2, 5. *N. amphibia*, 6. *N. obtusa* var. *scalpeliformis*, 7. *N. sigma*, 8. *N. parvula*, 9. *N. lorenziana*, var. *subtilis*, 10. *N. acicularis*, 11. *Surirella linearis*, 12. *S. moelleriana*, 13, 14. *S. inducta*, 15. *S. ovata* var. *pinnata*.

PL. XVII



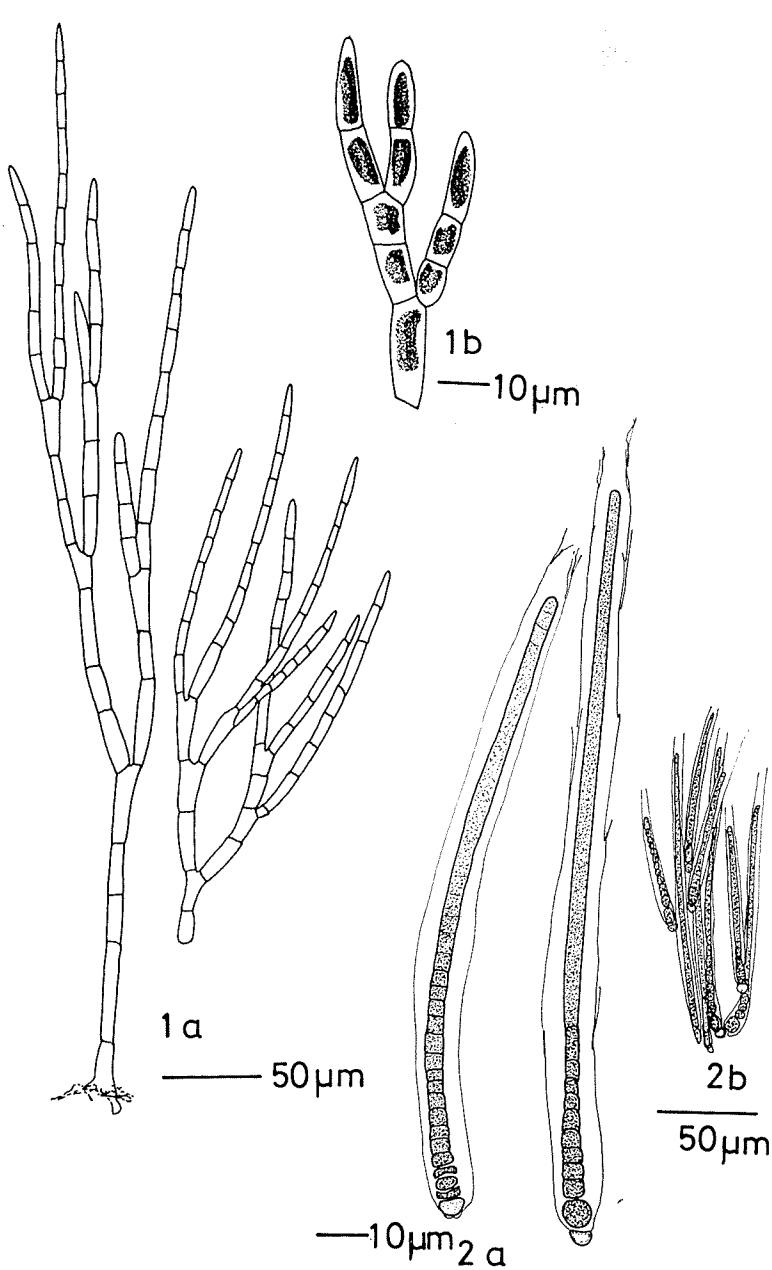
1. *Chaetoceros didimus*, 2. *Chaetoceros* sp.

PL. XVIII



1. *Eudorina elegans*, 2. *Elakatothrix gelatinosa*, 3. *Planktonema lauterbornii*, 4. *Dictyosphaerium ehrenbergianum*, 5. *Westella botryoides*, 6. *Micractinium, pusillum*, 7. *Oocystis* sp., 8. *Pediastrum duplex*, 9. *P. boryanum*, 10. *Closteriopsis longissima* var. *tropica*, 11. *Closterium* sp., 12. *Closterium moniliferum*, 13. *Spirogyra* sp. 1, 14. *Spirogyra* sp. 2, 15. *Scenedesmus acuminatus*, 16. *S. quadricauda*, 17. *S. intermedius*, 18. *S. spiuosus*.

PL. XIX

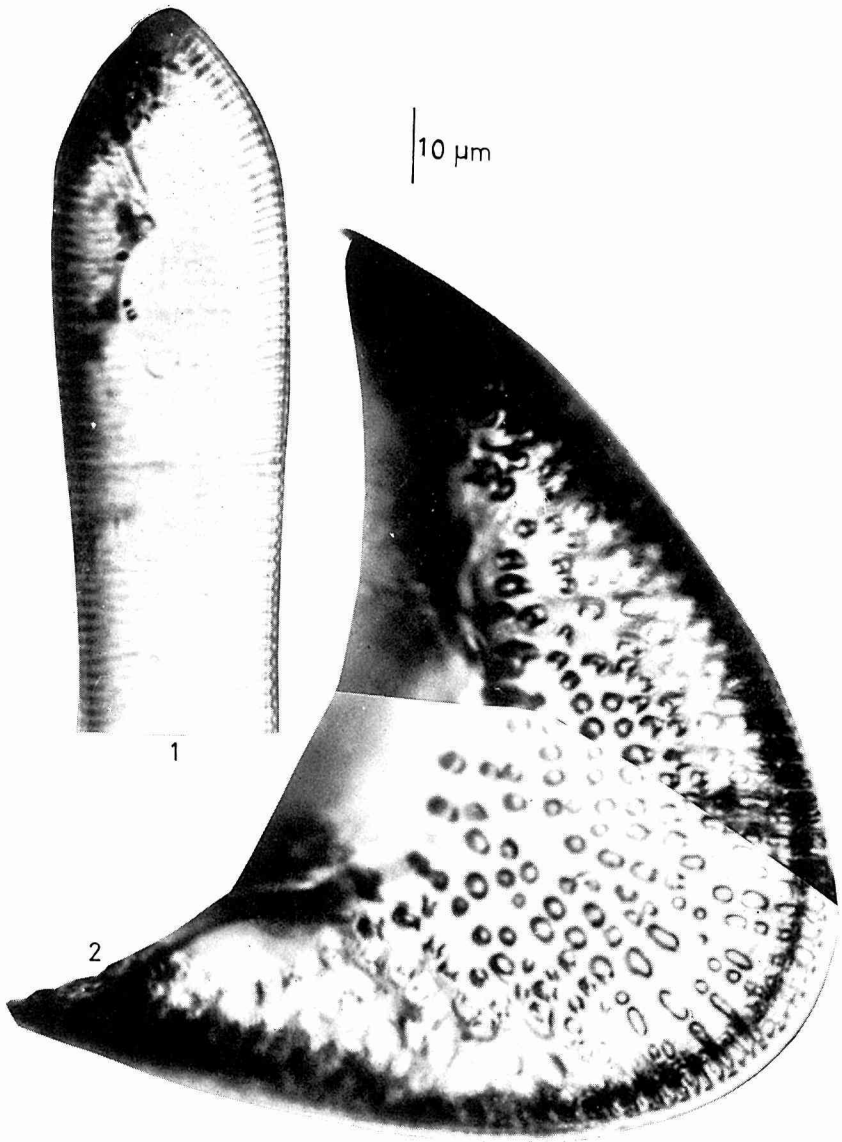


1. *Chaetophora elegans*, 2. *Calothrix* sp.

PL. XX

1. *Cladophora crispata.*

PL. XXI



1. *Cymatopleura librile*, 2. *Campylodiscus echeneis*.