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Studies on the Diatoms in the Suburbs of Kyungju

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慶州近郊의 珪藻에 對하여

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ABSTRACT

Investigations were performed on the flora, community composition and ecology of the diatoms collected from the water system in the suburbs of Kyungju city from June, 1981 to May, 1982 and from August to September, 1983. Total taxa of 157 were identified as diatoms consisting of 2 orders, 5 suborders, 8 families, 12 subfamilies, 26 genera, 97 species, 54 varieties and 6 forma. Among them 69 taxa were found as unreported ones in Korea. By the criteria of adaptability of these taxa to organic pollution in water, the taxa could be classified as 8 of tolerant, 34 of indifferent and 115 of intolerant taxa.

INTRODUCTION

Some reports concerning fresh-water diatoms in Korea have been reported (Chung, 1962, 1968, 1969; Chung and Lee, 1978), however, no report on diatoms in Kyungju areas has been appeared so far. In the present paper flora of diatoms in the suburbs of Kyungju city were described. Recently one of our authors established the pollution indexes of water system by using diatom indicators (Watanabe *et al.*, 1982). Hence, we have classified our specimens as tolerant, indifferent and intolerant taxa by the criteria as shown in Methods. These ecological survey on the tolerance of diatoms against organic pollution will be valuable data for the further environmental improvements of these areas.

These investigations were performed at the Laboratory of Environmental Biology, Department of Biology, Faculty of Science, Nara Women's University, Nara, Japan.

MATERIALS AND METHODS

Twenty sites from water-system of rivers, lakes, ponds, rise fields and even ditches

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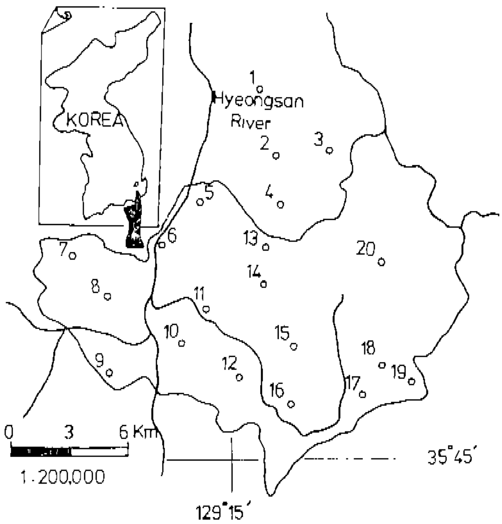

Fig. 1. A map showing the Kyungju area with sampling sites.
1. Moso-ri 2. Moa-ri 3. Songji-ri 4. Toksan-ri 5. Yonggang-dong 6. Pukbu-dong 7. Chonhyo-dong 8. Soak-dong 9. Song-ri 10. Posokchong 11. Kyo-dong 12. Namsan 13. Pulguk-ri 14. Pomun-dong 15. Tongbang-dong 16. Choyang-dong 17. Ma-dong 18. Pulguksa 19. Sokkuram 20. Tok-dong

were selected as sampling areas as shown in Fig. 1. Colllection of specimens for the present study were performed twice from June, 1981 to May, 1982 and from August to September, 1983 with plankton net (Nxxx 25), brush and forceps, and the collected samples were fixed in 3~5% formalin. Normal scanning microscopic examination was done at a magnification of 2,000x, but the microscopic pictures were reduced to two-fifth (Plate 1~9).

The following criteria of tolerance for the organic pollution were used to classify our diatoms (Watanabe *et al.*, 1982).

Tolerant taxa. This represents the taxa appeared in water system where BOD_5 is above 7 ppm with relative frequency of more than 10%. It also includes the taxon appeared in water system where BOD_5 is below 7 ppm with tendency of having relative frequency of less than 10%.

Indifferent taxa. This indicates the taxa appeared in water system where BOD_5 is above or below 7 ppm with more than 10% of relative frequency. It also includes the taxa appeared in water system where the relative frequency is usually less than 10%, regardless of its BOD_5, i.e., above or below 7 ppm.

Intolerant taxa. This indicates the taxa appeared in water system where BOD_5 is above or below 7 ppm with more than 10% of relative frequency. It also includes the taxa living in water system where BOD_5 is 7 ppm with the tendency of having relative frequency of less than 10%.

The unrecorded taxa in Korea were identified by the reference of Chung (1968) and other reports.

RESULTS AND DISCUSSION

Taxa of diatoms. Total taxa of diatoms identified were 157 including 2 orders, 5 suborders, 8 families, 12 subfamilies, 26 genera, 97 species, 54 varieties and 6 forma. The summary of orders of our taxa is presented in Table 1. Here we have found species containing genera as unrecorded taxa in Korea (Unrecorded taxa were expressed as asterisk(*) in each species.)

Table 1. Summary of orders of diatoms found in Kyungju areas

Order	Subord.	Fam.	Subfam.	Gen.	Sp.	Var.	Form.	
Centrales	1	1	2	3	8	1	—	
Pennales	4	7	10	23	89	53	6	
2	5	8	12	26	97	54	6	157 taxa

Adaptability of diatoms to organic pollution. The investigated taxa of diatoms in kyungju areas were almost similar to those found in Japan. Therefore it was possible that our samples could be classified by the criteria of tolerance for organic pollution as described by Watanabe *et al.* (1982). It was appeared as 8 of tolerant taxa, 34 of indifferent taxa and 115 of intolerant taxa.

In this paper we described the morphological characteristics and the tolerance for organic pollution of the taxa collected from the several sites in the Kyungju areas. The identification of each taxon was performed by using the references explained with each taxon. The ecology of each taxon was also described and all the taxa which were not explained the ecology are intolerant taxa.

Taxonomic and ecological description of taxa

Centrales

Discineaceae

Coscinodiscaceae

Melosiroideae

1. *Melosira granulata* (Ehr.) Ralfs (Pl. 1, Fig. 1)
Watanabe, T., *et al.* 1982, p. 51, pl. 6, F. 61. Valve: 8-21×5-18 μ, Striae: 10-13 in 10 μ, Puncta: 8-10 in 10 μ. Ecology: Tolerant taxon

2. *Melosira granulata* var. *angustissima* Müll. (Pl. 1, Fig. 2)
Hustedt, F., 1930, p. 88, F. 45. Valve: 5-21×5-18 μ, Striae: 8-9 in 10 μ, Puncta: 8-10 in 10 μ.

★3. *Melosira roeseana* Rath. (Pl. 1, Fig. 3)
Hustedt, F., 1930, p. 93, F. 59. Valve: 8-70 μ, Striae: 12 in 10 μ, Puncta: 20 in 10 μ.

4. *Melosira varians* C.A. Ag. (Pl. 1, Fig. 4)
Watanabe, T., *et al.* 1982, p. 49, pl. 1, F. 2. Valve: 8-35×9-13 μ. Ecology: Indifferent taxon

Coscinodiscoideae

5. *Cyclotella comata* (Ehr.) Kütz. (Pl. 1, Fig. 5)
Watanabe, T., *et al.* 1982, p. 51, pl. 6, F. 63. Valve: 15-50 μ, Striae: 13-15 in 10 μ. Ecology: Tolerant taxon

★6. *Cyclotella glomerata* Backmann (Pl. 1, Fig. 6)
Hustedt, F., 1930, p. 105, F. 81. Valve: 4-10 μ, Striae: 13-15 in 10 μ. Ecology: Indifferent taxon

7. *Cyclotella meneghiniana* Kütz. (Pl. 1, Fig. 7)
Watanabe, T., *et al.* 1982, p. 49, pl. 1, F. 4. Valve: 10-13 μ, Striae: 8-9 in 10 μ. Ecology: Indifferent taxon

8. *Cyclotella stelligera* A. Cl. et Grun. (Pl. 1, Fig. 8)
Watanabe, T., *et al.* 1982, p. 49, pl. 4, F. 5. Valve: 5-25 μ, Striae: 10-12 in 10 μ. Ecology: Indifferent taxon
9. *Coscinodiscus lacustris* Grun. (Pl. 1, Fig. 9)
Watanabe, T., *et al.* 1982, p. 51, pl. 6, F. 64. Valve: 20-25 μ, Puncta: 10-12 in 10 μ.

Pennales
Araphidineae
Fragilariaceae
Tabellarioideae

10. *Tabellaria fenestrata* (Lyngb.) Kütz. (Pl. 1, Fig. 10)
Hustedt, F., 1930, p. 122, F. 99a,b,c. Valve: 30-140×3-9 μ, Striae: 18-20 in 10 μ.
11. *Tabellaria flocculosa* (Roth) Kütz. (Pl. 1, Fig. 11)
Hustedt, F., 1930, p. 123, F. 101. Valve: 12-5×5-16 μ, Striae: 18 in 10 μ.

Fragilarioideae

12. *Fragilaria capucina* Desmazieres var. *lanceolata* Grun. (Pl. 1, Fig. 12)
Hustedt, F., 1930, p. 138, F. 127. Valve: 25-100×2-5 μ, Striae: 15 in 10 μ.
13. *Fragilaria construens* (Ehr.) Grun. (Pl. 1, Fig. 13)
Hustedt, F., 1930, p. 147, F. 135. Valve: 7-25×5-12 μ, Striae: 14-17 in 10 μ.
14. *Fragilaria construens* var. *binodis* (Ehr.) Grun. (Pl. 1, Fig. 14)
Watanabe, T., 1977, p. 34, pl. 4, F. 34. Valve: 7-25×5-12 μ, Striae: 14-17 in 10 μ.
15. *Fragilaria intermedia* Grun. (Pl. 1, Fig. 15)
Hustedt, F., 1930, p. 139, F. 130. Valve: 15-60×2.5-5 μ, Striae: 9-13 in 10 μ.

★16. *Fragilaria vaucheriae* (Kütz.) Peters (Pl. 1, Fig. 16)
Watanabe, T., *et al.* 1982, p. 49, pl. 1, F. 8. Valve: 10-40×2-4 μ, Striae: 12-16 in 10 μ.

17. *Synedra acus* var. *radians* (Kütz.) Hust. (Pl. 1, Fig. 17)
Hustedt, F., 1930, p. 155, F. 171. Valve: 40-200×2-4 μ, Striae: 12-14 in 10 μ. Ecology: Indifferent taxon
18. *Synedra pulchella* Kütz. (Pl. 1, Fig. 18)
Hustedt, F., 1930, p. 160, F. 187. Valve: 33-35×8 μ, Striae: 12-15 in 10 μ.
19. *Synedra rumpens* Kütz. (Pl. 1, Fig. 19)
Watanabe, T., *et al.* 1982, p. 52, pl. 6, F. 76. Valve: 30-80×3-4 μ, Striae: 18-20 in 10 μ. Ecology: Indifferent taxon

★20. *Synedra rumpens* Kütz. var. *fragilarioides* Grun. (Pl. 1, Fig. 20)
Hustedt, F., 1930, p. 156, F. 179. Valve: 27-70×2-3 μ, Striae: 10-11 in 10 μ.

★21. *Synedra rumpens* Kütz. var. *Meneghiniana* Grun. (Pl. 1, Fig. 21)
Patrick, R. & C. Reimer, 1966, p. 145, pl. 6, F. 3. Valve: 27-38×3-4 μ, Striae: 12-13.5 in 10 μ. Ecology: Indifferent taxon

★22. *Synedra socia* Wallace (Pl. 1, Fig. 22)
Patrick, R. & C. Reimer, 1966, p. 145, pl. 6, F. 5. Valve: 15-28×3-4 μ, Striae: 17 in 10 μ. Ecology: Indifferent taxon

23. *Synedrb ulna* (Nitz.) Ehr. var. *ulna* (Pl. 2, Fig. 23)
Patrick, R. & C. Reimer, 1966, p. 148, pl. 7, F. 1-2. Valve: 75-100×5-9 μ, Striae: 9-11 in

10 μ. Ecology: Inidfferent taxon

★24. *Synedra ulna* var. *danica* (Kütz.) V.H. (Pl. 2, Fig. 24)
Patrick, R. & C. Reimer, 1966, p. 151, pl. 7, F. 10. Valve: 120-200×5-8 μ, Striae: 9-11 in 10 μ.

Raphidioidineae

Eunotiaceae

Eunotioideae

★25. *Eunotia curvata* (Kütz.) Lagerst. var. *curvata* (Pl. 2, Fig. 25)
Patrick, R. & C. Reimer, 1966, p. 189, pl. 10, F. 4. Valve: 20-150×3-6 μ, Striae: 13-18 in 10 μ.

★26. *Eunotia exigua* (Bréb. ex Kütz.) Rabh. (Pl. 2, Fig. 26)
Watanabe, T., *et al.* 1982, p. 54, pl. 8, F. 113. Valve: 10-26×2-4 μ, Striae: 20-25 in 10 μ.

★27. *Eunotia faba* (Ehr.) Grun. (Pl. 2, Fig. 27)
Hustedt, F., 1930, p. 183, F. 246. Valve: 26-60×5-8 μ, Striae: 13-15 in 10 μ.

28. *Eunotia flexuosa* Bréb. ex Kütz. var. *flexuosa* (Pl. 2, Fig. 28)
Patrick, R. & C. Reimer, 1966, p. 187, pl. 10, F. 1. Valve: 90-300×2-5 μ, Striae: 15-19 in 10 μ.

★29. *Eunotia major* (W. Sm.) Rabh. var. *major* (Pl. 2, Fig. 29)
Patrick, R. & C. Reimer, 1966, p. 196, pl. 11, F. 5. Valve: 35-320×6-15 μ, Striae: 8-14 in 10 μ.

★30. *Eunotia monodon* var. *undulata* (A. Berg.) Cleve-Euler (Pl. 2, Fig. 30)
Cleve-Euler, 1953, p. 118, F. 455g. Valve: 43-93×8-12 μ, Striae: 9-10 in 10 μ.

31. *Eunotia pectinalis* (O.F. Müll.) Rabh. var. *pectinalis* (Pl. 2, Fig. 31)
Patrick, R. & C. Reimer, 1966, p. 204, pl. 12, F. 8, 10. Valve: 17-140×5-10 μ, Striae: 7-12 in 10 μ.

32. *Eunotia pectinalis* (Kütz.) var. *minor* Rabh. (Pl. 2, Fig. 32)
Watanabe, T., 1981, p. 180, pl. 2, F. 19. Valve: 10-50×5-10 μ, Striae: 7-12 in 10 μ.

★33. *Eunotia polydentula* var. *perpusilla* Grun. (Pl. 2, Fig. 33)
Fukushima, H. *et al.* 1973, p. 31, pl. 7, F. 1. Valve: 14×3 μ, Striae: 18 in 10 μ.

34. *Eunotia tenella* (Grun.) Hust. (Pl. 2, Fig. 34)
Watanabe, T., 1981, p. 180, pl. 2, F. 21. Valve: 6-27×3 μ, Striae: 16-20 in 10 μ.

35. *Eunotia valida* Hust. (Pl. 2, Fig. 35)
Hustedt, F., 1930, p. 178, F. 229. Valve: 30-150×3.5-7.5 μ, Striae: 11-15 in 10 μ.

Monoraphidineae

Achnanthaceae

Cocconeiodeae

36. *Cocconeis plaeontula* var. *euglypta* (Ehr.) A. Cl. (Pl. 2, Fig. 36)
Watanabe, T., *et al.* 1982, p. 49, pl. 2, F. 17. Valve: 10-50×8-30 μ, Striae: 19-23 in 10 μ.

37. *Cocconeis plaeentula* var. *lineata* (Ehr.) V.H. (Pl. 2, Fig. 37)
Patrick, R. & C. Reimer, 1966, p. 242, pl. 15, F. 5, 6. Valve: 10-70×8-40 μ, Striae: 19-20 in 10 μ.

★38. *Achnanthes delicicatula* Kg. (Pl. 3, Fig. 38)
Watanabe, T., 1977, p. 35, pl. 5, F. 51. Valve: 10-26×5-10 μ, Striae: 14-16 in 10 μ.

39. *Achnanthes hungaria* Gurn. (Pl. 3, Fig. 39)
Watanabe, T., 1977, p. 35, pl. 5, F. 49. Valve: 14-40×6-3 μ, Striae: 21-23 in 10 μ.

40. *Achnanthes lanceolata* (Bréb.) Grun. var. *lanceolata* (Pl. 3, Fig. 40)
Patrick, R. & C. Reimer, 1966, p. 269, pl. 18, F. 1-10. Valve: 13-31×4.5-8 μ, Striae: 11-14 in 10 μ.

★41. *Achnanthes lanceolata* var. *dubida* Grun. (Pl. 3, Fig. 41)
Watanabe, T., 1977, p. 35, pl. 5, F. 58. Valve: 8-16×35 μ, Striae: 10-14 in 10 μ. Ecology: Indifferent taxon

★42. *Achnanthes lanceolata* Bréb. var. *elliptica* Cleve (Pl. 3, Fig. 42)
Hustedt, F., 1930, p. 208, F. 306c. Valve: 18-40×4-10 μ, Striae: 13-16 in 10 μ.

★43. *Achnanthes lanceolata* (Bréb.) Grun. var. *rostrata* (Oestr.) Hust. (Pl. 3, Fig. 43)
Fukushima, H., *et al.* 1973, p. 11, pl. 9, F. a, f. Valve: 13-25×5.5-9 μ, Striae: 13-14 in 10 μ.

44. *Achnanthes linearis* (W. Sm.) Grun. (Pl. 3, Fig. 44)
Watanabe, T., 1982, p. 49, pl. 2, F. 15. Valve: 10-20×2.5-3.5 μ, Striae: 23-26 in 10 μ. Ecology: Indifferent taxon

Biraphidineae

Naviculaceae

Naviculoideae

45. *Frusteria vulgaris* Thwaites (Pl. 3, Fig. 45)
Hustedt, F., 1930, p. 221, F. 327. Valve: 50-70×10-13 μ, Striae: 24 in 10μ, Puncta: 34 in 10 μ. Ecology: Indifferent taxon

★46. *Gyrosigma obtusatum* (Sulliv. & Wormley) Boyer var. *obtusatum* (Pl. 3, Fig. 46)
Patrick, R. & C. Reimer, 1966, p. 316, pl. 23, F. 8. Valve: 65-90×12-14 μ, Transverses St.: 20, Longitudinal St. 22-24 in 10 μ.

47. *Caloneis bacillum* (Grun.) Mereshkowsky (Pl. 3, Fig. 47)
Hustedt, F., 1930, p. 237, F. 360. Valve: 15-45×4-9 μ, Striae: 22-28 in 10 μ.

48. *Caloneis silicula* (Ehr.) Cleve (Pl. 3, Fig. 48)
Hustedt, F., 1930, p. 236, F. 362. Valve: 25-120×6-24 μ, Striae: 16-20 in 10 μ.

★49. *Caloneis silicula* (Ehr.) Cleve var. *trucatula* Grun. (Pl. 3, Fig. 49)
Hustedt, F., 1930, p. 238, F. 363, 364. Valve: 25-120×6-20 μ, Striae: 16-20 in 10 μ.

50. *Neidium affine* (Ehr.) Cleve var. *amphirhynchus* (Ehr.) Cleve (Pl. 3, Fig. 50)
Hustedt, F., 1930, p. 243, F. 377. Valve: 20-150×4-20 μ, Striae: 27-29 in 10 μ.

51. *Neidium bisulcatum* (Lagerstedt) Cleve (Pl. 3, Fig. 51)
Hustedt, F., 1930, p. 242, F. 274. Valve: 30-76×7-12 μ, Striae: 26-30 in 10 μ.

★52. *Neidium gracile* Hust. f. *aequalis* Hust. (Pl. 3, Fig. 52)
Fukushima, H., *et al.* 1973, p. 53, pl. 14, :F. d, e. Valve: 46-48×9.5-11 μ, Striae: 23 in 10 μ.

★53. *Neidium iridis* (Ehr.) Cleve f. *vernalis* Reichelt (Pl. 3, Fig. 53)
Hustedt, F., 1930, p. 245, F. 380. Valve: 50-77×14-17 μ, Striae: 18-21 in 10 μ.

★54. *Diploneis elliptica* (Kütz.) Cl. var. *elliptica* (Pl. 3, Fig. 54)
Watanabe, T., 1981, p. 180, pl. 2, F. 18. Valve: 20-130×10-60 μ, Striae: 12-14 in 10 μ.

55. *Diploneis ovalis* (Hilse) Cleve (Pl. 3, Fig. 55)

Hustedt, F., 1930, p. 249, F. 390. Valve: 20-100×10-35 μ, Striae: 10-19 in 10 μ.

56. *Diploneis puella* (Schumann) Cleve (Pl. 3, Fig. 56)
Hustedt, F., 1930, p. 250, F. 394. Value: 13-27×6-14 μ, Striae: 14-18 in 10 μ.

★57. *Stauroneis acuta* W. Smith (Pl. 3, Fig. 57)
Hustedt, F., 1930, p. 259, F. 415. Value: 80-166×15-40 μ, Striae: 12-16 in 10 μ.

58. *Stauroneis anceps* Ehr. (Pl. 3, Fig. 58)
Hustedt, F., 1930, p. 256, F. 405. Valve: 25-130×6-18 μ, Striae: 20-30 in 10 μ.

59. *Stauroneis phoenicenteron* (Nitz.) Ehr. var. *phoenicenteron* (Pl. 4, Fig. 59)
Patrick, R. & C. Reimer, 1966, p. 359, pl. 29, F. 1-2. Valve: 70-380×16-53 μ, Striae: 12-17 in 10 μ.

★60. *Stauroneis phoenicenteron* (Nitz.) Ehr. var. *brunii* (M. Perag. & Herib.) Voigt (Pl. 4, Fig. 60)
Patrick, R. & C. Reimer, 1966, p. 359, pl. 29, F. 5. Valve: 125-160×29-32μ, Striae: 14-16 in 10 μ, Puncta: 12-14 in 10 μ.

★61. *Stauroneis phoenicenteron* f. *gracilis* (Ehr.) Hust. (Pl. 4, Fig. 61)
Patrick, R. & C. Reimer, 1966, p. 359, pl. 29, F. 3-4. Valve: 80-160×16-21 μ, Striae: 17-20 in 10 μ.

62. *Navicula americana* Ehr. (Pl. 4, Fig. 62)
Hustedt, F., 1930, p. 280, F. 464. Valve: 30-120×10-30 μ, Striae: 16-18 in 10 μ.

63. *Navicula anglica* var. *subsalsa* (Grun.) A. Cl. (Pl. 4, Fig. 63)
Watanabe, T., *et al.* 1982, p. 53, pl. 7, F. 87. Valve: 28-40×9-15 μ, Striae: 8-10 in 10 μ. Ecology: Indifferent taxon

64. *Navicula bacillum* Ehr. (Pl. 4, Fig. 64)
Hustedt, F., 1930, p. 280, F. 465. Valve: 30-80×10-20 μ, Striae: 12-14 in 10 μ,

65. *Navicula cincta* (Ehr.) Kütz. (Pl. 4, Fig. 65)
Hustedt, F., 1930, p. 298, F. 510. Valve: 20-40×5-6 μ, Striae: 12-17 in 10 μ.

66. *Navicula conrvaceae* Kütz. (Pl. 4, Fig. 66)
Watanabe, T., 1981, p. 181, pl. 3, F. 32. Valve: 20-23×5-9 μ, Striae: 18-24 in 10 μ.

67. *Navicula cryptocephala* Kütz. var. *cryptocephala* (Pl. 4, Fig. 67)
Patrick, R. & C. Reimer, 1966, p. 503, pl. 48, F. 3. Valve: 20-40×5-7 μ, Striae: 16-18 in 10 μ. Ecology: Indifferent taxon

68. *Navicula cryptocephala* var. *veneta* (Kütz.) Rabh. (Pl. 4, Fig. 68)
Watanabe, T., *et al.* 1982, p. 50, pl. 3, F. 23. Valve: 13:-26×5-6 μ, Striae: 14-16 in 10 μ. Ecology: Indifferent taxon

69. *Navicula cuspidata* Kütz. (Pl. 4, Fig. 69)
Hustedt, F., 1930, p. 268, F. 433. Valve: 50-170×17-37 μ, Striae: 11-19 in 10 μ. Ecology: Indifferent taxon

★70. *Navicula dispera* (Ehr.) W. Smith (Pl. 5, Fig. 70)
Hustedt, F., 1930, p. 302, F. 526. Valve: 20-4×8-13 μ, Striae: 9-11 in 10 μ.

★71. *Navicula dicephala* (Ehr.) Smith var. *neglecta* (Krabke) Hust. (Pl. 5, Fig. 71)
Hustedt, F., 1930 p. 303, F. 527. Valve: 20-48×8-13 μ, Striae: 12 in 10 μ.

★72. *Navicula frugalis* Hust. (Pl. 5, Fig. 72)
Hustedt, F., 1971, p. 234, F. 1356. Valve: 3-8×3.5-4 μ.

★73. *Navicula gregaria* Donkin (Pl. 5, Fig. 73)
Watanabe, T., 1981, p. 181, pl. 3, F. 34. Valve: 15-35×5-9 μ, Striae: 16-22 in 10 μ. Ecology: Indifferent taxon

★74. *Navicula gottlandica* Grun. (Pl. 5, Fig. 74)
Watanabe, T., *et al.* 1982, p. 50, pl. 3, F. 25. Valve: 35-60×8-9 μ, Striae: 14 in 10 μ. Ecology: Indifferent taxon

★75. *Navicula heufleri* var. *leptocephala* (Breb. ex Grun.) Patr. (Pl. 5, Fig. 75)
Watanabe, T., *et al.* 1982, p. 50, pl. 3, F. 28. Valve: 20-32×4-6 μ, Striae: 13-14 in 10 μ. Ecology: Indifferent taxon

★76. *Navicula hungarica* Gruu. var. *linearis* Ostrup (Pl. 5, Fig. 76)
Hustedt, F., 1930, p. 298, F. 507. Valve: 10-30×4-7 μ, Striae: 8-10 in 10 μ.

★77. *Navicula menisculus* var. *upsaliensis* (Grun.) Grun. (Pl. 5, Fig. 77)
Patrick, R. & C. Reimer, 1966, p. 519, pl. 49, F. 17-18. Valve: 13-40×8-15 μ, Striae: 9-12 in 10 μ.

78. *Navicula mutica* Kütz. (Pl. 5, Fig. 78)
Hustedt, F., 1930, p. 274, F. 453a. Valve: 10-40×7-12 μ, Striae: 15-20 in 10 μ. Ecology: Tolerant taxon

★79. *Navicula peregrina* (Ehr.) var. *peregrina* (Pl. 5, Fig. 79)
Patrick, R. & C. Reimer, 1966, p. 533, pl. 51, F. 5. Valve: 36-150×10-30 μ, Striae: 5-6 in 10 μ.

80. *Navicula pupula* Kütz. var. *pupula* (Pl. 5, Fig. 80)
Hustedt, F., 1971, p. 120, F. 1254a-g. Valve: 13-66×5-16 μ, Striae: 22-26 in 10 μ. Ecology: Indifferent taxon

81. *Navicula pupula* Kütz. var. *capitata* Skv. & Meyer (Pl. 5, Fig. 81)
Hustedt, F., 1971, p. 121, F. 1254i-m. Valve: 13-66×5-16 μ, Striae: 22-26 in 10 μ. Ecology: Indifferent taxon

82. *Navicula pupula* Kütz. f. *rectangularis* (Greg.) Grun. (Pl. 5, Fig. 82)
Hustedt, F., 1971, p. 121, F. 1254n-q. Valve: 13-66×5-16 μ, Striae: 22-26 in 10 μ.

83. *Navicula radiosa* Kütz. (Pl. 5, Fig. 83)
Hustedt, 1930, p. 299, F. 513. Valve: 40-120×10-19 μ, Striae: 10-12 in 10 μ.

84. *Navicula symmetrica* Patr. var. *symmetrica* (Pl. 5, Fig. 84)
Patrick, R. & C. Reimer, 1966, p. 513, pl. 49, F. 2. Valve: 32-35×5-7 μ, Striae: 15-17 in 10 μ. Ecology: Indifferent taxon

★85. *Navicula tripunctata* (O.F. Müll.) Bory var. *schizomoides* (V. H.) Patr. (Pl. 5, Fig. 85)
Patrick, R. & C. Reimer, 1966, p. 514, pl. 49, F. 4. Valve: 33-60×6-10 μ, Striae: 11-12 in 10 μ.

★86. *Navicula viridula* var. *avenancea* (Breb. ex Grun.) V.H. (Pl. 5, Fig. 86)
Patrick, R. & C. Reimer, 1966, p. 507, pl. 48, F. 10. Valve: 30-60×8-10 μ, Striae: 10-12 in 10 μ.

★87. *Navicula viridula* (Kg.) var. *rostellata* (Kütz.) Cleve (Pl. 5, Fig. 87)
Watanabe, T., 1977, p. 37, pl. 37, pl. 7, F. 101. Valve: 35-65×8-11 μ, Striae: 9-12 in 10 μ. Ecology: Indifferent taxon

★88. *Pinnularia abaujensis* var. *subundulata* (A. Meyer ex Hust.) Patr. (Pl. 5, Fig. 88)
Patrick, R. & C. Reimer, 1966, p. 599, pl. 58, F. 5. Valve: 50-140×7-13 μ, Striae: 10-13 in 10 μ.

89. *Pinnularia acrosphaeria* W. Smith var. *acrosphaeria* Patr. & Reimer (Pl. 5, Fig. 89)
Watanabe, T., 1977, p. 38, pl. 8, F. 120. Valve: 30-180×8-20 μ, Striae: 6-14 in 10 μ.

★90. *Pinnularia borelis* Ehr. var. *rectangularis* Caslson (Pl. 5, Fig. 90)
Patrick, R. & C. Reimer, 1966, p. 618, pl. 58, F. 13. Valve: 28-110×7-18 μ, Striae: 4-6 in 10 μ.

91. *Pinnularia braunii* (Grun.) A. Cl. var. *amphicephala* (A. Meyer) Hust. (Pl. 5, Fig. 91)
Patrick, R. & C. Reimer, 1966, p. 594, pl. 55, F. 4. Valve: 48-55×7-8 μ, Striae: 11-14 in 10 μ. Ecology: Tolerant taxon

★92. *Pinnularia horrida* var. *genuina* A. Cl. (Pl. 5, Fig. 92)
Cleve-Euler, 1952, p. 36, F. 1043ab. Valve: 120-165×22-25 μ, Striae: 6-7 in 10 μ.

★93. *Pinnularia gibba* var. *parva* (Ehr.) Grun. (Pl. 5, Fig. 93)
Hustedt, F., 1930, p. 327, F. 603. Valve: 34-70×7-13 μ, Striae: 9-11 in 10 μ.

★94. *Pinnularia gibba* Ehr. f. *subundulata* Meyer (Pl. 6, Fig. 94)
Hustedt, F., 1930, p. 327, F. 601. Valve: 50-140×7-13 μ, Striae: 9-11 in 10 μ.

★95. *Pinnularia imperfacta* A. Cleve (Pl. 6, Fig. 95)
Cleve-Euler, 1952, p. 29, F. 1030a. Valve: 26-50×6-10 μ, Striae: 10-11 in 10 μ.

96. *Pinnularia major* (Kütz.) Cleve (Pl. 6, Fig. 96)
Hustedt, F., 1930, p. 333, F. 614. Valve: 140-180×25-40 μ, Striae: 5-7 in 10 μ.

97. *Pinnularia mesolepta* (Ehr.) W. Smith (Pl. 6, Fig. 97)
Hustedt, F., 1930, p. 319, F. 575a. Valve: 30-65×9-11 μ, Striae: 10-14 in 10 μ.

98. *Pinnularia microstauron* (Ehr.) A. Cl. (Pl. 6, Fig. 98)
Watanabe, T., *et al.* 1982. p. 50, pl. 4, F. 41. Valve: 25-80×7-11 μ, Striae: 10-13 in 10 μ. Ecology: Indifferent taxon

★99. *Pinnularia microstauron* (Ehr.) Cleve var. *brevissonii* (Kütz.) Hust. f. *diminuta* Gurn. (Pl. 6, Fig. 99)
Hustedt, F., 1930, p. 322, F. 585. Valve: 20-30×7-8 μ, Striae: 15-16 in 10 μ.

100. *Pinnularia molaris* Gurn. (Pl. 6, Fig. 100)
Hustedt, F., 1930, p. 316, F. 568. Valve: 33-50×5-8 μ, Striae: 15-20 in 10 μ.

Gomphocymbelloideae

★101. *Amphora bullatoides* Hohn & Hellerm var. *bullatoides* (Pl. 6, Fig. 101)
Patrick, R. & C. Reimer, 1975, p. 74, pl. 14, F. 4. Valve: 17-30×4-6 μ, Striae: 16-18 in 10 μ.

★102. *Amphora libyca* var. *baltica* (Ehr.) Cleve-Euler (Pl. 6, Fig. 102)
Cleve-Euler, 1953, p. 90, F. 666e-h. Valve: 28-47×8-11.5 μ, Striae: 12-14 in 10 μ.

★103. *Amphora ovalis* var. *affinis* (Kütz.) V. H. ex Det. (Pl. 6, Fig. 103)
Patrick, R. & C. Reimer, 1975, p. 69, pl. 13, F. 3-4. Valve: 28-80×7-12 μ, Striae; 11-12 in 10 μ.

★104. *Amphora ovalis* Kg. var. *libyca* (Ehr,) Cleve (Pl. 6, Fig. 104)
Hustedt, F., 1930, p. 342, F. 628. Valve: 20-140×9-17 μ, Striae: 10-13 in 10 μ.

105. *Amphora ovalis* var. *pediculus* (Kütz.) V.H. ex De T. (Pl. 6, Fig. 105)

Patrick, R. & C. Reimer, 1975, p. 69, pl. 13, F. 5a-6b. Valve: 15-30×3. 6-6 μ, Striae: 15 in 10 μ. Ecology: Indifferent taxon

★106. *Amphora veneta* Kütz. var. *veneta* (Pl. 6, Fig. 106)
Patrick, R. & C. Reimer, 1975, p. 72, pl. 14, F. 2-3. Valve: 10-45×4-6 μ, Striae: 24-26 in 10 μ.

107. *Cymbella affinis* Kg. (Pl. 6, Fig. 107)
Hustedt, F., 1930, p. 362, F. 671. Valve: 20-70×7-16 μ, Striae: 9-11 (dors.), 10-12 (ventr.) in 10 μ.

108. *Cymbella aspera* (Ehr.) H. Perag. var. *aspera* (Pl. 6, Fig. 108)
Patrick, R. & C. Reimer, 1975, p. 72, pl. 14, F. 2-3. Valve: 10-45×4-6 μ, Striae: 24-26 in 10 μ.

109. *Cymbella leptocero* (Ehr.) Grun. (Pl. 7, Fig. 109)
Ohno, M., Fukushima, H., & T. Ko-Bayashi, 1971, p. 4, pl. 6, F. i, k, m-p. Valve: 23-47×8-13 μ, Striae: 7-11 in 10 μ.

★110. *Cymbella minuta* Hilse ex Rabh. var. *minuta* (Pl. 7, Fig. 110)
Watanabe, T., 1977, p. 38, pl. 9, F. 125. Valve: 9-28×4. 5-6 μ, Striac. 14-16 in 10 μ.

★111. *Cymbella minuta* var. *silesica* (Bleisch ex Rabh.) Reim (Pl. 7, Fig. 111)
Patrick, R. & C. Reimer, 1975, p. 49, pl. 8, F. 7a-10b. Valve: 18-40×7-9 μ, Striae: 11-13 in 10 μ.

112. *Cymbella naviculiformis* Auerswald (Pl. 7, Fig. 112)
Hustedt, F., 1930, p. 356, F. 653. Valve: 30-50×9-16 μ, Striae: 12-14 in 10 μ.

★113. *Cymbella Reinhardtii* Grun. (Pl. 7, Fig. 113)
Hustedt, F., 1930, p. 354, F. 644. Valve: 30-60×8-14 μ, Striae 13-14 in 10 μ.

114. *Cymbella sinuata* Greg. (Pl. 7, Fig. 114)
Fukushima, H., *et al.* 1973, p. 24, pl. 20, F. h-j. Valve: 10-17×3. 5-5 μ, Striae: 11-13 in 10 μ.

115. *Cymbella tumida* (Breb.) van Heurck (Pl. 7, Fig. 115)
Watanabe, T., 1977, p. 39, pl. 9, F. 129. Valve: 40-105×15-23 μ, Striae: 8-10 in 10 μ.

116. *Cymbella turgida* (Gerg.) Cleve (Pl. 7, Fig. 116)
Hustedt, F., 1930, p. 358, F. 660. Valve: 30-100×9-25 μ, Striae: 7-9 in 10 μ.

★117. *Cymbella turgidula* Grun. var. *nipponica* Skv. (Pl. 7, Fig. 117)
Watanabe, T., 1977, p. 38, pl. 9, F. 128. Valve: 27-37×9. 5-12 μ, Striae: 9-11 in 10 μ.

118. *Gomphonema acuminatum* Ehr. var. *acuminatum* (Pl. 7, Fig. 118)
Patrick, R. & C. Reimer, 1975, p. 112, pl. 15, F. 2, 4, 7. Valve: 30-85×7-11 μ, Striae: 8-11 in 10μ.

★119. *Gomphonema affine* Kütz. var. *affine* (Pl. 7, Fig. 119)
Watanabe, T., *et al.* 1982, p. 53, pl. 7, F. 105. Valve: 30-75×7-11 μ, Striae: 10-13 in 10 μ.

120. *Gomphonema angustatum* (Kütz.) Robh. (Pl. 7, Fig. 120)
Watanabe, T., *et al.* 1982, p. 51, pl. 4, F. 43. Valve: 12-45×5-9 μ, Striae: 9-12 in 10 μ. Ecology: Indifferent taxon

★121. *Gomphonema angustatum* var. *citera* (Hohn & Hellerm.) Patr. (Pl. 7, Fig. 121)
Patrick, R. & C. Reimer, 1975, p. 125, pl. 17, F. 14. Valve: 18-2. 5×5-7 μ, Striae: 11-13 in 10 μ.

122. *Gomphonema augur* Ehr. var. *augur* (Pl. 7, Fig. 122)
Patrick, R. & C. Reimer, 1975, p. 111, pl. 15, F. 9. Valve: 17-50×9-13μ, Striae: 11-15 in 10μ.

★123. *Gomphonema clevei* Fricko var. *clevei* (Pl. 7, Fig. 123)
Patrick, R. & C. Reimer, 1975, p. 138, pl. 18, F. 6. Valve: 17-37×5-8 μ, Striae: 12-14 in 10 μ.

★124. *Gomphonema clevei* Frick var. *edilis* Fukushima (Pl. 7, Fig. 124)
Watanabe, T., 1977, p. 39, pl. 10, F. 140. Valve: 34-44×6.5-9 μ, Striae: 16 10 μ.

125. *Gomphonema intricatum* Kütz. var. *intricatum* (Pl. 7, Fig. 125)
Hustedt, F., 1930, p. 375, F. 697. Valve: 25-70×5-9 μ, Striae: 8-11 in 10 μ.

126. *Gomphonema lanceolatum* Ehr. var. *insignis* (Creg.) Cleve (Pl. 7, Fig. 126)
Hustedt, F., 1930, p. 376, F. 701. Valve: 27-70×7-10 μ, Striae: 8-18 in 10 μ.

127. *Gomphonema longiceps* Ehr. var. *subclavate* Grun. (Pl. 7, Fig. 127)
Watanabe, T., 1981, p. 181, pl. 3, F. 31. Valve: 44-51×9-11 μ, Striae: 10-12 in 10 μ.

128. *Gomphonema pavulum* (Kütz) Grun. (Pl. 7, Fig. 128)
Watanabe, T., *et al.* 1982, p. 51, pl. 4, F. 49. Valve: 15-30×5-18 μ, Striae: 13-16 in 10 μ.
Ecology: Tolerant taxon

129. *Gomphonema sphaerophorum* Ehr. var. *sphaerophorum* (Pl. 7, Fig. 129)
Fukusnima, H., *et al.* 1973, p. 39, pl. 24, F.b. Valve: 30-47×7-10 μ, Striae: 11-13 in 10 μ.

★130. *Gomphonema tetrastigmatum* Horikawa et Okuno (Pl. 7, Fig. 130)
Watanabe, T., *et al.* 1982, p. 51, pl. 4, F. 48. Valve: 12-35×7-10 μ, Striae: 13-15 in 10 μ.

★131. *Gomphonema truncatum* Ehr. var. *truncatum* (Pl. 7, Fig. 131)
Patrick, R. & C. Reimer, 1975, p. 118, pl. 16, F. 3. Valve: 26-65×6-14 μ, Striae: 10-12 in 10 μ.

Epithemiaceae

Epithemioideae

★132. *Epithemia adnata* var. *minor* (Perg. & herib.) Patr. (Pl. 8, Fig. 132)
Patrick, R. & C. Reimer, 1975, p. 180, pl. 24, F. 7-8. Valve: 30-41×9-11 μ, Costae: 3-5 in 10 μ, Striae: 12-14 in 10 μ.

133. *Epithemia zebra* (Ehr.) Kütz. var. *porcellus* (Kütz.) Grun. (Pl. 8, Fig. 133)
Hustedt, F., 1930, p. 384, F. 731. Valve: 30-150×7-14 μ, Striae: 12-14 in 10 μ.

Rhopaldioideae

134. *Rhopalodia gibba* (Ehr.) O. Müll. var. *gibba* (Pl. 8, Fig. 134)
Patrick, R. & C. Reimer, 1975, p. 189, pl. 28, F. 1. Valve: 80-300×8-11 μ, Breadth of frustule: 18-30 μ.

★135. *Rhopalodia gibberula* var. *vanheurckii* O. Müll. (Pl. 8, Fig. 135)
Patrick, R. & C. Reimer, 1975, p. 192, pl. 28, F. 7. Valve: 27-40×6-7 μ, Costae: 2-8 in 10 μ, Alveoli in rows: 14-17 in 10 μ.

136. *Rhopalodia gibba* var. *ventricosa* (Kütz.) H. & M. Perag. (Pl. 8, Fig. 136)
Patrick, R. & C. Reimer, 1975, p. 190, pl. 28, F. 3-4. Valve: 25-100×7-10 μ, Striae: 5-8 in 10 μ.

Nitzschiaceae

Nitzschioideae

137. *Hantzschia amphioxys* (Ehr.) Grun. (Pl. 8, Fig. 137)

Watanabe, T., *et al.* 1982, p. 51, p. 5, F. 52. Valve: 20-100×5-10 μ, Carnate dots: 5-8 in 10 μ, Striae: 13-20 in 10 μ. Ecology: Indifferent taxon

★138. *Hantzschia linearis* (O.M.) A. Cl. (Pl. 8, Fig. 138)
Cleve-Euler, 1952, p. 51, F. 1421a-d. Valve: 150-200×8-16 μ, Striae: 15-16 in 10 μ.

139. *Bacillaria paradoxa* Gmelin (Pl. 8, Fig. 139)
Hustedt, F., 1930, p. 396, F. 755. Valve: 60-150×4-8 μ, Striae: 20-25 in 10 μ, Carnate dots: 6-8 in 10 μ.

★140. *Bacillaria paradoxa* Gmelin var. *tumidula* Grun. (Pl. 8, Fig. 140)
Hustedt, F., 1930, p. 397, F. 756. Valve: 60-150×4-8 μ, Striae: 20-25 in 10 μ, Carnate dots: 6-8 in 10 μ.

141. *Nitzschia amphibia* Grun. (Pl. 8, Fig. 141)
Hustedt, F., 1930, p. 414, F. 793. Valve: 12-50×3-5 μ, Carnate dots: 7-8 in 10 μ, Striae: 15-19 in 10 μ.

★142. *Nitzschia denticula* Grun. (Pl. 8, Fig. 142)
Watanabe, T., 1981, pl. 3, F. 41. Valve: 10-100×3-8 μ, Carnate dots: 5-8 in 10 μ, Striae: 14-20 in 10μ. Ecology: Indifferent taxon

143. *Nitzschia filiformis* (W. Smith) Hust. (Pl. 8, Fig. 143)
Hustedt, F., 1930, p. 422, F. 818. Valve: 20-100×4-6 μ, Carnate dots: 8-11 in 10 μ, Striae: 36 in 10μ. Ecology: indifferent taxon

★144. *Nitzschia gandersheimiensis* Krasske (Pl. 8, Fig. 144)
Hustedt, F., 1930, p. 416, F. 804. Valve: 60-70×4 μ, Carnate dots: 8-9 in 10 μ. Ecology: Tolerant taxon

145. *Nitzschia obtusa* W. Smith (Pl. 8, Fig. 145)
Hustedt, F., 1930, p. 422, F. 817c. Valve: 120-350×6-13 μ, Carnate dots: 5-9 in 10 μ.

146. *Nitzschia palea* (Kütz.) W. Sm. (Pl. 8, Fig. 146)
Watanabe, T., *et al.* 1982, p. 54, pl. 9, F. 123. Valve: 20-65×2.5-5 μ, Carnate dots: 10-15 in 10 μ, Striae: 35-40 in 10 μ. Ecology: Tolerant taxon

★147. *Nitzschia parvula* Lovis (Pl. 8, Fig. 147)
Watanabe, T., *et al.* 1982, p. 54, pl. 9, F. 124. Valve: 20-40×3-6μ, Carnate dots: 5-8 in 10μ.

148. *Nitzschia recta* Hantzsch (Pl. 8, Fig. 148)
Hustedt, F., 1930, p. 411, F. 785. Valve: 60-130×5-7 μ, Carnate dots: 5-9 in 10 μ.

★149. *Nitzschia sinuata* (W. Smith) Grun. var. *tabellaria* Grun. (Pl. 9, Fig. 149)
Hustedt, F., 1930, p. 409, F. 782. Valve: 15-30×5-8 μ, Striae: 5-8 in 10 μ.

Surirellaceae

Surirelloideae

150. *Surirella angustata* Kütz. (Pl. 9, Fig. 150)
Watanabe, T., *et al.* 1982, p. 51, pl. 5, F. 58. Valve: 18-70×6-15 μ, Costae: 6-7.5 in 10 μ. Ecology: Tolerant taxon

★151. *Surella biwaensis* Skv. (Pl. 9, Fig. 151)
Watanabe, T., 1977, p. 40, pl. 12, F. 172. Valve: 87-200×13-18 μ, Costae: 5-7 in 10 μ.

★152. *Surirella lapponica* A. Cleve var. *kemensis* A. Cl. (Pl. 9, Fig. 152)

Cleve-Euler, 1952, p. 119, F. 1558e-g. Valve: 50-90×8-12 μ, Striae: 55-70 in 10 μ.

153\. *Surirella linearis* var. *constricta* (Ehr.) Grun. (Pl. 9, Fig. 153)
Hustedt, F., 1930, p. 434, F. 839. Valve: 20-125×9-25 μ, Costae: 20-30 in 10 μ.

154\. *Surirella ovalis* Brebisson (Pl. 9, Fig. 154)
Hustedt, F., 1930, p. 441, F. 860-861. Valve: 20-100×10-40 μ, Costae: 1.5-4.5 in 10 μ.

155\. *Surirella robsta* Ehr. (Pl. 9, Fig. 155)
Hustedt, F., 1930, p. 437, F. 850. Valve: 150-400×50-150 μ, Striae: 7-15 in 10 μ.

★156. *Surirella tenuissima* Hust. (Pl. 9, Fig. 156)
Watanabe, T., *et al.* 1982, p. 55, pl. 9, Fig. 131. Valve: 17-38×6-11 μ, Costae: 4-7 in 10 μ.

157\. *Surirella ovata* Kütz. (Pl. 9, Fig. 157)
Watanabe, T., *et al.* 1982, p. 51, pl. 5, F. 59. Valve: 15-79×8-23 μ, Striae: 4-7 in 10 μ.
Ecology: Indifferent taxon

摘 要

慶尙北道에 位置하고 있는 慶州近郊의 珪藻를 1981年 6月부터 1982年 5月까지의 一年間과 1983年 8月과 9月에 採集하여 調査된 珪藻의 flora와 그 生態에 對하여 研究하였다.

同定된 珪藻는 2目, 5亞目, 8科, 12亞科, 26屬, 97種, 54變種, 6品種이고 總 157 taxa 였다.

이들中에는 32種, 33變種, 4品種인 總 69 taxa의 韓國未報告 taxa가 包含되어 있고 이들 taxa를 有機汚濁에 對한 適應性에 依해서 區別하면 tolerant taxa 8, indifferent taxa 34, intolerant taxa 115 였다.

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EXPLANATION OF PLATES

Plate 1

1. *Melosira granulata* 2. *M. granulata* var. *angustissima* 3. *M. Roeaeana* 4. *M. varians* 5. *Cyclotella comata* 6. *C. glomerata* 7. *C. Meneghiniana* 8. *C. stelligera* 9. *Coscinodiscus lacustris* 10. *Tabellaria fenestrata* 11. *T. flocculosa* 12. *Fragilaria capucina* var. *lanceolata* 13. *F. construens* 14. *F. construens* var. *binodis* 15. *F. intermedia* 16. *F. vaucheriae* 17. *Synedra acus* var. *radians* 18. *S. pulchella* 19. *S. rumpens* 20. *S. rumpens* var. *fragilarioides* 21. *S. rumpens* var. *Meneghiniana* 22. *S. socia*

Plate 2

23. *S. ulna* var. *ulna* 24. *S. ulna* var. *danica* 25. *Eunotia curvata* var. *curvarta* 26. *E. exigua* 27. *E. faba* 28. *E. flexuosa* 29. *E. major* var. *major* 30. *E. monodon* var. *undulata* 31. *Eunotia pectinalis* var. *pectinalis* 32. *E. pectinalis* var. *minor* 33. *E. polydentula* var. *perpusilla* 34. *E. tenella* 35. *E. valida* 36. *Cocconeis placontula* var. *euglypta* 37. *C. placentula* var. *lineata*

Plate 3

38. *Achnanthes delicicatula* 39. *A. hungaria* 40. *A. lanceolata* var. *lanceolata* 41. *A. lanceolata* var. *dubida* 42. *A. lanceolata* var. elliptica 43. *A. lanccolata* var. *rostrata* 44. *A. linearis* 45. *Frusteria vulgaris* 46. *Gyrosigma obtusatum* var. *obtusatum* 47. *Caloneis bacillum* 48. *C. silicula* 49. *C. silicula* var. *trucatula* 50. *Neidium affine* var. *amphirhynchus* 51. *N. bisulcatum* 52. *N. gracile* f. *aequalis* 53. *N. iridis* f. *vernalis* 54. *Diploneis elliptica* var. *elliptica* 55. *D. ovalis* 56. *D. puella* 57. *Stauroneis acuta* 58. *S. anceps*

Plate 4

59. *Stauroneis phoenicenteron* var. *phoenicenteron* 60. *S. phoenicenteron* var. *brunii* 61. *S. phoenicenteron* f. *gracilis* 63. *Navicula anglica* var. *subsalsa* 64. *N. bacillum* 65. *N. cincta* 66. *N. confervaceae* 67. *N. cryptocephals* var. *cryptocephala* 68. *N. cryptocephala* var. *veneta* 69. *N. cuspidata*

Plate 5

70. *N. dispera* 71. *dicephala* var. *Neglecta* 72. *N. frugalis* 73. *N. gottlandica* 74. *N. gregaria* 75. *N. heufleri* var. *leptocephala* 76. *N. hungarica* var. *linearis* 77. *N. menisculus* var. *upsaliensis* 78. *N. mutica* 79. *N. peregrina* var. *peregrina* 80. *N. pupula* var. *pupula* 81. *N. pupula* var. *capitata* 82. *N. pupula* f. *rectangularis* 83. *N. radiosa* 84. *N. symmetrica* var. *symmetrica* 85. *N. tripunctata* var. *schizomoides* 86. *N. viridula* var. *avenancea* 87. *N. viridula* var. *rostllata* 88. *Pinnularia abaujensis* var. *subundulata* 89. *P. acrosphaeria* var. *acrosphaeria* 90. *borelis* var. *rectangularis* 91. *P. braunii* var. *amphicephala* 92. *P. horrida* 93. *P. gibba* var. *parva*

Plate 6

94. *P. gibba* f. *subundulata* 95. *P. imperfacta* 96. *P. major* 97. *P. mesolepta* 98. *P. microstauron* 99. *P. microstauron* var. *brevissonii* 100. *P. molaris* 101. *Amphora bullatoides* var. *bullatoides* 102. *A. libyca* var. *baltica* 103. *A. ovalis* var. *affinis* 104. *A. ovalis* var. *libyca* 105. *A. ovalis* var. *pediculus* 106. *A. veneta* var. *veneta* 107. *Cymbella affinis* 108. *C. aspera* var. *aspera*

Plate 7

109. *C. leptoceros* 110. *C. minuta* var. *minuta* 111. *C. minuta* var. *silesica* 112. *C. naviculiformis* 113. *C. Reinhardtii* 114. *C. sinuata* 115. *C. tumida* 116. *C. turgida* 117. *C. turgidula* var. *nipponica* 118. *Gomphonema acuminatum* var. *acuminatum* 119. *G. affine* var. *affine* 120. *G. angustatum* 121. *G. angustatum* var. *citera* 122. *G. augur* var. *augur* 123. *G. Clevei* var. *Clevei* 124. *G. Clevei* var. *edilis* 125. *G. intricatum* var. *intricatum* 126. *G. lanceolatum* var. *insignis* 127. *G. longiceps* var. *subclavate* 128. *G. pervulum* 129. *G. sphaerophorum* var. *sphaerophorum* 130. *G. tetrastigmatum* 131. *G. truncatum* var. *truncatu*

Plate 8

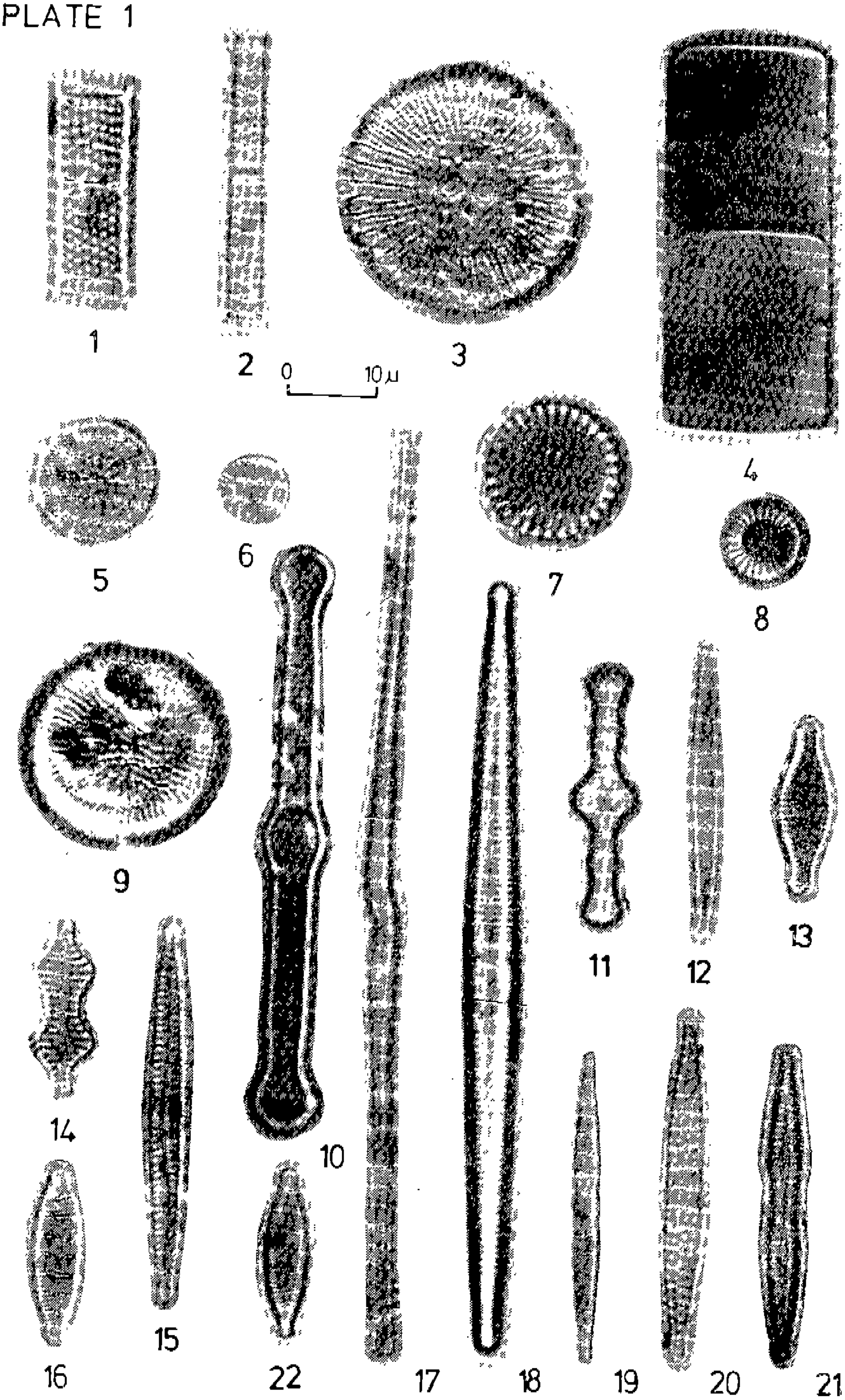
132. *Epithemia adnata* var. *minor* 133. *E. zebra* var. *porcellus* 134. *Rhopalodia gibba* var. *gibba* 135. *R. gibberula* var. *vanheurckii* 136. *R. gibba* var. *ventricosa* 137. *Hantzschia amphia* 138. *H. linearis* 139. *Bacillaria paradoxa* 140. *B. paradoxa* var. *tumidula* 141. *Nitzchia amphibia* 142. *N. denticula* 143. *N. filiformis* 144. *N. gandersheimiensis* 145. *N. obtusa* 146. *N. palea* 147. *N. parvula*

Plate 9

148. *N. recta* 149. *N. sinuata* var. *tabellaria* 150. *Surirella angustata* 151. *Surirella biwaensis* 152. *S. lapponica* var. *kemensis* 153. *S. linearis* var. *constricta* 154. *S. ovalis* 155. *S. robsta* 156. *S. tenuissima* 157. *S. ovata*

*The final magnification of each picture is about 800×.

PLATE 1



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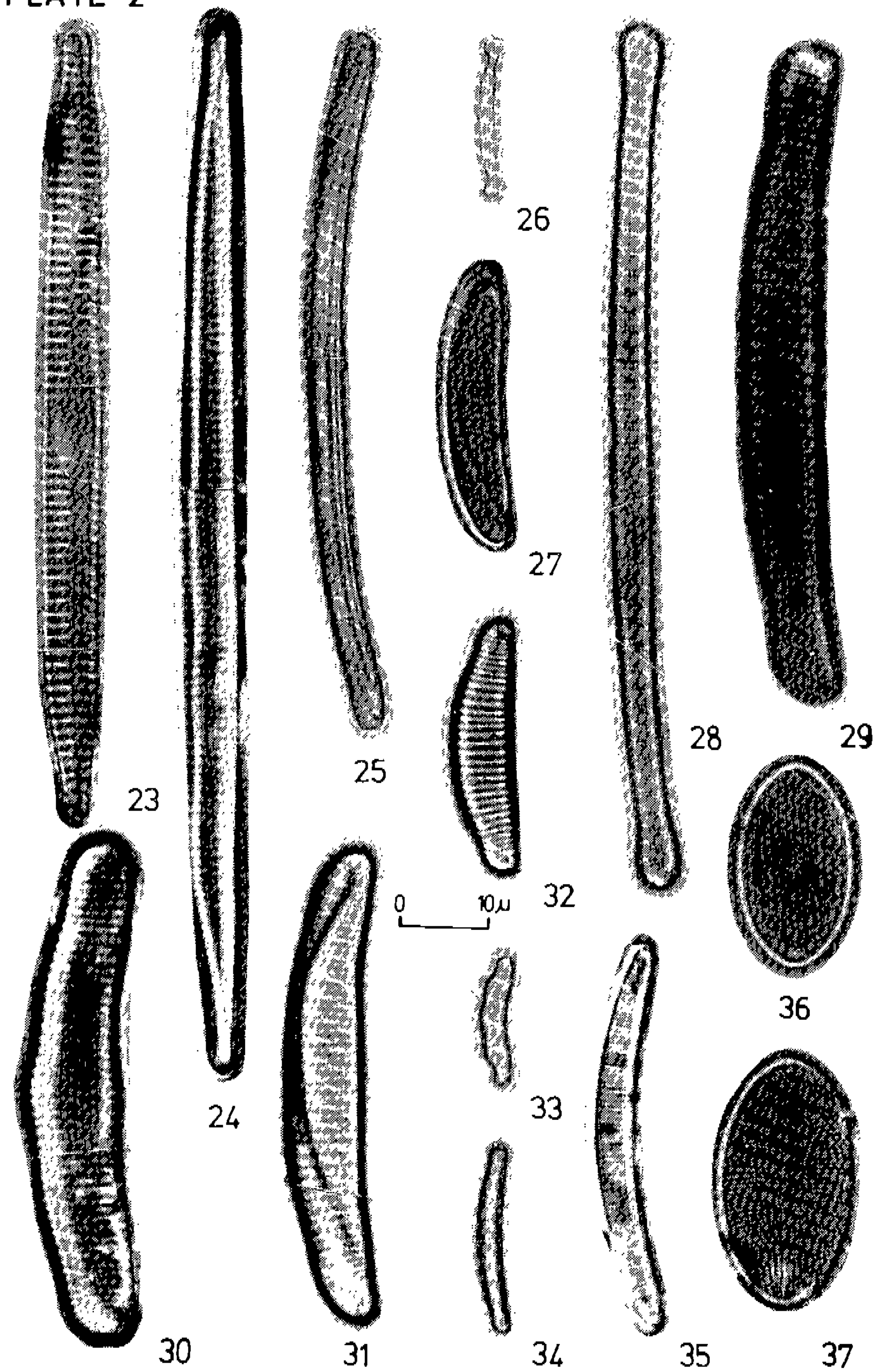

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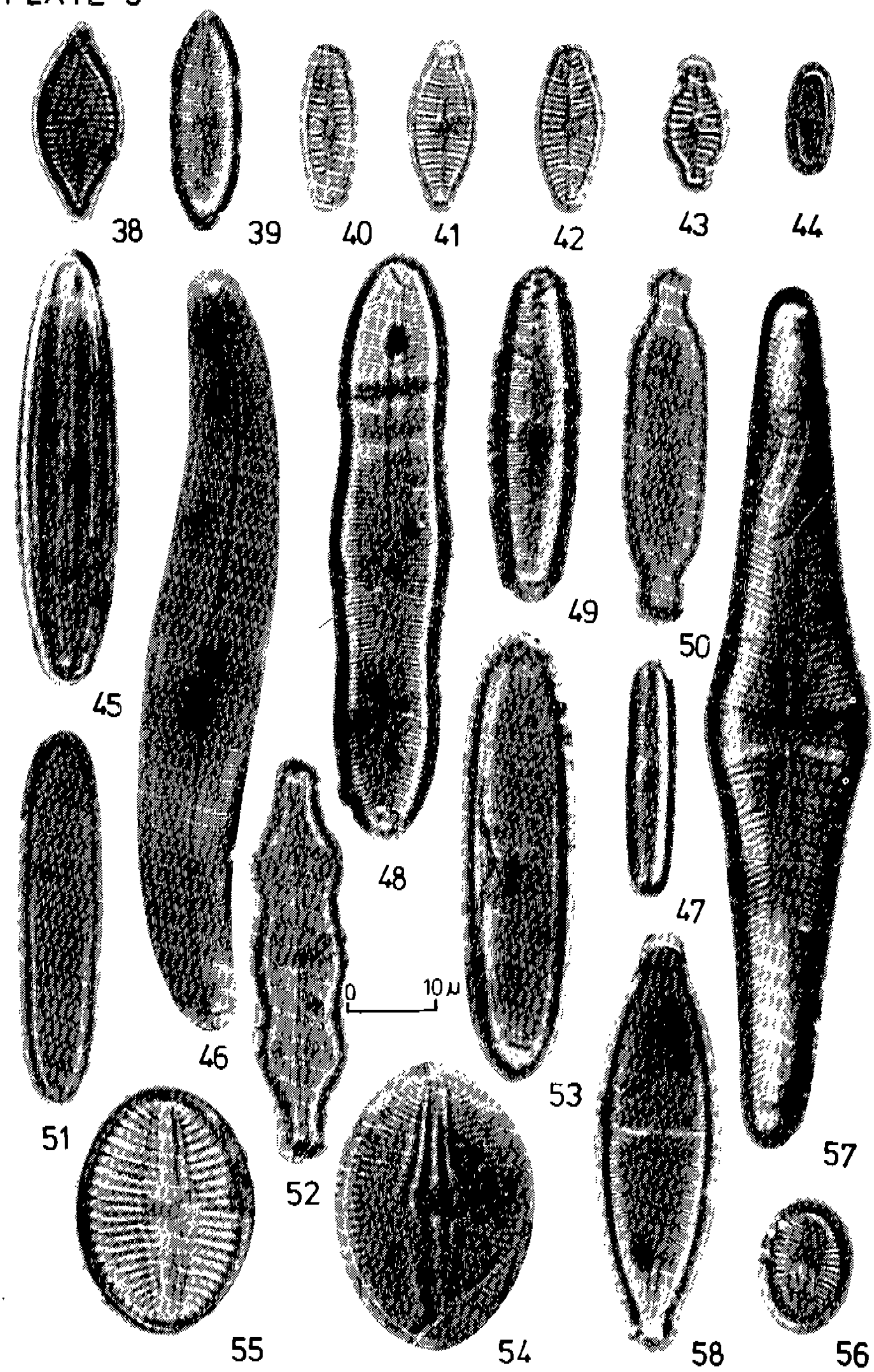

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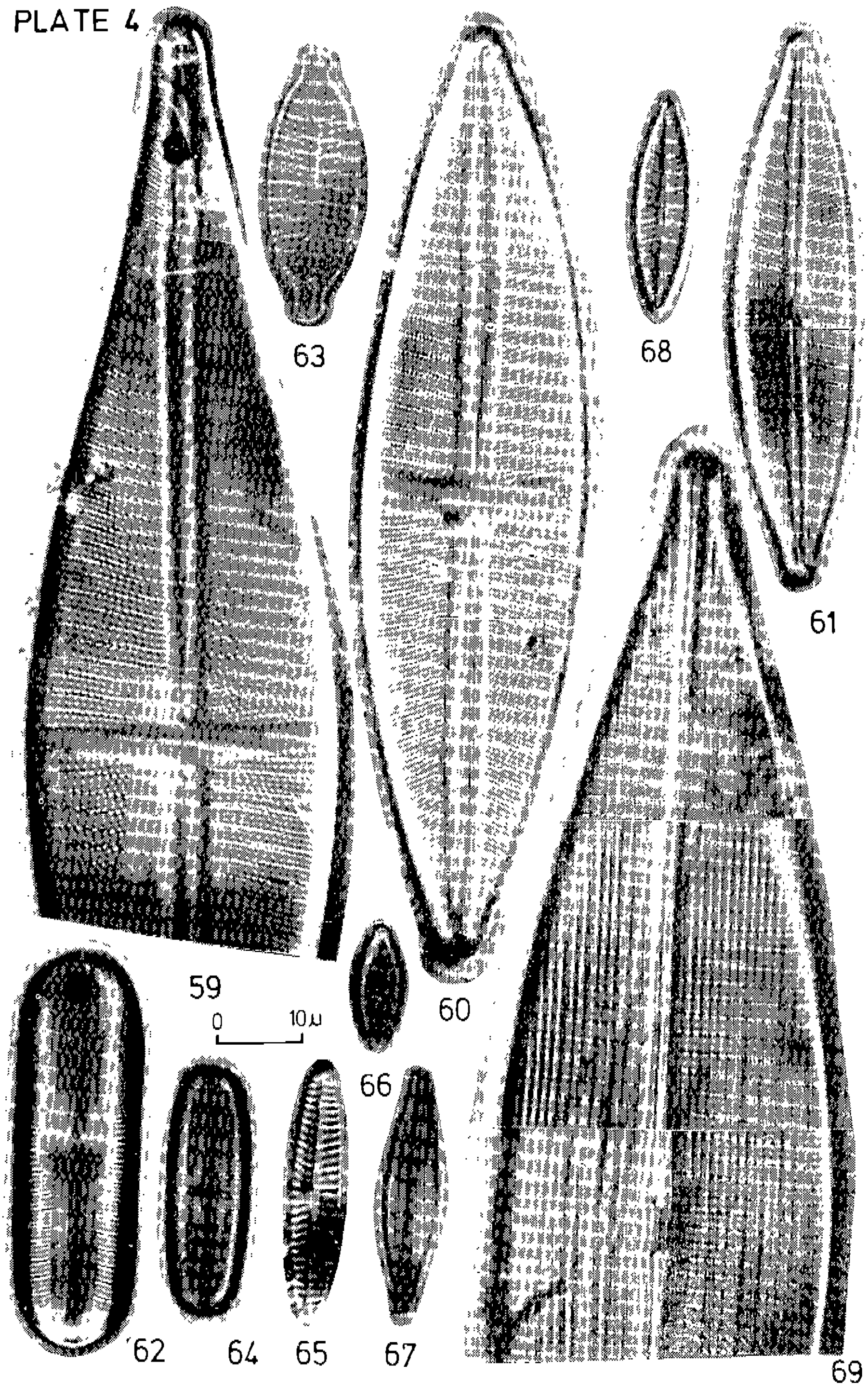

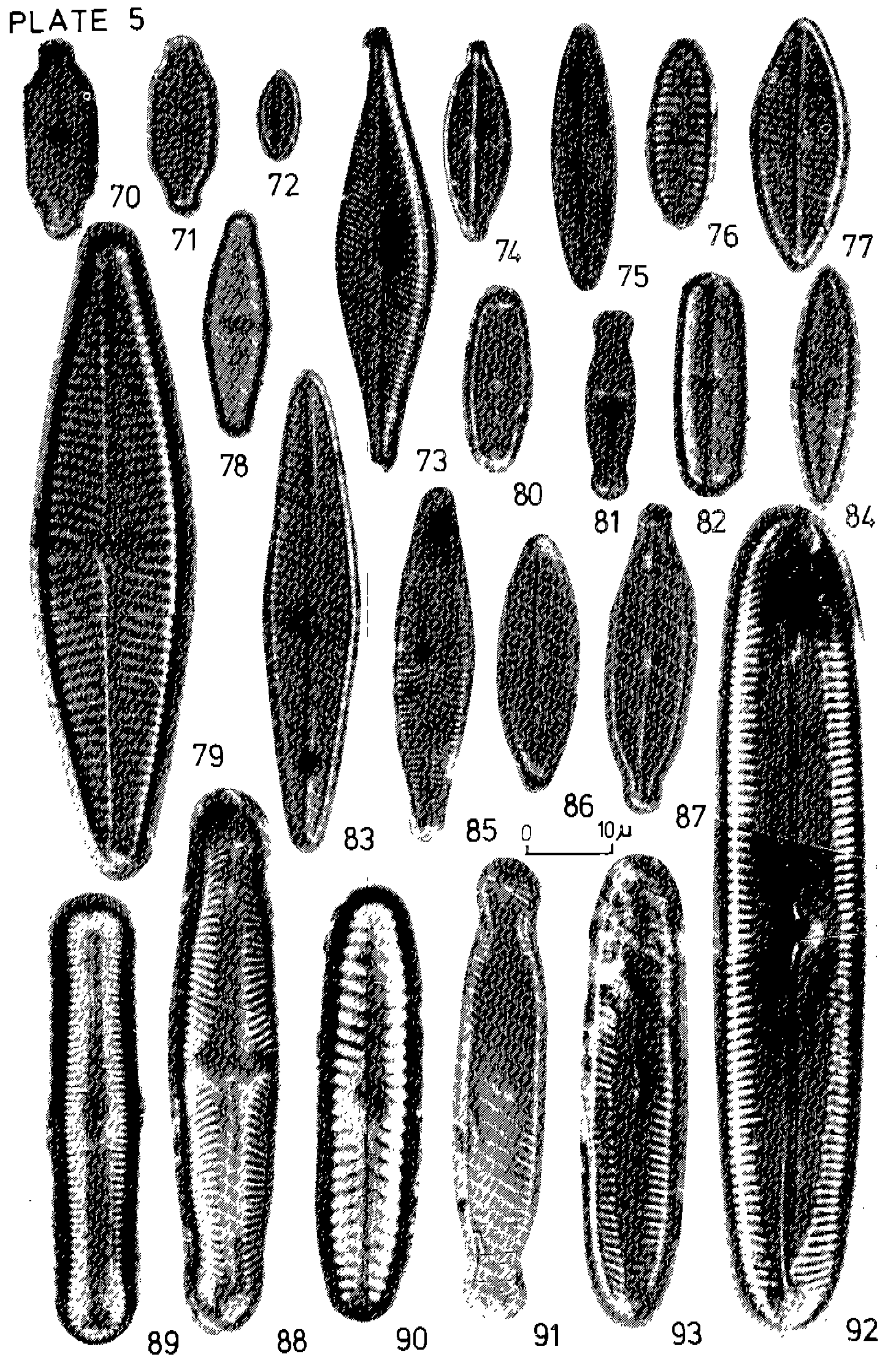
PLATE 5
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PLATE 6

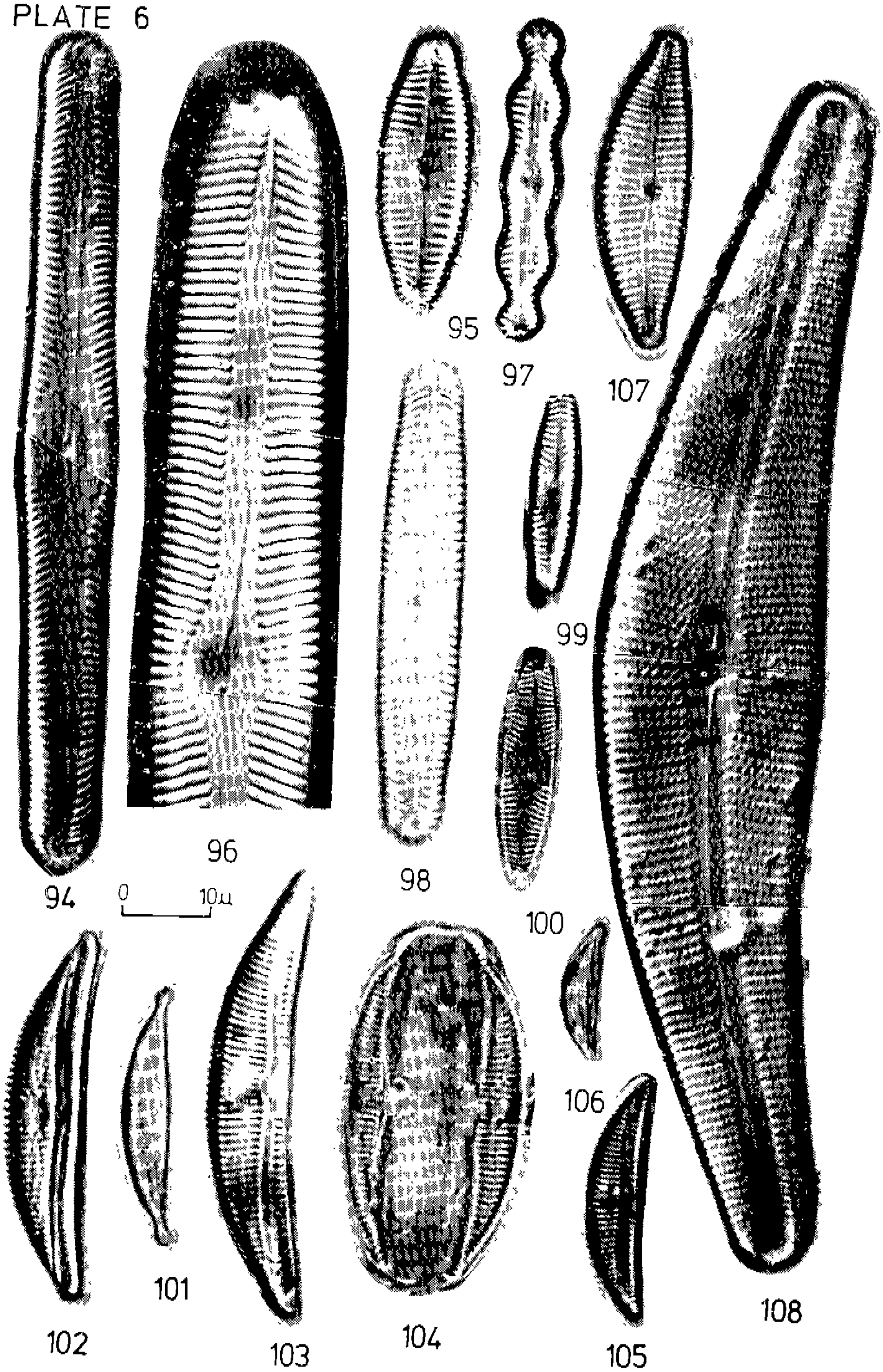

PLATE 7

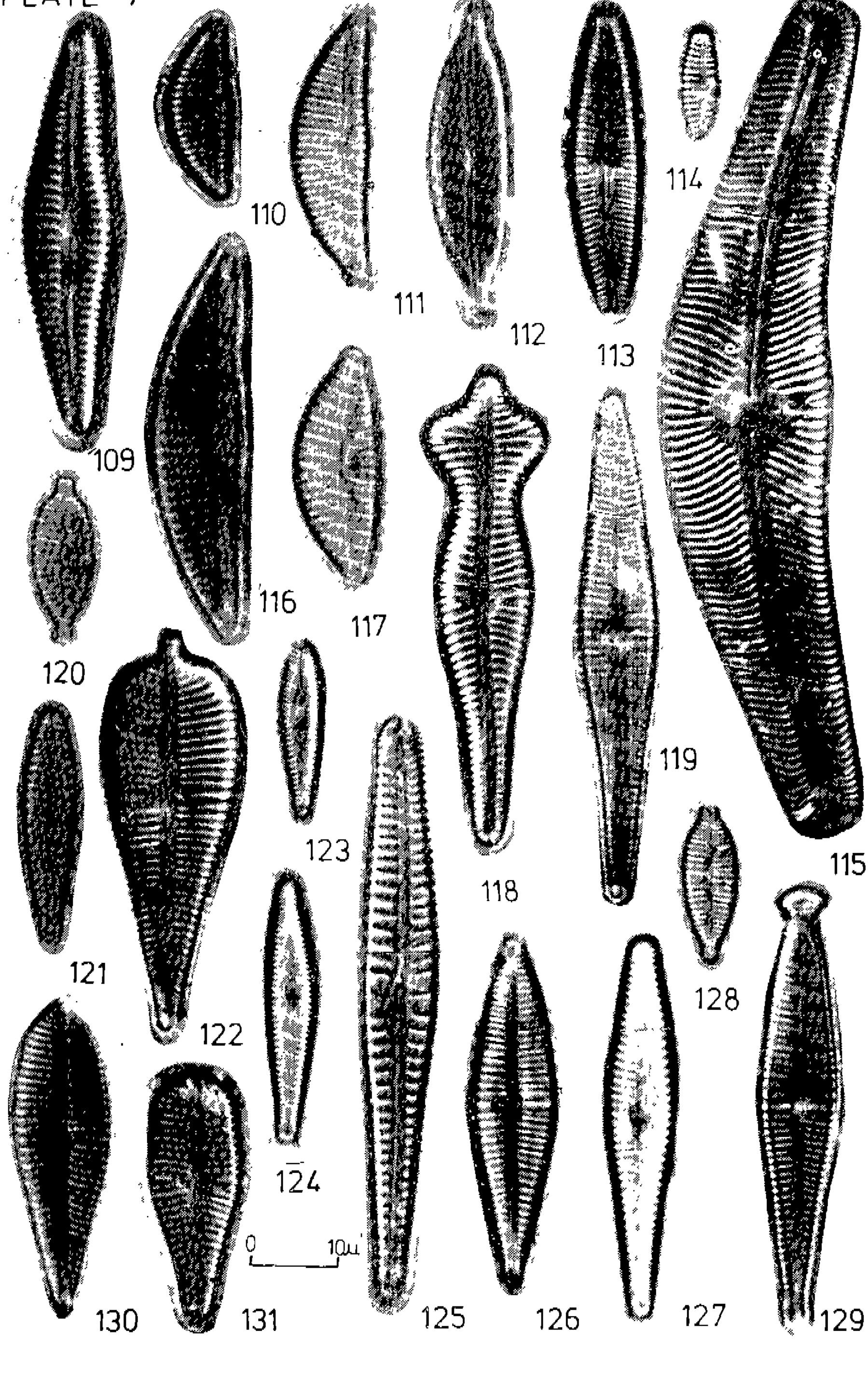
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PLATE 8

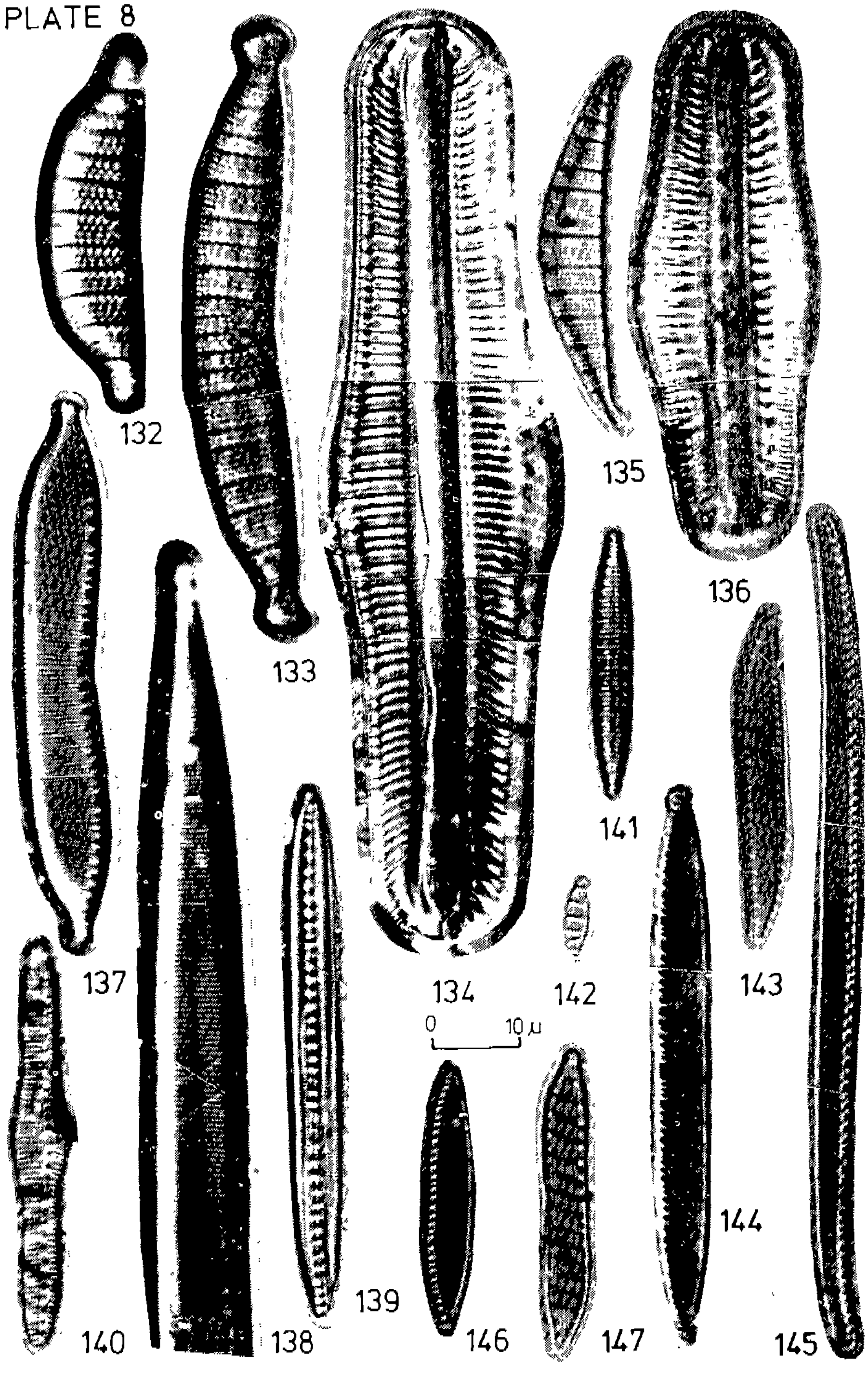
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PLATE 9