Contr. Biol. Lab. Kyoto Univ. 23: 30. Jan. 1971

Freshwater Algae of the Northwestern Himalayas

by

Minoru HIRANO

The present contribution is based on collections made by the Japanese Scientific Expedition to Nepal in 1958. This expedition was conducted by Prof. Jiro KAWAKITA of Osaka City University, with the help of the Fauna and Flora Research Society of Kyoto University and the Japanese Society of Ethnology. The purpose of this expedition was to survey scientifically the Torbo district of northwestern Nepal which is surrounded by the high mountains of Kanjiroba Himal and Hanga Himal on the frontier of Nepal and Tibet. The climate is generally dry in the district that was surveyed. A subsidiary purpose of the trip was to collect freshwater algae. Collections were made on our routes both into and out of the Torbo district, that is, along the valleys of Kali Gandaki and the Mugu Karnati river systems. Other collections were taken on mountain slopes near the valleys. In dry districts there are not very many stagnant ponds and pools and the collections were made chiefly at flowing waters. But stagnant moor-bogs are sometimes found on the plateau especially on gentle slopes sited at the bases of high peaks covered by glaciers. Such moor-bog areas are generally rich in desmids and in some of the diatoms. But the collections for this paper were not brought back from such habitats, As mentioned below, the places where we found desmid-species are somewhat stagnant. These places are semi-permanent and are reported to be wet habitats even in dry season. The content of our collections suggests that knowledge of the desmid-flora of the high mountain area would be promtly increased even for dry-climate areas of the Himalayas, if collections were made at more stable places such as moor-bogs, which are supplied by spring water or melting water from glaciers. But the alga-flora at our collecting places was rich in species of rheophilous diatoms such as *Cymbella* and *Gomphonema*, in spite of the fact that they were taken from ponds and stagnant waters. The following is a list of the places where we collected the materials reported in the present paper:

No. 1. The small stream of Phijer, which lies at the elevation of 3730 m above sea level and is situated at the inner part of Torbo district. This position is on the east slope of Kanjiroba Himal. The water temperature was 7°C when the sample was taken, on 15 October, 1958.

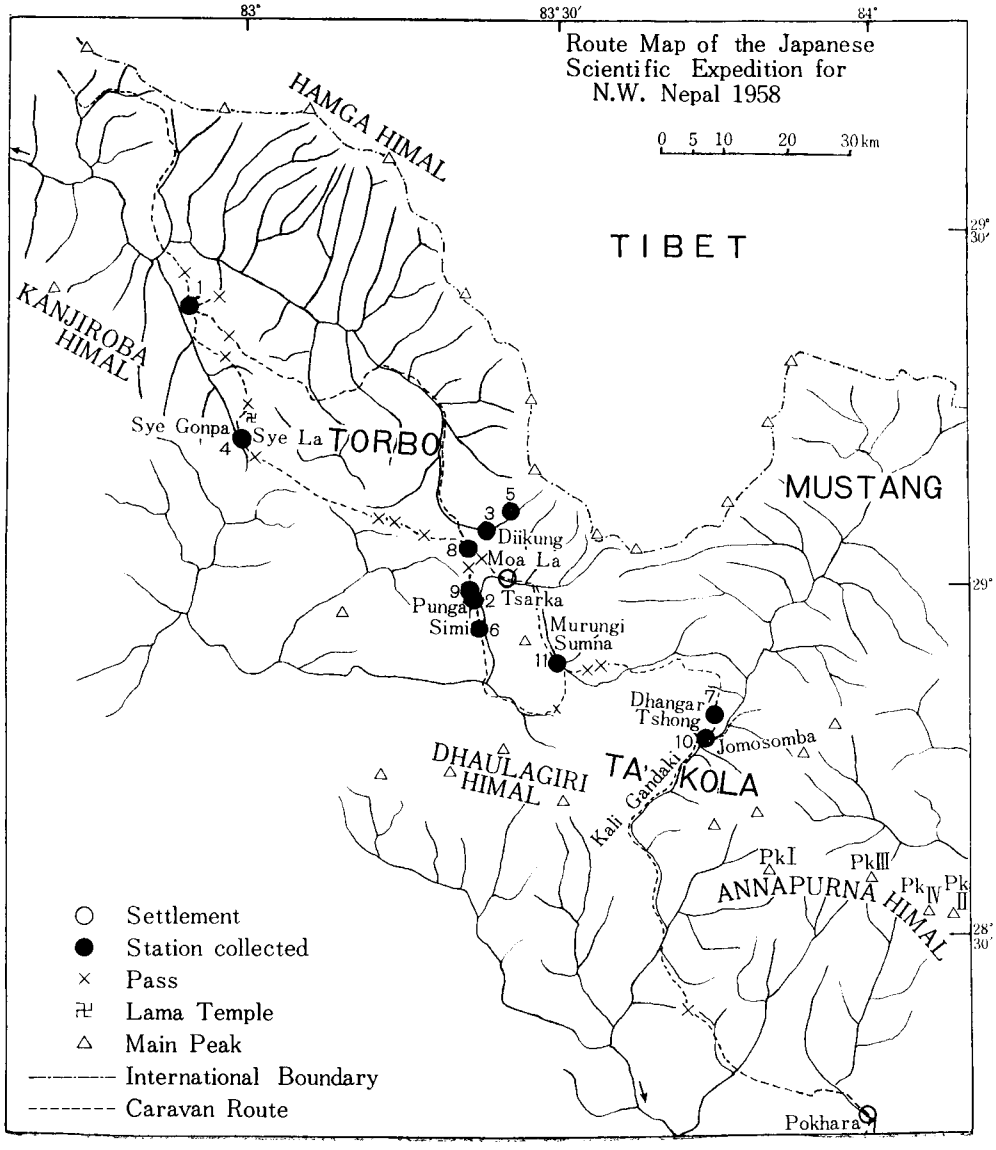
No. 2. A stagnant pool made by the overflow of stream-water, situated to the

north of Punga. Its elevation is 3700 m above the sea. Water temperature was 17°C. The pool is situated on the upper reaches of the river Parbung Khola.

No. 3. Diikung lying at about 4600 m above sea level. Collected on 10 August, 1958.

No. 4. A stream between Sye Gonpa and Sye-La, situated at about 4350 m above the sea. This position lies on the east slope of Kanjiroba Himal. Water temperature was about 5°C. Collected on 20 October, 1958.

No. 5. A stagnant pool of Diikung, sited near the side of river and situated about



4600 m above the sea. Water temperature was 7°C. Collected on 16 August, 1958. The surrounding area, called Chordang, means "stock farm" in the Tibetan language.

No. 6. A slow running stream near Simi, on the way from Therang to Tsarka. Its altitude is about 4000 m above the sea.

No. 7. A marshy place, sited at the several hundred meters north of Dhangar. Its altitude is about 3300 m above the sea. Water temperature was 15°C. Collected on 25 July, 1958.

No. 8. Running water, a little west of Moa-La, south of Diikung district.

No. 9. A stagnant pool, situated north of Punga. Its altitude is about 3850 m sea level. Collected on 4 September, 1958.

No. 10. A stagnant pool near Jomosomba of Takola district. Its elevation is about 2720 m above the sea. Water temperature was 19.5°C, and air temperature was 23°C. Collected on 23 July, 1958.

No. 11. A stagnant pool at Mulungi Sumna. Water temperature was 8°C. Collected at August, 1958.

CYANOPHYTA

Oscillatoriaceae

Oscillatoria agardhi GOM. in Monogr. Oscill. p. 205, 1892; GEITLER, Süssw. -fl. 12, p. 369, f. 455, 456, 1925; HUBER-PESTALOZZI, Binnengew. 16:1, p. 240, f. 190, 1938; HIRANO, Contr. Biol. Lab. Kyoto Univ. 22, p. 8, 1969.

Trichomes are 4.4 μ in diameter and not constricted at the joint, gradually attenuated to the apex and curved in one direction; cells shorter, 1.5-2/3 times as long as broad, cell content not granulated.

Hab. 5. Distr. Previously known from Himalaya

Oscillatoria amoena (KÜTZ.) GOM. in Monogr. Oscill. p. 255, pl. 7, f. 9, 1892; GEITLER, l. c. p. 370, f. 450, 1925; HIRANO, l. c. p. 9, 1969.

Trichomes not constricted at the cross wall, 4.4-4.8 μ in diameter, gradually attenuated to the apex and curved in one direction. However in some specimens, apices spirally twisted somewhat capitated; cells with a pair of small granules in both sides of the cross wall. Pl. 1, fig. 4, 5.

Hab. 5, 9, 11. Distr. Previously known from Himalaya.

Oscillatoria anguina (BORY) GOM. in l. c. p. 214, pl. 6, f. 16, 1892; GEITLER, Krypt. Fl. 14, p. 948, f. 599b, 1932; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 173, pl. 1, f. 15, 1964.

Trichomes 7 μ in diameter. Pl. 1, fig. 6.

Hab. 11. Distr. India, Burma, Afghanistan, Europe, Japan, and N. America.

Oscillatoria angustissima W. & G. S. WEST in GEITLER, l. c. p. 364, 1925; DESIKACHARY, Cyanoph. p. 227, 1959; HIRANO, l. c. 22, p. 9, 1969.

Trichomes 0.4 μ in diameter, not constricted at the cross wall.

Hab. 2. Distr. Previously known from Himalaya.

Oscillatoria proboscidea GOM. in l. c. p. 209, pl. 6, f. 10, 11, 1892; GEITLER, l. c. p. 948, f. 598b, 1932; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 8, p. 18, pl. 1, f. 4, 1966.

Trichomes broad and not constricted at the cross wall, 17-17.5 μ in diameter, attenuated at the apex; cells very short. Pl. 1, fig. 9.

Hab. 7. Distr. Burma, Yunnan, Ceylon, Afghanistan, Siberia, Japan, Europe, and N. America.

Phormidium ambiguum GOM. in l. c. p. 178, pl. 5, f. 10, 1892; GEITLER, l. c. p. 1015, f. 647e, 1932; FRÉMY, Mém. Soc. Nat. Sci. Natur. Math. 41, p. 91, pl. 24, f. 1, 1934; HIRANO, l. c. 3, p. 175, 1964.

Trichomes 5.7 μ in diameter. Pl. 1, fig. 7.

Hab. 7. Distr. Burma, Japan, Afghanistan, Europe, and N. America

Phormidium autumnale (AG.) GOM. in l. c. p. 187, pl. 5, f. 23, 24, 1892; GEITLER, l. c. p. 388, f. 494, 1925; HIRANO, Fauna Flora Nepal Himalaya p. 11, pl. 1, f. 19, 1955; l. c. p. 10, 1969.

Trichomes 4.4 μ in diameter.

Hab. 2, 6. Distr. Previously known from Himalaya. Cosmopolitan.

Phormidium Boryanum KÜTZ. in GEITLER, l. c. p. 382, 1925; HIRANO, l. c. 22, p. 10, 1969.

Trichomes 3.5 μ in diameter.

Hab. 6. Distr. Previously known from Himalaya.

CHLOROPHYTA

Desmidiaceae

Closterium acerosum (SCHRANK) EHRENB. in WEST, Monogr. Brit. Desm. 1, p. 146, pl. 18, f. 2-5, 1904; KRIEGER, Krypt. Fl. 13, Abt. 1, p. 314, pl. 23, f. 11, 12, 1935; HIRANO, l. c. 22, p. 28, 1969.

Cells 360-372 μ long, 39-40 μ broad.

Hab. 1. Distr. Cosmopolitan, previously known from Himalaya.

Closterium idiosporum W. & G. S. WEST in l. c. 1, p. 180, pl. 23, f. 20, 21, 1904; KRIEGER, l. c. p. 271, pl. 15, f. 1, 2, 1935; HIRANO, l. c. p. 18, pl. 3, f. 6, 1955.

Cells 255-260 μ long, 15-15.5 μ broad.

Hab. 7. Distr. Previously known from Himalaya.

Closterium Leibleinii KÜTZ. in WEST, l. c, 1, p. 141, pl. 16, f. 9-14, 1904; KRIEGER, l. c. p. 283, pl. 17, f. 5-7, 1935; HIRANO, l. c. p. 18, pl. 3, f. 11, 1955; l. c. 22, p. 28, 1969,

Hab. 2. Distr. Previously known from Himalaya. Cosmopolitan.

Cosmarium Botrytis MENEGH. in WEST, l. c. 4, p. 1, pl. 96, f. 1, 2, 5-15, 1911; FÖRSTER, Ergebn. Forsch.-Unters. Nepal Himal. p. 38, pl. 3, f. 36, 1965; HIRANO, l. c. 22, p. 29, 1969.

Cells 84-86 μ long, 60-61.6 μ broad, and isthmus 19-22 μ broad. Pl. 1, fig. 14.

Hab. 5, 10. Distr. Previously known from Himalaya. Cosmopolitan.

var. ***subtumidum*** WITTR. in WEST, Monogr. 4, p. 4, pl. 97, f. 1, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. 5, p. 182, pl. 27, f. 25, 1957.

Cells 62-66 μ long, 51-52.8 μ broad, and isthmus 16-17.6 μ broad. Pl. 1, fig. 3.

Hab. 10. Distr. Japan, Siberia, Europe, Greenland, and Canada.

Cosmarium cucurbitinum (BRÉB.) LÜTKEM. forma MINOR (WEST) LÜTKEM. in HIRANO, Contr. Biol. Lab. Kyoto Univ. 2, p. 80, pl. 16, f. 8, 1956.

Cells 55-57 μ long, 26.4-27 μ broad, and isthmus 22 μ broad.

Hab. 5. Distr. Thailand, Europe, U.S.A., and Brazil.

Cosmarium curtum (BRÉB.) RALFS in Brit. Desm. p. 109, pl. 32, f. 9, 1848; INSAM & KRIEGER, Hedw. 76, p. 99, pl. 1, f. 25, 26, 1936; MESSIKOMMER, Beitr. geobot. Landesaufn. Schw. 24, p. 142, pl. 4, f. 7, 1942; KRIEGER & GERLOFF, Gatt. Cosm. p. 350, pl. 59, f. 1, 1969.

Cells 41-43 μ long, 19.8-20 μ broad, and isthmus 18.5-19 μ broad. Pl. 1, fig. 2.

Hab. 5. Distr. Cosmopolitan.

Cosmarium formosulum HOFF. in WEST, Monogr. Brit. Desm. 3, p. 240, pl. 88, f. 1-3, 1908; CARTER, Journ. Linn. Soc. Bot. 50, p. 163, f. 5, 1935; HIRANO, l. c. 22, p. 30, pl. 3, f. 10, 14, 1969.

Cells 44-46 μ long, 34.5-35 μ broad, and isthmus 15-15.4 μ broad. Pl. 1, fig. 12.

Hab. 5. Distr. Nepal, China, Japan, Manchuria, Europe, and U.S.A.

Cosmarium granatum BRÉB. in WEST, Monogr. Brit. Desm. 2, p. 196, pl. 63, f. 1-3, 1905; HIRANO, Contr. Biol. Lab. Kyoto Univ. 4, p. 129, pl. 20, f. 25, 1957.

Cells 34-35 μ long, 23-23.5 μ broad, and isthmus 6.5-7 μ broad.

Hab. 7. Distr. Cosmopolitan.

var. ***subgranatum*** NORDST. in WEST, l. c. 2, p. 188, pl. 63, f. 5-8, 1905; HIRANO,

l. c. 4, p. 130, pl. 20, f. 26, 1957.

Cells 28-29 μ long, 19-19.7 μ broad, and isthmus 6-6.5 μ broad.

Hab. 7. Distr. S. China, Manchuria, Europe, N. & S. America, and New Zealand.

Cosmarium ochthodes NORDST. in WEST, l. c. 4, p. 10, pl. 98, f. 1-3, 1911; KRIEGER, Ber. dtsch. Bot. Ges. 56, p. 62, pl. 1, f. 30, 1938.

Cells 86-101 μ long, 64-70.5 μ broad, and isthmus 22-25 μ broad. Pl. 1, fig. 13.

Hab. 11. Distr. S. China, Europe, Greenland, Spitzbergen, Novaya Semliae, N. America and Kuriles.

Cosmarium petsamoense CEDERGREUTZ in Mem. Soc. Fauna Flora Fenn. 7, p. 244, f. 12, 13, 1932; GRÖNBLAD, l. c. 10, p. 269, f. 4: 15, 16, 1934.

Cells 55-56 μ long, 35-35.4 μ broad, and isthmus 15.4-15.7 μ broad. Specimens slightly larger than those of the original description by CEDERGREUTZ. The number of lateral crenation in Himalayan specimens is 6, while in Swedish specimens lateral margin has 5 crenae in each side. Cell walls are smooth. Pl. 1, fig. 1.

Hab. 11. Distr. North Europe.

Cosmarium solidum NORDST. in WEST, Monogr. Brit. Desm. 3, p. 170, pl. 80, f. 23, 1908.

Cells 28.6-29 μ long, 22 μ broad, and isthmus 8.8-9 μ broad. Pl. 1, fig. 10.

Hab. 11. Distr. Europe, Greenland, Spitzbergen, and Novaya Semlya.

Cosmarium subcrenatum HANTZSCH in WEST, l. c. 3, p. 228, pl. 86, f. 10-14, 1908; HIRANO, Fauna Flora Nepal Himalaya p. 26, 1955; Contr. Biol. Lab. Kyoto Univ. 22, p. 36, pl. 3, f. 13, 1969.

Cells 35-37.4 μ long, 26-27.7 μ broad, and isthmus 12.5-13.2 μ broad.

Hab. 2. Distr. Cosmopolitan. Previously known from Nepal.

Cosmarium subexcavatum W. & G. S. WEST in l. c. 3, p. 148, pl. 77, f. 13, 1908.

Cells with a broad isthmus and acuminate sinus at their extremities. Semicells broad and elliptic. Cell wall covered with small rounded granules in the face of semicell; granules disposed in somewhat irregular longitudinal and transverse series. Cells 29.5-30 μ long, 22 μ broad, and isthmus 8.8-9 μ broad. Present specimens are somewhat different from those of *C. Wittrockii*, not having rounded extremities of the sinus.

Hab. 11. Distr. Europe.

Cosmarium tumens NORDST. in WEST, Monogr. 3, p. 264, pl. 90, f. 19, 20, 1908; INSAM & KRIEGER, Hedw. 76, p. 110, pl. 4, f. 34, 1936.

Cells moderately constricted at the middle; sinus acutely open but in some specimens closed at the extremities; semicells truncate-pyramidate, lateral margin slightly

convex and convergent toward the apex which is truncate and faintly 4-crenate, lateral margin 7-crenate including the apical angle, crenation larger and distinct at the upper part but gradually smaller toward the lower part and indistinct. Cell wall are furnished with radial series of granules, granules disposed within each peripheral crenation in 4 series; but the innermost series somewhat irregular in radiation. Centre of semicell smooth. Cells 48-50 μ long, 35-35.7 μ broad, and isthmus 22-22.5 μ broad. Pl. 1, fig. 11.

Hab. 2. Distr. Europe.

var. ***rotundatum*** HIRANO, var. nov.

Cellulae circiter 1.5 longiores quam latiores, modice constrictae, sinu acuto et aperto; semicellulae ovato-circulares, apice levissime recto; membrana granulata, granulis in serie radialibus quaternis intra totum marginem sed glabris in centrum, granulis in seriebus verticalibus trans basim semicellularum ordinatis; a vertice visae cellulae late ellipticae cum polis leviter mamillatis. Pl. 1, fig. 8.

Hab. 1.

Euastrum dubium NÄG. in WEST, Monogr. 2, p. 43, pl. 38, f. 5-8, 1905; KRIEGER, Krypt. Fl. 13, Abt. 1, p. 571, pl. 79, f. 1-5, 1937.

Cells 36-38.7 μ long, 24-25.5 μ broad, and isthmus 6.8-7.5 μ broad.

Hab. 7. Distr. China, Japan, Siberia, Europe, Spitzbergen, Greenland, N. America.

Staurastrum punctulatum BRÉB. var ***subproductum*** W. & G. S. WEST in Monogr. 4, p. 182, pl. 127, f. 15, 1911; HIRANO, Contr. Biol. Lab. Kyoto Univ. 7, p. 300, pl. 38, f. 17, 1959.

Cells 39-40.7 μ long, 36-37.5 μ broad, and isthmus 14-15 μ broad. The length of cells is very slightly longer than broad, sinus acuminate at their extremities. The specimens are not always distinctly different from the var. *Kjellmani* reported by FÖRSTER from Nepal.

Hab. 2, 11. Distr. Europe.

CHRYSOPHYTA

DIATOMEAE

Coscinodiscaceae

Cyclotella comta (EHRENB.) KÜTZ. in HUSTEDT, Süssw.-fl. 10, p. 103, f. 69, 1930.

Valves 12-14 μ in diameter.

Hab. 2. Distr. Europe.

Fragilariaceae

Diatoma hiemale (LYNGB.) HEIBERG in HUSTEDT, l. c. p. 129, f. 115, 1930; HI-

RANO, Contr. 22, p. 14, pl. 4, f. 23, 1969.

Valves 17-32 μ long and 8-8.5 μ broad.

Hab. 1, 2, 7. Distr. Previously known from Himalaya.

var. ***mesodon*** (EHRENB.) GRUN. in HUSTEDT, l. c. p. 129, f. 116, 1930; HIRANO, l. c. 22, p. 14, pl. 4, f. 15, 16, 1969.

Valves 11-12 μ long and 6-7 μ broad.

Hab. 3, 4, 7. Distr. Previously Known from Himalaya.

Fragilaria construens (EHRENB.) GRUN. in HUSTEDT, l. c. p. 140, f. 135, 1930; HIRANO, Result Kyoto Univ. Sci. Exped. Karak. Hind. 3, p. 182, pl. 2, f. 10, 1964.

Valves 18-21 μ long and 11-12 μ broad. Pl. 2, fig. 29.

Hab. 2. Distr. Afghanistan, Burma, China, Japan, Europe, Greenland, and Africa.

Fragilaria pinnata EHRENB. in HUSTEDT, l. c. p. 142, f. 141, 1930.

Valves 8.5-13.6 μ long, 4.6-5 μ broad.

Hab. 2, 6. Distr. Cosmopolitan.

Fragilaria virescens RALFS in HUSTEDT, l. c. p. 142, f. 144, 1930; A. CLEVE, K. V. Akad. Handl. 4:1, p. 48, f. 361 a, b, 1953; HIRANO, l. c. 3, p. 183, 1964.

Valves 60-64 μ long and 6-6.5 μ broad.

Hab. 2. Distr. Afghanistan, Burma, China, Japan, and Europe.

Synedra acus KÜTZ. var *acula* (KÜTZ.) V. H. in A. CLEVE, K. V. Akad. Handl. 4:1, p. 65, f. 385 d, e, 1953.

Valves 124-130 μ long and 3.7-4 μ broad.

Hab. 8. Distr. Europe.

Synedra ulna (NITZSCH) EHRENB. in HUSTEDT, l. c. p. 151, f. 158, 159, 1930; HIRANO, Contr. Biol. Lab. Kyoto Univ. 22, p. 15, pl. 5, f. 1, 1969.

Valves 110-130 μ long and 5.7-6 μ broad.

Hab. 1, 2, 3. Distr. Previously known from Himalaya. Cosmopolitan.

var. ***oxyrhynchus*** (KÜTZ.) V. H. in HUSTEDT, Krypt. Fl. 7 : 2, p. 198, f. 691B, q, 1932; A. CLEVE, K. V. Akad. Handl. 4:1, p. 63, f. 382t, 1953; HIRANO, l. c. 3, 185, pl. 2, f. 15, 1964.

Valves 87-92 μ long and 5.5-5.8 μ broad.

Hab. 9. Distr. Afghanistan and Europe.

Synedra Vaucheriae KÜTZ. in SCHÖNFELD, Diat. Germ. p. 105, f. 40, 1907; HUSTEDT, l. c. 10, p. 161, f. 192, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 33, pl. 6, f. 26, 1955.

Valves 24-26 μ long and 3 μ broad.

Hab. 1. Distr. Previously known from Himalaya.

Achnanthaceae

Achnanthes anceps (ÖSTR.) A. CLEVE in K. V. Akad. Handl. 4:5, p. 37, f. 548, 1953.
Valves 21-22 μ long and 6.7-7 μ broad.
Hab. 8. Distr. Europe.

Achnanthes lanceolata (BRÉB.) GRUN. in HUSTEDT, l. c. 10, p. 207, f. 306a, 1930; HIRANO, l. c. 22, p. 18, 1969.
Valves 18-23 μ long, 6.8-7 μ broad, and striae 11-12 in 10 μ.
Hab. 7. Distr. Pamir, Tibet, Japan and Europe.

Achnanthes microcephala KÜTZ. in HUSTEDT, l. c. 10. p. 198, f. 273, 1930; A. CLEVE, K. V. Akad. Handl. 4:5, p. 40, f. 568a-d, 1953.
Valves 12-15 μ long and 2.6 μ broad.
Hab. 4. Distr. Europe.

Achnanthes minutissima (KÜTZ.) GRUN. in HUSTEDT, l. c. 10, p. 198, f. 274, 1930; A. CLEVE, l. c. 4:5, p. 40, f. 567a-e, 1953.
Valves 10-15 μ long and 2.6-3 μ broad.
Hab. 4. Distr. Europe.

Achnanthes orientalis HUSTEDT in A. CLEVE, l. c. 4:5, p. 38, f. 555, 1953.
Valves 14.5-15 μ long and 5 μ broad.
Hab. 2. Distr. Europe.

Eucocconeis lapponica HUSTEDT, l. c. 10, p. 194, f. 272, 1930;
Valves 32-41 μ long and 14.5-17 μ broad.
Hab. 2, 3. Distr. Europe.

Naviculaceae

Mastogloia lacustris GRUN. var. ***amphicephala*** (GRUN.) A. CLEVE in K. V. Akad. Handl. 4:5, p. 60, f. 609e, f, 1953.
Valves 30-31 μ long and 10 μ broad. Pl. 2, fig. 18.
Hab. 8. Distr. Europe.

Frustulia rhomboides (EHRENB.) De TONI in HUSTEDT, l. c. 10, p. 220, f. 324, 1930.

Hab. 8. Distr. Cosmopolitan.

Caloneis bacillaris (GREGORY) CLEVE in A. CLEVE, K. V. Akad. Handl. 5:4, p. 103, f. 1148a-e, 1955.
Valves 32-35 μ long, 5.5-6 μ broad, and striae 20-21 in 10 μ.
Hab. 7. Distr. Europe.

Caloneis bacillum (GRUN.) MERESCHK. in HUSTEDT, l. c. 10, p. 236, f. 360, 1930; KOBAYASHI, Bull. Chichibu Mus. Nat. Hist. 10, p. 72, pl. 2, f. 20, 1960.
Valves 47-51 μ long and 8-8.5 μ broad. Pl. 2, fig. 9.
Hab. 7. Distr. Europe.

Caloneis Backmanii A. CLEVE forma ***continua*** A. CL. in K. V. Akad. Handl. 5:4, p. 105, f. 1151a, 1955.
Valves 46-47 μ long and 8.5 μ broad.
Hab. 2. Distr. Europe.

forma ***stauroneiformis*** A. CLEVE in l. c. 5:4, p. 105, f. 1151b, 1955.
Valves 53-54.5 μ long and 8-8.5 μ broad. Pl. 2, fig. 14.
Hab. 10. Distr. Europe.

Caloneis silicula (EHRENB.) KÜTZ. in A. CLEVE, l. c. 5:4, p. 97, f. 1144a, 1955; HIRONO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 189, pl. 5 f. 27, 1964.
Hab. 6. Distr. Afghanistan and Europe.

var. ***truncata*** (GRUN.) MAYER in A. CLEVE, l. c. 5:4, p. 98, f. 1143p, 1953.
Valves 59.5 μ long and 12.8 μ broad.
Hab. 6. Distr. Europe.

Neidium affine (EHRENB.) CLEVE in HUSTEDT, l. c. p. 242, f. 376, 1930.
Valves 47-57 μ long, 12-14 μ broad, and striae 12-13 in 10 μ.
Hab. 2. Distr. Europe.

Neidium bisulcatum (LAGERSTEDT) CLEVE in HUSTEDT, l. c. 10, p. 242, f. 374, 1930; HIRANO, Res. Kyoto Univ. Sci. Exped. Karak. Hind. 3, p. 189, 1964.
Valves 51-68 μ long, 8-14 μ broad, and striae 18-20 in 10 μ.
Hab. 1, 3, 7, 10. Distr. Tibet, Afghanistan, China, Japan, and Europe.

Neidium incurvum (GREGORY) ÖSTR. var. ***fasciatum*** (ÖSTR.) A. CLEVE in l. c. 5:4, p. 112, f. 1162d-f, 1955.
Valves 26-34 μ long, 7.5-8 μ broad.
Hab. 3. Distr. Europe.

Stauroneis anceps EHRENB. in HUSTEDT, l. c. 10, p. 256, f. 405, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 35, pl. 6, f. 11, 1955.

Valves 44-48 μ long and 11-12 μ broad.

Hab. 2, 3, 5, 8. Distr. Previously known from Himalaya.

Stauroneis Smithii GRUN. var. ***karelica*** WISLOUCH & KOLBE in A. CLEVE, K. V. Akad. Handl. 4:5, p. 216, f. 957e, 1953.

Valves 25.5-27 μ long and 7.7-8 μ broad. Pl. 2, fig. 17.

Hab. 2. Distr. Europe.

Navicula cari EHRENB. in HUSTEDT, l. c. 10, p. 299, f. 512, 1930; A. CLEVE, 4:5, p. 153, f. 810a, 1953 (as var. genuina A. CL.); HIRANO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 191, pl. 5, f. 3, 1964.

Valves 31.5-34 μ long, 6.5-7 μ broad, and striae 14-15 in 10 μ. Pl. 2, fig. 32.

Hab. 1. Distr. Yunnan, Burma, Afghanistan, and Europe.

Navicula cincta EHRENB. in HUSTEDT, l. c. 10, p. 298, f. 510, 1930; A. CLEVE, K. V. Akad. Handl. 4:5, p. 152, f. 809a, b, 1953; FOGED, Medd. Cronl. 128:7, p. 53, pl. 6, f. 10. 1955.

Valves 29-32 μ long, 7.5-8 μ broad, and striae 15-16 in 10 μ. Pl. 2, fig. 10.

Hab. 2. Distr. Europe and Greenland.

Navicula cryptocephala KÜTZ. in HUSTEDT, l. c. 10, p. 295, f. 496, 1930; HIRANO, Contr. 22, p. 19, 1969.

Valves 20.5-27 μ long, 7 μ broad, and striae 16 in 10 μ.

Hab. 4. Distr. Previously known from Himalaya. Cosmopolitan.

Navicula cuspidata KÜTZ. in HUSTEDT, l. c. 10, p. 268, f. 433, 1930; MAYER, Denkschr. Bayer. Bot. Ges. Regensb. 22, N. F. 16, pl. 4, f. 4, 1946; HIRANO, Fauna Flora Nepal Himalaya p. 36, pl. 6, f. 40, 1955.

Valves 51-66 μ long, 14.5-18.5 μ broad, and striae 17-18 in 10 μ.

Hab. 5, 7. Distr. Previously known from Himalaya.

var. ***ambigua*** (EHRENB.) CLEVE in HUSTEDT, l. c. 10, p. 268, f. 434, 1930; MAYER, Denkschr. Bayer Bot. Ges. Regensb. 22, N. F. 16, pl. 4, f. 1-3, 1946; HIRANO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 191, 1964.

Valves 59.5-67 μ long, 15-17.5 μ broad, and striae 14-15 in 10 μ. Pl. 2, fig. 24.

Hab. 7. Distr. Afghanistan, Java, Sumatra, and Europe.

Navicula dicephala (EHRENB.) W. SMITH in HUSTEDT, l. c. 10, p. 302, f. 526, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 36, pl. 6, f. 28, 1955.

Valves 37.5-38 μ long, 10-10.5 μ broad, and striae 9-10 μ in 10 μ. Pl. 2, fig. 8.

Hab. 6. Distr. Previously known from Himalaya.

Navicula gregaria DONKIN in HUSTEDT, l. c. 10, p. 269, f. 437, 1930; A. CLEVE, K. V. Akad. Handl. 4:5, p. 130, f. 755a-c, 1953; HIRANO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 192, pl. 5, f. 16, 1964.

Valves 20.5-25 μ long, 7.5-8 μ broad, and striae 12 in 10 μ.

Hab. 2. Distr. Pamir, Afghanistan, China, Thailand, Europe, N. & S. America.

Navicula Grimmei KRASSKE in HUSTEDT, l. c. p. 274, f. 448, 1930.

Valves 21-23 μ long, 6-7 μ broad, and striae 18 in 10 μ.

Hab. 2, 3. Distr. Europe.

Navicula lanceolata (AG.) KÜTZ. in HUSTEDT, l. c. 10, p. 305, f. 540, 1930; A. CLEVE, l. c. 4:5, p. 134, f. 772a, b, 1955; HIRANO, l. c. 3, p. 192, pl. 5, f. 24, 1964.

Valves 37.5-42 μ long, 8-9.5 μ broad, and striae 9-10 in 10 μ.

Hab. 2. Distr. Tibet, Pamir, China, Siberia, Japan, Afghan, and Europe.

Navicula Paulseniana BOYE PETERSEN in Dansk. Bot. Arkiv 6:6, p. 40, f. 4, 1930; FOGED, Biol. Skrift Det. Kongl. Dansk. Vidensk. Selskab. 11:1, p. 62, pl. 7, f. 1, 1959.

Valves 37.5-42 μ long, 11 μ broad, and striae 18 in 10 μ. SKVORTZOW reported *Stauroneis anceps* EHRENB. var. *kansouensis* SKV. from China and the present specimens resemble very much his form. (Publ. Mus. Hoangho Paiho Tien Tsin 36, p. 9, pl. 1, f. 31, 1935) Pl. 2, fig. 22.

Hab. 10. Distr. Afghanistan and China.

Navicula radiosa KÜTZ. in HUSTEDT, l. c. 10, p. 299, f. 513, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 36, pl. 6, f. 34, 1955.

Valves 60-82 μ long, 11.5-12 μ broad, and striae 12 in 10 μ.

Hab. 6, 8. Distr. Previously known from Himalaya.

var. ***tenella*** (BRÉB.) GRUN. in HUSTEDT, l. c. 10, p. 299, 1930.

Valves 32-35 μ long, 6 μ broad, and striae 12 in 10 μ.

Hab. 6. Distr. Europe.

Navicula seminulum GRUN. in HUSTEDT, l. c. 10, p. 272, f. 443, 1930.

Valves 18-20 μ long, 4.5-5 μ broad, and striae 18-19 in 10 μ. Pl. 2, fig. 21.

Hab. 10. Distr. Europe.

Pinnularia appendiculata (AG.) CLEVE in HUSTEDT, l. c. 10, p. 317, f. 570a, 1930.

Valves 37-41 μ long, 7 μ broad, and striae 12 in 10 μ. Pl. 2, fig. 16.

Hab. 7. Distr. Europe.

Pinnularia Brebissonii (KÜTZ.) CLEVE var. ***diminuta*** GRUN. in A. CLEVE, K. V. Akad. Handl. 5:4, p. 54, f. 1072 g, 1955.

Valves 22-24 μ long, 5.5-6 μ broad, and striae 12 in 10 μ. Pl. 2, fig. 7.

Hab. 5. Distr. Europe.

Pinnularia gibba EHRENB. in HUSTEDT, l. c. 10, p. 327, f. 600, 1930.

Valves linear-lanceolate with broadly rounded ends, lateral margin slightly convex, 64-80 μ long, 12-13 μ broad, axial area narrow but widely expanded in the middle of the valve, central area rhomboidal and without striae. Striae divergent in the centre of the valve but convergent at the end, 12-14 in 10 μ. The present specimens are rather shorter than those of the figure by HUSTEDT. Pl. 2, fig. 3, 4.

Hab. 1, 10. Distr. Europe and Japan.

Pinnularia karelica CLEVE in A. CLEVE, K. V. Akad. Handl. 5 : 4, p. 19, f. 1009 a, b, 1955.

Valves lanceolate-elliptic with broadly rounded ends, axial area narrow-linear, central area circular, striae radial at the middle but convergent near the end. Valves 44-46 μ long, 12 μ broad, and striae 12 in 10 μ.

Hab. 7. Distr. Europe.

var. ***tibetana*** (HUSTEDT) A. CLEVE in Act. Soc. Sci. Fenn. 13, II, 2, p. 15, f. 28, 1939.

Valves 47-58 μ long, 14-15 μ broad, and striae 9 in 10 μ.

Hab. 1. Distr. Tibet and Finland.

Pinnularia microstauron (EHRENB.) CLEVE in HUSTEDT, l. c. p. 320, f. 582, 1930; HIRANO, Contr. 22, p. 21, 1969.

Valves 51-60 μ long, 10 μ broad, and striae 15 in 10 μ. Pl. 2, Fig. 1, 12.

Hab. 7. Distr. Tibet, Pamir. Previously known from Himalaya.

var. ***nipponica*** SKVORTZOW in Philip. Journ. Sci. 61, p. 40, pl. 6, f. 8, 1936.

Valves 39-43 μ long, 8.5 μ broad, and striae 12 in 10 μ.

Hab. 8. Distr. Japan.

Pinnularia stauroptera (RABENH.) CLEVE var. ***minuta*** MAYER in A. CLEVE, K. V. Akad. Handl 5:4, p. 68, f. 1091o, p. 1955; HIRANO, Nature Life SE. Asia 5, p. 27, pl. 5, f. 6, 12, 1967.

Valves 36-57 μ long, 10 μ broad, and striae 12 in 10 μ. Pl. 2, fig. 13.

Hab. 7. Distr. Thailand, Borneo, and Europe.

Pinnularia viridis (NITZSCH) EHRENB. in HUSTEDT, l. c. p. 334, f. 617a, 1930; HIRANO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 196, pl. 6, f. 9, 1964.

Valves 107-113 μ long, 22-23 μ broad, and striae 6-8 in 10 μ. Pl. 2, fig. 5.

Hab. 6. Distr. Cosmopolitan.

var. ***fallax*** CLEVE in A. CLEVE, l. c. 5; 4, p. 74, f. 1103h, i, 1955; HIRANO, l. c. p. 196, 1964.

Valves 56-73 μ long, 14.5-15 μ broad, and striae 12 in 10 μ.

Hab. 10. Distr. Afghanistan and Europe.

Cymbellaceae

Amphora coffaeiformis (AG.) CLEVE var. ***transcaspica*** PETERSEN in Dansk Bot. Arkiv 6:6, p. 48, f. 8, 1930.

Valves 20-22 μ long, 4 μ broad. The present specimens similar to *A. luciae* CHOLNOKY from Africa. Pl. 2, fig. 19.

Hab. 7. Distr. Europe.

Cymbella aequalis W. SMITH in HUSTEDT, 1, c. p. 361, f. 667, 1930; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 197, pl. 5, f. 17, 1964.

Valves almost symmetrical, both sides slightly convex, apex truncately rounded, axial area narrow, expanded at the middle, striae radial and middle stria short and slightly separated from adjacent striae. Valves 46-49 μ long, 9-9.5 μ broad, and striae 12 in 10 μ.

Hab. 2. Distr. Tibet, Pamir, Afghanistan, and Europe.

Cymbella affinis KÜTZ. in HUSTEDT, Süssw-fl. 10, p. 362, f. 671, 1930; HIRANO, Res. Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 197, pl. 8, f. 17-19, 1964.

Valves 29-34 μ long, 8-10 μ broad, and striae 10-11 in 10 μ.

Hab. 4, 8. Distr. Cosmopolitan.

Cymbella alpina GRUN. in HUSTEDT, l. c. p. 352, 1930; A. CLEVE, K. V. Akad. Handl. 5:4, p. 153, f. 1229d, 1955; HIRANO, l. c. p. 197, pl. 7, f. 8, 1964.

Valves semilanceolate and robust, ventral margin almost straight, ends broadly rounded, raphe central and slightly curved, axial area narrow, not expanded at the middle, striae strong and slightly radial. Valves 30-34 μ long, 8.5-9 μ broad, and striae 9 in 10 μ. SKVORTZOW reported a form elongated from Lake Ikeda, Japan as forma *nipponica* SKVORTZOW and the present specimens quite coincide with his form except for its elongated shape. The present specimens do not fully coincide with the European illustration by HUSTEDT and A. CLEVE; but A. CLEVE explains the variation of the species in her monograph, and our form coincide with figure 1229d. Pl. 2, fig. 30.

Hab. 3. Distr. Europe.

Cymbella bipartita MAYER in A. CLEVE, K. V. Akad. Handl. 5:4, p. 155, f. 1233a, b, 1955 (as var. genuina A. CLEVE)

Valves 21-22 μ long, 6 μ broad, and striae 10 in ventral side and 8 in dorsal side.

Hab. 9. Distr Europe.

Cymbella cesati (RABENH.) GRUN. in HUSTEDT, l. c. p. 351, f. 638, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 38, pl. 7, f. 16, 1955.

Valves asymmetrical, ventral margin slightly convex, dorsal margin more convex than the ventral one, ends prolonged and rounded, raphe straight, slightly excentric, axial area narrow, expanded at the middle. Valves 34-39 μ long, 7 μ broad, and striae 12 in 10 μ. Pl. 2, fig. 27.

Hab. 2, 10. Distr. Previously known from Himalaya.

Cymbella cymbiformis KÜTZ. var ***multipunctata*** A. CLEVE in K. V. Akad. Handl. 5:4, p. 16, f. 1246h, i, 1955; HIRANO, Contr. 22, p. 22, pl. 4, f. 26, 1969.

Valves 43-98 μ long, 13-22 μ broad, and striae 7-12 in 10 μ.

Hab. 1, 4, 5, 6, 7, 8, 9. Distr. Previously known from Himalaya.

var. ***nonpunctata*** FONTELL in A. CLEVE, K. V. Akad. Handl. 5:4, p. 160, f. 1246e, f, 1955; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 199, pl. 9, f. 1, 1964.

Valves asymmetrical, ventral margin almost straight in the middle, dorsal margin convex, raphe central and axial area narrow linear, not expanded at the middle. Valves 32-37 μ long, 7-8 μ broad, and striae 9-12 in 10 μ. Pl. 2, fig. 31.

Hab. 1. Distr. Afghanistan and Europe.

Cymbella hungarica (GRUN.) PANT. var. ***Grunowii*** A. CLEVE in K. V. Akad. Handl. 5:4, p. 159, f. 1245a-g, 1955; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 199, pl. 10, f. 22, 1964.

Valves semielliptic or semilanceolate, ventral margin almost straight, ends fairly broad and truncate or rounded, sometimes prostrated, raphe slightly curved, axial area narrow but slightly expanded in elliptic shape at the central node, striae radial, without a isolate puncta in dorsal side of the central part of valve. Valves 41-43 μ long, 9-10 μ broad, and striae 9-10 in 10 μ.

Hab. 3, 7, 9. Distr. Afghanistan and Europe.

Cymbella microcephala GRUN. in HUSTEDT, l. c. p. 351, f. 637, 1930; A. CLEVE, l. c. 5:4, p. 136, f. 1193a-c, 1955. (as forma *minor* GRUN.)

Valves 15-15.5 μ long, 3 μ broad,

Hab. 3. Distr. Afghanistan and Europe.

Cymbella obtusiuscula (KÜTZ.) GRUN. in HUSTEDT, l. c. p. 352, f. 640, 1930; SKVORTZOW, Publ. Mus. Hoangho Paiho Tien Tsin 36, p. 23, pl. 5, f. 17, 1935; FOGED, Biol. Skrift. D. Kongl. Dansk. Vid. Selsk. 11 : 1, p. 73, pl. 10, f. 1, 1959.

Valves small, asymmetric, ventral margin almost straight in the middle, ends prostrated and rounded at the extremity, raphe straight and central, axial area narrow, not expanded at the middle, striae parallel and horizontal against the raphe. Valves 19-20 μ long, 8-8.5 μ broad, and striae 9 in 10 μ. The present specimens smaller than those of the European dimension. Pl. 2, fig. 11.

Hab. 5. Distr. China, Afghanistan, and Europe.

Cymbella parva (W. SM.) CLEVE in HUSTEDT, l. c. p. 363, f. 675, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 39, pl. 7, f. 3, 11, 1955.

Valves somewhat arcuate-semilanceolate, ends slightly prostrate-capitated, truncate-rounded at the extremity, raphe slightly arcuate, axial area narrow, expanded at the central node, ventral margin slightly concave. Valves 36.5-49 μ long, 7-8.5 μ broad, and striae 9 in 10 μ. Pl. 2, fig. 26.

Hab. 4, 6. Distr. Previously known from Himalaya.

Cymbella ventricosa KÜTZ. in A. CLEVE, K. V. Akad. Handl. 5 : 4, p. 124, f. 1177a-c, 1955; HIRANO, Contr. 22, p. 23, 1969.

Valves 20-22 μ long, 5.5-7 μ broad, and striae 13-14 in 10 μ.

Hab. 8, 9. Distr. Previously known from Himalaya.

var. ***excavata*** A. CLEVE in l. c. p. 125, f. 1177t, u, 1955.

Ventral margin of valves slightly excavated, ends slightly curved toward ventral side. Valves 18-19 μ long, 7.7 μ broad, and striae 9-10 in 10 μ. Pl. 2, fig. 33.

Hab. 4. Distr. Europe.

var. ***silesiaca*** (BLEISCH) A. CLEVE in l. c. p. 124, f. 1177d-f, 1955; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 202, pl. 9, f. 3, 1964.

Valves 17-24 μ long, 7-8 μ broad, and striae 12-14 in 10 μ.

Hab. 2, 3. Distr. Afghanistan and Europe.

Gomphonema angustatum (KÜTZ.) RABENH. var. ***producta*** GRUN. in HUSTEDT, l. c. p. 373, f. 693, 1930.

Valves 24-40 μ long, 7.5-8.5 μ broad, and striae 12 in 10 μ.

Hab. 3, 4, 5, 7, 8, 10. Distr. Europe.

var. ***undulata*** GRUN. in HUSTEDT, l. c. p. 373, f. 694, 1930; A. CLEVE, K. V.

Akad. Handl. 5:4, p. 180, f. 1270p-s, 1955.

Valves 38-43 μ long, 8.5-9.5 μ broad, and striae 9-10 in 10 μ.

Hab. 2, 4. Distr. Europe.

Gomphonema intricatum KÜTZ. var. ***pumila*** GRUN. in HUSTEDT, l. c. p. 375, f. 699, 1930.

Valves 22-31 μ long, 5-7 μ broad, and striae 12 in 10 μ.

Hab. 8. Distr. Europe.

Gomphonema lapponicum A. CLEVE in K. V. Akad. Handl. 5:4, p. 193, f. 1292a-d, 1955.

Valves slightly heteropolar, with rostrate ends, 57-58 μ long, 13-13.5 μ broad, and striae radial in the middle and convergent at the end, 12 in 10 μ. The present specimens are slightly larger than those of the European form described by A. CLEVE. Pl. 2, fig. 23.

Hab. 10. Distr. Europe.

Comphonema parvulum (KÜTZ.) GRUN. var. ***micropus*** (KÜTZ.) CLEVE in HUSTEDT, l. c. p. 373, f. 713c, 1930; A. CLEVE, K. V. Akad. Handl. 5 : 4, p. 178, f. 1269k-m, 1955.

Valves 18-19 μ long, 7.5-8 μ broad, and striae 10-11 in 10 μ.

Hab. 2, 7. Distr. Europe.

Epithemiaceae

Rhopalodia gibba (EHRENB.) O. MÜLL. in A. CLEVE, K. V. Akad. Handl. 3:3, p. 44, f. 1416a, e, 1952.

Valves 64.5-88 μ long, 10-11 μ broad.

Hab. 6, 7, 8. Distr. Europe.

Rhopalodia gibberula (EHRENB.) O. MÜLL. var. ***producta*** (GRUN.) A. CLEVE, l. c. p. 43, f. 1415d-i, 1952; HIRANO, Nature Life SE. Asia 5, p. 32, 1967.

Valves 30-36 μ long, 6-7 μ broad.

Hab. 6. Distr. Thailand and Europe.

Epithemia argus KÜTZ. in HUSTEDT. l. c. p. 383, f. 727a, 1930; A. CLEVE, l. c. 3 : 3, p. 34, f. 1406a-d, 1952; HIRANO, Fauna Flora Nepal Himalaya p. 40, pl. 7, f. 27, 1955.

Valves 41-75 μ long, 10-12 μ broad.

Hab. 2, 6, 7, 8. Distr. Previously known from Himalaya,

Nitzschiaceae

Hantzschia amphioxys (EHRENB.) GRUN. in HUSTEDT, l. c. p. 394, f. 747, 1930; HIRANO, Nature Life SE. Asia 5, p. 32, 1967.

Valves 53-60 μ long, 7.7-8.5 μ broad, and striae 18 in 10 μ.

Hab. 2, 3, 6, 7, 10. Distr. Tibet. Pamir, Afghanistan, Thailand, Japan, and Europe.

var. ***prolongata*** A. CLEVE in l. c. 3 : 3, p. 48, f. 1419d, 1952.

Valves 140-145 μ long, 11-11.5 μ broad, and striae 12 in 10 μ.

Hab. 6. Distr. Europe.

var. ***pusilla*** DIPPEL in A. CLEVE. l. c. 3 : 3, p. 48, f. 1419l 1952; HIRANO, Contr. 22, p. 24, pl. 4, f. 11, 1969.

Valves 36-50 μ long, 5-6.5 μ broad, and striae 18 in 10 μ.

Hab. 5, 7, 8. Distr. Previously known from Himalaya.

var. ***rupestris*** GRUN. in A. CLEVE, l. c. 3 : 3, p. 49, f. 1419v, w, 1952.

Valves 120-128 μ long, 16-17 μ broad, and striae 12 in 10 μ.

Hab. 3, 7, 8. Distr. Europe.

Nitzschia amphibia GRUN. in HUSTEDT, l. c. p. 414, f. 793, 1930; HIRANO, Nature Life SE. Asia 5, p. 32, 1967.

Valves 49-52 μ long, 4-5.5 μ broad, and striae punctate-striated, ca 15 in 10 μ.

Hab. 6. Distr. Cosmopolitan.

Nitzschia bacillum HUSTEDT in SKVORTZOW, Publ. Mus. Hoangho Tien Tsin 36, p. 16, pl. 2, f. 27, pl. 3, f. 23, 24, 1935; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 206, pl. 11, f. 10, 1964.

Valves 15-16 μ long, 3 μ broad.

Hab. 2. Distr. Tibet, China, Afghanistan, and Europe.

Nitzschia denticula GRUN. in HUSTEDT, l. c. p. 407, f. 780, 1930; A. CLEVE, l. c. 3 : 3, p. 66, f. 1451a, 1952; HIRANO, Fauna Flora Nepal Himalaya p. 41, pl. 7, f. 29, 1955.

Valves 17-31 μ long, 4.5-6 μ broad.

Hab. 2. Distr. Previously known from Himalaya.

Nitzschia frustulum (KÜTZ.) GRUN. var. ***perpusilla*** (RABENH.) GRUN. in A. CLEVE, l c. 3 : 3, p. 87, f. 1497c, d, g, h, 1952; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 207, pl. 11, f. 18, 1964.

Valves 18-20 μ long, 3 μ broad.
Hab. 8. Distr. Afghanistan, Java, Sumatra, Japan, and Europe.

var. ***subsalina*** HUSTEDT in l. c. p. 415, f. 796, 1930; SKVORTZOW, Publ. Mus. Hoangho Paiho Tien Tsin 36, p. 28, pl. 6, f. 27, 1935.
Valves 17-24 μ long, 3-3.5 μ broad.
Hab. 6. Distr. China.

Nitzschia hybrida GRUN. in A. CLEVE, l. c. 3 : 3, p. 66, f. 1449, 1952.
Valves 58-60 μ long, 5 μ broad.
Hab. 9. Distr. Europe.

Nitzschia linearis W. SMITH in HUSTEDT, l. c. p. 409, f. 784, 1930; A. CLEVE, l. c. 3 : 3, p. 80, f. 1480a-d, 1952.
Valves 85-115 μ long, 6.5-7 μ broad.
Hab. 3, 4, 5. Distr. Europe.

Nitzschia vitrea NORMAN in HUSTEDT, l. c. p. 411, f. 787, 1930; A. CLEVE, l.c. 3 : 3, p. 80, f. 1483a-c, 1952.
Valves 11-12 μ long and 10 μ broad.
Hab. 8. Distr. Europe.

Surirellaceae

Cymatopleura solea (BRÉB.) W. SMITH in HUSTEDT l. c. p. 425, f 823a, 1930; HIRANO, Result Kyoto Univ. Sci. Exp. Karak. Hind. 3, p. 208, pl. 11, f. 20, 1964.
Valves 97-102 μ long, 27-28.5 μ broad.
Hab. 6. Distr. Asia Minor, Afghanistan, Sumatra, Japan, and Europe.

Surirella ovata KÜTZ. var. ***pinnata*** (W. SM.) HUSTEDT in A. CLEVE, K. V. Akad. Handl. 3 : 3, p. 122, f. 1566g, h, 1952.
Valves 25-43 μ long, 8-11 μ broad.
Hab. 4. Distr. Europe.

var. ***Smithii*** A CLEVE in l. c. p. 123, f. 1566m, 1952.
Valves 25-26 μ long, 7.5-8 μ broad.
Hab. 5. Distr. Europe.

Surirella spiralis KÜTZ. in HUSTEDT, l. c. p. 445, f. 870, 1930; HIRANO, Fauna Flora Nepal Himalaya p. 42, pl. 7, f. 25, 1955.
Hab. 1. Distr. Previously known from Himalaya.

Surirella tenera GREGORY var. ***pusilla*** A. MAYER in Denkschr. Bayer Bot. Ges. 13, N. F. 7, p. 68, pl. 8, f. 12, 1915.

Valves 22-25 μ long, 8-10 μ broad.

Hab. 3, 5. Distr. Europe.

Acknowledgement: I wish to express my sincere gratitude to Mr. OSAMU NAMIKAWA of Department of Agriculture, Kyoto University for his kindness in submitting for my study the valuable materials collected by him.

Plate 1

1. *Cosmarium petsamoense* CEDERCREUTZ
2. *Cosmarium curtum* (BRÉB.) RALFS
3. *Cosmarium Botrytis* MENEGH. var. *subtumidum* WITTR.

4, 5. *Oscillatoria amoena* (KÜTZ.) GOM.

6. *Oscillatoria anguina* (BORY) GOM.
7. *Phormidium ambiguum* GOM.
8. *Cosmarium tumens* NORDST. var. *rotundatum* HIRANO, var. nov.
9. *Oscillatoria proboscidea* GOM.
10. *Cosmarium solidum* NORDST.
11. *Cosmarium tumens* NORDST.
12. *Cosmarium formosulum* HOFF.
13. *Cosmarium ochthodes* NORDST.
14. *Cosmarium Botrytis* MENEGH.

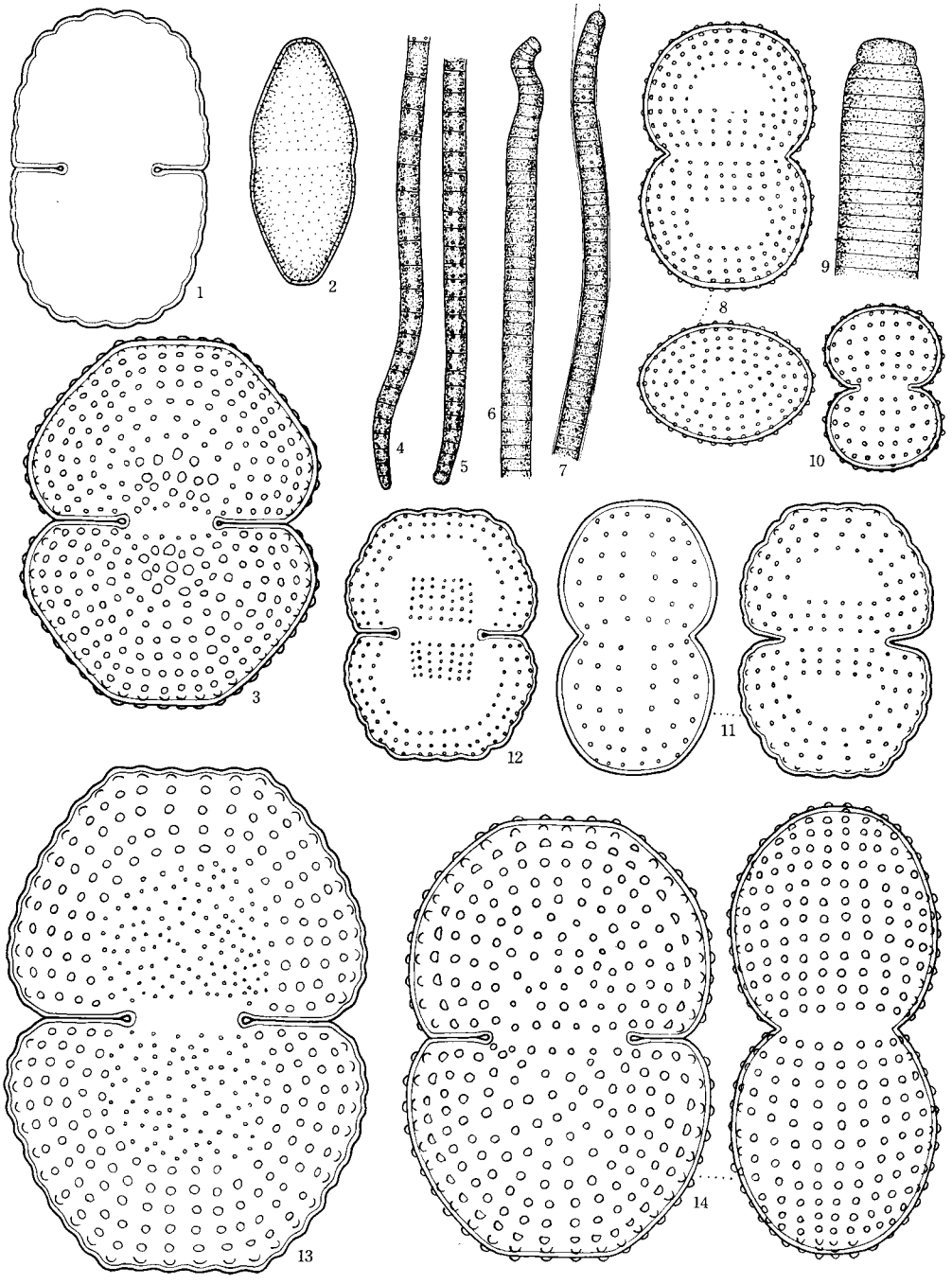

1
2
3
4
5
6
7
8
9
10
11
12
13
14

Plate 2

1. *Pinnularia microstauron* (EHRENB.) CLEVE
2. *Pinnularia karelica* CL. var. *tibetica* (HUSTEDT) A. CLEVE
3, 4. *Pinnularia gibba* EHRENB.
5. *Pinnularia viridis* (NITZSCH) EHRENB.
6. *P. viridis* var. *fallax* CLEVE
7. *Pinnularia Brebissonii* (KÜTZ.) CLEVE var. *diminuta* GRUN.
8. *Navicula dicephala* (EHRENB.) W. SMITH
9. *Caloneis bacillum* MERESCHK.
10. *Navicula cincta* (EHRENB.) KÜTZ.
11. *Cymbella obtusiuscula* (KÜTZ.) GRUN.
12. *Pinnularia microstauron* (EHRENB.) CLEVE
13. *Pinnularia stauroptera* (RABENH.) CLEVE var. *minuta* MAYER
14. *Caloneis Backmanii* A. CLEVE forma *stauroneiformis* A. CLEVE
15. *Pinnularia karelica* CLEVE
16. *Pinnularia appendiculata* (AG.) CLEVE
17. *Stauroneis Smithii* GRUN. var. *karelica* WISLOUCH & KOLBE
18. *Mastogloia lacustris* GRUN. var. *amphicephala* (GRUN.) A. CLEVE
19. *Amphora coffaeiformis* (AG.) CLEVE var. *transcaspica* PETERSEN
20. *Navicula simplex* KRASSKE
21. *Navicula seminulum* GRUN.
22. *Navicula Paulseniana* BOYE PETERSEN
23. *Gomphonema lapponicum* A. CLEVE
24. *Navicula cuspidata* KÜTZ. var. *ambigua* (EHRENB.) GRUN.
25. *Gomphonema angustatum* (KÜTZ.) RABENH. var. *undulata* GRUN.
26. *Cymbella parva* (W. SM.) CLEVE
27. *Cymbella cesati* (RABENH.) GRUN.
28. *Eucocconeis lapponica* HUSTEDT
29. *Fragilaria construens* (EHRENB.) GRUN.
30. *Cymbella alpina* GRUN.
31. *Cymbella cymbiformis* KÜTZ. var. *nonpunctata* FONTELL
32. *Navicula cari* EHRENB.
33. *Cymbella ventricosa* KÜTZ. var. *excavata* A. CLEVE

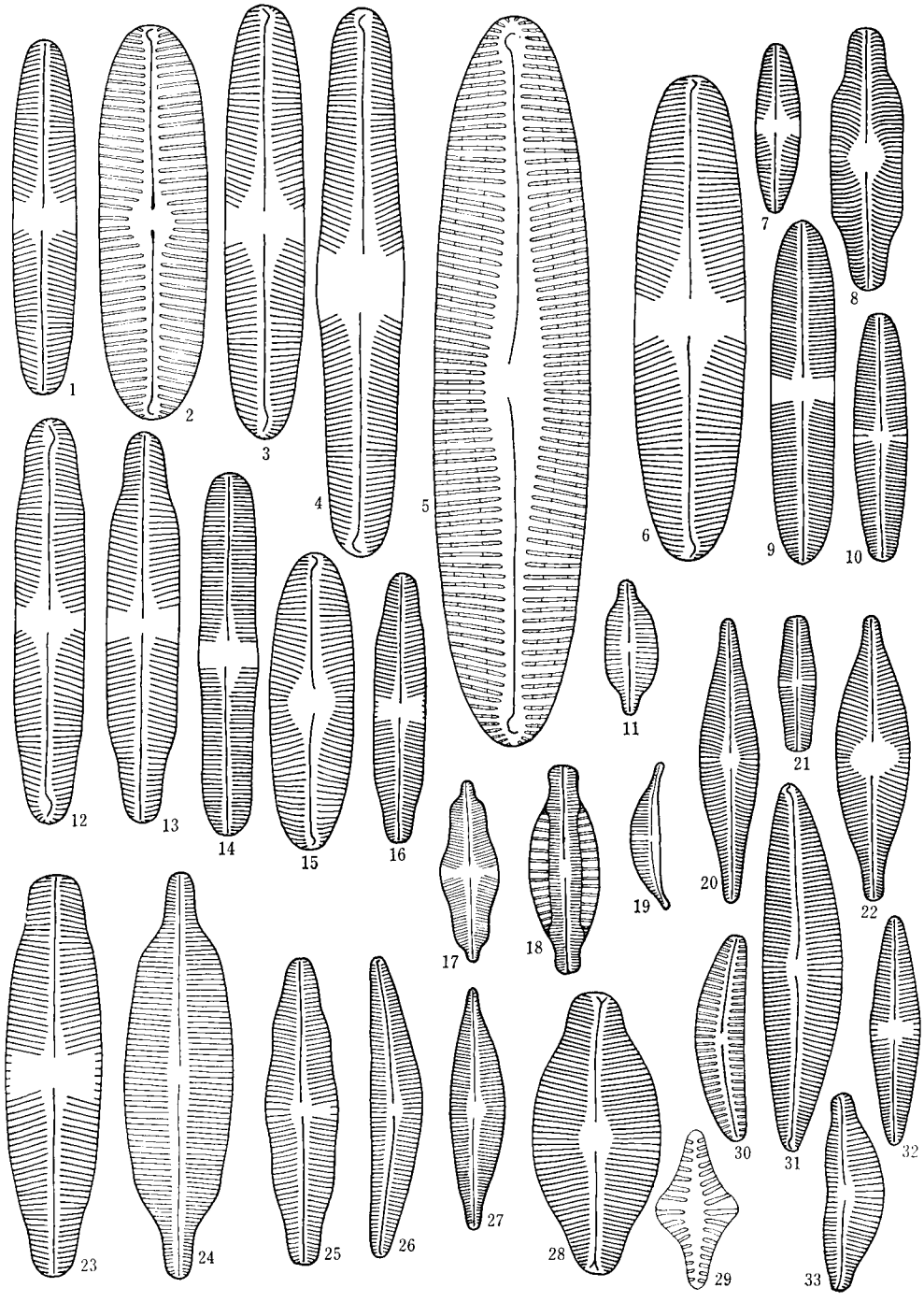

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33

Plate 3

1-3. *Navicula cincta* (EHRENB.) KÜTZ.
4. *Cymbella aequalis* W. SMITH
5-7. *Stauroneis anceps* EHRENB.
8-10. *Navicula grimmei* KRASSKE
11, 12. *Navicula cryptocephala* KÜTZ.
13. *Navicula radiosa* KÜTZ.
14, 15. *Navicula cuspidata* KÜTZ. var. *ambigua* (EHRENB.) CLEVE
16. *Surirella tenella* GREG. var. *pusilla* A. MAYER
17. *Diatoma hiemale* (LYNGB.) HEIBERG
18. *D. hiemale* var. *mesodon* (EHRENB.) A. CLEVE
19. *Navicula radiosa* KÜTZ. var. *tenella* (BRÉB.) GRUN.

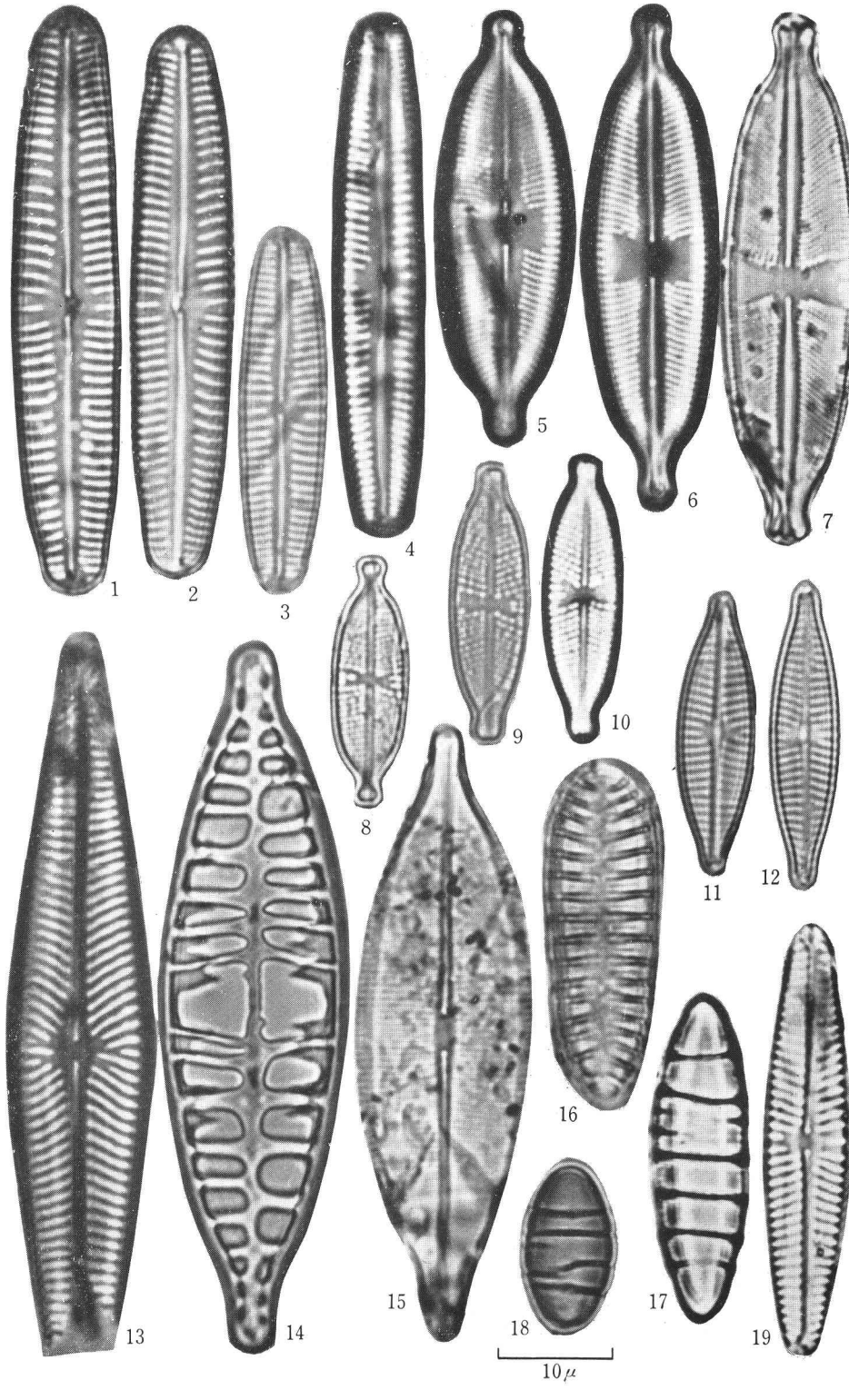

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
10μ

Plate 4

1-7. *Cymbella cymbiformis* (AG.) KÜTZ. var. *multipunctata* A. CLEVE

8. *Pinnularia microstauron* (EHRENB.) CLEVE

9. *Pinnularia Brebissonii* (KÜTZ.) CLEVE var. *diminuta* GRUN.

10-12. *Cymbella cesati* (RABENH.) GRUN.

Plate 4

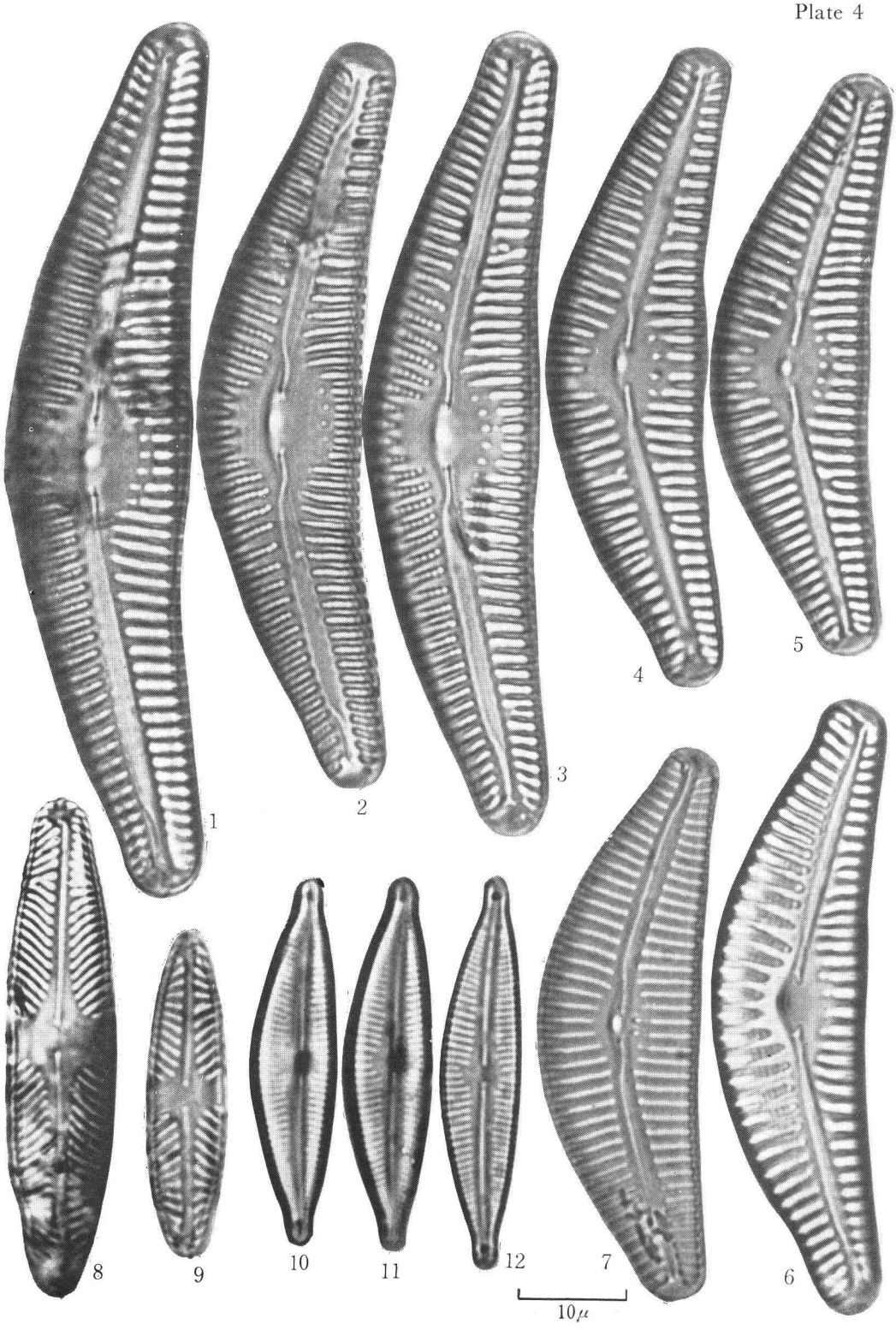


Plate 5

1-5. *Cymbella hungarica* (GRUN.) PANT. var. *Grunowii* A. CLEVE
6-9. *Cymbella ventricosa* KÜTZ. var. *silesiaca* (BLEISCH) A. CL.
10, 11. *Cymbella bipartita* MAYER
12-17. *Cymbella affine* KÜTZ.
18. *Cymbella ventricosa* KÜTZ.
19, 20. *Cymbella microcephala* GRUN.
21. *Cymbella affine* KÜTZ.
22-25. *Amphora coffaeiformis* (AG.) CLEVE var. *transcaspica* PETERSEN
26. *Mastogloia lacustris* GRUN. var. *amphicephala* (GRUN.) A. CL.
27, 28. *Neidium incurvum* (GREGORY) ÖSTR. var. *fasciatum* (ÖSTR.) A. CLEVE
29. *Navicula dicephala* (EHRENB.) W. SMITH

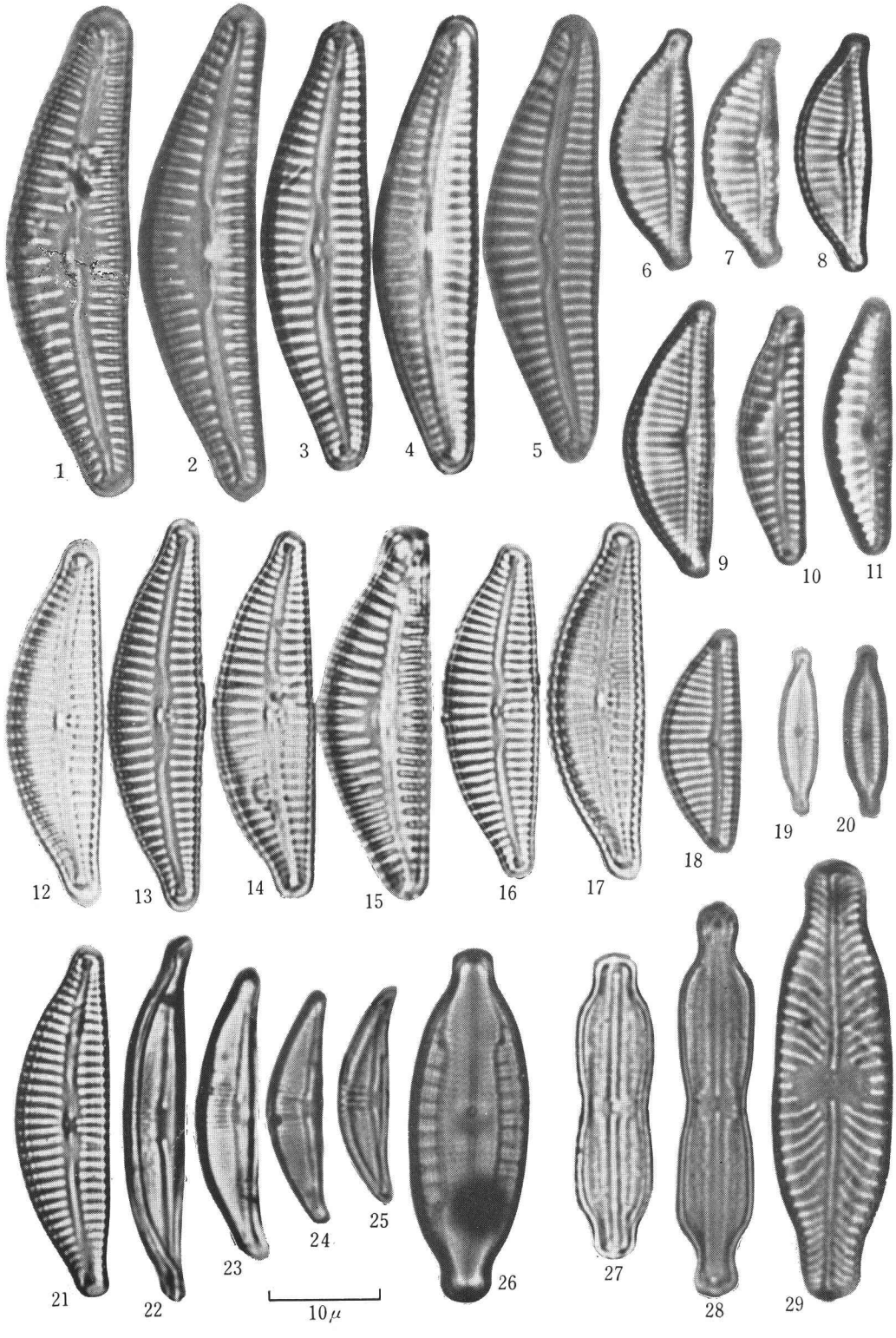

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
10μ

Plate 6

1-16. *Gomphonema angustatum* (KÜTZ.) RABENH. var. *producta* GRUN.
17-20. *Gomphonema intricatum* KÜTZ. var. *pumila* GRUN.
21. *Gomphonema* cf. *angustatum* Abnormal form ?
22-24. *Surirella ovata* KÜTZ. var. *pinnata* (W. SM.) HUSTEDT
25. *Surirella tenella* GREGORY var. *pusilla* A. MAYER

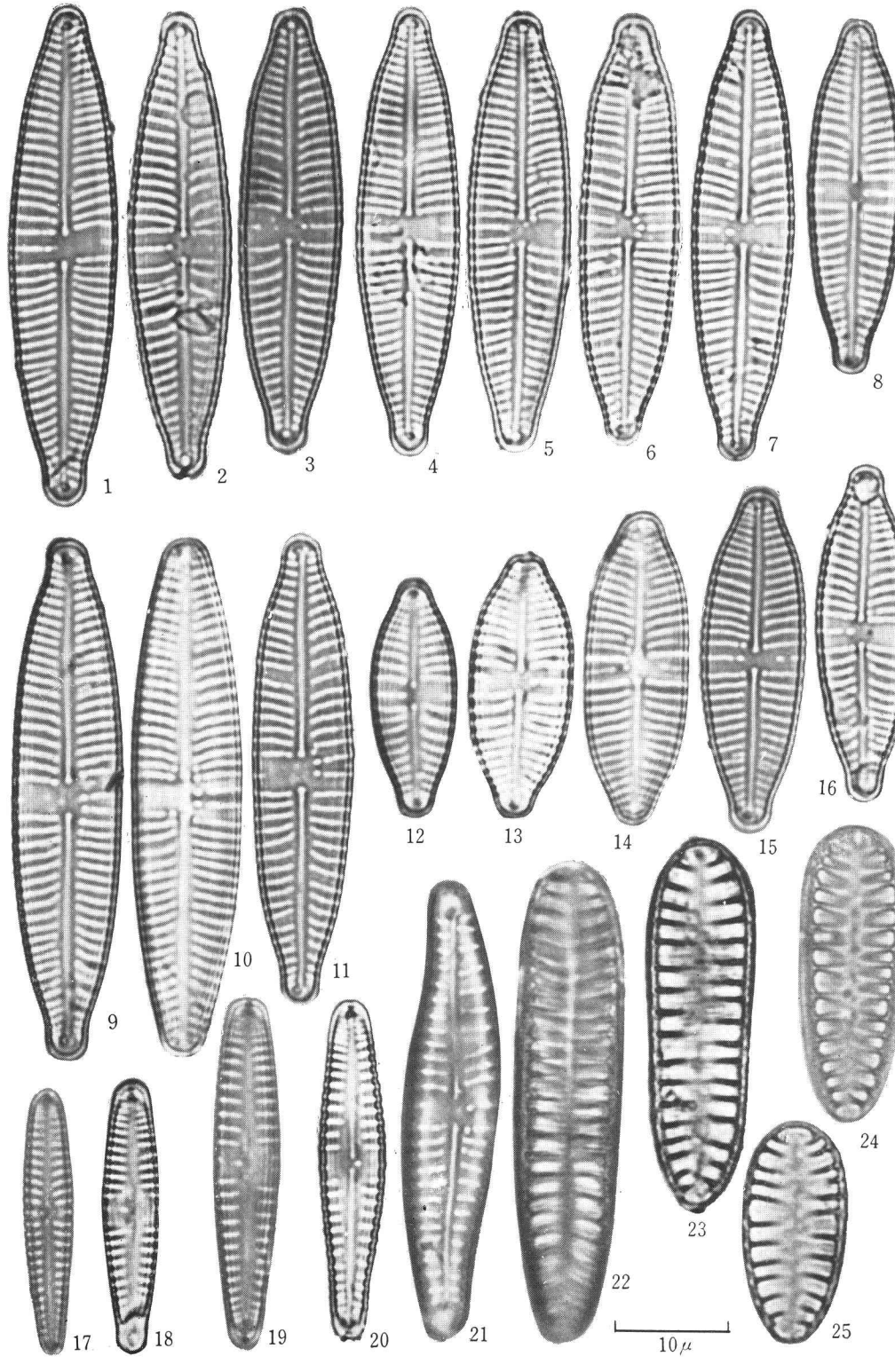
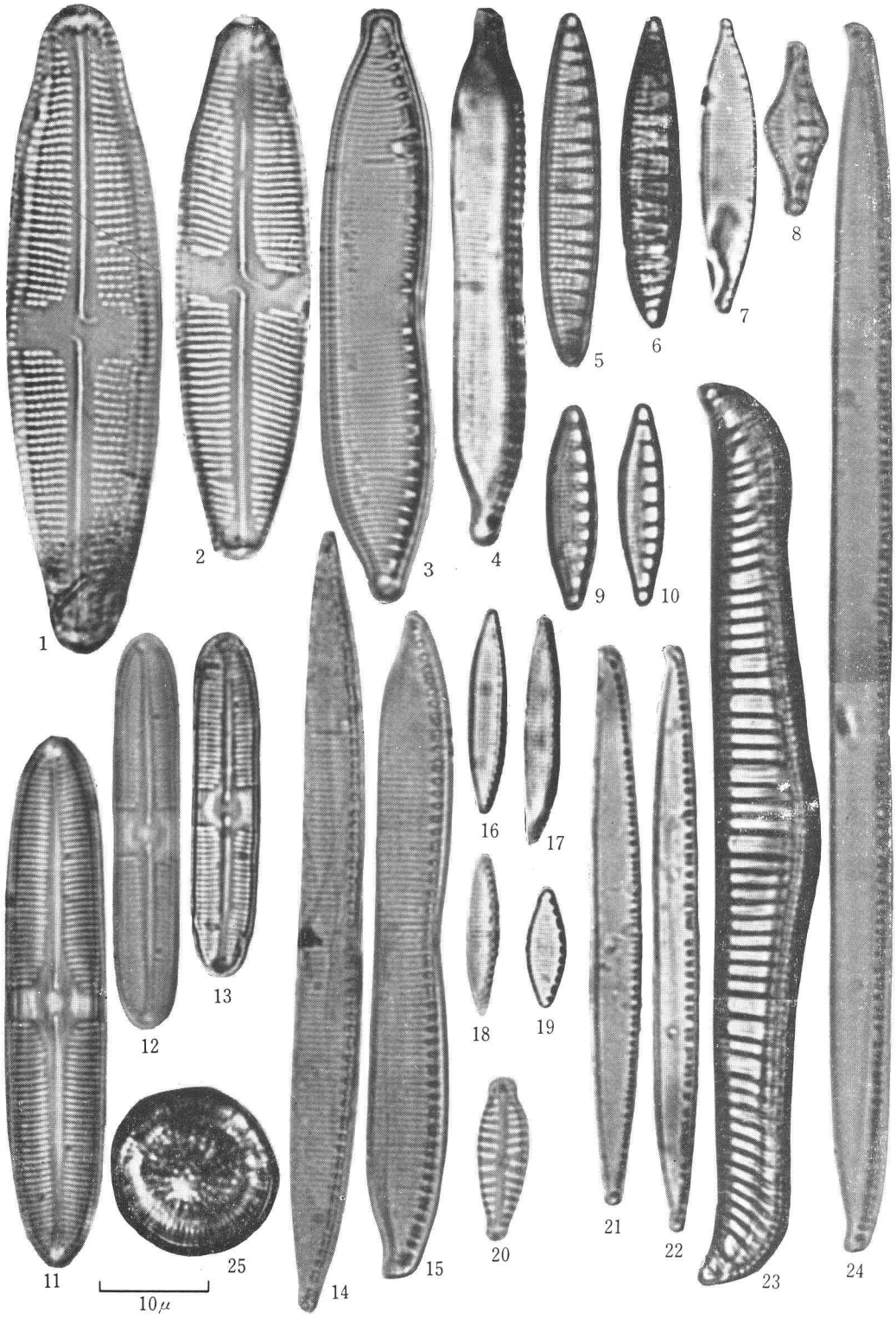

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
10μ

Plate 7

1, 2. *Neidium affine* (EHRENB.) CLEVE
3. *Hantzschia amphioxys* (EHRENB.) GRUN.
4. *H. amphioxys* var. *pusilla* DIPPEL
5, 6. *Nitzschia denticula* GRUN.
7. *Nitzschia palea* (KÜTZ.) W. SMITH
8. *Nitzschia sinuata* (W. SM.) GRUN. var. *tabellaria* GRUN.
9, 10. *Nitzschia bacillum* HUSTEDT
11. *Caloneis silicula* (EHRENB.) CLEVE
12, 13. *Caloneis bacillaris* (GREGORY) CLEVE
14, 15. *Nitzschia hybrida* GRUN.
16-18. *Nitzschia frustulum* (KÜTZ.) Grun. var. *subsalsa* HUSTEDT
19. *Nitzschia fonticola* GRUN.
20. *Gomphonema parvulum* (KÜTZ.) GRUN. var. *micropus* (KÜTZ.) CLEVE
21, 22. *Nitzschia sublinearis* HUSTEDT
23. *Rhopalodia gibba* (EHRENB.) O. MÜLL.
24. *Nitzschia linearis* W. SMITH
25. *Cyclotella comta* (EHRENB.) KÜTZ.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
10μ