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FRESH-WATER DIATOMS FROM THE DOON VALLEY, DEHRA DUN—I*

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ABSTRACT

The paper records for the first time twenty-three species of fresh-water diatoms, represented by the eleven genera belonging to six families, from the permanent fresh-water streams—Mohand nala, Rajpur nala, Sahastradhara nala and Tapkeshwar nala situated in the Doon Valley and out of which four are described as a new. Only one species belongs to the order Centrales and rest of the species represent the order Pennales. The presence of these diatoms in the above nalas suggests that their distribution in these nalas is affected by the chemical composition of the water, nature of the surrounding rocks and some ecological factors.

INTRODUCTION

The present study is based on the fresh-water diatoms collected from the four fresh-water permanent tributaries known as Mohand nala, Rajpur nala, Sahastradhara nala and Tapkeshwar nala of the Doon Valley in the month of February, 1969 by the authors. The Doon Valley (Fig.1) is situated at a height of about 679 metres from the mean sea level. The study was carried out in the Geology Department, Lucknow University, Lucknow.

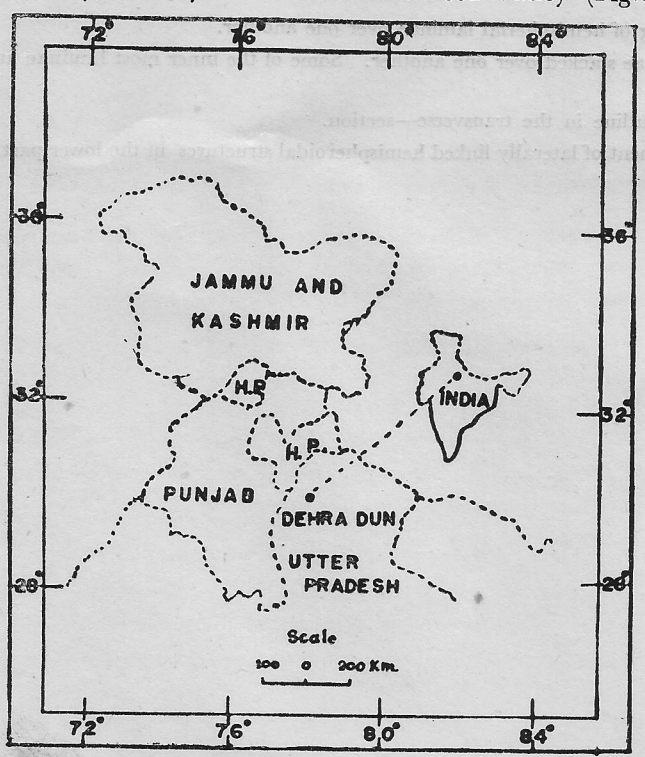

Fig. I—showing location of the area.

The Mohand nala flows on the Siwalik formation which is mainly composed of sandstones and shales and its water contains a low percentage of calcium carbonate. The Rajpur nala flows through limestones and shales and its water contains a high percentage of calcium carbonate. The Sahastradhara nala mainly flows through the limestone region and its water contains a high percentage of calcium carbonate. The Tapkeshwar nala, named after the Tapkeshwar temple of God Shiva, flows on the basement of the Upper Siwalik Boulder Beds containing big boulders of quartzite, limestones and chert etc. and its water contains a low percentage of calcium carbonate. The table-1 shows that the distribution of the diatoms in these nalas is mainly influenced by the chemical composition of water, nature of the surrounding substratum and fluctuation in climate.

No work on the fresh-water diatoms of this region has been made prior to the present study. Some of the poorly described species of the diatoms have been redescribed in this paper. The living diatoms from the other parts of India have been described by Skvortzow (1935), Biswas (1936), Venkataraman (1939, 1956), Gonzalves and Gandhi (1952-1954), Krishnamurthy (1954), Gandhi (1955-1956, 1958-1960), Misra (1956), Desikachary (1956, 1962), Subrahmanyan (1958), Singh (1960) and Singh (1961-1963).

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Table 1

Showing distribution of the fresh-water diatoms in the Doon Valley

Index: A—Absent; P—Present.

Diatoms	Mohand Nala	Rajpur Nala	Sahastradhara Nala	Tapkeshwar Nala
Anomoeoneis sp.	P	A	A	A
Cymbella budda	P	A	A	A
Cymbella cymbiformis ..	A	A	P	A
Cymbella sharmai sp. nov. ..	P	A	A	A
Cymbella tapkeshwarneis sp. nov. ..	A	A	A	P
Cymbella turgidula	A	A	A	P
Diploneis ovalis	A	A	P	A
Eunotia desikacharyi sp. nov. ..	P	A	A	A
Fragilaria brevistriata ..	A	A	P	A
Fragilaria capucina	P	P	P	P
Fragilaria intermedia Grun. var. *robusta*	A	A	P	A
Gomphonema ?olivaceum ..	P	A	A	A
Melosira varians	P	A	A	A
Navicula bishti sp. nov. ..	A	P	P	A
Navicula calcuttaensis ..	P	A	P	A
Navicula capitellata	P	A	A	A
Navicula cryptocephala ..	P	A	A	A
Navicula viridula	A	P	P	A
Pinnularia calcutta	P	A	A	A
Rhopalodia gibba (Ehr.) Mull. var. *ventricosa*	P	A	A	A
Rhopalodia sp. 1	P	A	A	A
Rhopalodia sp. 2	P	A	A	A
Synedra ulna	A	A	P	A

METHOD

The samples containing diatoms were first treated with concentrated Sulphuric acid for twelve hours. After the acid treatment, the samples were thoroughly washed with distilled water till all the acid was removed. The washed samples were centrifused for fifteen minutes and mixed with the cooked liquid of polyvinyl alcohol. A small drop of this material was spread over a coverslip with the help of a needle and allowed to dry. When the material dried up completely, the coverslip was mounted over the glass slide with a small quantity of Bional which is a very good mounting media for making the slides of diatoms because it does not require oven treatment and has a good refractive index.

The classification of diatoms which is given in Smith (1950) is followed in the present paper.

SYSTEMATIC BOTANY

Division Chrysophyta

Class Bacillariophyceae

Order Centrales

Suborder Coscinodiscineae

Family Coscinodiscaceae

Genus *Melosira* Agardh, 1824

Melosira varians Agardh.

Plate 1, fig. 1

1936 *Melosira varians* Agardh., Skvortzow, p. 11.

Hypotype. A filament, slide no. D. L. U. 1, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	22.9	13.8	1.65

Remarks. The present form is identical to the type species *Melosira varians* Agardh (see Skvortzow, 1936) and occurs in abundance in the Mohand nala only.

Locality. Mohand nala.

Order Pennales

Suborder Fragilarineae

Family Fragilariaceae

Genus Fragilaria Lyngbye, 1819

Fragilaria brevistriata Grun.

Plate 1, figs. 2-3.

1963 *Fragilaria brevistriata* Grun., Singh, p. 623.

Hypotype. 2 frustules, slide nos. D. L. U. 2-3, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	33.6	9.2	3.65
Hypotype	32.1	10.7	3.00

Remarks. The form agrees with the type species (figured in Singh, 1963) and occurs in the Rajpur and Sahastradhara nalas. Samples were collected from the bottom of Rajpura nala and Sahatradhara.

Locality. Rajpur and Sahastradhara nalas.

Fragilaria capucina Desm.

Plate 1, figs. 4-6; Plate 2, fig. 6.

1936 *Fragilaria capucina* Desm., Skvortzow, p. 16.

Hypotype. 3 frustules and one filament, slide nos. D. L. U. 4-6, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	10 4	7.6	13.68
Hypotype	79.6	7.6	10.47
Hypotype	79.6	7.6	10.47

Remarks. It resembles the type species and is very well distributed in all the four nalas.

Locality. Mohand, Rajpur, Sahastradhara and Tapkeshwar nalas.

Fragilaria intermedia Grun. var. *robusta* Venkataraman

Plate 1, figs. 8-11

1939 *Fragilaria intermedia* Grun. var. *robusta* Venkataraman, pp. 304-305.

Hypotype. 5 frustules, slide Los. D. L. U. 8-10, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	71.9	9.1	7.9
Hypotype	61.2	7.6	8.05
Hypotype	56.6	7.6	7.44
Hypotype	50.5	9.2	5.48
Hypotype	50.5	7.6	6.65

Remarks. The recorded species is similar to *Fragilaria intermedia* Grun. var. *robusta* described by Venkataraman (1939) from the fresh-water stream, Vaiyampatti, Trichinopaly, Madras. It occurs in abundance in the Sahastradhara nala only.

Locality. Sahastradhara nala.

Genus Synedra Ehrenberg, 1830

Synedra ulna (Nitzsch) Ehrenberg

Plate 1, figs. 7, 12-13

1939 *Synedra ulna* (Nitzsch) Ehrenberg, Venkataraman, pp. 305, 307.

1963 *Synedra ulna* (Nitksch) Ehrenberg, Singh, p. 623.

Hypotype. 3 Frustules, slide nos. D. L. U. 4, 7, 11, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	110.2	7.6	14.5
Hypotype	82.6	6.1	13.54
Hypotype	82.6	6.1	13.54

Remarks. The described species agrees with the type species and occurs rarely in the Sahastradhara nala.

Locality. Sahastradhara nala.

Family Eunotiaceae

Genus Eunotia Ehrenberg, 1837

Eunotia desikacharyi sp. nov.

Plate 2, figs. 1-5.

Holotype. A frustule, slide no. D. L. U. 12 (Pl. 2, fig. 2), Museum, Geology Department, Lucknow University, Lucknow.

Paratype. 4 frustule, slide nos. D. L. U. 2-3, 13, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve kidney shaped; dorsal margin convex in the middle and concave at both the extremities; ventral margin concave in the middle; ends obtuse. Raphe indistinct; polar nodules indistinct. Striae prominent, vary in number from 10 to 15.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Holotype	33.7	9.2	3.66

Paratype	39.8	9.2	4.32
Paratype	32.1	9.2	3.48
Paratype	30.6	10.7	2.85
Paratype	30.6	9.2	3.32

Remarks. The described new species resembles *Eunotia pectinalis* (Kütz.) Rabh. var. *minor* (Kutel) Rabh. in outline but differs from the latter in having less number of striae and more width. It can be also differentiated from *Eunotia tschirchiana* Mull. from its prominently concave ventral margin. It grows in abundance in the Mohand nala.

Type locality. Mohand nala.

Etymology. The species is named after Prof. T. V. Desikachary, University Botany Laboratory, Madras.

Suborder Naviculineae

Family Naviculaceae

Genus *Navicula* Bory, 1822

Navicula bishti sp. nov.

Plate 3, figs. 1-2, 4.

Holotype. A frustule, slide no. D. L. U. 6 (Pl. 3, fig. 2), Museum, Geology Department, Lucknow University, Lucknow.

Paratype. 2 frustules, slide no. D. L. U. 6, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve lanceolate shaped, symmetrical; lateral margins entire, convex and with thick borders; ends obtuse. Axial area straight and narrow; raphe prominent in the middle and narrow. Central nodule may or may not be divided into two parts by the raphe, polar nodules well developed. Striae prominent, radial in the middle and obliquely arranged in the rest part of the valve, vary in number from 55-70.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Holotype	71.9	12.2	5.89
Paratype	76.5	10.7	7.14
Paratype	67.3	12.2	5.51

Remarks. The obtuse ends and higher dimensions of the valve of the present new species differentiate it from the *Navicula cryptocephala* Kütz. It resembles *Navicula rostellata* Kutz. in outline but differs from the latter in having well-developed polar nodules, larger length and less number of striae. The species grow in the Rajpur and Sahastradhara nalas in abundance.

Type locality. Sahastradhara nala; other locality—Rajpur nala.

Etymology. The species is named after Dr. S. S. Bisht, Botany Department, Lucknow University, Lucknow.

Navicula calcuttensis Skvortzow

Plate 5, figs. 1-3

1935 *Navicula calcuttensis* Skvortzow, p. 184.

Hypotype. 3 frustules, slide nos. D.L.U. 8-9, 12, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	36.7	10.7	3.42
Hypotype	29.1	7.7	3.77
Hypotype	29.1	6.1	4.77

Remarks. The described form resembles closely the type species reported from the fresh-water pond of Calcutta by Skvortzow (1935).

Locality. Sahastradhara and Mohand nalas.

Navicula capitellata Skvortkow

Plate 2, fig. 7.

1935 *Navicula capitellata* Skvortzow, p. 183.

Hypotype. 2 frustules, slide no. D. L. U. 13, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	27.5	9.2	2.98
Hypotype	24.5	7.7	3.18

Remarks. The type species is reported from freshwater pools of Calcutta, India by Skvortkow (1935). The forms, obtained from the bottom mud samples of the Mohand nala, are identical to the type species.

Locality. Mohand nala.

Navicula cryptocephala Kutz.

Plate 3, fig. 3

1937 *Navicula cryptocephala* Kütz., Skvortzow, p. 327.

1954 *Navicula cryptocephala* Kütz., Gonzalves and Gandhi, p. 345.

1963 *Navicula cryptocephala* Kütz. Singh, p. 624.

Hypotype. 1 frustules, slide no. D. L. U. 13, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	46	10.7	4.29

Remarks. It is similar to the type species and grows in the Mohand nala only.

Locality. Mohand nala.

Navicula viridula Kütz.

Plate 4, figs. 1-3.

1954 *Navicula viridula* Kütz., Gonzalves and Gandhi, p. 347.

Hypotype. 3 frustules, slide nos. D. L. U. 6, 11, 14, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	65.8	13.8	4.76
Hypotype	62.7	15.3	4.09
Hypotype	56.6	12.7	4.45

Remarks. It resembles *Nvicula viridula* Kütz. reported by Gonzalves and Gandhi (1954) from the fresh-water Powai Lake and streams at Borinli in Bombay. The undivided central nodule has also been noticed in some of the specimens. It grows profusely in the Rajpur and Sahastradhara nalas.

Locality. Rajpur and Sahastradhara nalas.

Genus Pinnularia Ehrenberg, 1840

Pinnularia calcutta Skvortzow

Plate 5, fig. 4.

1935 *Pinnularia calcutta* Skvortzow, p. 184.

Hypotype. A frustule, slide no. D. L. U. 13, Museum, Geology Department, Lucknow Univer sity, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	36.7	9.2	3.98

Remarks. It agrees with the type species. Only a single fairly preserved specimen of this species has been found.

Locality. Mohand nala.

Genus Anomoeoneis Pfitzer, 1871

Anomoeoneis sp. indet.

Plate 1, fig. 14.

Specimen. A frustule, slide no. D. L. U. 13, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valves rhombic-lanceolate; ends rostrate and produced. Axial area narrow and straight, raphe straight, narrow and distinct. Central and polar nodules distinct. Surface smooth.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
,, ,,	70.4	16.8	4.19

Remarks. The present form could not be identified up to specific level due to lack of good specimens.

Locality. Mohand nala.

Genus Diploneis Ehrenberge, 1844

Diploneis ovalis (Hilse) Clev.

Plate 5, figs. 5-6.

1936 *Diploneis ovalis* (Hilse) Cleve., Skvortzow, p. 30.

Hypotype. 2 frustules, slide no. D. L. U. 6, 15, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	44.4	24.5	1.81
Hypotype	42.8	23.0	1.86

Remarks. The present form is similar to the type species and is quite frequent in the Sahastradhara nala.

Locality. Sahastradhara nala.

Family Gomphonemataceae

Genus Gomphonema Agardh, 1824

Gomphonema olivaceum (Lyngbye) Kütz.

Plate 6, figs. 1-3.

1936 *Gomphonema olivaceum* (Lyngbye) Kütz.; Skvortzow, p. 53.

1937 *Gomphonema olivaceum* (Lyngbye) Kütz.; Skvortzow, pp. 352-353.

1954 *Gomphonema olivaceum* (Lyngbye) Kütz.; Krishnamurthy, p. 375.

Hypotype. 3 frustules, slide nos. D. L. U. 3, 13, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	38.2	10.7	3.57
Hypotype	39.8	10.7	3.71

Remarks. The present form is identical to the type species but due to the lack of photomicrographs of the type species it has been doubtfully referred to the latter. It grows in abundance in the Mohand nala.

Locality. Mohand nala.

Family Cymbellaceae

Genus *Cymbella* Agardh., 1930

Cymbella budda (Skvortzow)

Plate 6, figs. 4-5.

1935 *Navicula budda,* Skvortzow, p. 183.

Hypotype. 2 frustules, slide nos. D. L. U. 5, 9, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve lanceolate; asymmetrical; dorsal margin prominently arched; ventral margin slightly convex; ends produced. Axial area narrow and distinct; raphe narrow and prominent. Central and polar nodules well-developed. Striae prominent, slightly curved, radial and parallel to each other, terminating at the axial area, their number vary from 21 to 24.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	32.1	10.7	3.0
Hypotype	33.7	10.7	3.14

Remarks. The illustrated form resembles *Cymbella budda* (Skvortzow). Skvortzow (1935) identified the type species as *Navicula budda.* The authors noticed that the valves of this species are not symmetrical but are asymmetrical. The genus Navicula includes the forms having symmetrical valves. Therefore, this species was erroneously referred to the genus *Navicula* by Skvortzow (1935).

Locality. Mohand nala.

Cymbella cymbiformis (Agardh., Kütz.) Van Heurck

Plate 7, figs. 1-5.

1937 *Cymbella cymbiformis* (Agardh., Kütz.) Van Heurck; Skvortzow, pp. 49-50.

Hypotype. 5 frustules, slide nos. D. L. U. 6, 8, 10, 14, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve lanceolate, asymmetrical; dorsal margin dentated, convex in the middle and gently sloping at both the ends; ventral margin distinctly convex in the centre and slightly concave at both the extremities; ends obtuse. Axial area distinct, narrow and slightly curved; raphe distinct. Central and polar nodules well-developed. Striae prominent, thick and parallel to each other; small beads present on the each striae; the gap between the two successive striae small; striae obliquely arranged and meeting the axial area with a wide angle, vary in number 33—57.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Hypotype	68.9	12.2	5.64
Hypotype	56.6	10.7	5.28
Hypotype	55.1	12.2	4.51
Hypotype	47.4	10.7	4.42
Hypotype	41.3	10.7	3.85

Remarks. It agrees with the type species and grows in abundance in the Sahastradhara nala only.

Locality. Sahastradhara nala.

Cymbella sharmai sp. nov.

Plate 8, figs. 1-4, 7.

Holotype. A frustules, slide no. D. L. U. 9 (Pl. 8, fig. 2), Museum, Geology Department, Lucknow University, Lucknow.

Paratype. Two frustules, slide no. 13, Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve boat shaped, slightly asymmetrical; dorsal margin dentated and distinctly convex at the centre and gradually slopes towards the ends; ventral margin prominently concave in the middle and going upward towards the ends. Axial area narrow and convex in outline; raphe very narrow and distinct. Central and polar nodules indistinct. Striae thin, curved and prominent, radial in the central region, very close to each other, meeting the axial area with an angle, vary in number from 79-83; interstitial spaces of the striae occupied by short numerous transverse thin bars which connect together the two adjacent striae.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Holotype	107.1	30.6	3.5

Paratype	110.2	27.5	4.0
Paratype	99.5	26.0	3.82

Remarks. The described new species has some similarity in outline with *Cymbella leptoceras* (Ehr.) Grun. but differs from the latter in having larger dimensions of the valve and larger number of the striae. It differs from the *Cymbella tumida* (Breb.) Van Heurck var. *borealis* Grun. in having concave ventral margin and larger width.

Type locality. Mohand nala.

Etymology. The species is named after Prof. S. D. Sharma, Botany Department, D. A. V. postgraduate College, Dehra Dun.

Cymbella tapkeshwarensis sp. nov.

Plate 4, fig.

Holotype. A frustule, slide nos. D. L. U. 4 (Pl. 4, fig. 4), Museum, Geology Department, Lucknow University, Lucknow.

Description. Valve boat shaped, slightly asymmetrical; dorsal margin dentated, distinctly convex in the middle and cohcave at both the ends; ventral margin more or less straight in the middle but depressed in the middle. Axial area narrow, constricted in the middle part of the valve and bordered at both the sides by a thin wall; raphe distinct. Central and polar nodules well-developed. Striae prominent, curved, obliquely arranged, more or less parallel to each other, radially arranged in the middle, vary in number from 45-50, meeting the border walls of the axial area with an angle; small beads present at the junction between the striae and border walls of the axial area.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
Holotype	55.1	16.8	3.27

Remarks. The present new species resembles *Cymbella turgidula* Grun. var. *nipponica* Skvorteow in outline but differs from the latter in having depressed extremities, more or less straight ventral dentated margin and large number of the striae. It can also be differentiated from the *Cymbella amphicephala* Naegeli by the presence of large number of striae and more or less straight ventral margin in former. The species is named after the Tapkeshwar temple of God Shiva.

Type locality. Tapkeshwar nala.

Cymbella turgidula Grun.

Plate 9, figs. 1-8.

1936 *Cymbella turgidula* Grun; Skvortzow, p. 49,

Hypotype: 8 frustules, slide no. D. L. U. 16, Museum, Geology Department, Lucknow University, Lucknow.

Description: Valve lanceolate, asymmetrical; dorsal margin dentated and convex in the middle, slightly depressed at both the ends; ventral margin concave in the middle and slightly depressed at both the ends; ends rounded and slightly bulging out. Axial area narrow and distinct; raphe distinct and narrow. Central and polar nodules well-developed. Striae prominent, obliquely arranged, parallel to each other, joined the axial area in the middle, the two striae of the opposite sides meet raphe with an angle, vary in number from 30 to 39.

Measurements in μ :

Specimen	Length (L)	Width (W)	L/W
Hypotype ..	44.4	15.3	2.90
Hypotype ..	41.3	13.8	2.99
Hypotype ..	35.2	10.7	3.28
Hypotype ..	33.7	10.7	3.14
Hypotype ..	32.1	12.2	2.63
Hypot pe ..	27.7	9.2	2.98

Remarks: The describeo form is identical to the type species and grows in abundance in the Tapkeshwar nala The forms of this species were collected from the pink colour mass of musilage floating over the water in the Tapeskwhar nala

Locality Tapkeshwar nala

Rhopalodia gibba (Ehr.) Mull. var. *ventricosa* (Ehr.) Grun.

Plate 8, fig. 8; Plate 10, fig. 5.

1940 *Rhopalodia gibba* (Ehr.) Mull. var. *ventricosa* (Ehr.) Grun., Venkataraman, p. 350.

Hypotype: 2 frustules, slide no. D. L. U. 12, Museum, Geology Department, Lucknow University, Lucknow.

Measurements in μ :

Specimen	Length (L)	Width (W)	L/W
Hypotype ..	68.9	23.0	2.99
Hypotype ..	84.2	27.6	3.05

Remarks: It resembles *Rhopalodia gibba* (Ehr.) Mull. var. *ventricosa* Grun. described by Venkataraman (1940) from the fresh-water brook, Masingudi, Ootacamund, Nilgiris.

Locality Mohand nala.

Rhopalodia sp. 1

Plate 6, fig. 6; Plate 10, figs. 3-4

Specimen 2 frustules, slide no. D. L. U. 12, Museum, Geology Department, Lucknow University, Lucknow.

Description: In girdle view, valve linear, gibbous in the middle, lateral margins slightly depressed behind the middle part of the frustule; ends obtuse. Girdle zone broad in the middle and slightly decrease in breadth towards the extremities. Transverse costae prominent, vary in number from 58—60. Axial field narrow and disitnct, ornamented with transverse costae. Central and polar nodules indistinct.

Measurements in μ.

Specimen	Length (L)	Width (W)	L/W
,, ...	82.6	23.0	3.59
,, ...	78.1	19.9	3.92

Remarks. The present form differs from its associated species *Rhopalodia* sp. 2 in having broader girdle zone.

Locality: Mohand nala.

Rhopalodia sp. 2

Plate 8, figs. 5-6; Plate 10, figs. 1-2.

Specimen: 4 frustules slide nos. D. L. U. 12, Museum, Geology Department, Lucknow University, Lucknow.

Description: In girdle view, valve linear, inflated in the middle; lateral margins behind the central part of the frustule concave; ends obtuse. Girdle zone very narrow in the middle and broader at both the extremities. Transverse costae prominent, vary ir number from 48-67. Axial field narrow, ornamented by the transverse costae. Central and polar nodules not distinct.

Locality Mohand nala:

Measurements in μ

Specimen	Length (L)	Width (W)	L/W
,, ...	88.8	22.9	3.87
,, ...	87.2	22.9	3.80
,, ...	68.9	15.3	4.50
,, ...	65.8	21.4	3.07

Remarks: It grows in abundance in the Mohand nala.

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EXPLANATION OF PLATES

PLATE 1

1. *Melosira varians* Agardh., valve view, ×700.
2-3. *Fragilaria brevistriata* Grun., valve views, ×700.
4-6. *Fragilaria capucina* Desm., valve views, ×700.
7, 12-13. *Synedra ulna* (Nitz.) Ehrenberg, valve views, ×700.
8-11. *Fragilaria intermedia* Grun. var. *robusta* Venkataraman, valve views, ×700.
14. *?Anomoeoneis* sp., valve view, ×700.

PLATE 2

1-5. *Eunotia deshikacharyi* sp. nov., Figs. 1, 3-5, valve views of the paratypes; Fig. 2, valve view of the holotype, ×1500.
6. *Fragilaria capucina* Desm., girdle view, ×700.
7. *Navicula capitellata* Skvortzow, valve view, ×1500.

PLATE 3

1-2, 4. *Navicula bishti* sp. nov., Figs. 1, 4, valve views of the paratype; Fig. 2, valve view of the holotype, ×1500.
3. *Navicula cryptocephala* Kutz., valve view, ×1500.

PLATE 4

1-3. *Navicula viridula* Kutz., valve views, ×1500.
4. *Cymbella tapkeshwarensis* sp. nov., valve view of the holotype, ×1500.

PLATE 5

1-3. *Navicula calcuttensis* Skvortzow, valve views, ×1500.
4. *Pinularia calcutta* Skvortzow, valve view, ×1500.
5-6. *Diploneis ovalis* (Hilse) Cleve., valve views, ×1500.

PLATE 6

1-3. *Gomphonema ?olivaceum* (Lyngbye) Kutz., Fig. 1, girdle view; Fig. 2-3, valve views, ×1500.
4-5. *Cymbella budda* (Skvortzow), valve views, ×1500.
6. *Rhopalodia* sp. 1, girdle view, ×700.
7. *Rhopalodia* sp. 2, girdle view, ×700.

PLATE 7

1-5. *Cymbella cymbiformis* (Agardh., Kutz) Van Heurck., Figs. 1-4, valve views; Fig. 5, girdle view, ×1500.

PLATE 8

1-4, 7. *Cymbella sharmai* sp. nov., Figs. 1, 3, valve views of the paratypes; Fig. 2, valve view of the holotype; Fig. 4, 7, girdle view of the paratype; ×1500.
5-6. *Rhopalodia* sp. 2, girdle views, ×700.
8. *Rhopalodia gibba* (Ehr.) Mull. var. *ventricosa* (Ehr.) Grun., girdle view, ×700.

PLATE 9

1-8. *Cymbella turgidula* Grun., Figs. 1-6, valve views; Fig. 7-8, girdle views, ×1500.

PLATE 10

1-2. *Rhopalodia* sp. 2, girdle views, ×700.
3-4. *Rhopalodia* sp. 1, girdle views, ×700.
5. *Rhopalodia gibba* (Ehr) Mull var. *ventricosa* (Ehr.) Grun , girdle view, ×700.

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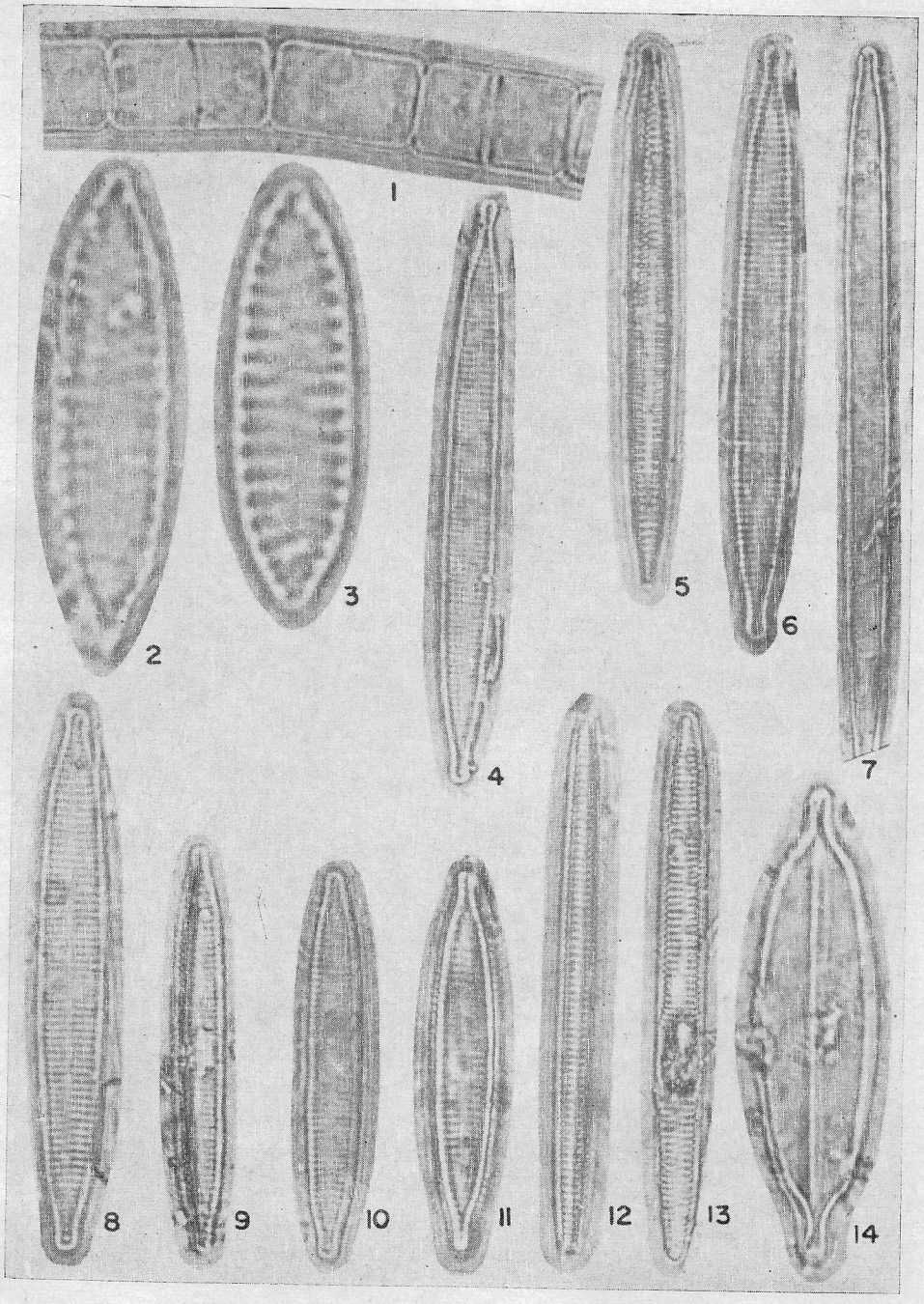
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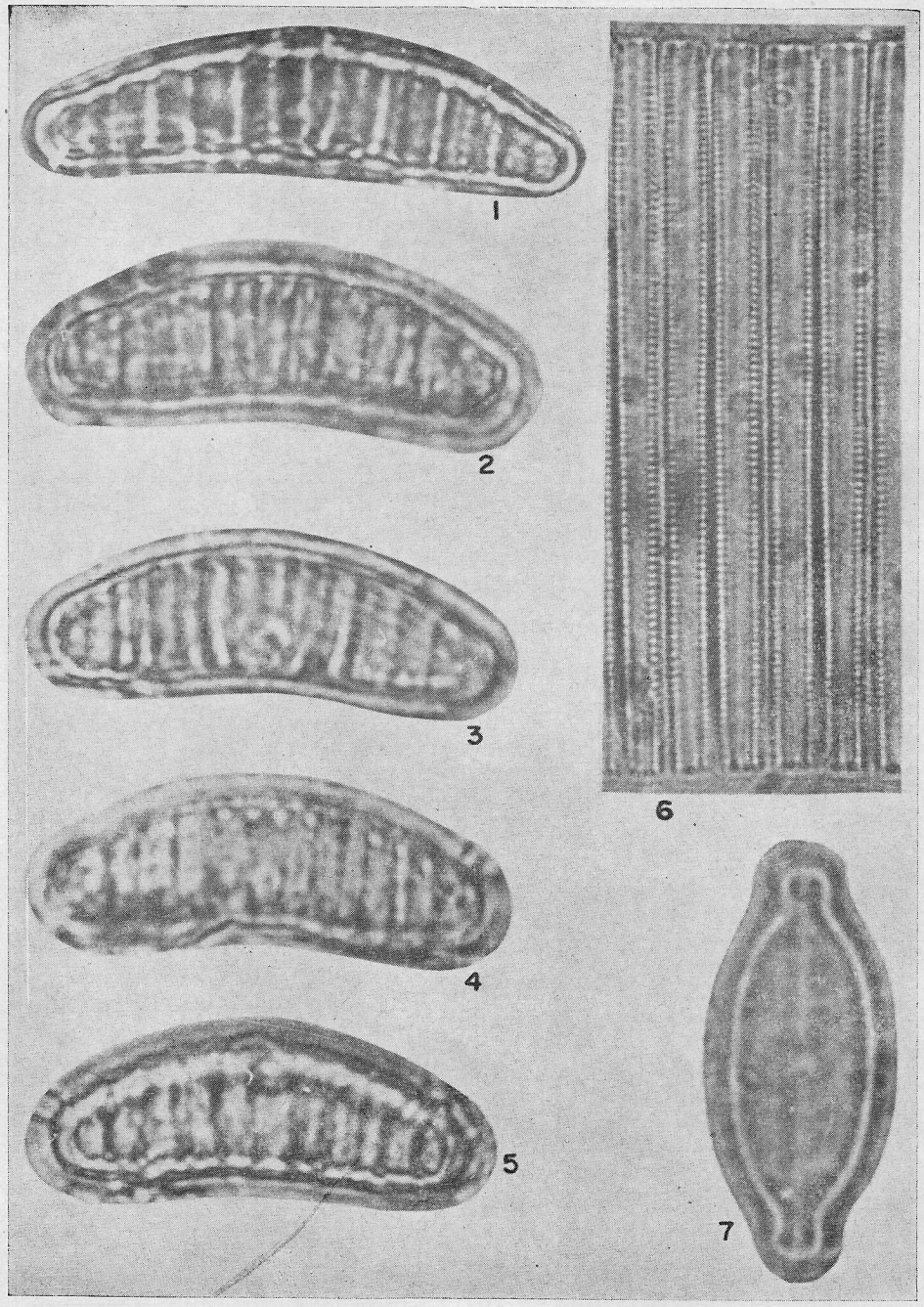
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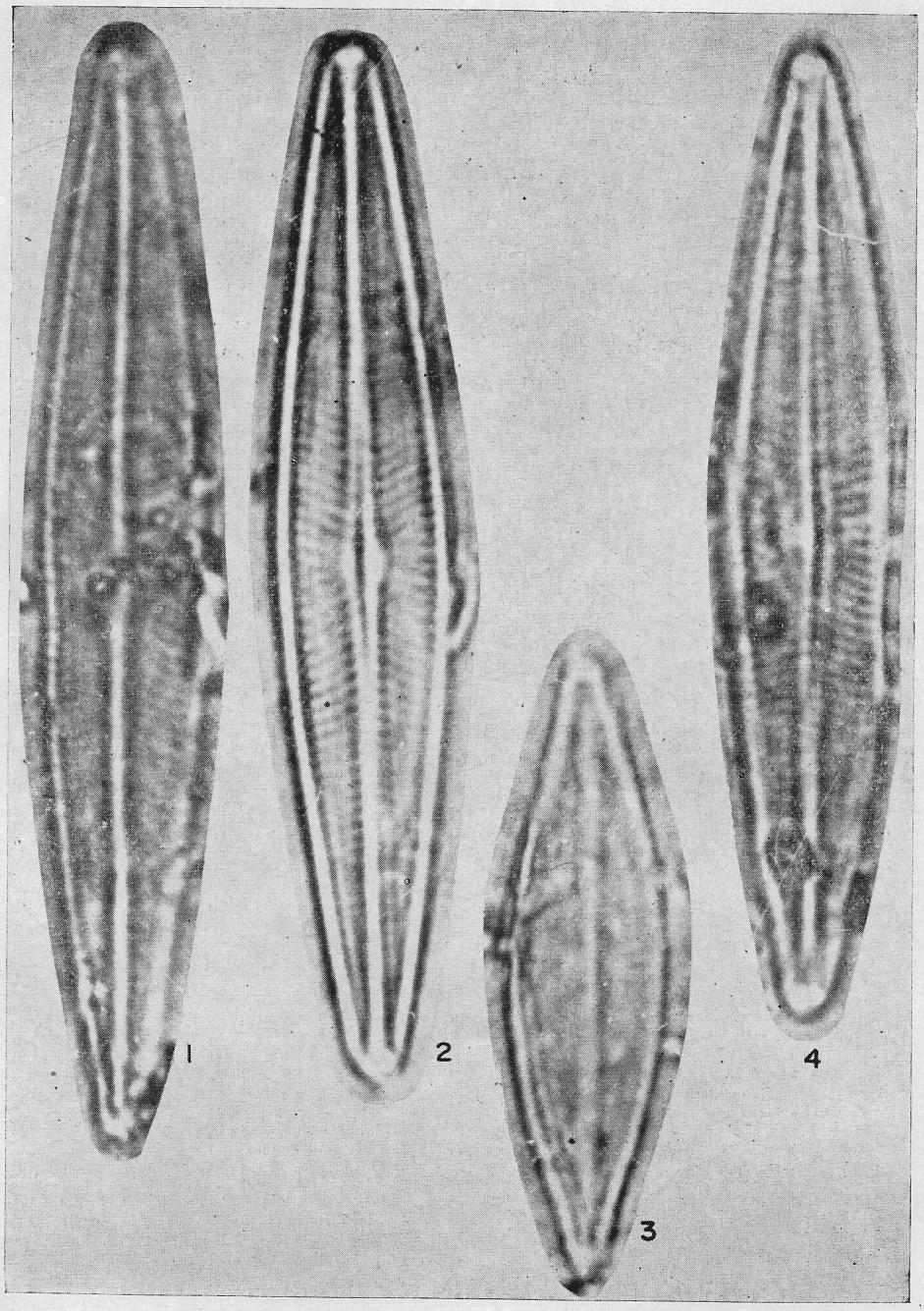
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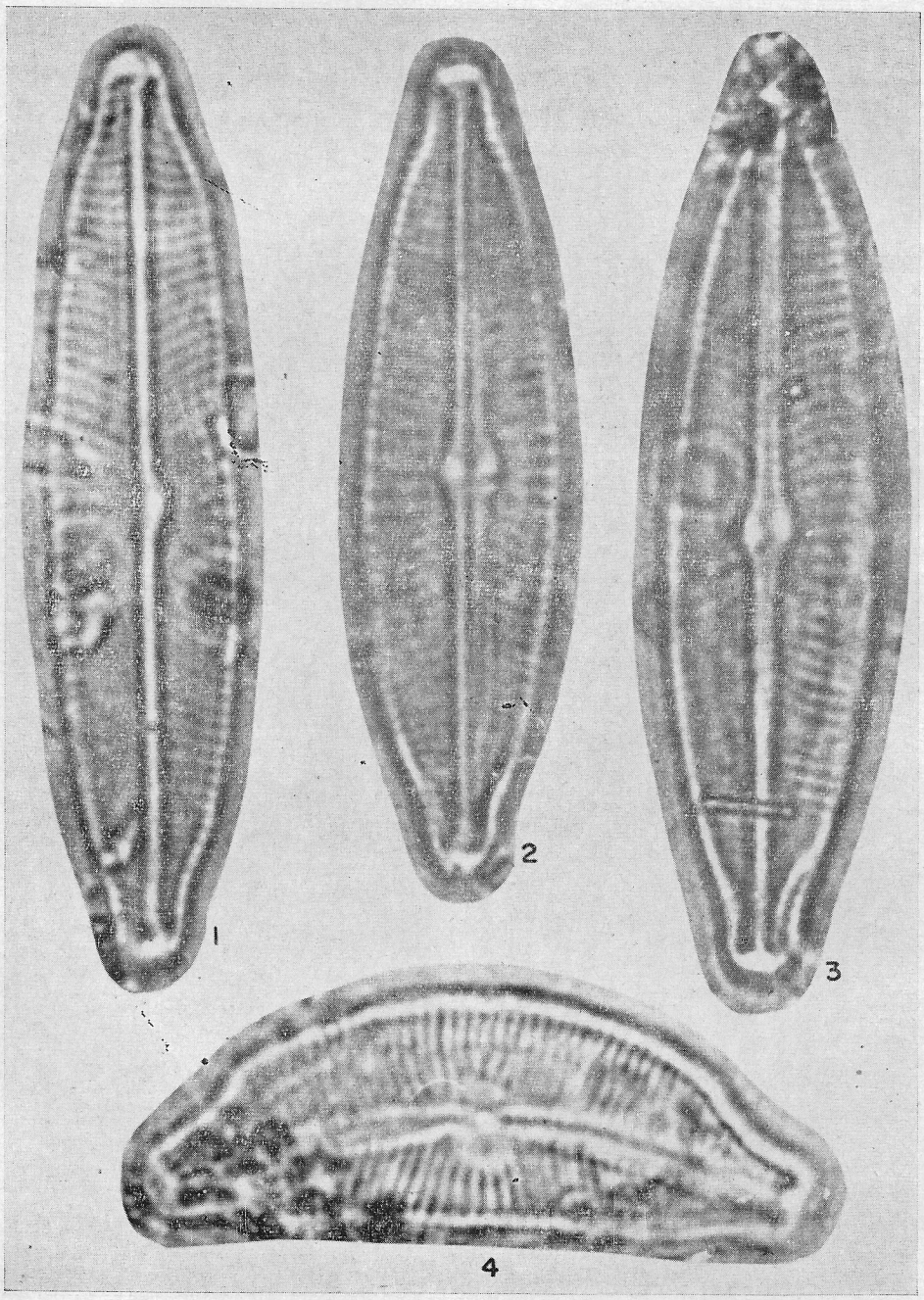
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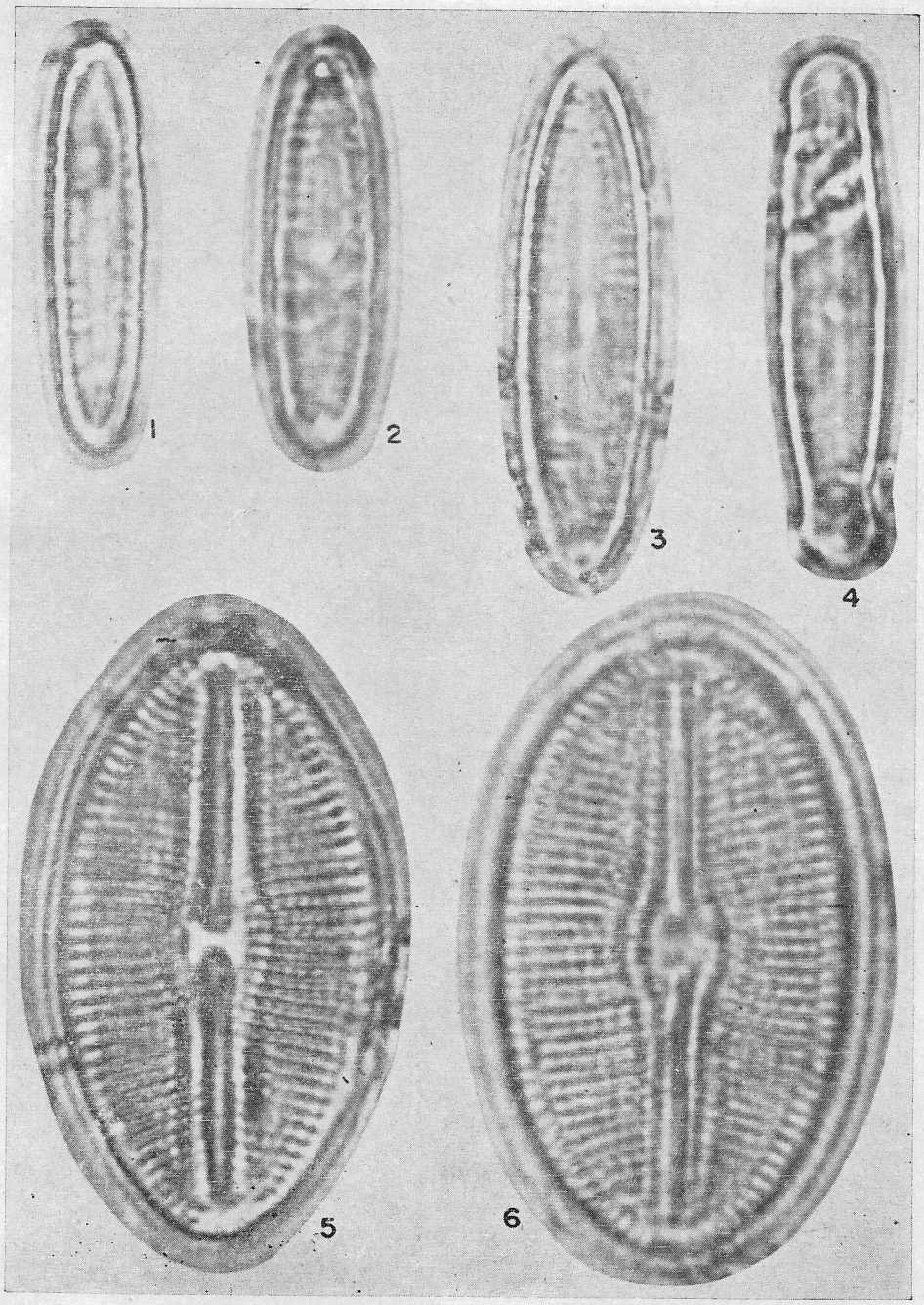
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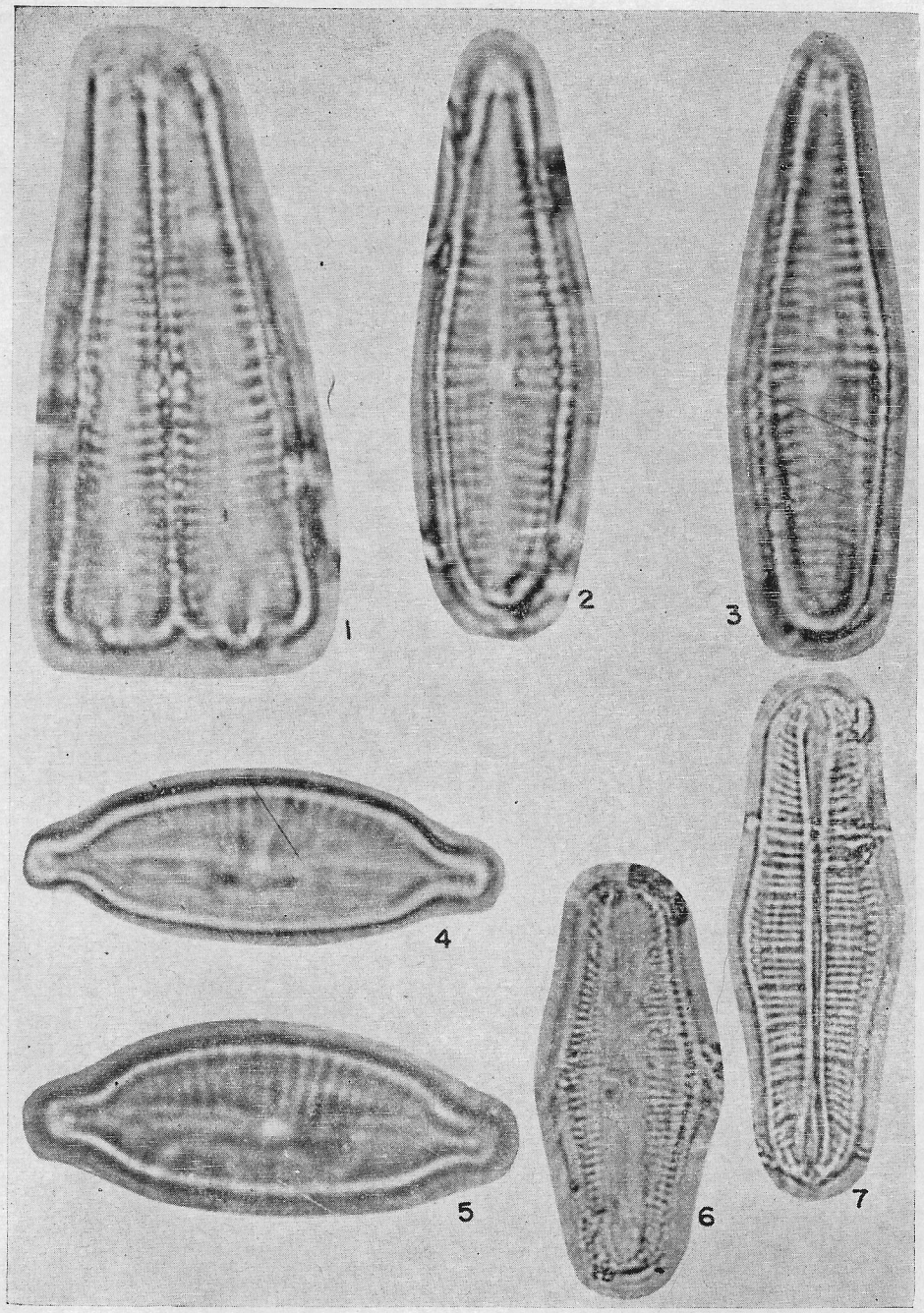
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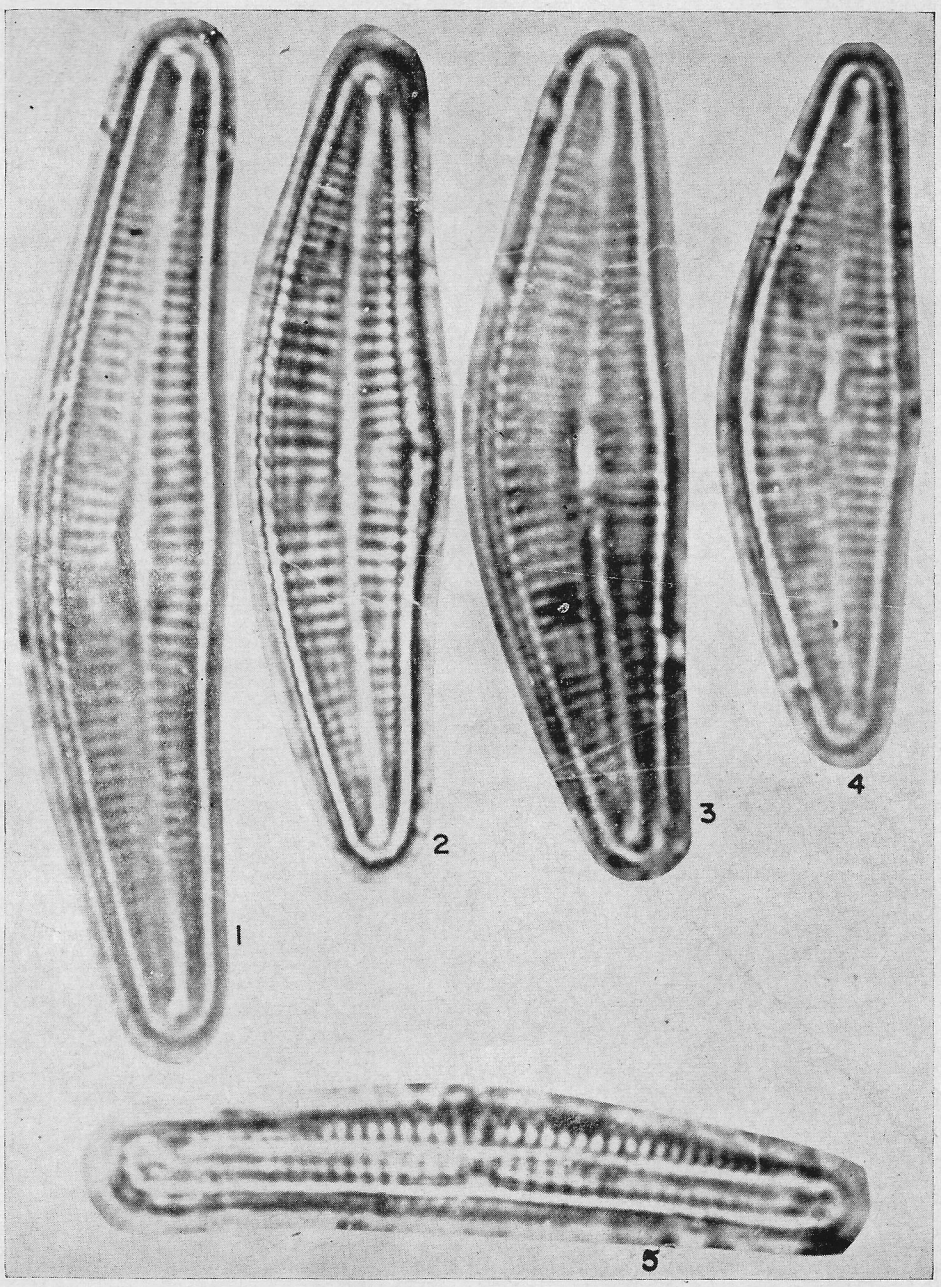
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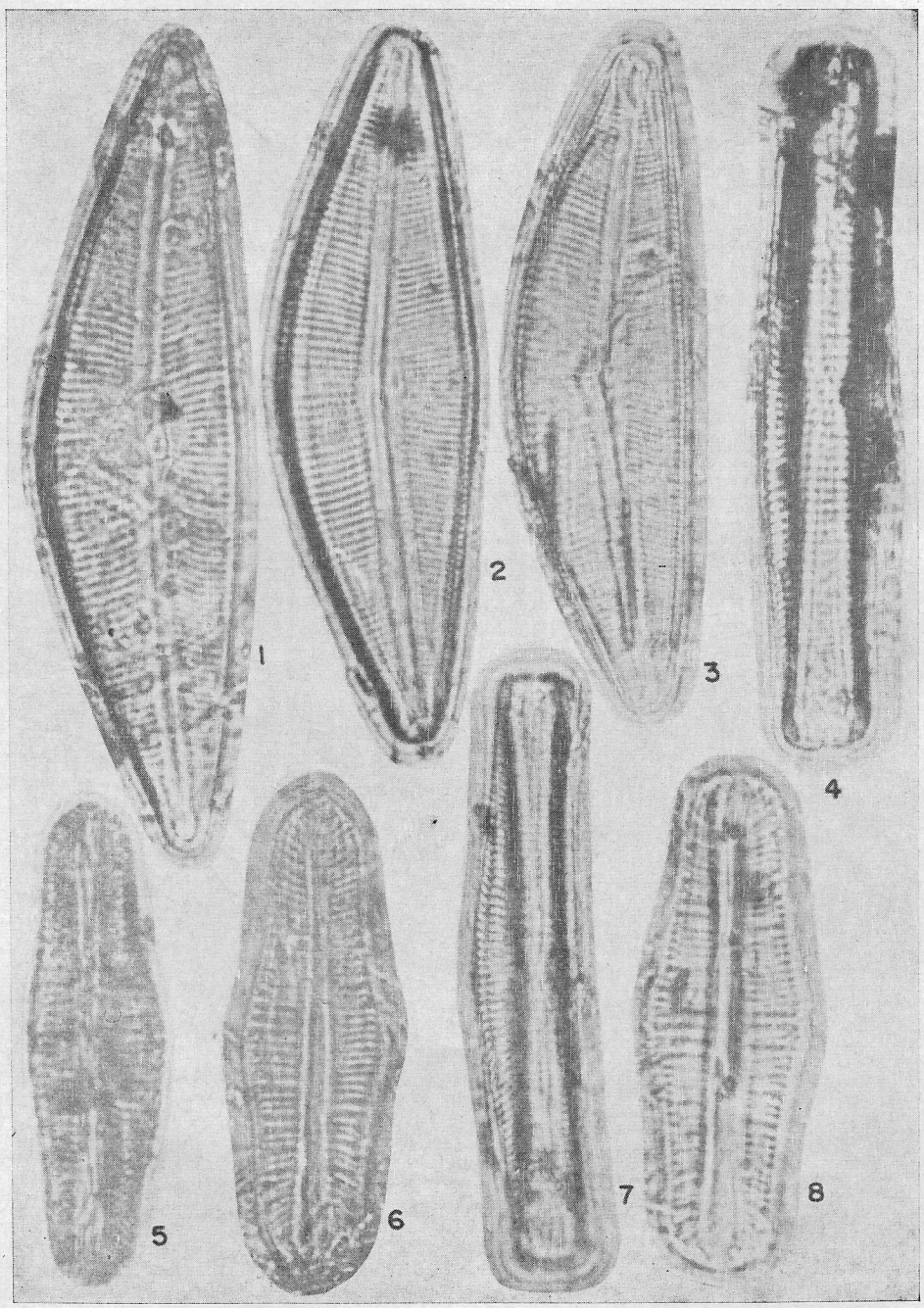
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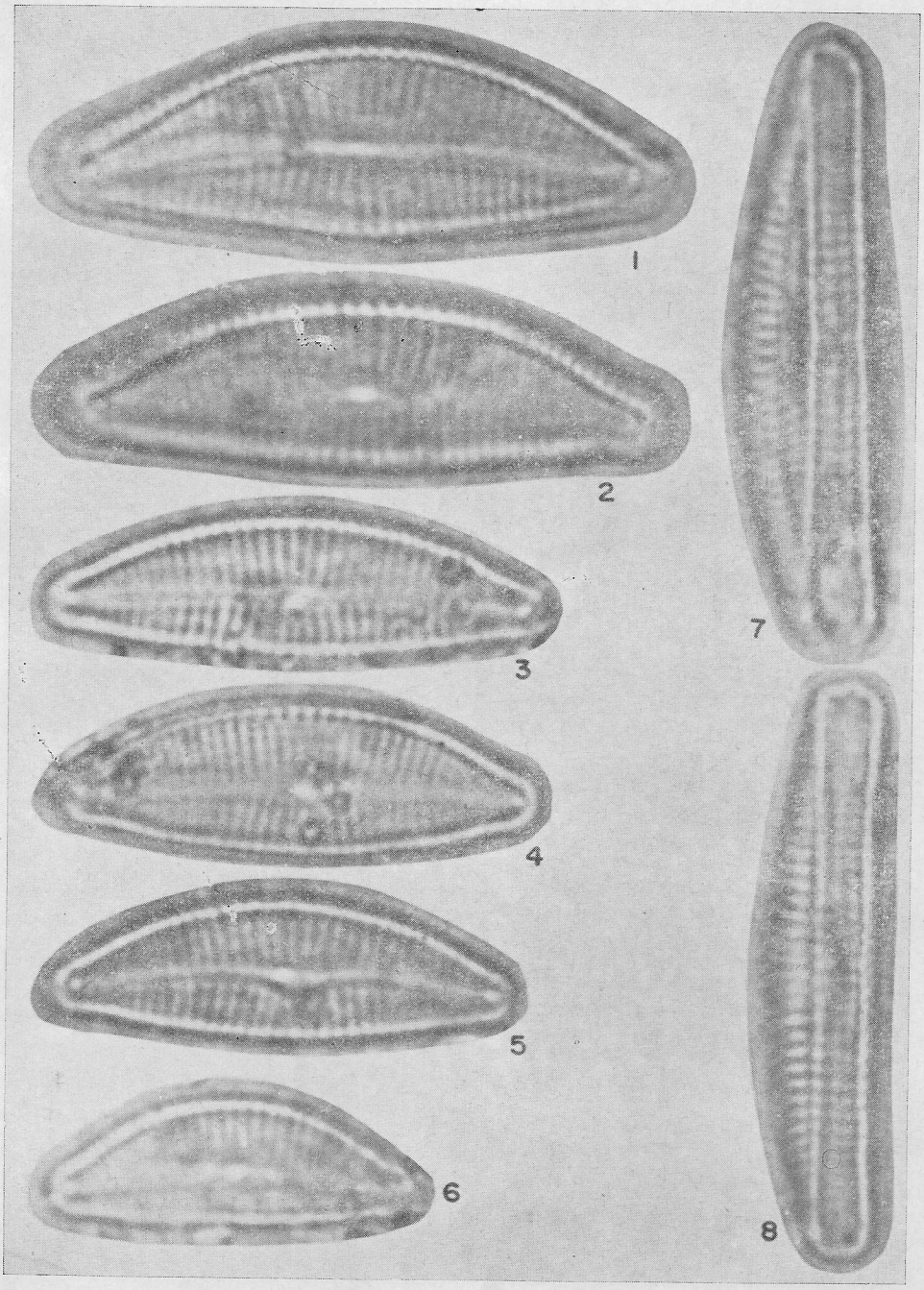
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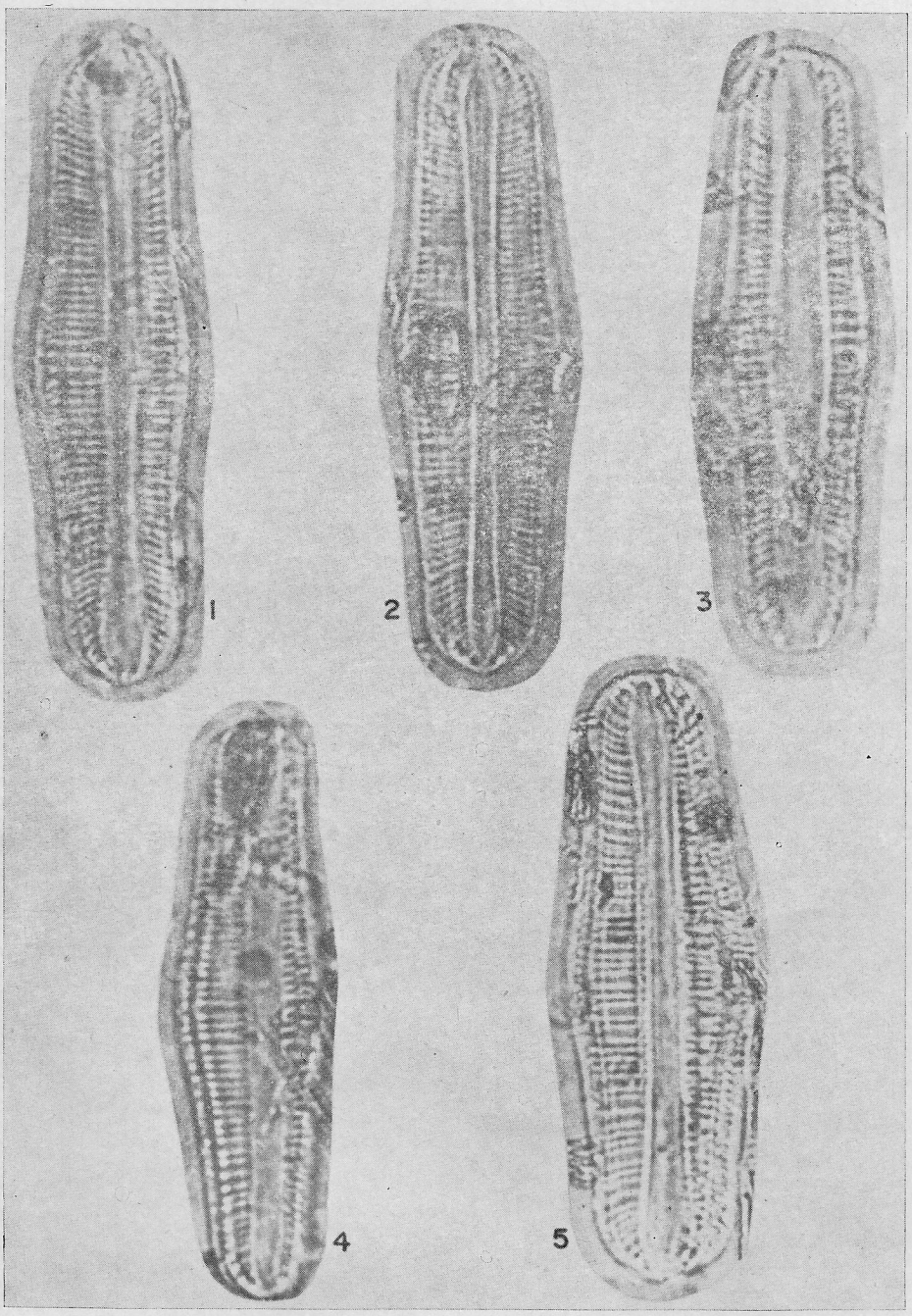
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