

MARINE PHYTOPLANKTON OF THE MANGROVE DELTA REGION OF WEST BENGAL, INDIA

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ABSTRACT

The paper deals with the taxonomic account of 46 marine phytoplankton taxa of Bacillariophyceae, Dinophyceae and Cyanophyceae, collected from mangrove delta regions of West Bengal, India. All these taxa have been recorded for the first time from this part of India. Among these, *Coscinodiscus*, *Rhizosolenia*, *Chaetoceros*, *Biddulphia*, *Pleurosigma*, *Ceratium* and *Proto-peridinium* are found to be the dominant genera and almost present round the year.

INTRODUCTION

THERE are a few reports on systematic accounts of the marine phytoplankton of the Indian Coast; though a considerable work has been done by a large number of scientists in temperate and polar areas (Allen, 1936; Bainbridge, 1953; Brunel, 1962; Hendey, 1954, 1964, 1971; Hustedt, 1930; Parke, 1953; Yamaji, 1968).

Regarding the Indian Ocean, Karsten (1907) and Steemann Neilsen (1939) gave some reports of phytoplankton; Subrahmanyam (1946, 1958) reported different forms of diatoms from the Madras Coast and also listed more than three hundred species of phytoplankton from the Arabian Sea off the West Coast of India. He (1968, 1971) also added a detailed account of the Dinophyceae of the Indian Seas. Chacko (1950) reported the marine plankton of the southern Bay of Bengal around the Krusadi Island. Venkataraman (1958) contributed the report of marine diatoms from Kanyakumari and Nair (1959) reported marine

diatoms from Trivandrum Coast. Wood (1963) gave a check list of Dinoflagellates from the Indian Ocean. Taylor (1966) recorded some species of phytoplankton of the South Western Indian Ocean. But there is no records of marine phytoplanktonic flora of Mangrove delta of Sundarban area of West Bengal, India. Hence, this study was undertaken and the results reported here.

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MATERIALS AND METHODS

For the purpose of systematic study, the phytoplankton were collected from various parts of river networks of Sundarban delta of West Bengal, India. Collections were made round the year 1986 by phytoplankton nets of different mesh sizes from the surface waters upto the depth of 60 cm during high tides. The collecting locations were situated between 21° 32'-21° 58' N and 87° 55'-88° 35' E.

After collection, the net was held vertically and washed carefully with flowing sea water.

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so that all plankters were collected at the bottom of the net bucket. Then the phytoplankton samples were preserved in 5% formalin for analysis.

Before analysis, materials were cleaned by adding hydrochloric acid for dissolving the calcareous matter. After centrifugation the acid was decanted and the sediment was washed by adding water. Then concentrated sulphuric acid was added carefully. Some crystals of potassium dichromate was then added. The sulphuric-chromic acid mixture was then poured off and water was added. After proper cleaning the materials were mounted in a drop of distilled water and studied. For longer preservations materials were mounted in Canada balsam or DPX.

SYSTEMATIC DESCRIPTION OF THE SPECIES

Altogether 46 forms were recorded, representing 24 genera of Bacillariophyceae, Dinophyceae (Dinoflagellates) and Cyanophyceae. Among these *Coscinodiscus*, *Rhizosolenia*, *Chaetoceros*, *Biddulphia*, *Pleurosigma*, *Ceratium* and *Proto-peridinium* are found to be the dominant genera and almost present round the year.

These forms showed close resemblances to those of the Madras Coast (Subrahmanyam, 1946), Java Sea (Allen and Cupp, 1935), Japan Coast (Yamaji, 1968), the Indian Ocean (Subrahmanyam, 1958, 1968), Bay of Bengal and Bangladesh (Islam and Aziz, 1979).

Class : BACILLARIOPHYCEAE
Order : Centrales
Genus : *Skeletonema* Greville

Skeletonema costatum (Greville) Cleve (Fig. 1 i)

Cleve, 1878. *Bih. Kongl. Sv. Vet. —Akad. Handl.* 5 (8) : p. 18.

= *Melosira costata* Greville, 1866. *Trans. Micr. Soc. Bd.* 14 : p. 77, pl. 8, Fig. 3-6, (1866); Cupp, 1943. p. 43, fig. 6; Fritsch, 1935. p. 605, fig. 201; YDamaji, 1968. p. 27, 97.

Valves lens-shaped, ends rounded, arranged in straight chain with the help of marginal spines; space between cells longer than cells; frustules 8-12 μ long, 9-10 μ dia.

Locality : Prentice Island (South 24 Paraganas, W.B.).

Genus : *Coscinodiscus* Ehrenberg

Coscinodiscus eccentricus Ehrenberg (Fig. 1 a)

Ehrenberg, 1839. *Abh. Berl. Akad.*, p. 146; Allen and Cupp, 1935. p. 114, fig. 5; Fritsch, 1935. fig. 187 A; Subrahmanyam, 1946. p. 93, fig. 29, 30, and Islam and Aziz, 1975. p. 5, pl. 1, fig. 7-8.

Cells disc-shaped, valves flat, areolae arranged in tangential series, areolae almost all of same size, number 6 in 10 μ at the centre and about 8-9 in 10 μ near the margin, valves 35-45 μ dia.; margin striated, 18-20 striae in 10 μ .

Locality : Bhubaneswari (South 24 Paraganas, W.B.).

Coscinodiscus jonesianus (Greville) Ostenfeld (Fig. 1 d)

Ostenfeld, 1915. *Dansk Bot. Ark.*, 2 (4), p. 13, fig. 7.

= *Eupodiscus jonesianus* Greville, 1862. *Trans. Micr. Soc. N.S. Bd.*, 10 : p. 22, Pl. II, fig. 3; Allen and Cupp, 1935. p. 116, fig. 10; Subrahmanyam, 1946. p. 97, fig. 42, 45, 48.

Cells large, disc-shaped, areolae in the centre form a rosette; areolae 4 in 10 μ at the centre; 8-9 in 10 μ near the margin, 6-7 in 10 μ in between margin and centre; radial and spiral rows of areolae showing clear chamber opening; irregular ring of interstitial meshes found; near the margin two cone-shaped processes present at about 120° apart; valve 150-210 μ diam.

Locality : Prentice Island, Chandanpiri, and Bhubaneswari (South 24-parganas, W.B.).

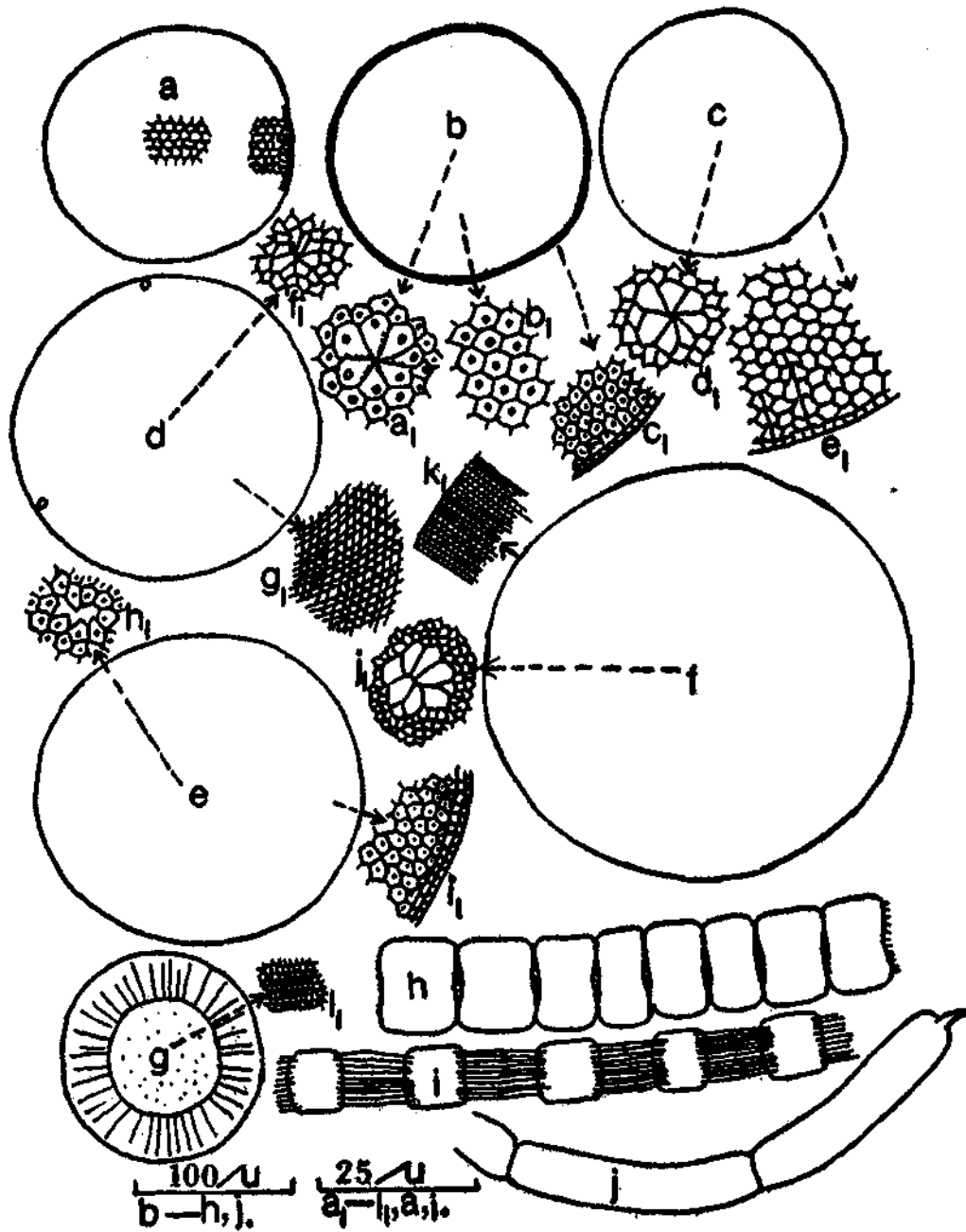


Fig. 1. a. *Coscinodiscus eccentricus* Ehrenberg; b. *C. oculusiridis* Ehrenberg; c. *C. perforatus* var. *pavillardi* (Forti) Hustedt; d. *C. jonesianus* (Greville) Ostenfeld; e. *C. asteromphalus* Ehrenberg; f. *C. concinnus* W. Smith; g. *Planktoniella sol* (Wallich) Schutt; h. *Lauderia annulata* Cleve; i. *Skeletonema costatum* (Greville) Cleve and j. *Rhizosolenia stouterfothii* H. Peragollo and a₁-l₁ — highly magnified.

Coscinodiscus oculus-iridis Ehrenberg (Fig. 1 b)

Ehrenberg, 1939. *Abh. Berl. Akad.*, p. 147; Allen and Cupp, 1935. p. 119, fig. 15; Subrahmanyam, 1946. p. 101, fig. 66-68 and 72.

Cells disc-shaped, large, dark coloured, with large areolation and a central rosette; 3 areolae in 10μ around the rosette, $2\frac{1}{2}$ areolae in 10μ between rosette and margin and 4-5 areolae in 10μ near margin; radial and secondary spiral series present; inner chamber opening clearly seen. Valves $160-175\mu$ diam.

Locality: Prentice Island (South 24-Paraganas. W.B.).

Coscinodiscus concinnus W. Smith (Fig. 1 f)

Smith, 1856. *Syn. Brit. Diat.*, 2: p. 85; Subrahmanyam, 1946. p. 98, fig. 44, 50, 53, 54 and 56.

Cells large, areolae in the centre form a well differentiated rosette, surrounding the centre; areolae suddenly become smaller and slender, about 8-10 areolae in 10μ at the centre and 11-12 in 10μ near the margin. Chamber openings indistinct. Two small asymmetrical processes clearly seen at about 120° apart; radial and secondary series regular, valves $250-300\mu$ dia.

Locality: Chandanpiri (South 24-Paraganas. W.B.).

Coscinodiscus perforatus var. **pavillardi** (Forti) Hustedt (Fig. 1 c)

Hustedt, 1930. Rabenhorst's *Kryptogamen—Fl.*, Bd. 7: Teil 1, p. 447, fig. 247,

=*Coscinodiscus pavillardi* Forti, 1922. *R. Com Talassograf. Ital.*, Mem. 97: p. 124, pl. 8, fig. 143; Subrahmanyam, 1946. p. 99, fig. 52, 57 and 61.

Cells disc-shaped, valves largely areolated with a central rosette, areolae in radial rows, 3-5 in 10μ around the rosette and 3-4 in 10μ near the margin; both radial and secondary systems of areolation seen; valves $145-165\mu$ diam.; margin striated, striae 6 in 10μ .

Locality: Prentice Island, Bhubaneswari (South 24-Parganas. W.B.).

Coscinodiscus asteromphalus Ehrenberg (Fig. 1 e)

Ehrenberg, 1844. *Ber. Berl. Akad.* p. 77; Allen and Cupp, 1935. p. 119, fig. 14; Subrahmanyam, 1946. p. 99, fig. 62-65.

Cell disc-shaped, valves depressed in the middle; areolae in radial rows, polygonal, almost all of same size, 3-4 in 10μ near centres and 4-5 in 10μ near margin; chamber opening clear; centre with a large rosette with or without a clear area at its centre; valves $200-215\mu$ diam.

Locality: Chandanpiri (South 24-Parganas. W.B.).

Genus Planktoniella Schütt**Planktoniella sol** (Wallich) Schütt (Fig. 1 g)

Schütt 1893. *Pflanzenleb. d. Hochsee*, p. 20, fig. 8.

=*Coscinodiscus sol* Wallich, 1860. *Trans. Micr. Soc. Bd., N.S.*, 8: p. 38, fig. 1, 2; Allen and Cupp, 1935. p. 121, fig. 19, Fritsch, 1935. p. 607, fig. 203C; Cupp, 1943. p. 63, fig. 27; Yamaji 1968. p. 21; Islam and Aziz, 1975. p. 6, pl. 1, fig. 19.

Cell disc-shaped, flat; valve surface areolated areolae hexagonal, arranged in parallel rows, areolae 12 in 10μ ; epitheca with wing like expansion all around provided with radial rays; frustules $70-80\mu$ diam.; frustules with wing $115-132\mu$ diam.

Locality: Prentice Island (South 24-Parganas W.B.).

Genus: Lauderia Cleve**Lauderia annulata** Cleve (Fig. 1 h)

Cleve, 1873. *Bih. Kongl. Sv. Vet.-Akad. Handl.*, 1 (11): p. 8; Allen and Cupp, 1935. p. 124 fig. 25; Subrahmanyam, 1946. p. 111, fig. 100, 102.

Cells cylindrical, touching the adjacent cell by their valve surface form a straight chain

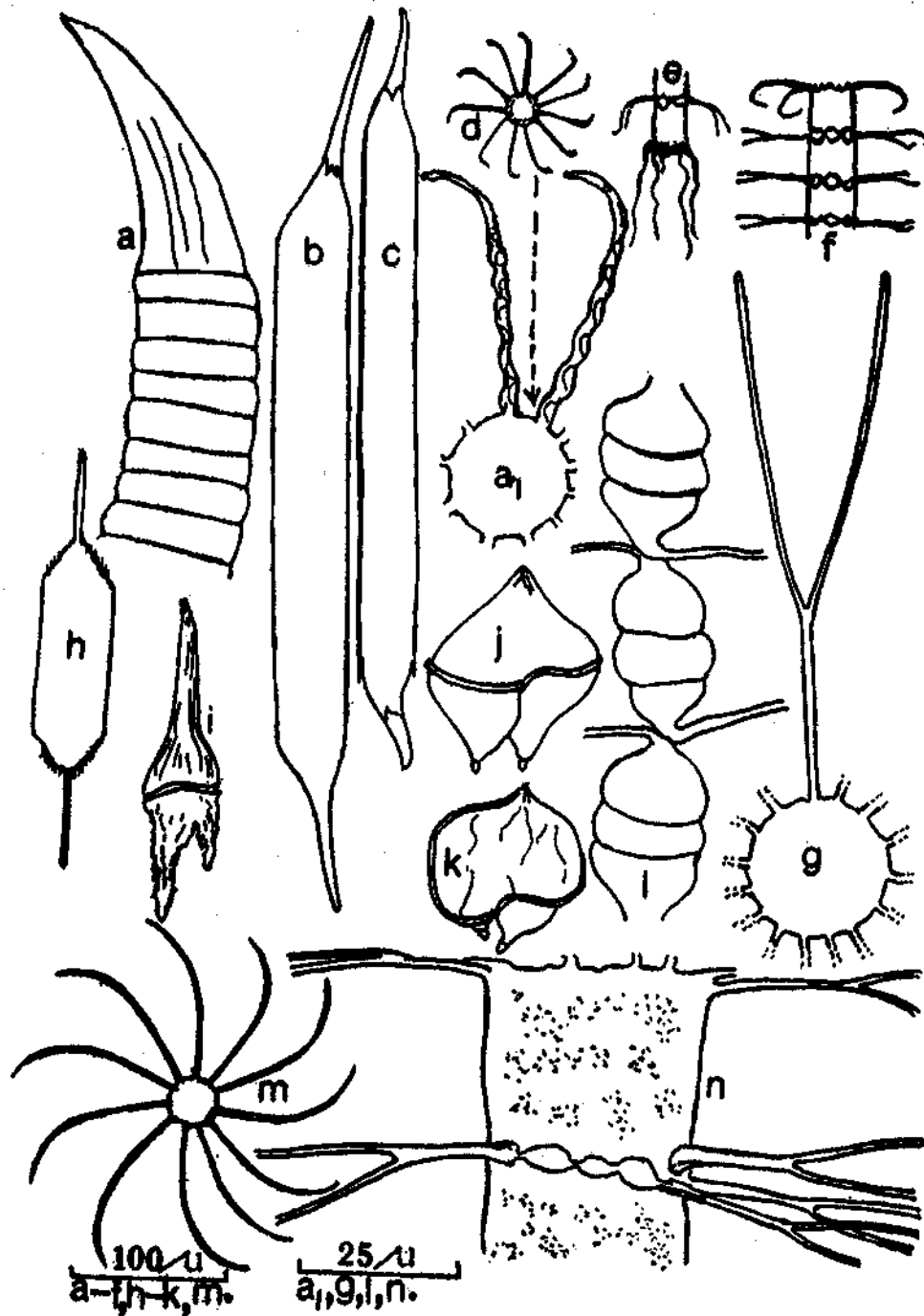


Fig. 2. a. *Rhizosolenia robusta* Norman; b. *R. setigera* Brightwell; c. *R. alata* Brightwell; d, e. *Bacteriastrum comosum* Pavillard; f, g. *B. varians* Lauder; h. *Ditylum brightwellii* (West) Grunow; i. *Ceratium furca* (Ehrenb.) Claparede et Lachmann; j, k. *Protoperidinium depressum* (Bailey) Balech; l. *Chaetoceros indicus* Subrahmanyan; m. *Bacteriastrum hyalinum* Lauder var. *princeps* (Castracane) Ikari and n. *B. hyalinum* Lauder and a₁—highly magnified.

valves slightly convex with a depression in middle and raised at margin; adjacent cells touch raised portions provided with short spines; frustules 32-50 μ long, 55-70 μ diam.

Locality: Saptamukhi, Prentice Island (South 24-Parganas, W.B.).

Genus: *Rhizosolenia* Ehrenberg

Rhizosolenia stolterfothii H. Peragallo (Fig. 1 j)

Peragallo, 1888. *Bull. Soc. Hist. Nat. Toulouse*, 22: p. 82, pl. VI fig. 44; Allen and Cupp 1935, p. 127 fig. 29; Cupp, 1943. p. 83, fig. 54. Subrahmanyam, 1946. p. 115, fig. 113, 115 and 117; Yamaji, 1975., p. 25, (1968); Islam and Aziz, p. 9, pl. 1, fig. 21.

Cells cylindrical, uniformly bent along pervalver axis and form spirally coiled chains; valve with spine for fitting into a depression of adjoining cell; frustules 140-160 μ long, 28-34 μ dia.

Locality: Prentice Island (South 24-Parganas, W.B.).

Rhizosolenia robusta Norman (Fig. 2 a)

Norman, 1861. In Pritchard *Infus.*, p. 866, pl. VIII, fig. 42; Allen and Cupp, 1935. p. 127, fig. 31; Subrahmanyam, 1946. p. 115, fig. 118-120, and 124; Cupp, 1943. p. 83, fig. 46; Yamaji, 1968. p. 109, Islam and Aziz, 1975. p. 8, pl. 1, fig. 15.

Cell crescent-shaped and cylindrical in the middle, valve ends conical, curved having fine excentric process; intercalary bands many, robust and collar shaped; cellwall easily breakable; frustules 580-600 μ long, 75-100 μ dia.

Locality: Saptamukhi, Prentice Island (South 24-Parganas, W.B.).

Rhizosolenia setigera Brightwell (Fig. 2 b)

Brightwell, 1858. *Quart. Journ. Micr. Sc.*, 6: p. 95, pl. V, fig. 7; Allen and Cupp, 1935. p. 129, fig. 37; Cupp, 1943. p. 88, fig. 49; Subrah-

manyam, 1946. p. 119, fig. 127, 140 and 142. Yamaji, 1968. p. 109; Islam and Aziz, 1975² p. 9, pl. 1, fig. 17.

Cells rod-shaped and cylindrical; apical processes long, hollow and slightly oblique ending in a long spine; intercalary bands scale like; frustules 40-50 μ dia., 510-560 μ long.

Locality: Saptamukhi, Prentice Island (South 24-Parganas W.B.).

Rhizosolenia alata Brightwell (Fig. 2 c)

Brightwell, 1855. *Quart. Journ. Micr. Sc.* 6: p. 96, pl. V, fig. 8; Allen and Cupp, 1935. p. 131, fig. 45; Subrahmanyam, 1946. p. 123, fig. 144, 148, 155.

Cells cylindrical, valves with short tube-like curved process at each end; a small depression at the base of each process into which apex of adjoining cell fits; intercalary bands scale like in two rows; frustules 450-510 μ long, 25-40 μ diam.

Locality: Prentice Island, Chandanpiri (South 24-Parganas, W.B.).

Genus: *Bacteriastrium* Shadbolt

Bacteriastrium hyalinum Lauder (Fig. 2 n)

Lauder, 1864. *Trans. Micr. Soc.*, (12) p. 6, pl. 3, fig. 7; Allen and Cupp, 1935. p. 132, fig. 47; Cupp, 1943. p. 96, fig. 56A; Subrahmanyam, 1946. p. 125, fig. 164, 166, 167, 169 173; Venkataraman, 1958. p. 312 fig. 16; Yamaji, 1968 p. 39; Islam and Aziz, 1975. p. 10, pl. 3 fig. 46-48.

Cells broader than long, form chains, setae numerous 20-24, setae of two adjoining cells fuse at base; terminal setae bent over chain axis; frustules 27-30 μ long, 32-34 μ dia.

Locality: Prentice Island (South 24-Parganas, W.B.).

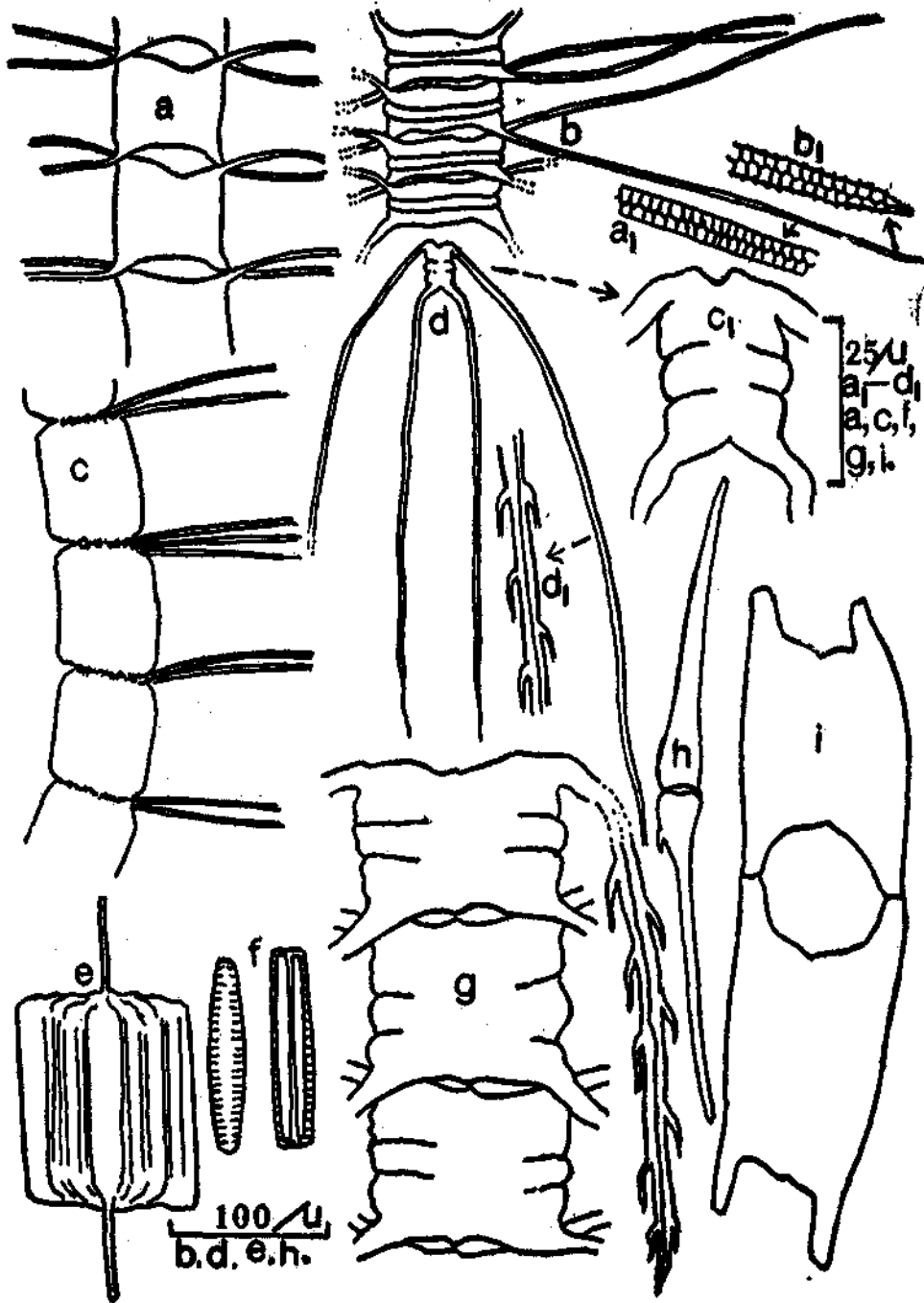


Fig. 3. a. *Chaetoceros curvisetus* Cleve; b. *C. lorenzianus* Grunow; c. *C. curvisetus* Cleve; d. *C. peruvianu* Brightwell; e. *Ditylum sol* Grunow; f. *Diatoma vulgare* Bory var. *lineare* Grun.; g. *Chaetoceros elbenti* Grunow; h. *Ceratium extensum* (Gourret) Cl. f. *strictum* (Okamura and Nishikawa) Steemann Nielsen and i. *Eucampia* sp. and a₁-d₁ — highly magnified.

Bacteriastrium hyalinum Lauder var. **princeps**
(Castracane) Ikari (Fig. 2 m)

Ikari, 1927. *J. On Bacter. of Japan* p. 423 fig. 3 ;
Castracane, 1886. *Diat. Chall. -Exped.* p. 84,
pl. 14, fig. 2, pl. 29, fig. 3 ; Subrahmanyam,
1946. p. 127, fig. 165 and 168.

Cells 20-31 μ in dia., setae 11, spirally twisted.

Locality: Prentice Island, Bhubaneswari
(South 24-Parganas, W.B.).

Bacteriastrium varians Lauder (Fig. 2 f, g)

Lauder, 1864. *Trans. Micr. Soc.*, p. 8, pl. III, fig.
1-6 ; Allen and Cupp, 1935. p. 133, fig. 48 ;
Subrahmanyam, 1946. p. 127, fig. 170-172 and
175.

Cells in chains, squarish in girdle view ;
setae 12-19, setae of two adjoining cells fuse
at base ; 18-33 μ dia., terminal setae with
fine spines.

Locality: Prentice Island (South 24-Parganas,
W.B.).

Bacteriastrium comosum Pavillard (Fig. 2 d, e)

Pavillard, 1916. *Rech. sur les diat. pelag. du Golfe
du Lion*, p. 29, pl. 1, fig. 3 ; Allen and Cupp,
1935. p. 133, fig. 50 ; Subrahmanyam, 1946
p. 128, fig. 176-178.

Cells cylindrical forming chains, with
apertures between adjoining cells ; setae 8-11,
setae of two adjoining cells fuse at base ;
anterior terminal setae curved, directed towards
the posterior part and with spirally arranged
spines ; fused basal part of inner setae remain
perpendicular to the chain axis and the bifur-
cated portion bends posteriorly, posterior
terminal setae thicker and hanging downwards ;
cells 15-20 μ diam.

Locality: Prentice Island (South 24-Parganas,
W.B.).

Genus : **Chaetoceros** Ehrenberg

Chaetoceros eibentii Grunow (Fig. 3 g)

Grunow, 1881. *Van Heurck, Syn.* pl. 82, fig. 9,
10 ; Allen and Cupp, 1935. p. 135, fig. 51 ;

Subrahmanyam, 1946. p. 128, fig. 179-181 ;
Yamaji, 1968. p. 110 ; Islam and Aziz 1975,
p. 11, pl. 5, fig. 69-70.

Cells cylindrical forming straight chains ;
apertures between adjoining cells elliptical ;
setae with bulbous base, interlocked with the
opposite setae at bases and armed with spines
distally ; tiny spine at the centre of the valve ;
frustules 23-28 μ long in girdle view, 30-325 μ
dia.

Locality: Prentice Island (South 24-Parga-
nas, W.B.).

Chaetoceros peruvianus Brightwell (Fig. 3 d)

Brightwell, 1856. *Quart. Journ. Micr. Sc.* 4 p. 107,
pl. 7, fig. 16-18 ; Allen and Cupp, 1935. p. 136,
fig. 56 ; Subrahmanyam, 1946. p. 129, fig. 191-
196.

Cells single, valves dissimilar, setae of upper
valve start from near the centre of the valve
in which a depression is seen and after turning
run backward ; setae of lower valve start near
the margin and slightly convex towards outside,
then run almost parallel to the perivalvar
axis ; setae four cornered with spines, frustules
23-30 μ long in girdle view, 17-22 μ dia.

Locality: Saptamukhi ; Chandanpiri (South
24-Parganas, W.B.).

Chaetoceros lorenzianus Grunow (Fig. 3 b)

Grunow, 1863. *Verh. zool. bot. Ges. Wien*, 13,
p. 157 pl. 5 fig. 13 ; Allen and Cupp, 1935.
p. 137 fig. 58 ; Cupp, 1943. p. 118, fig. 71 ;
Subrahmanyam 1946. p. 131 fig. 198-199,
202-204, 206-209 ; Islam and Aziz, 1975. p.
12, pl. 4, fig. 52-54, 56-57.

Cells form straight chain ; valve surface
slightly elevated at the centre ; setae four sided,
punctate-areolate ; terminal setae thicker inner
setae interlocking ; apertures between frustules
of varying sizes ; frustules 25-40 μ long in girdle
view, 45-75 μ dia., setae 150-280 μ long.

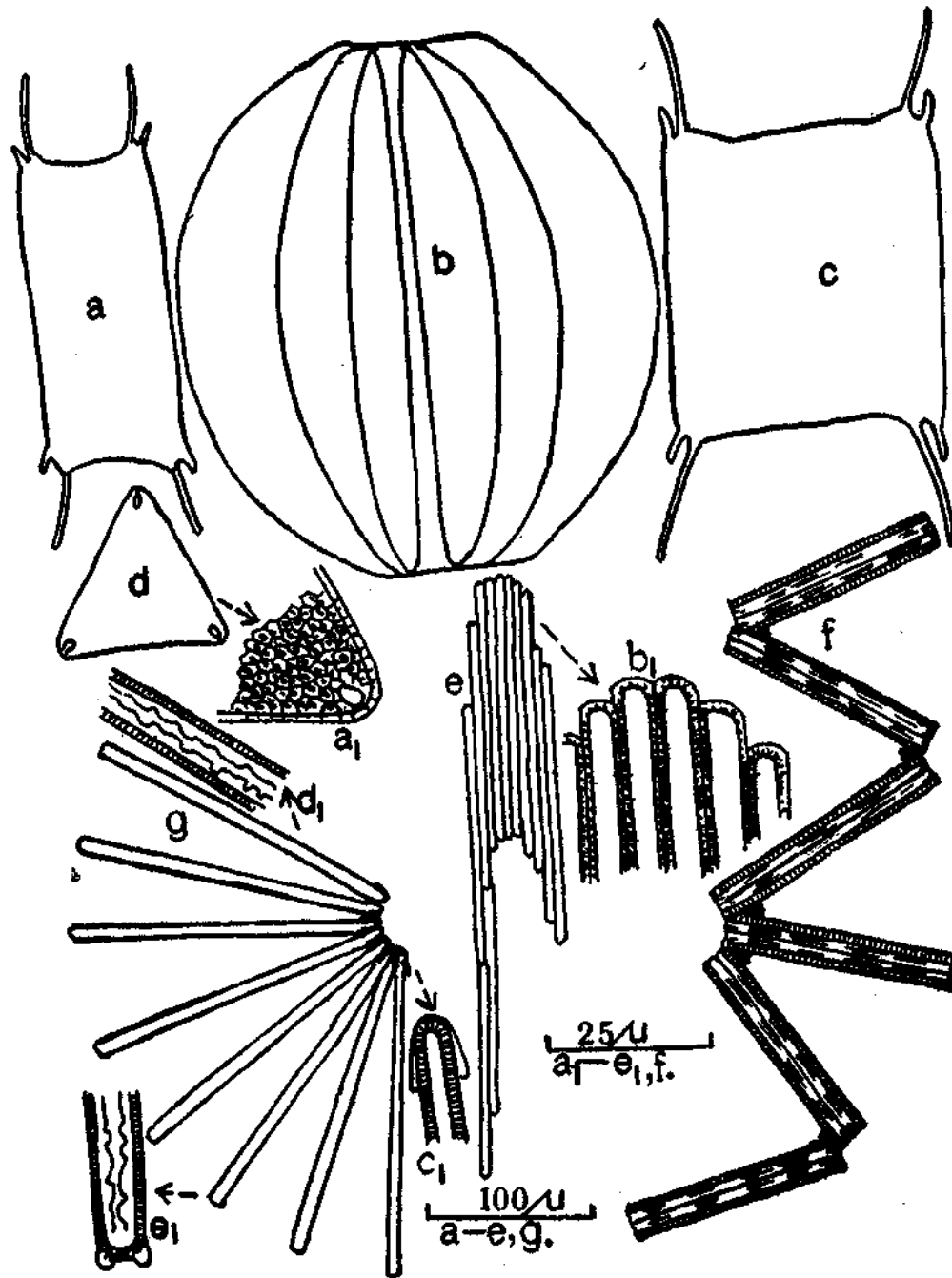


Fig. 4. a. *Biddulphia sinensis* Greville ; b. *Hemidiscus cuneiformis* Wallich ; c. *Biddulphia sinensis* Greville ; d. *Triceratium fuvus* Ehrenberg ; e. *Bacillaria paradoxa* Gmelin ; f. *Thalassionema nitzschioides* Grunow and g. *Thalassiothrix frauenfeldii* Grunow and a₁, c₁ — highly magnified.

Locality: Prentice Island, Chandanpiri, Bhubaneswari, Saptamukhi (South 24-Parganas, W.B.).

Chaetoceros indicus Subrahmanyam (Fig. 2 l)

Subrahmanyam, 1946. p. 133, fig. 197, 205, 210.

Cells forming straight chains, Madgeburgh-sphere-shaped in girdle view; setae starting from the corners armoured with short spines; frustules 22-28 μ long in girdle view, 15-17 μ dia.

Locality: Prentice Island (South 24-Paraganas, W.B.).

Chaetoceros curvisetus Cleve (Fig. 3 a, c)

Cleve, 1889. *Vidensk. Udb. Kanonbaad. Haucks Tugt. danske Have*, p. 55; Cupp, 1943. p. 137, fig. 93; Subrahmanyam, 1946. p. 143, fig. 238, 244-246; Yamaji, 1968. p. 135; Islam and Aziz, 1975. p. 11, pl. 6, fig. 75 A-B.

Cells in curved chain, frustules four cornered and bent, in broad girdle view oblong; setae arising from corners of cells; all bent towards same side-towards outside of curved axis; frustules 14-19 μ long 13-17 μ dia., setae 30-35 μ long.

Locality: Prentice Island, Bhubaneswari (South 24-Paraganas, W.B.).

Genus: **Eucampia** Ehrenberg

Eucampia sp. (Fig. 3 i)

Cells flat, united in straight chain by blunt processes; valves concave in the middle part so that a large space occurs between neighbouring cells; frustules 26-35 μ long 25-28 μ dia., processes 5-10 μ long.

Locality: Prentice Island, Chandanpiri (South 24-Parganas, W.B.)

Genus: **Ditylum** L. W. Bailey

Ditylum brightwellii (West) Grunow (Fig. 2 h)

Grunow, v. H. Syn., pl. 114, (1881).

= *Triceratium Brightwellii* West, 1860. *Trans. Micr. Soc.*, 8: p. 149, pl. 7, fig. 6; Cupp, 1943. p. 148, fig. 107-A, B; Subrahmanyam, 1946. p. 147, fig. 263, 264; Yamaji, 1968. p. 38; Islam and Aziz, 1975. p. 14, pl. 7, fig. 85.

Cells prism-shaped, 3-4 times as long as broad; with a central spine, rim of valve with small spines; frustules 130-155 μ long, 25-50 μ dia., central spine 45-55 μ long.

Locality: Prentice Island, Chandanpiri, Bhubaneswari (South 24-Paraganas, W.B.).

Ditylum sol Grunow (Fig. 3 e)

Grunow, 1881. *In van Heurck, Syn.* pl. 115, fig. 1, 2; Subrahmanyam, 1946. p. 149, fig. 266; Yamaji, 1968. p. 38; Islam and Aziz, 1975. p. 14, pl. 7, fig. 86.

Cells very large, valve surface waved with a central spine, no small spines on valve, many longitudinal lines in girdle view; frustules 130-155 μ long, 100-125 μ dia.; spines 50-95 μ long.

Locality: Prentice Island, Chandanpiri, Saptamukhi, (South 24-Parganas, W.B.).

Genus: **Triceratium** Ehrenberg

Triceratium favus Ehrenberg (Fig. 4 d)

Ehrenberg, 1841. *Abh. Berl. Akad.* 1839, p. 159, pl. 4, fig. 10; Subrahmanyam, 1946. p. 150, fig. 265, 267, 271, pl. 1, fig. 5.

Cells with three cornered valvar plane and short perivalvar axis; corners rounded, side measuring 100-110 μ ; areolae 2-3 μ dia., almost all of same size; chamber opening clear.

Locality: Saptamukhi (South 24-Parganas, W.B.).

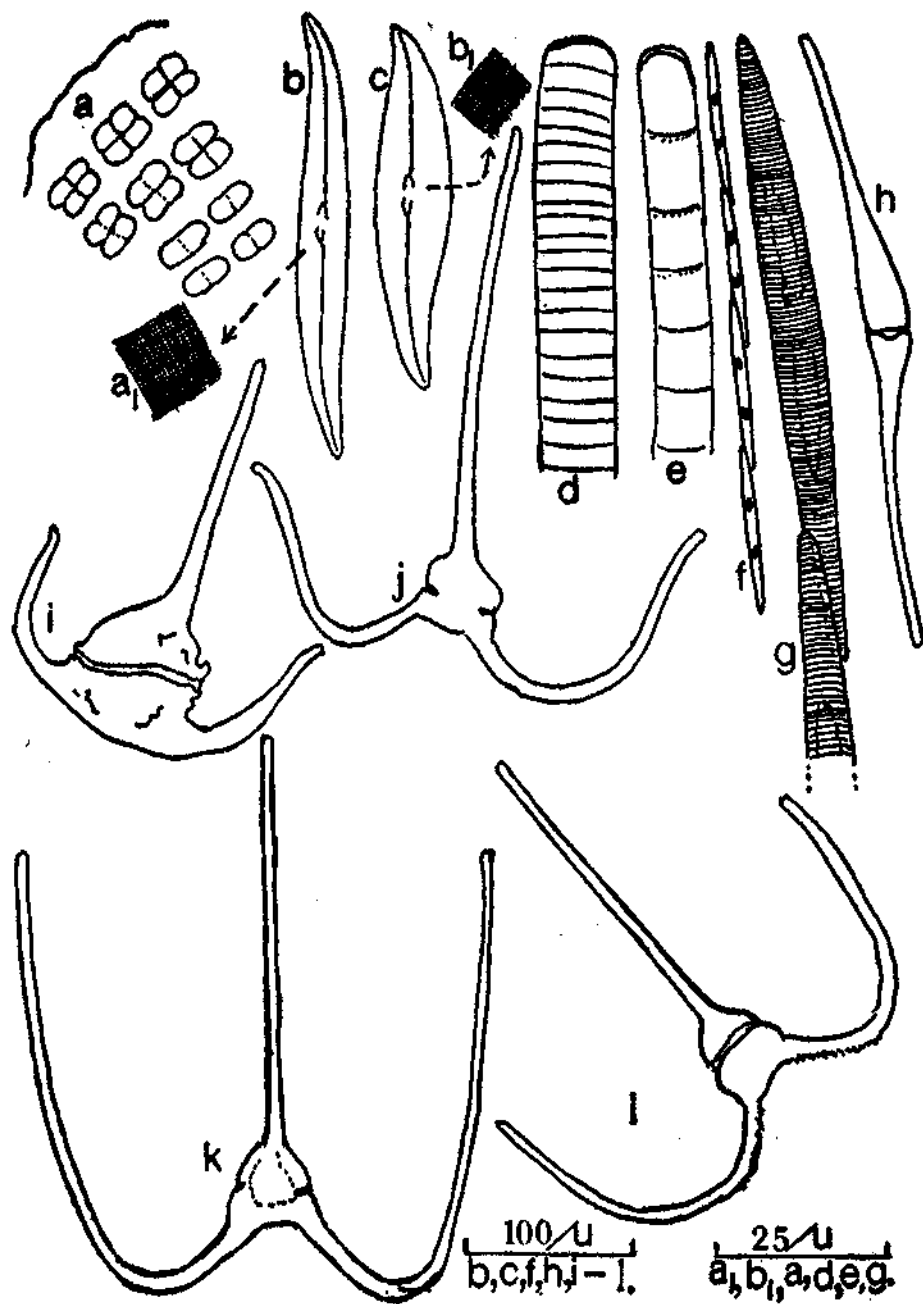


Fig. 5. a. *Merismopedia glauca* (Ehrenb.) Nag. ; b. *Pleurosigma elongatum* Smith ; c. *P. normanii* Ralfs ; d. *Oscillatoria limosa* Ag. ex Gomont ; e. *Trichodesmium thiebautii* Gomont ; f, g. *Nitzschia seriata* Cleve ; h. *Ceratium extensum* (Gourret) Cleve ; i. *Ceratium tripos* (O.F. Muller) Nitzsch ; j. *C. trichoceros* (Ehrenb.) Kofoid var. *contrarium* (Gourret) Schiller and k. *C. trichoceros* (Ehrenb.) Kofoid ; l. *C. horridum* Gran and a₁-b₁ — highly magnified.

Genus : *Biddulphia* Gray*Biddulphia sinensis* Greville (Fig. 4 a, c)

Greville, 1866. *Trans. Micr. Soc. Lond.*, 14 : p. 81, pl. 9, fig. 16; Allen and Cupp, 1935. p. 146, fig. 81; Subrahmanyam, 1946. p. 154, fig. 281, 289; Islam and Aziz, 1975. p. 13, pl. 7, fig. 93.

Cells large, valve end concave or convex; square to rectangular in girdle view and ovate to lanceolate in valve view, with short thin blunt horns and long, thin spines at the corners; 80-160 μ (-200 μ) long in girdle view, 65-150 μ (-200 μ) dia., horns 14-17 μ long; spines 52-58 μ long.

Locality: Prentice Island, Saptamukhi, Bhubaneswari, Chandanpiri (South 24-Parganas, W.B.).

Genus : *Hemidiscus* Wallich*Hemidiscus cuneiformis* Wallich (Fig. 4 b)

Wallich, 1860. *Trans. Micr. Soc. Lond.*, (8) p. 42, pl. 2, fig. 3, 4; Cupp, 1968. p. 170, fig. 121, (1943); Yamaji, p. 15. Islam and Aziz, 1975. p. 7, pl. 6, fig. 79-80.

Valves semicircular; ventral margin straight; ends obtuse; frustules 300-400 μ dia., each valve 140-200 μ broad.

Locality: Saptamukhi (South 24-Parganas, W.B.).

Order : Pennales

Genus : *Diatoma* De Candolle*Diatoma vulgare* Bory var. *lineare* Grun. (Fig. 3 f)

Grunow, 1881. in *Van Heurck, Syn.* pl. 50, fig. 8, 8; Synonym: *Diatoma vulgare* forma *abbreviata* Partocsek, 1902. *Bacill. Bal.* p. 80, pl. 9, fig. 236, *Diatoma grande* var. *linearis* Meister, 1912. *Kieselalg. d. Schw.* p. 62; Islam and Aziz, 1975. p. 15, pl. 8, fig. 95-97.

Valve lanceolate, transverse coastae present across the valve; frustules 28-33 μ long, 5.5-6.3 μ dia.

Locality: Prentice Island (South 24-Parganas, W.B.).

Genus : *Thalassiothrix* Cleve and Grunow*Thalassiothrix frauenfeldii* Grunow (Fig. 4 g)

Cleve and Grunow, 1880. *Beilage Z. Kenntniss d. Arct. Diat.*, p. 109; Allen and Cupp, 1935. p. 154, fig. 97; Cupp, 1943. p. 184, fig. 135; Subrahmanyam, 1946. p. 169, fig. 349, 351, 354-357 and 360; Yamaji, 1968. p. 26; Islam and Aziz, 1975. p. 15, pl. 8, fig. 98-99.

Cells forming stellate colony, in girdle view linear and poles dissimilar, one end bluntly pointed and other end widened; pseudoraphe present throughout the whole length; frustules 188-210 μ long, 6-7.5 μ dia., striae 12 in 10 μ .

Locality: Prentice Island, Chandanpiri, Bhubaneswari (South 24-Parganas, W.B.).

Genus : *Thalassionema* Grunow*Thalassionema nitzschioides* Grunow (Fig. 4 f)

Van Heurck, 1899. *Traite des Diatomees*, p. 314, pl. X, fig. 434; Cupp, 1943. p. 182, fig. 133; Subrahmanyam, 1946. p. 167, fig. 344-346; Yamaji, 1968. p. 27, pl. 5, fig. 13; Islam and Aziz, 1975. p. 15, pl. 8, fig. 100-101.

Cells form zig-zag chains due to the presence of protoplasmic cushions at junctions; in girdle view cells linear rectangular, both poles alike; frustules 30.5-36 μ long, 4-5.5 μ diam., striae 12-14 in 10 μ , here striae slightly closer.

Locality: Prentice Island, Saptamukhi (South 24-Parganas, W.B.).

Genus : *Pleurosigma* W. Smith*Pleurosigma elongatum* W. Smith (Fig. 5 b)

Smith, 1852. *Notes. Diat. Pleurosigma*, pl. 1, fig. 4; Allen and Cupp, 1935. p. 157, fig. 105; Subrahmanyam, 1946. p. 175, fig. 380-382.

Cells slightly sigmoid, elongated, gradually attenuated, ends acute; raphe central and sigmoid, 210-280 μ long, 27-35 μ broad; striae about 21 in 10 μ .

Locality: Prentice Island (South 24-Parganas, W.B.).

Pleurosigma normanii Ralfs (Fig. 5 c)

Pritchard, 1861. *Hist Infusoria*, p. 919; Allen and Cupp, 1935. p. 157, fig. 106; Cupp, 1943. p. 196, fig. 148; Subrahmanyam, 1946. p. 175, fig. 378, 379 385 and 387; Yamaji, 1968. p. 107, fig. 6; Islam and Aziz, 1975. p. 16, pl. 8, fig. 108.

Valves broadly lanceolate, slightly sigmoid, ends subacute; raphe sigmoid; valve 205-250 μ long, 40-52 μ broad in the middle; striae 18-21 in 10 μ .

Locality: Saptamukhi (South 24-Parganas, W.B.).

Genus: *Bacillaria* Gmelin

Bacillaria paradoxa Gmelin (Fig. 4 e)

Smith, 1856. *W., Syn Brit. Diat.* 2: p. 10, pl. 32, fig. 279; Allen and Cupp, 1935. p. 162, fig. 117; Subrahmanyam, 1946. p. 187, fig. 417, 421 and 427.

Cells in girdle view linear rectangular, forming a mat-like colony; cells 152-200 μ long and 5.5-7 μ diam.

Locality: Prentice Island (South 24-Parganas, W.B.).

Genus: *Nitzschia* Hassal

Nitzschia seriata Cleve (Fig. 5 f, g)

De-Toni, 1891-94. *Syll. Alg.*, 2: p. 501; Allen and Cupp, 1935. p. 164, fig. 124; Subrahmanyam, 1946. p. 191, fig. 432-434.

Cells spindle-shaped with pointed ends, arranged in long chains by overlapping tips of the cells, frustules 90-105 μ long, 5-7 μ dia, striae 12 in 10 μ in the middle.

Locality: Prentice Island, Bhubaneswari (South 24-Parganas, W.B.).

Class: DINOPHYCEAE

Order: Peridinales

Genus: *Ceratium* Schrank

Ceratium extensum (Gourret) Cleve (Fig. 5 h)

Cleve, 1901. *K. Sv. Vet. Akad. Handl.* 35 (5), p. 14; 1903. *Ark. Zool.*, 1, p. 340; = *C. furca* v. *mediterraneum* Gourret, 1883. *Ann. Mus. Hist. Nat. Marseille, Zool.* 1: p. 49, pl. 1, fig. 13; Subrahmanyam, 1968. p. 32, fig. 56, 57; Islam and Aziz, 1975. p. 17, pl. 9, fig. 114.

Cells very long, having long, narrow epitheca with long, straight gradually narrowed apical horn; hypotheca shorter than epitheca and produced into long, slightly curved left horn; right posterior horn absent; cell proper 65-75 μ long, 26-30 μ dia., apical horn 135-155 μ long, posterior horn 135-160 μ long.

Locality: Chandanpiri, Prentice Island (South 24-Parganas, W.B.).

Ceratium extensum (Gourret) Cl. f. **strictum** (Okamura and Nishikawa) Steemann Nielsen (Fig. 3 h)

Steemann Nielsen, 1934. *Dana-Rep.*, 4, p. 14, fig. 24; Subrahmanyam, 1968. p. 33; Aziz and Islam, 1979. p. 48, pl. 3, fig. 44.

Epitheca long, narrow with slightly bent apical horn; hypotheca shorter than epitheca, left posterior horn narrow, more or less bent; rarely straight, right horn little developed, pointed, 4-6 μ long; cell proper 60-70 μ long, 23-28 μ , diam., apical horn 135-165 μ long, left posterior horn 135-160 μ long.

Locality: Prentice Island, Chandanpiri (South 24-Parganas of W.B.).

Ceratium furca (Ehrenb.) Claparede et Lachmann (Fig. 2 i)

Cleve, 1903. *Ark. Zool.*, p. 341, (1903); Subrahmanyam, 1968. p. 20, pl. II, fig. 7-12; text figs. 21-29; Salam and Khan, 1979. p. 34, fig. 3.

Epitheca narrowing and forms a long apical horn; posterior horns parallel, more or less pointed, toothed, left one is double as long as the right, both ending in a point; cell proper 40-52 μ long, 34-48 μ dia.; apical horn 75-80 μ long; left posterior horn 47-56 μ long, right posterior horn 25-27 μ long.

Locality: Prentice Island, Chandanpiri, (South 24-Paraganas, W.B.).

Ceratium tripos (O. F. Müller) Nitzsch (Fig. 5 i)

Müller, 1786. *Animalcula infusoria fluvialitilis et marina.*, p. 136, pl. 19, fig. 22; Cleve, 1901. *K. Sv. Vet. Akad. Handl.*, 35 (5): p. 14; Subrahmanyam, 1968. p. 35, fig. 59; pl. III, fig. 17, 18; Islam and Aziz, 1975. p. 19, pl. 9, fig. 113; pl. 10, fig. 126.

Cell large, body as broad as long; epitheca twice as broad as long; left side contour concave, right side strongly convex; all the horns robust; right posterior horn weakly developed than left; cell proper 80-85 μ long, 75-82 μ dia., apical horn 150-165 μ long, posterior horns 120-135 μ long from the place of joining; both horns more or less equal in length.

Locality: Prentice Island (South 24-Parganas, W.B.).

Ceratium horridum Gran (Fig. 5 l)

Gran, 1902. *Rep. Norweg. Fish. Invest.* 2 (5): p. 54, 193, 194; Subrahmanyam, 1968. p. 63, fig. 127; Islam and Aziz, 1975. p. 18, pl. 9, fig. 111.

Epitheca triangular in outline shorter than the hypotheca, produced into straight long slightly bent apical horn; left posterior horn converging in relation to the apical horn; right posterior horn diverging from the apical horn; dentation at the curvatures of the posterior horns; cell proper 39-49 μ long, 38-42 μ dia., apical horn 150-210 μ long; posterior right horn 230-250 μ long; posterior left horn 225-238 μ long.

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Locality: Prentice Island, Saptamukhi, Chandanpiri (South 24-Parganas, W.B.).

Ceratium trichoceros (Ehrenberg) Kofoid (Fig. 5 k)

Kofoid, 1908. *Zool. Anz.*, 4 (7), p. 388; Subrahmanyam, 1968. p. 81, pl. VII, fig. 37.

Long-horned species; body longer than broad; epitheca slightly oblique and longer than hypotheca; length of hypotheca shorter than breadth; all the three horns long and directed parallel; both horns are more or less equal in length, cell proper 53-57 μ long, 40-48 μ dia., apical horn 210-240 μ long, posterior horns 340-380 μ long from the place of joining.

Locality: Bhubaneswari, Chandanpiri, Prentice Island (South 24-Parganas, W.B.).

Ceratium trichoceros (Ehrenb). Kofoid var. **contrarium** (Gouret) Schiller (Fig. 5 j)

Schiller, 1937. in *Rabenhorst's Kryptogamen Fl.* 10, Abt. 3, Teil 2, p. 431, fig. 471; Subrahmanyam, 1968. p. 82, fig. 148.

Epitheca is broader than length; produced into straight slightly curved long apical horn; posterior horns directed backward for a small distance and then forwardly directed, undulate, bent and diverging in relation to one another and apical horn, the right horn is smaller and not lying so far back as of left; the cell proper 45-50 μ long, 50-55 μ diam, apical horn 250-280 μ long; right posterior horn 190-220 μ long, and left posterior horn 215-250 μ long.

Locality: Prentice Island (South 24-Parganas, W.B.).

Genus: **Protoperidinium** Bergh

Protoperidinium depressum (Bailey) Balech (= **Peridinium depressum** Bailey) (Fig. 2 j, k)

Balech, 1974. *Hydrobiol.*, 4 (1): p. 1; Bailey, 1855. *Smithsonian Inst. Contrib. Know.* p. 12,

fig. 33-34; Subrahmanyam, 1968. p. 80, pl. LV, f. 4, 6, 7; Aziz and Islam, 1979. p. 44, pl. 3, f. 36-38.

Cell broad, flattened obliquely dorsoventrally; apical horn distinct, girdle slightly left handed, excavated; hypotheca with two antapical horns; cell 120-140 μ long, 100-125 μ diam.

Locality: Prentice Island (South 24-Parganas, W.B.).

CLASS : CYANOPHYCEAE

Order : Chroococcales

Genus : *Merismopedia* Meyen

Merismopedia glauca (Ehrenb.) Nag. (Fig. 5 a)

Gatt. 1849. *einzell. Algen*, p. 55, pl. 1D, fig. 1; Geitler, 1932. p. 264, fig. 129 d; Desikachary, 1959. p. 155. pl. 29. fig. 5.

Thallus 200 μ long, 150 μ broad; cells spherical to subspherical, closely arranged, colonies of 4-8 cells, cell 4.0-5.5 μ long, 3-4 μ broad, pale blue-green colour.

Locality: Prentice Island (South 24-Parganas, W.B.).

Order : Nostocales

Genus : *Trichodesmium* Ehrenb.

Trichodesmium thiebautii Gomont (Fig. 5 e)

Gomont, 1890. *J. de Bot.*, 4 : p. 356; Desikachary, p. 243, pl. 42, fig. 4, 5.

Trichome in free swimming bundles, colour blue green, not constricted at cross walls, thickened at apices, cells 8-10 μ long, 7.5-10.0 μ broad.

Locality: Prentice Island (South 24-Parganas, W.B.).

Genus : *Oscillatoria* Vaucher

Oscillatoria limosa Ag. ex Gomont (Fig. 5 d)

Agardh, 1812. *Dispositio Algarum Sueciae*, p. 35; Gomont, 1892. *Monogr. Oscillariees*, p. 210, pl. 6, fig. 13; Desikachary, 1959. p. 206, pl. 42, fig. 11.

Trichome more or less straight, not constricted at cross-walls, 11-14 μ broad; cells 2-4 μ long; end-cells flatly rounded with slightly thickened membrane.

Locality: Prentice Island (South 24-Parganas, W.B.).

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