A SYSTEMATIC ACCOUNT OF THE LITTORAL DIATOMS OF THE SOUTHWEST COAST OF INDIA

C. P. GOPINATHAN*

Central Marine Fisheries Research Institute, Cochin-682 031

ABSTRACT

In this account, a systematic enumeration of 109 littoral and epiphytic diatoms of the south west coast of India is presented. This work forms a supplement to the available information regarding the diatom flora of the Indian Seas.

INTRODUCTION

ALTHOUGH some work has been done on the taxonomy of the plankton diatoms of the Indian Seas (Venkataraman, 1939; Menon, 1945; Subrahmanyan, 1946; Nair, 1959; Gopinathan, 1975) very little information is available on the littoral and epiphytic diatoms of our coastal waters. Gandhi (1965, 1967) reported on several species of freshwater littoral forms from the North Indian waters. Apart from the studies by Misra (1956) on the littoral diatoms of the west coast of India, no systematic study has been made hitherto on the littoral marine forms from the Indian waters. In view of this fact, an attempt was made to enumerate the littoral diatoms of the south west coast of India, especially from the estuarine and inshore area of Cochin.

Altogether 109 diatoms have been described including 10 varieties and a new species, representing 40 genera. Out of these 8 genera and 17 species belong to the group Centrales and 32 genera and 92 species to the Pennales. The diatoms showed a good deal of resemblance to those of the British coast (Hendey, 1964). Many of the diatoms described here have been recorded previously from the east coast (Subrahmanyan, 1946) and a few forms from the Trivandrum coast (Nair, 1959), yet 49 species are found to be new distributional records from the Indian waters. The classification followed is that of Schutt (1896) as later modified by Hustedt (1930).

* Present address: Tuticorin Research Centre of CMFRI, 93 North Beach Road, Tuticorin 628 001.
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Taxonomy

Order : CENTRALES
Sub Order : DISCOIDEAE
Family : Coscinodiscaceae
Sub-Family : Melosirineae
Genus Podosira Ehrenberg

Podosira montagnei Kutzting (Fig. 1 a)

Podosira montagnei Kutzting, 1844, p. 52, pl. 29; fig. 85; Smith, 1856, p. 53, pl. 59, fig. 326; Hustedt, 1930, p. 281, fig. 122; Subrahmanyan, 1946, p. 87, figs. 5, 6, 10; Mistry, 1956, p. 538, fig. 4; Hendey, 1964, p. 90.

Podosira lancea Gregory, Greville, 1859, p. 53, pl. 6, figs. 15-17; Melosira montagnei Lagerstedt, 1876, p. 9.

Cells round cylindrical, united to form short chains, attached to higher algae. Cell wall areolated, areolae 22 in 10 μ. In valve view the areolae arranged in straight oblique lines. Girdle composed of intercalary bands. Length of valve 46 μ.

Distribution : Atlantic Coast, coastal areas of Britain, Caspian Sea and coasts of India.

Genus Cyclotella Kutzting

Cyclotella striata (Kutzting) Grunow (Fig. 1 b)

Cyclotella striata (Kutzting) Grunow, 1880, p. 119; Van Heurck, 1899, p. 444, pl. 22, fig. 651; Boyer, 1926, p. 37; Hustedt, 1930, p. 744, fig. 176; Wood, 1963, p. 256, pl. 6, fig. 98; Subrahmanyan, 1946, p. 92, fig. 31; Hendey, 1964, p. 131, pl. 1, fig. 8; Foged, 1975, p. 20; Huang, 1979, p. 196, pl. 1, fig. 1.

Cyclotella striata Kutzing 1844, p. 131, pl. 1, fig. 8.

Cyclotella datastricta Smith, 1856, p. 87.

Cyclotella radiata Brightwell, 1860, pl. 6, fig. 11.

Cells discoid, rectangular, valves with two distinct surface areas, the central portion coarsely punctate, valve surface striate, striae 12 in 10 μ. Diameter of valve 45 μ.

Distribution : Estuaries of Atlantic Coast, North Sea Coast and coasts of India.

Family : Actinodisceae

Sub-Family : Actinoptychineae

Genus Actinopychus Ehrenberg

Actinopychus senarios (Ehrenberg) Ehrenberg, (Pl. I A)

Actinopychus senarios Ehrenberg, 1843, p. 6, pl. 1, fig. 27; Hendey, 1937, p. 271; 1951, p. 32, pl. 8, fig. 11; 1964, p. 95, pl. 23, fig. 1-2; Wood, 1963, p. 241, pl. 1, fig. 14; Huang, 1979, p. 196, pl. 1, fig. 11.

Actinopychus undulatus (Bailey) Ralfs, Hustedt, 1930, p. 475; Lebour, 1930, p. 51, fig. 27; Allen and Cump, 1935, p. 121, fig. 20.

Cells discoid, valves divided into 6 sectors, alternately raised and depressed. Central area hexagonal, hyaline. The raised sectors possess a short blunt process in the middle near the margin. Valve surface strongly areolated, areolae 6 in 10 μ. Depressed sectors with processes, areolae not so prominent. Diameter of valve 56 μ.

Distribution : European coastal waters, Atlantic and Pacific Coasts, coastal waters of Australia and India.

Actinopychus splendens (Shadbolt) Pritchard (Pl. I B)

Actinopychus splendens Pritchard, 1861, p. 860; Van Heurck, 1899, p. 497, pl. 22, fig. 649; Lebour, 1930, p. 51, pl. 1, fig. 6; Nair, 1959, p. 10, fig. 25; Hendey, 1964, p. 95, pl. 22, fig. 1.
Actinosphenio splendens Shadbolt, 1854, p. 116;
Actinoptychus quattuordecimarius Ehrenberg, 1854, pl. 18, fig. 25.
Actinoptychus halionyx Grunow, 1860, p. 25.

Valves circular, divided into 18 sectors that are alternately raised and depressed. Valve structure complex, alternate sectors differ in structure with coarse hexagonal areolae and are of fine areolae. Central space large, stellate, valve margin narrow. Diameter of valve 85 µ.

Distribution: Atlantic and Pacific Coasts, coastal regions of Mediterranean, Java Seas and west coast of India.

Sub Order: Biddulphioideae
Sub-Family: Anauleae
Genus Terpsinoe Ehrenberg

Terpsinoe musica Ehrenberg (Fig. 1 c)
Terpsinoe musica Ehrenberg in De Toni, 1894, p. 894; Van Heurck, 1899, p. 452, fig. 176; Boyer, 1927, p. 144; Hustedt, 1930, p. 998, fig. 540; Venkataraman, 1939, p. 301, fig. 15: 18-21.

Valves quadrangular in girdle view, united to form zig-zag chains. The septa of the frustules thickened to form a structure resembling the musical notes. Valves linear, elliptical with undulating sides, slightly knobbed at the ends. The septa divides the inner side into 5-6 chambers. Surface of valve coarsely punctate. Length of valve 112 µ and breadth 64 µ.

Distribution: Estuaries in Europe, British coastal waters, east coast of India.

Family: Eupodiscaceae
Sub-Family: Eupodiscineae
Genus Auliscus Ehrenberg

Auliscus sculptus (Smith) Ralfs (Fig. 1 d)
Auliscus sculptus Ralfs in Pritchard, 1861, p. 845, pl. 6, fig. 3; Schmidt, 1875, p. 32, figs. 21-22

Van Heurck, 1899, p. 482, pl. 21, fig. 646; Subrahmanyan, 1946, p. 108, figs. 93, 97; Hendey 1964, p. 98, pl. 25, fig. 4.

Eupodiscus sculptus Smith, 1853, p. 25, pl. 4, fig. 42.

Auliscus caecatus Bailey, 1854, p. 6, pl. 1, figs. 3-4.

Cells discoid, broadly elliptical, median area clear and distinct. Valves furnished with two large slightly produced ocelli which are situated near the margin, termed as ‘eyes’ facing opposite each other. Valves sculptured strongly radial ribs, which are faint towards the centre. Valves radially striated, striae 26 in 104. Diameter of valve 62 µ in long axis and 56 µ in short axis.

Distribution: North Sea Coastal, West Indies, coastal waters of Australia and India.

Family: Biddulphioideae
Sub-Family: Triceratineae
Genus Triceratium Ehrenberg

Triceratium dubium Brightwell (Fig. 1 e)
Triceratium dubium Brightwell, 1839, p. 180, pl. 9, fig. 17; Hustedt, 1930, p. 406, fig. 469; Subrahmanyan, 1946, p. 151, figs. 274-276; Misra, 1956, p. 542, fig. 14; Huang, 1979, p. 201, pl. 2, fig. 3.

Triceratium bicornum Cleve, 1878, p. 17, pl. 6, fig. 30.

Amphitetrus bicornis De Toni, 1891, p. 902.

Biddulphia dubia Cleve in Boyer, 1900, p. 707; Allen and Cupp, 1935, p. 148, fig. 84.

Cells rhomboid, lanceolate and four sided. In side view of the valve, two angles, each with a stout horn-like process, and the other angle with short blunt process. Valves strongly sculptured, irregularly areolated, valve margin striated. Length of apical axis, 65 µ.

Distribution: European coastal waters, Atlantic and Pacific Coasts, coasts of Australia and India.
Triceratium reticulatum Ehrenberg (Fig. 1 f)

*Triceratium reticulatum* Ehrenberg, 1844, p. 88, pl. 18, fig. 20; Hustedt, 1930, p. 823, figs. 483-486; Subrahmanyan, 1946, p. 151, figs. 274, 280.

*Triceratium sculptum* Shadbolt, 1854, p. 15, pl. 1, fig. 4.

*Triceratium punctatum* Brightwell, 1856, p. 275, pl. 9, fig. 18.

*Biddulphia sculpa* Van Heurck, 1899, p. 151, figs. 274, 280.

*Triceratium reticulatum* Ehrenberg, 1844, p. 88, pi. 18 fig. 50; Hustedt, 1930, p. 823, figs. 483-486; Subrahmanyan, 1946, p. 151, figs. 274, 280.

*Triceratium sculptum* Shadbolt, 1854, p. 15, pi. 1, fig. 4.

*Triceratium punctatum* Brightwell, 1856, p. 275, pi. 9, fig. 18.

*Subrahmanyan*, 1946, p. 151, figs. 274, 280.

Cells with triangular valves and rounded corners. Valves punctate, small at the peripheral region and larger at centre, scattered and of different sizes, groups of areolae seen separated by a hyaline ring. Length of valve 115μ.

*Distribution*: Coastal waters of Europe, Mediterranean and Scandinavian Coasts, Texas Bay, coasts of India.

*Triceratium robertsianum* Greville (Fig. 1 g)

*Triceratium robertsianum* Greville, 1863, p. 231, pl. 9, fig. 9; Hustedt, 1930, p. 803, fig. 466; Subrahmanyan, 1946, p. 150, figs. 272-273.


Valves triangular with convex sides, angles rounded, strongly sculptured. Valve corners with hollow cylindrical process. Length of valve 135μ.

*Distribution*: Mediterranean Coast, Texas Bay, east coast of Africa, coasts of Australia and India.

*Sub-Family*: Biddulphineae

Genus *Biddulphia* Gray

*Biddulphia pulchella* Gray (Fig. 1 h-j)

*Biddulphia pulchella* Gray, 1821, p. 1, fig. 294; Smith, 1856, pl. 44, fig. 321; Van Heurck, 1899, p. 470, pl. 20, fig. 630; Subrahmanyan, 1946, p. 154, figs. 283-284; Misra, 1956, p. 544, fig. 17; Hendey, 1964, p. 101, pl. 25, fig. 1; Huang, 1979, p. 196, pl. 2, fig. 1.

*Biddulphia pulchella* var. *major* Castracane, 1876, p. 102, pl. 23, fig. 6.

*Biddulphia biddulphiana* Boyer, 1900, p. 694; Lebour, 1930, p. 172.

Cells colonial, united by their angles to form short chains, valves elliptic, swollen margin, strongly sculptured, divided into 3 sections by strong costae. Ends of the valve furnished with large globular process covered with fine pores, areolae arranged in longitudinal and transverse rows, girdle punctate in longitudinal lines. Length of valve 98μ.

*Distribution*: European coastal waters, coasts of Atlantic and Pacific, coasts of Australia and India.

*Biddulphia alternans* (Bailey) Van Heurck (Fig. 1 k)

*Biddulphia alternans* Van Heurck, 1899, p. 206, pl. 21, fig. 644; Boyer, 1923, p. 137; Lebour, 1930, p. 181; Hendey, 1964, p. 102, pl. 25, fig. 5.

*Triceratium alternans* Bailey, 1851, p. 40; Subrahmanyan, 1946, p. 153, figs. 277, 282.

Cells box shaped, valves triangular with straight concave sides, corners rounded. Valve surface areolated, rows in the margin, but irregular at the centre, 9 in 10 μ. Usually forms short chains by attaching at the angles of the cells by means of mucous. Length of valve 65μ.

*Distribution*: Coastal waters of Europe, British Coast, North Sea, coasts of India.

*Biddulphia aurita* (Lyngbye) Brebisson (Fig. 1 l)

*Biddulphia aurita* Brebisson, 1838, pl. 12; Smith, 1856, p. 49, pl. 45, fig. 319; Van Heurck, 1899, p. 471, pl. 20, fig. 631; Lebour, 1930, p. 173, fig. 133; Misra, 1956, p. 544, fig. 19; Wood, 1963, p. 247, pl. 3, fig. 48; Hendey, 1964, p. 103, pl. 24, fig. 6.

*Diatoma aurita* Lyngbye, 1819, p. 182, pl. 62, D.

Cells quadranagonal, valves elliptical, with cornuate process, united by their processes to form short chains. Valves slightly swollen at the centre and furnished with radiating punctae. Length of valve 62μ.

*Distribution*: Coasts of Atlantic and Pacific, North Sea, coasts of Australia and India.
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*Biddulphia laevis* Ehrenberg (Fig. 1 m)

*Biddulphia laevis* Ehrenberg, 1843, p. 410; Van Heurck, 1899, p. 474, pl. 20, fig. 639; Hustedt, 1930 p. 852, figs. 506-507; Misra, 1956, p. 546, fig. 20; Wood, 1953, p. 247, pl. 3, fig. 49; Hendey, 1964, p. 105, pl. 25, fig. 7.

Cells sub-circular, valve surface flat, finely punctate. Valve mantle deep, occupying one third of the pervalvar length. On the major axis of the valve surface two large processes and on a line almost at right angles, two short spines present. In girdle view, the valves appear rectangular with straight sides. Diameter of valve 82 μ.

**Distribution**: Estuaries of Europe, coastal areas of Australia and west coast of India.

*Biddulphia granulata* Roper (Fig. 1 n)

*Biddulphia granulata* Roper, 1859, p. 13, pl. 1, figs. 10-11; Van Heurck, 1899, p. 473, pl. 21, fig. 638; Gran, 1905, p. 107, fig. 140; Lebour, 1930, p. 177, fig. 137; Hendey, 1964, p. 105.

Cells elliptic lanceolate, bearing two spines alternate with the terminal process. Valve surface punctate, arranged oblique rows. Girdle rectangular, punctate, arranged in decussate rows. Length of valve 74 μ.

**Distribution**: Coasts of Atlantic, North Sea, British Coast, coasts of Australia and India.

Genus *Lithodesmium* Ehrenberg

*Lithodesmium undulatum* Ehrenberg (Fig. 1 o-p)

*Lithodesmium undulatum* Ehrenberg, 1840, p. 155, pl. 4, fig. 13; Lebour, 1930, p. 185, fig. 145; Misra, 1946, p. 149, figs. 268-70; Hendey, 1964, p. 111, pl. 6, fig. 6.

*Triceratium undulatum* Brightwell, 1858, p. 154.

*Triceratium intricatum* West, 1860, p. 148, pl. 7, fig. 5.

*Ditylum intricatum* Grunow, Van Heurck, 1899, p. 424, pl. 17, fig. 607.

*Lithodesmium victorion* Karsten, 1907, p. 171, pl. 28, fig. 6.

Cells united to form a colony. Valves rectangular in girdle view, triangular in valve view with a median inflation, finely areolate. A small spine present from a conical base at the centre. Length of valve 56 μ.

**Distribution**: Coastal areas of Europe, North Sea, coasts of Australia and India.

**Family**: *Isthemineae*

Genus *Isthmia* Agardh

*Isthmia enervis* Ehrenberg (Fig. 1 r)

*Isthmia enervis* Ehrenberg, 1838, p. 209, pl. 16, fig. 5; Kutzing, 1844, p. 157, pl. 19, fig. 4; Smith, 1856, p. 52, pl. 48; Hustedt, 1930, p. 866, fig. 516; Subrahmanyan, 1946, p. 157; fig. 297; Hendey, 1964, p. 110, pl. 25, fig. 2.

*Isthmiella obliqua* (Smith) Boyer, 1900, p. 689.

Cells are united to form short chains, valves elongate, without costae, but well developed girdle with two distinct poles, one short and other slightly big. Valve surface and girdle areolated, 7 in 10 μ. Length of cell 72 μ.

**Distribution**: Epiphytic form found in the coasts of Atlantic, British Coast, coasts of Australia and India.

*Isthmia nervosa* Kutzing (Fig. 1 q)

*Isthmia nervosa* Kutzing, 1844, p. 137, pl. 19, fig. 5; Smith, 1856, p. 52, pl. 47; Hustedt, 1930, p. 865, fig. 515; Cupp, 1943, p. 166, fig. 116; Hendey, 1964, p. 110, pl. 25, fig. 3.

Cells trapezoidal in girdle view, 2-3 cells united to form short chains. The girdle is large, rectangular valve mantle strongly costate, irregularly arranged. Cells showing two poles, somewhat equal and rounded, not elongate as in *I. enervis*. Valve surface and girdle areolated, the areolae on the border of the girdle longer than the others. Length of valve 120 μ.
**Distribution**: European coastal waters, British Coast and Australian waters. New record to the Indian Coasts.

**Order**: PONNALES

**Sub Order**: ARAPHIDINEAE

**Family**: Fragilarioideae

**Sub-Family**: Tabellarieae

**Genus Rhabdonema** Kutzing

*Rhabdonema mirificum* Smith (Fig. 1 s)

(Rhabdonema mirificum Smith. 1856, p. 36, pl. 38, figs. 305 a-b; Brightwell. 1859, p. 180, pl. 9, fig. 11: Subrahmanyan. 1946, p. 161, figs. 316, 318-319.)


*Rhabdonema punctatum* Stoddar, Boyer, 1926, p. 150.

Cells in girdle view ribbon-shaped with hyaline rounded corners forming more or less long bands. Valves linear with numerous intercalary bands, transversely striated, 15 in 10. Length of cell 46 μ.

**Distribution**: Coastal areas of Pacific, Red Sea, British Coast, Sri Lanka Coast, coasts of India.

**Genus Striatella** Agardh

*Striatella unipunctata* (Lyngbye) Agardh (Fig. 1 t)

(Striatella unipunctata (Lyngbye) Agardh. 1832, p. 61; Van Heurck. 1899, p. 363, pl. 12, fig. 485 a; Lebour, 1930, p. 200, fig. 162: Cupp, 1943, p. 173, fig. 122; Hendey, 1964, p. 161, pl. 26, figs. 17-18.)

*Fragilaria unipunctata* Lyngbye. 1819, p. 183, pl. 52, fig. 6.

Cells colonial, united by their corners by small mucuous pads, to form zig-zag chains. Cells rectangular in girdle view, composed of numerous intercalary bands, alternate with short septa. Valve surface striate, undulating pseudoraphes, the striae crossing each other in curved oblique lines. Length of valve 118 μ and breadth 45 μ.

**Distribution**: Coastal waters of Europe, British Coast, west Coast of America. New record to the Indian Coasts.

**Genus Grammatophora** Ehrenberg

*Grammatophora undulata* Ehrenberg (Fig. 1 u)

(Grammatophora undulata Ehrenberg. Kutzing. 1849, p. 121; Boyer. 1926, p. 156; Hustedt. 1931-32, p. 48. fig. 576; Subrahmanyan. 1946, p. 163, figs. 320, 324, 326.)

Cells united to form short colonies, valves quadrangular, rounded corners and undulate septa. Valves linear, oblong, broad, widened in the middle, ends capitulate. Striae not visible on the valve. Length of valve 52 μ.

**Distribution**: European coastal waters. Mediterranean Coast, West Indies, coasts of India.

**Family**: Licmophorineae

**Genus Licmophora** Agardh

*Licmophora abbreviata* Agardh (Fig. 1 v)

(Licmophora abbreviata Agardh. 1831, p. 42; Hustedt, 1931-32, p. 66, fig. 590; Cupp, 1943, p. 177, fig. 127: Subrahmanyan, 1946, p. 163, figs. 320-32: Misra, 1956, p. 550, fig. 31; Nair. 1959, p. 36, fig. 105.)

**Distribution**: European coastal waters.

**Family**: Licmophorineae
distinct. Numerous internal septa projecting into the cell in girdle view. Valve surface striate, 12 in 10 μ. Length of valve 65 μ.

Distribution: Coasts of Atlantic and Pacific, North Sea Coast, English channel, coasts of India.

Licmophora ehrenbergii (Kutzing) Grunow

(Fig. 1 w)

Licmophora ehrenbergii (Kutzing) Grunow, 1867, p. 36; Van Heurck, 1899, p. 344, pl. 31, fig. 853; Cleve-Euler, 1953, p. 18, fig. 319 a, b; Hendey, 1964, p. 168.

Podosphenia ehrenbergii Kutzing, 1844, p. 121, pl. 9, fig. B.

Cells in girdle view cuneate, deep septa at the upper end, valves broadly clavate, with broad cuneate upper apex and rounded lower apex. Valve surface striate 8 in 10 μ, arranged in transverse lines upon either side of a well marked pseudoraphe. Length of valve 110 μ and breadth 22 μ.

Distribution: Coastal waters of Europe, British Coast, coasts of Australia. New record for the Indian Coasts.

Licmophora flabellata (Greville) Agardh

(Fig. 1 x)

Licmophora flabellata (Greville) Agardh, 1830-32, p. 41; Smith, 1853, p. 86, pl. 26, fig. 234; Van Heurck, 1899, p. 342, pl. 31, fig. 852; Boyer, 1927, p. 165; Hustedt, 1931-32, p. 58, fig. 581; Miura, 1956, p. 549, fig. 28 a-c; Hendey, 1964, p. 168, pl. 26, fig. 5.

Exilaria flabellata Greville, 1823-28, pl. 289.

Cells in girdle view, narrow, elongate and cuneate, valves join to form a 'fan' shaped appearance, supported upon a branching mucous stipe. Valves clavate, inflated at the base, faintly striated. Internal septa appear in girdle view as line penetrating the cell from the broad end. Length of valve 86 μ.

Distribution: Coastal areas of Europe, British Coast, coasts of Australia and India.

Licmophora gracilis (Ehrenberg) Grunow

(Fig. 1 y)

Licmophora gracilis (Ehrenberg) Grunow, 1867, p. 34; Van Heurck, 1899, p. 343, pl. 31, fig. 851; Hendey, 1964, p. 167.

Podosphenia gracilis Ehrenberg, 1838, p. 214, pl. 17, fig. 6.

Cells in fan shaped colonies, supported upon a simple stipe, valves cuneate, broadly rounded, tapering to a narrow slender lower end with a truncate base. Valves obovate inflated with internal septa, appear in girdle view as lines, pseudoraphe present with faint transverse striation. Striae 18 in 10 μ. Length of valve 82 μ.

Distribution: Coastal waters of Europe, Mediterranean Coast, British Coast and Australian waters. New record to the Indian Coasts.

Licmophora juergensii Agardh (Fig 1 z, aa)

Licmophora juergensii Agardh, 1830-32, p. 42; Van Heurck, 1899, p. 343, pl. 31, fig. 850; Cleve-Euler, 1953, p. 19, fig. 325 b, d; Hendey, 1964, p. 168, pl. 26, fig. 14.

Podosphenia juergensii (Agardh) Kutzing, 1844, p. 121, pl. 9, fig. 12.

Colonial form, attached to the substratum by means of stipes, fan shaped appearance, being smaller than the other species. Valves cuneate, truncate at the upper end, slightly rounded, clavate, sides straight, surface striate, striation transverse, 10 in 10 μ. Length of valve 58 μ.

Distribution: Coasts of Britain, Mediterranean Coast, coasts of Atlantic and Australian Coasts. New record for the Indian Coast.

Licmophora paradoxa (Lyngbye) Agardh

(Fig. 1 ad)

Licmophora paradoxa (Lyngbye) Agardh, 1825-35 p. 32; Van Heurck 1899, p. 344, pl. 31, fig. 855; Boyer, 1927, p. 167; Lebour, 1930, p. 203, fig. 165; Hendey, 1951, p. 40; 1964, p. 168.

Echinella paradoxa Lyngbye, 1819, p. 211.

Cells in fan shaped colonies, supported by a mucuous stipe, valves obovate, rounded at both sides, broad at the posterior portion in girdle view, valve mantle faintly striate, well distinct pseudoraphe. Striae 22 in 10 μ, length of valve 78 μ.

**Genus Climacosphenia Ehrenberg**

*Climacosphenia moniligera* Ehrenberg

(Fig. 1 ae-af)

*Climacosphenia moniligera* Ehrenberg, 1841, p. 411, pl. 2, fig. 6; Boyer, 1926, p. 171; Hustedt, 1931-32, p. 89, fig. 625; Cupp, 1943, p. 178, fig. 128; Subrahmanyan, 1946, p. 164, figs. 322, 323, 333-334; Nair, 1959, p. 37, fig. 106-108.

*Climacosphenia australis* Kutzing, 1849, p. 114.

*Climacosphenia caudata* Shadbolt, 1854, p. 17, pl. 1, fig. 15.

*Climacosphenia moniligera* Van Heurck, 1899, p. 346, fig. 100.

Epiphytic form, cells are borne on short stalked mucilage colonies, cells wedge shaped in girdle view, valves clavate, rounded at the apex, elongate below, traversed longitudinally by two parallel lines. Valves striated, 16 in 10 μ, length of valve 268 μ and breadth 32 μ at the tip and 12 μ at the base.

**Distribution:** Coasts of Europe, Atlantic Coast, Gulf of Mexico, West Indies, coasts of Australia and India.

*Climacosphenia elongata* Bailey (Fig. 1 ag-ah)


Cells very slender and narrow, slightly rounded at angles with truncate bases, valves are more elongate than *C. moniligera*. Valves clavate, rounded at the apex and very much elongate below, traversed by two parallel longitudinal lines. Upper broader part short, 28μ broad and rather suddenly diminish in breadth lower down and becoming linear, lower part 12μ broad. Length of valve 820μ.

**Distribution:** Coasts of Atlantic, North Sea, Florida Coast, coasts of India.

**Genus Rhaphoneis Ehrenberg**

*Rhaphoneis ampliceros* Ehrenberg (Fig. 1 ai)

*Rhaphoneis ampliceros* Ehrenberg, 1844, p. 87.

*Rhaphoneis nisutonicus* Rabenhorst, 1864, p. 126.

*Doryphora ampliceros* Kutzing, 1849, p. 50.

*Rhaphoneis ampliceros* var. rhombica Grunow, Van Heurck, 1899, p. 330, pl. 10, fig. 394.

Cells solitary, lanceolate or boat shaped, inflated at the centre, valve surface punctate, punctae in curved radiating lines, 6 in 10 μ. Length of valve 55 μ.

**Distribution:** European coastal waters, North Sea Coast, west coast of N. America, coasts of India.

**Genus Synedra Ehrenberg**

*Synedra superba* Kutzing (Fig. 1 aj)

*Synedra superba* Kutzing, 1844, p. 69, pl. 15, fig. 13; Smith, 1853, p. 74, pl. 12, fig. 102; Van Heurck, 1899, p. 316, pl. 30, fig. 835; Hendey, 1964, p. 163.

Cells solitary, often in fan shaped clusters, supported on short mucous pads. Valves broadly linear, slightly rounded at the apices. Valves striate, crossed by three equidistant longitudinal lines, transverse except at the apices, 10 in 10 μ. Length of valve 360 μ, breadth 15 μ.

**Distribution:** Coasts of Europe, North Sea Coast, coasts of Britain. New record for the Indian Coasts.
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Synedra pulchella Kutzing (Fig. 1 ak-al)

Cells in fan shaped colonies, valves linear, lanceolate in girdle view with rounded apices. Valves with a distinct narrow pseudoraphe in the axial area, central area large. Valve striate, 15 in 10 μ. Length of valve 78 μ.

Distribution: Estuaries in Europe, North Sea Coast and coasts of Britain. New record for the Indian Coasts.

Synedra crystallina (Agardh) Kutzing

Valves very long, linear lanceolate, slightly tapering from the middle towards the weakly inflated rounded apices. Valve surface striate, 9 in 10 μ, finely punctate, arranged either side a thin, but distinct pseudoraphe. Striae transverse, slightly radiate near the apices. Length of valve 760 μ and breadth 22 μ.

Distribution: Coastal areas of Europe, Atlantic and North Sea Coasts. New record for the Indian Coasts.

Synedra ulna Ehrenberg (Fig. 1 ac)

Valves narrowly linear, somewhat broadened at the ends, rounded, pseudoraphe narrow, linear, central area rectangular, striae coarse, 12 in 10 μ. Length of valve 145 μ and breadth 10 μ.

Distribution: Estuaries and coastal areas of Atlantic, Pacific and North Sea, coasts of India.

Genus Podocystis Bailey

Podocystis adriatica (Kutzing) Ralfs

Podocystis adriatica (Kutzing) Ralfs in Pritchard, 1861, p. 772; Smith, 1856, p. 101; Van Heurck, 1899, p. 265, fig. 117; Hendey, 1964, p. 169, pl. 27, fig. 4.

Synedra crystallina Agardh, 1824, p. 3.

Distribution: Coastal areas of Europe, Atlantic and North Sea Coasts. New record for the Indian Coasts.

Genus Cocconeis Ehrenberg

Cocconeis scutellum Ehrenberg

Cocconeis scutellum Ehrenberg, 1838, p. 194; Van Heurck, 1899, p. 287, pl. 8, fig. 338; Boyer, 1927, p. 245; Hustedt, 1930, p. 191, fig. 267; 1931, p. 337, fig. 790; Wood, 1963, p. 222, pl. 4, fig. 73a; Hendey, 1964, p. 180, pl. 27, fig. 8.

Cells broadly elliptical, flat, upper valve with pseudoraphe, coarse punctate, arranged...
in transverse lines, equidistant rows. The lower valve with a broad, marginal loculiferous rim and a small rounded central area, radiately striate, 9 in 10\(\mu\), raphe straight. Length of valve 65\(\mu\) and breadth 38\(\mu\).

**Distribution:** European coastal waters, British Coast and coasts of Sri Lanka. New record for the Indian Coasts.

**Cocconeis placentula** Ehrenberg

*(Fig. 1 ao-ap)*

*Cocconeis placentula* Ehrenberg, 1838, p. 194; Van Heurck, 1899, p. 288, pl. 8, fig. 341; Boyer, 1916, p. 57, pl. 16, fig. 29; Hustedt, 1930, p. 199, fig. 264.

Valves elliptical, plain, median hyaline zone of the upper valve enlarged at the centre and showing feeble traces of raphe and nodules, punctae distinct, separated by a hyaline zone. Striae 35 in 10\(\mu\). Length of valve 65\(\mu\) and breadth 35\(\mu\).

**Distribution:** British Coast, mud flats in the North Sea, coastal areas of N. America, Pacific Coasts. New record for the Indian Coasts.

**Cocconeis littoralis** Subrahmanyan

*(Fig. 1 aq)*

*Cocconeis littoralis* Subrahmanyan, 1946, p. 171, figs. 368-70.

Epiphytic form, broadly elliptical, rapheless, with three well defined hyaline areas, demarcated by striated bands, striae unequal in length, dot like thickening at the centre. Valve with raphe with somewhat radial punctate, alternating with those of the adjacent one, raphe sigmoid, axial area narrow dilating into a very small central area. Striae 18 in 10\(\mu\). Length of valve 55\(\mu\) and breadth 35\(\mu\).

**Distribution:** Coasts of India.

**Cocconeis pseudomarginata** Gregory *(Fig. 1 ar)*

*Cocconeis pseudomarginata* Gregory, 1857, p. 492, pl. 9, fig. 27; Boyer, 1927, p. 248; Hustedt, 1931, p. 359, fig. 813; Hendey, 1964, p. 179, pl. 28, fig. 20.

Valves broadly elliptical, upper valve with a narrow lanceolate axial area and several longitudinal curved folds, lower valve with a narrow area, raphe terminating at a distance from the ends of the valve, central area small, valve surface striated, 18 in 10 \(\mu\). Length of valve 68\(\mu\), breadth 45\(\mu\).

**Distribution:** Atlantic and North Sea Coasts, British Coast. New record for the Indian Coasts.

**Sub-Family:** Achnanthaceae

**Genus Achnanthes** Bory

*Achnanthes brevipes* Agardh *(Fig. 2 a)*

*Achnanthes brevipes* Agardh, 1824, p. 1; Smith, 1856, p. 27, pl. 37, fig. 301; Van Heurck, 1899, p. 279, pl. 8, fig. 324; Hustedt, 1935, p. 18; Wood, 1963, p. 239, pl. 1, fig. 2; Hendey, 1964, p. 174, pl. 28, figs. 7-8.

Cells united to form short chains by mucuous pads, valves linear elliptical, slightly constricted in the middle with broad obtuse ends. Valve structure punctate, 8 in 10\(\mu\). Valves dissimilar, lower one with a marked raphe enclosed in a stout rib, while the upper one bearing eccentric pseudoraphe. Girdle structure composed of annular segments. Length of valve 76\(\mu\) and breadth 27\(\mu\).

**Distribution:** Estuarine and coastal areas of Atlantic and Pacific, coasts of Britain. New record for the Indian Coasts.

*Achnanthes longipes* Agardh *(Fig. 2 b, c)*

*Achnanthes longipes* Agardh, 1824, p. 1; Smith, 1856, p. 25, pl. 35, fig. 300; Van Heurck, 1899, p. 279, pl. 8, fig. 323; Boyer, 1927, p. 231; Lebour, 1930, p. 305, fig. 166; Cupp, 1943, p. 192, fig. 141; Hustedt, 1955, p. 18; Wood, 1963, p. 240, pl. 1, fig. 9; Hendey, 1964, p. 174, pl. 28, figs. 1-6, pl. 42, fig. 2.
DIATOMS OF SOUTHWEST COAST OF INDIA

Cells united by mucuous pads to form short chains. Valves variable, elongate, elliptical, constricted in the middle, apices obtuse, valve punctate, in double rows, alternating with strong costae 6 in 10μ, girdle with annular segments, upper valve with a narrow pseudoraphe, lower one a distinct raphe, dilated to form a narrow stauros. Length of valve 92μ and breadth 28μ.

Distribution: Coastal areas of Atlantic, Pacific, North Sea, west coast of N. America, Texas Bay and coasts of Australia. New record for the Indian Coasts.

Sub Order: Biraphideae
Family: Naviculoideae
Sub-Family: Naviculeae
Genus Mastogloia Thwaites

Mastogloia pumula (Grunow) Cleve (Fig. 2 d)
Mastogloia pumula (Grunow) Cleve, 1895, p. 157; Hustedt, 1931, p. 553, fig. 983; Wood, 1963, p. 266, pl. 8, fig. 154 a-c; Hendey, 1964, p. 238.

Valves linear elliptical, broadly rounded apices, raphe straight, axial area very narrow, central area rectangular with longitudinal extensions on either side of the raphe in the form of an ‘H’, valve surface striate, radial, 22 in 10μ. Septate plate marginal, composed of one or two large loculi and two or three smaller ones either side. Length of valve 77μ and breadth 32μ.

Distribution: Coastal areas of Atlantic, North Sea, British Coast, Texas Bay, west coast of N. America. New record for the Indian Coasts.

Mastogloia braunii Lewis (Fig. 2 e)
Mastogloia braunii Lewis, 1861, pi. 2, fig. 5; Van Heurck, 1899, p. 155, pl. 2, fig. 63; Hustedt, 1931-32, p. 569, fig. 1003; Venkataraman, 1939, p. 317, figs. 44-45.

Valves lanceolate with bluntly rounded ends, raphe curved slightly in the middle, axial area very narrow, central area small, circular in form. Valve surface with transverse and irregular striae, loculi numerous, but not reaching the ends. Striae 14 in 10μ. Length of valve 74μ and breadth 32μ.

Distribution: Coastal areas of North Sea, British Coast, west coast of N. America, Texas Bay. New record for the Indian Coasts.

Mastogloia dolosa Venkataraman (Fig. 2 h)
Mastogloia dolosa Venkataraman, 1939, p. 316, fig. 49.
Valves elliptical, lanceolate, sub rostrate, axial area narrow, central area large, rectangular, widened to form a 'H' shape. The furrows on either side of raphe seem to meet at the tip. Striations radial, 24 in 10 μ, loculi 10 on either side, ending at a distance from the apices. Length of valve 52 μ, breadth 18 μ.

**Distribution**: Estuaries in the east and southwest coasts of India.

*Mastogloia exilis* Hustedt (Fig. 2 i)

*Mastogloia exilis* Hustedt, 1931-32, p. 553, fig. 985; Subrahmanyan, 1946, p. 172, fig. 366, 367.

Valves lanceolate, constricted, bluntly rounded, raphe straight, axial area narrow, central area widened and connected to two small half lanceolate areas forming an 'H' shape, loculi bigger 4 in number, bigger in the middle and outermost smaller, transapical striae fine, 22 in 10 μ. Length of valve 36 μ and breadth 14 μ.

**Distribution**: Coastal areas of Indo-Malayan Archipelago, European coastal waters, Texas Bay, east and southwest coast of India.

*Mastogloia cochinensis* sp. nov. (Pl. IV D)

Valves broadly elliptical, raphe straight, axial area narrow, central area small, valve surface evenly areolated, forming radiate and concentric system, areolae 16 in 10 μ, loculi marginal, big, striated, 6 in either side, reaching the apices. Length of cell 68 μ and breadth 52 μ.

This diatom shows a close resemblance to *Mastogloia crucicula* (Grunow) Cleve and *M. hovarthiana* Grunow in the broadly elliptical shape of the cell and in the arrangement of the areolae. However, the distinguishing characteristic features of these two species are: in *M. crucicula*, the loculi are 4 in each side, uniform and not reaching the apex and in *M. hovarthiana*, numerous small loculi are present on either side.

**Distribution**: Estuarine area of Cochin, southwest coast of India.

Family: *Naviculoidae*

Sub-Family: *Naviculaceae*

Genus *Navicula* Bory

*Navicula forcipata* Greville (Fig. 2 j)

*Navicula forcipata* Greville, 1859, p. 83, pl. 6, figs. 10-11; Van Heurck, 1899, p. 203, pl. 4, fig. 163; Boyer, 1927, p. 416; Subrahmanyan, 1946, p. 182, fig. 405; Nair, 1959, p. 44, fig. 125; Hendey, 1964, p. 211, pl. 33, figs. 8-9.

Valves elliptical with broad, rounded ends, lateral areas narrow, constricted in the middle of the valve with convergent ends towards the pole, valve surface striated. 12 in 10 μ, transverse. Length of valve 78 μ and breadth 34 μ.

**Distribution**: Adriatic Sea, coasts of Britain, Belgium, Atlantic and Pacific Coasts, coasts of India.

*Navicula permagna* Bailey (Fig. 2 k)

*Navicula permagna* Bailey, 1850, p. 40, pl. 2, fig. 28; Van Heurck, 1899, p. 218, pl. 5, fig. 202.

Cells solitary, broadly lanceolate, sub-acute apices, raphe distinct, surrounded by a broad hyaline zone, dilated into a round area, striae distinct, finely divided transversely and interrupted near the margin of the valve by a broad depression. Length of valve 82 μ and breadth 24 μ.

**Distribution**: Atlantic and Pacific Coasts, coasts of Britain, west coast of N. America. New record for the Indian Coasts.

*Navicula lyra* Ehrenberg (Fig. 2 l)

*Navicula lyra* Ehrenberg, 1843, p. 419; Van Heurck, 1899, p. 205, pl. 4, fig. 161; Hendey, 1964, p. 200, pl. 33, fig. 2.
Navicula lyra var. ehrenbergi Cleve, 1895, p. 63.

Valves elliptical, rostrate apices, striated, slightly radial, 12 in 10μ, interrupted by lateral hyaline areas upon either side of the narrow axial area, forming a central area. Some striae lie in between the lateral area and the valve margin, while others form a band between the bowshaped area and the raphe. Length of valve 85μ.

Distribution: Coastal areas of Europe, Pacific and Atlantic Coasts, British Coast. New record for the Indian Coasts.

Navicula gracilis Kutzing (Fig. 2 m)

Navicula gracilis Kutzing, 1844, p. 91, pi. 3, fig. 48; Van Heurck, 1899, p. 179, pi. 3, fig. 109.

Cells elongate, lanceolate, acute at the extremeties. Valve surface striate, striae robust, central nodule short, the median ones scarcely radiant, all the striae are reaching to the raphe. Striae 12 in 10μ. Length of valve 65μ and breadth 15μ.


Navicula gracilis var. schizonemoides Van Heurck (Fig. 2 n)

Navicula gracilis var. schizonemoides Van Heurck, 1899, p. 179, pi. 3, fig. 110.

Cells are endophytic, elongated and very narrow, striae, median striae longer and of unequal length, 9 in 10μ. Length of valve 68μ, breadth 15μ. Cells usually embedded in mucilage tubes or in decayed a gal pieces.

Distribution: Coastal areas of Atlantic, North Sea. New record for the Indian Coasts.

Navicula hasta Pantocsek (Fig. 2 o)

Navicula hasta Pantocsek in Cleve, 1895, p. 25; Boyer, 1923, p. 399; Hustedt, 1930, p. 306, fig. 541; Venkataraman, 1939, p. 331, fig. 98.

Valves lanceolate, broad in the middle, tapering to sub acute ends. Axial area narrow, slightly widened in the middle, radial striae, coarse and slightly wide apart in the centre. Striae 9 in 10μ. Length of valve 65μ, breadth 17μ.

Distribution: Estuaries and coastal areas of Europe, coasts of Britain and India.

Navicula pygmoea Kutzing (Fig. 2 p)

Navicula pygmoea Kutzing, 1849, p. 77; Cleve, 1895, p. 65; Van Heurck, 1899, p. 203, pl. 4, fig. 164; Boyer, 1927, p. 416; Hustedt, 1930, p. 312, fig. 561.

Valves hyaline, elliptical, with broadly rounded ends. Axial area indistinct, lateral area constricted in the middle and converged at the ends, delicate striations, 22 in 10μ. Length of valve 36μ and breadth 14μ.

Distribution: Estuaries, coastal areas of Europe, coasts of India.

Navicula bicapitata Lagerstedi (Fig. 2 q)

Navicula bicapitata Lagerstedi in Van Heurck, 1899, p. 172, pl. 2, fig. 90.

Valves narrow, linear with apices attenuated, rostrate, valve surface costate, 8 in 10μ, radiate in the middle of the valve, convergent at the apices, leaving round the raphe a narrow hyaline zone which expands into a sub-quandrangular area, round the central nodule. Length of valve 62μ.

Distribution: Coastal waters of Europe, North Sea Coast, estuaries in Britain, Ireland. New record for the Indian Coasts.

Navicula granulata Bailey (Fig. 2 r)

Navicula granulata Bailey, 1854, p. 10, fig. 16; Cleve, 1895, p. 48; Van Heurck, 1899, p. 211, pl. 4, fig. 183; Hendey, 1964, p. 208, pl. 31, fig. 6.

Valves elliptical, rounded apices, axial area widened, central area round, surface striated, striae punctate, 16 in 10μ, transverse at
the centre, radiate at the poles. Length of valve 62μ and breadth 26μ.

Distribution: Estuaries and coastal areas of Europe, North Sea, coasts of Britain. New record for the Indian Coasts.

**Navicula monilifera** Cleve (Fig. 2 s)

*Navicula monilifera* Cleve, 1895, p. 43; Hendey, 1964, p. 206, pl. 31, fig. 4-5.

Valves broadly elliptical, sides parallel with rostrate apices, axial area clear, narrow and central area orbicular, moderately large, raphe straight, valve surface coarsely striated. 8 in 10μ. Length of valve 85μ, breadth 35μ.

Distribution: North Sea Coast, coasts of N. America, British Coast. New record for the Indian Coasts.

**Navicula notabilis** Greville (Fig. 2 t)

*Navicula notabilis* Greville, 1863, p. 18, pl. 1, fig. 9; Cleve, 1894, p. 93; Schmidt, 1875, pl. 8, figs. 46-52; Van Heurck, 1899, p. 200, pl. 20, fig. 750.

*Diploneis notabilis* (Greville) Cleve, Hendey, 1964, p. 224.

Valves elliptical, broadly rounded apices, central nodule moderately large, raphe narrow, lying between strongly silicified parallel horns, lateral areas small, narrow, valve surface costate, transverse, between the costae are elongated alveoli of different lengths. Costae 7 in 10μ, length of valve 82μ and breadth 32μ.

Distribution: Coastal waters of Europe, coasts of Britain. New record for the Indian Coasts.

**Navicula plicata** Donkin (Fig. 2 u)

*Navicula plicata* Donkin, 1870-73, p. 59, pl. 9, figs. 2a-b; Cleve, 1894, p. 154; Van Heurck, 1899, p. 235, pl. 27, fig. 787; Hendey, 1964, p. 193.

Valves in girdle view rectangular, rounded angles, girdle composed of numerous bands, valves linear, lanceolate, with tapering obtusely rounded ends in valve view, axial area narrow, central area small, valve surface more or less convex, fine parallel striae, 17 in 10μ. Length of valve 85μ, breadth 28μ.

Distribution: Coastal waters of Europe, British Coast. New record for the Indian Coasts.

**Navicula hennedyei var. neapolitana** Cleve (Fig. 2 v)

*Navicula hennedyei var. neapolitana* Cleve, 1895, p. 58.

Valve elliptical, middle region wide and broad, axial area narrow, raphe straight, surface of valve straight, striae in two bands, the axial striae forming a narrow band about 3-5 punctae, wide open either side of the raphe. Length of valve 110μ and breadth 62μ.

Distribution: Coasts of Scotland, North Sea and Java Seas. New record for the Indian Coasts.

**Navicula hennedyei var. nebulosa** Cleve (Fig. 2 w)

*Navicula hennedyei var. nebulosa* Cleve, 1895, p. 58; Van Heurck, 1899, p. 204, pl. 27, fig. 755; Boyer, 1927, p. 413; Subrahmanyan, 1946, p. 181, fig. 404.

*Navicula nebulosa* Gregory, 1857, p. 480, pl. 9, fig. 8; Hendey, 1964, p. 213.

Valves elliptical, angular margin, apices note fully round, axial area narrow, raphe straight, axial striae transverse, very short, marginal striae in a narrow band of approximately equal length, hyaline lateral area. Striae 18 in 10μ. Length of valve 55μ and breadth 26μ.

Distribution: North Sea Coast, coasts of Scotland, English channel and coasts of India.
Genus *Dictyneis* Cleve

*Dictyneis marginata* Cleve (Fig. 2 x)


*Navicula strangulata* Leuduger-Fortmorel, Lagerstedt, 1876, p. 42.

Valve elongated, broad and round apex, median part of valve constricted, raphe straight, surrounded by a narrow hyaline zone, surface of valve striated, marginal striae broad and large, resembling the loculi of the genus *Mastogloia*. Length of valve 68 μ.


**Genus Caloneis** Cleve

*Caloneis liber* (Smith) Cleve (Fig. 2 y)

*Caloneis liber* (Smith) Cleve, 1894, p. 54; Boyer, 1927, p. 310; Hendey, 1964, p. 229, pl. 29, fig. 2.

*Navicula liber* Smith, 1853, p. 48, pi. 16, fig. 133; Van Heurck, 1899, p. 222, fig. 219.

Valves elliptical, oblong, with rounded apices. Axial area very narrow, developing into a small, orbicular centre area, valve surface striate, striae parallel 8 in 10 μ. Longitudinal lines median, about half way between the raphe and the valve margin. Length of valve 65 μ and breadth 18 μ.

**Distribution**: North Sea Coast, coasts of Britain and Australia. New record for the Indian Coasts.

**Genus Diploneis** Ehrenberg

*Diploneis smithii* Cleve (Fig. 2 ac)

*Diploneis smithii* Cleve, 1894, p. 96; Boyer, 1927, p. 334; Hustedt, 1930, p. 253, fig. 402; Subrahmanyan, 1946, p. 180, fig. 399; Wood, 1963, p. 259, pl. 6, fig. 112; Hendey, 1964, p. 225, pl. 32, fig. 10.

*Navicula smithii* Van Heurck, 1899, p. 192, pl. 4, fig. 151 a, b.

Cells small, elliptical, oval, central nodule, small, produce two horns, enclosing the raphe furrows narrow, punctate, close to the horns. Surface of valve costate, alternating with double rows of areolae. Length 72 μ and breadth 38 μ.

**Distribution**: Coasts of Atlantic, North Sea, Mediterranean Sea, Texas Bay, Australian waters and coasts of India.

*Diploneis dydima* (Ehrenberg) Cleve (Fig. 2 z)

*Diploneis dydima* (Ehrenberg) Cleve, 1894, p. 90; Hustedt, 1931, p. 685, fig. 1075; Smith, 1853, p. 53, pl. 17, fig. 154; Boyer, 1925, p. 352; Hendey, 1964, p. 226, pl. 32, fig. 12.

*Navicula dydima* Ehrenberg, 1840, p. 155; Van Heurck, 1899, p. 193, pl. 3, fig. 147.

Cells slightly constricted in the middle, ovoid, valves divided into two tongue-shaped segments. The central nodule is subquadrature or almost circular. Valve surface costate, transverse in the middle, slightly curving radiating lines towards the apices and crossed by numerous undulating longitudinal lines. Costae 6 in 10 μ, length of valve 85 μ and breadth 35 μ.

**Distribution**: European coastal waters, North Sea Coast. New record for the Indian Coasts.

*Diploneis subovalis* Cleve (Fig. 2 aa)

*Diploneis subovalis* Cleve, 1894, p. 96, pl. 1, fig. 27; Venkataraman, 1939, p. 322.

Cells oval, valves elliptical, central nodule large, rounded, furrows narrow, closely following the central nodule and its horns. Costae strong, and far apart alternating with double rows of areolae, costae 12 in 10 μ. Length of valve 62 μ and breadth 36 μ.

**Distribution**: Coastal waters of Europe, North Sea Coast, Coasts of India.
Diploneis splendida (Gregory) Cleve  
(Fig. 2 ab)

Diploneis splendida (Gregory) Cleve, 1894, p. 87;  
Hustedt, 1931, p. 712, fig. 1089; Hendey, 1964, p. 227.

Navicula splendida Gregory, 1856, p. 44, pi. 5,  
fig. 14.

Navicula entomon Donkin, 1870-73, pl. 7, fig. 5.

Valves linear elliptical, constricted in the  
middle, dividing the valve into two tongue-  
shaped broadly cuneate segments, furrows  
somewhat wide and linear, inner margin  
straight, horns strong, linear and parallel.  
Beyond the furrows, the valve surface costate,  
8 in 10 μ. Length of valve 110 μ and breadth  
45 μ.

Distribution: Coastal waters of Europe,  
British Coast. New record for the Indian  
Coasts.

Diploneis elliptica (Kutzing) Cleve  
(Fig. 2 ad)

Diploneis elliptica (Kutzing) Cleve, 1894, p. 92;  
Boyer, 1927, p. 335; Wood, 1963, p. 175;  

Navicula elliptica Kutzing, 1844, p. 98, pi. 30,  
fig. 55; Van Heurck, 1899, p. 201, pi. 4,  
fig. 156.

Cells elliptical, valves with broad and  
rounded apices, central nodule medium in  
size, furrows narrow, close to the slender  
horn, uniform breadth throughout. Valve  
surface punctate, 12 in 10 μ, transverse in  
the middle, slightly radiate towards the apices.  
Length of valve 45 μ and breadth 18 μ.

Distribution: Estuaries in North Sea Coast,  
British Coast, coasts of Australia. New record  
for the Indian Coasts.

Diploneis chersonensis (Grunow) Cleve  
(Fig. 2 ae)

Diploneis chersonensis (Grunow) Cleve, 1894, p. 91;  
Hustedt, 1931, p. 709, fig. 1088; Hendey, 1964, p. 227, pl. 32, figs. 7-8.

Navicula chersonensis Grunow in Schmidt, 1875,  
pl. 12, fig. 40; Venkataraman, 1939, p. 196,  
pl. 26, fig. 738.

Navicula opis Schmidt, 1874, pl. 1, fig. 9.

Valves linear, elliptic, with a deep trans-  
apical constriction, opposite the central nodule  
to form ovoid outline, with two tongue shaped  
segment having round apices. Central nodule  
small, horns narrow, linear, flanked by narrow  
linear furrows, having longitudinal lines of  
punctae and transverse striae, 12 in 10 μ.  
Length of valve 88 μ and breadth 24 μ.

Distribution: Coasts of Atlantic, North  
Sea, west coast of Britain, Wales and coasts  
of Australia. New record for the Indian  
Coasts.

Genus Anomoeoneis Cleve

Anomoeoneis sculpta (Ehrenberg) Cleve  
(Fig. 2 af)

Anomoeoneis sculpta (Ehrenberg) Cleve, 1895, p. 6;  
Boyer, 1928, p. 324; Hendey, 1964, p. 218,  
pl. 37, fig. 12.

Navicula sculpta Ehrenberg, 1854, pl. 10, figs. 1,  
5; Van Heurck, 1899, p. 216, pi. 4, fig. 194.

Cells lanceolate, obtuse apices, axial area  
narrow, linear, bordered upon each side with  
a single row of punctae, valve surface striate,  
15 in 10 μ, radiate, irregular towards the  
lateral sides, closely packed near the margin.  
Length of valve 95 μ and breadth 28 μ.

Distribution: Coastal areas of Britain,  
France, English Channel, coasts of Australia.  
New record for the Indian Coasts.

Genus Trachyneis Cleve

Trachyneis aspera (Ehrenberg) Cleve  
(Fig. 2 ag)

Trachyneis aspera (Ehrenberg) Cleve, 1894, p. 191;  
Boyer, 1927, p. 428; Subrahmanyan, 1946,  
p. 183, fig. 408; Hendey, 1964, p. 236, pl. 29,  
fig. 11.

Navicula aspera Ehrenberg, 1840, p. 213; Van  
Heurck, 1899, pl. 10, fig. 13.
Plate I A. Antimenes septata - valve view; B. A. splendens - valve view; C. Crassastrea glorifica - grill view and D. Mamanista echinata sp. nov. - valve view.
Stauroneis pukhella Smilh, 1853, p. 61, pi. 19, fig. 194.

Trachyneis aspera var. pukhella Cleve 1894, p. 191.

Valves linear-lanceolate, obtuse ends, axial area narrow, central area chilated to form a transverse staurose, slightly widening towards the margin, transapical striae alveolate, 9 in 10 μ, longitudinal striae 22 in 10 μ. Length of valve 145 μ and breadth 35 μ.

Distribution: North Atlantic Coast, Mediterranean Sea Coast, coasts of North Sea, Adriatic Sea and coasts of India.

Trachyneis antillarum Cleve (Fig. 2 ah)

Trachyneis antillarum Cleve, 1894, p. 193; Boyer, 1927, p. 429; Subrahmanyan, 1946, p. 183, fig. 409.

Alloneis antillarum Cleve and Grunow, Cleve, 1878, p. 8, pi. 2, fig. 11.


Valves linear, elliptical, with obtuse ends. Raphe eccentric, axial area broad, irregularly linear, transverse striae in radial rows alveolate, alveolae 9 rows in 10 μ. Length of valve 118 μ and breadth 45 μ. The main difference between T. aspera is the broad nature of the cell and the alveolar arrangement on the surface of the valve.

Distribution: Coastal areas of Britain, Belgium, West Indies, coasts of Sri Lanka and India.

Sub-Family: Amphiproroideae

Genus Amphiprora Ehrenberg

Amphiprora gigantea Grunow var. sulcata (O'Meara) Cleve (Fig. 2 ap)

Amphiprora gigantea Grunow var. sulcata (O'Meara) Cleve, 1894, p. 18; Allen and Cupp, 1935, p. 160, fig. 113; Cupp, 1943, p. 198, fig. 151; Subrahmanyan, 1946, p. 184, figs. 410-411.

Amphiprora sulcata O'Meara, 1871, p. 22, pl. 3, fig. 3.

Cells strongly constricted and sides resemble 'bow' like appearance. Keel with hyaline margin, keel punctate, forming obliquely decussating rows, 15 rows in 10 μ, striae curved, connecting zone with numerous longitudinal divisions, striae on the connecting zone 16 in 10 μ. Length of valve 86 μ and breadth 38 μ.

Distribution: Coasts of North Sea, Java Sea, west coast of N. America, coasts of Australia and India.

Genus Pleurosigma Smith

Pleurosigma formosum Smith (Fig. 2 aq)

Pleurosigma formosum Smith, 1853, p. 63, pl. 20, fig. 193; Boyer, 1916, p. 73, pi. 22, fig. 5; Wood, 1963, p. 277, pl. 11, fig. 220; Hendey, 1964, p. 232.

Valves elongated, sigmoid and linear with sub-acute apices. Raphe strongly sigmoid, sweeping across the valve at about middle distance and becoming almost coincident with the convex margin as it approaches the apices. Valve surface, striae, arranged in oblique lines, 14 in 10 μ and in transverse lines 16 in 10 μ. Length of valve 380 μ and breadth 45 μ.

This species is often confused with P. decorum Smith, but it is less lanceolate and the apices are a little more obtuse. The striations are more coarse than in P. decorum.


Genus Gyrosigma Hassel

Gyrosigma balticum (Ehrenberg) Cleve (Fig. 2 as)

Gyrosigma balticum (Ehrenberg) Cleve, 1894, p. 118; Boyer, 1927, p. 456; Hustedt, 1930, p. 224; fig. 331; Venkataraman, 1939, p. 318, fig. 71; Subrahmanyan, 1946, p. 173, figs. 373-375; Hendey, 1964, p. 248, pi. 35, fig. 9.

Navicula baltica Ehrenberg 1838, p. 180, pl. 13, fig. 10.
Pleurosigma balticum Smith, 1853, p. 66, pl. 22, fig. 207.

Valves linear, sides parallel, sigmoid towards the ends with obtuse apices. Raphe slightly eccentric, sigmoid, having the same sigmoid curvature as the valve margin, central area small, oblique, transverse and longitudinal striae equi-distant, 14 in 10 μ. Length of valve 310 μ and breadth 42 μ.

Distribution: Coasts of Atlantic, North Sea, Britain and Sri Lanka, east and south west coast of India.

Gyrosigma scalproides var. eximia (Thwaites) Cleve (Fig. 2 ar)

Gyrosigma scalproides var. eximia (Thwaites) Cleve, 1894, p. 118; Hustedt, 1930, p. 226, fig. 339; Venkataraman, 1939, p. 319, fig. 76.

Valves short, linear, parallel sides and obliquely rounded ends. Raphe slightly sigmoid at the ends, rarely central, transverse striae finely punctate, longitudinal striae very faint. Transverse striae 22 in 10 μ. Length of valve 55 μ and breadth 18 μ.

Distribution: Atlantic Coast, British Coast, west coast of North America, coasts of India.

Sub Order: Raphidiozineae
Family: Eunotiaceae
Sub-Family: Eunotioideae
Genus Eunotia Ehrenberg

Eunotia monodon Ehrenberg (Fig. 2 aj)

Eunotia monodon Ehrenberg, Smith, 1853, p. 16, pl. 11, fig. 16; Boyer, 1927, p. 221; Hustedt, 1930, p. 183, fig. 224; Venkataraman, 1939, p. 310, fig. 40.

Valves arcuate with the dorsal side well bent, narrow towards the ends, rounded, structures coarse, narrower near ends. Striae 9 in 10 μ. Length of valve 65 μ and breadth 15 μ.

Distribution: Estuaries and coastal waters of Europe, North Sea Coast, coasts of India.

Eunotia diodon Ehrenberg (Fig. 2 ak)

Eunotia diodon Ehrenberg, 1856, p. 192, pl. 21, fig. 22; Van Heurck, 1899, pl. 30, fig. 829; Hustedt, 1930, p. 173, fig. 207.

Valves with ventral margin, concave, dorsal margin showing two slight rounded ridges, apices obtuse, rounded, valves finely punctate, punctae 5 in 10 μ. Length of valve 26 μ and breadth 12 μ.

Distribution: Estuaries of European countries, North Sea Coast, British Coast, coasts of Ireland and Sweden. New record for the Indian Coasts.

Family: Epithemiaceae
Sub-Family: Epithemoideae
Genus Epithemia Brebisson

Epithemia turgida Kützing (Fig. 2 al)

Epithemia turgida Kützing, 1856, pl. 5, fig. 14; Van Heurck, 1899, p. 294, pl. 9, fig. 346; Hustedt, 1930, p. 387, fig. 733.

Valves arcuate, apices more or less rostrate, capitata, dorsal margin rather flexed, costate radiate, 4 in 10 μ about 8 radiate rows of coarse elongated beads in the same space, girdle view more or less strongly inflated in the median portion. Length of valve 77 μ and breadth 18 μ.

Distribution: Coastal waters of Europe, North Sea Coast, Japanese waters and Sri Lanka Coast. New record for the Indian Coasts.

Epithemia musculus Kützing (Fig. 2 an)

Epithemia musculus Kützing, 1844, p. 33, pl. 30, fig. 6; Smith, 1853, p. 14, pl. 1, fig. 10; Van Heurck, 1899, p. 297, pl. 9, fig. 350; Hendey, 1964, p. 271.

Cells broadly elliptical, sub-orbicular, with dorsal margin strongly arcuate and ventral
margin concave, apices acute, valve complex, consisting of an inner plate, costae radiant, variable in number, moniliform striae, 15 in 10 µ. Length of valve 45 µ and breadth 18 µ.

**Distribution**: Estuarine waters of Europe, North Sea Coast and coasts of Britain. New record for the Indian Coasts.

**Genus Encyonema** Kutzing

*Encyonema prostratum* Ralfs (Fig. 2 am)

Encyonema prostratum Ralfs, Van Heurck, 1899, p. 149, pl. 1, fig. 44.

Valves large, dorsal side considerably inflated, ventral side with slight curvature, apices abruptly produced, obtuse and rounded, raphe straight with its median ends slightly arcuate towards the dorsal margin, surrounded by a hyaline zone. Valve surface striated, 7 in 10 µ. Length of valve 75 µ and breadth 22 µ.

**Distribution**: Estuaries and coastal areas of Europe, North Sea and British Coasts. New record for the Indian Coasts.

**Sub-Family**: Gomphocymbelloideae

**Genus Amphora** Ehrenberg

*Amphora ovalis* Kutzing (Fig. 2 ai; 3 c)


Cells oval, inflated at the median portion, then slightly attenuate, apices broadly truncate, valves arcuate, at dorsal margin, concave at internal margin, raphe inflexed, striae strongly marked with coarse punctae, 12 in 10 µ. Length of valve 62 µ and breadth 28 µ.


*Amphora laevissima* Gregory (Fig. 2 ao)

*Amphora laevissima* Gregory, 1857, p. 41, pl. 4, fig. 72; Schmidt, 1874, pl. 26, figs. 13-14; Van Heurck, 1889, p. 139, pl. 24, fig. 694.

Valves linear, oblong, extremities hyaline, raphe abruptly inflexed towards the median portion, with a broad stauros, striae invisible. Length of valve 62 µ and breadth 28 µ.

**Distribution**: European coastal waters and North Sea Coast. New record for the Indian Coasts.

*Amphora lineolata* Ehrenberg (Fig. 3 a)

Amphora lineolata Ehrenberg, 1836, p. 188, pl. 14, fig. 4; Van Heurck, 1899, p. 138, pl. 1, fig. 10; Subrahmanyan, 1946, p. 184, fig. 407; Wood, 1963, p. 22.

Amphora tenera Smith, 1853, p. 20; pl. 30, fig. 252.

*Amphora plicata* Gregory, 1857, p. 70, pl. 1, fig. 31.

Valves weakly silicafl, hyaline, in girdle view rectangular, elliptical, with slightly convex sides. Intercalary bands numerous, 10 in 10 µ, raphe with straight branches, axial area narrow, central area absent, transapical striae slightly radial, finely punctate, 18 in 10 µ. Length of valve 92 µ and breadth 44 µ.

**Distribution**: Coastal waters of Europe, North Sea Coast, west coast of N. America and coasts of India.

*Amphora decussata* Grunow (Fig. 3 b)

Amphora decussata Grunow, 1877, p. 178; Cleve, 1895, p. 128, pl. 4, fig. 10; Boyer, 1927, p. 267; Allen and Cupp, 1935, p. 161, fig. 116; Subrahmanyan, 1946, p. 185, figs. 414-15; Hendey, 1964, p. 266, pl. 37, fig. 9.

Cells elliptical, valves flat with straight ventral margin and truncate ends, arcuate dorsal margin with somewhat flattened side from the sub-arcuate apices, giving the valve the appearance of an equilateral triangle. Raphe along the ventral margin, central nodule dilated to form a narrow stauros, striated, 16 in 10 µ. Length of valve 98 µ and breadth 46 µ.
Distribution: European coastal waters, North Sea Coast, west coast of N. America and coasts of India.

*Amphora ostrearia* (Brebisson) Kutzing

(Fig. 3 d; PI. IV C)

*Amphora ostrearia* (Brebisson) Kutzing, 1849, p. 94; Van Heurck, 1899, p. 129, pl. 24, fig. 671; Wood, 1963, p. 245, pl. 2, figs. 36a-e; Hendey, 1964, p. 262.

Cells in girdle view elliptic to oblong, parallel sides and rounded ends, valves lunulate, surface striate, raphe biarcuate, central area variable. Length of valve 82 \( \mu \) and breadth 36 \( \mu \).

Distribution: Coasts of Atlantic, North Sea, English Channel, Texas and Galvastone Bays, Western Indian Ocean. New record for the Indian Coasts.

Sub-Family: *Amphiproroidae*

Genus *Tropidoneis* Cleve

*Tropidoneis lepidoptera* (Gregory) Cleve

(Fig. 3 f)

*Tropidoneis lepidoptera* (Gregory) Cleve, 1894, p. 25; Boyer, 1916, p. 69, pl. 4, fig. 693; Venkataraman, 1939, p. 340, figs. 101, 106; Wood, 1963, p. 284, pl. 12, figs. 251 a, b; Hendey, 1964, p. 256, pl. 36, figs. 2-4.

*Amphiprora lepidoptera* Gregory, 1857, p. 505, pl. 12, fig. 59b.

*Orthotropis lepidoptera* Van Heurck, 1899, p. 263, pl. 5, fig. 287.

Cells rectangular, linear oblong, constricted in the middle, valves lanceolate, acute central area small, transversely lanceolate, wing unilateral, projecting above the median line, striae transverse, 18 in 10 \( \mu \). Length of valve 245 \( \mu \) and breadth 35 \( \mu \).

Distribution: North Sea Coasts, west coast of N. America, coasts of Australia and India.

*Tropidoneis semistriata* Grunow (Fig. 3 i)

*Tropidoneis semistriata* Grunow, Cleve, 1894, p. 27, pl. 3, figs. 9-11; Subrahmanyan, 1946, p. 184, figs. 411-12.

Valves membranaceous, lanceolate, acute and in girdle view slightly constricted in the middle. Keel somewhat eocoentric, surface
striated, 16 in 10 μ, not reaching the margin
of the valve. Length of valve 128 μ and breadth
22 μ.

Distribution : Coasts of North Sea,
Java Sea, N. America, Australia and India.

*Tropidoneis antarctica* var. *polyplasta*
Gran and Angst (Fig. 3 g)

*Tropidoneis antarctica* var. *polyplasta* Gran and
Angst, 1931, p. 501, fig. 90; Cupp, 1943,
p. 198, fig. 150.

Cells elliptical in girdle view, slightly con­
stricted at the central nodule, in valve view
lanceolate, with broad ends. Keel median,
long, valves with two transverse rod-like
thickening at both sides of the central nodule.
Cell wall thin, weakly silicified, both transverse
and longitudinal striae present, striae 22 in
10 μ.

Distribution : West coast of N. America
and North Sea Coast. New record for the
Indian Coasts.

Genus *Cymbella* Agardh

*Cymbella marina* Castracane (Fig. 3 k)

*Cymbella marina* Castracane, 1886, p. 21, pl. 27,
fig. 13; De Toff. 1891-94, p. 359; Subrahmanyan,
1948, p. 187, fig. 416.

Valves linear, elliptical, convex sides and
obtuse ends, raphe straight, somewhat broad,
axial area narrow, central area slightly dilated,
striae radiate 9 in 10 μ. Length of valve
74 μ and breadth 21 μ.

Distribution : West coast of N. America,
Japanese coastal waters, coasts of Australia
and India.

*Cymbella cistula* (Hemprich)
Van Heurck (Fig. 3 j)

*Cymbella cistula* (Hemprich) Van Heurck, 1899,
p. 147, pl. 1, fig. 41; Boyer, 1927, p. 280;
Venkataraman, 1939, p. 344, fig. 136; Wood,
1963, p. 256, pl. 8, fig. 100a.

*Cocconema cistula* Hemprich in Ehrenberg, 1838,
p. 224.

Valves asymmetrical, ventral margin swollen,
ends rounded, central area dilated on dorsal
side, distinct row of punctae on ventral side,
striae radial. Length 85 μ.

Distribution : Estuarine regions of North
Sea, Texas Bay, coasts of Australia and India.

Family : *Nitzschiaeae*

Sub-Family : *Nitzschioideae*

Genus *Nitzschia* Hassal

*Nitzschia panduriformis* Gregory
(Pl. III, Fig. h)

*Nitzschia panduriformis* Gregory, 1875, p. 529,
pl. 14, fig. 102; Grunow, 1880, p. 71; Van
Heurck, 1899, p. 386, pl. 15, fig. 500; Boyer,
1927, p. 197; Subrahmanyan, 1946, p. 188,
fig. 425; Hendey, 1964, p. 279.

Cells elliptical, slightly constricted in the
middle, with pointed extremities. Margin
with strongly marked keel, punctae 8 in 10 μ;
valve finely punctae, 24 in 10 μ arranged in
transverse and oblique lines. Length of valve
85 μ and breadth 24 μ.

Distribution : Coasts of Europe, North
Sea Coast, coasts of Britain and India.

*Nitzschia sigma* (Kutzing) Smith var.*
*indica* Karsten (Fig. 3 o - p)

*Nitzschia sigma* (Kutzing) Smith var. *indica* Karsten,
1907, p. 400, pl. 44, figs. 11a-b; Allen and Cupp,
1935, p. 163, fig. 129; Subrahmanyan, 1946,
p. 189, figs. 423-24, 430-431.

*Synedra sigma* Kutzing, 1844, p. 67, pl. 30, fig. 14.

*Nitzschia sigma* Smith var. *sigma*. Hendey, 1964*
pl. 42, fig. 1.

Valves linear, with weakly truncate ends,
slightly sigmoid in girdle view, in valve
view almost straight, considerably diminish
in size at the extremities, elongated, keel
distinct, punctae 8 in 10 μ, valve surface
striate, striae transverse 16 in 10 μ. Length
of valve 285 μ, breadth at the middle 18 μ.


Fig. 1. For explanation, see page 22.
Fig. 2. For explanation, see page 22.
Fig. 3. For explanation, see page 22.
Distribution: Estuaries in Europe, coasts of North Sea, Java Sea, N. America, coasts of India.

*Nitzschia acuminata* (Smith) Grunow (Fig. 3 n)

*Nitzschia acuminata* (Smith) Grunow, Cleve and Grunow, 1880, p. 73; Van Heurck, 1899, p. 388, pl. 11, fig. 596; Hendey, 1964, p. 290, pl. 39, fig. 10.

*Tryblionella acuminata* Smith, 1853, p. 36, pl. 10, fig. 77.

Valves broad and linear, with apiculate apices, valve margin straight, slightly concave, keel marginal, valve surface striate, striae transverse, 7 in 10 μ, interrupted by a longitudinal fold which is hyaline. Length of valve 76μ and breadth 16 μ.

Distribution: Coasts of Europe, North Sea and British Coasts. New record for the Indian Coasts.

*Nitzschia longissima* (Brebisson) Ralfs (Fig. 3 r)


*Ceratoneis longissima* Brebisson, Kutzing, 1849, p. 891.

*Nitzschia bisostra* Smith, 1853, p. 42, pl. 14, fig. 110.

*Nitzschiella longissima* Rabenhorst, 1864, p. 164.

Valves linear lanceolate, tapering to very long apical extremities, valves straight over the whole length, extremities not curved, marginal keel strong, keel punctae definite, valve surface faintly striate, keel punctae 12 in 10 μ. Length of valve 768 μ.

Distribution: Coastal and estuarine regions of France, Britain, Denmark, North Sea Coast, west coast of N. America, coasts of India.

*Nitzschia obtusa* Smith (Fig. 3 q)

*Nitzschia obtusa* Smith, 1853, p. 39, pl. 13, fig. 109; Van Heurck, 1899, p. 397, pl. 16, fig. 539; Wood, 1963, p. 273, pl. 10, fig. 200 a-b; Hendey, 1964, p. 282.

Cells linear, slightly sigmoid at the ends, valves with obtuse apices, keel central, slightly turned in at the margin, keel punctae 6 in 10 μ, the 3 median ones more distant, giving the impression of central nodule, valve surface striate, 22 in 10 μ. Length of valve 182 μ and breadth 18 μ.

Distribution: Coasts of North Sea, North America, Britain, Australia and Texas Bay. New record for the Indian Coasts.

Genus *Bacillaria* Gmelin

*Bacillaria paradoxa* Gmelin (Fig. 3 s-u)

*Bacillaria paradoxa* Gmelin, 1788, p. 3903; Smith, 1856, p. 10, pl. 32, fig. 279; Lebour, 1930, p. 211, fig. 175; Venkataraman, 1939, p. 351, figs. 144-45; Subrahmanyan, 1946, p. 187, figs. 417, 421, 427.

*Vibrio paxillifer* Muller, 1786, p. 54.

*Nitzschia paxillifer* Huberg in Boyer, 1927, p. 509.

*Nitzschia paradoxa* Grunow in Cleve and Grunow, 1880, p. 85; Van Heurck, 1899, p. 392, pl. 16, fig. 518.

*Bacillaria paradoxa* Hendey, 1964, pl. 21, fig. 5.

Cells united by their valves to form a mat-like colony, valves linear, lanceolate with squarish apices, spindle shaped in appearance, keel punctae strong, central valve striate, transverse 18 in 10 μ. Length of valve 115 μ and breadth 12 μ.

Distribution: Coasts of Europe, North Sea, west coast of N. America, Japanese Coast, coasts of Australia and India.

Genus *Hantzschia* Grunow

*Hantzschia amphioxys* (Ehrenberg) Grunow (Fig. 3 v)

**Eunotia amphioxys** Ehrenberg, 1840, p. 25, pl. 1, fig. 26.

**Nitzschia amphioxys** Smith, 1853, p. 41, pl. 13, fig. 105.

Cells narrowly rectangular, in girdle view, elongated, narrow and slightly bent in valve view, sides almost straight, keel punctae irregular, striated, 16 in 10 μ. Length of valve 72 μ and breadth 18 μ.

**Distribution:** Atlantic Coast, west coast of N. America, Texas Bay, coasts of Australia. New record for the Indian Coasts.

**Hantzschia amphioxys** var. major

**Hantzschia amphioxys** var. major Van Heurck, 1899, p. 381, pl. 15, fig. 144b.

Cells rectangular, much linear and longer than the type species, with 6 carinal dots, valve striate 12 in 10 μ. Length of valve 120 μ and breadth 18 μ.

**Hantzschia amphioxys** var. intermedia

**Hantzschia amphioxys** var. intermedia Van Heurck, 1899, p. 381, pl. 15, fig. 485b.

Cells rectangular in girdle view, linear and longer, slightly constricted in the middle, with 4 carinal dots, striated valve with 11 in 10 μ. Cells similar to the type species except its slightly bigger size and shape. Length of valve 85 μ and breadth 16 μ in the middle.

**Hantzschia amphioxys** var. vivax

**Hantzschia amphioxys** var. vivax Van Heurck, 1899, p. 381, pl. 15, fig. 485b.

Valves slender, long, rostrate, 5 carinal dots and 13 striae in 10 μ, slightly squarish at the apices in girdle view, much bigger than the type species. Length of valve 92 μ and breadth 14 μ.

**Distribution:** Estuaries in Britain, coastal areas of North Sea. New record for the Indian Coasts.

**Family:** Surirellaceae

**Sub-Family:** Surirellinoideae

**Genus** Surirella Turpin

**Surirella neumeyeri** Janish (Fig. 3 z)

**Surirella neumeyeri** Janish, 1862, pl. 31, fig. 33; Schmidt, 1875, p. 66; Smith, 1853, fig. 1; Wood, 1963, p. 210, pl. 4, fig. 100.

**Surirella nervatus** Grunow, Lefèbre, 1947, pl. 31 fig. 6.

Valves reniform, radiating septa, reniform axial area, surface of valve hyaline, striae indistinct. Length of valve 62 μ, breadth 28 μ.

**Distribution:** Coasts of North Sea, Britain and Australia. New record for the Indian Coasts.

**Surirella fastuosa** (Ehrenberg)

**Kutzing** (Fig. 3 aa)

**Surirella fastuosa** (Ehrenberg) Kutzing, 1844, p. 69, pl. 28, fig. 19; Smith, 1853, p. 32, pl. 2, fig. 66; Van Heurck, 1899, p. 372, pl. 13, fig. 583; Hendey, 1951, p. 75, pl. 9, fig. 7; Huang, 1979, p. 201, pl. 6, fig. 5.

**Navicula fastuosa** Ehrenberg, 1840, p. 214.

Valves broadly oval, costae robust, directed towards the margin, become narrow to the central space, lanceolate and hyaline. Valve surface striate, delicate, 20 in 10 μ. Length of valve 65 μ and breadth 42 μ.

**Distribution:** Estuaries of the coasts of North Sea, British Coast, west coast of N. America and Texas Bay. New record for the Indian Coasts.

**Surirella fluminensis** Grunow (Fig. 3 ab)

**Surirella fluminensis** Grunow, 1862, p. 463; Schmidt, 1875, p. 5, fig. 6; Allen and Cupp, 1935, p. 164, fig. 126; Subrahmanyan, 1946, p. 102, fig. 438.

**Surirella fluminensis** Grunow in Rabenhorst, 1864, p. 58.

Valve ovate, broad, ribs or canalioli few on the valve surface, inflated towards the
marginal region linear and large, marginal striae 18 in 10 μ. Length of valve 55 μ and breadth 35 μ.

Distribution: Coasts of North Sea, Java Sea, N. America, Adriatic Sea and coasts of India.

Surirella eximia Greville (Fig. 3 ac)

Surirella eximia Greville, 1857, p. 10, pl. 3, fig 6; Subrahmanyan, 1946, p. 192, fig. 439; Nair, 1959, p. 48.


Valves linear oblong, rounded ends, slightly constricted in the middle, canaliculate delicate, 18 in each side, reaching the narrow linear space and attenuate from ring-like space near the margin. Length of valve 92 μ and breadth 43 μ.

Distribution: North Sea Coast, British Coast, West Indies, coasts of India.

Sub-Family: Campylodiscoideae

Genus Campylodiscus Ehrenberg

Campylodiscus hodgsonii Smith (Fig. 3 ad)

Campylodiscus hodgsonii Smith, 1853, p. 29, pl. 6, fig. 63; Van Heurck, 1899, p. 376, pl. 32, fig. 868; Boyer, 1927, p. 549; Hendey, 1964, p. 291.

Valves sub-orbicular, nearly circular, canaliculi numerous, 3 in 10 μ, equal in length, about one third of the radius of the valve, central area punctate, arranged in radiating lines, interrupted by a linear median space. Length of valve 85 μ and breadth 78 μ.

Distribution: Estuaries in west coast of N. America, North Sea Coast and coasts of Britain. New record for the Indian Coasts.

Campylodiscus biangulatus Greville (Fig. 3 ae)

Campylodiscus biangulatus Greville, 1863, p. 4, fig. 2; Schmidt, 1895, pl. 14, figs. 18-22; Wood, 1963, p. 249, pl. 4, fig. 60.

Valve heart-shaped, strongly concolute, costae strong, bifurcate near margin, reaching linear ovate median space, costae strong in valve view than girdle view, 3 in 10 μ. Length of valve 65 μ and breadth 35 μ.

Distribution: Estuarine and coastal waters of Europe, west coast of N. America, sediments of Texas Bay. New record for the Indian Coasts.

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