Some Planktonic Diatoms from the Indian Ocean

By

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Introduction

Collections of phytoplankton were made by me at various stations between latitude 5°S and 25°S and longitude 78°E and 101°E (Fig. 1) from December 1962 to January 1963 during a cruise of the research vessel "Umitaka Maru" belonging to the Tokyo University of Fisheries. This vessel was engaged in work in connection with the I. I. O. E. The collections made by me from these stations were examined at the Fisheries Research Station, Colombo, for the various diatoms present and the findings are reported in this paper.

Some Stations covered by Umitaka Maru in connection with I.I.O.E.

29.12.62 Station 11 Latitude 4°57'.2"S Longitude 78°49'.6"E
30.12.62 Station 12 Latitude 7°05'.0"S Longitude 78°04'.0"E
31.12.62 Station 13 Latitude 8°52'.4"S Longitude 78°03'.0"E
2. 1.63 Station 15 Latitude 12°55'.9"S Longitude 78°02'.2"E
3. 1.63 Station 16 Latitude 15°10'.6"S Longitude 78°03'.8"E

Some Stations where experimental tuna fishing was carried out from the Umitaka Maru

13. 1.62 Station 1 Latitude 12°46'.S Longitude 97°19'.E
15. 1.63 Station 2 Latitude 10°10'.8"S Longitude 98°41'.E
16. 1.63 Station 3 Latitude 8°15'.2"S Longitude 100°04'.6"E

Stations covered in connection with the International Indian Ocean Expedition will be referred to as I. I. O. E; Stations covered for experimental tuna fishing will be referred to as T. G.

Material and Method

Horizontal hauls were made at Stations 11-16 with the following nets:—

(1) Pocket high-speed sampler, 4·5 cm. dia., 30 cm. long metal cylinder, 2 cm. dia. mouth opening with Japanese standard net No. XX 13.

(2) Marutoku net, 45 cm. diameter mouth ring, 90 cm. long with Japanese standard net No. XX 13.

Vertical hauls were made at Stations 1-3 with a Hart closing net, 25 cm. dia. mouth ring, 30 cm. diameter trunk ring; Japanese standard net No. XX 13.

The plankton collected was poured into a plankton concentration net and transferred into glass bottles, preserved in 10% formalin and examined in the laboratory.

Bacillariophyceae

Order : Centrales
Sub-order : Discoideae
Family : Coscinodisceae
Genus : Melosira Agardh

Melosira sulcata (Ehrenberg) Kuetzing

Cupp 1943, p. 40, fig. 2, Orthosira marina Smith 1856, p. 59, pl. 53, fig. 338, Paralia sulcata (Ehrenberg) Gran 1908, p. 14, fig. 5, Lebour 1930, p. 28, fig. 9.
Cells were found in long chains. Cells disc shaped thick walled 20-28 μ in diameter. Valves concave, areolate and punctate. Margin of valve with double rows of cells. Chromatophores numerous and disc shaped.

Station: T. G. 1, 2, 3.

Geographic distribution: Arctic Ocean, Indian Ocean, Atlantic and Pacific coasts of America, West Coast of France, Northern seas, Mediterranean Sea, Java Sea, Skaggerak.

**Sub-family Skeletonemineae**

*Genus Skeletonema* Greville

_Skeletonema costatum_ (Greville) Cleve

Cleve 1878, p. 18, Lebour 1930, p. 311, fig. 149, Cupp 1943, p. 43, fig. 6.

*Melosira costata* Greville 1866, p. 77, pl. 8, figs. 3-6.

These were found in long straight chains, cells lens-shaped or cylindrical with rounded ends. Cells separated from each other by a long space and connected by straight marginal spines. Chromatophores two, plate like, sometimes dissected. Diameter of cells 12-18 μ. Auxospores were observed.

Station: T.G. 1, 2, 3.

Geographic distribution: Generally neritic and widely distributed, Indian Ocean, English coasts, Baltic Sea, Arctic Sea, and Java Sea.

**Genus Thalassiosira** Cleve

_Thalassiosira decipiens_ (Grunow) Jorgenson

Hustedt 1864, p. 322, fig. 158. Cupp. 1943, p. 48, fig. 10.

*Coscinodiscus decipiens* Grunow 1899, p. 532, pl. 34, fig. 905.

Cells disc-shaped, united in loose chains with long spaces between cells. Valves with minute spines along the border; diameter 18 μ. Areolae in the valves larger in the centre than towards the periphery. Chromatophores small and numerous.

Station: T. G. 1, 2, 3.

Geographic distribution: Europe, Indian Ocean, Mediterranean Sea, Aral Sea, Caspian Sea.

**Sub-family Coscinodiscineae**

*Genus Coscinodiscus* Ehrenberg

_Coscinodiscus lineatus_ Grunow

Cupp. 1943, p. 53, fig. 15.

Cells disc-shaped 34-36 μ in diameter. Valve surface areolated. Areolae arranged in straight lines, those at the centre larger than those at the periphery. Valve margin radially striated, striae 12 in 10 μ; marginal spinulae strong.

Station T.G. 1, 2.

Geographic distribution: Europe, Indian Ocean, Pacific coast of America, Campochi Bay, Florida, Vera Cruz, Java.
Coscinodiscus centralis Ehrenberg

Lebour 1930, p. 39, fig. 16 a–b, 17b, 18b., Cupp. 1943, p. 60, fig. 24.
Disc-shaped cells of 162 μ diameter. Valves with distinct rosette at the centre. Areolae 4 in 10 μ near centre, 4–5 midway to margin and 5–6 near the margin. Valve margin radially striated, 6–8 striae in 10 μ.
Geographic distribution: North Atlantic Ocean, Mediterranean Sea, Gulf of California, Florida, Algeria.

Coscinodiscus marginatus Ehrenberg

De Toni, 1891–94, p. 1241, Allen and Cupp. 1935, p. 115, fig. 7, Cupp. 1943, 55, fig. 19; plate 1, fig. 3.
Station: T. G. 2, 3.
Geographic distribution: Sumatra, Indian Ocean, Singapore, Antarctic, Ceylon, Arabian Sea and in all oceans.

Genus Planktoniella Schutt

Planktoniella sol (Wallich) Schutt

Lebour 1930, p. 50, pl. 1, fig. 5, Cupp. 1943, p. 63.
Coscinodiscus sol Wallich, 1860, p. 38, figs. 1–2.
Cells disc-shaped; diameter of central disc 45 μ with wing 120 μ.
Valve surface areolated; areolae 5–7 in 10 μ at the centre of valve, 7–8 in the middle and 8–9 in the margin, wing like expansions present on cell margin.
Station: T. G. 1, 2, 3.

Genus Asteromphalus Ehrenberg

Asteromphalus wyvillei Castracane

Castracane 1876, p. 134, Pl. 5, fig. 6.
Cells round; diameter 72 μ, with numerous small disc-shaped chromotophores. Segments wedge-shaped, areolated.
Station: T. G. 1, 2, 3.
Geographic distribution: Indian Ocean.

Asteromphalus flabellatus (Brebisson) Greville

Cells convex, valves sub-elliptical; long axis 55–60 μ, short axis 40–52 μ. Compartments finely reticulated. Median ray straight or slightly curved. Border segments areolated.
Station: T. G. 1, 2, 3.
Geographic distribution: Mediterranean Sea, Campeche Bay, Java Sea, Peruvian guano, North Sea, Indian Ocean.
Genus *Gossleriella* Schutt

*Gossleriella tropica* Schutt

Schutt 1893, p. 20; Subrahmanyan 1946, p. 107, fig. 86.

Cells disciform, valves orbicular, diameter 180 to 190 μ. Valve border with a ring of hairs of equal length but of unequal thickness. Chromatophores numerous and disc-shaped.

Station: I. I. O. E. 11; T. G. 1, 2, 3.

Geographic distribution: Mediterranean Sea, Indian Ocean.

Genus *Actinocyclus* Ehrenberg

*Actinocyclus ehrenbergii* Ralfs


Station: T. G. 1, 2, 3.

Geographic distribution: Atlantic and Pacific Coasts of America, North Sea, Norwegian and Danish Seas, Gulf of Finland, Gulf of Bothnia, Baltic, Skagerrak, Aral and Caspian Seas, Black Sea, North Atlantic, Mediterranean, Peruvian guano.

Sub-order: Solenoideae

Family: Solenieae

Sub-family: Lauderiineae

Genus: *Corethron* Castracane

*Corethron hystrix* Hensen

Hustedt 1930, p. 547, fig. 311; Cupp. 1943, p. 70. *Corethron criophylum* Castracane 1886, p. 85, pl. 21, figs. 12, 14 and 15; Lebour 1930, p. 80, fig. 24.

Cells with cylindrical mantle and valves arched hemispherically. Diameter 52 μ. Valve margin with a crown of slender spines. Spines of both valves pointed in the same direction. Chromatophores numerous, small and disc-shaped.

Station: T. G. 1, 3.

Geographic distribution: Atlantic Ocean, Java Sea, Vancouver, California.

Sub-family Rhizosoleniinae

Genera: *Rhizosolenia* Ehrenberg

*Rhizosolenia setigera* Brightwell

Brightwell 1858, p. 95, pl. 5, fig. 7, De Toni, 1891–94, p. 827, Lebour 1930, p. 98, fig. 70, Hustedt 1930, p. 588, fig. 336, Cupp. 1943, p. 88, fig. 40.

Cells cylindrical, diameter 38 μ, length 512 μ, valves conical, slightly oblique. Apical process hollow for some distance and ending in a long spine. Chromatophores numerous, small and ellipsoidal.

Station: T. G. 1, 2.

Geographic distribution: California, Vancouver, Java Sea, European Seas, Bay of Fundy.
Rhizosolenia robusta Norman

Norman 1861, p. 866, pl. 8, fig. 42; Lebour 1930, p. 94, fig. 68; Cupp. 1943, p. 83, fig. 46.

Cells cylindrical, valves convex or conical curved, 52-258 μ in diameter cells crescent-shaped or S-shaped. Intercalary bands robust, collar shaped. Cell wall thin, membrane delicately punctuated, puncta in three lines self crossing system. Numerous chromatophores lying along the wall.

Station: T. G. 2.

Geographic distribution: European Seas, Pacific Coast of America.

Rhizosolenia alata Brightwell

Brightwell 1858, p. 96, pl. 5, fig. 8; Lebour 1930, p. 88, fig. 60; Allen and Cupp 1935, p. 131, fig. 43; Cupp 1943, p. 90, fig. 52A.

Cells rod-shaped, cylindrical, 7-24 μ in diameter and 658-980 μ in length. Valves conical ending in tube-like or curved oblique process. Depression at the base of tube into which the apical process of adjoining cell fits. Intercalary bands scale-like rhombic in two dorsiventral rows. Cell wall thin and finely striated. Chromatophores small and numerous.

Station: I. I. O. E. 11, 12, 13, 16.

Geographic distribution: Java Sea, Indian Ocean, Red Sea, Gulf of Aden, Arabia, Malaya, Antarctic, Madras, Boston Strait, America.

Rhizosolenia alata Brightwell forma gracillima (Cleve) Grunow

Allen and Cupp 1935, p. 131, fig. 44; Cupp 1943, p. 92, fig. 52B; Subrahmanyan 1946, p. 121.

Cells rod-shaped, straight 4-7 μ in diameter.

Station: T. G. 1, 2.

Geographic distribution: Coastal form found in most, usually northern, seas.

Rhizosolenia alata Brightwell forma indica (Peragallo) Ostenfeld

Allen and Cupp 1935, p. 131, fig. 45; Cupp 1943, p. 93.

Cells much broader than the type 15-110 μ. Calyptrae suddenly attenuated due to the greater diameter of cell. Process very strikingly curved. Cell wall finely punctuated, puncta in quincunx rows short and irregular.

Station: T. G. 1, 2, 3.

Geographic distribution: In all warm seas, California.

Rhizosolenia styliformis Brightwell

Brightwell 1858, p. 95, Pl. 5, fig. 5d; De Toni, 1891-94, p. 826; Hustedt 1930, p. 584, fig 335; Cupp. 1943, p. 87, fig. 46.

Cells cylindrical, diameter 54 μ and length 484 μ, valves obliquely pointed. Apical process long and hollow. Wing not distinct. Intercalary bands scale like in two rows, punctuate. Chromatophores round, small, and numerous.

Station: I. I. O. E. 12, 13, 16; T. G. 2, 3.

Geographic distribution: European seas, Vancouver, California, West Indies, Antarctic, coast of Barbados, Java Sea.
Sub-order : Biddulphioidae  
Family : Chaetocereae  

*Chaetoceros pervianus* Brightwell  
1856, p. 107, pl. 7, figs. 16-18; Allen and Cupp 1935, p. 137, fig. 57; Cupp 1943, p. 113.

Cells usually single, sometimes forming short chains 15-35 µ broad. Valves dissimilar, the upper rounded, the lower flat. Both with well developed valve mantles. Setae of upper valve originate near the centre, turn sharply and run backwards in wide outwardly convex curves. Setae of lower valve originate near the margin, curve outwards and run parallel to the pervalvar axis. Setae strong, four sided, 3-5 µ thick with strong spines; striated 19-25 in 10 µ. Chromatophores numerous, small and disc-shaped, present in setae as well.  

*Station*: I. I. O. E. 16; T. G. 2, 3.  
*Geographic distribution*: Atlantic and Pacific Oceans, Java Sea, Peruvian guano, Mediterranean Sea, widely distributed in warmer seas.

*Chaetoceros didymus* var. *protuberans* (Lauder) Gran and Yendo  
Allen and Cupp 1935, p. 139, fig. 62; Cupp 1943, p. 121; *Chaetoceros protuberans* Lauder, 1864, pl. 8, fig. 11.  
Cells forming straight chains 15-36 µ wide with concave surface and with semicircular knob in the middle. Setae arising from the corners of the adjacent cells crossing at the base or further out. Terminal setae mostly thicker than others and strongly divergent. Chromatophores two in each cell pressed against the valve with a pyrenoid located in the protuberance.  

*Station*: T. G. 2, 3.  
*Geographic distribution*: Mediterranean, warmer seas, California, Arctic and Atlantic Oceans, Peruvian guano, Europe.

*Chaetoceros affinis* Lauder  
Lauder 1864, p. 78, pl. 8, fig. 5; Lebour 1930, p. 135, fig. 99; Allen and Cupp 1935, p. 140, fig. 85; Cupp 1943, p. 125.  
Chains straight, 6-25 µ wide, apertures lanceolate and constricted in the middle. Cells oblong in broad girdle view. Setae delicate, terminal setae strongly divergent with spirally arranged spines; chromatophores one in each cell lying on broad side of girdle with single pyrenoid.  

*Station*: T. G. 1, 2, 3.  
*Geographic distribution*: Common in all seas.

*Chaetoceros diversus* Cleve  
Cleve 1873, p. 9, pl. 11, fig. 12; Allen and Cupp 1935, p. 142, fig. 71; Cupp 1943, p. 132, fig. 37.  
Short straight chains 10-12 µ broad. Valves flat or slightly raised at the centre. Apical axis 5-12 µ long. Apertures very small. Setae arise from 4 corners of cell. Setae thick, tubular and spinous, more or less curved or straight turning towards chain ends. Terminal setae thin and hair-like. Chromatophores are in each cell on girdle side.  

*Station*: T. G. 1, 2, 3.  
*Geographic distribution*: Tropical and sub-tropical, North Sea, Mediterranean.

*Chaetoceros coarctatus* Lauder  
Lauder 1864, p. 79, pl. 8, fig. 8; Lebour 1930, p. 119, Allen and Cupp 1935, p. 135, fig. 62; Cupp 1943, p. 107, fig. 62.  
terminal setae shorter than others, strongly curved and heavily spined. Anterior terminal setae less robust, curved backwards and sparsely spined. Inner setae resembling the anterior ones. Chromatophores numerous and disc-shaped.

Station: I. I. O. E. No. 15.

Geographic distribution: Tropical and sub-tropical seas, Mediterranean Sea.

Family Biddulphaceae
Sub-family Eucampineae
Genus Eucamnia Ehrenberg
Eucamnia zodiaca Ehrenberg

Ehrenberg 1840, p. 71, pl. 4, fig. 8.; Lebour 1930, p. 187, fig. 147; Allen and Cupp, 1935, p. 143; Cupp 1943, p. 145, fig. 103.

Eucamnia britannica, W. Smith 1856, p. 25, pl. 71, fig. 378; Eucamnia groenlandica, Cleve 1896, p. 10, pl. 2, fig. 10.


Station: T. G. 1, 2, 3.

Geographic distribution: North Sea, Skagerrak, Baltic Sea, English Channel, Mediterranean, North Atlantic, California, Europe, Belgian Coast.

Genus Climacodium Grunow
Climacodium frauenfeldianum Grunow

Grunow 1867, p. 102, pl. 1a, fig. 24; De Toni 1891-94, p. 986; Lebour 1930, p. 189, fig. 149a; Allen and Cupp, 1935, p. 144, fig. 76; Cupp 1943, p. 147, fig. 10j.

Cells flat, forming ribbon-like chains. Length of apical axis 70-158 μ, pervalvar axis 12-20 μ. In valve view cells are linear-elliptical. Apertures large, oblong or almost at right angles and wider than the cell in pervalvar direction.

Station: I. I. O. E. 11, 13; T. G. 1, 3.

Geographic distribution: Mediterranean, Red Sea, California, Central America.

Order: Pennales
Sub-order: Araphidineae
Family: Fragilarioideae
Sub-family: Fragilarieae,
Fragilarinae

Genus Fragilariae Lyngbye
Fragilaria oceanica Cleve

Cleve 1873, p. 22, pl. 4, fig. 25; Lebour 1930, p. 193, fig. 153.

Fragilaria arctica Grunow, Cleve and Grunow, p. 110, pl. 7, fig. 124.

Cells in girdle view rectangular, forming compact ribbon-like chains; valves lanceolate or elliptical, with rounded ends 12-30 μ in length and 7-8 μ broad. Pseudoraphi, narrow and linear.

Station: T. G. 1.

Geographic distribution: Norway, Denmark, Russia, Davis Strait, England and Gulf of Maine.
Genus *Synedra*

*Synedra formosa* Hantzsch

Hustedt 1931–32, p. 233, fig. 720; Subrahmanyan 1946, p. 167, figs. 342, 343 and 348.

*Ardissonia formosa* (Hantzsch), De Toni 1891–94, p. 675.


**Station:** T. G. 1.

**Geographic distribution:** Honduras, Vera Cruz, East Indian Archipelago, Europe.

Genus *Thallassiothrix* Cleve and Grunow

*Thallassiothrix longissima* Cleve and Grunow

Cleve and Grunow 1880, p. 108; De Toni 1891–94, p. 672; Lebour 1930, p. 199, fig. 159; Cupp 1943, p. 184, fig. 134.

Cells four sided, long and threadlike often more or less curved. Valves narrow and linear, ends slightly narrowed more in one end than the other. Length 0.5 to 4 mm. width 2.5–6 μ. Delicate spines present in the corner of the valves, more towards the centre than towards the ends or absent.

**Station:** I. I. O. E. 12; 13, 15; T. G. 1, 2, 3.

**Geographic distribution:** North Atlantic, Arctic Sea, Scotland, Belgium, Russia, Sweden, Norway, Germany, California and Antarctic, Denmark, Mediterranean.

Genus *Pleurosigma* W. Smith

*Pleurosigma angulatum* (Quekett) W. Smith

var _strigosa* (W. Smith) Van Heurck

Van Heurck 1899, p. 251, pl. 6, fig. 261; De Toni 1891–94, p. 233, Allen and Cupp 1935, p. 158, fig. 108; *Pleurosima "strigosum"* W. Smith, p. 7, pl. 1, fig. 6.

Valves lanceolate, slightly sigmoid, 110 μ long and 15 μ broad, raphe sigmoid, excentric at the ends. Oblique and transverse striae equidistant, 18–22 in 10 μ.

**Station:** T. G. 1.

**Geographic distribution:** England, Sicily, Italy, Finmark, Adriatic Sea, Mediterranean Baltic.

*Nitzschia longissima* (Brebiisson) Ralfs


*Nitzschia birostrata* W. Smith 1853, p. 42, pl. 14, fig. 119; *Ceratoneis longissima* (Brébiisson) Ralfs, 1861, p. 783; *Nitzschiella longissima* (Brébiisson) Rabenhorst, 1864, p. 104.

Cells 95–565 μ long and 3–6 μ broad; valves linear, lanceolate; ends elongated into hair-like horns. Keel punctae, 8–14 in 10 μ. Chromatophores, two in the centre.

**Station:** T. G. 1, 2, 3.

**Geographic distribution:** England, Denmark, France, Virgin Islands, New Jersey, Pacific Coast of America, Java Sea.
Nitzschia closterium (Ehrenberg) W. Smith

W. Smith 1853, p. 42, pl. 15; Lebour 1930, p. 212, fig. 176; Allen and Cupp 1935, p. 163, fig. 122; Cupp 1943, p. 200, fig. 153.

Ceratoneis closterium Ralfs 1861, p. 783, pl. 12, fig. 59; Nitzschiella closterium (Ehrenberg) Rabenhorst 1864, p. 163.

Cells single, valves spindle-shaped or lanceolate in the middle, ends hair-like, slightly bent. Two Chromatophores placed in the centre. Valves 25-150 μ in length, 3-7 μ broad.

Station: T. G. 1, 2, 3.

Geographic distribution: England, Scotland, Davis Strait, Norway, Sweden, Denmark, California, Java Sea.

Ceratoneis closterium Ralfs 1861, p. 783, pl. 12, fig. 59; Nitzschiella closterium (Ehrenberg) Rabenhorst 1864, p. 163.

Cells single, valves spindle-shaped or lanceolate in the middle, ends hair-like, slightly bent. Two Chromatophores placed in the centre. Valves 25-150 μ in length, 3-7 μ broad.

Station: T. G. 1, 2, 3.

Geographic distribution: England, Scotland, Davis Strait, Norway, Sweden, Denmark, California, Java Sea.

Nitzschia seriata Cleve

Cleve 1883, p. 478, pl. 38, fig. 75; De Toni 1891-94, p. 501; Lebour 1930, p. 213, fig. 178; Allen and Cupp 1935, p. 164, fig. 124; Cupp 1943, p. 201, fig. 155.

Cells spindle shaped, ends pointed or slightly rounded; united into stiff hair-like chains by the overlapping points of the cells. Length of valves 60-135 μ, width 3-5·8 μ. Striae 13-19 in 10 μ. Chromatophores 2 on each side of the central nucleus.

Station: T. G. 1, 2, 3.

Geographic distribution: Davis Strait, England, Scotland, Holland, Belgium, Germany, Sweden, Denmark, Atlantic and Pacific Coasts of America, Antarctic and Java Sea.

Navicula hennedyii W. Smith

W. Smith 1856, p. 93; De Toni 1891-94, p. 103; Cleve 1894, p. 57; Subrahmanyan, p. 181, fig. 402.

Valves elliptical, 38-62 μ long, 21-36 μ wide. Lateral areas, narrow, linear, lanceolate or broad semilanceolate with parallel inner margins. Striae 12-15 in 10 μ.

Station: I. I. O. E. 16.


Sub-family: Amphiporoideae

Genus Amphipora Ehrenberg

Amphipora gigantea Grunow, var. sulcata (O'meara) Cleve

Cleve 1894, p. 18; Allen and Cupp 1935, p. 160, fig. 113; Cupp 1943, p. 198, fig. 151.

Amphipora sulcata O'meara 1871, p. 22, pl. 3, fig. 3.


Station: T. G. 1, 2, 3.

Geographic distribution: Java Sea, California.

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References


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Fig. 1. Collecting Stations marked X.