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HYDROBIOLOGICAL STUDIES IN THE INSHORE WATERS OF THE BAY OF BENGAL

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Abstract

The occurrence and abundance of diatoms in the nearshore waters of the bay in relation to physico-chemical characteristics of waters was studied. Two stations were chosen for collecting samples. Station 1 was located midway between Adyar River and Cooum River and station 2 opposite the mouth of river Cooum. Weekly surface samples were made and hydrological datc collected. Phytoplankton that occurred in the collections were analysed for diatoms and 34 diatoms were identified and their abundance was correlated with the existing hydrological conditions. Dissolved oxygen content was low at high temperature and high salinity. pH was dependent on changes in total CO_2 and this in turn was dependent on diatom population. At station 2 low salinity generally coincided with dense diatom population while at station 1 there was no such correleation. The standing crop of phytoplankton was high. Availability of high amount of nutrients could well be the cause for high production. Studies on growth characteristic of some diatoms and blue green algae in the laboratory revealed that while diatoms seemed to thrive better under existing hydrological conditions blue green algae preferred a medium very rich in nitrogen nutrients..

Introduction

Phytoplankton investigations in the Indian Coastal waters have centered on their systematics and seasonal occurrence (Menon, 1945; Prasad, 1954; Prasad and Ramachandran Nair, 1963). Many workers have studied only the physico-chemical characteristics of the waters (Jayaraman, 1951; Ganapathy and Murthy, 1954; Ramamirtham and Patil, 1964; Singbal and Reddy, 1983). Quantitative and qualitative studies on phytoplankton populations and correlating their occurrence and abundance with physico-chemical characteristics of the water have also been made (Ramamurthy, 1953 b; George, 1953; Subrahmanyan, 1959 a, b; Ramamurthy, 1965; Varshney *et al.*, 1983.) The present study relates to occurrence and abundance of diatoms in the nearshore waters of the bay in relation to physico-chemical characteristics of the waters. Growth characteristics of some of these algae have also been studied with a view to understand their perferences for available nutrients.

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Material and Methods

Sample collection: Two stations in the nearshore waters of the bay were chosen for collecting samples. Station 1 was located midway between Adyar River and Cooum River and Station 2 was located opposite the mouth of river Cooum (Fig. 1). Sea water was collected from the surface at 7.00 a.m. at weekly intervals for two months (April-May, 1984) in polythene containers and brought to the laboratory as quickly as possibile for detailed chemical analyses. For measurement of dissolved oxygen, water samples were fixed on the spot using Winkler's method. For pH measurements, samples were collected in polythene bottles upto the brim, closed at once with a tight fitting screw cap and stored in dark at low temperature until just before analysis. Seawater containing phytoplankton was centrifuged and made up to a known quantity with 8 % sea water formalin. The number of diatoms were counted in a haemocytometer and the total number of diatoms/ml of sea water was calculated.

Physico-chemical analyses: Analyses of water samples were carried out for temperature, pH, total alkalinity, carbonate alkalinity, total CO_2, partial pressure of CO_2, concen-

TABLE 1. *Abundance of the dominant diatoms in the collections (Number per ml)*

Diatom	Station 1									Station 2								
	April 1984				May 1984					April 1984				May 1984				
	6	12	19	26	3	10	17	24	31	6	12	19	26	3	10	17	24	31
Asterionella japonica Cleve	3477	125	4057	331	752	657		63	28	1650	653	4328	237	886	156	525	381	32
Chaetoceros wighami Brightwell	266	80	685	102	300	85	220	25	•	230	•	285	134	57	12	2125	64	•
Coscinodiscus lineatus Ehr.	144	38	970	215	605	852	400	50	39	66	•	2284	86	•	50	320	150	23
Melosira sp.	17700	142	8701	•	4187	170	•	•	28	5906	1579	1915	•	3209	23	•	•	10

tration of dissolved CO_2, bicarbonate and carbonate ion concentrations, dissolved oxygen, biochemical oxygen demand, salinity, nitrate, nitrite, reactive phosphorus and reactive silicate, following the procedures given by Strickland and Parsons (1972).

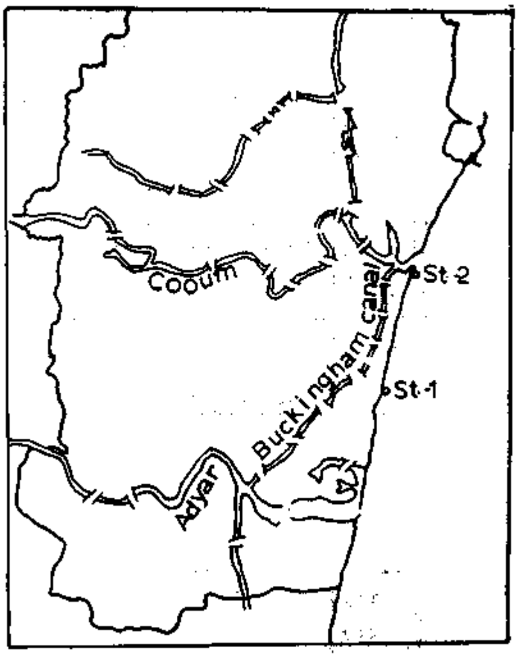

Fig. 1. Location of Station 1 and Station 2 along the Madras Coast.

RESULTS AND DISCUSSION

Hydrobiological data

The hydrological data obtained during the period of study is given in Figs. 2 and 3.

Temperature

Surface water temperature of the bay generally showed a bimodal oscillation (Sewell, 1929; Bal *et al.*, 1946; Prasad, 1957; Subrahmanyan, 1959; Ramamurthy, 1953 b).

In the present study water temperature was comparable to those obtained in April and

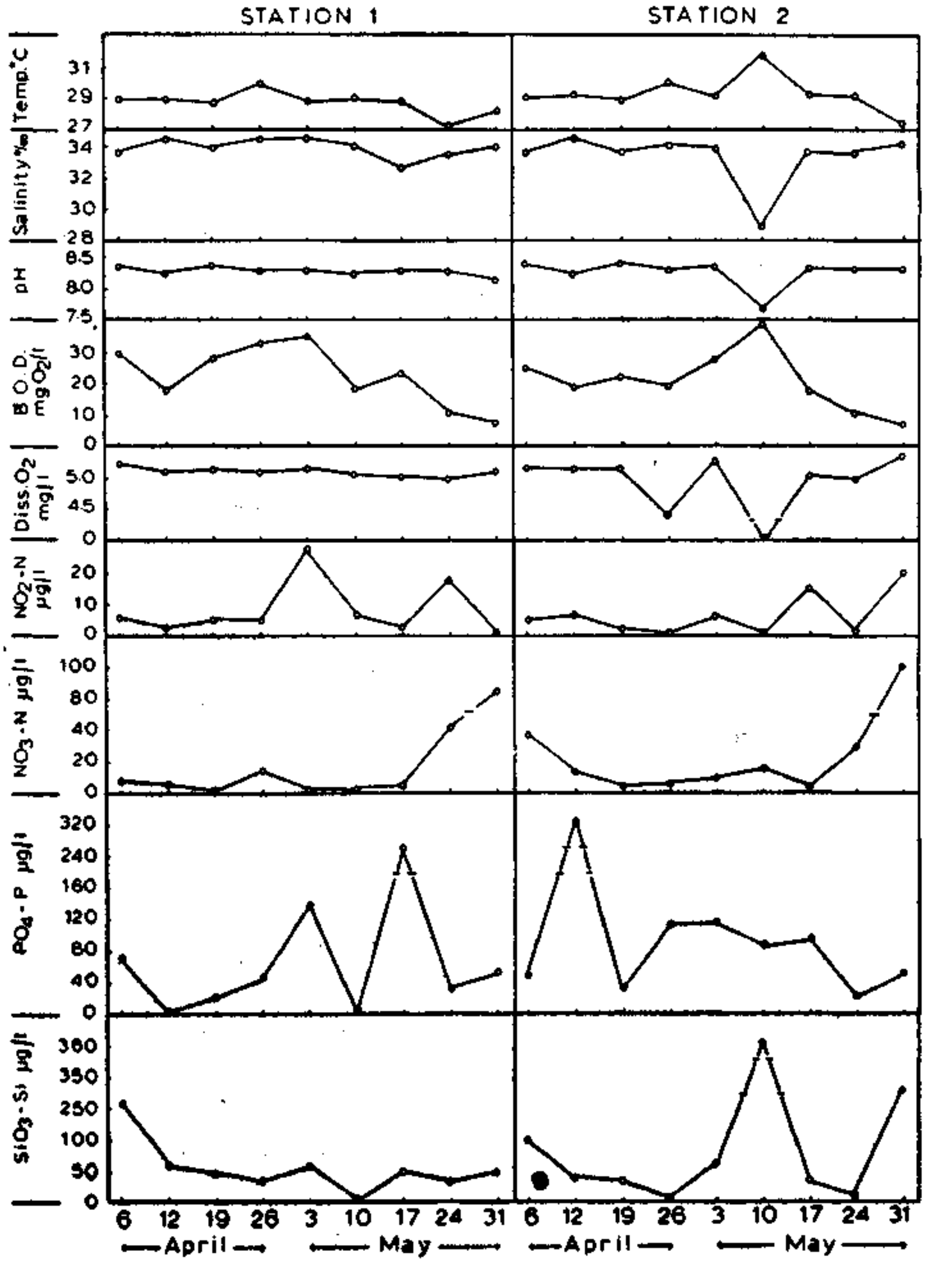

Fig. 2. Temperature, salinity, pH, dissolved oxygen, biochemical oxygen demand, NO_3-N, NO_2-N, PO_4-P, SiO_3-Si for stations 1 and 2 during April and May 1984.

May by other workers for Madras coastal waters. Temperature for both stations slightly decreased towards the end of May.

pH

Monthly averages in pH for station 1 and station 2 during April and May were found to be little higher compared to those of other workers (Ramamurthy, 1953 a; Muthu, 1956). Factors that caused an increase in carbondioxide such as rise in temperature or salinity decreased the pH.

Salinity

Salinity of sea water in both stations were more or less uniform with station 2 showing slightly lower salinity on an average. At station 2, salinity showed a sharp decrease on May 10, 1984. Except for this low value, salinity on other days were comparable to values obtained by other workers (Jayaraman, 1951; Ramamurthy, 1953 b; Muthu, 1956).

During the period of study, salinity curve was found to follow temperature curve only during April and early May, but in late May salinity increased with a decrease in temperature. This was perhaps due to upwelling which might have brought colder more saline waters from the deep to the surface.

Dissolved oxygen

Low values of dissolved oxygen were obtained during the study period at both stations. Generally low oxygen content was associated with a high temperature and high salinity.

Biochemical oxygen demand

BOD values were found to be generally low. There was no correlation between BOD and cell counts.

Phosphate-phosphorus

Uniformly high PO_4-P was observed during the period of study. Perhaps this was due to water samples being taken from a shallow region.

TABLE 2. *Number of filaments of blue green algae per ml* (Initial inoculum = 25000 filaments/ml)

Concentration of NO_3-N (µg/ml)	Filaments/ml			
	2nd day	4th day	6th day	8th day
0.045	41820	45880	90000	53125
50	62000	155700	258750	212500
100	73990	103600	238750	178750
123	80000	118100	180000	131250
250	90010	96010	216200	115000
500	137500	152000	197500	42500
1000	67010	94450	140000	52857

Nitrate-nitrogen

The nitrate maxima occurred in the last week of May at station 2. This was little short of the maxima obtained by Jayaraman (1951).

Nitrite-nitrogen

NO_2-N content was found to fluctuate widely. At times it was not detectable. Other workers (Ramamurthy, 1953 b; Muthu, 1956) have also reported that nitrite was absent on some occasions during April and May.

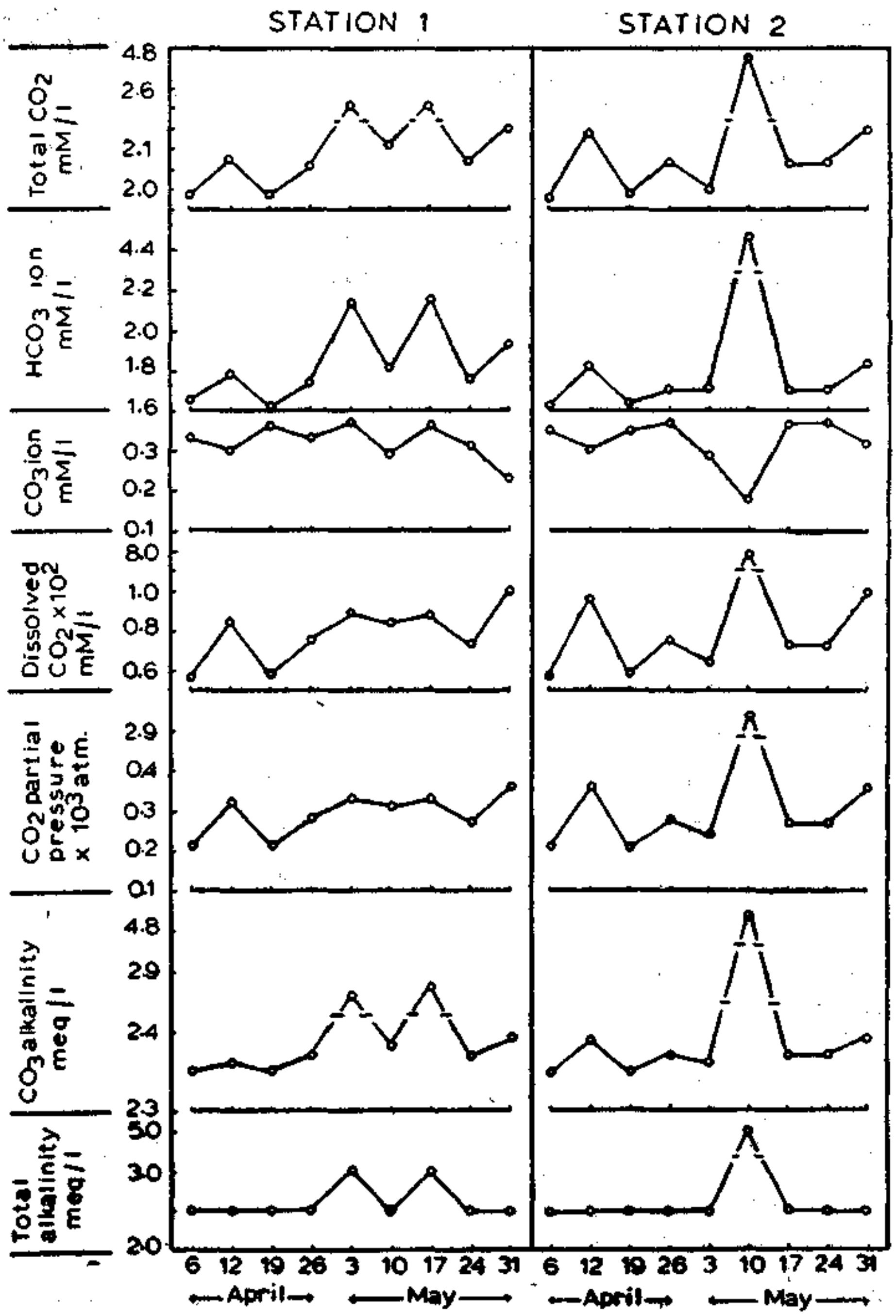

Fig. 3. Total CO_2, HCO_3 and CO_3 ion concentrations, total alkalinity, CO_3 alkalinity, partial pressure of CO_2 and dissolved CO_2 for stations 1 and 2 during April and May, 1984.

Silicate silicon

High silicate silicon correlated with low salinity. Silicate concentrations here were generally higher when compared to other areas. The postulated inverse relationship between diatom population and silicate of the waters was not observed.

Free carbon dioxide, carbonate and bicarbonate

Curves showing the amount of total CO_2, dissolved CO_2, partial pressure of CO_2 and bicarbonate ion concentration were all similar. The lowest amount of CO_2 was found when there was an increase in phytoplankton. On these days the pH was maximum.

Some diatoms appeared to occur sporadically as was the case with *Amphiprora gigantea Amphora proteus, Cyclotella* sp., *Ditylum br'ghtwelli., Eucampia cornuta, Guinard flaccida, Nitzschia closterium, Rhaphoneis-amphiceros, Thalassosira* sp., *Triceratium. dubium, T. favus, T. reticulatum* and *T. sculptum Bacteriastrum* sp., *Rhizosolenia* sp., *Thalassionema* sp. and *Thalassiothrix* sp. were found to occur rarely and in less numbers. *Melosira* sp., *Asterionella japonica, Coscinodiscus lineatus* and *Chaetoceros wighami* occurred throughout and in large numbers. High total counts of diatoms coincided with low salinity at station 2. Diatom population at station 1 showed rise and fall and seemed to be independent of salinity changes. Increase in

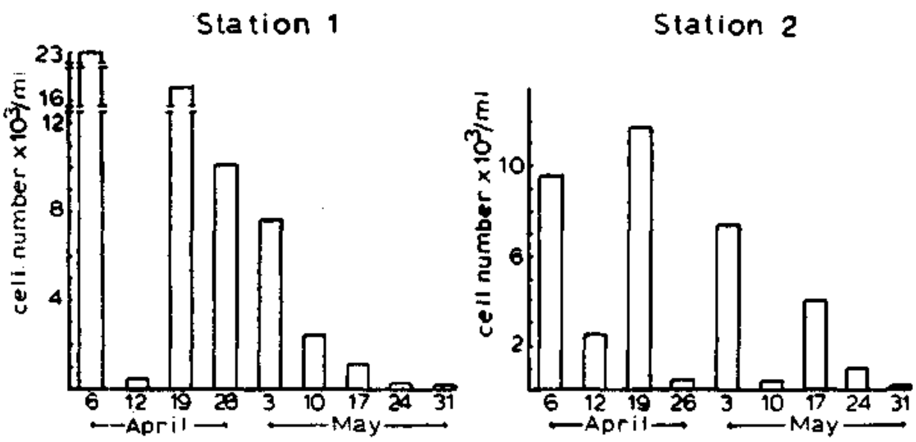

Fig. 4. Total number of diatoms per ml of sea water samples.

Phytoplankton in relation to other factors

Diatoms present in the water samples were estimated and are represented as histograms (Fig. 4). In all 34 diatoms were identified in the collections and data relating to abundance of the dominant diatoms are given in Table 1. Some of the diatoms and two silicoflagellates that occurred in the collections were photographed and are presented in Plate I A-Y.

diatom populations correlated with increase in pH and dissolved oxygen as reported for temperate by Marshall and Orr (1927, 1930) and Gaarder and Gran (1927).

Phytoplankton and nutrients

Nitrates, phosphates and silicates are very important for phytoplankton productivity. In temperate and polar waters an inverse relationship has been observed between the number of diatoms and the dissolved phosphate content (Atkins, 1923; Marshall and Orr, 1927; Riley, 1941). No such correlations was observed in this study though the maximum

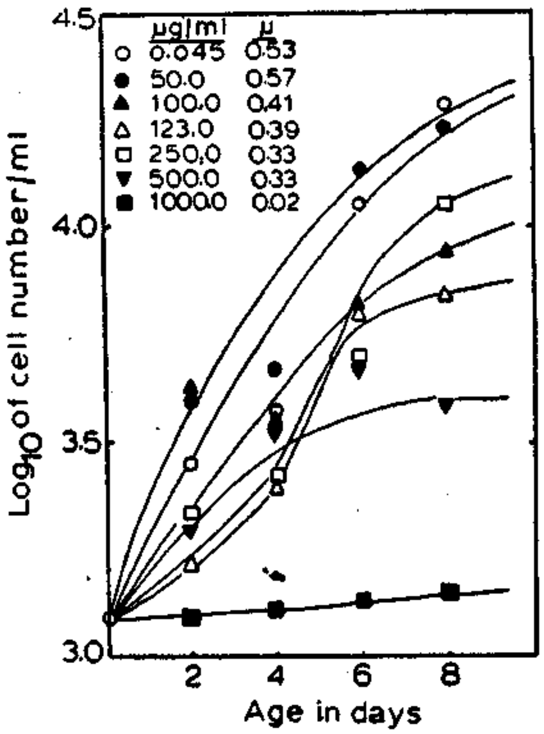

Fig. 5. Growth curves of diatoms in various concentrations of NO_3-N. (μ=division rates).

amount of phosphate-phosphorus was found to occur coinciding with relatively low counts of diatoms. At both stations the maximum amount of nitrate - nitrogen was found to occur when cell was minimum. The available NO_3-N, PO_4-P, SiO_3-Si were enough to support a high diatom population during the period of study.

In order to find out the effect of increasing nitrate on phytoplankton population the following experiment was conducted. One litre of sea water sample was centrifuged and the phytoplankton pelleted. The pellet was resuspended in 5 ml of filtered sea water and from this 1 ml was inoculated into 9 ml of F/2 medium contained in test tube and incubated for 10 days at 2000 lux and 24$\pm$1°C. A mixed population containing mostly *Amphiprora gigantea*, *Navicula* sp. and the blue green alga *Phormidium tenue* (Menegh) Gomont developed. One ml of this was used to inoculate 9 ml of media prepared by amending F/2 medium with several concentrations of KNO_3 providing the different treatments and the results are expressed in Fig. 5 and Table 2.

While diatoms were able to multiply many times their own number at very low concentration of NO_3-N, blue green algae could do so only at higher concentrations of NO_3-N. Moderately high concentrations of NO_3-N retarded growth of diatoms while growth was maximum for blue greens. Very high concentrations of NO_3-N (1000μg/ml) were found to be inhibitory to both diatoms and blue greens.

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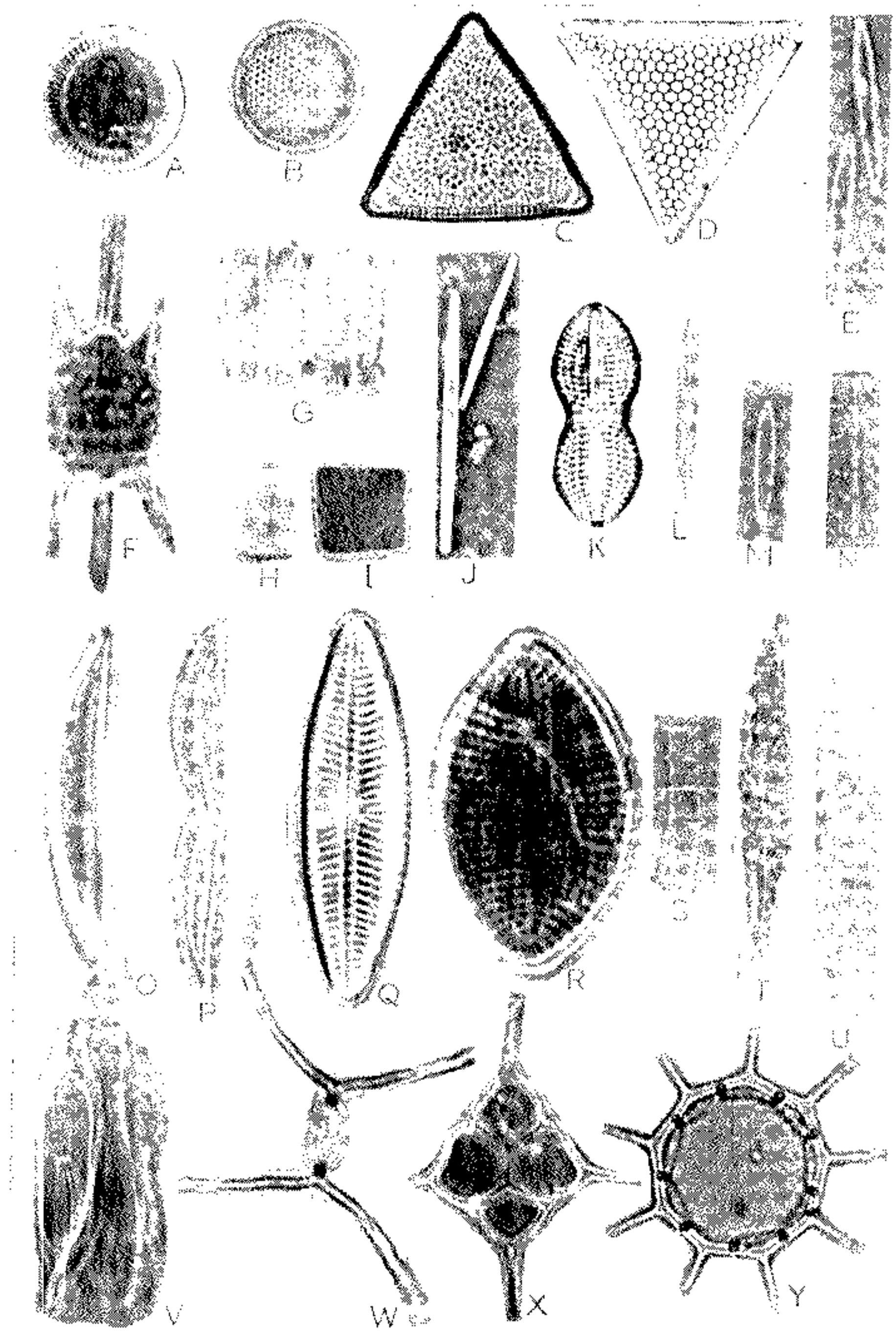

PLATE I. A. *Paralia sulcata* (x 950), B. *Coscinodiscus lineatus* (x 870), C. *Triceratium reticulatum* (x 950), D. *Triceratium favus* (x 400), E. *Nitzschia palea* (x 1500), F. *Biddulphia mobiliensis* (x 950), G. *Triceratium sculptum* (x 950), H and I. *Triceratium dubium* (x 900), J. *Synedra tabulata* (x 600) K. *Diploneis weissflogii* (x 900), L. *Amphora proteus* (x 900), M. *Nitzschia palea* (x 940), N. *Asterionella japonica* (x 375), O. *Amphora terroris* (x 800), P. *Amphiprora gigantea* (x 900), Q. *Navicula cancellate* (x 560), R. *Rhaphoneis amphiceros* (x 1350), S. *Chaetoceros wighami* (x 1000), T. *Pleurosigma aestuarii* (x 375), U. *Chaetoceros perpusilla* (x 1200), V. *Amphiprora gigantea* (x 300), W. *Chaetoceros wighami* (x 950), X. *Dictyocha fibula* (x 900) and Y. *Silicoflagellata* (x 950).

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