MINISTRY OF COMMERCE AND INDUSTRY

Hydrobiological and Fisheries Directorate

NOTES AND MEMOIRS No. 24

PLANKTON OF THE EGYPTIAN WATERS

A Study of The Suez Canal Plankton

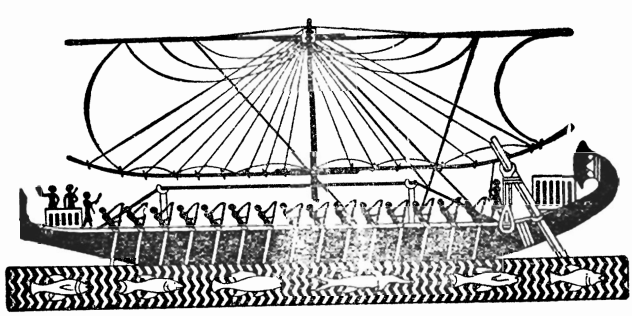
(*A*) THE PHYTOPLANKTON.

Preliminary Report

(with 11 Figures and 2 Charts in the Report and 65 Figures in the Appendix)

BY

F. M. GHAZZAWI, B.Sc. (Cairo), Ph.D. (Liverpool)



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Contents

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Plankton of the Egyptian Waters
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INTRODUCTION

Various Scientific bodies—and of these the "Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée"—have been recently interested in the study of the faunistic relations between the Red Sea and the Mediterranean. A study of the plankton in the Suez Canal might throw some light from the explanatory point of view, on the distribution of the planktonic forms characteristic of each mass of the two different waters mentioned above. From the fisheries point of view, the plankton study is indispensable to seek out the relation between the abundance, and movements of fishes and the fluctuations in the plankton, both in quantity and quality at different times, places and depths. Some of our most important food fishes, like the sardines, are plankton-eaters, and certain fishes "migrate" in search for food and may be traced in shoals where the plankton is abundant. As a source of food for our commercial fishes, the plankton is of prime economic importance.

Little work has been done on the plankton in the Suez Canal. Giesbrecht (1896) and Thompson and Scott (1903) collected samples of copepods from the canal and Bitter Lakes.

The Cambridge Expedition to the Suez Canal (1924) collected samples of plankton at every available opportunity during the last three months of that year. The Expedition made no report on the phytoplankton.

Macdonald (19) examined plankton hauls collected by Wimpenny (25) from the Suez Canal during four intermittent months. Macdonald (19) was therefore the first to report on the distribution of the microplankton throughout the canal. But the hauls at his disposal were limited to a short period of the year, a fact that would not enable the investigator to form a definite and conclusive result about the actual distribution of the plankton throughout the canal at the different seasons of the year. Besides, in his month of July no hauls seemed to have been made with the fine nets, while in September, hauls were made only at three stations. As a result of this irregularity whether in the peridoical collections, or in the use of gear, many facts have been either missed or mis-represented. For example, in the month of July, the canal at many places was invariably rich in phytoplankton. Also, in his mention of the Ceratia, Macdonald (19) noticed that these dinoflagellates were characteristically found in the south half of the Canal, with the exception of Ceratium massiliense which he found at Port Said in October. My observations indicate that the Ceratia are commonly and unevenly distributed throughout the Canal, and that, at Port Said end, at least nine different species of Ceratia were recorded in March.

I have been in a better position than my predecessors regarding the study of the ditribution of the plankton, as I have aimed, from the start, at filling the gaps in their previous investigations, by collecting samples from the Canal throughout the year—and many successive years: and by suing vertical nets for quantitative investigations.

Although horizontal catches could easily be utilsed to give a more or less correct and preliminary idea about the frequency and distribution of the plankton as a whole at the different seasons of the year, yet a precise quantitative study of the plankton would be practically difficult in a region where the identity of the species is unknown and therefore the qualitative side of the planktonic problem should be attacked first; so my collections were mainly made for such purpose.

Hauls were taken with the international horizontal tow-nets only; the fine net has 200, and the coarse 60 strands per inch. The length of the bolting silk is 2 metres and the mouth of the net is 50 cm. in diameter.

Samples of plankton were collected from the six different stations chosen by Wimpenny (25) for his hydrographical observations and plankton collection. These stations are (*see* chart).

S.C. 1.—Western Jetty at mouth of the Canal.

S.C. 2.—Ballah signal station.

S.C. 3.—1 km. S. W. of the Canal Company's landing stage at Ismailia.

S.C. 4.—Northern Light buoy in Great Bitter Lake.

S.C. 5.—Kilometre 130 of the Canal in Little Bitter Lake.

S.C. 6.—Last buoy but one on the Western side of the Canal at Port Tewfik.

Trips either started from Port Tewfik or from Port Said, once every month, and each trip lasted two days on each occasion. The coastguards motor-boats "EL-HILAL" and "EL-ZAFIR" were at my disposal in every excursion. From Port Tewfik to Ismailia, or vice versa, a-one-day-trip, I travelled by one boat, and from Ismailia to Port Said, or vice versa, another-one-day-trip, I travelled by the other. These motor-boats, however, proved to be of very unpractical assistance for towing my nets. When hauls are made, a uniform slow speed is desired for towing. The nets should be preferably towed at a uniform speed of ½ metre per second, thus a haul of 10 minutes duration should cover a distance of 300 metres. If this was achieved, one could have the advantage of enabling the different collections to be made in a strictly uniform manner. This, however, was not possible as the small motor boats were too fast for my requirements, and although my hauls were of 10 minutes duration, yet the distance over which the nets were towed at the different stations, was not the same. The not-wanted, but inevitable, high speed of the motor boats caused not only the nets to tear on more than one occasion, particularly the fine nets, but also the quantity of the plankton in the catches must be affected, being a little less or a little more than it should have been had the nets filtered the same amount of water. To obviate this obstacle, nets were towed from a small rowing boat for 10 minute duration. This method proved to be workable only under favourable weather conditions, for I was often confronted with the same difficulty when the water was choppy.

The fine and coarse nets were towed at each station simultaneously, thus collecting samples of plankton over the same distance for the same time.

The nets after each catch were washed thoroughly first in sea water and then in fresh water and allowed to dry in the shade by hanging in the air, as our direct sunlight is scorching and has a detrimental effect upon the life of nets.

As soon as the catches were brought up, they were treated with 4 per cent formalin (40% commercial formalin diluted with sea water to 4%).

Hydrographical observations were recorded at each station at the time of making my hauls. A Nansen-Peterson insulated water bottle with a Schmidt thermometer was used for collecting samples of water for salinity and oxygen-content determinations. The temperatures and pH. were also recorded. The catches were placed in 4 oz. corked bottles and transferred to the Marine Laboratory at Alexandria for further microscopic examination.

Geographical Note

The geography of the Suez Canal has been described in detail by Fox (7) in his general report on the Cambridge Expedition in 1924. Briefly, the canal was opened in 1869, it is 162 kilometres in length including Lake Timsah, the Great Bitter Lakes and the Little Bitter Lake through which the canal passes. The canal proper is 130 metres in width and 12 metres in depth in the centre. It is therefore a very narrow capillary passage between the two different seas. The canal is connected at Port Said with Lake Menzaleh, which contains brackish water, through a lock which is frequently closed. Another lock is situated at Ismailia and through which the Nile water pours into Lake Timsah from a branch of a canal which supplies that region with fresh water.

Temperature

The temperature was recorded at each of the six Suez Canal stations on nine monthly occasions. Temperature was not taken for the month of February, May and September. The figures recorded in the table for September are taken from 1933 temperature data, while those for February and May are taken from 1934 temperature records. Table I shows the surface temperatures.

Wimpenny (25) has drawn the attention to the importance of temperature as a possible limiting factor in the migration of the distributary stages through the Suez Canal.

On another page, the possible relation between the plankton production and temperature is discussed. The changes in temperatures that take place throughout the canal during the different months of the year could be seen from Fig. 1, which illustrates 12 graphs for the 12 months of the year. It shows, speaking generally and broadly, that the highest temperatures are recorded in August, and the lowest in February. From March, the outset of the spring, the temperature starts to rise steadily until it reaches its maximum in August. In November, the temperature throughout the canal is nearly the same. If November is excluded, then for eight months of the year, starting from March, or in other words during the spring, summer and autumn, the temperature at Port Said is higher than at Suez. In winter, namely in December, January and February, the reverse occurs,

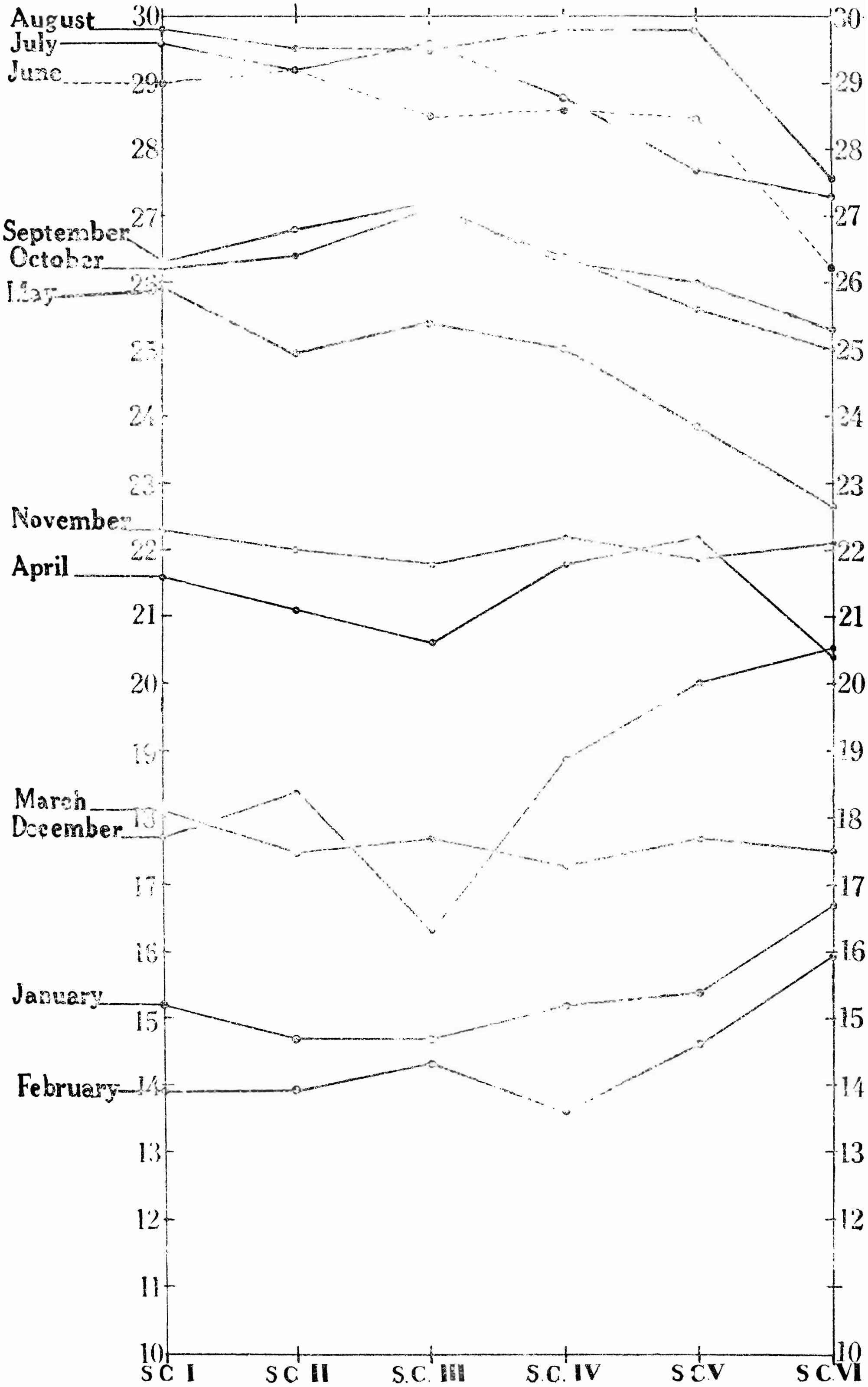

FIG. 1.—Curves showing surface Temperatures in the Suez Canal

TABLE I.—MONTHLY SURFACE TEMPERATURES

	January		February		March		April		May	
	T°	Time	T°	Time	T°	Time	T°	Time	T°	Time
S.C. 1	15·2	10·40	13·9	8·58	18.1	16·30	21·6	11·35	25·9	10·50
Date	23–1–1935		26–2–1934		10–3–1935		22–4–1935		23–5–1934	
S.C. 2	14·7	15·10	13·9	12·59	17·5	12·10	21·1	16·5	24·95	16·06
Date	ditto		ditto		ditto		ditto		ditto	
S.C. 3	14·7	16·45	14·3	14·45	17·7	17·50	20·6	9.30	25·4	18·10
Date	ditto		ditto		ditto		ditto		ditto	
S.C. 4	15·2	12·00	13·6	10·32	17·3	15·50	21·8	11·20	25·0	10·12
Date	24–1–1935		27–2–1934		9–3–1935		24–4–1935		24–5–1934	
S.C. 5	15·4	14·30	14·6	13·15	17·7	13·25	22·2	13·30	23·85	12·55
Date	ditto		ditto		ditto		ditto		ditto	
S.C. 6	16·7	17·15	15·9	15·40	17·5	11·00	20·4	16·00	22.65	14·57
Date	ditto		ditto		ditto		ditto		ditto	

IN THE SUEZ CANAL.

June		July		August		September		October		November		December	
T°	Time	T°	Time	T°	Time	T°	Time	T°	Time	T°	Time	T°	Time
29·0	16·30	29·6	13·05	29·8	16·50	26·3	9·20	26·2	14·45	22·3	10·20	17·7	14·30
28-6-1935		25-7-1935		4-8-1934		24-9-1933		4-10-1934		16-11-1934		18-12-1934	
29·2	11·20	29·2	17·20	29·5	11·40	26·8	13·35	26·4	10·50	22·0	14·00	18·4	11·00
ditto		ditto		ditto		ditto		ditto		ditto		ditto	
28·5	9·05	29·6	17·10	29·5	9·05	27·2	35·30	27·1	15·45	21·8	15·50	16·3	9· 2
ditto		ditto		ditto		ditto		ditto		ditto		ditto	
28·6	13·35	28·8	8·25	29·8	14·35	26·3	12·50	26·4	14·00	22·2	11·00	18·9	14·15
26-6-1925		26-6-1935		5-8-1934		25-9-1933		3-10-1934		17-11-1934		17-12-1934	
28·5	15·10	27·7	10·40	29·8	12·15	26·0	12·50	25·6	11·30	21·9	13·00	20·0	12·20
ditto		ditto		ditto		ditto		ditto		ditto		ditto	
26·2	12·00	27·3	13·20	27·6	9·10	25·3	15·15	25·00	9·00	22·1	15·05	20·5	10·00
ditto		ditto		ditto		ditto		ditto		ditto		ditto	

the temperature at Port Said is lower than at Suez. The Pola Expedition took water temperatures on the 2nd and 8th of May 1896 at Suez and Port Said, and on the 16th and 24th of October 1895, at Port Said and Port Tewfik respectively and arrived at the same conclusion. Wimpenny (25), in 1928, found the same condition in his temperatures for July and September, although he found that in October (and not in November as my records show) the temperatures are nearly the same at both ends of the Canal. In an interesting way, Wimpenny (25) put forward the hypothesis that the marine water at Port Said is heated above the normal Mediterranean water, by the hotter Flood water of the Nile that has been travelling through more than a thousand miles of desert and which is being discharged into the sea through the Damietta mouth of the Eastern Branch of the Nile, and through Lake Menzaleh, the water of which being rapidly heated by the sun owing to its extreme shallowness. In winter the Nile is at its lowest, and so the water at S.C. 1 receiving no Nile water, falls to that normal to the coastal water of the Mediterranean and is therefore lower than at Suez. Fig. 2 shows graphically the above results for S.C. 1 and S.C. 2.

Salinity

The determinations of salinity were kindly made by Dr. Samra according to Knudsens method. Table II shows the salinity of each of the six stations in the Suez Canal at the different depths. These figures would tempt the observer to distinguish between at least four different masses of water according to their salinity (*see* Faouzi 6). S.C. 1. at Port Said, has generally a lower salinity than the other stations. Ordinarily, it has a salinity near to that normal to the coastal Mediterranean water, but in August, September and October, when the Nile flood water pours into the sea, the salinity decreases rapidly, and during that year, it attained a minimum at the surface reaching 21·71‰ in October. The water at S.C. 2 gets also fresher at the time of the Nile Flood. Secondly, S.C. 3, at Ismailia has a very varying salinity, reaching sometimes below 30‰ and sometimes above 43‰. The salinity at S.C. 3 varies within wide limits from place to place, and from one depth to another. The reason for this enormous variation is that the water at Lake Timsah receives frequently fresh water from the fresh water canal mentioned before. But it should be noticed that denser and more saline water lies under this brackish surface water. Thirdly, S.C. 4 and S.C. 5, in the Bitter Lakes, are noted for their very high salinities. In both these stations, the salinity at the surface never fell below 42‰ and, in both, too, it reached as high as above 47‰. But there is a

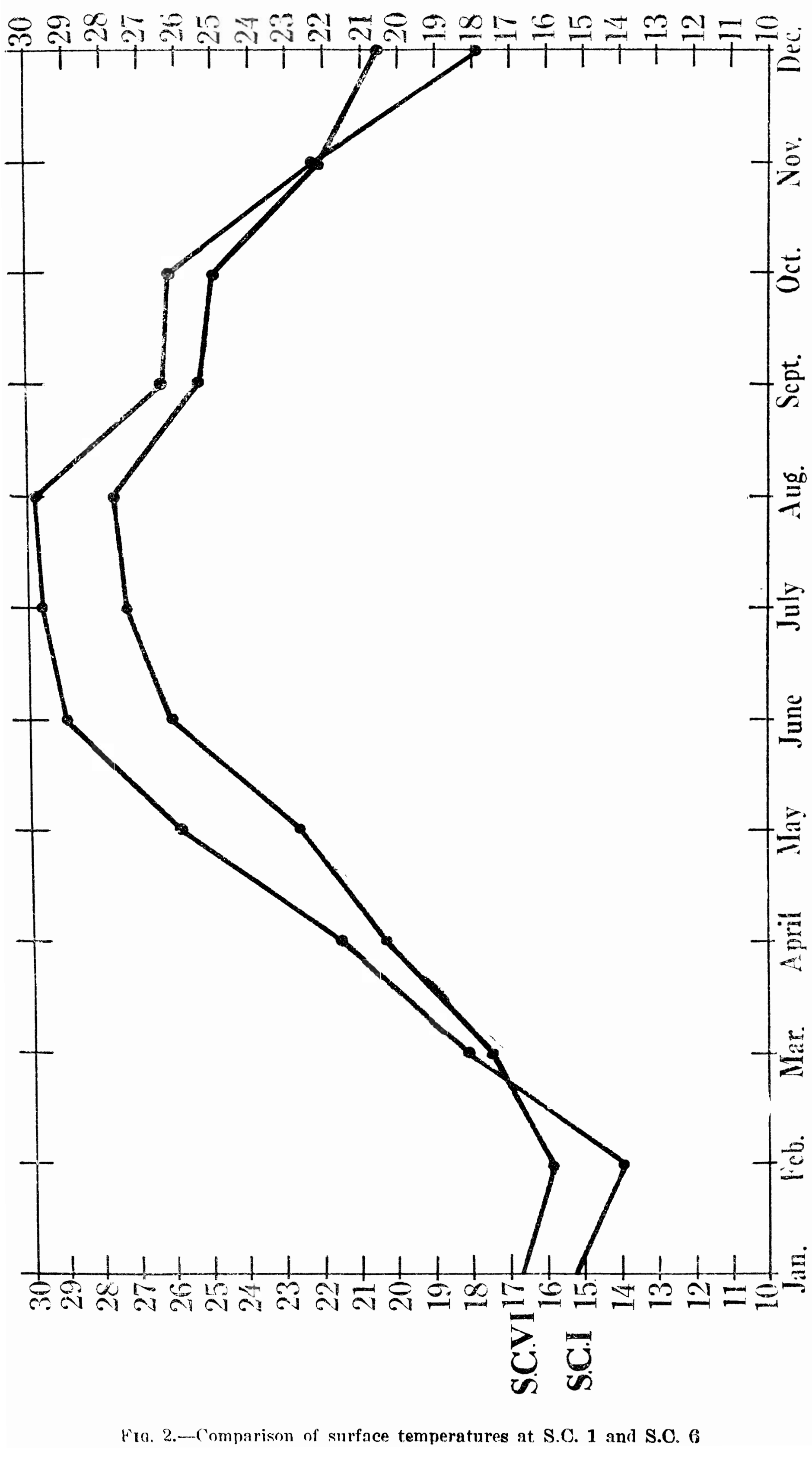

FIG. 2.—Comparison of surface temperatures at S.C. 1 and S.C. 6

TABLE II.—SALINITY OBSERVATIONS I

Station	Depth Metres.	January S ‰	February S ‰	March S ‰	April S ‰	May S ‰
S.C. 1	0	37·14	38·51	38·12	38·75	39·51
	5	37·32	38·46	—	38·71	39·51
	10	43·44	42·50	41·46	41·47	43·87
Date		23–1–35	25–2–36	9–3–35	22–4–35	24–5–3[illegible]
S.C. 2	0	44·44	42·84	43·71	43·44	44·23
	5	44·44	42·75	43·71	43·40	44·23
	10	44·18	42·84	43·64	43·40	44·14
Date		ditto	ditto	ditto	ditto	ditto
S.C. 3	0	43·53	43·19	42·19	43·49	38·53
	5	44·40	44·16	43·71	44·54	44·23
	10	44·49	44·87	44·16	44·47	44·83
Date		ditto	26–2–36	ditto	ditto	23–5–3[illegible]
S.C. 4	0	44·67	44·41	44·47	34·41	44·92
	5	44·67	44·87	44·43	44·51	44·92
	10	44·97	44·87	44·60	44·47	44·83
Date		24–1–35	ditto	8–3–35	44–4–35	ditto
S.C. 5	0	42·09	42·23	42·39	42·70	42·57
	5	42·05	42·50	42·48	42·57	42·48
	10	42·09	42·50	42·48	42·88	42·48
Date		ditto	ditto	ditto	ditto	ditto
S.C. 6	0	41·96	41·89	42·19	42·27	41·96
	5	42·05	41·89	42·19	42·27	41·96
	10	42·23	—	42·19	42·27	42·05
Date		ditto	ditto	ditto	ditto	ditto

IN THE SUEZ CANAL

Juce	July	July	August	September	October	November	December
S ‰	S ‰	S ‰	S ‰	S ‰	S ‰	S ‰	S ‰
38·89	37·05	39·11	36·09	32·47	21·71	35·01	36·60
38·89	37·59	39·18	38·75	38·48	—	—	—
39·25	38·12	—	—	—	—	—	—
8–6–35	24–7–35	3–7–34	4–8–34	5–9–35	4–10–34	16–11–34	18–12–34
43·66	39·34	43·40	40·95	39·18	40·43	45·19	43·35
43·87	39·00	40·95	40·77	40·43	—	—	—
44·05	39·52	—	—	—	—	—	—
ditto	ditto	ditto	ditto	ditto	ditto	ditto	ditto
42·03	38·82	43·40	36·55	44·77	30·23	35·01	29·43
42·45	39·00	42·70	42·33	43·22	—	—	—
43·10	42·95	—	—	—	—	—	—
ditto	ditto	ditto	ditto	ditto	ditto	ditto	ditto
45·26	45·12	45·15	46·21	46·74	46·65	46·41	45·19
45·53	46·09	45·15	46·31	47·48	—	—	—
45·53	46·44	—	—	—	—	—	—
26–6–35	25–7–35	4–7–34	3–8–34	6–9–34	3–10–34	17–11–34	17–12–34
44·00	47·48	43·83	47·35	46·92	46·74	52·57	42·29
43–78	47–48	43–74	47–17	46–92	—	—	—
44–00	47–65	—	—	—	—	—	—
ditto	ditto	ditto	ditto	ditto	ditto	ditto	ditto
42·48	42·70	42·33	42·70	12·60	43·22	42·48	42·39
42·39	42·86	42·17	42·88	42·60	—	—	—
42·45	43·04	—	—	—	—	—	—
ditto	ditto	ditto	ditto	ditto	ditto	ditto	ditto

noteworthy remark about the salinities in S.C. 4 and S.C. 5. During the summer months, both have a high salinity, this is partly due to the excessive evaporation of the sea water caused by the intense heat and thus leading to its concentration, and partly due to the fact that hot water dissolves more salts than cold water. There is a salt-bed at the bottom of the Bitter Lakes, and naturally more of the salt would pass into solution the higher the temperature of the water. In November, the temperature sinks to 21·9° and 22·4° at S.C. 4 and S.C. 5 respectively, the temperature in October at the two stations was still a summer one, being 25·6° at S.C. 5 and 26·4° at S.C. 4. From November, the temperature begins to fall gradually until it starts something like its summer value in May again. During those comparatively cold months, the salinity at S.C. 4, remain still high being above 44‰ while at S.C. 5 falls to little above 42‰.

The difference in salinity seems to have a marked effect on the production of phytoplankton as will be shown later. A main factor seems to bring about this result, S.C. 5 at Kilometre 130 is within the tidal influence of the gulf of Suez. There is a rapid tidal current between Suez and station 5 reversing its direction twice every day. This tidal current would, in the absence of the summer factors increasing the salt content of water, thoroughly mix the Suez water with that of South Bitter Lake. It is clearly seen from the tables, that not only the surface water, but also at 5 and 10 metres deep, the salinity at S.C. 5 approximates that of S.C. 6, this prevails for nearly six months from November to April. S.C. 4 on the other hand, is out-side the influence of any tides, as the tidal current vanishes in the Little Bitter Lake beyond five kilometres from the Southern end. The water, for 6 months, stretching for about 30 kilometres in the southern section of the canal is clearly an erythrean water. Fox (7) mentioned that for 10 months of the year, from October to July, the high salinity water of the bitter Lakes flows northward in the canal as far as kilometre 10, and for two months, namely August and September, the fresher water of the Mediterranean extends southward as far as Lake Timsah.

Faouzi (6), from his salinity figures for the same stations of the Suez Canal, agrees in his observations with Fox regarding the month of August and September, namely that there is during these two months a general inflow of the Mediterranean water into the Suez Canal as far as Lake Timsah. But he also contributed the following conclusions : (1) For six months of the year, namely from November to April, Red Sea water flows northward and *reaches* the Mediterranean (and not to K. 10 as Fox (7) mentioned) ; (2) In May, June, and October, the Erythrean water reaches northward as far as S.C. 2 only ; (3) While Suez Water reaches the Mediterranean, the latter never

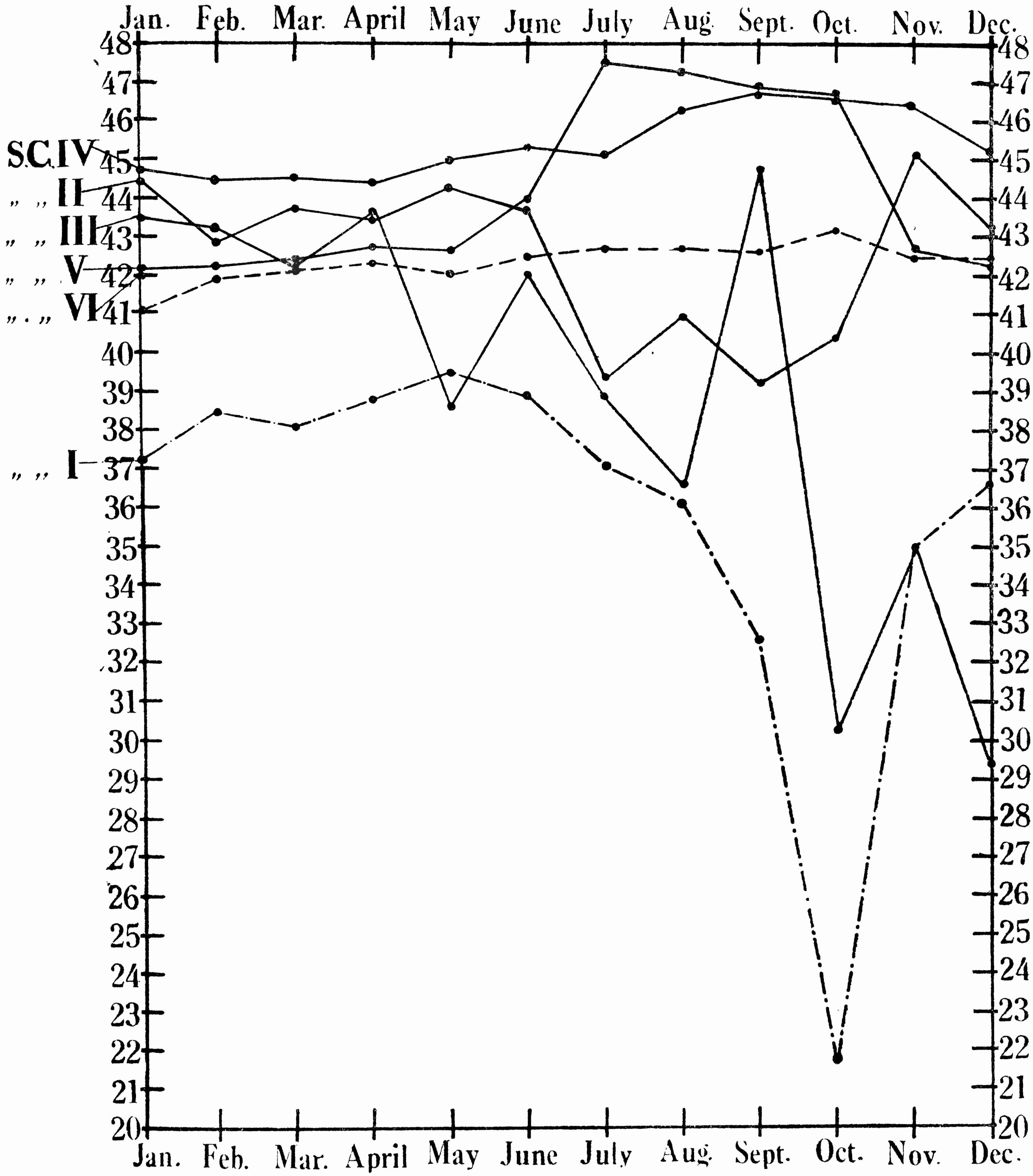

FIG. 3.—Curves showing surface salinity in the Suez Canal.

reaches the Red Sea and therefore there is no direct current from Port Said to Suez contrary to what had been stated by the earlier investigators.

My figures would show that the fresh water of S.C. 1 started during 1934 to drift along southward from July and not August. It is highly probable that the exact time and period of these northward currents vary from year to year. The Mediterranean tidal currents are very slight and almost imperceptible. We have therefore to deal with three main sets of currents: (1) a strong rapid tidal current at the southern end of the canal; (2) a current from the Red Sea northward for 10 months of the year; (3) a current from the Mediterranean southard for 2 months of the year. This is all important in explaining the distribution of the various members of the plankton throughout the Canal, and the possible invasions of some of the Erythrean species into the Mediterranean or vice versa. The discussion of these various currents are stressed upon as they are the main agents for the distribution of plankton from one place to another.

The Phytoplankton

Under this heading, two main groups are included, namely the Diatoms and the Dinoflagellates.

In the Suez Canal Stations there are numerous species of Diatoms and Peridinians, but the number of the most important and abundant species is relatively few. For convenience only, in certain cases as when there are many species belonging to one genus, or when it was difficult to identify the exact species, generic titles are dealt with in the general review of the distribution of the plankton.

The following at least nine genera are the most common among the Diatoms. They are roughly arranged in the order of their abundance in the Suez Canal :—

Thalassiothrix.

Chætoceros.

Guinardia.

Coscinodiscus.

Rhizosolenia.

Bacteriastrum.

Nitzschia.

Skeletonema.

Ditylium.

The Dinoflagellates are represented chiefly by Ceratium, Peridinium, and Goniaulax. Another genus, Dinophysis was also recorded in the Suez Canal water, in occasional numbers.

Notes on the Status of the prominent genera of Diatoms

THALASSIOTHRIX

This genus is one of the most important elements in the phytoplankton of the Suez Canal. Thalassiothrix is represented by two species *viz.* Thal. Frauenfeldii and Thal. longissima, the former is by far the most important, and is very easily recognized by the charateristic union of the cells into star-like or zigzag chains. Thal. longissima, occurring usually in single cells, was also noted to be united together in fan-like shape, the cells united at their pointed poles. Thal. Frauenfeldii is widely distributed throughout the Canal. It was detected at almost every station, but seems to prefer the northern half of the Canal. It is a summer from, and it was recorded in very great numbers in August and September at S.C.1 and S.C.2, while it was less abundant at other stations. During the winter it was sparingly represented, and it was a notable feature that the length of the cells decreased in the cold months. Thal. longissima was less frequent than Thal. Frauenfeldii, and it was characteristic of the northern half of the Canal. In December it was abundant at S.C.1, thus appearing to be a winter form, unlike its sister diatom Thal. Frauenfeldii. Thal. Frauenfeldii is most probably, Th. nitzchioides of Macdonald (19). The diatom in my catches exactly agrees with that figured in plate XIV of Castracane (3) Report. On the other hand, Macdonald (19) did not record Th. longissima in his paper. Dr. Lebour, of the Plymouth Laboratory, has kindly confirmed the identification of this last named species.

CHAETOCEROS

The chief species of the genus in the Suez Canal stations are Chætoceros decipiens, Ch. lauderi, Ch. affinis, Ch. holasticus, Ch. didymus, Ch. brevis, Ch. Ralfsii, Ch. curvisetum and Ch. densum. The last species is a temperate oceanic form and was almost only located at S.C.6, but sometimes at S.C.5. Minute vorticella were almost always found attached by their conspicuous spiral stalks to the valve surface of Ch. densum. This species was present in July and March.

Ch. decipiens is an oceanic from while all other species are neritic. Certain species attain their maximum in spring, others in Autumn, while some forms have their greatest numbers in summer.

Consequently the genus as a whole is well represented in the Suez Canal throughout most of the year, particularly in the Nothern region of the Canal.

The genus was absent in January, while it fell to its minimum in August, but in September the genus appeared at S.C.1 in great quantities, Ch. decipiens being chiefly responsible for the richness of the catch. Ch. didymus was abundant at S.C.4 in October. Macdonald (19) indentified only three species of Chætoceros in his hauls, namely Ch. decipiens, Ch. lorenzianus and Ch. sociale. He located the last species at S.C.3 in December, while he recorded Ch. lorenzianus from S.C.1 in October, but – as far as my observations go – I have not met with these two species in any collection throughout the year, on the other hand, he did not record at least 8 species of Chætoceros that I have met with frequently in the Canal.

Guinardia

The only species of the genus, namely Guinardia flaccida occurs throughout the Suez Canal, and it is almost the only species that was detected at every station. It is a summer form, occurring in great abundance in June and July almost throughout the Canal. In August, it was noticed only at the Southern half of the Canal. In November, it was again detected at S.C.2 while in December it appeared at S.C.1, S.C.2, S.C.5 and S.C.6. It was found also during the spring time probably causing a spring maximum in the Canal. It follows that this genus is widely distributed in the Canal both in time and space. This genus also was not recorded by Macdonald (19).

Coscinodiscus

The various species of Coscinodiscus are mainly winter forms. S.C.1 seems to be the most favourable locality for this genus. In December and January, Coscinodiscus was the dominant genus of diatoms at S.C.1. It seems that at this time of the year Coscinodiscus decidely reaches its maximum being found in very great numbers at S.C.1. Various species were detected throughout the Canal at different times of the year but in scarce numbers. Three species were very predominent in the Northern half of the Canal, Coscinodiscus Granii, Cos. gigas, and Cos. oculis-iridis. In the southern end of the Canal, particularly at S.C.6, only one species of Coscinodiscus was recorded, namely Cos. nobilis. It was found in great numbers at S.C.6 and S.C.5 in January, and less frequently in February and March. Coscinodiscus excentricus, var. minor was seen in sparse numbers at S.C.1 and S.C.2 in September. Macdonald (19) recorded 3 species of Coscinodiscus, two of which, namely Cosc. subtilis and Cosc. marginatus, were not seen in any of my collection.

Rhizosolenia

The genus Rhizosolenia is widely distributed throughout the Canal. The important species in the phytoplankton that appeared frequently in the Canal are: Rhizosolenia Shrubsolei, Rh. Calcar-avis, Rh. hebetata form semispina and less abundantly Rh. alata, Rh. fragillima and Rh. stolterfothii. Rh. calcar-avis occurs in fair numbers during the summer months; particularly at the southern half of the Canal, in autumn it was still represented, and in November it was very abundant at S.C.5 and S.C.6. In December it occurred at nearly all the stations in the Suez Canal. Rh. Shrubsolei has also a wide distribution throughout the Canal, both in time and space, but it is mainly a summer form probably attaining its maximum in July in the southern half of the Canal. Rh. hebetata is an autumn form and was not detected to the south beyond S.C.3. It was abundant at S.C.1 in September. Rh. alata was represented sparingly, and its chief locality is S.C.6 and S.C.5 but was once located at S.C.2 in March. Rh. fragillima and Rh. stolterfothii were chiefly located at S.C.1, but the former was recorded in common numbers at S.C.4 in May. All these species, with the exception of Rh. alata, was recorded by Macdonald (19), but, *on the other* hand, I have not seen in my hauls either Rh. setigera, or Rh. acuminata recorded in his paper.

Bacteriastrum

Bacteriastrum delicatulum is the main dominent species in my catches. This is a pelagic genus known to be distributed in the Mediterranean. I have never found this genus at S.C.6 or S.C 5 It is chiefly characteristic of the Northern half of the Canal. It is a summer form and seems to attain its maximum in late July and early August. Variation in salinity does not seem to deter its distribution, for it was found in October at S.C.1 when the salinity was at its lowest (21·71 $^0/_{00}$), and in late July at S.C.4 when the salinity was above 45 $^0/_{00}$. It disappears, or at least falls to a minimum during the winter, and during the autumn it was only sparsely located at S.C.1. Another species, namely Bact. hyalinum was also present but in occasional numbers. Its distribution is similar to that of Bact. delicatulum. Macdonald (19) recorded this diatom as Bact. varians. Lauder which probably included both my two species.

Nitzchia.

Only one species, Nitzchia seriata, a neritic form, is an important factor in the spring phytoplankton. In the summer of 1934 it was absent from the Canal, but was detected in sparse numbers at

S.C.4 in July, 1935. In September it appeared sparsely at S.C.3, while it was absent from the Canal in October and November. In December, it was detected at S.C.1, and in January at S C.2, S.C.3 and S.C.4. It was very abundant in March atS.C.2 and was common throughout the Canal.

This species also has not been recorded by Macdonald (19).

Skeletonema

Skeletonema costatum is the only species of this genus recorded in the Suez Canal. Skeletonema is a typical neritic form. It was first detected at S.C 3 in December, and later it distributed itself towards the northern end. In January it was abundant at S.C 3 and was recorded at S.C 2 in February, it was found to have reached S.C.1, and it was so abundant in the northern half of the Canal during that month that it was the dominant element in the phytoplankton. It disappeared in March, but was again seen at S.C.3 in April and in May it reached S.C.4. No Skeletonema was found at S.C.5 or S.C.6 during any time of the year, while it disappeared from the Canal during the summer and autumn seasons.

This species was not recorded by Macdonald (19).

Ditylium

Two species of this genus, namely Ditylium intricatum and D. Brightwelli were recorded among the phytoplankton of the Suez Canal. The genus is characteristic of the northern half of the Canal, it was never found southerly beyond S.C.3. Of the two species above, the first is the more important element in the plankton. Ditylium intricatum seems to be a summer form, it was found in its greatest numbers in July at S.C.2. D. Brightwelli, on the other hand, is a minor factor in the plankton and was found in occasional numbers during autumn and winter at S.C.1 and S.C.2. The genus is strictly nerritic. D. intricatum was absent during August, September, October and November, but appeared again in December at S.C.1. This genus was not recorded by Macdonald (19).

Notes on other Diatoms Less frequent in the Suez Canal

Asterionella

Asterionella japonica is the only species of this genus recorded in my catches. Its favourable locality is S.C.1, but was found also, though less frequently, at S.C.2. It appeared in July, August, September and October, but never in great quantities.

This species was not recorded by Macdonald (19).

Biddulphia

Various species of this genus was found in few numbers amongst other phytoplankton chiefly at S.C.1. Biddulphia vesiculosa, B. mobiliensis, B. rhombus were recorded at S.C.1 only. B. smithii was located at S.C.1, S.C.2 and S.C.3. B. alternans and B. favus at S.C.1, and as far as S.C.3. No Biddulphia was detected at S.C.4, S.C.5 or S.C.6

Macdonald (19) recorded only B. rhombus and B. mobiliensis at S.C.1.

Hemiaulus

Hemiaulus Heirbergii is the only species representing this genus in the Suez Canal It has a wide distribution, being located at nearly all the stations. It was rather abundant at S.C.1. in October.

Hemiaulus was not recorded by Macdonald (19).

Climocodium

Only a single species of this genus was recorded in the Suez Canal namely Cl. biconcavum. Its chief localitly is S.C.6 and S.C.5. It was recorded at S.C.6 in January, February and March, and once in July. At S.C.5 it was recorded in March while it was rather abundant at both stations.

This species was not recorded by Macdonald (19).

Lithodesmium

Lithodesmium undulatum is the only species recorded, and was only located at S.C.1. In December it was present in fairly common numbers, while in January, February and March it was only sparsely represented.

Lithodesmium was not recorded by Macdonald (19).

Hyalodiscus.

Hyalodiscus stelliger was located at S.C.1 only. It was not recorded by Macdonald (19).

Horizontal Distribution of the Phytoplankton throughout the Year

The area investigated comprises waters that seem to be rather different as to their phytoplankton. This may be due in part to the natural position of the stations themselves, and in part to the physico-chemical nature of the different masses of water. The determination of nutrient salts, particularly the phosphates and nitrates, at each of the six stations is very desirable to elucidate the variable distribution of the various elements of the phytoplankton throughout the Suez Canal. Such determination is expected to be done shortly. In the mean time, and in the light of the present available facts, one may divide the area of investigations into at least five localities according to their natural position, *viz*: (*a*) the two most southerly stations, S.C.5 and S.C.6 which lie within the tidal influence of the Gulf of Suez. Wimpenny (25) from his observations in his report on the hydrographic data, has stated that the water of the tidal area of the Canal as far as the Little Bitter Lake, has all the characteristics of the Red Sea. The general effect of the flood tides will be to drive the planktonic organisms from one area into another, or to mix waters, with their contained plankton, of different sources. The tidal effects are at their greatest at the time of spring tides, and the influence will be still more intensified if there are some prevalent winds in action. Thus we may except that the distribution of the plankton, in space, time and quanitity at Stations 5 and 6, would be to a great extent concievably influenced by either tides or winds or by their combined action. (*b*) S.C.4 which is within highly saline region, and where the water frequently tumultuous and turbulent. The result of this turbulence is that the water at this station is frequently charged with suspended particles *particularly fine sand* grains, and will effect a thorough mixing of the waters from below to the surface. (*c*) Station 3, on the other hand, has its water frequently diluted with fresh water as has been mentioned before. (*d*) S.C.2 which is about 55 kilometres from Port Said Station, the only station lying within the narrow cappilary canal proper. From the salinity observations it is clearly seen that the Nile flood water reaches this station during the summer months. During the Nile flood period, mainly August and September, Faouzi (6) has shown that currents of water are set from the Mediterranean to enter the Suez Canal, passing across S.C.2. At this time of the year, these currents bring less saline water from that part of the Mediterranean at Port Said with its contained organisms together with a fresh supply of nutrient salts, to S.C.2. Thus we see that such currents, due to difference in level, may affect the distribution of the plankton, whether in quantity or quality. (*e*) We have finally to consider S.C.1. Salinity observations show that throughout the year, the water at this station, down to a depth of 5 metres, is decidely less saline than the water in the Suez Canal as a whole, being always less than 40 ‰. During January, February, March, April and May deeper waters at 10 metres are more saline, being above 40 ‰. than the surface waters or the normal water of the Mediterranean as a whole.

The variation of salinity and planktonic organisms at this station seems to be firmly and closely correlated with the fresh water of the Nile discharged into the Mediterranean during the flood period. This important flood factor needs some elucidation at this place. In February or March the water in the two main branches of the Nile reaches, or about to fall below, sea-level, and in order to prevent the saline water of the Mediterranean from flowing into the fresh water, a " sadd " is erected by filling up sacks of sand, etc., across the whole width of the river. Two such " sadd " are set up, one on the Damietta branch, near the village Fariskur, and the other " sadd " on the Rosetta branch of the Nile near Edfina. (*see* chart). These two artificial " sadds " are pulled down in July or August, when the Nile rises during the flood time, allowing enormous quantities of fresh water to be added to the sea water every year during the summer and autumn time. The water brought down to sea besides its contained organisms is laden with silt, but also must be rich in nutrient salts particularly nitrates and phosphates necessary for the flowering and flourishing of the phytoplankton. There are clear indications of the influence of the Nile upon the phytoplankton along the Nothern Coast of Egypt. Steuer (23) noticed that when the Nile begins to rise the amount of the phytoplankton likewise begins to increase at Alexandria. Also, soon after the Nile waters reaches the sea, great shoals of Sardines visit our coasts, from Alexandria as far as Port Said. The examination of their stomach contents reveals that they feed vigourosly on diatoms, the main category of the phytoplankton Microscopic examination of plankton hauls reveals that the coastal waters at this time are teeming abundantly with such minute unicellular plants. Thus we see the effect of the Nile flood on the flourishing of the plankton, and in turn, on an at leat one important item of the Egyptian Fisheries. The water in the neighbourhood of Port Said, receives—besides the fresh water from the Damietta mouth an additional fresh or brackish water supply from the large shallow lake Menzaleh, the lake itself receives annually enormous supplies of the Nile water, particularly at the flood period, through canals between the lake and the main Damietta branch of the Nile, and also after the flood time through land drains in the Delta.

The water levels in the lake are almost always above sea-level. Water is therefore almost constantly discharged from the lake into the sea, through a natural and permanently opened channel—Boghaz-el-Gamil—between the sea and the lake (*sea* chart).

July 1934.

The first collection was made on the 4th of July 1934, twenty-two days before the Fariskur Sadd was pulled down. The salinity was 39·11 ⁰/₀₀ at Port Said station.

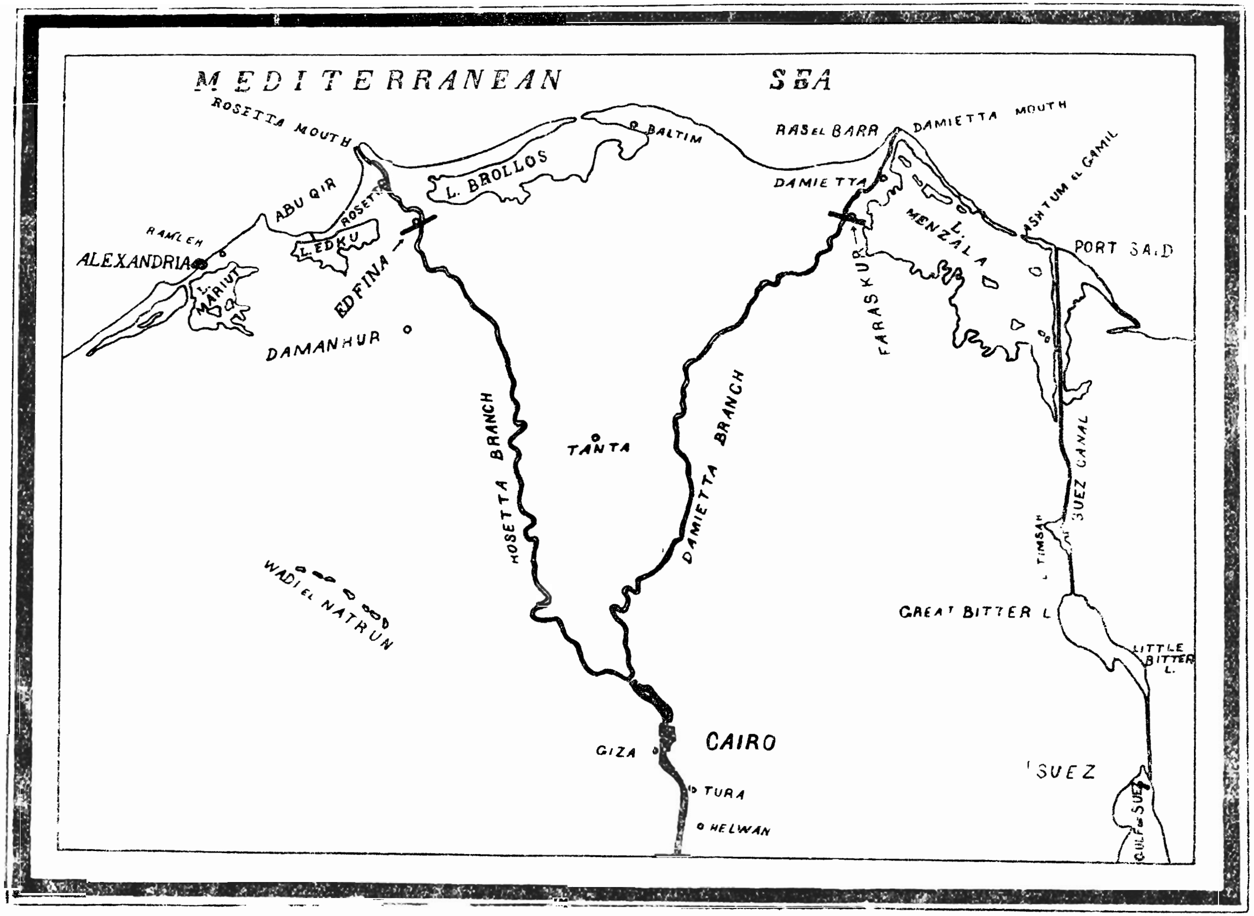

Chart II showing the position of the two "Sadds" at *Faraskur* and *Edfina* on the two main branches of the Nile

Phytoplankton was present but not abundant.

The Dinoflagellates were sparsely represented by few species.

The Zooplankton, Copepods, larvæ of Copepods, sagitta, etc., was abundant.

The inspection of the planktonic forms at S.C.2 showed a striking difference from those at S.C.1.

A very rich haul of phytoplankton was brought up, consisting chiefly of enormous numbers of Guinardia flaccida, great quantities of minute forms of chætoceros, and Rhizosclenia shrubsolei. It was noteworthy that Guinardia, as well as the other diatoms, were devoid of chlorophyll, or, in other words, they seemed to be dead frustules and on their way to sink to the bottom after perhaps attaining their full flourishing sometime in June. Resting spores of Chaetoceros lauderii were not infrequent.

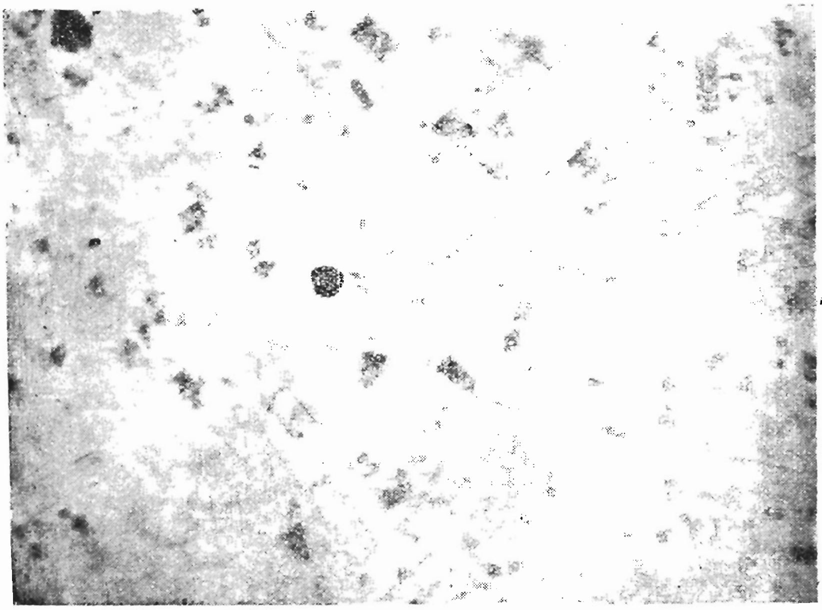

FIG. 4.—*Phytoplankton* dominated by *Guinardia*
S.C. 2. July 1934
(Microphoto by Ghazzawi)

The dinoflagellates were very sparsely represented.

Contrary to S.C.1, there was here very little zooplankton.

At S.C.3., the case was again different.

The phytoplankton was scanty, the diatoms were poor.

The dinoflagellates were better represented by Ceratia and Peridinium. Ceratium pulchellum was common, chains of it, as well as chains of C. furca were noticed.

the plankton as a whole was scanty.

At S.C.4., Great numbers of Guinardia frustules, similar to those seen at S.C.2, were present Hemiaulus Heibergii made its first appearance in frequent numbers at this station. The dinoflagellates were poorly represented.

The plankton at S.C.5 was also poor.

The diatoms were rare and although there were few dinoflagellates, yet there was a good number of different species. It was noticed also that Ceratium macroceros and Ceratium massiliense appeared for the first time here. Copepods were rather common.

At S.C.6., The phytoplankton, scanty as it was composed chiefly of Guinardia frustules and Ceratia.

The zooplankton was predominent.

To sum up, we find that the richest haul came from S.C.2, and that striking difference as well as certain resemblance, existed between adjacent stations. Such similarity and divergence may be due to hydrographic, weather or tidal factors.

August 1934.

The second monthly collection was made on the 3rd and 4th of August, nine days after the Nile flood water has reached the sea. The effect of the fresh water was already perceptible, as the salinity went down from 39·11 ‰ in July to 36·09 ‰ in August, at S.C.1, and from 43·40 to 40·95 ‰ at S.C.2.

We may therefore expect to find striking features in the composition and distribution of the phytoplankton as a result of this fresh water invasion. It was very unfortunate that the International fine tow-net would, through an incident that was beyond my control, tear at S.C.4, on my way northward. This curtailment of my routine work made the material less complete for this month. However, the inspection of forms brought up by the coarse net revealed that the water at S.C.1 was teeming with a monotonous element of phytoplankton. this diatom was Thalassiothrix Frauenfeldii. During last month July Thalassiothrix was noticed in very few numbers at most of the stations of the Suez Canal. Single specimens of coastal and neritic forms like Rhabdonema adriaticum and Grammatophora were also observed, as well as a few Coscinodiscus.

Single specimens of Ceratium and Peridinium were recorded at S.C. 1. In all probability, a haul with the fine net, would have revealed greater numbers of phytoplankton species.

It was noteworthy here that the comparatively rich zooplankton of last month had now disappeared, except for a few single specimens of adult copepods. No haul was taken with the fine net at S.C. 2, but the catch with the coarse net was exceedingly rich in Thalassiothrix. Other littoral diatoms as minute Naviculoides and Pleurosigma, as well as a few Coscinodiscus, were observed in odd numbers. A few specimens of Asterionella japonica were seen. Ceratium furca, Dinophysis caudata, Peridinium and Prorocentrum micans and Goniaulax catenata were recorded.

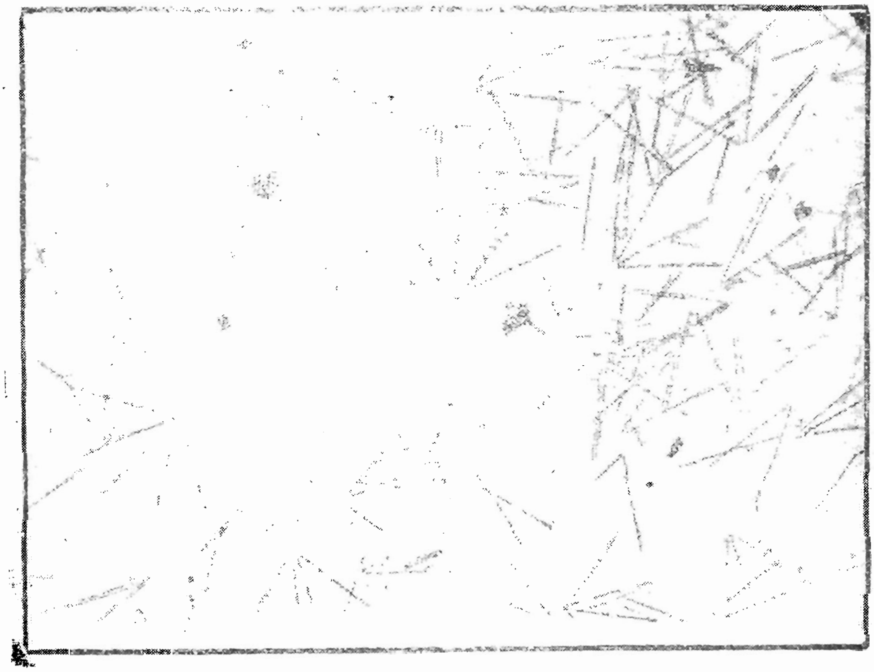

FIG. 5.—*Phytoplankton* dominated by *Thalassiothrix Frauenfeldii*
S C. 2. August 1934
(Microphoto by Ghazzawi)

As was to be expected from the appearance of the fustules last month, Guinardia flaccida must have sunk down to the bottom as it had completely disappeared at S.C. 1 and S.C. 2.

The dinoflagellates were very scanty:

When the fine net was torn at S.C. 4, an attempt was made to repair it at Ismailia town. This was accomplished, but when towed again at S.C. 3, the repair did not prove a success, and it was torn again. It brought up, however, a sample of the phytoplankton at S.C. 3. The most outstanding feature was the appearance of Bacteriastrum in abundant quantities, that it seemed to be the dominant diatom among the other species of the phytoplankton here. Thalassiothrix was fairly abundant, but not in such enormous quantities as in S.C.1 or S.C.2. Remainders of the sinking Guinardia were noticed in very few numbers. Few sinking frustules of Rhizosolenia Shrubsolei were also noticed. Chaetoceros brevis, and Ch. affinis were recorded in small numbers.

The Dinoflagellates were very sparsely represented by Ceratium pulchellum. C. furca. C. fusus, Peridinium and Prorocentrum micans.

The zooplankton was rather poor.

S.C. 4 was the station at which the fine net was torn, but, nevertheless, an incomplete sample of the plankton have showed that the dominant organism was an Acantharian radiolarian, belonging to the genus Acanthometron.

I had no true picture of the phytoplankton here. except for a very few species of Chaetoceros. the phytoplankton seemed to be almost absent. Frustules of Ch. brevis, Rhizosolenia calcar-avis and Rh. Shrubsolei were seen. Hemiaulus Heirbergii was met with occasionally.

The Dinoflagellates seemed to be almost absent, but Ceratium pulchellum was sparsely present.

The zooplankton was also poor here.

The striking feature at S.C. 5 was its poverty in the phytoplankton.

Empty frustules of Rhizoslenia calcar-avis, Rh. Shrubsolei and Guinardia flaccida were seen. Few Coscinodiscus were also noticed.

The Dinoflagellates were more frequent than the Diatoms. Ceratium pulchellum, C. fusus, C. furca and Peridinium spp., were fairly abundant.

The zooplankton, consisting chiefly of copepods and nauplii and decapod larvae, was predominant.

At S.C. 5, the phytoplankton was nearly absent. The Diatoms were represented by very few numbers of Hemiaulus, Rhizosolenia Thalassiothrix, Chaetoceros densum and frustules of the sinking Guinardia.

Among the Dinoflagellates, on the other hand, more species of Ceratia appeared in fairly abundant numbers. C. fusus, C. furca, C. arietinum, C. massiliense, C. macroceros, Peridinium spp. were among the recognised peridinians.

The zooplankton was very abundant.

To recapitulate the distribution of the plankton throughout the Suez Canal for the month of August, there was a noticable difference in the composition of phytoplankton and zooplankton in the northern and southern half of the Canal. From Port Said down to Ismailia (S.C. 1, S.C. 2 and S.C. 3) there was a conspicuous flourishing in the phytoplankton and an almost absence of the zooplankton. The reverse may be said about the plankton in the southern half of the Canal (S.C. 4, S.C. 5 and S.C. 6). Such points of divergence can only be attributed to the influence of the Nile flood water which was already perceptible as far as S.C. 3, as could be concluded from the salinity observation.

September 1934.

During September the influence of the Nile was still exerted at S.C. 1 and S.C. 2, the salinity, less than last month, being 32·47 ‰ and 39·18 ‰ at both stations respectively.

The phytoplankton at S.C. 1 was still very abundant. The leading species of Diatoms was, like last month, Thalassiothrix which was recorded in incredible numbers. Macdonald (9) counted over two millions of this diatom in his September haul of 1928. Other species of diatoms were recorded but none of them occurred in very great quantities. Among the other diatom population composing the phytoplankton, Chaetoceros was common, among which, Ch. decipiens was the most predominant, while Ch. didymus, Ch. curvisetum were also easily recognised, together with Bacteriastrum, Coscinodiscus, and Rhizosolenia hebetata form semispina.

Thalassiothrix longissima and Ditylium Brightwelli were recorded in very few numbers.

The Dinoflagellates were represented by Ceratium furca, Goniaulax catenata and Peridinium spp., all in very few numbers.

The zooplankton as brought up by the coarse net was also abundant

At S.C. 2, the fine net caught a very varied plankton.

The phytoplankton was well represented by the abundant Thalassiothrix. Although it was still the leading species among the diatoms present yet it was not so abundant as was at S C. 1. Almost all the same species of Chaetoceros found at S.C. 1 were quite common here. Rhizosolenia hebetata form semispina was less frequent, while Coscinodiscus was more abundant than at S.C. 1.

The outstanding feature among the Dinoflagellates was the occurrence of very great quantities of Goniaulax catenata here, a species that was only found in very few numbers at S.C. 1. Ceratium furca, C. fusus, C. pulchellum, Peridinum spp. were not uncommon.

The zooplankton (Copepods, larvae of copepods and decapods) was quite abundant.

At S.C. 3, the plankton as a whole was poor. It should be noticed that the salinity, in the area at which the plankton was fished, was rather high, being above 43·00

The diatoms were sparsely represented by Thalassiothrix, Coscinodiscus, Rhizosolenia Shrubsolei, Rh. calcar-avis and Nitzschia seriata. The last named species made its first appearance here.

Among the phytoplankton, the Dinoflagellates were predominant Goniaulax was still leading, while Ceratia were common. C. trichoceros, C. furca, Peridinium and Prorocentrum micans were frequent.

The zooplankton, however, was dominant.

The diatoms were very scanty at S.C. 4. Frustules of Rhizosolenia calcar-avis and Rh. Shrubsolei were seen, while Thalassiothrix and Coscinodiscus were observed in very few numbers.

The Dinoflagellates were not infrequent, and were represented by C. arietinum, C. furca, C. fusus, C. pulchellum, C. tripos, C. trichoceros and Peridinium species.

The zooplankton, however, was fairly abundant.

At S.C. 5, there were no diatoms, except for a few broken frustules of Rhizosolenia.

Dinoflagellates were also scanty:

The zooplankton–mainly larvae of decapods, nauplii, and adult copepods–was abundant.

The plankton at S.C. 6 was varied. Among the diatoms, Guinardia flaccida was frequent, not all as sinking frustules, but some chains of cells were seen with chromatophores in them. Frustules of Rhizosolenia calcar-avis, Rh. Shrubsolei, and Rh. alata, were seen. Thalassiothrix was sparsely represented.

The Dinoflagellates were better represented by Ceratia.

The zooplankton, as a whole, was dominant.

To summarise, the distribution of plankton in September was more or less similar to that in August. The phytoplankton in the northern half of the Canal was prevalent and dominant, while the reverse was observed in the lower southern half.

October 1934.

The water at S.C. 1 was, on the 4th of this month, at which date collection was made, quite brackish. The salinity reached its lowest record, being 21·71 $^0/_{00}$ The water was distinctly coloured and turbid, resembling that of the Nile. It was supersaturated with oxygen. Its oxygen content was 6·336 cc. per litre, a phenomena indicating enormous withdrawal of CO_2 from the water for the process of photosynthesis by the phytoplankton, and giving off O_2 . The water was very alkaline, giving a pH. value about 8·7.

The phytoplankton was again very abundant. Thalassiothrix which was the leading species during August and September, was now waning. Its place was taken by Hemiaulus Heirbergii, which was now very predominant. Two features were noticed in Thalassiothrix, first there was a very noticeable decrease in the length of the valves than had been noticed during August and September, and secondly, most of these dwarf cells were no longer united into star-like shape, but as zigzag chains. Hemiaulus was seen in single cells as well as in chains. Other common diatoms were Chaetoceros Aecipiens, Ch. curvisetum, Rhizosolenia hebetata semispina and dsterionella japonica. Chaetoceros affinis with resting spores was quite common. Bacteriastrum was sparsely represented. Ditylium Brightwelli was seen in very few numbers. Thalassiothrix longissima was not uncommon.

Macdonald (19) in his October hauls recorded Rhizosolenia stolterfothii, Rh. fragillima, Coscinodiscus, Biddulphia, all of which were absent in my plankton catch at S.C. 1. On the other hand, he did not record Hemiaulus—the dominant species in my haul.

The Dinoflagellates were very scanty. Single specimens of Ceratium pulchellum were seen. Ceratium furca was not infrequent. Goniaulax and Peridinium were also scanty.

At S.C. 2, there was a noticeable poverty in the plankton as a whole. The phytoplankton was rare, and, particularly the diatoms were very sparse. They were represented by few specimens of Chaetoceros affinis, Ch. didymus, Coscinodiscus, Thalassiothrix longissima, Rhizosolenia Shrubsolei, and Nitzschia seriata. Hemiaulus, so prominent at S.C. 1, was almost absent here.

The Dinoflagellates, however, were rather common, particularly Goniaulax and Ceratium furca.

The zooplankton was quite abundant.

At S.C. 3, the diatoms were fairly abundant, Nitzschia seriata being quite common. Remnants of the sinking Rhizosolenia hebetata form semispina were seen. Other Diatoms present were Chaetoceros didymus, Bacteriastrum, Hemiaulus Heirbergii and Thalassiothrix longissima. But none occurred in any considerable quantities.

The main feature, however, was the presence of very great numbers of peridinians; among which Goniaulax catenata was the dominant species. Peridinum spps., and ceratia contributed a good deal to the abundance of the Dinoflagellates. Ceratium furca and C. pulchellum were predominent, while C. tripos and C. macroceros were not infrequent.

The plankton at S.C. 4 was scanty. The phytoplankton in general was poor, the diatoms were almost chiefly represented by Chaetoceros didymus, the cells of which were present in a loose state. Hemiaulus was present in single specimens. Few Rhizosolenia Shrubsolei and Rh. calcar-avis were seen.

The Peridinians were also rare. Few Ceratia and Peridinium spp. were recorded.

At S.C. 5, the plankton was almost absent, except for occasional specimens of Thalassiothrix, Coscinodiscus, Guinardia and Rhizosolenia.

Few Ceratia (furca, macroceros, tripos, and trichoceros) were seen.

The plankton at S.C. 6, although not very rich, yet it was far richer than at S.C. 5.

The phytoplankton included Guinardia, Hemiaulus, Rhizosolenia alata, Rh. calcar-avis, Rh. Shrubsolei, Climocodium biconcavum and Coscinodiscus. The first two species were quite common.

The peridinians were well represented by Ceratia. C. macroceros, C. trichoceros, C. tripos and C. arietinum were rather numerous.

The zooplankton was rather dominant.

To sum up, there was, if we exclude S.C. 1, a noticeable poverty in the plankton throughout the Suez Canal as a whole, particularly in the southern half. While the diatoms showed a considerable decrease, the Peridinians on the other hand showed a marked increase. The Ceratia were more abundant at the southern half of the Canal.

November 1934.

The main hydrographic data for this month differ considerably from those of October. The salinity started to rise after reaching its lowest record last month, being now 35·01 $^{0}/_{00}$ at S.C. 1. The temperature had fallen about four degrees below that of October, being now more or less about 22°C throughout the Suez Canal. The summer had passed, and it was then autumn time.

The plankton, as a whole, was poor at S.C. 1. The phytoplankton seemed to be falling to a minimum after its summer maximum. The phytoplankton did not completely disappear, on the contrary, there were numerous species of diatoms, but none was dominant or abundant. Chaetoceros affinis, Ch. curvisetum, Coscinodiscus, Thalassiothrix Frauenfeldii, Thal. longissima, Ditylium Brightwelli, Bacteriastrum, Rhizosolenia calcar-avis and Rh. Shrubsolei, Biddulphia alternans, Biddulphia Smithii, Ch. decipiens were all recognised.

The Peridinians—except few single specimens of C. pulchellum—were absent.

The zooplankton, on the other hand, compared with the phytoplankton, was predominant.

S.C. 2 resembles S.C. 1 in its plankton poverty. Occasional numbers of Thalassiothrix, Coscinodiscus, Chaetoceros and Rhizosolenia were seen.

The Dinoflagellates were very scanty, represented only by Ceratia.

On the other hand, S.C. 3 was comparatively rich in phytoplankton which was composed almost entirely of great quantities of Rhizosolenia hebetata. Few Chaetoceros affinis were seen. It seemed as if this form of Rhizosolenia attained its maximum sometime during this month. Cells, closely packed together, were seen, and some were already on their way to sink.

The phytoplankton at S.C. 4 was almost absent, except for a few scattered cells of Thalassiothrix, Guinardia, Chaetoceros and Rhizosolenia.

The Peridinians were not uncommon. Ceratia were frequent, while Peridinium was occasionally seen.

The outstanding feature, however, was the appearance of very great quantities of a Radiolarian protozoon.

Important changes in salinity had taken place at S.C. 5. While the salinity at S.C. 4 was still as high as 46·41 $^0/_{00}$, it was only 42·57 $^0/_{00}$ at S.C. 5, which had a salinity amounting to 46·74 $^0/_{00}$ in October. On the other hand, the salinity at S.C. 6 was also 42·29 $^0/_{00}$.

From Faouzi's (6) diagram of salinity, it is clearly seen that in November the water at the surface at S.C. 5 is a Red Sea water. My plankton observations confirm his remarks. The water at S.C. 5 and S.C. 6 teemed with the same elements of phytoplankton. Very great quantities of Rhizosolenia Calcar-avis were present. Other diatoms as Guinardia, Rhizosolenia Shrubsolei and Rh. alata were also present but none was found in great quantities. Large masses of Rh. Calcar-avis, made up of close packed bundles, appearing as flakes, were frequently seen.

The Peridians at S.C. 5 were sparsely represented by Ceratia. Guinardia and Ceratia were more frequent at S.C. 6.

To sum up, at this time of the autumn, we notice a falling in the phytoplankton at the northern half of the Canal after the previous summer increase. S.C. 4 was almost devoid of phytoplankton. On the other hand, the *two most southern stations seemed to have their first phytoplankton maximum in November*. This autumnal maximum was caused by the great increase of Rhizosolenia calcar-avis. *It should be recalled here that, contrary to the northern half of the Canal, there was no summer phytoplankton maximum for the southern end of the Canal.*

December ***1934.***

The important change in the physical conditions of the water was the continued decrease in temperature which was now below 18°C at the surface. The salinity was only 1·59 $^0/_{00}$ above that of last month.

The examination of hauls made at S.C. 1 suggested that we were now facing a " winter " maximum for diatoms. The plankton —both zoo– and phyto—was very abundant.

The phytoplankton was quite predominant. The leading diatoms were Coscinodiscus and Thalassiothrix longissima which were very frequent. Other diatoms were quite common. These were Chaetoceros, Ditylium, Rhizosolenia, Biddulphia, Hemiaulus and Hyalodiscus. Up to 6 cells of " Thalassiothrix " longissima were frequently seen united into a radiating form at their pointed ends. Thalassiothrix Frauenfeldii was also quite common, but not so abundant as was noted during the summer.

The Peridinians were very sparsely represented. Ceratium furca, C. fusus, C. massiliense, C. pulchellum were seen in very few numbers. C. arietinum and C. candelabrum were recorded in single specimens.

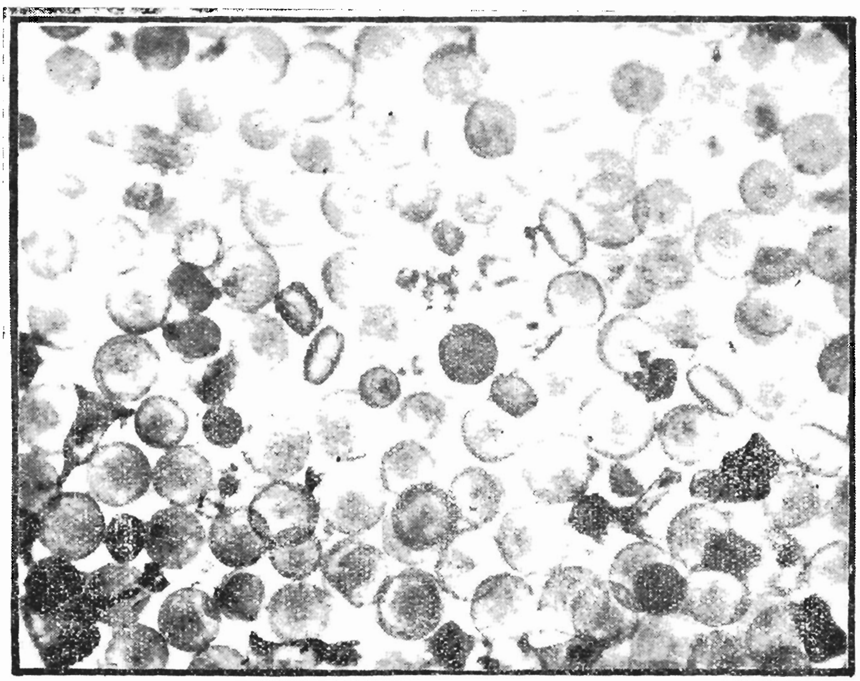

FIG. 6.—*Plankton* dominated by *Coscinodiscus*
S.C. 1. December 1934
(Microphoto by Ghazzawi)

The rich and varied phytoplankton at S.C. 1 was not seen at S.C. 2, but, instead, a rich haul of sinking and broken frustules of Rhizosolenia calcar-avis was brought up. It should be borne in mind here, that this diatom was responsible for the autumnal maximum at S.C. 5 and S.C. 6 last month, and, in recalling that, the question naturally arises whether this diatom had been carried out from the southern half of the Canal to S.C. 2, or whether it had flourished locally to an autumnal peak at this station and was now sinking to a minimum. The question is solved again from Faouzi's (6) diagram of Salinity which shows clearly that this diatom might had been transported to S.C. 2 with the Red Sea water carried to there.

That Rhizosolenia was not seen at S.C. 1 is explained also from Faouzi's (6) diagram which shows that the Red Sea water was not present at the surface, where I fished for the plankton.

Peridinians were few, and were represented by Ceratium arietinum, C. furca, C. pulchellum, C. massiliense and Dinophysis caudata.

The composition of the plankton at S.C. 3 did not differ much from that at S.C. 2. Remnants of the sinking frustules of Rhizosolenia calcar-avis were seen in abundance, also in confirmation with Faouzi's (6) diagram. A neritic diatom, skeletonema costatum; was not infrequent.

Peridinians were fairly common, and were chiefly represented by various species of Ceratia.

The plankton at S.C. 4 was very scanty. Here also sinking Rhizosolenia was present.

Ceratia were not uncommon.

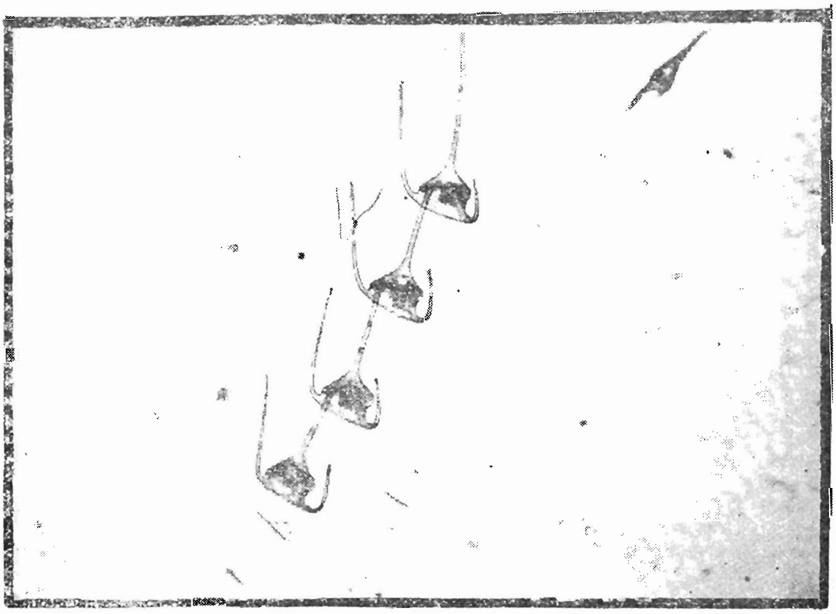

FIG. 7.—*Ceratium pulchellum* in chains

(Microphoto by Ghazzawi)

At S.C. 5 and S.C. 6, the same condition of Rhizosolenia was met with.

Dinoflagellates were also quite common.

The plankton, particularly at S.C. 6, was very abundant.

To sum up, it was clear that the autumnal phytoplankton maximum in November at S.C. 5 and S.C. 6, was now disappearing gradually in December. Sinking Rhizosolenia was seen throughout the Canal as far as S.C. 2, and it is definite from Faouzi's (6) diagram that it had shifted northward.

On the other hand, the Northern station at S.C. 1 seemed to have started a winter maximum in December. The diatoms responsible for the phytoplankton increase at S.C. 1 were mainly Coscinodiscus.

January 1935.

The temperature had fallen down to a littleabove 15°C at S.C. 1, while the salinity had gone up to 37·14 $^0/_{00}$ at the surface.

The phytoplankton was very rich at S.C. 1, the leading diatom was Coscinodiscus which no doubt was causing now a definite winter maximum that started last month. Ditylium Brightwelli was placed second in importance among the diatoms regarding its abundance. Thalassiothrix longissima was found in fairly common quantities, but it was less common than in December, on the other hand, Th. Frauenfeldii seemed to have flourished more. Chaetoceros were almost, but not quite, absent. Biddulphia mobiliensis was rather common.

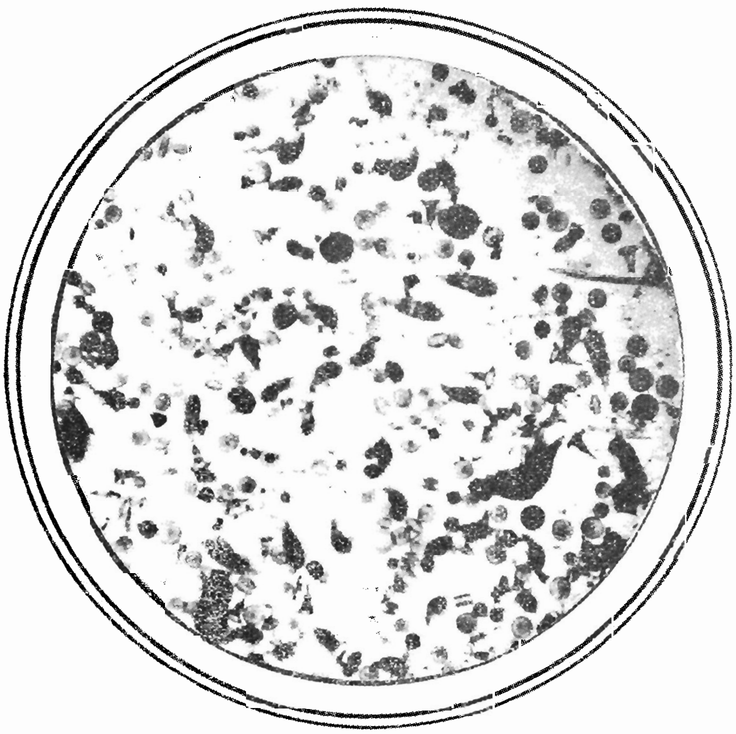

FIG. 8.—*Phytoplankton* dominated by *Coscinodiscus*
S.C. 1. January 1935
(Microphoto by Ghazzawi)

The Dinoflagellates were very sparsely represented by a few Ceratia and Peridinium.

Contrary to what was seen at S.C. 1, the plankton in general, and the phytoplankton in particular, at S.C. 2 was very sparse. Sinking frustules of Rhizosolenia calcar-avis were still seen. Skeletonema costatum and Nitzschia seriata were, however, not infrequent. Few Coscinodiscus were present.

The Peridinians were likewise sparse and were represented by different species of Ceratia, Peridinium, and Prorocentrum.

At S.C. 3, the plankton was rather poor. Skeletonema costatum in particular, and Nitzschia seriata, were, however, common.

The distribution of the latter diatom extended southward as far as S.C. 4, and except for this diatom and few Ceratia, which occurred in very sparse numbers, the plankton as a whole was almost absent at S.C. 4.

At S.C. 5 the only phytoplankton forms present were few single specimens and Coscinodiscus and Ceratia.

On the other hand, it was noticed that the plankton at S.C. 6 was comparatively rich.

Among the diatoms, Coscinodiscus was not infrequent, together with Rh. alata, Chaetoceros densum and Climocodium biconcavum.

The Dinoflagellates were the more predominent. Various forms of Ceratia were quite common.

The zooplankton was quite rich.

To summarise, there was a noticeable winter maximum of phytoplankton at S.C. 1 caused chiefly by Coscinodiscus and Ditylium. There was a general poverty in the plankton in general, and the phytoplankton in particular, throughout the Suez Canal.

February 1935.

Unfortunately, no hauls were taken for February 1935, but on the 25th and 26th of February of 1936, a collection of plankton was made as usual, and, although there was not a direct link between the plankton of this month and that of January or March of 1935, yet I thought it would be best to insert the plankton results for this month at this place. The salinity at S.C. 1 was still rising, being now 38·51 $^0/_{00}$ at the surface, but the temperature records were rather above the usual average for this month. The temperature results were not unexpected, as it was perceivable that the winter of 1936 was warmer than the average. The temperatures were :—

Station	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Date	25–2–1936			26–2–1936		
Depth o.	16·5°	16·7°	17·0°	17·1°	18·3°	18·50°
Time	10·30	15·50	10·08	11·30	13·30	16·00
Depth 5 m.	16·4°	16·5°	16·7°	16·8°	17·7°	18·1°
Time	10·33	15·52	10·11	11·33	13·33	16·03
Depth 10 m. ...	16·4°	16·5°	16·6°	16·8°	17·5°	18.1°
Time	10·37	15·55	10·15	11·37	13·36	16·07

S.C. 1 was quite rich in diatoms.

The leading diatoms were Skeletonema costatum and Chaetoceros affinis. Other diatoms were also present but not in any great quantities. These were Coscinodiscus, Biddulphia mobiliensis, Chaetoceros and Thalassiothrix.

The Dinoflagellates were few, and chiefly represented by Ceratia.

The zooplankton was also quite common.

S.C. 2 was almost devoid of phytoplankton, except for a very few sinking frustules of Skeletonema costatum, a chain of Melosira, and single specimens of Ceratium fusus.

The plankton at S.C. 3 was fairly common being composed chiefly of Skeletonema costatum, but there were also few cells of Chaetoceros, and Rhizosolenia.

Peridinians were very sparse.

The phytoplankton at S.C. 4 was also comparatively common. It was almost entirely composed of Chaetoceros curvisetum and Nitzschia seriata.

Of the Dinoflagellates present, C. pulchellum was rather abundant.

At S.C. 5 the diatoms present were almost all merely sinking frustules.

The Peridinians — chiefly Ceratium pulchellum — were quite common. The plankton as a whole was poor, and a great amount of detritus was brought up.

At S.C. 6 there was also a general poverty in the plankton. The Diatoms present—except Climocodium biconcavum—were empty frustules without chromatophores. Chaetoceros densum was seen.

The Dinoflagellates were rather numerous, mostly Ceratia.

To sum up, there was a considerable flourishing of diatoms at S.C. 1 but throughout the Canal there was noticed a general poverty in the plankton as a whole. The Dinoflagellates— particularly Ceratia— seemed to be rather abundant at the southern half of the Canal.

The unusually high temperature could not, therefore, be the only factor to induce a growth of Diatoms at S.C. 1, as there was not seen a similar growth at the southern end. *Physical and Chemical conditions of the water must therefore be different at both ends.*

March 1935

This month usually marks the outset of the temperature rise throughout the Suez Canal after reaching its lowest during February in normal years. The temperature had jumped to round about 18° at almost all stations. The salinity at S.C. 1 was about the same as in the previous month.

The plankton haul for this month was quite rich at S.C. 1.

The phytoplankton was quite common, Coscinodiscus was the most dominant genus among the diatoms, as well as the most abundant. Biddulphia mobiliensis was quite common. Ditylium, Hemiaulus, Hyalodiscus, Lithodesmium and others were recorded but not in great numbers.

The Peridinians were not uncommon. Various species of Ceratia were seen.

The zooplankton was rather abundant being composed chiefly of Copepods, Copepod larvae, medusae and sagitta.

At S.C. 2 the fine net brought a moderate catch of phytoplankton. The rich Coscinodiscus haul seen at S.C. 1, was absent here, but Nitzchia seriata was rather quite frequent. Other diatoms recorded were found almost as sinking frustules.

The Dinoflagellates were common, particularly C. furca.

The zooplankton was rich.

At S.C. 3, there was a poor phytoplankton haul.

Diatoms were rather sparse, but Nitzschia seriata was frequent.

Ceratia, however, were quite common. Ceratium pulchellum was very abundant.

The plankton at S.C. 4 resembled more or less that at S.C. 3.

Diatoms were very scarce.

Here also the Peridinians were the dominant group of the phytoplankton and C. furca were the most abundant.

The plankton as a whole at S.C. 5 was very sparse.

Except Climocodium biconcavum, the diatoms were almost—but not quite—absent.

The Peridinians were also rather rare.

At S.C. 6, Climocodium biconcavum was quite abundant, as well as it was the only species among the phytoplankton as a whole that could be recorded in any considerable quantities.

Ceratia were sparse.

To sum up, there was a rich phytoplankton mostly of Coscinodiscus at S.C. 1, and of Nitzschia seraita at S.C. 2.

At S.C. 3 the Peridinians were abundant, while diatoms were rare. At S.C. 4 and S.C. 5 the plankton was rather poor, and lastly at S.C. 6 Climacodium was quite common but not very abundant. Except at S.C. 1 and probably also S.C. 2, it might be said that there was a general poverty in the phytoplankton throughout the Canal.

April 1936.

The temperature was still rising throughout the Canal while the salinity at the various stations was about the same as in March 1935.

The examination of the plankton hauls at the six stations showed that—contrary to what might be expected—the phytoplankton was quite poor.

At S.C. 1 the diatoms were almost absent. Few empty cells of Coscinodiscus and Hyalodiscus were seen.

Peridinium was not uncommon.

The zooplankton was—however—quite common.

At S.C. 2, the fine net brought up a lot of detritus and some frustules of Skeletonema costatum and Chaetoceros,

The zooplankton was also here abundant.

At S.C. 3. the case was rather different, as Sk. costatum was very abundant, while Nitzschia seriata appeared frequently:

At S.C. 4. phytoplankton was poor. There ware seen Chaetoceros with resting spores. few frustules of Guinardia and a few Ceratia.

At S.C. 5 Nitzschia seriata was not uncommon. and there were seen frustules of Guinardia. Chaetoceros. Thalassiothrix and Rhizosolenia.

Ceratia were sparse.

S.C. 6 was poorer still than S.C. 5. Here there was only seen few broken frustules of Guinardia and Rhizosolenia.

During April, there was not an indication of anything like a spring phytoplankton growth as seen in other localities.

May 1936.

Collections were made for May to see what had become of the usual spring diatom maximum occurring usually elsewhere. The temperature had increased considerably, being now round about 24°.

The examination of the plankton hauls at S.C 1. showed that the phytoplankton—again contrary to my expectation,—was very sparse.

At S.C. 2 the case was different. There were indications of a short spring phytoplankton flourishing. Frustules of Guinardia were very frequent. Nitzschia seriata was also quite common. Sometime, may be shortly before collecting samples of plankton for this month, Guinardia must have made its appearance in great quantities and was at the time of collection sinking. The diatoms together with Nitzschia seriata, and probably also Skeletonema costatum, must have caused a sort of spring phytoplankton maximum.

Dinoflagellates were sparse.

This condition was almost the same at S.C. 3. Nitzschia seriata was very frequent. Skeletonema costatum so abundant in April seemed now to be sinking and the same Guinardia frustules were seen.

The Peridinians were rare.

At S.C. 4 the phytoplankton was quite common. Again Nitz. seriata was very abundant, Guinardia frustules were common. Rhizosolenia fragillima made its first appearance here.

The Dinoflagellates were rare.

At S.C. 5 the phytoplankton was almost absent.

Nitzschia seriata—so common at S.C. 2, 3 and 4—was very sparse here.

There were few Ceratia.

There was a similar poverty in phytoplankton at S.C. 5. Few frustules of Rhizosolenia alata, calcar-avis and Shrubsolei were seen. Hemiaulus— in very rare number—was seen. Nitz. seriata was also very sparse here.

Ceratia were also rare.

The fact that Nitzschia seriata was so abundant and prevelant from S.C. 4, to S.C. 2 northward, and the re-appearance of Guinardia frustules, would suggest that there had been some sort of a spring diatom growth in the Suez Canal sometimes early in May. The occurrence of Nitzschia seriata in rare numbers at S.C. 5 and S.C. 6 might indicate that there had been at the Southern end of the Canal a similar diatom flourishing, but that it had disappeared—through some reason—earlier than at S.C. 4, 3, and 2. If we bear in mind that this species of Nitz. was quite prevalent throughout the Canal—except at S.C. 1—in March 1935, we might conclude that it was the chief species causing a sort of spring maximum sometime in March, April or May. Such maximum might be augmented by Guinardia and Skeletonema at sometime or other.

The absence of any indications of a similar maximum at S.C. 1 will be explained later.

June 1935

While the temperature had risen to that of summer months at S.C. 1, the salinity at this station was noticed to be decreasing, not only at the surface but also at depths of 5 and 10 metres.

At S.C. 1, the phytoplankton was distinctly poor.

There were only a few sporadic Coscinodiscus and few single specimens of Ceratia.

The zooplankton was likewise poor.

At S.C. 2 the phytoplankton was not uncommon, and was represented chiefly by Chaetoceros (Ch. affinis and Ch. brevis).

The Dinoflagellates were very sparse.

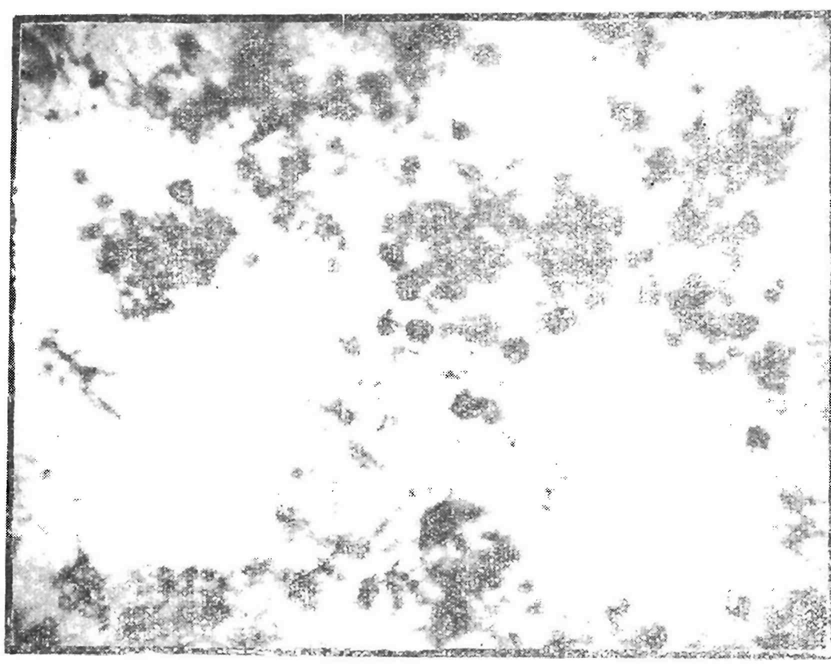

FIG. 9.—*Plankton* dominated by radiolarian *genus Acanthometron*
S.C. 4. June 1935
(Microphoto by Ghazzawi)

A very rich phytoplankton haul was obtained from S.C. 3. Frustules of Guinardia flaccida were very numerous, while Chaetoceros was very predominant. Bacteriastrum was not infrequent.

The Peridinians were rare. Unfortunately no direct correlation could be made between this month and May of 1936. In May we saw a sort of a diatom spring maximum caused by the presence of Nitzschia seriata. It may be probable that the diatom flourishing would extend to June, when Nitzschia disappeared and Chaetoceros would be the leading diatom at this time of the year. The salinity at S.C. 3 was about 42 $^0/_{00}$, indicating that the diatoms were flourishing irrespective of high salinity.

The phytoplankton content at S.C. 4 was similar to that at S.C. 3 both in quality and quantity.

The coarse net brought a rich Acanthometron radiolarian similar to that recorded in August at this same station.

At S.C. 5, the plankton as a whole was poor. There were few numbers of Chaetoceros, Thalassiothrix, Guinardia and broken frustules of Rhizosolenia.

The Ceratia were not uncommon.

The zooplankton was better represented, although still sparse.

There was a similar poverty in the phytoplankton at S.C. 6.

Among the diatoms, Hemiaulus, Guinardia, Rhizosolena were all recorded but none in any great numbers.

The Peridinians were rather common.

The zooplankton was quite common.

It is noteworthy that the general frequency of the phytoplankton in June 1935 resembled that of May 1936. Here and there, there was a conspicuous flourishing of diatoms at S.C. 2, 3 and 4 and a corresponding poverty at S.C. 1, S.C. 5 and S.C. 6. What govern, decide, or influence such frequency and distribution remains to be solved. The spring diatom flourisning seemed to start sometime in May extending to June from whereabout S.C. 4 to northward as far as whereabout S.C. 2. The spring diatom maximum at such regions appeared therefore later than the corresponding spring maximum, in northern European waters.

July 1936.

With June plankton collection, a year had been completed.

A July collection, however, was made in order to pursue the fate of diatoms recorded in June. The collection was made on the 24th of July, 12 days after the Fariskour " Sadd " had been demolished and the Nile water was then pouring vigourously into the sea.

The effect of this fresh water was already perceptible as far as S.C. 3. At S.C. 2, for example, about 55 kilometres from S.C. 1, the salinity has decreased from over 43 $^0/_{00}$ to about 39 $^0/_{00}$ from the surface to the bottom.

The July collection of 1934 was made while the Fariskour " Sadd " was still erected, and therefore the collections of July 1935 was made under different natural conditions from those made in July 1934.

It was now clear that the water at S.C. 1 was teeming with planktonic organisms.

Among the phytoplankton, Chaetoceros curvisetum and Ch. affinis were quite common. Other species of Chaetoceros, Bacteriastrum, Biddulphia mobiliensis, Rhizosolenia stolterfothii, Asterionella, Coscinodiscus, Hemiaulus and Ditylium were also quite frequent-

The Peridinians were very sparse.

The zooplankton was also quite rich.

The fine net at S.C. 2 caught probably some millions of a monotonous phytoplankton, almost a pure sample of the diatom Ditylium intricatum, appearing as a thick slimy-like dirty greenish precipitate. Coscinodiscus was also quite common.

The Dinoflagellates were sparse.

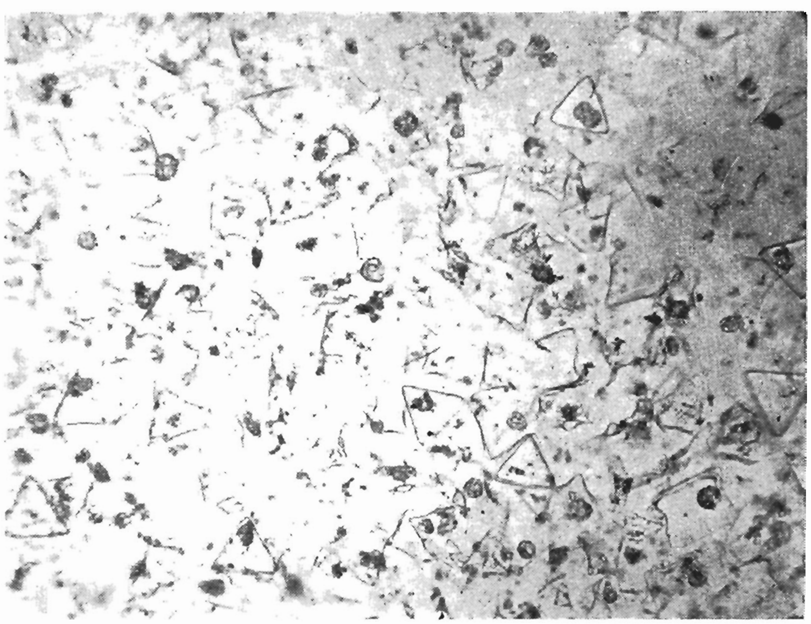

Fig. 10.—Monotonous *phytoplankton* of *Ditylium intricatum*
S.C. 2. July 1935
(Microphoto by Ghazzawi)

At S.C. 3, the phytoplankton was also very rich. Ditylium intricatum was present but not so abundant as S.C. 2. The leading diatom here was Bacteriastrum.

But the Dinoflagellates was also very abundant. Goniaulax catenata was very predominant, in fact, it looked as if the Peridinians

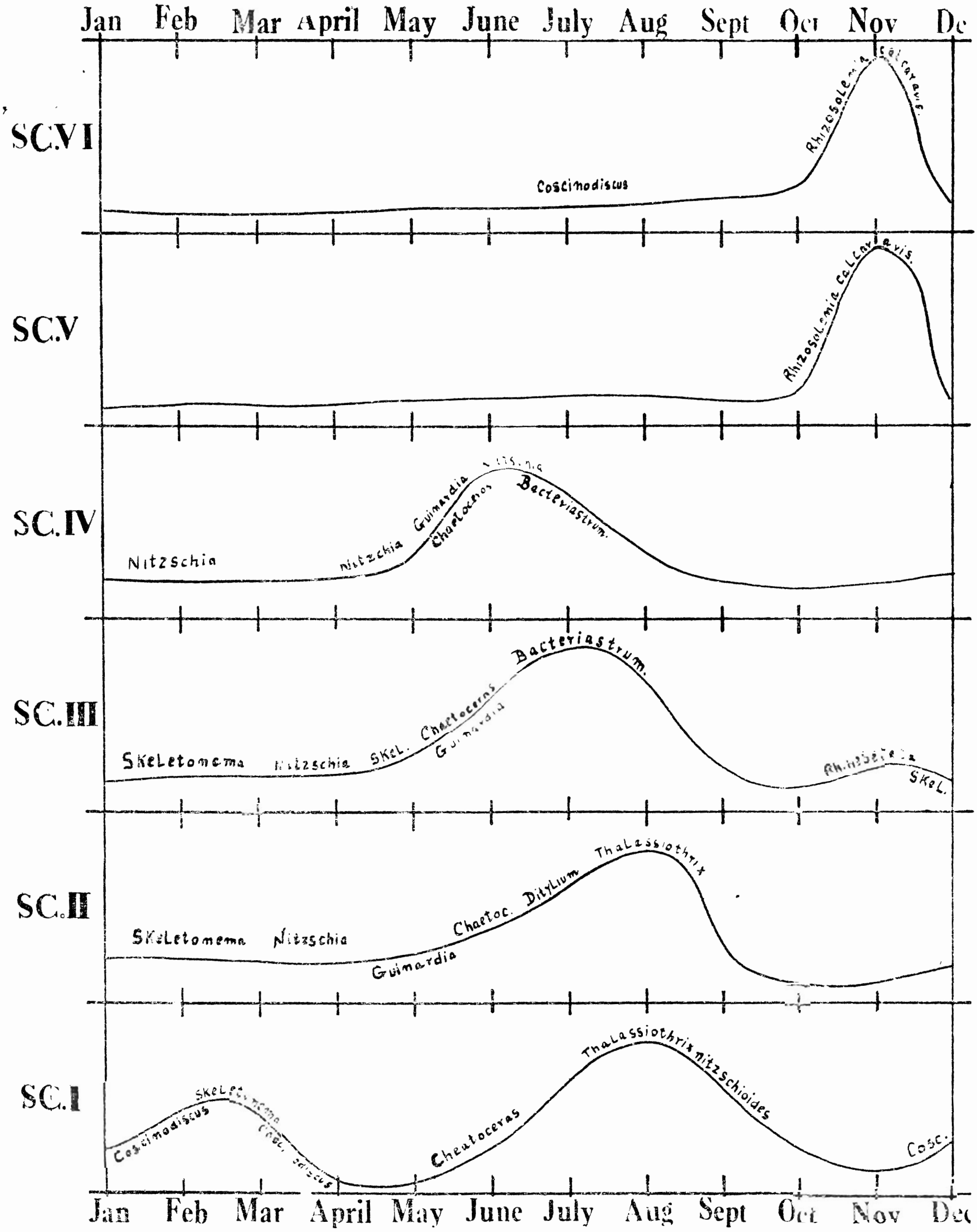

Fig. II.—Diatom Production in the Suez Canal were the dominant group of the phytoplankton. At S.C. 4, the phytoplankton was less frequent than had been noticed at the previous stations. Nitzschia seriata and Bacteriastrum were rather abundant. There were also sporadic numbers of Chaetoceros, frustules of Guinardia and Rhizosolenia.

Peridinians were not uncommon.

The fine net brought no phytoplankton at S.C. 5, but few cells of Rhizosolenia Shrubsolei and still fewer frustules of Rh. calcar-avis were caught by the coarse net.

There was a similar poverty of the phytoplankton at S.C. 6. Diatom frustules and few Ceratia were seen.

If we therefore sum up, it was seen clearly how the Nile flood had induced a diatom flourishing in the regions where the effect of the fresh water was felt. This was clearly noticed at S.C. 1, 2 and 3. The two most southern stations on the other hand were almost devoid of phytoplankton. There was also a marked difference in the phytoplankton content of this July 1935 and that of July 1934 when the Fariskour Bank was not yet demolished.

General Conclusion.

The general frequency of the phytoplankton has been the subject of detailed investigation and discussion in many regions. It is generally expected in waters under no special physical or natural conditions, to find an increase in the abundance of planktonic diatoms in the spring, after which the diatoms fall to a minimum in summer, to be followed by a second — but smaller — maximum in autumn, while in winter reproduction of diatoms slackens down and finally practically ceases. To mention but a few examples, Herdman's and Scott's intensive study of the marine Plankton around the south end of the Isle of Man remains outstanding. Also, the same sequence of changes in the plankton has been demonstrated by Dakin (4) in the southern Hemisphere, at a latitude 33 51, in the Oceanic water of the Pacific at a point about 5 miles off the coast outside Port Jackson, New South Wales, Australia.

From the general distribution of the phytoplankton throughout the year in the Suez Canal, we have clearly seen that :

1. There is a " summer " maximum in the northern half of the Suez Canal.

2. There is no similar " summer " maximum in the southern half of the Canal.

3. There is a second maximum in " winter " in the north and not in " autumn ".

4. There is a marked maximum of diatoms in "autumn" in the south and not in the winter.

5. In spring there is not noticed a well marked spring increase of diatoms in the south.

We have therefore in the area of our investigation a different picture of diatom production from what is seen at other places. At Port Said end of the Canal, for example, we have a "summer" and a "winter" maximum and not a "spring" and "autumn" increase as found, for instance in a place like Port Erin, although it should be noticed that we have in our waters many of the same species found in altogether different latitudes.

On the other hand, at Suez, in the south, we have a plankton rythm more or less similar to that seen elsewhere, this is especially clearly demonstrated in the autumn maximum.

We must, therefore, attempt to explain: (1) The causation of the diatom flourishing. (2) The deviation in the north from the usual seasonal frequency. (3) The presence of the usual seasonal frequency in the south.

The theory has been long advanced that the vernal abundance in diatoms is to be due to an increase in the intensity of sunlight on the onset of spring. In northern cold region, probably also an increase in the temperature would accelerate the reproductive activity that would lead to an abundance of diatoms. But in our area of investigation it is quite difficult to explain the diatom flourishing on temperature and light grounds, as there is always sufficient brilliant sunlight throughout the year for the process of photosynthesis, as could be shown from the following data during 1935.

MONTHLY AVERAGE LENGTH OF DAY

January	February	March	April	May	June
10h. 29m.	11h. 7m.	11h. 59m.	12h. 53m.	3h. 36m.	14h. 00m.
July	**August**	**September**	**October**	**November**	**December**
13h. 50m.	13h. 10m.	12h. 22m.	11h. 29m.	10h. 41m.	10h. 17m.

Thus our longest day is approximately 14 hours and our shortest is about 10. As regards temperature, we have seen that even in winter, the water temperature is sufficiently high to induce a reproductive activity, if required.

In all probability, the quantity of nutritive substances in the water is the prime deciding factor in the seasonal abundance of phytoplankton in our area of investigation. Brandt drew the attention to the importance of nitrates and phosphates in playing a role in the seasonal variations of the diatom plankton. Speaking generally and broadly, our waters are much poorer in the phytoplankton than, say, the Northern European Seas. This may be mainly due to the action of denitrifying bacteria found in sea water. Such bacteria, at our high temperature, act more rapidly upon the nitrates in solution and reduce them finally to elementary free nitrogen, thus depriving the diatoms of one of the most essential nutritive substance necessary for their growth and reproduction. But there is a most important factor in the production and abundance of diatoms in our area of investigation. This factor is the effect of the Nile flood every year. The huge millions of cubic metres of fresh water discharged daily into the sea during the flood period seem to bring into solution sufficient quantities of nutritive materials for a good diatom growth. Unfortunately, no estimation has yet been made of those quantities, but it is borne in mind to be done in due time.

Willcocks (24) wrote " We have found in the Nile water at the end of August up to 1·8 grams of deposit per litre. This deposit contained lime 21–23 per cent, phosphoric acid 1·10–1·35, potash 1–1220, N. 95–1·25 per cent."

The diatom maximum in summer in the north of the Canal must therefore be attributed almost entirely to the effect of the Nile flood. Such effect must be so great that it overcomes the great activity of the dentrifying bacteria at such high temperature of the summer. At the northern half of the Canal, the diatoms seem to exhaust during the summer all the nutritive material, thus leaving no sufficient food substances to allow for an autumn maximum. During the autumn, food material accumulates, until when winter starts, Coscinodiscus and Skeletonema appear to find optimum conditions for their growth and reproduction, utilising the available nutrive materials accumulated during the autumn, causing the winter maximum. In winter, therefore, the food substance is exhausted leaving no sufficient material for a diatom increase in spring.

Thus we see how the effect of the Nile flood has completely shaped the diatom picture in the northern end of the Canal.

The southern end of the Canal, on the other hand, is entirely out of the sphere of the Nile influence. We have seen from Faouzi's (6) diagram that the Mediterranean water never reaches the Suez. We should therefore expect to find the diatom production similar to other regions under normal physico-chemical and environmental conditions.

And this is what we have seen to a more or less certain extent. Thus we have dealt in Novembei with a marked autumn maximum caused by Rhizosolenia which must have found optimum physico-chemical conditions for its growth and reproduction. When the food salts have been exhausted in autumn, the curve must fall down to minimum in winter during which food may accumulate to induce a spring maximum. Such a vernal increase is not well marked to justify a diatom second peak in the south. The absence of such diatom flourishing at this time of the year might be due again to the destruction of the necessary nitrates by the denitrifying bacteria which would be most active at the prevailing high temperature of our spring.

JANUARY

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	11.00	15.05	16.46	12.10	14.30	17.15
	Date	23-1-1935			24-1-1935		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		—		—	—	—	—
Biddulphia alternans			—	—		—	—
,, favus		*	—		—	—	—
,, mobiliensis		‡		—	—	—	—
,, obtusa					—	—	—
,, rhombus			—	—	—		—
,, smithii		†				—	—
,, vesiculosa			—	—	—	—	—
Bacteriastrum delicatulum ...				—	—	—	—
,, hyalinum					—	—	—
Chaetoceros decipiens		‡		—	—	—	—
,, curvisetum		†	—		—	—	—
,, densum				—			*
,, didymus			—	—	—	—	—
,, affinis var. Schuttii ...		—	—	—	—	—	—
,, Lauderi		—			—	—	—
,, brevis		—		—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	†	‡
,, gigas		‡	†	—	—	—	—
,, oculus-iridis		‡	†	—	—	—	—
,, Granii		[illegible]	†	—	—	—	—
,, excentricus (var. minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	‡
Ditylium intricatum		—	—	—	—	—	—
,, Brightwelli		‡	—	—	—	—	—
Guinardia flaccida		—	†	†	—	—	—
Hemiaulus Heirbergii		—	—	—	—	—	—
Hyalodiscus stelliger		—	—	—	—	—	—
Nitzschia seriata		—	‡	‡	†	—	—
Lithodesmium undulatum		†	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	—	†
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		—	—	—	—	—	—
,, Shrubsolei		—	*	*	—	—	—
,, calcar-avis		—	*	*	—	—	—
,, stolterfothii		—	—	—	—	—	—

JANUARY (*Contd.)*

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	11.00	15.05	16·46	12.10	14.30	17.15
	Date	23-1-1935			24-1-1935		
Skeletonema costatum...		—	‡	§	—	—	—
Thalassiothrix longissima		‡	—	—	—	—	—
„ Frauenfeldii ...		‡	—	—	—	—	—
Ceratium candelabrum		—	—	—	—	—	—
C. furca		*	*	*	*	*	*
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		*	*	*	—	—	†
C. tripos		—	*	—	—	—	†
C. pulchellum		—	*	*	—	—	†
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var gracilentum ...		—	—	—	—	—	†
C. arietinum var detortum ...		—	—	—	—	—	—
C. macroceros		—	—	*	—	—	†
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	*	†
C. trichoceros		—	—	—	*	—	*
Dinophysis caudata		—	—	—	—	—	—
„ tripos		—	—	—	—	—	—
Goniaulax catenata		—	*	—	—	—	—
Prorocentrum micans		*	*	—	—	—	—
Peridinium cerasus		*	—	—	—	—	—
Peridinium Spp.		*	*	—	*	—	—

* Rare. † Few. ‡ Common. § Abundant: ¶ Very Abundant.

FEBRUARY

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	10.40	16.00	10 10	11.45	13.40	16.05
	Date	25-2-1936			26-2-1936		
Acnanthes longipes		one	—	—	—	—	—
Asterionella japonica		†	—	—	—	—	—
Biddulphia alternans		*	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		†	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		—	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum ...		—	—	—	—	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceros decipiens		‡	—	—	—	—	—
,, curvisetum		†	—	—	‡	—	—
,, densum		—	—	—	—	*	—
,, didymus		—	—	—	—	—	—
,, affinis var. Schuttii ...		‡	—	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	†
,, gigas		†	—	—	—	—	—
,, oculus-iridis		†	—	—	—	—	—
,, Granii		†	—	—	—	—	—
,, excentricus (var. minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	‡
Dityliun intricatum		†	—	—	—	—	—
,, Brightwelli		—	—	—	—	—	—
Guinardia flaccida		—	—	†	—	‡	†
Hemiaulus Heirbergii		*	—	—	—	*	*
Hyalodiscus stelliger		*	—	—	—	—	—
Nitzschia seriata		—	—	*	†	†	—
Lithodesmium undulatum		*	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	†	†
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		—	—	—	—	—	—
,, Shrubsolei		—	—	†	—	*	*
,, calcar-avis		—	—	‡	—	†	†
,, stolterfothii		—	—	—	—	—	—

FEBRUARY (*contd.*)

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	10.40	16.00	10.10	11.45	13.40	16.05
Date	25–2–1936			26–2–1936		
Skeletonema costatum	§	†	¶	—	—	—
Thalassiothrix longissima	—	—	—	—	—	—
,, Frauenfeldii ...	*	—	—	—	—	—
Ceratium candelabrum	—	—	—	—	—	—
C. furca	*	—	—	—	*	‡
C. pentagonum var. subrobustum	—	—	—	—	—	—
C. falcatum	—	—	—	—	—	—
C. fusus	*	*	*	*	*	—
C. tripos	—	—	—	—	—	—
C. pulchellum	*	—	†	†	‡	—
C. pulchellum f. semipulchellum	—	—	—	—	—	—
C. pulchellum f. eupulchellum ...	—	—	—	—	—	—
C. gracile var. symmetricum ...	—	—	—	—	—	—
C. arietinum var. gracilentum ...	—	—	—	—	—	—
C. arietinum var. detortum ...	—	—	—	—	—	—
C. macroceros	—	—	—	—	—	‡
C. maroceros subsp. gallicum ...	—	—	—	—	—	—
C. massiliense	—	—	—	—	—	—
C. trichoceros	—	—	—	—	—	—
Dinophysis caudata	—	—	—	*	—	—
,, tripos	—	—	—	—	—	—
Goniaulax catenata	—	—	—	—	—	—
Prorocentrum micans	—	—	—	—	—	—
Peridinium cerasus	—	—	—	—	—	—
Peridinium Spp.	—	—	—	†	—	—

* Rare. † Few. ‡ Common. § Abundant. ¶ Very abundant.

MARCH

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	16.50	12.35	18.01	15.50	13.25	11.00
	Date	9–3–1935			8–3–1935		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		†	—	—	—	—	—
Biddulphia alternans		*	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		‡	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		*	—	—	—	—	—
,, smithii		†	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum ...		—	—	—	—	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceros decipiens		†	—	—	—	—	—
,, curvisetum		†	—	—	—	—	—
,, densum		—	—	—	—	*	—
,, didymus		—	—	—	—	—	—
,, affinis var. Schuttii ...		—	—	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	—
,, gigas		§	†	—	—	—	—
,, oculus-iridis		‡	†	—	—	—	—
,, Granii		§	†	—	—	—	—
,, excentricus (var. minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	‡	§
Ditylium intricatum		—	—	—	—	—	—
,, Brightwelli		‡	—	—	—	—	—
Guinardia flaccida		—	†	—	—	*	*
Hemiaulus Heirbergii		—	—	—	—	—	—
Hyalodiscus stelliger		†	—	—	—	—	—
Nitzschia seriata		—	‡	‡	‡	†	†
Lithodesmium undulatum		†	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	*	*
Rhizosolenia alata		—	†	—	—	*	*
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		—	—	—	—	—	—
,, Shrubsolei		—	†	—	—	—	—
,, calcar-avis		—	—	—	—	*	*
,, stolterfothii		—	—	—	—	*	*

MARCH (*contd*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	16.50	12.35	18.01	15.50	13.25	11.00
	Date	9–3–1935			8–3–1935		
Skeletonema costatum		—	—	—	—	—	—
Thalassiothrix longissima		—	—	—	—	—	—
,, Frauenfeldii ...		—	*	*	—	*	—
Ceratium candelabrum		*	—	—	—	—	—
C. furca		†	‡	†	§	†	—
C. pentagonum var. subrobustum		*	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		‡	†	†	†	†	†
C. tripos		†	†	—	—	*	*
C. pulchellum		‡	‡	¶	‡	‡	—
C. pulchellum f. semipulchellum		†	—	—	—	—	—
C. pulchellum f. eupulchellum ...		†	—	—	—	—	—
C. gracile var. symmetricum ...		‡	—	—	—	—	—
C. arietinum var. gracilentum ...		†	—	—	—	—	—
C. arietinum var. detortum ...		*	—	—	—	—	—
C. macroceros		—	—	—	—	—	—
C. maroceros soubsp. gallicum ...		‡	—	—	—	—	—
C. massiliense		†	—	—	‡	†	†
C. trichoceros		—	—	*	—	—	—
Dinophysis caudata		—	—	—	—	*	—
,, tripos		—	—	—	—	—	—
Goniaulax catenata		—	—	—	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	†	—	†	†	—

* Rare. † Few. ‡ Common. § Abundant. ¶ Very abundant.

APRIL

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	15.05	11.05	9.20	17.17	15.03	12.55
Date	27-4-1936			26-4-1936		
Acnanthes longipes	—	—	—	—	—	—
Asterionella japonica	—	—	—	—	—	—
Biddulphia alternans	—	—	—	—	—	—
,, favus	—	—	—	—	—	—
,, mobiliensis	—	—	—	—	—	—
,, obtusa	—	—	—	—	—	—
,, rhombus	—	—	—	—	—	—
,, smithii	—	—	—	—	—	—
,, vesiculosa	—	—	—	—	—	—
Bacteriastrum delicatulum ...	—	—	—	—	—	—
,, hyalinum	—	—	—	—	—	—
Chaetoceros decipiens	—	—	—	—	—	—
,, curvisetum	—	—	—	*	—	—
,, densum	—	—	—	—	—	—
,, didymus	—	—	—	—	—	—
,, affinis var. Schuttii ...	—	—	—	—	—	—
,, Lauderi	—	—	—	—	—	—
,, brevis	—	—	—	—	—	—
,, holasticus	—	—	—	—	—	—
,, Ralfsii	—	—	—	—	—	—
Coscinodiscus nobilis	—	—	—	—	—	—
,, gigas	*	—	—	—	—	—
,, oculus-iridis	*	—	—	—	—	—
,, Granii	*	—	—	—	—	—
,, excentricus (var. minor)	—	—	—	—	—	—
Climacodium biconcavum	—	—	—	—	—	—
Ditylium intricatum	—	—	—	—	—	—
,, Brightwelli	—	—	—	—	—	—
Guinardia flaccida	—	—	—	*	*	*
Hemiaulus Heirbergii	—	—	—	—	—	—
Hyalodiscus stelliger	*	—	—	—	—	—
Nitzschia seriata	—	—	‡	—	*	—
Lithodesmium undulatum	—	—	—	—	—	—
Rhabdonema adriaticum	—	—	—	—	—	—
Rhizoselenia alata	—	—	—	—	—	—
,, fragillima	—	—	—	—	—	—
,, hebetata form semispina	—	—	—	—	—	—
,, Shrubsolei	—	—	—	—	—	—
,, calcar-avis	—	—	—	—	†	*
,, stolterfothii	—	—	—	—	—	—

APRIL (*contd.*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	15.05	11.05	9.20	17.17	15.03	12.55
	Date	27-4-1936			26-4-1936		
Skeletonema costatum...		—	*	¶	—	—	—
Thalassiothrix longissima		—	—	—	—	—	—
,, Frauenfeldii ...		—	—	—	—	—	—
Ceratium candelabrum		—	—	—	—	*	—
C. furca		*	*	*	—	—	—
C. pentagonum var. subrobustum		—	—	—	—	*	—
C. falcatum		—	—	—	—	—	—
C. fusus		*	—	*	*	—	—
C. tripos		—	—	—	—	—	—
C. pulchellum		—	*	*	—	*	—
C. pulchellum f. semipulchellum		—	—	—	*	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	—	—	—	*	—
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	*	—
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	—	—
C. trichoceros		—	—	—	—	—	—
Dinophysis caudata		*	—	—	—	—	—
,, tripos...		*	—	—	—	—	—
Goniaulax catenata		—	—	—	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		*	*	—	—	—	—
Peridinium Spp.		*	*	*	*	*	*

* Rare. † Few. ‡ Common. § Abundant. ¶ Very abundant.

MAY

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	14.30	9.55	16.55	15.15	13.00	11.00
	Date	24–5–1936			23–5–1936		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		—	—	—	—	—	—
Biddulphia alternans		—	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		—	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		†	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum ...		—	—	—	—	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceros decipiens		—	—	—	—	—	—
,, curvisetum		—	—	—	—	—	—
,, densum		—	—	—	—	—	—
,, didymus		—	—	—	—	—	—
,, affinis var. Schuttii...		—	—	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	—
,, gigas		*	—	—	—	—	—
,, oculus-iridis		*	—	—	—	—	—
,, Granii		*	—	—	—	—	—
,, excentricus (var minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	—
Ditylium intricatum		—	—	—	—	—	—
,, Brightwelli		—	—	—	—	—	—
Guinardia flaccida		—	§	‡	‡	—	—
Hemiaulus Heirbergii		—	—	—	—	—	*
Hyalodiscus stelliger		*	—	—	—	—	—
Nitzschia seriata		—	§	¶	¶	*	*
Lithodesmium undulatum		—	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	—	—
Rhizoselenia alata		—	—	—	—	—	*
,, fragillima		—	—	—	‡	—	—
,, hebetata form semispina		—	—	—	—	—	—
,, Shrubsolei		—	*	—	—	*	*
,, calcar-avis		—	*	—	—	—	*
,, stolterfothii		—	—	—	—	—	—

MAY (*contd.*)

SPECIES	Station	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	14.30	9.55	16.55	15.15	13.00	11.00
	Date	24-5-1936			23-5-1936		
Skeletonema costatum...		—	†	†	†	—	—
Thalassiothrix longissima		—	—	—	—	—	—
,, Frauenfeldii		—	—	—	—	—	*
Ceratium candelabrum		—	—	—	—	—	—
C. furca		—	*	*	*	—	—
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		—	*	—	—	—	—
C. tripos		—	—	—	—	—	*
C. pulchellum		—	*	*	*	—	—
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	—	—	—	—	—
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	—	†
C. maroceros subsp, gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	†	†
C. trichoceros		—	—	—	—	—	—
Dinophysis caudata		—	—	—	—	—	—
,, tripos		—	—	—	—	—	—
Goniaulax catenata		—	—	—	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		—	—	—	*	—	—
Peridinium Spp.		—	—	*	*	—	—

* Rare. † Few, ‡ Common. § Abundant. ¶ Very abundant.

JUNE

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	16.30	11.40	9.20	17.40	15.20	12.10
Date	28-6-1935			26-6-1935		
Acnanthes longipes	—	—	—	—	—	—
Asterionella japonica	—	—	—	—	—	—
Biddulphia alternans	—	—	—	—	—	—
,, favus	—	—	—	—	—	—
,, mobiliensis	*	—	—	—	—	—
,, obtusa	—	—	—	—	—	—
,, rhombus	—	—	—	—	—	—
,, smithii	*	—	—	—	—	—
,, vesiculosa	—	—	—	—	—	—
Bacteriastrum delicatulum ...	—	*	‡	†	—	—
,, hyalinum	—	—	—	—	—	—
Chaeteceros decipiens	—	—	—	—	—	—
,, curvisetum	—	—	†	—	—	—
,, densum	—	—	—	—	—	—
,, didymus	—	—	—	—	—	—
,, affinis var. Schuttii ...	*	†	†	—	—	—
,, Lauderi	—	—	—	—	—	—
,, brevis	*	†	†	†	—	—
,, holasticus	—	—	—	—	—	—
,, Ralfsii	—	—	—	—	—	—
Coscinodiscus nobilis	—	—	—	—	—	—
,, gigas	*	*	—	—	—	—
,, oculus-iridis	*	*	—	—	—	—
,, Granii	—	—	—	—	—	—
,, excentricus (var. minor)	—	—	—	—	—	—
Climacodium biconcavum	—	—	—	—	—	—
Ditylium intricatum	—	—	—	—	—	—
,, Brightwelli	—	—	—	—	—	—
Guinardia flaccida	—	*	§	‡	†	†
Hemiaulus Heirbergii	—	—	—	—	—	†
Hyalodiscus stelliger	—	—	—	—	—	—
Nitzschia seriata	—	—	—	—	—	—
Lithodesmium undulatum	—	—	—	—	—	—
Rhabdonema adriaticum	—	—	—	—	—	—
Rxizoselenia alata	—	—	—	—	†	†
,, fragillima	—	—	—	—	—	—
,, hebetata form semispina	—	—	—	—	—	—
,, Shrubsolei	—	—	—	—	—	*
,, calcar-avis	—	—	*	*	*	†
,, stolterfothii	—	—	—	—	—	—

JUNE (*contd*)

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	16.30	11.40	9.20	17.40	15.20	12.10
Date	28-6-1935			26-6-1935		
Skeletonema costatum...			—	—		—
Thalassiothrix longissima			—		—	—
,, Frauenfeldii	—	*	*		*	—
Ceratium candelabrum	—	—			—	—
C. furca		—	*	—	—	*
C. pentagonum var. subrobustum	—			—	—	—
C. falcatum		—	—		—	—
C. fusus	*	*	.	—	—	†
C. tripos	—	*	—	.	—	*
C. pulchellum		*	*	*	†	†
C. pulchellum f. semipulchellum	—	—	—	—	—	—
C. pulchellum f. eupulchellum ...	—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—
C. arietinum var. gracilentum ...	—	*	—	—	—	—
C. arietinum var. detortum ...	—	—	—	—	—	—
C. macroceros	—	—	*	—	†	†
C. maroceros subsp. gallicum ...	—	—	—	—	—	—
C. massiliense	—	—	*		†	†
C. trichoceros	—	—	—	—	—	—
Dinophysis caudata	—	—	—	—	—	*
,, tripos	—	.	—	—	—	—
Goniauoax catenata		—	—	—	—	—
Prorocentrum micans	—	—	—	—	—	—
Peridinium cerasus	—	—	—	—	—	—
Peridinium Spp.	—	*	*	—	—	—

* Rare. † Few. ‡ Common. § Abundant. ¶ Very abundant.

JULY

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	12.55	14.38	17.20	8.35	10.50	13.30
	Date	24-7-1935			25-7-1935		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		‡	†	†	—	—	—
Biddulphia alternans		—	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		‡	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		‡	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum ...		†	—	§	§	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceros decipiens		†	—	—	—	—	—
,, curvisetum		§	—	—	—	—	—
,, densum		—	—	—	—	—	—
,, didymus		‡	—	—	—	—	—
,, affinis var. Schuttii ...		‡	—	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	—	—	—	—
,, holasticus		†	—	—	—	—	—
,, Ralfsii		‡	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	—
,, gigas		—	—	—	—	—	—
,, oculus-iridis		—	—	—	—	—	—
,, Granii		*	*	—	—	—	—
,, excentricus (var. minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	†
Ditylium intricatum		†	¶	‡	—	—	—
,, Brightwelli		—	—	—	—	—	—
Guinardia flaccida		—	—	—	†	—	—
Hemiaulus Heirbergii		†	—	—	—	—	—
Hyalodiscus stelliger		†	—	—	—	—	—
Nitzschia seriata		—	—	—	§	—	—
Lithodesmium undulatum		—	—	—	—	—	—
Rhabdonema adriaticum		†	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	—	—
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		‡	—	—	—	—	—
,, Shrubsolei		—	—	—	*	†	†
,, calcar-avis		—	—	—	*	†	†
,, stolterfothii		‡	—	—	—	—	—

JULY (*contd.*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	12.55	14.38	17.20	8.35	10.50	13.30
	Date	24-7-1935			25-7-1935		
Skeletonema costatum...		—	—	—	—	—	—
Thalassiothrix longissima		—	—	—	—	—	—
,, Frauenfeldii ...		—	—	—	—	—	—
Ceratium candelabrum		—	—	—	—	—	—
C. furca		†	—	*	*	*	*
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		—	—	*	—	*	—
C. tripos		—	—	—	—	—	—
C. pulchellum		†	—	*	‡	*	—
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		†	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	—	*	—	—	†
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	—	†
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	—	†
C. trichoceros		—	—	—	—	—	—
Dinophysis caudata		—	—	*	—	—	—
,, tripos		—	—	—	—	—	—
Goniaulax catenata		—	*	¶	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	†	†	—	—	—

* Rare. † Few. ‡ Common. § Abundant. ¶ Very Abundant.

AUGUST.

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	17.00	11.50	8.50	14.40	12.30	9.25
	Date	4-8-1934			3-8-1934		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		†	*	—	—	—	—
Biddulphia alternans		—	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		—	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		—	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum... ...		—	†	§	—	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceros decipiens		—	—	†	—	—	—
,, curvisetum		—	—	—	—	—	—
,, densum		—	—	—	—	—	*
,, didymus		—	—	—	—	—	—
,, affinis var. Scuhttii...		—	—	†	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	†	*	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	—
,, gigas		†	*	—	—	—	—
,, oculus-iridis		†	*	—	—	—	—
,, Granii		—	—	—	—	—	—
,, excentricus (var minor)		—	*	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	—
Ditylium intricatum		—	*	—	—	—	—
,, Brightwelli		—	—	—	—	—	—
Guinardia flaccida		—	—	*	—	*	*
Hemiaulus Heirbergii		—	—	—	*	—	*
Hyalodiscus stelliger		—	—	—	—	—	—
Nitzschia seriata		—	—	—	—	—	—
Lithodesmium undulatum		—	—	—	—	—	—
Rhabdonema adriaticum		†	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	—	—
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		—	—	—	—	—	—
,, Shrubsolei		—	—	—	*	*	—
,, calcar-avis		—	—	—	*	*	—
,, stolterfothii		—	—	—	—	—	—

AUGUST *(Contd)*

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	17·00	11.50	8.50	14.40	12.30	9.25
	Date	4–8–1934			3–8–1934		
Skeletonema costatum...		—	—	—	—	—	—
Thalassiothrix longissima		—	*	—	—	—	—
,, Frauenfeldii ...		¶	¶	§	—	†	†
Ceratium candelabrum		—	—	—	—	—	—
C. furca		†	‡	*	—	†	†
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		—	—	*	—	†	‡
C. tripos		—	—	—	—	—	—
C. pulchellum		—	—	†	—	†	—
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	—	*	—	*	†
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	—	†
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	—	†
C. trichoceros		—	—	—	—	—	*
Dinophysis caudata		—	*	—	—	—	—
,, tripos...		—	—	—	—	—	—
Goniaulax catenata		—	†	—	—	—	—
Prorocentrum micans		—	†	—	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	*	†	—	†	†

* Rare. † Few. ‡ Common. § Abundant. ¶ very abundant

SEPTEMBER

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	9.20	13.40	15.40	10.25	13.05	16.40
	Date	5-9-1934			6-9-1934		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		†	†	—	—	—	—
Biddulphia alternans		—	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		†	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		—	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum... ...		‡	†	—	—	—	—
,, hyalinum		†	—	—	—	—	—
Chaetoceros decipiens		‡	†	—	—	—	—
,, curvisetum		‡	†	—	—	—	—
,, densum		—	—	—	—	—	—
,, didymus		†	—	—	—	—	—
,, affinis var. Schuttii...		—	‡	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	—	—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	†	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	—	—
,, gigas		‡	‡	*	—	—	—
,, oculus-iridis		‡	†	—	—	—	—
,, Granii		‡	†	—	—	—	—
,, excentricus (var minor)		*	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	—
Ditylium intricatum		—	—	—	—	—	—
,, Brightwelli		‡	—	—	—	—	—
Guinardia flaccida		—	—	—	—	—	‡
Hemiaulus Heirbergii		—	*	—	—	—	—
Hyalodiscus stelliger		—	—	—	—	—	—
Nitzschia seriata		—	—	—	—	—	—
Lithodesmium undulatum		—	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	—	*
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		‡	*	—	—	—	—
,, Shrubsolei		—	*	*	*	*	*
,, calcar-avis		—	*	—	*	*	*
,, stolterfothii		—	—	—	—	—	—

SEPTEMBER (*contd.*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	9.20	13.40	15.40	10.25	13.05	16.40
	Date		5–9–1934			6–9–1934	
Skeletonema costatum...		—	—	—	—	—	—
Thalassiothrix longissima		†	‡	—	—	—	—
,, Frauenfeldii ...		§	§	†	†	—	*
Ceratium candelabrum		—	—	—	—	—	—
C. furca		*	—	†	*	*	*
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		—	*	—	*	—	*
C. tripos		—	*	—	*	*	*
C. pulchellum		—	*	†	*	*	*
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	‡	*	†	†	†
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	—	†
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	—	†
C. trichoceros		—	—	*	*	—	—
Dinophysis caudata		—	*	—	—	—	—
,, tripos...		—	—	—	—	—	—
Goniaulax catenata		*	§	‡	—	—	—
Prorocentrum micans		—	—	*	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	†	†	†	*	—

* Rare † Few. ‡ Common. § Abundant. ¶ Very abundant.

OCTOBER

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	14.50	10.55	15.50	14.5	11.35	9.15
	Date	4-10-1934			3-10-1934		
Acnanthes longipes		—	—	—	—	—	—
Asterionella japonica		†	—	—	—	—	—
Biddulphia alternans		—	—	—	—	—	—
,, favus		—	—	—	—	—	—
,, mobiliensis		—	—	—	—	—	—
,, obtusa		—	—	—	—	—	—
,, rhombus		—	—	—	—	—	—
,, smithii		—	—	—	—	—	—
,, vesiculosa		—	—	—	—	—	—
Bacteriastrum delicatulum ...		*	*	*	—	—	—
,, hyalinum		—	—	—	—	—	—
Chaetoceres decipiens		‡	—	—	—	—	—
,, curvisetum		‡	—	—	—	—	—
,, densum		—	—	—	—	—	—
,, didymus		—	†	†	‡	—	—
,, affinis var Scuthtii....		—	†	—	—	—	—
,, Lauderi		—	—	—	—	—	—
,, brevis		—	*	—	—	—	—
,, holasticus		—	—	—	—	—	—
,, Ralfsii		—	—	—	—	—	—
Coscinodiscus nobilis		—	—	—	—	*	‡
,, gigas		—	—	—	—	—	—
,, oculus-iridis		—	—	—	—	—	—
,, Granii		—	—	—	—	—	—
,, excentricus (var minor)		—	—	—	—	—	—
Climacodium biconcavum		—	—	—	—	—	†
Ditylium intricatum		—	—	—	—	—	—
,, Brightwelli		†	—	—	—	—	—
Guinardia flaccida		—	—	—	—	*	‡
Hemiaulus Heirbergii		¶	*	*	*	—	‡
Hyalodiscus stelliger		—	—	—	—	—	—
Nitzschia seriata		—	†	‡	—	—	—
Lithodesmium undulatum		—	—	—	—	—	—
Rhabdonema adriaticum		—	—	—	—	—	—
Rhizosolenia alata		—	—	—	—	—	†
,, fragillima		—	—	—	—	—	—
,, hebetata form semispina		‡	—	‡	—	—	—
,, Shrubsolei		—	*	—	*	*	†
,, calcar-avis		—	—	—	*	*	†
,, stolterfothii		—	—	—	—	—	—

OCTOBER (*contd.*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	14.50	10.55	15.50	14.5	11.35	9.15
	Date	4-10-1934			3-10-1934		
Skeletonema costatum...		—	—	—	—	—	—
Thalassiothrix longissima		‡	†	*	—	—	—
,, Frauenfeldii		‡	—	—	*	*	—
Ceratium candelabrum		—	—	—	—	—	—
C. furca		*	‡	‡	—	*	—
C. pentagonum var. subrobustum		—	—	—	—	*	—
C. falcatum		—	—	—	—	—	*
C. fusus		—	—	*	*	*	*
C. tripos		—	*	†	*	*	‡
C. pulchellum		†	—	‡	—	—	—
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		—	—	—	—	*	‡
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	†	—	‡	§
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		—	—	—	—	—	*
C. trichoceros		*	*	*	—	*	‡
Dinophysis caudata		—	*	*	*	—	—
,, tripos		—	—	—	—	—	—
Goniaulax catenata		†	‡	‡	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	†	†	†	*	*

* Rare † Few. ‡ Common, § Abundant. ¶ Very abundant:

NOVEMBER

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	10.25	14.10	16.00	11.05	13.05	15.10
Date	16-11-1934			17-11-1934		
Acnanthes longipes	—	—	—	—	—	—
Asterionella japonica	—	—	—	—	—	—
Biddulphia alternans	*	—	—	—	—	—
,, favus	—	—	—	—	—	—
,, mobiliensis	—	—	*	—	—	—
,, obtusa	—	one	—	—	—	—
,, rhombus	—	—	—	—	—	—
,, smithii	†	†	*	—	—	—
,, vesiculosa	—	—	—	—	—	—
Bacteriastrum delicatulum... ...	*	—	—	—	—	—
,, hyalinum	—	—	—	—	—	—
Chaetoceros decipiens	*	—	—	—	—	—
,, curvisetum	‡	—	—	—	—	—
,, densum	—	—	—	—	—	—
,, didymus	†	—	—	†	—	—
,, affinis var. Schuttii...	*	†	*	—	—	—
,, Lauderi	—	—	—	—	—	—
,, brevis	—	—	†	—	—	—
,, holasticus	—	—	—	—	—	—
,, Ralfsii	*	*	—	—	—	—
Coscinodiscus nobilis	—	—	—	—	†	†
,, gigas	†	*	—	—	—	—
,, oculus-iridis	*	*	—	—	—	—
,, Granii	*	*	—	—	—	—
,, excentricus (var. minor)	—	—	—	—	—	—
Climacodium biconcavum	—	—	—	—	—	—
Ditylium intricatum	—	—	—	—	—	—
,, Brightwelli	†	—	—	—	—	—
Guinardia flaccida	—	*	—	†	*	†
Hemiaulus Heirbergii	—	*	—	†	—	—
Hyalodiscus stelliger	—	—	—	—	—	—
Nitzschia seriata	—	—	—	—	—	—
Lithodesmium undulatum	—	—	—	—	—	—
Rhabdonema adriaticum	—	—	—	—	—	—
Rhizosolenia alata	—	—	—	—	*	*
,, fragillima	—	—	—	—	—	—
,, hebetata form semispina	—	*	§	—	—	—
,, Shrubselei	*	—	—	*	*	*
,, calcar-avis	*	—	—	*	¶	¶
,, stolterfothii	—	—	—	—	—	—

NOVEMBER (*contd.*)

SPECIES	Station …	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time … …	10.25	14.10	16.00	11.05	13.05	15.10
	Date … …	16-11-1934			17-11-1934		
Skeletonema costatum… … …		—	—	—	—	—	—
Thalassiothrix longissima … …		*	*	—	—	—	—
,, Frauenfeldii …		†	*	—	*	—	—
Ceratium candelabrum … …		—	—	—	—	—	—
C: furca … … … … …		—	—	—	*	—	—
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum … … … … …		—	—	—	—	—	—
C. fusus … … … … … …		—	*	*	†	—	—
C. tripos … … … … …		—	*	—	*	—	—
C. pulchellum … … … …		*	†	—	†	—	*
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. 'eupulchellum …		—	—	—	—	—	—
C. gracile var. symmetricum …		—	—	—	—	—	—
C. arietinum var. gracilentum …		—	—	—	*	*	—
C. arietinum var. detortum …		—	—	—	—	—	—
C. macroceros … … … …		—	—	—	—	—	—
C. maroceres subsp. gallicum …		—	—	—	—	—	—
C. massiliense … … … …		—	—	—	—	—	—
C. trichoceros … … … …		—	*	—	*	—	*
Dinophysis caudata … … …		—	—	—	*	—	—
,, tripos… … … …		—	—	—	—	—	—
Goniaulax catenata … … …		—	—	—	—	—	—
Prorocentrum micans … … …		—	—	—	—	—	—
Peridinium cerasus … … …		—	—	—	—	—	—
Peridinium Spp. … … …		—	—	†	*	—	*

* Rare. † Few. ‡ Common. § Abundant. ¶ Very abundant.

DECEMBER

SPECIES	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Station	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
Time	14.30	11.10	9.22	14.05	12.25	10.10
Date	18–12–1934			17–12–1934		
Acnanthes longipes	—	—	—	—	—	—
Asterionella japonica	—	—	—	—	—	—
Biddulphia alternans	†	—	—	—	—	—
,, favus	—	—	—	—	—	—
,, mobiliensis	†	—	—	—	—	—
,, obtusa	—	—	—	—	—	—
,, rhombus	—	—	—	—	—	—
,, smithii	†	—	—	—	—	—
,, vesiculosa	—	—	—	—	—	—
Bacteriastrum delicatulum... ...	*	—	—	—	—	—
,, hyalinum	*	—	—	—	—	—
Chaetoceros decipiens	*	—	—	—	—	—
,, curvisetum	†	—	*	—	—	—
,, densum	—	—	—	—	—	—
,, didymus	—	—	*	—	—	—
,, affinis var. Schuttii...	‡	—	—	—	—	—
,, Lauderi	—	—	—	—	—	—
,, brevis	—	—	—	—	—	—
,, holasticus	—	—	—	—	—	—
,, Ralfsii	—	—	—	—	—	—
Coscinodiscus nobilis	—	—	—	—	—	†
,, gigas	§	—	—	—	—	—
,, oculus-iridis	§	—	—	—	—	—
,, Granii	†	—	—	—	—	—
,, excentricus (var.minor)	†	—	—	—	—	—
Climacodium biconcavum	—	—	—	—	—	—
Dityliun intricatum	†	—	—	—	—	—
,, Brightwelli	†	—	—	—	—	—
Guinardia flaccida	*	—	—	—	—	—
Hemiaulus Heirbergii	†	—	—	—	—	—
Hyalodiscus stelliger	†	—	—	—	—	—
Nitzschia seriata	*	—	*	—	—	—
Lithodesmium undulatum	†	—	—	—	—	—
Rhabdonema adriaticum	—	—	—	—	—	—
Rhizosolenia alata	—	—	—	—	†	†
,, fragillima	—	—	—	—	—	—
,, hebetata form semispina	—	—	—	—	—	—
,, Shrubsolei	†	*	*	—	†	†
,, calcar-avis	*	†	*	†	†	†
,, stolterfothii	†	—	—	—	—	—

DECEMBER (*contd.*)

SPECIES	Station ...	S.C. 1	S.C. 2	S.C. 3	S.C. 4	S.C. 5	S.C. 6
	Time	14.30	11.10	9.22	14.05	12.25	10.10
	Date	18-12-1934			17-12-1934		
Skeletenema costatum		—	—	‡	—	—	—
Thalassiothrix longissima		§	—	—	—	—	—
,, Frauenfeldii ...		‡	—	—	—	—	—
Ceratium candelabrum		*	—	—	—	—	—
C. furca		—	*	†	*	—	—
C. pentagonum var. subrobustum		—	—	—	—	—	—
C. falcatum		—	—	—	—	—	—
C. fusus		†	—	†	*	†	†
C. tripos		*	—	*	—	*	—
C. pulchellum		*	*	†	*	—	—
C. pulchellum f. semipulchellum		—	—	—	—	—	—
C. pulchellum f. eupulchellum ...		—	—	—	—	—	—
C. gracile var. symmetricum ...		—	—	—	—	—	—
C. arietinum var. gracilentum ...		*	*	†	—	—	†
C. arietinum var. detortum ...		—	—	—	—	—	—
C. macroceros		—	—	—	—	‡	‡
C. maroceros subsp. gallicum ...		—	—	—	—	—	—
C. massiliense		*	*	†	†	†	‡
C. trichoceros		—	*	*	*	*	*
Dinophysis caudata		—	*	—	—	—	—
,, tripos		—	—	—	—	—	—
Goniaulax catenata		—	—	—	—	—	—
Prorocentrum micans		—	—	—	—	—	—
Peridinium cerasus		—	—	—	—	—	—
Peridinium Spp.		†	—	—	—	—	—

* Rare. † Few. ‡ Common. § Abundant. ¶ Veryabundant.

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APPENDIX

(With 65 Figures)

LIST OF ABBREVIATIONS

D.V. = Diameter of Valve.

L.V. = Length of Valve.

D.C. = Diameter of Cell.

L.C. = Length of Cell.

Castr. = Castracane, F.D.A.

Ag. = Agardh, C.A.

Ehr. = Ehrenberg, D.C.G.

Kutz. = Kutzing, F.T.

Planktonic Diatoms of the Suez Canal

No qualitive report has been made on the Planktonic Diatoms of the Egyptian Waters in general, the following is therefore the first record of a descriptive account of the diatoms throughout the Suez Canal. The literature on the subject of Diatomaceae is very sporadic and profuse, and, in carrying out quantitative studies of the seasonal, geographical and bathymetrical distribution of the Planktonic Diatoms, we have no specific reference for those species occurring only in our waters. The present record is written intentionally to fill such a gap. Other areas for investigations will be soon attacked for the purpose of making as complete a survey as possible of all the Planktonic Diatoms that are familiar to our Egyptian Waters. When such a survey is completed in due time, there will be before the hands of the beginner, as well as the research worker, a guide for rapid consultation. I have drawn every species from nature, except otherwise stated, with a short and bare essential diagnosis.

Gran " Diatomeen " in " Nordisches Plankton," and Lebour's " Planktonic Diatoms of the Northern Seas " have been specially and freely consulted. The distribution of most of the present diatoms have been taken from Lebour's.

Classification

The classification adopted here is based on that of Lebour (18) (1930).

CLASS : DIATOMALES or BACILLARIALES

ORDER I.—CENTRICÆ Schutt, 1896

GROUP A.—DISCOIDÆ Schutt, 1896

Family 1	*Melosiraceae*	Schroder, 1911.
Genus	Hyalodiscus	Ehrenberg, 1845.
Family 2	*Coscinodiscaceae*...	Schroder, 1911.
Genus	Coscinodicus.	
Family 3	*Skeletonemaceae*	Lebour 1930.
Genus	Skeletonema	Greville 1865.
Family 4	*Leptocylindraceae*	Lebour 1930.
	Guinardia	H. Peragallo 1892.
Family 5	*Bacteriastraceae*	Lebour 1930.
Genus	Bacteriastrum.	

GROUP B.—SOLENOIDAE Schutt, 1896.

Family	*Rhizosoleniaceae*	Schroder 1911.
Genus	Rhizosolenia (Ehrenberg)	Brightwell 1858*a*.

GROUP C.—BIDDULPHIOIDAE Schroder, 1911

Family 1	*Chaetoceraceae*	Schroder, 1911.
Genus	Chaetoceros	Ehrenberg, 1844.
Family 2	*Biddulphiaceae*	Lebour, 1930.
Genus	Biddulphia	Gray, 1832.
	Hemiaulus	Ehrenberg, 1844.
	Lithodesmium	Ehrenberg, 1841.
	Ditylium	L. Bailey, 1862.
Family 3	*Eucampiaceae*	Schroder, 1868.
	Climacodium	Grunow, 1868.

ORDER II.—PENNATAE Schutt, 1896

Family 1	*Fragilariaceae*	Schroder, 1911.
Genus	Asterionella	Hassal, 1845.
Genus	Thalassiothrix	Cleve and Grunow, 1880.
Family 2	*Tabellariaceae*	West, 1927.
Genus	Rhabdonema	Kutzing, 1844.
Family 3	*Achnanthaceae*	West, 1927.
Genus	Achnanthes	Bory, 1822.
Family 4	*Nitzschiaceae*	Schroder, 1911.
Genus	Nitzschia	Hassal, 1845.

THE DINOFLAGELLATES

General remarks.

All the peridinians described in this paper were taken with tow nets. They should not therefore be considered as representing all the Dinoflagellates existing in the Suez Canal. Many peridinians are so minute as to escape capture by the ordinary silk tow-nets. In order to obtain such small organisms, water should be centrifuged. No attempt has been made to do this, as these minute peridinians are very difficult to identify, and need painstaking care and special study and technique for their identification. Many of peridinians that were caught even with my tow-nets were left without identifying their species for the same reason, few however, were referred to their specific names, but I had only to refer to the genus on many occasions.

On the other hand, I was able to identify all the species of Ceratiae thanks to the good and indispensable work of E. Jorgenson on the Mediterranean Ceratia. The peridinians occur all the year round throughout the Suez Canal. They were not absent completely at any station, even when they were exceedingly rare at certain times of the year.

It has been generally noticed that the peridinians become abundant about the time the diatoms decrease. Speaking generally, such rythm was not noticed in the Suez Canal. The only two instances when the Dinoflagellates were very predominent were in July 1935 at S.C. 2 and S.C. 3, and in September 1934 at S.C. 2 when Goniaulax catenata was very abundant. Even in September various forms of diatoms were also very numerous at S.C. 2. There were times when the Ceratia were rather abundant at the southern end of the Canal, but they did not follow a diatom decrease.

As was noticed by MacDonald the right horn of C. Pulchellum was always longer than the left horn while it is the usual case on all other varieties of euceratium that the right horn is always shorter than the left. I noticed, however, that the left horn sometimes does not extend beyond the girdle, while sometimes it does. In general, there was noticed great variation in the length and general trend of the two horns in this species. C. candelabrum, C. falcatum, and C. pentagonum were all evry rare. The most common species were C. furca, C. fusus, C. Pulchellum, C. macroceros, C. massiliense and C. arietinum.

CLASSIFICATION

The classification adopted here is based on that in Lebour's "The Dinoflagellates of Northern Seas" 1925. (17)

Class : *Flagellata.*

Sub-Class : *Dinoflagellata.*

ORDER I.—*Adiniferidea* Kofoid and Swezy.

Tribe	*Thecatoidae*	Kofoid and Swezy.
Family	*Prorocentridae*	Kofoid.
Genus	Prorocentrum	Ehrenberg.

ORDER II.—*Diniferidea* Kofoid and Swezy.

Tribe	*Peridinioidae* ...	Kofoid and Swezy.
Family	*Dinophysidae* ...	Kofoid and Michener.
Genus	Dinophysis ...	Ehrenberg.
Family	*Peridiniidae* ...	Kofoid.
Genus	Goniaulax	Diesing.
Genus	Peridinium	Ehrenberg.
Genus	Ceratium	Schrank.

Hyalodiscus stelliger Bailey, 1855

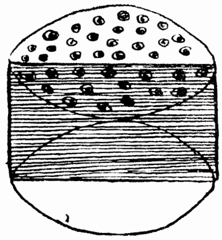


FIG. 1.—*Hyalodiscus stelliger*
D.V.=54 u. Neritic.

Distribution.—(18) North Sea, Sea of Kora, Barents Sea, Norwegian and Danish Seas, Finland, English Channel, Flemish Seas, British Isles, Atlantic Coasts of America, Mediterranean.

Suez Canal (S.C. 1).

References.—(8) p. 26, (2) p. 34, (18) p. 30.

Coscinodiscus nobilis Grun, 1879

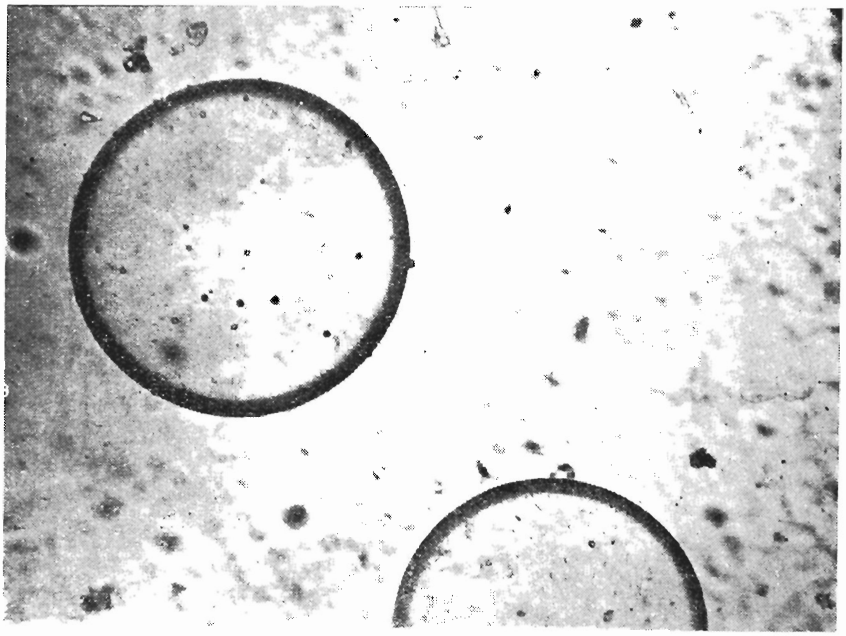


FIG. 2.—*Coscinodiscus nobilis*×88 (Microphoto by Ghazzawi)

Hyaline central space present. Valve sculpture distinct, markings in radial straight rows. Sculpture hexagonal near border.

D.V. up to 550 u. Large diatoms, seen easily with the naked eye.

Distribution.—S.C. 6 and S.C. 5.

References.—(2) p. 56.

Coscinodiscus Granii Gough, 1905

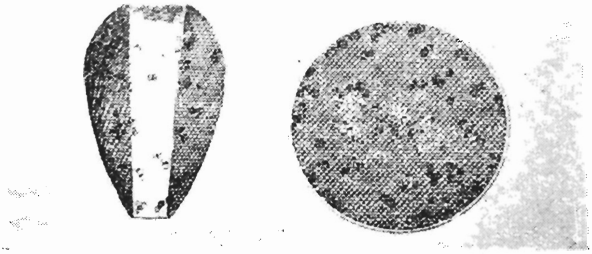


FIG. 3.—*Coscinodiscus Granii* (after Lebour)

Valves round, not parallel, with slightly centric central meshes. sculpture extremely fine but very distinct, radiating. spinulæ present a circular row inside the valve margins.

Neritic. D.V. = 90-120 u.

Distribution.—(18) Norwegian Seas. North Sea. Baltic. English Channel, Irish Sea, San Diego, California.

Suez Canal (S.C. 1).

References.—(8) pp. 34-35, (18) pp. 44-45.

Coscinodiscus gigas Ehr., 1841

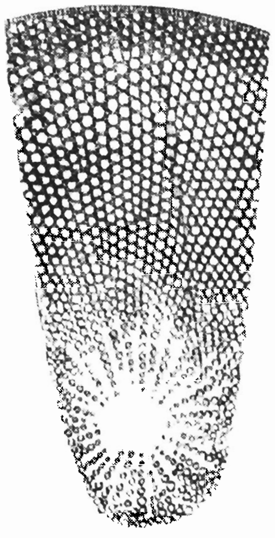


FIG. 4.—*Coscinodiscus gigas* (after Perogallo)

Cells arranged in star-shaped clusters. Breadth of cell 10:8 u., length 14:4 u., length hexagonal meshes towards the border, meshes become smaller and circular towards centre.

D.V. = 150-225 u.

Distribution.—S.C. 1.

References.—(22) p. 433.

Coscinodiscus oculis-iridis Ehr., 1839

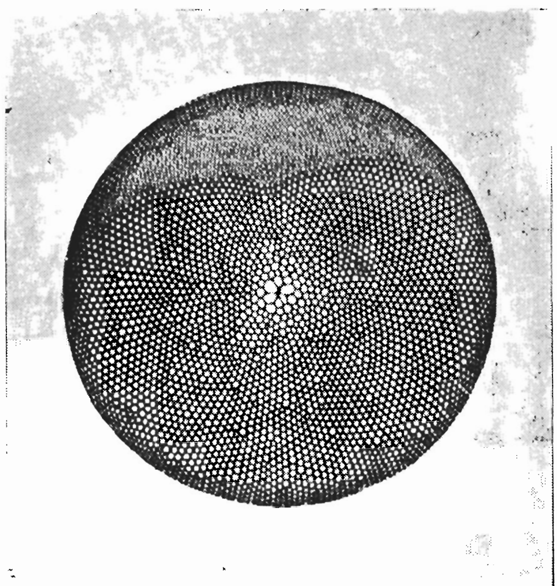


Fig. 5.—*Coscinodiscus oculis-irdis* (after Perogallo)

Central space absent. Central rosette of large angular meshes present. Valve sculpture hexagonal radiating from the central rosette.

D.V. = 110-150 u.

Distribution.—Widely distributed.

Suez Canal (S.C. 1).

References.—(2) p. 57, (22) p. 424.

Coscinodiscus excentricus Ehr. (Var. minor)

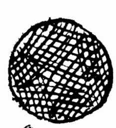


Fig. 6.—*Coscinodiscus* var minor

D.V. = 36 u.

Distribution.—S.C. 1 and S.C. 2.

References.—(22) p. 426.

Skeletonema costatum (Greville), Cleve, 1873

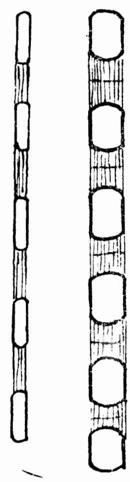


FIG. 7.—*Skeletonema costatum*

Cells delicate, hyaline, attached together by numerous thread like processes.

D.V. = 3-7 μ. Neritic.

Distribution.—(18) Cosmopolitan, all Seas, chiefly near the coast.

References.—(8) p. 15, (18) p. 70, (2) p. 63.

Guinardia flaccida Castr., 1886

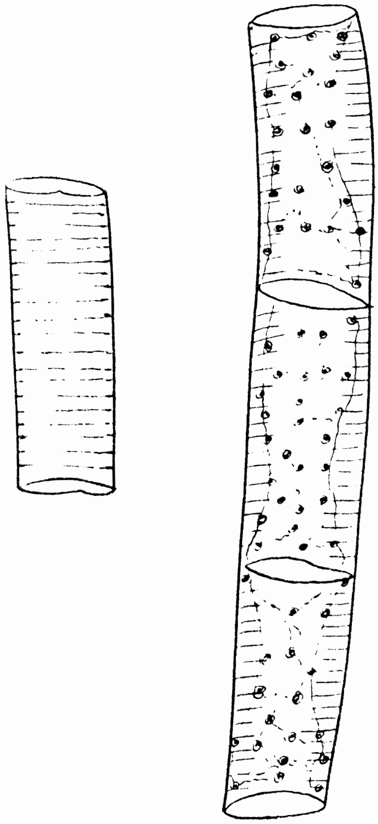


FIG. 8.—*Guinardia flaccida*

Cells single or in chains. D.V. = 35-55 u. Neritic. South temperate.

Distribution.—(18) North Sea, Baltic, Danish Seas. Skaggerak. North Atlantic, English Channel, Mediterranean.

Suez Canal (all stations).

References.—(8) pp. 24-25. (18) p. 79, (2) p. 559.

Bacteriastrum delicatulum Cleve, 1897*a*

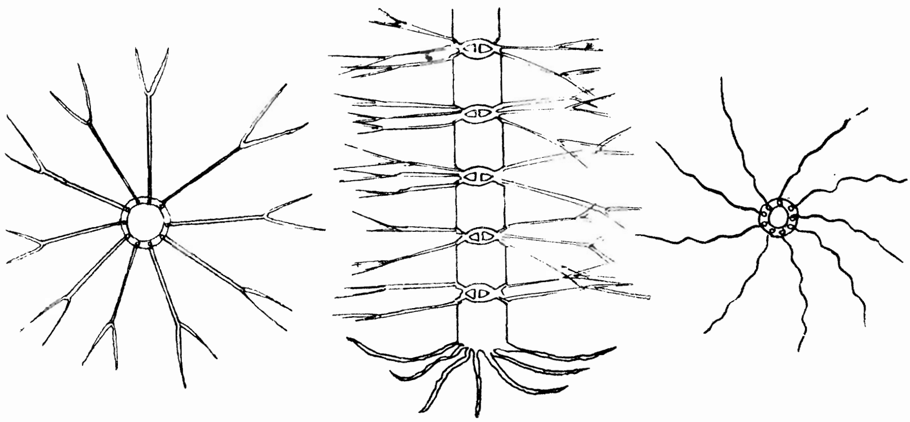


FIG. 9.—*Bacteriastrum delicatulum*

Cells united in chains. D.V. = 17 u. Oceanic temperate form

Distribution.—North Atlantic. Europe and America, Mediterranean.

References.—(8) pp. 57-58, (18) p. 82.

Bacteriastrum hyalinum Lauder, 1864

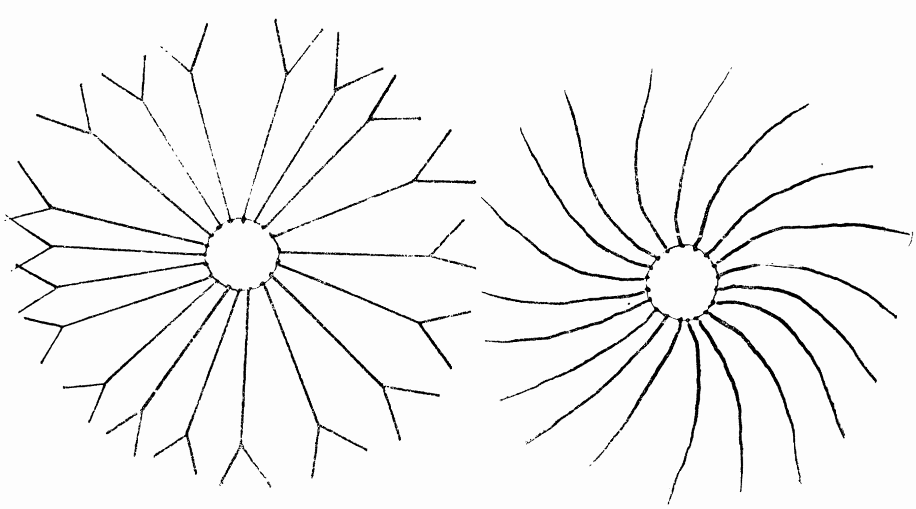


FIG. 10.—*Bacteriastrum hyalinum*

Number of Bristles about 20 upwards

Distribution.—(18) Welsh Coast, Belgian Coast, Mediterranean, Suez Canal (S.C. 1 to S.C. 3).

References.—(18) pp. 83-84.

Rhizosolenia alata form *indica* (Peragollo 1892) = *Rh. corpulenta* eleve, 1897a.

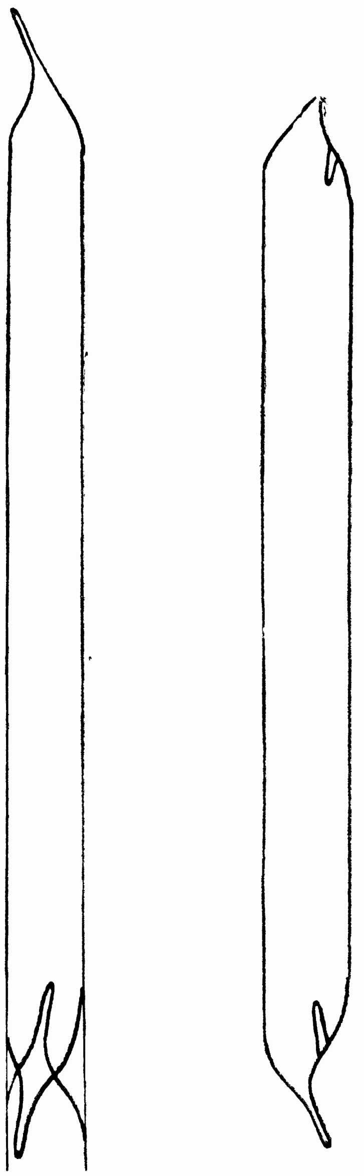


FIG. 11.—*Rhizosolenia alata* form *indica*
D.V. = 54 u.

Distribution.—(18) Red Sea, Gulf of Aden, Indian Ocean, Northern Seas. Suez Canal (S C. 6, S.C. 5, and once seen at S.C. 2).

References.—(22) p. 466. (18) p. 90.

Rhizosolenia fragillima (Bergon), Gran.

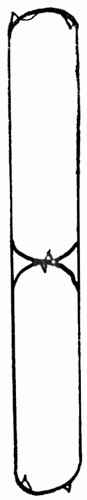


FIG. 12.—*Rhizosolenia fragillima*

Cells united in short chains. D.V. = 15 u. Neritic. Temperate.

Distribution.—(18) Southern North Sea. Skaggerak, Atlantic Coast from France to Norway, English Channel, Mediterranean.

Suez Canal (S.C. 1, S.C. 4).

References.—(18) p. 49, (18) pp. 92-93, (22) p. 460.

Rhizosolenia Stolterfothii **H. Péragallo, 1888**

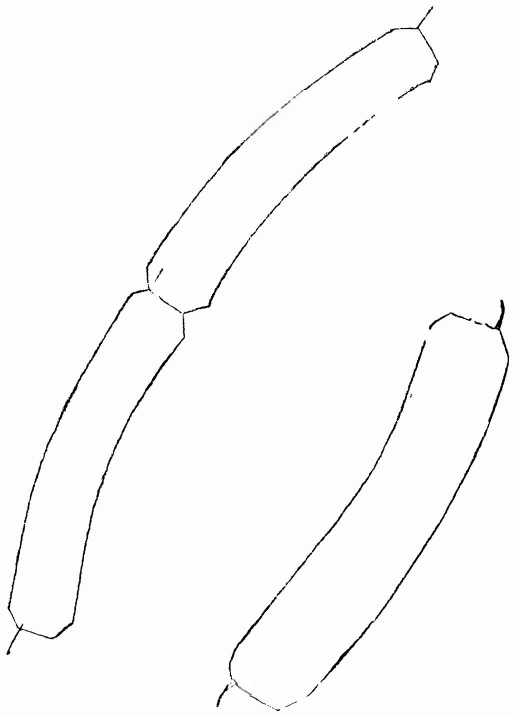


FIG. 13.—*Rhizosolenia Stolterfothii*
Cells in curved chains. D.V. = 22 µ. Neritic.

Distribution.—(18) Arctic Seas, North Sea, Danish Seas, Skaggerak, **North Atlantic**, English Channel, Belgian Coast, Mediterranean, California, **Indian Ocean.**

Suez Canal (S.C. 1).

References.—(18) p. 49, (18) p. 93, (2) p. 558, (22) p. 460.

Rhizosolenia Shrubsolei Cleve, 1881

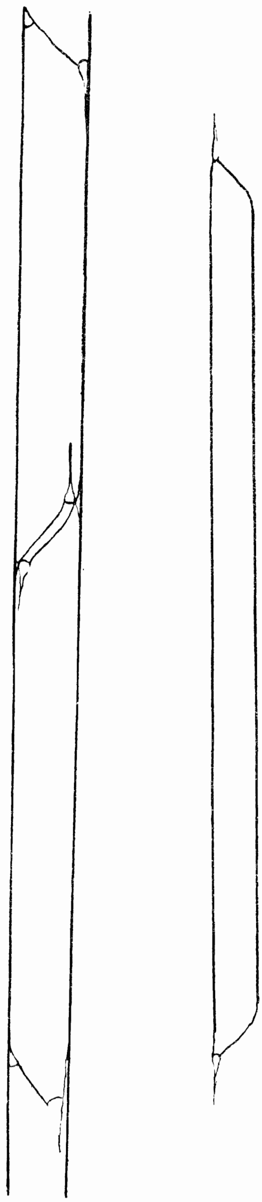


Fig. 14.—*Rhizosolenia Shrubsolei*

Cells single or in chains. D.V. = 20-25 μ. Neritic.

Distribution.—(18) North Sea, Skaggerak, Baltic, Atlantic, English Channel, Belgian Coast. Mediterranean.

Suez Canal (all the stations).

References.—(2) p. 100, (8) p. 52, (18) p. 96.

Rhizosolenia calcar-avis Schultze, 1858

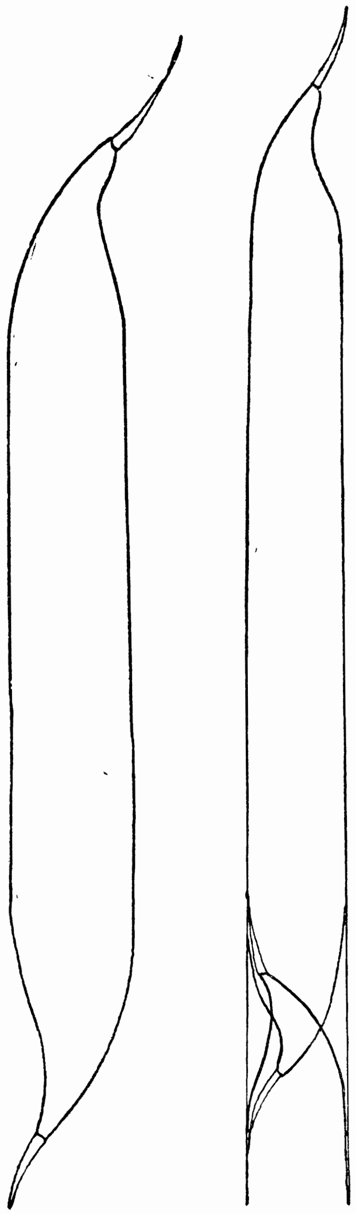


FIG. 15.—*Rhizosolenia calcar-avis*

Cells single or in bundles. D.V. = 36-40 μ. Neritic. Tropical.

Distribution.—(18) Southern part of North Sea, Danish Sea, Skaggerak, Finland, North Atlantic, Mediterranean, California, Indian Ocean.

Suez Canal (all the stations).

References.—(8) p. 54-55, (18) p. 99, (22) p. 465.

Rhizosolenia hebetata (Bail), 1856, form *semispina* (Hensen)

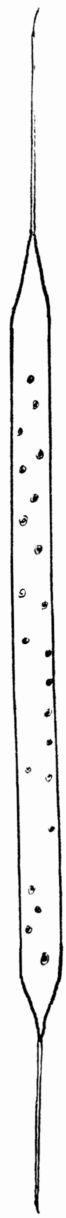


FIG. 16.—*Rhizosolenia hebetata*

Cells ending in a long curved hair like spine. D.V.=3:5 u.—9 u.

Distribution.—(18) Arctic Seas, North Sea, Baltic, Skaggerak, English Channel, Belgian Coast, Mediterranean, California, Antarctic.

Suez Canal (S.C. 1, S.C. 2, S.C. 3).

References.—(8) p. 55, (18) pp. 99-150.

Chætoceros densum Cleve, 1901 *a*

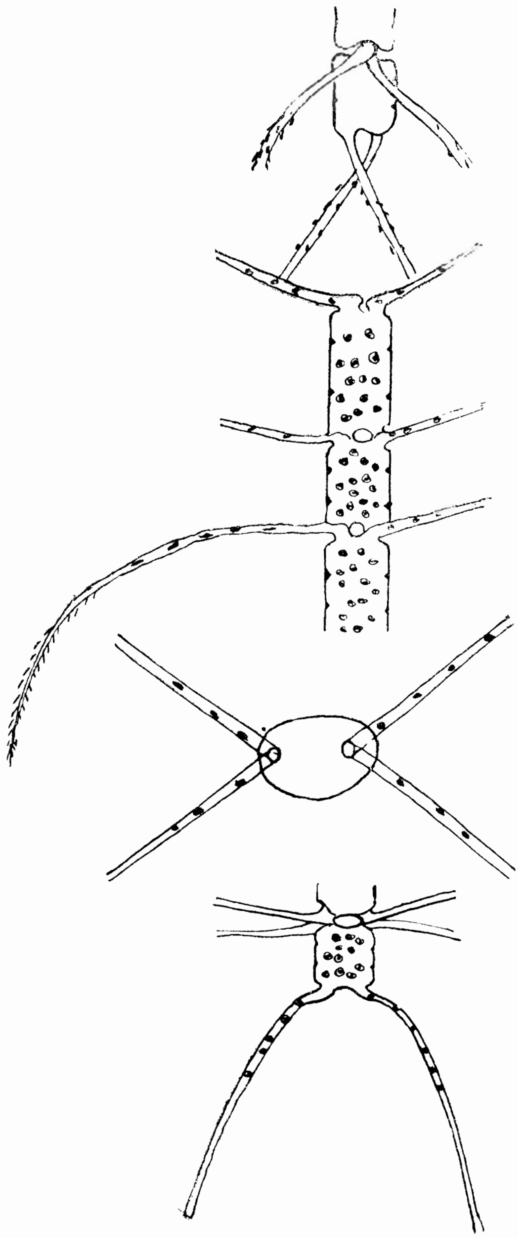


FIG. 17.—*Chætoceros densum*

Cells in straight chains. Chromatophores penetrate into the bristles.

L.V. = 30 μ. D.V. = 18 μ. Oceanic. Temperate.

Distribution.—(18) Arctic Seas, North Sea, Norwegian and Danish Seas, Baltic, North Atlantic, English Channel, Belgian Coast, Mediterranean, Japan, California.

Suez Canal (S.C. 6 and S.C. 5).

References.—(8) p. 67. (18 p. 115, (20) p. 14.

Chætoceros decipiens Cleve, 1873

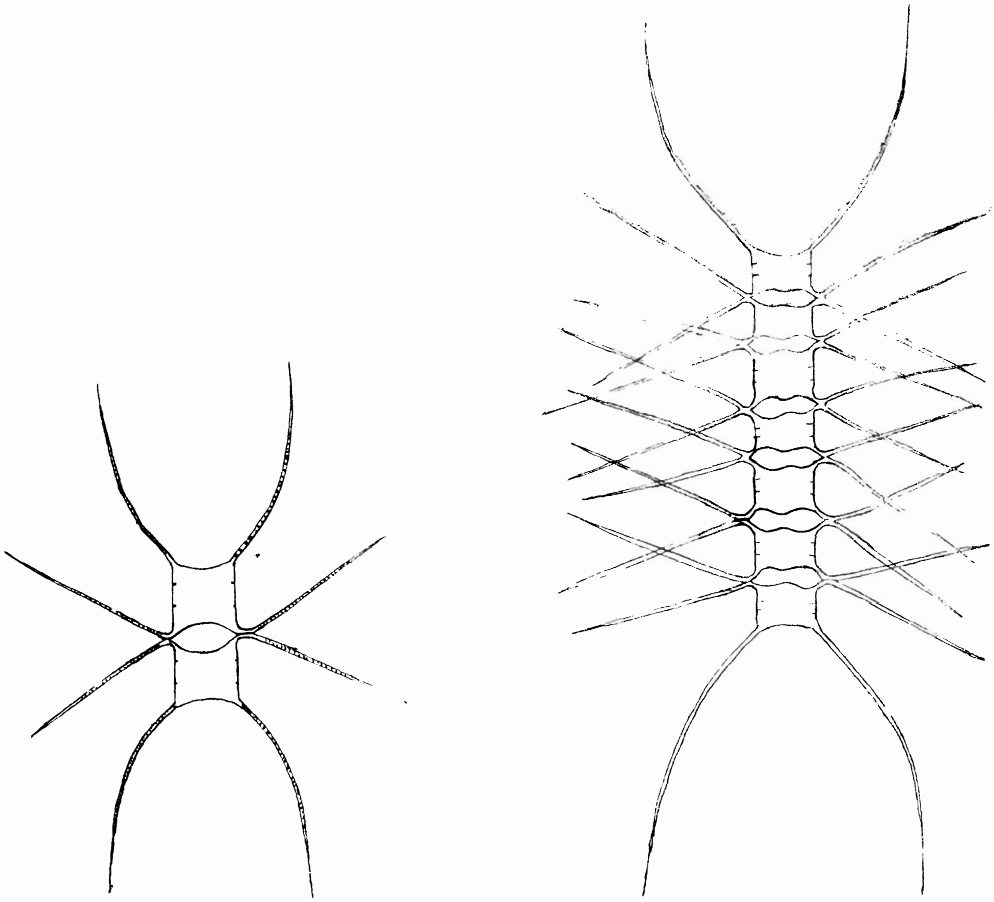


FIG. 18.—*Chætoceros decipiens*
Cells in straight chains. D.V. = 30 u. Oceanic.

Distribution.—(18) Arctic Seas, Davis Straits, Norwegian Sea, North Sea, North Atlantic. Baltic, Skaggerak, English Channel, Belgian Coast, Mediterranean, California. Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(18) p. 126, (8) pp. 74-75, (2) p. 108.

Chaetoceros Lauderi Ralfs, in Lauder, 1864

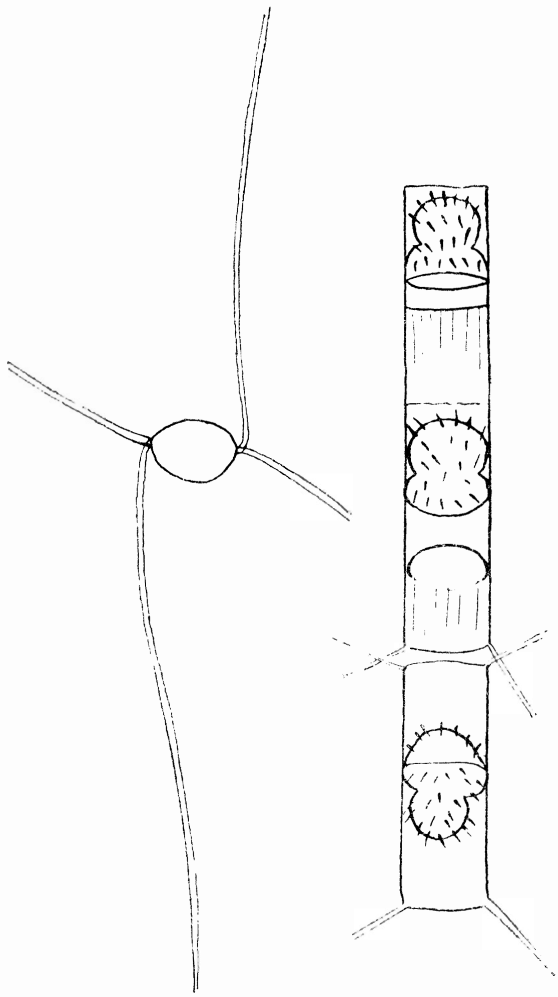


FIG. 19.—*Chætoceros Lauderi*
(Ch. Weissflogii Schütt).

D.V. = 15-25 μ. Neritic. Southerly temperate form.

Distribution.—(18) S. North Sea, Skaggerak, Baltic, English Channel, Belgian Coast, Suez Canal (S.C. 2).

References.—(18) p. 77-78, (18) p. 131, (20) p. 22.

Chætoceros didymus Ehr., 1845

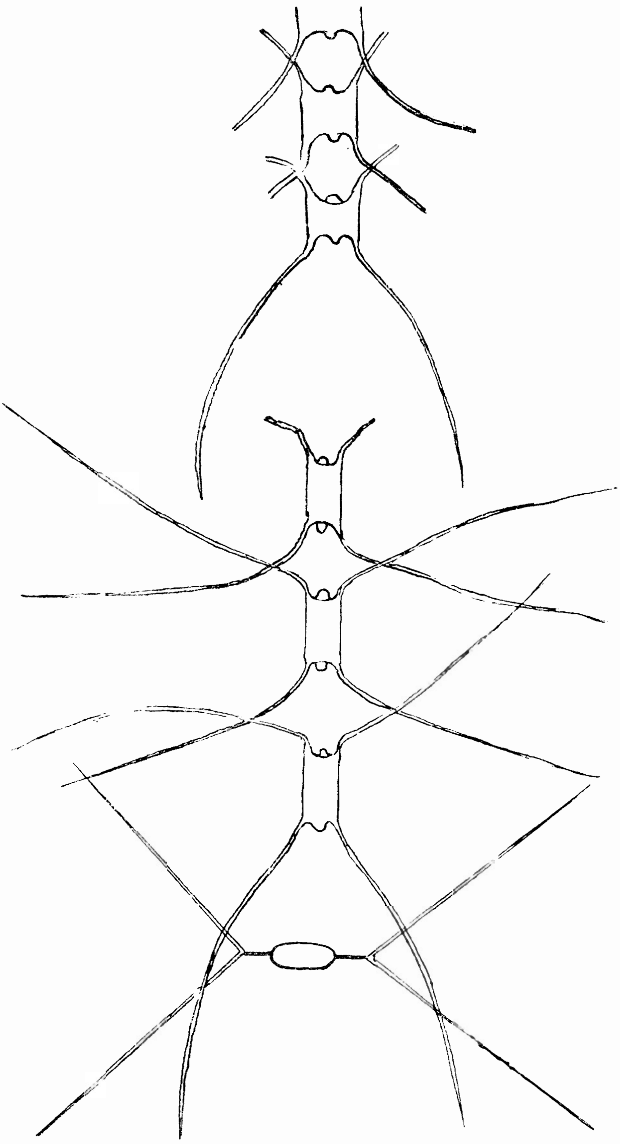


FIG. 20.—*Chætoceros didymus*

Cells in straight chains. Valves with characteristic Knobs. **Neritic.**

Distribution.—(18) Norwegian and Danish Seas, North Sea, Belgian Coast, Baltic, Skaggerak, English Channel, North Atlantic, Mediterranean, California.

Suez Canal (S.C. 1. S.C. 2. S.C. 3 and S.C. 4).

References.—(8) pp. 77-80, (18) p. 133. (20) p. 25. (2) p. 107.

Chætoceros affinis var. *Schüttii* Cleve

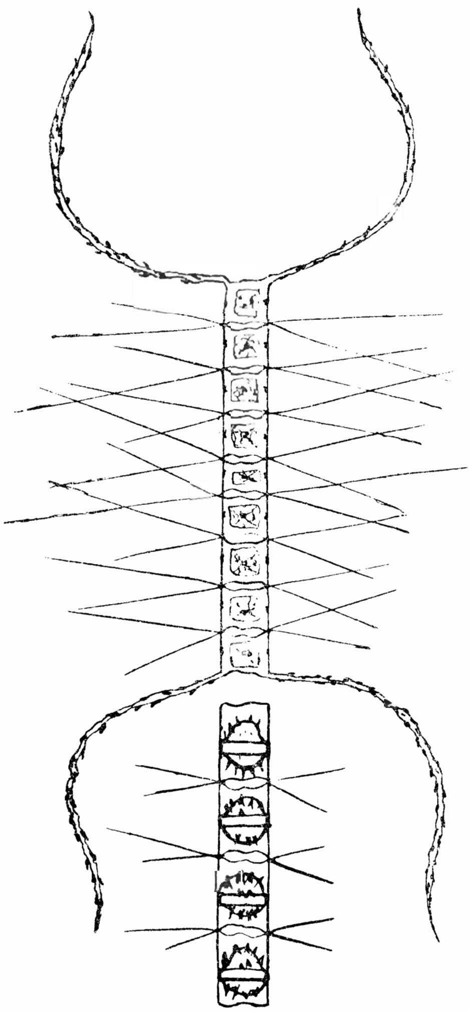


FIG. 21.—*Chætoceros affinis*

D.V. = 14-21. 6 μ. Neritic. Southerly temperate species.

Distribution.—(18) North Sea, Danish Seas, Skaggerak, Finland, North Atlantic, English Channel, Belgian Coast, Mediterranean.

Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(22) p. 479.

Chætoceros Ralfsii Cleve

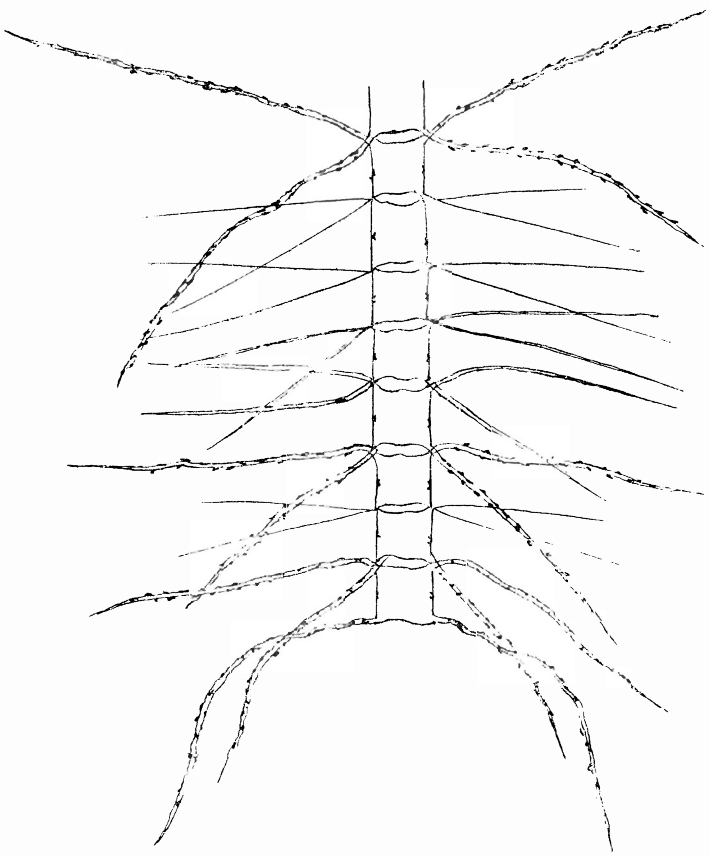


FIG. 22.—*Chætoceros Ralfsii*

Terminal bristles more wide-opened than in *Ch. affinis* var. *Schütti,* also some of the intermediate bristles are thick and undulating Tropical.

Distribution.—Like *Ch. affinis* var. *Schütti.*

References.—(22) p. 479.

Chætoceros holasticus Schütt, 1895

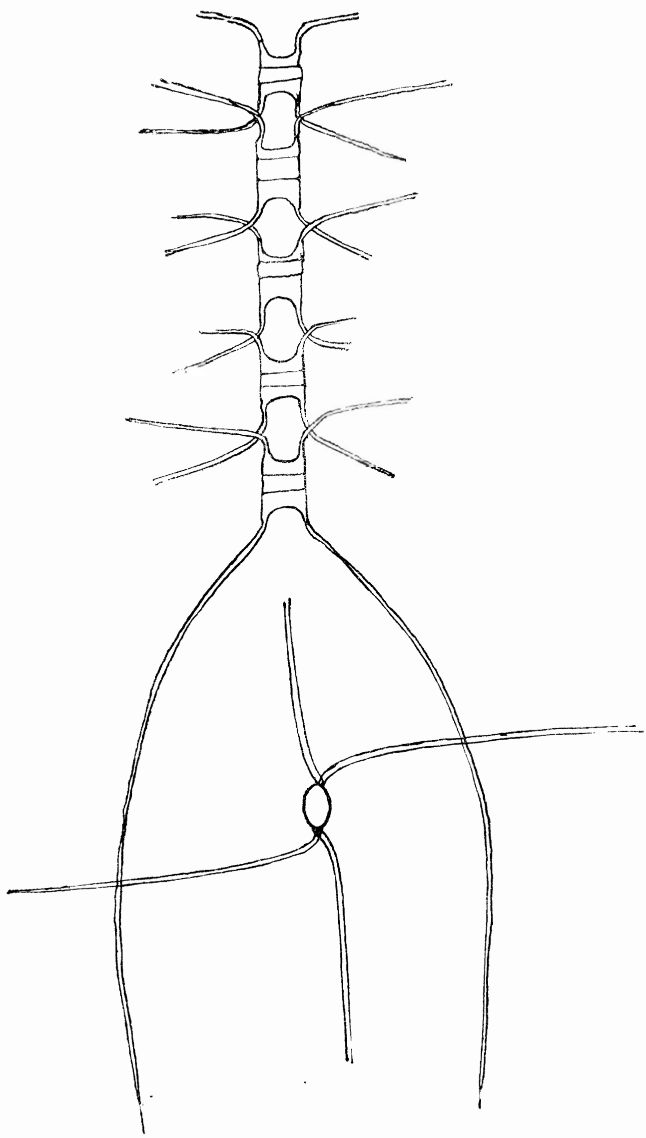


Fig. 23.—*Chætoceros holasticus*

Chains very brittle weakly siliceous. D.V. = 8 μ. Neritic.

Distribution.—(18) Baltic, Skaggerak, N. Norway, Gulf of Finland, Gulf of Bothnia, N. Atlantic, Belgian Coast, English Channel.

Suez Canal (S.C. 2).

References.—(8) pp. 85-86, (18) pp. 142-143, (20) p. 35.

Chætoceros curvisetum

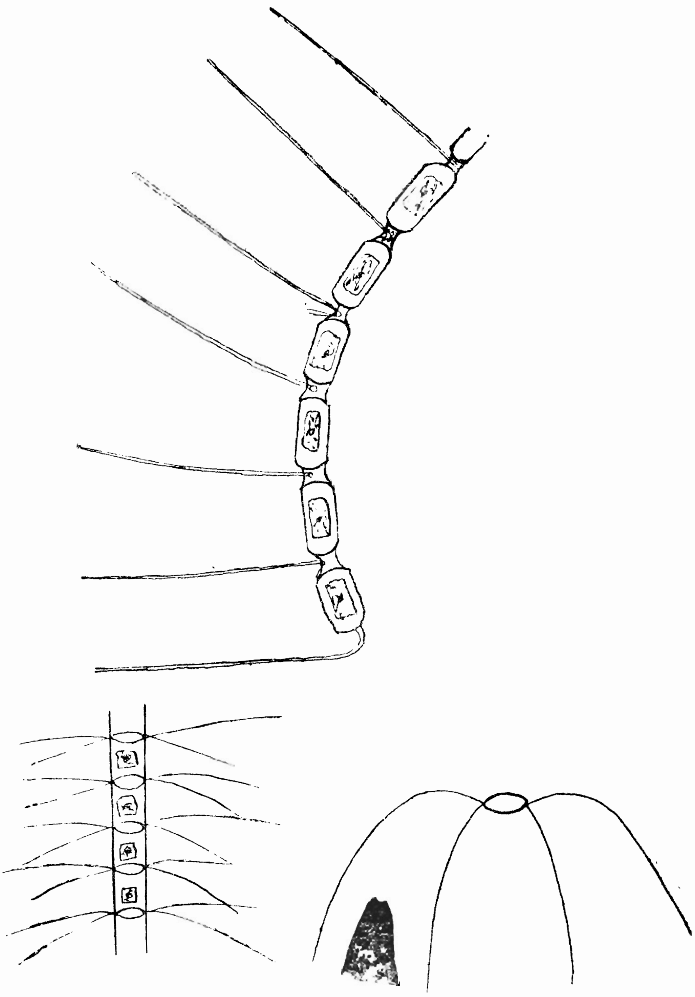


FIG. 24.—*Chætoceros* ***curvisetum***

Cells in curved filaments. D.V. = 10 u. L.V. = 20 u. Neritic.

Distribution.—(18) North Sea, Norwegian Sea, Skaggerak, Belgian Coast, North Atlantic, Mediterranean, California.

Suez Canal (S.C. 1, S.C. 2, S.C. 3 and S.C. 4).

References.—(8) pp. 91-92, (18) pp. 156-157, (2) p. 108.

Chætoceros brevis Schutt, 1895

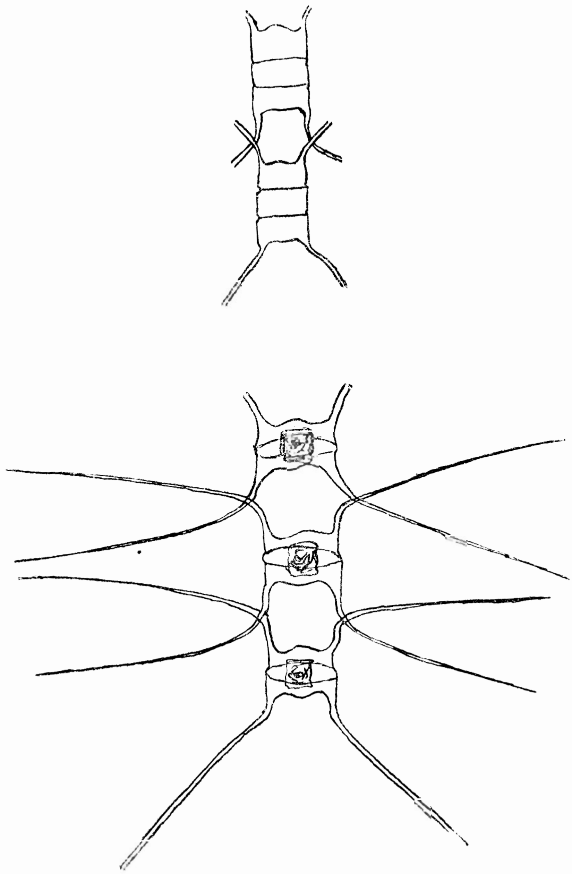


Fig. 25.—*Chætoceros brevis*

D.V. = 12-16 μ. Neritic. Temperate Species.

Distribution.—(18) All parts of the North Sea, Skaggerak, Baltic, English Channel, North Atlantic, California, Indian Ocean.

Suez Canal (northern half of the Canal)

References.—(18) p. 139. (8) p. 83.

Biddulphia mobiliensis (Bailey), Grun., Van Heurck. 1881

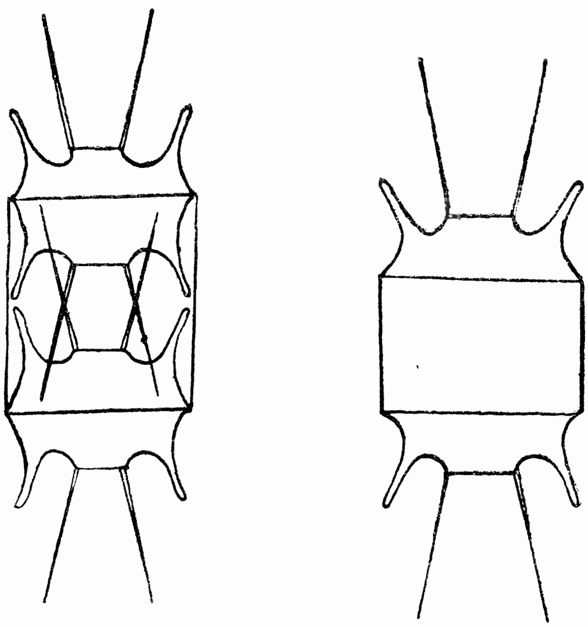


FIG. 26.—*Biddulphia mobiliensis*

Cells single or in short chains. Neritic. D.V. = 43-65 u.

Distribution.—(18) Norwegian Seas. North Sea, English Channel, North Atlantic, Mediterranean, Pacific Coasts of America.

Suez Canal (S.C. 1).

References.—(8) p. 106. (18) pp. 174-175, (2) p. 122.

Biddulphia alternans (Bailey) Van Heurck, 1885

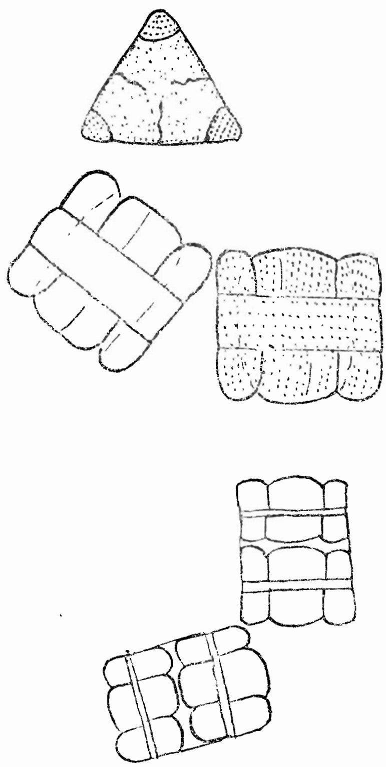


Fig. 27.—*Biddulphia alternans*

Frustules frequently in pairs. Neritic. D.V. = 36 u.

Distribution.—(18) Coasts of England, Belgium, Holland, Sweden, Denmark, North Atlantic.

Suez Canal (S.C. 1).

References.—(8) pp. 91-92, (18) pp. 156-157, (2) p. 108.

Biddulphia vesiculosa (Ag), Boyer, 1900

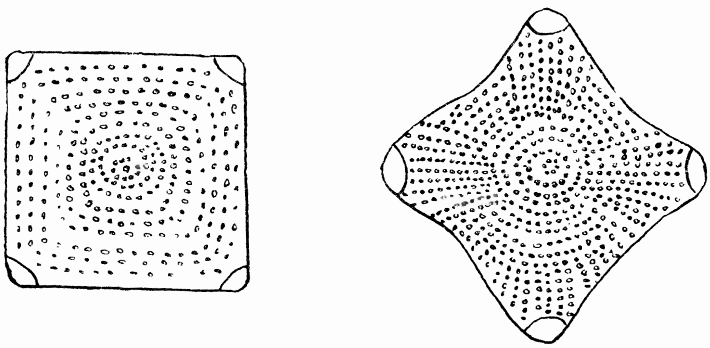


Fig. 28.—*Biddulphia vesiculosa*
Valves four-cornered. D.V. = 100 u. Neritic.

Distribution.—English Coasts.
Suez Canal (S.C. 1).

References.—(8) p. 111, (18) pp. 181-182.

Biddulphia Smithii (Ralfs) Van Heurk. 1885. *Certualus Smithii* (Ralfs)

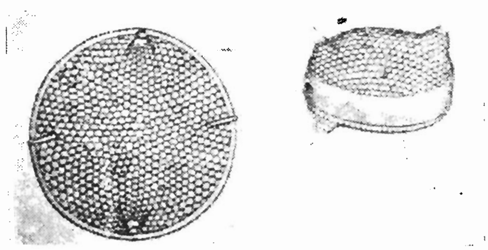


Fig. 29.—*Biddulphia Smithii* (afer Peragollo)
Valves spherical. D.V. = 65-75 u. Marine.

Distribution.—England, Atlantic Coast. Scotland.
Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(8) p. 102, p. 134, (2) p. 126, (22) p. 398.

Biddulphia favus (Ehrenberg) Van Heurck

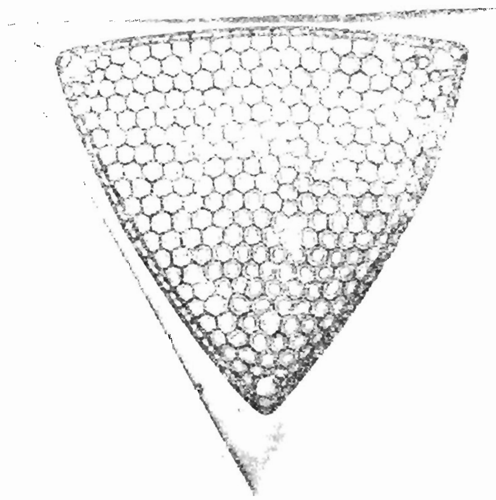


Fig. 30.—*Biddulphia favus* (after Peragollo)
Cells outline 3 cornered. Neritic.

Distribution.— Coasts of England, North Sea, Norway, Sweden, Danemark, Atlantic (Gulf of Mexico).

Suez Canal (S.C. 3.)

References.—(18) pp. 180-181, (8) pp. 109-110.

Biddulphia obtusa Kutzing, 1844

Fig. 31.—*Biddulphia obtusa* (after Lebour)
Cells united in zigzag chains.

Distribution.—Atlantic and Pacific Coasts of America.

Suez Canal (S.C. 1.)

References.—(18) p. 179.

Biddulphia rhombus (Ehrenberg) W. Smith. 1856

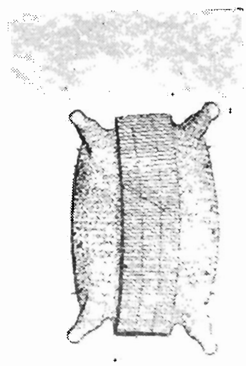


FIG. 32.—*Biddulphia rhombus* (after Lebour)

Distribution.—(18) Coasts of England, North Sea. Holland, Belgium. Germany, Sweden. Danemark. North Atlantic.

Suez Canal (S.C. 1.)

References.—(18) p. 178. (8) p. 108.

Hemiaulus Heirbergii, Cleve

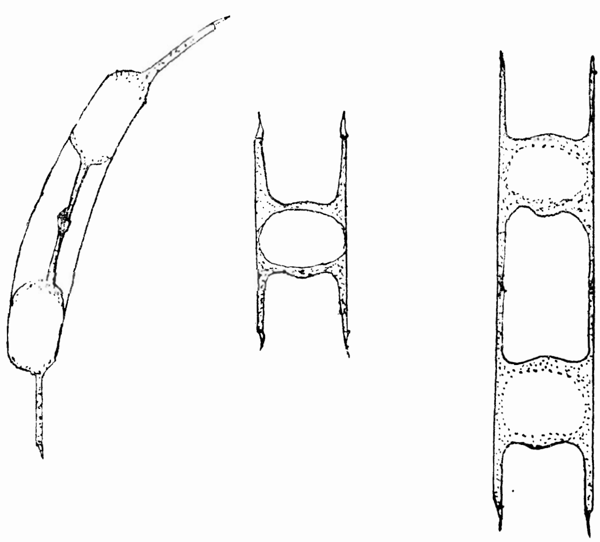


FIG. 33.—*Hemiaulus Heirbergii*

Cells single or in chains. D.V. = 39 u. L.V. (excluding horns) = 23 u. L.V. (including valves) = 69 u.

Distribution.—Suez Canal (all stations).

References.—(22) p. 392.

Lithodesmium undulatum Ehr., 1841

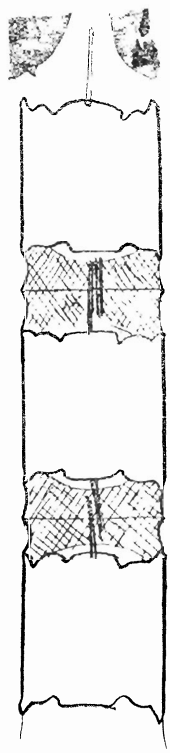


FIG. 34.—*Lithodesmium undulatum*

Cells straight chains. D.V. = 64 u. Neritic.

Distribution.—(18) Coasts of England, North Sea, Holland, Belgium, Germany, California Suez Canal (S.C. 1).

References.—(8) p. 112, (18) p. 185, (22) p. 394.

Ditylium Brightwelli (West). 1860

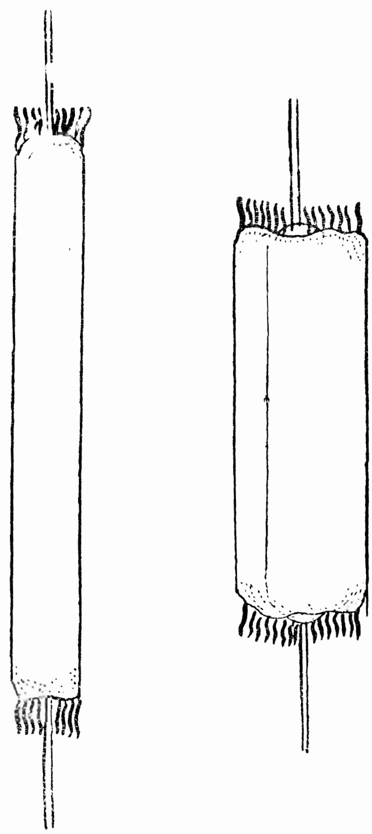


FIG. 35.—*Ditylium Brightwelli*

Cells single or in short chains. A straight hollow spine projects from the centre of the valve

L.V. = 170-270 u. D.V. = 32-60 u. Neritic. Southerly temperate.

Distribution.—(18) Coasts of England, Scotland, North Sea, Holland, Belgium, Germany, Norway, Sweden, Denmark, North Atlantic.

Suez Canal (S.C. 1).

References.—(8) p. 112, (18) p. 186.

Ditylium intricatum (West), **Grun., in** Van Heurck, 1881

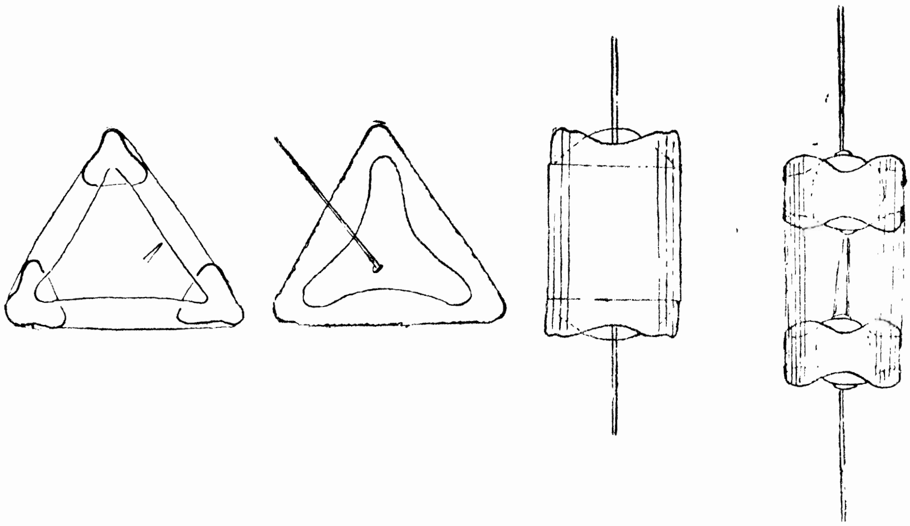


Fig. 36.—*Ditylium intricatum*

Cells solitary or united in short chains by the spines. D.V. = 90-110 u. L.V. = 47-140 u. Pelagic

Distribution.—**England.**

Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(2) p. 117, (22) p. 394.

Climacodium biconcavum Cleve, 1897 *a*

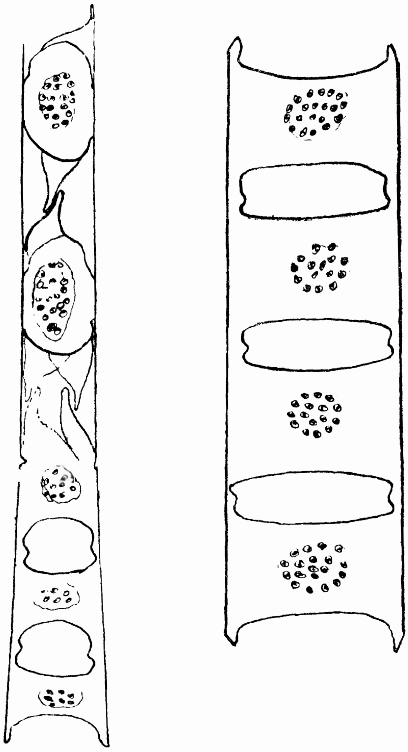


FIG. 37.—*Climacodium biconcavum*

Cells in chains easily twisted. D.V. = 50-60 u. Oceanic.

Distribution.—(18) Tropical Atlantic Ocean, Mediterranean, Indian Ocean. Suez Canal (S.C. 5 and S.C. 6).

References.—(8) p. 100, (18) p. 189.

Asterionella Japonica Cleve & Moller, 1878

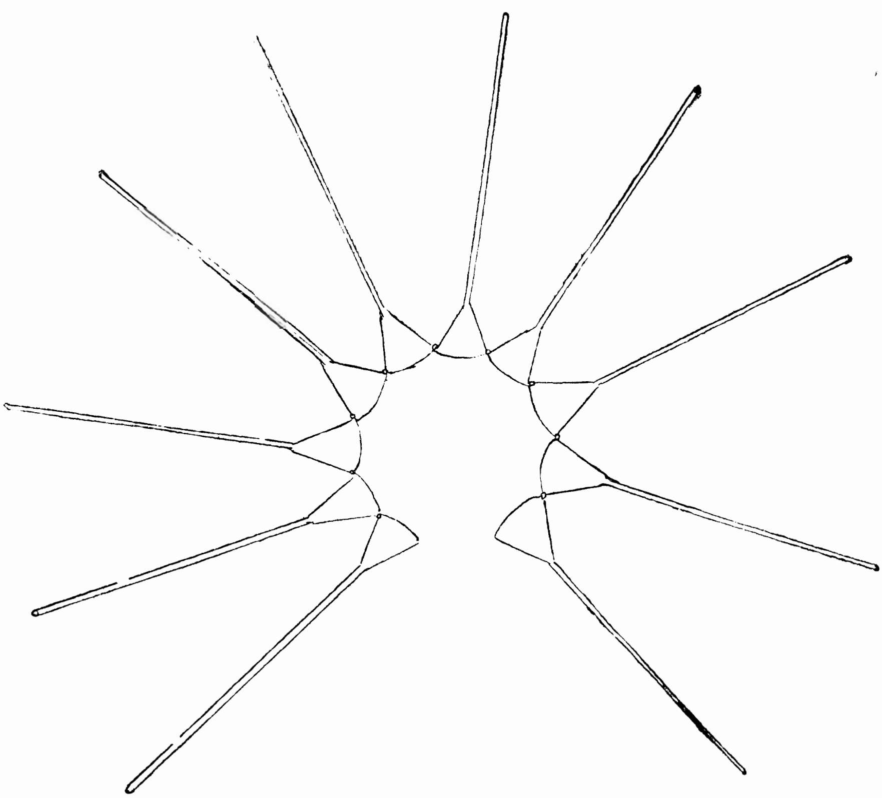


Fig. 38.—*Asterionella Japonica*

Cells arranged in star-shaped clusters. Breadth of cell 10·8 u., length 14·4 u., length of hair-like outer part 43-58 u. Neritic. South temperate.

Distribution.—(18) Japan, California, Atlantic Coast, Coast of England, Scotland. English Channel, Holland, Belgium, Germany, Sweden, Denmark, Mediterranean.

Suez Canal at S.C. 1, S.C. 2 and S.C. 3.

References.—(8) p. 118. (2) p. 560. (18) p. 195.

Thalassiothrix Frauenfeldii (Grun), Cleve & Grun. 1880. Castr. Rep. Voy. Chall. Bot. 2: 54. 1886. Pl. 14. f. 7 and 8

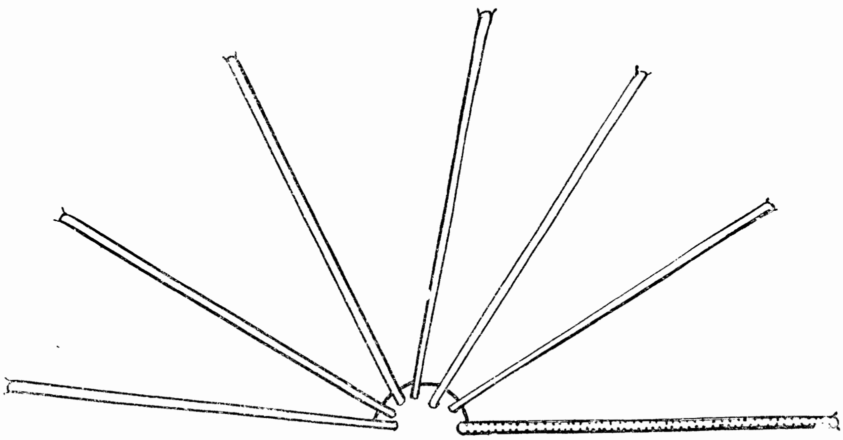


FIG. 39.—*Thalassiothrix Frauenfeldii*

Cells in radiate clusters. L.V. = 36-190 u. Oceanic. Temperate.

Distribution.—(18) Coasts of England, Scotland, Belgian Russia, Germany, Norway Sweden, Denmark, Mediterranean, American North Atlantic.

Suez Canal (found at all stations but most abundant at S.C. 1 and S.C. 2).

References.—(2) p. 214, (18) p. 200.

Thalassiothrix longissima Cleve & Brun, 1880

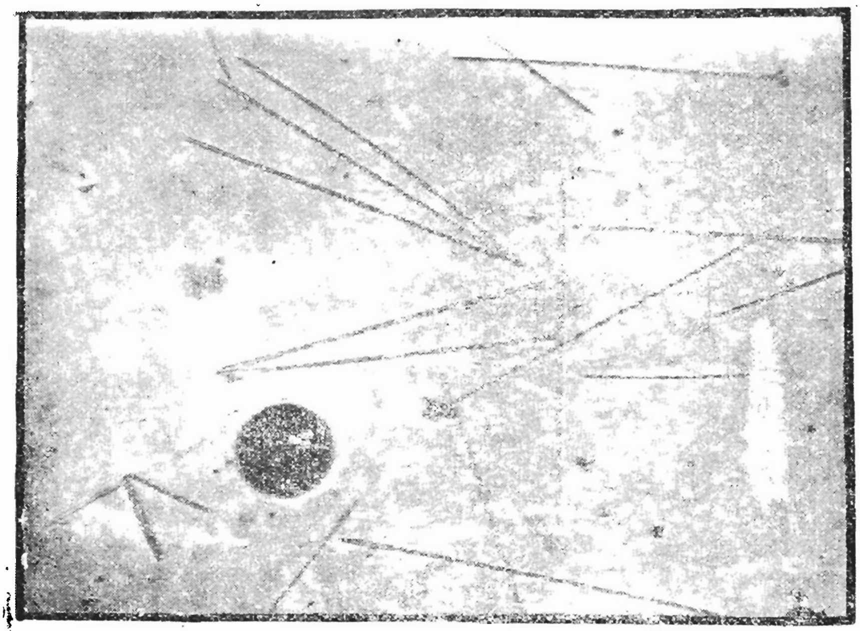


FIG. 40.—*Thalassiothrix longissima* (Microphoto by Ghazzawi).
Cells solitary or joined in radiate bundles by their topering ends.
L.V. = up to 720 u. Oceanic.

Distribution.—(18) Arctic Seas, North Sea, Coasts of Scotland, Belgium, Russia, Germany, Norway, Sweden, Denmark, Mediterranean, North Atlantic, California, Antarctic Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(8) pp. 116-117, (18) p. 198, (2) p. 207.

Rhabdonema adriaticum Kütz. 1844

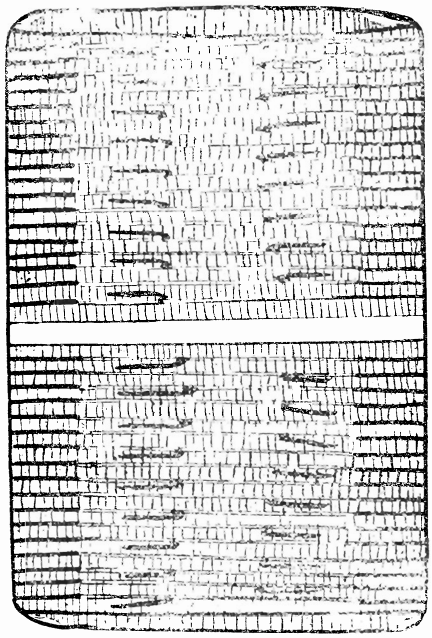


FIG. 41.—*Rhabdonema adriaticum*
L.V. about 100 u. Coastal. South temperate.

Distribution.—(18) Atlantic (European and American). American Pacific, England, Mediterranean, Adriatic Sea.

Suez Canal S.C. 1.

References.—(18) p. 202, (2) p. 150.

Achnanthes longipes Agardh, 1824

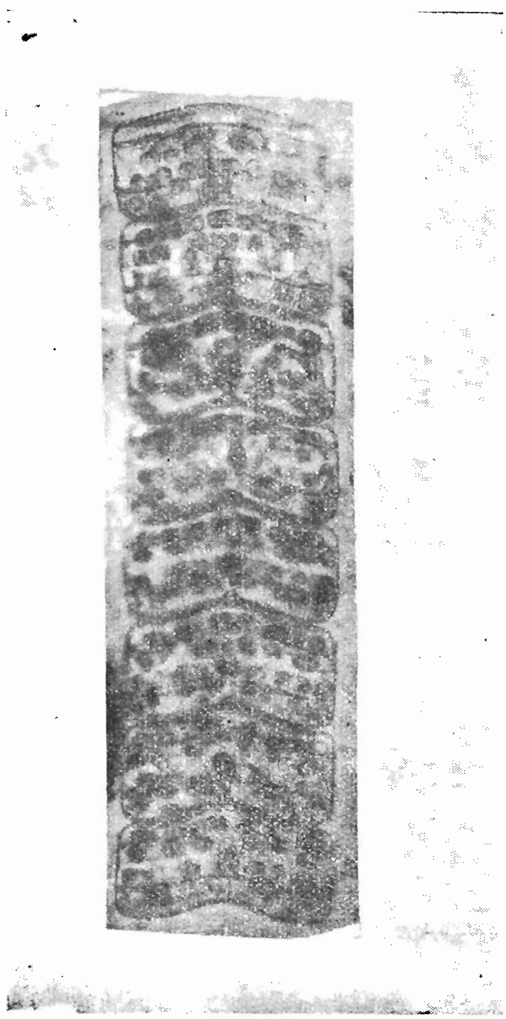


Fig. 42.—*Achnanthes longipes* (microphoto by Ghazzawi)
Littoral

Distribution.—(18) Coasts of England, Ireland, Danemark, N. Atlantic (European and American). S.C. 2.

References.—(18) p. 205.

Nizschia seriata Cleve, 1883

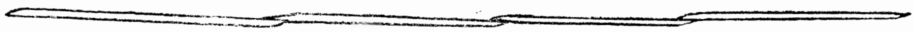


FIG. 43.—*Nitzschia seriata*

Cells united at the ends in long hair like chain. L.V. = 80-100 u.

Neritic. D.V. = 3 u.

Distribution.—(18) Davis stuarts, England, Scotland, Holland, Belgium, Germany, Norway Sweden, Denmark, American Atlantic, Pacific Coast.

Suez Canal (all stations).

References.—(8) pp. 129-130, (18) p. 213, (2) p. 526.

Prorocentrum Ehrenberg

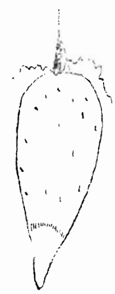


FIG. 44.—*Prorocentrum* ***micans***

L.C. = 54-60 u. Neritic.

Distribution.—(17) English Channel, Baltic and Danish Seas, Mediterranean, Black Sea, Bosphorus, Gulf of Siam, Japan, Woods Hole, U.S.A.

Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(17) p. 16, (21) p. 8.

Dinophysis caudata Kent, 1882

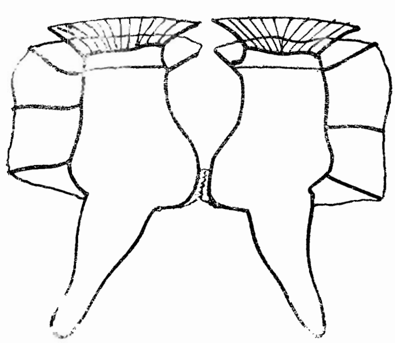


FIG. 45.—*Dinophysis caudata*

L.C. about 106 u. Twin forms of two joined cells are common.

Distribution.—(17) Warm water, Atlantic, Indian Ocean, Mediterranean, Adriatic, English Channel, Brittany Coast, North Sea, Norwegian Seas, Bosphorus.

Suez Canal (occasionally at all stations).

References.—(17) p. 82.

Dinophysis tripos Gourret, 1883

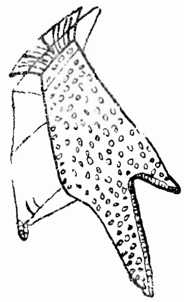


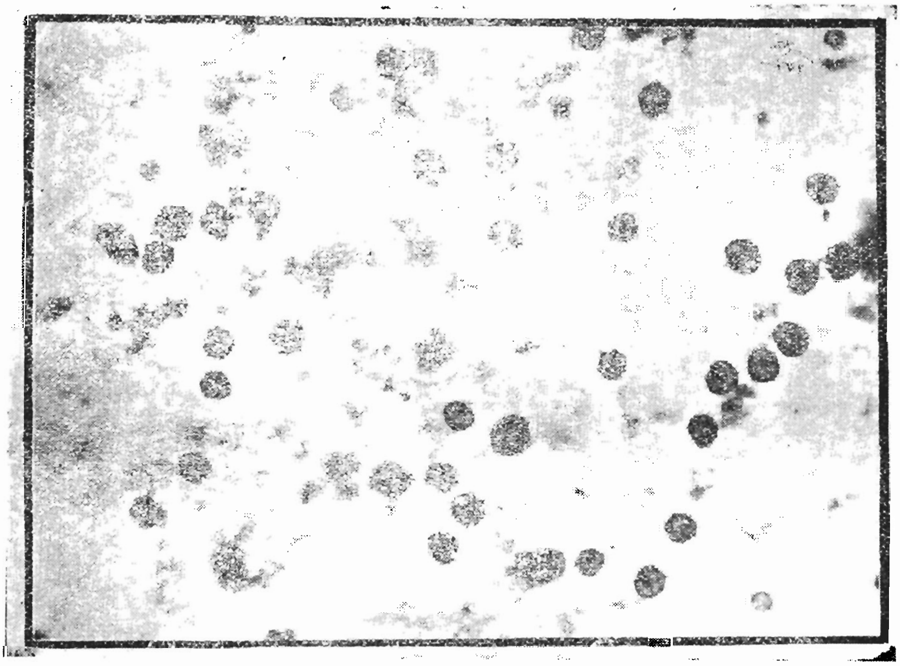
Fig. 46.—*Dinophysis tripos*
L.C. = 115 u. Neritic.

Distribution.—(17) Warm seas, English Channel, found from Scotland to Greenland, Coast of Norway, S. Africa to Australia, perennial in the Mediterranean.

Suez Canal (single specimen at S.C. 1. April).

Reference.—(17) pp. 82-83.

Goniaulax catenata (Levander), 1894



Phytoplankton dominated by Gonionlax.
S.C. 3. July, 1935.

Fig. 47.—*Goniaulax catenata* (microphoto by Ghazzawi)
L.C. about 30 u. Cells in chains.

Distribution.—Baltic, North Sea, North Atlantic.

Suez Canal (S.C. 1, S.C. 2 and S.C. 3).

References.—(17) pp. 97-98.

Peridinium cerasus Paulsen, 1907

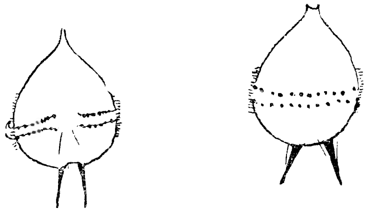


FIG. 48.—*Peridinium cerasus*
D.C. = 43 u. Neritic.

Distribution.—(17) North Sea, Ireland, Greenland, Mediterranean, Flemish and Brittany Coast, English Channel.

Suez Canal (S.C. 1, S.C. 2, S.C. 3 and S.C. 4).

References.—(17) p. 130, (21) pp. 43-44.

Genus Ceratium
Subgenus Biceratium (Vanhoffer) Ostenfeld
Ceratium candelabrum (Ehrenberg), 1859, Stein

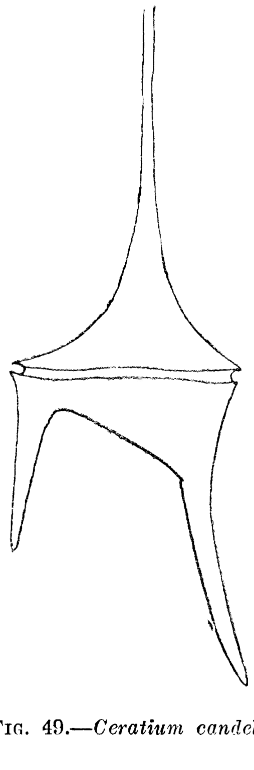


FIG. 49.—*Ceratium candelabrum*

Distribution.—S.C. 1.

References.—(17) pp. 143-144, (21) p. 88, (15) pp. 11-17, fig. 6.

C. furca (Ehrenberg) Claparede and Lachmann

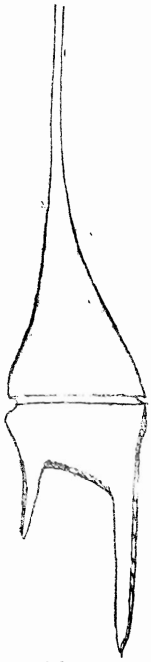


Fig. 50.—*C. furca*

Breadth about 47 u., Epitheca — apricol horn = 133 u.

Distribution.—Throughout the Suez Canal.

References.—(17) p. 145, (21) pp. 89-90, (15) pp. 17-22, fig. 7.

C. pentagonum var. subrobustum Gourret

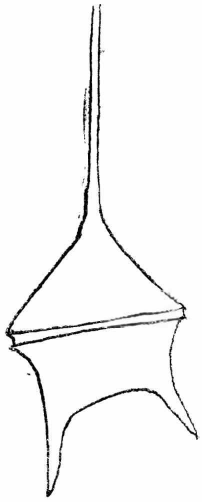


Fig. 51.—*C. Pentagonum var. subrobustum*

Distribution.—S.C. 1.

References.—(15) pp. 24-28 (fig. 15).

Subgenus Amphiceratium Vanhoffen

Ceratium falcatum (Kofoid.)

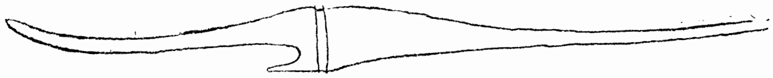


FIG. 52.—*Ceratium falcatum*

Distribution.—S.C. , S.C. 4. S.C. 2 and S.C. 6.

References.—(15) pp. 39-40, fig. 29.

C. fusus (Ehrenberg), 1859

FIG. 53.—*C. fusus*

Breadth 29 u. Total length up to 670 u.

Distribution. Throughout the Suez Canal.

References.—(17) pp. 146-148, (2) pp. 90-91, (15) pp. 41-43.

Subgenus Euceratium (Gran) Ostenfeld

Ceratium tripos (O. F. Muller) Nitzsch

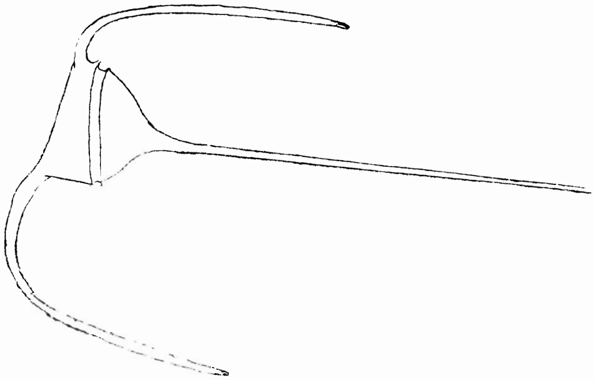


FIG. 54.—*Ceratium tripos*

Variety Baltica Schütt (1892) form *hiemale* Paulsen

(21) p. 80.

C. tripos variety *atlanticum* Ostenfeld, 1903

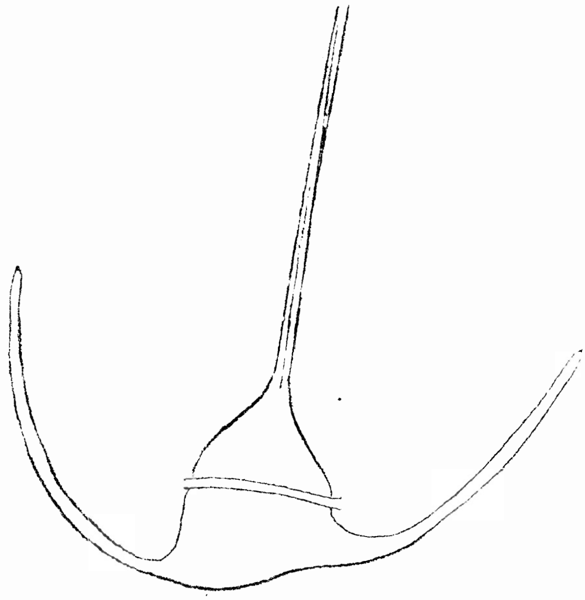


FIG. 55.—*C. tripos* var. *atlanticum*

References.—(17) pp. 148-150, (2) pp. 77-80, (15) pp. 46-50.

Ceratium pulchellum Schröder

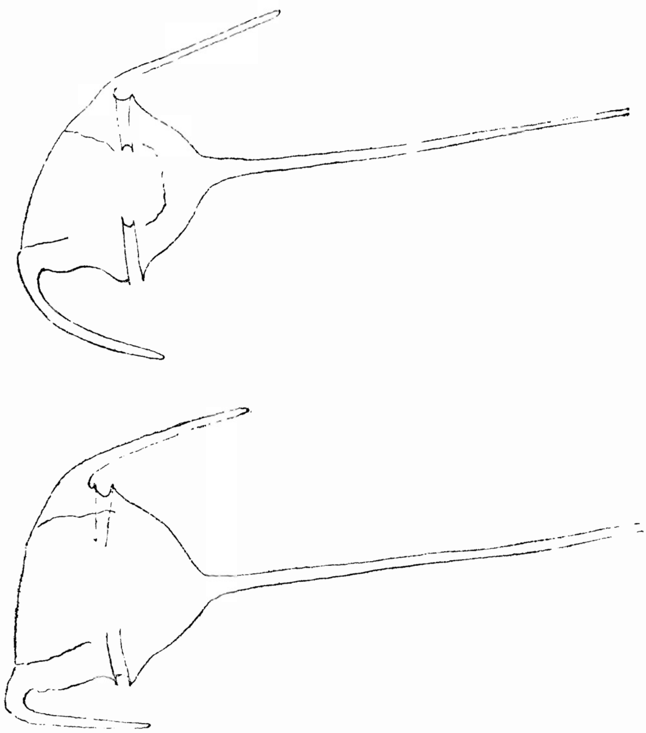


FIG. 56 *a.*—*Ceratium pulchellum*

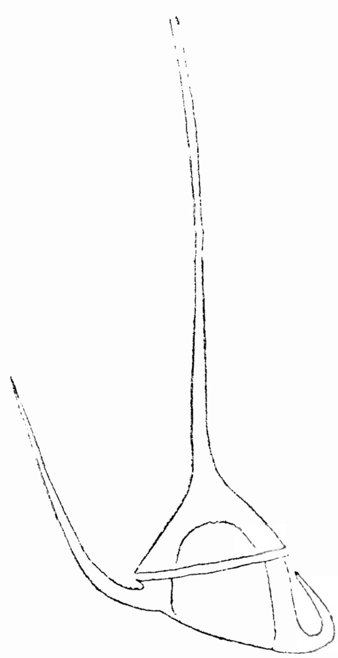


FIG. 56 *b.*—*Ceratium pulchellum f. tripodioides*

Distribution.—Throughout the Canal.

References.—(15) pp. 50-56.

C. pulchellum f. eupulchellum

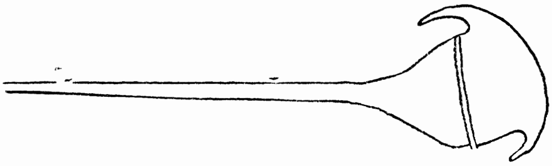


FIG. 57.—*C. pulchellum f. eupulchellum*

References.—**(15) p.**

C. pulchellum f. semipulchellum

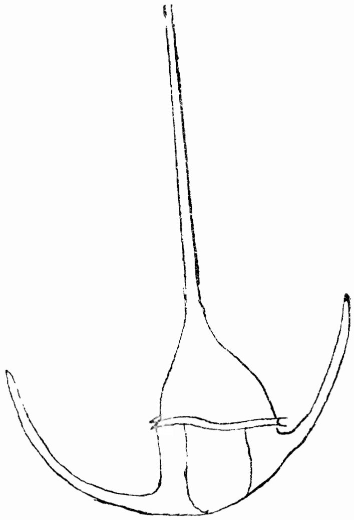


FIG. 58.—*C. Pulchellum f. semipulchellum*

References.—**15 p.**

C. gracile (Gourret) Jorgensen, variety *symmetricum*

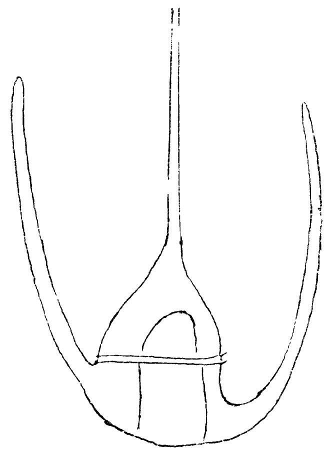


FIG. 59.—*C. gracile* var. *symmetricum*

Distribution.—S.C. 1.

References.—(15) pp. 59-61 (fig. 58).

C. arietinum *Cleve* var. *gracilentum*

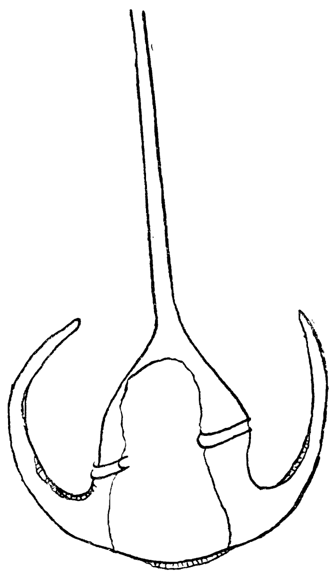


FIG. 60.—*C. arietinum* var. *gracilentum*

Distribution.—Throughout the Canal.

References.—(15) pp. 62-66 (fig. 62).

C. arietinum Cleve f. *detortum*

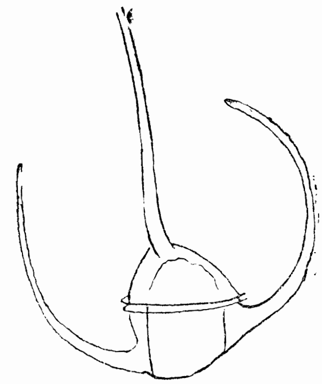


Fig. 61.—*C. arietinum* f. *detortum*

Distribution.—S.C. 1.

References.—(15) pp. 62-66 (fig. 61).

C. macroceros (Ehrenberg) Vanhoffer

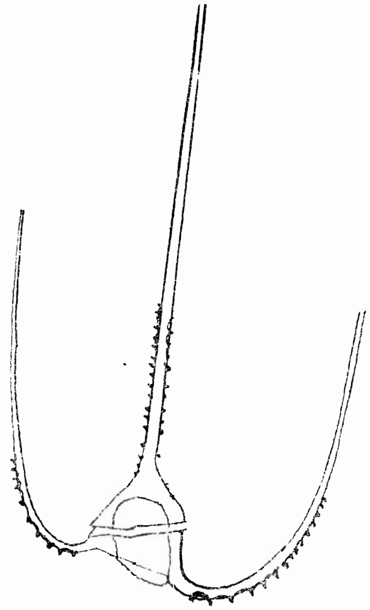


Fig. 62.—*C. macroceros*

Distribution.—Throughout the Canal.

References.—(17) pp. 81-82, (21) p. 156, (15) pp. 83-85.

C. macroceros subsp. gallicum (Kof)

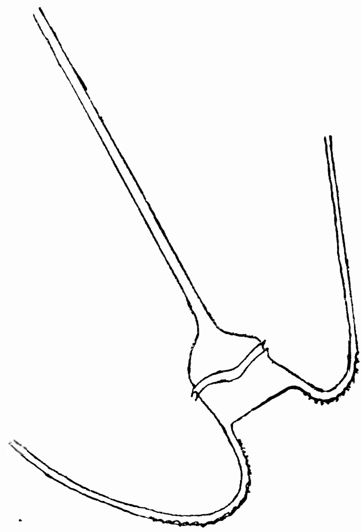


FIG. 63.—*C. macroceros subsp. gallicum*

Distribution.—S.C. 1.

References.—(15) pp. 83-85 (fig. 77).

C. massiliense (Gourret, Karsten) Jorgensen

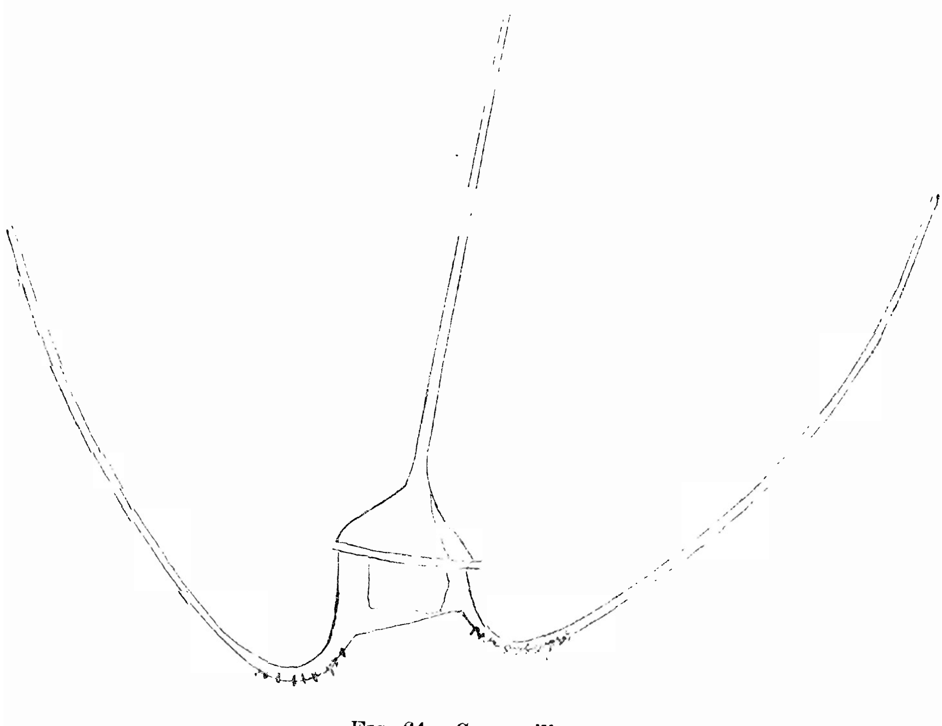


FIG. 64.—*C. massiliense*

Distribution.—Throughout the Canal.

References.—(15) pp. 85-89 (fig. 78).

C. trichoceros (Ehrenberg) Kofoid

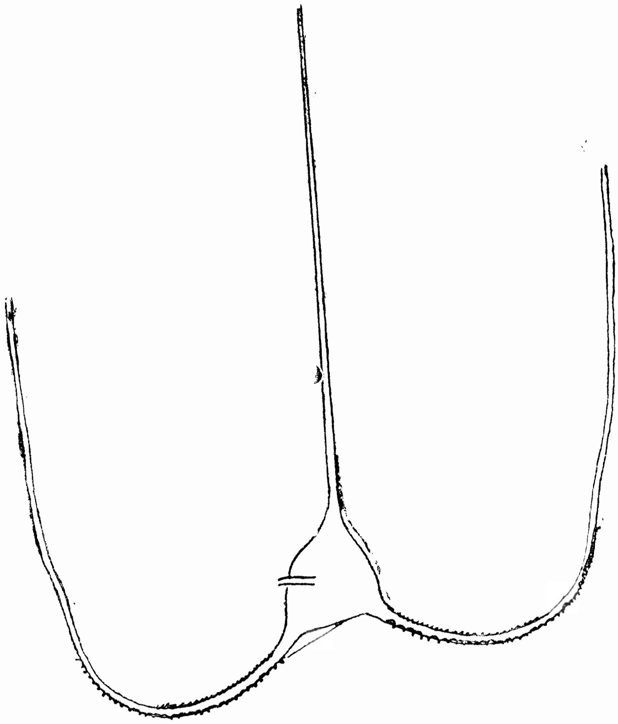


Fig. 65.—*C. trichoceros*

Distribution.—Southern end of the Canal.

References.—(15) pp. 95-96 (fig. 85).