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NOTES AND MEMOIRS No. 8

THE FISHERY GROUNDS NEAR ALEXANDRIA

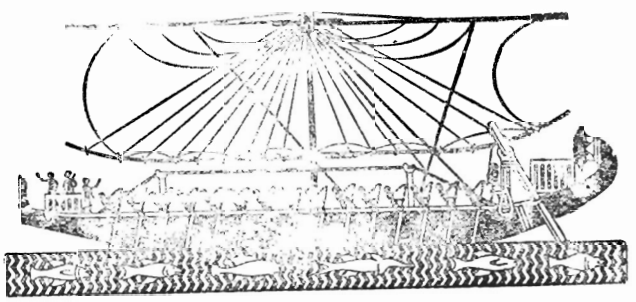
1.—PRELIMINARY REPORT

(with 4 Figures and 2 Charts)

BY

ADOLF STEUER

Co-Director, Italo-German Institute of Marine Biology Rovigno d'Istria



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The Fishery Grounds near Alexandria

1.—Preliminary Report

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ADOLF STEUER

In a survey of the results of the Cambridge Expedition to the Suez Canal of the year 1924, the leader Mr. Fox (1929 p. 844) remarks, that the Fauna of the Red Sea is now partially(1) better known than that of the Eastern Mediterranean. He writes " it is clear that there is need of an investigation of the coastal faunas of Northern Egypt and Palestine." Concerning the Plankton it would be especially desirable to investigate the occurrence of plankton larvae in late summer, " for only those Mediterranean animals which breed in August and September will tend to invade the Canal from the North." (Fox 1926, p. 24).

Therefore, I accepted very gladly the invitation to make a floristical and faunistical survey of the coasts near Alexandria;(2) I chose the summer time for this purpose. It was not of great importance to find many new and rare species, but I intended to determine the distribution of just the most common and perennial forms which survive in summer time.

All excursions were one-day trips. For these purposes I had at my disposal:—

(1) The sea-worthy motor-launch of the Marine Laboratory, " El Hoot," about 15 metres long. The trips could only be extended as far as the coast was still visible and therefore the 100 fathoms line could be surpassed only at a few points.

(2) For work near the coast a small rowing boat was available; but it was only used during favourable weather conditions.

(1) Evidently, this concerns chiefly Hydroidea (Billard 1926, p. 86), Amphipoda (Schellenberg 1928, p. 686) and Tunicata (Harrant 1927, p. 366). I wish to express my sincere thanks to Dr. Fox for the dedication of a copy of the " Results of the Cambridge Expedition."

(2) It is a very agreeable duty for me to express my thanks at this place to the amiable Director of the Marine Laboratory of Alexandria Dr. Hussein Faouzi and his scientific and technical staff for their kind reception, which was of great help to my work. In this respect I am indebted also very much to the Captain of the launch El Hoot, Lieutenant Hassan Eff. and his crew and also to the ever helpful A.B. Sayed Youssof. My wife was a great assistance to me in preserving the catches.

(3) For excursions along the coast, to visit the mouth of the Nile near Rosetta (Rashid), Lake Mariout (=Maryût) and Lake Edku (=Idku) the motor car of the laboratory was at my disposal.

(4) The connections of the Marine Laboratory with the Coastguards Service proved to be very practical for my purposes, as we had in this way at our disposal boats and fishermen, wherever the Coastguards had their posts.

Plankton

(Figs. 1-3)

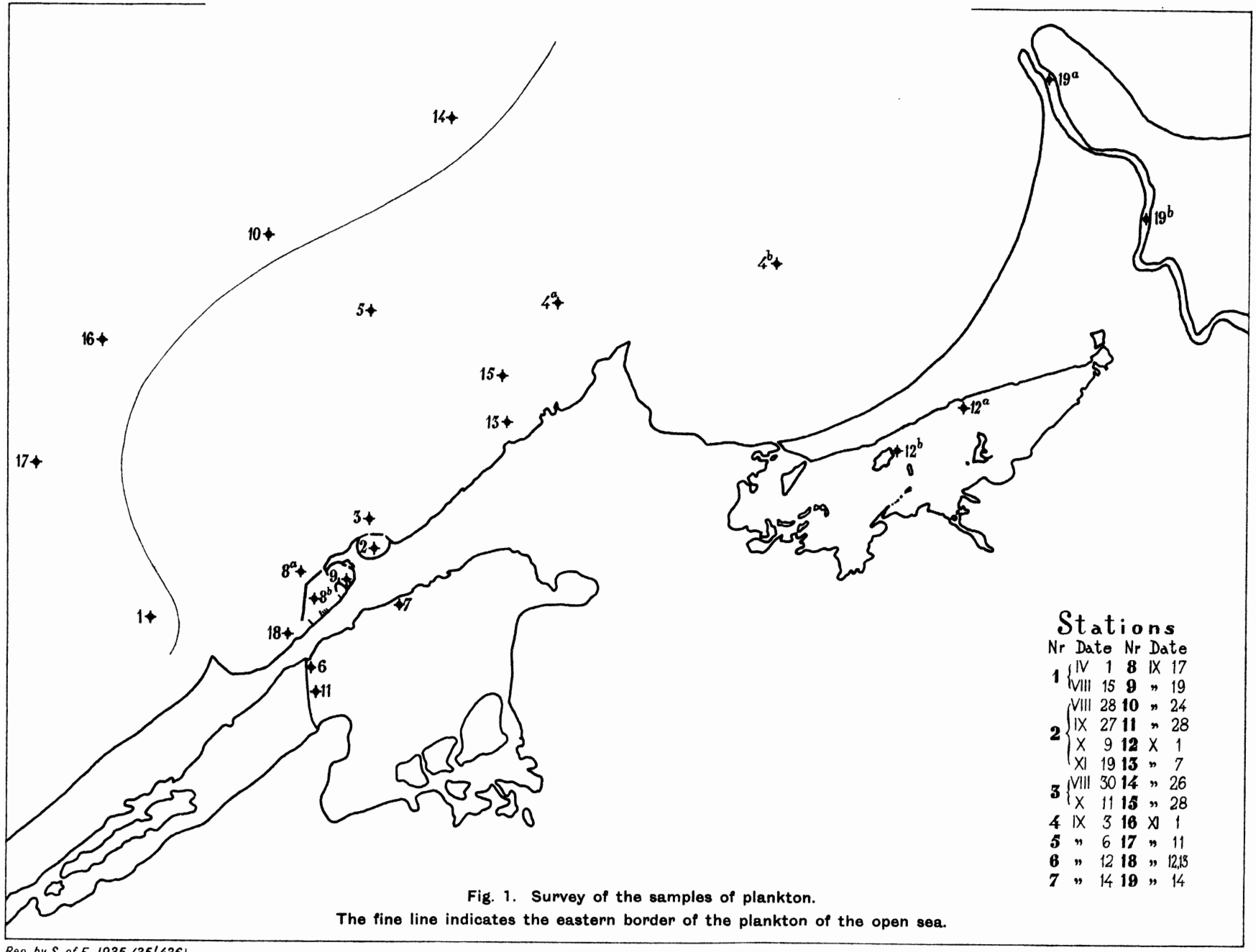
Unfortunately, only medium sized nets with very unpractical buckets of celluloid with gauze bottom were available for taking samples of Plankton. Though we could obtain a "net with large opening"—which, after Jespersen (1923), was used by the Danish Oceanographic Expedition (1908–1910) with good success—the El Hoot proved to be too weak to handle a net of such big dimensions; at that time the research vessel "Mabahiss" was cruising in the Indian Ocean. According to Jespersen, somewhat over 100 c.cm. of macroplankton are to be expected in an hour's haul, in the South-Eastern part of the Mediterranean which is poor in plankton during summer.

The determination of the amount of nannoplankton could not be done on account of lack of time.(1)

Upon my suggestion, vertical hauls with the above mentioned plankton net were made monthly since April 1st, 1933, at a station 3 nautical miles N.W. Agami island, situated in front of Fort El Ayana (comp. Fig. 1, St. 1). A water column of 30 metres was filtered every time. A false maximum in May (Fig. 2) is caused by swarms of Salpae. Perhaps this may occur during the first months of the year; Rose (1927, p. 21), in the Bay of Alger, found the spring maximum already in February–March.

Only after the relaxation of the summer heat, when the Nile begins to rise in an interesting way, the amount of phytoplankton at Alexandria began to increase, till it attained an Autumn maximum in September and October. I noticed for the first time this phenomenon starting in the Western Harbour on September 17th (at St. 8 *b*), where a strikingly great quantity of diatoms was taken. Tintinnids, glass worms, *nauplii of cirripeds* and larvae of decapods were also

(1) Such a quantitative study of the amount of nannoplankton on the Northern coast of Egypt in relation to the salinity, phosphate and nitrate content would be very desirable in order to determine exactly the influence of the Nile. The "Deutsche Meteorexpedition im Südatlantik" finds "dass eine wesentlich fördernde Wirkung der grossen Ströme auf das Meeresplankton nicht zu beobachten sei" (Hentschel 1933, p. 164).



Stations

Nr	Date	Nr	Date
1	IV 1	**8**	IX 17
	VIII 15	**9**	» 19
2	VIII 28	**10**	» 24
	IX 27	**11**	» 28
	X 9	**12**	X 1
	XI 19	**13**	» 7
3	VIII 30	**14**	» 26
	X 11	**15**	» 28
4	IX 3	**16**	XI 1
5	» 6	**17**	» 11
6	» 12	**18**	» 12,13
7	» 14	**19**	» 14

Fig. 1. Survey of the samples of plankton.
The fine line indicates the eastern border of the plankton of the open sea.

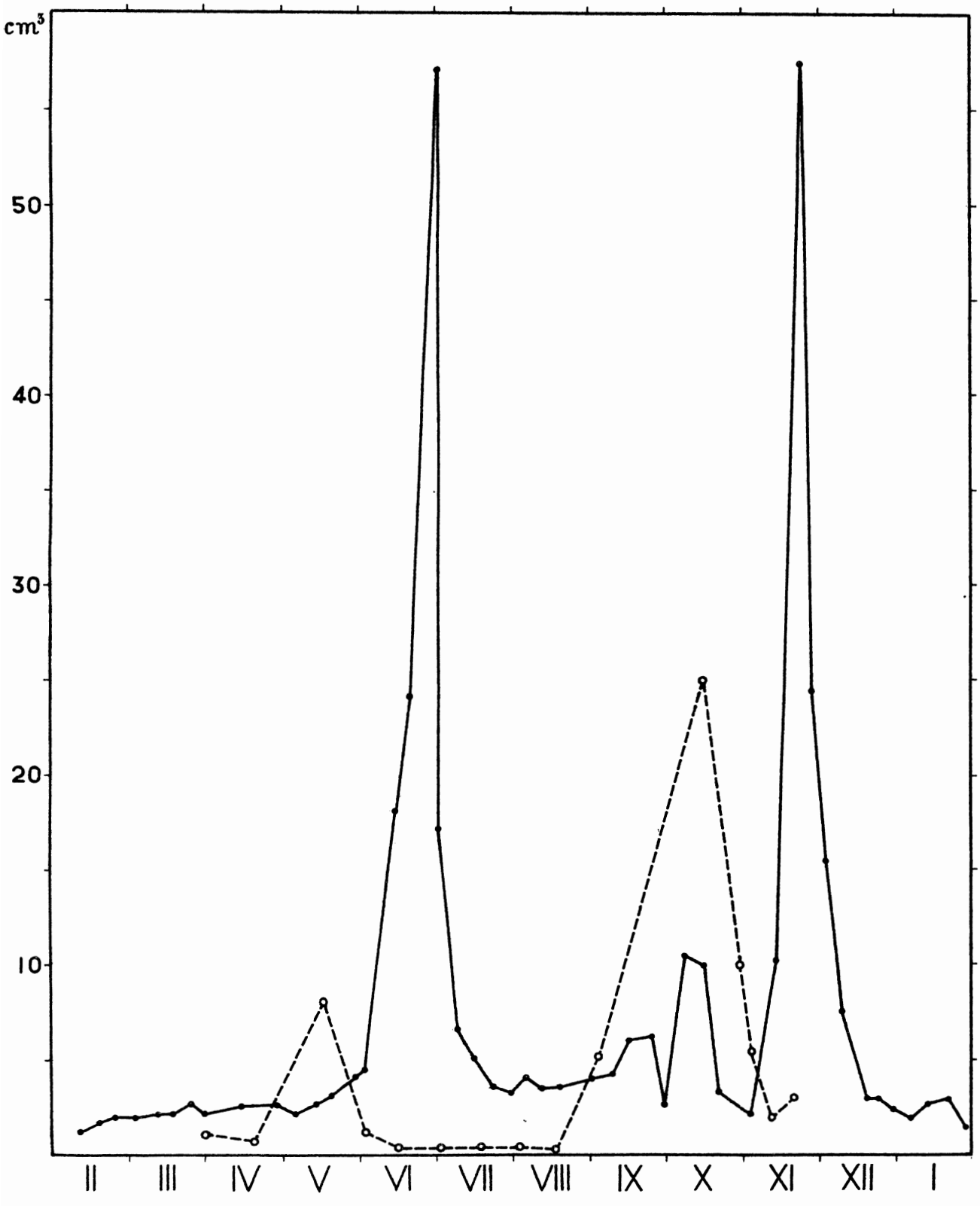


Fig. 2. Annual curves of the plankton of Rovigno d'Istria (straight line) and Alexandria (broken line) for 1933.

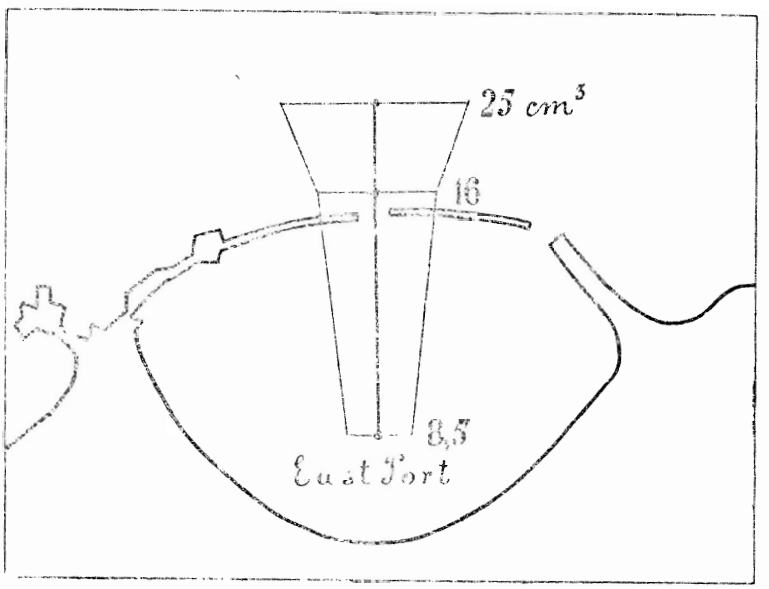


FIG. 3.—Three quantitative samples of plankton taken in and out of East Harbour of Alexandria on October 11, 1933.

found. On September 27th, in the Eastern Harbour (St. 2), the monotonous phytoplankton formed such a thick greenish yellow mud in the bucket of the net, that it was first thought that the net had reached the bottom. This sample contained, of zooplankton, only few copepods, larvae of decapods and a ctenophore: *Bolinopsis infundibulum* (Othfr. Müller 1776 respectively *vitrea* L. Agassiz 1860*). This maximum had not reached yet the open sea (St. 10, on September 24th); on the contrary, it extended along the coast (sample 13 near Sidi Bishr, October 7th). A sample taken at Port Said on September 24th, and examined by me contained likewise almost exclusively phytoplankton. In a remarkable way, the maximum seems to begin later in the Suez Canal. When it began to fall down off Port Said (samples of October 22nd), particular large quantities of plankton were found in the Suez Canal (St. II and III, expecially in the first one; comp. R. MacDonald 1933 Chart). On the other hand the phytoplankton was driven out in the open sea like an immense cloud. I took, *e.g.*, on October 11th (Fig. 3) North of the Eastern Harbour (St. 3) over 16 metres depth, 25 cubic centimetres, while nearer the coast over 10 metres, only 16 cubic centimetres, and in the Eastern Harbour itself over 7 metres, only 8·5 cubic centimetres were taken. In this way, the maximum had been displaced from the coast to the open sea, where on October 26th (St. 14) in 10 cubic centimetres gross volume, phytoplankton was still abundant.

As a water column of 30 metres height was also filtered regularly through a medium sized plankton net in the Northern Adriatic (near Rovigno), these two curves of volume may be compared with each other. They show (Fig. 2) very clearly the poverty of plankton in the eastern basin of the Mediterranean. They also show that the maxima, at any rate the maximum in Autumn, presumably also the maximum in Spring (compare Alger) appear earlier in the South than in the North. Qualitative study will probably elucidate in some points the length of the swarming period of none-perennial plankton. But significant differences do not seem to occur. Lo Bianco (1888 and 1908–1909) states, for example, that *Bolinopsis* mentioned above is common near Naples especially in Autumn, while Chun (1880) only found it "in several specimens during the Summer of 1877 and the Spring of 1878." I observed the first Ctenophores (still small individuals) in larger quantities near Alexandria in mid-September (September 17th) off El Aramil (Abubakar), that is, off the outer border of theWestern Breakwater (St. 8*a*); they were also found in the open sea on September 24th (St. 10). On September 27th I noticed the first full grown specimens in the Eastern Harbour (St. 2), but they were still lacking more to the East off Sidi Bishr (St. 13). Only by the end

* The exact determination will be done by specialists of the different groups.

of October (October 28th) were they taken even with the dredge a little more to the North (at St. 15). In mid-October, they were so abundant in the Western Harbour, that they formed a monotonous plankton, and in the Eastern Harbour it was impossible to take a bucket of sea water in front of the Laboratory without taking plenty of them. In the middle of October, they were also found everywhere in the Bay of Aboukir (St. 44–47, *see* Chart II). The migration of this swarm of Ctenophores seems to be mostly ended in the second half of October, as I did not find any more in the following month (November 1st and 11th) on the western limit of the region of research (St. 16 and 17). It may be stated, that these Ctenophores had been streaming from the West and had been dammed up in immense quantities, in coastal waters, especially so in the harbours. But they were, as well, almost the only larger components of the plankton which came under observation. Larger Hydro–and Scyphomedusae as well as Siphonophora were scanty. Of Pteropods, only Creseis was taken in larger quantities. A few shells of Janthina were floating off the outer side of Pharos (October 25th) and in the Bay of Abukir near the channel which leads from the sea to lake Edku (October 17th). They were the only representatives of the "Planktopleuston" (HENTSCHEL 1933). The "Nektopleuston" was much richer. It was not rare to observe Dolphins quite near the coast (in the Eastern Harbour and once in the Bay of Abukir); flying fishes in abundance were very significantly seen in the Western part of the research region (between St. 1 and 17 on November 11th). Turtles had not been met with in the open sea, but they were always abundant on the fish market near the Laboratory; they were kept there in a fenced part of the sea.*) As representative of the "Pteropleuston" we may recall besides the gulls, the numerous petrels. On the cliffs near Fort El Ayana cormorants were observed.

The scarcity of species composing the plankton was surprising. Amongst Protozoa, Sticholonche, for example, were lacking; of the Entomostraca, Podon, *e.g.*, was not found. Neither was this genus met with at Port-Said by the Cambridge Expedition (GURNEY 1927), but MACDONALD mentions *Podon polyphemoides* from that region, unfortunately without any date. Up to the present, Port-Said may be given as the most Southern point on the Northern hemisphere where that species is met with. Temopterids, *e.g.*, were strikingly rare amongst the worms; larvae of Polygordius were completely lacking and of Heteropods only Atlanta was found. The scarce appearance of forms of the real open sea near Alexandria can be understood, if we consider the distribution of the Plankton. This shows (Fig. 1) that the genuine forms of the open sea avoid the coastal waters around

(*) S. A. Gruvel, 1931 p. 70!

Alexandria in a wide bow, which begins on Agami Island in front of Fort el Ayana. Siphonophores, Creseis and Salpae have been only found at the Northern and Western margin of the region investigated, Ostracods only in the two most southern stations of the western margin, Sapphirina and Copilia only at the far-most West (St. 17 on November 11th), Tomopteris only in the far most North (St. 14 on October 26th); Trichodesmium and Atlanta only in front of Agami Island at St. 1. This shows that the water of the open sea with its plankton is pushed away from the coast by the waters of the Nile. The Egyptian sailors know very well that the "water of Rashîd" (Rosetta), which they distinguish by its colour, reaches far West. On the other hand, the occurrence of neritic plankton as Evadne and Larvae of Cirripeds is bound more or less to the coast.

Samples of plankton were also collected from the brackish and fresh water districts nearby. Unfortunately, the mouth of the Nile near Rosetta (=Rhashîd) could not be investigated in detail for technical reasons. Two samples taken near Rosetta (St. 19 *b*) and further North at about the latitude of Fort East Bughaz (St. 19 *a*) revealed great quantities of detritus, many diatoms (Melosira), a few Volvox and Rotatoria (*Brachionus pala* Ehrbg. forma *amphiceros* (Ehrbg.), Daphnia, Bosmina and some Diaphanosoma (planktonic Cladocera), *Thermodiaptomus galebi* (Barrois) and Cyclopids (Copepods). The composition of the zooplankton out of the mostly well known representatives of the fresh water fauna, the large amount of detritus and the lack of Appendicularia are after THIEMANN (1934, p. 246), very characteristic of "rivers with wide mouth" (Elbe, Ric-Pará, La Plata, Congo), and thus the Nile must be included in this category. As in the case of the Amazonas-Pará (Thiemann op. cit., p. 223) the biological boundaries, within which the Nile exerts its influence from the Delta northward might be said to lay "im Gebiete des Überganges vom Schelfgebiet in die tiefe See," that is, about the 100-fathoms line. Along the coast, going south-westerly, the Nile exerts its influence at least till Fort el Ayana, that is about 40 nautical miles, as could be seen from the distribution of the plankton of the open sea. The effect of the Nile may be readily shown in the way the fauna and flora become poorer; but this may be seen more surely in the sessile bottom fauna than in the much less stable plankton.

Moina dubia De Guerne et Richard is characteristic of Lake Edku[1]; this form also occurs in the Nile. Diaphanosoma, Ostracods, Cyclopids, Ergasilids and Schizopods were also met with in this Lake.

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[1] I am indebted to Dr. Abu Samra for the determination of the following water samples taken on:
October 1st near the village Edku (St. 12*a*) =S: 2·83‰ Cl: 1·55‰.
October 17th at St. 49 (chart II) =S: 2·07‰, Cl: 1·13‰.

Lake Mareotis(1) seems to be lacking in Cladocers. Besides *Thermodiaptomus galebi* already mentioned to be found in the Nile, this Lake contains Argulids, Schizopods, insect larvae and (as in the mouth of the Nile) Volvox and heads of Hydropolyps.

Thus, the plankton of these two lakes may be characterized in the following way :—

(1) Schizopods dominate, Copepods are reduced in quantity or are rare ; the same is the case with Rotatoria and Protists. Cladocera are lacking or only represented by small individuals.

(2) In the shallow waters which are often stirred up, many animals of the bottom are found as heads of hydroids, insect larvae and shells of Follicularia.

Benthos

(Fig. 4)

I used for collecting the bottom samples (about 150), almost exclusively a dredge with 20×70 centimetres opening. Only a single catch could be made in a depth of 20 metres with a large otter trawl (T on Chart II) in the eastern part of the Bay of Abukir. Unfortunately, this kind of fishing gear was not possible in deeper waters. In general, " El Hoot " was used for dredging, but in favourable weather conditions and in shallow water, the dredge could be used also from the rowing boat. In this way the cliffs could be visited. Material from the bottom in shallow waters was taken by diving, as no pair of tongs was available. For distant excursions the car of the institute was at our disposal. Some catches with the dredge were possible in Lake Maryût and Lake Edku. Collections on the shore were also made, whenever possible.

An important point in my research programme was the quantitative determination of bottom fauna, a work that was never tried before in the Eastern Mediterranean. A bottom sampler was available, but after the first attempt from " El Hoot " on anchor, in the Eastern Harbour, the machine proved to be too weak, so I had to give up further investigations with this gear.

In the Western Mediterranean, the production of organic matter averages after the few determinations of Spärk (1931) to about 12·6 grammes per square metre only. The highest value, over 800 grammes per square metre, was found in the lagunes of Venice (Vatova 1931). It may be assumed, according to the smaller quantities of plankton, that the bottom fauna of the eastern basin is more scarce than that

(1) A determination of two water samples also done by Dr. Abu Samra gave the following results:
September 14th at St. 7 = S : 11·13‰, Cl : 6·15‰.
September 28th at St. 11 = S : 1·52‰, Cl : 0·83‰.

of the western basin of the Mediterranean. In the single catch with the bottom sampler made at the landing pier of " El Hoot " in front of the Marine Laboratory (L on Chart I), 590 grammes fresh weight of organic substance were found on the sandy bottom covered with Caulerpa. It is interesting to note that this catch contained chiefly molluscs, namely mussels and snails. Besides molluscs, only a single Asterina gibbosa, a small crab and a single Cumacea were found. This result contradicts only apparently the statement of SPÄRK about the " scantity of the Mediterranean Fauna," as he already remarks that " the richest ..... samples originate from the mouth of ..... harbours .... which also serve to emphasise, that it is the problem of nourishment which is of importance to the scantity of the fauna of the Mediterranean." SPÄRK finds that carnivorous animals, *e.g.* crabs, are characteristic of poor bottoms, while sedentary mussels and annelids, which feed on micro-organisms and detritus are characteristic of rich bottom. In this way the single sample from the Eastern Harbour comes well within this scheme.

The length of the coast which I was able to investigate (Chart II), reaches from L.E. 29° 40′ to the mouth of the Nile at Rosetta (Rashîd) at L.E. 30° 20.′ This coast is divided by the peninsula of Abukir into a more shallow eastern part (Fig. 4*e-f*) and a steeper western part (Fig. 4*b-d*). This latter bears on a peninsula the " Native District " of Alexandria, which is bordered to the West by the larger and more modern Western Harbour (Port of " good return " or Eunostes of the ancients) and to the East by the smaller Eastern Harbour (the " great harbour " of the ancients), which seems to be in the way of becoming a sport harbour. On its north-western corner, the old dam, the " Heptastadion," connects the mainland with the formerly isle of Pharos. Three years ago the Government Marine Laboratory was built on this point (L on Chart I).

The coasts are in part shallow and sandy, in part steep. Transitions are common, where smaller or larger rocks overhang the sandy shore. A row of rocky islands and cliffs stands a short way off the coast and extends from Fort el Ayana and Agami Island to the Royal Palace of Ras-el-Tin (Chart I) ; a circle of rocks shuts off the shallow bay of Anfoushy (Chart I BA). The rocks extend from Fort Ada to Pharos, which was once a rocky island too and the mainland was only attained by the peninsula of Silsileh (= Silsila or Pharillon = Pharallon, the Lochias of the ancients). A similar row of rocks extends from the peninsula of Abukir in a north eastern direction (Nelson Island) (Chart II).

These rows of cliffs cause a " reverse orientation " of the distribution of vegetation. While on rocky coasts, usually, the zone of brown algae is followed seaward by meadows of sea grass (compare TECHET

1906, p. 9), here in the district of the cliffs, sea grass is followed seaward by a belt of brown algae.

On the pure sandy shores of the shallow coasts, well inland, from the Eastern edge of the Bay of Abukir, to the far West behind Fort el Ayana, dwelling holes of the fiddler crab *Ocypoda hippeus* Olivier were to be seen.

Weeds thrown out by the sea are not generally sea grasses but Caulerpa, often mixed with *Codium tomentosum*, Corallina and others. Such places yield a lot of all sorts of small animals; on the other side of Pharos, *e.g.*, were collected: beetles, larvae of Diptera, forficulids, spiders, pseudoscorpions,* isopods, amphipods, copepods, nematodes and turbellaria. In some places, near the fish market of Kayed Bey, for example, the Caulerpa are drifted down in such immense quantities, that they poison the air and have to be collected in loads to be taken away. On the other places, as on the eastern side of Fort Silsileh small collecting trenches with steep walls are digged on the seaside for the thrown Caulerpa. As soon as the algae begin to dry out, the isopods (*Idothea baltica* Pall) (the Cocora of the Egyptians) which come adrift together with the weeds, begin to wander towards the sea and fall into the ditches. In this way they are collected in quantities by the fishermen who use them as bait. Where larger fields of Posidonia occur, one finds the well known Pillulae marinae; this is the case near Sidi Bishr, in the Eastern Harbour (Western part near St. 4) and in the West at Sts. 135, 138, 110 and 105.

Concerning the *bionomic division* of the North-African coast, CHAMBOST (1928) could distinguish only two zones at the coast of Salammbô:

(1) A *subterrestrial zone*, which always stands out of the water and which is only wet by heavy sea, and

(2) The *proper littoral zone*, which lies under the influence of the tides and whose upper levels emerge during low tide.

At Alexandria, it was possible to separate a tidal zone (which however was not very extended or often well characterised) from a following sublittoral zone. Thus we can distinguish:

(1) The *subterrestrial zone* (Supralitorale=Spritzzone). On the "artificial steep coast" of the quai in front of the Marine Laboratory, *e.g.*, were to be found in the Spritzzone (at heavy sea the waves splashed on the windows of the Laboratory) besides Littorina, the isopod *Ligia italica* Fabr. remarkably in its "western form" (Santuzzi 1928).

(2) In the *tidal zone* (auftauchende Litoralregion=Emersionsregion) the growth of Ulva was characteristic; the specimens

* *Garypus beauvoisi* Sav. after the identification of Dr. Max Beier (Vienna).

were small (the large but straight *Ulva "latissima"* on which Prof. SCHIFFNER (Vienna) called my attention, was found near the laboratory somewhat deeper in between sea grass and Caulerpa). The whole vegetation on the top of the rocks dies out in late summer and the Ulvas become snow white. In this zone live: Patellas, Chitons, *Mytilus minimus*, the latter one very rare. Only on the outer part of Pharos or near Sidi Bishr, that is, on the coasts of the open sea, they occurred in larger nests. Fissurella covered with Corallina used to climb up from the lower levels. I never found *Actinia equina*, which is distributed all over the Mediterranean (PAX 1908, Chart 3). Barnacles used to settle on the lower border of the Ulva. On stones lying in greater depth, the highest points are still covered with Ulva, whereas below, Corallina already occurs in closed sods.

(3) In the following *sublittoral zone* (Untergetauchte Litoralregion=submerse Zone) the stones are covered with a dense vegetation of Corallina and other red algae. On the higher border of this zone are to be found: *Anemonia sulcata* Penn. (hitherto the only well identified actinia from Alexandria), Asterina gibbosa, Turbellaria and Synascidians.

This zone is followed by extensive fields of Caulerpa on the bottom, which are interrupted here and there by the large Ulva and sea grasses mentioned above.

The composition of the littoral biocoenoses is very different of course at different parts of the coast; *e.g.* on the outer side of the break-water near Pharos, the stone blocks, which are piled up in the subterrestrial zone are covered with lichens, and larvae of dipters are found living in humid bolsters of algae. At Sidi Bishr, Ulva is represented in the tidal zone by Enteromorpha and in the next sublittoral zone, Cystosira (covered with Corallina and *Mytilus minimus*) follows, to which is joined seawards, Sargassum (as could be judged from the stranded weeds). On the rocks of Abukir (after samples taken on October 14th), Enteromorpha is also followed by Cystosira (covered with hydroids) and *Padina pavonia*. Of animals, the following were collected: Patella, Caprella, Pantopods, Turbellaria and *Anemonia sulcata*. The fore-mentioned *Padina pavonia* also grows on the rocks near Fort Ada (October 10th, November 2nd) and around El Ayana (November 5th, 9th). It is restricted to the rocky bottoms of the three peninsulas. Only in few places, as on the rocks West of Fort el Ayana (St. 110) scarce specimens of *Helimeda tuna* reach the Corallina lawns of the tidal zone. On the inner side of Fort El Ayana the highest points of the rocks emerged from the water at low tide. Here, the "associations" of Pagurids in Cerithium shells were found crowded together in such a manner that they appeared as if a collector had deposed them there.

The description of the *Biocoenosis of the Sea-Bottom* is best commenced in the East at the Rosetta mouth of the Nile (Chart II). On account of the relative long distance from Alexandria, few catches could be managed; but these might help in a first orientation. It was already surprising to find how few organisms were thrown out by the sea on the sandy shore of the eastern part of Abukir Bay (*i.e.* near Rosetta). Plants lack completely. Besides crabs, only shells of Cardium and Pholas were met with representing animals. Further south-west, near the canal which leads to Lake Edku, the assortment was already more rich; here lay, besides starfishes, shells of Dolium, Murex, Natica, Cypraea, Pectunculus, Cardium and Solen. But I was given the assurance that Solen had never been found alive. It was not possible unfortunately to dredge with "El Hoot" in the shallow coastal waters of this area (St. 48). Further seaward (St. 47), in 6 fathoms, where the sand was already mixed with mud, besides Dentalium and Cucumaria, the pennatulid *Virgularia mirabilis* O. F. Müller was found (that was the only place where this species was taken). Further north, off the middle of the Bay (St. 46), the mud increases; here lives (St. 45, 44) in about 10 fathoms, as a characteristic form of the bottom, a small Enteropneust (Dolichoglossus).

Off the peninsula of Abukir, extensive grounds of characteristic coarse sand sometimes mixed with stones, are found in 4-13 fathoms; they reach the middle of the bay in a north-easterly direction. Leading forms of this sand, which, as will be shown later, extends also to the South-West, are *Amphioxus lanceolatus* Pall. and a worm *Armandia polyophthalma* Kückenth., which remarkably resembles this Amphioxus externally.

The sand has generally a fine yellow colour, and when taken on board, smells in the sun strongly of iodoform. I never noticed this with the "Amphioxus sand" of the Adriatic, which has a different look, besides the absence of this odour (the white and finer Amphioxus sand of St. 106 and 112 lacks this odour just as well). Further North (St. 52) in 22 fathoms, *Phoronis mülleri* Sel. Lon. was found as a characteristic form of these muddy bottoms; Polytrema, Dentalium, *Chenopus pes-pelecani* L., small Cucumaria and Ophiurids were met with. Another sample taken further South-East (St. 53) brought in a yellowish mud from 33 fathoms, a second larger Enteropneust, probably *Glandiceps talaboti* (Marion). This worm had also a characteristic smell as *Balanoglossus clavigerus*, especially at St. 74. Less common were Brissopsis (St. 55 and 62), Labidoplax (St. 55) and Polytrema (St. 55, 61). This Glandiceps—mud extends further South to South-West (St. 60, 62, 73, 74), where, at depths of 23-38 fathoms, it begins to show a scarce vegetation of Caulerpa (St. 60, 62); but which later on (St. 74) becomes covered with Dasycladus, Udotea, red algae and Halimeda (St. 73). While the Bay of Abukir up to

about the communication canal of Lake Edku is almost free of plants, a more or less dense vegetation begins from the eastern coast of Abukir peninsula. There are, to begin with, meadows of Posidonia and Cymodocea (St. 42) mixed with small Caulerpa on a grey sand mixed with mud. The two latter plants could be traced eastwards till station 57 and 58. On the tip of the peninsula (St. 41) there were to be seen Caulerpa and brown algae; on the west coast (St. 43) Posidonia and some more Caulerpa were found. The outer border of the vegetation leads from the west coast of the Bay of Abukir over station 50 (with Udotea, red algae and a minute specimen of Halimeda) and 39, 1 and 38, 74 and 62. Some Caulerpa (displaced?) were also taken at St. 60. To the West, this transitory territory is bordered by a rocky wall covered with Halimeda, which runs North from about Alexandria Eastern Harbour and which is perhaps only interrupted in one place (St. 72). This transitory territory has a triangular shape with the base on the coast between Silsileh and the peninsula of Abukir. Off the coasts, which bear a more sandy character in the West and a steeper aspect in the East, a more or less rocky or sandy bank is situated, which is covered with Caulerpa (St. 29, 30, 37) and, in some places, with sea grass and brown algae. Seaward, from 7 to 15 fathoms, a stripe of coarse Amphioxus sand is found, which is the continuation of this facies already known to us from the Bay of Abukir.

In the western part, the bottom, in about 10-20 fathoms, is rocky and always covered with Halimeda as the characteristic form. This Halimeda bottom reaches from the outer edge of the Amphioxus sand already mentioned, far to the North-East. On the other hand, rocky Halimeda bottom reaches north from the mouth of the Eastern Harbour till the 50-fathoms line (St. 61). Extensive territories covered with Caulerpa follow westwards, they are only found here and there from the coast to 50 fathoms, on muddy bottom, mixed with sand. Only a rocky stripe along the coast is covered again with Halimeda (besides Caulerpa).

There is not much to be said in a preliminary way about the benthos of the two lakes situated near Alexandria. In Lake Edku (near Isle Derfil) the stalks of the reed are covered with Cirripeds. In the delta of the Danube, Cirripeds also reach brackish waters (Pesta 1926). In the black mud, larvae of dipters, Amphipods and Polychaets were found. In Lake Mariotis the reed was covered with crusts of tubes of Serpulids and Hydroids. There were observed besides: small shrimps, water bugs and swimming beetles. In the middle of the lake, only few Polychaets, Isopods and small mussels were found in the mud.

The bottom around Alexandria need a special consideration. The shallow Eastern Harbour which has a depth of 8 fathoms near

its entrance, is sandy in its western and eastern part, and only the deeper parts already mentioned are covered with mud and stones; the bottom is stony or rocky in few places only. It is densely covered with Caulerpa associated with *Codium tomentosum* at the edge. The west side is scarcely covered with sea grass, which is followed by large districts of *Ulva latissima* already mentioned Of animals may be named Cucumarians, Ophioderma, Ophiothrix, Astropecten,(1) Murex, Modiola, especially Philine, and of Crustaceans Cumacea.

A row of rocks runs from the outer side of Fort Kayed Bey to Fort Ada and further to Ras-el-Tin. These cliffs include two shallow basins which are covered with Caulerpa, Ulva, Padina, Posidonia and Cymodocea. They harbour amongst others (St. 25) *Anemonia sulcata*, shrimps, Echinoderms (Asterina, Asterias, sea urchins and Holothurians). The Posidonia grow on foraminifera sand in which lived Cumacea. On the Posidonia, Mysidea and Spadella were searched for in vain. As Armandia was taken in the sand near the rocks it may by assumed that Amphioxus occurs also there.

In the Western Harbour, the real harbour for traffic, the biocoenosis are more varied than in the Eastern Harbour. Its north-western edge, which as "Harbour Bank" leads along the breakwater, is covered, in 6–12 fathoms, by thick black mud mixed with sand, on which Caulerpa grows but not in abundance. Cardium and Alpheus are common. A small field of Posidonia with *Codium tomentosum* (St. 12) grows where the breakwater bends in an obtuse angle. Here Pinna is said to occur under shelter of the breakwater, and incidently shell fragments were found in the dredge. The stones on the outer side of the breakwater contain Lithodomus. The other parts of the harbour, the so-called Outer Harbour and the Inner Harbour are filled up with bad smelling black mud, partially mixed up with sand, which harbours the well-known euroxybiontic fauna (St. 9, 11, 16, 132, 133, 141). A stripe of almost pure sand, mixed with only little mud with its characteristic form an Ilia-like crab (St. 15), is found running in a south-westerly direction, in front of the tip of the coal quai; here this crab which characterises this bottom was found. On charts of the years 1898 and 1915,(2) sandy bottom is indicated still further south-east till the head of the quai (St. 132, 133), but there, however, I found the sand mixed with mud and no more of the Ilia-like crabs. It might be concluded that the filling up with mud is progressing and slowly covering the sand. The harbour mud pours in 10 fathoms depth into the shallow Bay of Dekhela (=Dikheila= Dekheli=Dukhele) in a south-western direction, but only some

(1) Edible sea urchins are taken here by the fishermen by pains-taking diving.

(2) I wish to express my sincere thanks to the Institut für Meereskunde of Berlin, which sent me this latter chart for study.

distance from the coast. Far behind (St. 130, 87), Caulerpa occurs, and only behind Marsa el Kanat on a rising bottom of 8 fathoms, but which is still black and muddy, a dense vegetation of Posidonia and Caulerpa is found, still some distance from the coast. Still further west, in sand and mud, at a depth of 7 fathoms, the first Udotea, sponges and Holothurians occur (St. 128, 129). On the coast itself, in a depth of few fathoms, grow Posidonia and Caulerpa (and also Cymodocea near Mex and Marsa el Kanat). Further seaward at relatively greater depths (up to 8 fathoms) they grow on coarse Amphioxus sand, which borders the mud bottoms mentioned just now. It advances furthest into the mud of Minat el Fransawi and approaches here the amphioxus bottoms situated in the north. In 4–15 fathoms depth, these are partially mixed with mud and stones (St. 106, 104, 112, 81, 93, 86, 143, 23, 97, 119, 122, 125, 121) and stretch along the coast of El Aramil. The spot on the edge of the "Foul Ground" (St. 25*a*), where Armandia was found, is also situated in the direction of this sand streak; this spot would therefore establish the connection with the Amphioxus grounds near the peninsula of Abukir. From the amphioxus sands before the Bay of Dekhela, a protrusion occurs along the eastern rim of the "Great Pass" into the mud bottom in a south-eastern direction (St. 97), and it seems as if here, the Amphioxus sands near the coast and far from it had been once connected with each other.

The two sides of this "Great Pass" are occupied by rocky, stony, or sandy bottoms in $4\frac{1}{2}$ to 10 fathoms, which are covered with Caulerpa and Posidonia. Halimeda, common on the western part of Dekhela Bay, transgresses eastwards the "Great Pass" at three points (St. 97, 121, 125), where it follows stony bottoms. It is also found on them wherever amphioxus bottoms are mixed with stones (St. 104, 112, 81, 93, 143, 23,121). There, it reaches the 20-fathoms line together with Caulerpa and followed by its two satellites Udotea and Dasycladus (St. 144, 8, 80). In the deeper muddy bottoms annexed, only Caulerpa is found up to 50 fathoms. This Caulerpa mud is bordered on the western edge of the region investigated, as well as on the eastern edge, by stony bottoms mixed with sand and mud on which Halimeda occurs with its accompanying algae (characteristic of this bottom). In 35 fathoms, Valonia and Vidalia were also met with. Where stones lack, Halimeda has its attachment on sponges (St. 116 at 35 fathoms). Red and green algae still occurred in 55 fathoms (St. 117).

But while some species of animals are widely distributed on the Caulerpa bottoms, others are restricted to small territories. Chitons, *e.g.* were taken only on the stony bottoms near Alexandria (St. 7 in 17 fathoms, St. 30 in 7 fathoms) and off the Bay of Dekhela (St. 94 in $4\frac{1}{2}$ fathoms); Pinna seems to occur, according to some pieces of

shells, only in the Western Harbour and perhaps in the adjoining Bay of Dekhela (St. 12, 13, 136, 137). Lima was taken alive at 3 stations only (St. 71, 78, 121) near Alexandria in depths from 5 to 23 fathoms. The only three places where Antedon was taken (St. 114, 92, 67), run in a line about 6–7 miles parallel to the coast in 22–25 fathoms. The beautiful *Hermodice carunculata* Pall, prefers Halimeda bottoms, but is more common in the West than in the East. Empty Arca shells were only found in the environment of the Bay of Dekhela (St. 7, 110, 140, 144). I found adult living specimens only once on a stone brought from Mersa Matruh, that is even more to the West. From there, I received also the unique specimens of *Codium bursa* and *Echinaster sepositus*.

All this shows that the total fauna and flora of Alexandria, in the occurrence and distribution of its species, is very much influenced by the Nile. Going from about Mersa Matruh to the East, there is an increasing impoverishment caused by the progressive dilution of the sea water. This impoverishment could be also noticed in greater depths, beyond the 50 fathoms line, where few catches could be made.

In greater depths, from 70 to 110 fathoms, Stylocidaris (St. 61, 64, 63, 26, 27, 73) and larger Brachiopods (St. 117, 64, 27) were found only in the West, while in the East in 50–70 fathoms, the small white calcareous tubes of a sedentary annelid were chiefly taken (St. 27, 61, 54). Greater depths could not be investigated there. Pteropod mud (with *Clio pyramidata*, Cavolinia and Atlanta) was only found in the West (St. 64, 26) in 110–126 fathoms depths.

General Remarks

The small size of the specimens is a striking character of the fauna dealt with here. It may be possible that more extensive fishing with the trawl would have revealed bigger forms. In any case, the lack of larger animals is striking, not only in greater depths but near the coasts as well. We missed, *e.g.*, the large Geodia among the sponges, Alcyonium and other larger Anthozoa among the Cnidaria, Spirographis, Aphrodite and larger Nemertines among the worms, lobsters, spiny crayfishes and spider crabs among the crabs, larger Chitons and Aplysia among the molluscs. The Mytilids, which were found after searching for them for a long time in the Western Harbour, were small. Large sea urchins and star fishes lack among the echinoderms. I found the remains of one large crushed Astropecten on the road near Fort Kayed Bey. The Holothuria are also relatively small. It could be assumed that the animals live here in the vicinity of the Nile in a " tolerance region " (Toleranzgebiet) in the sense of

H. Broch (1933). The small size of individuals seems to occur however on the entire southern coasts of the Mediterranean. CHAMBOST (1928 p. 24) says generally of the marine fauna of Salammbô (Tunis) that it is " pauvre en espèces, pauvre en individus, et la taille de ses formes est en général réduite." The same remark is also made by LE DANOIS (1925, p. 48) on the fishes of Tunis and the Mediterranean in general; he assumes as reasons: lack of food and high salinity of water.

The relative poverty of plant and animal species, near Alexandria is also striking. Of conspicuous plants, I missed *Acetabularia mediterranea*, which occurs, *e.g.*, in the Gulf of Gabés (SEURAT, 1924, p. 45, 1929, p. 35, 43). Of animals which cannot be overlooked I missed, as already said, *Actinia equina* L., which occurs still in the small Syrte (SEURAT 1929, p. 51); also larger Echinoderms and crabs, found further west, are here lacking. Now GRUVEL (1926, p. 35) makes the remark, that concerning crayfishes, lobsters and Scyllarus, the Tunisian fauna is " still poorer " than that of Algeria. Accordingly, the wealth of forms on the southern coasts of the Mediterranean decreases to the East.

But seasonal changes must also be taken in consideration, as catches were taken during the hot season. Making allusion to the small number of individuals of each species and the slight density of animal populations of the littoral zone of Salammbô, CHAMBOST (1928, p. 24) makes the restriction that this holds at least for summer time. It was striking to me, that, at Alexandria, the Caulerpa did not yet show any recognisable epifauna in September. Only in the beginning of October, during the maximum shown by the plankton, Hydroids and Bryozoa began to settle and the first small Caprella and Nudibranchs were met with. In the middle of October, the first Pantopods and Turbellars were found (besides Hydroids) on Cystosira.

If we finally try to connect our results with the investigations of other authors on the African coast we may state the following: –

The exemplary maps of LE DANOIS (1925) of the coasts of Algeria and Tunisia show that the facies of the bottom from Morocco up to Susa on the east coast of Tunisia are quite uniform. Rocky and sandy facies are followed at about 100–200 metres depth by mud bottoms. South of Susa, lawns of Posidonia begin, which are joined, further south and seaward as "ceinture de défense," by Caulerpa mixed with Sargassum up to 40 metres South of Sfax, Halimeda occurs as third characteristic plant of the bottoms from 10 to 30 metres. The mud bottoms come near the coast up to 50 metres (about 30 fathoms); their characteristic form is Arca, while the coastal region covered with the plants mentioned above is called "region of sponges."

"Toute cette région compte parmi les plus riches de la Tunisie au point de vue spongifère." (Le Danois, 1925, p. 25).

Further East, a large gap follows. Of the coasts of Tripolitania and Barka and of the northern coast of Egypt, only the sponge beds are known. After Sella (1912, p. 2) they reach on the coasts of Tripolitania and Barka down to "45 braccia" (about 50 fathoms) and are also limited by the 50-fathoms lined on the Egyptian coast (from Sollum to Medina Reefs off El Jamayo (after Paget 1922.) From the middle of this coastal tract, I received the two Mersa Matrûh samples already mentioned (p. 14). To judge from these samples, the Egyptian sponge beds seem to have more relation to the Gulf of Gabés than to the regions around Alexandria investigated by me and revealing poorer flora and fauna. But nevertheless, here and there, we are able to distinguish bottoms covered with sea grass, Halimeda and Caulerpa, even if they occur in a different order of succession and reach different depths, as is shown in the sections (Fig. 4 *a-d*). Of course the Gulf of Gabés is shallow and the 50 metres line occurs at about 100 nautical miles distance from the coast, while, off Alexandria, it runs already at 10 nautical miles distance.

As regards the value, for the fisheries, of the coastal regions west of Alexandria, a word of Le Danois (1925, p. 47) might be mentioned, where he judges the coastal regions of the Gulf of Gabés as "de valeur nulle au point de vue du chalutage." Sure data can only be procured here and there by systematic investigations with the bottom sampler.*

* *See* the next report of A. Vatova (No. 9 of notes and Memoirs).

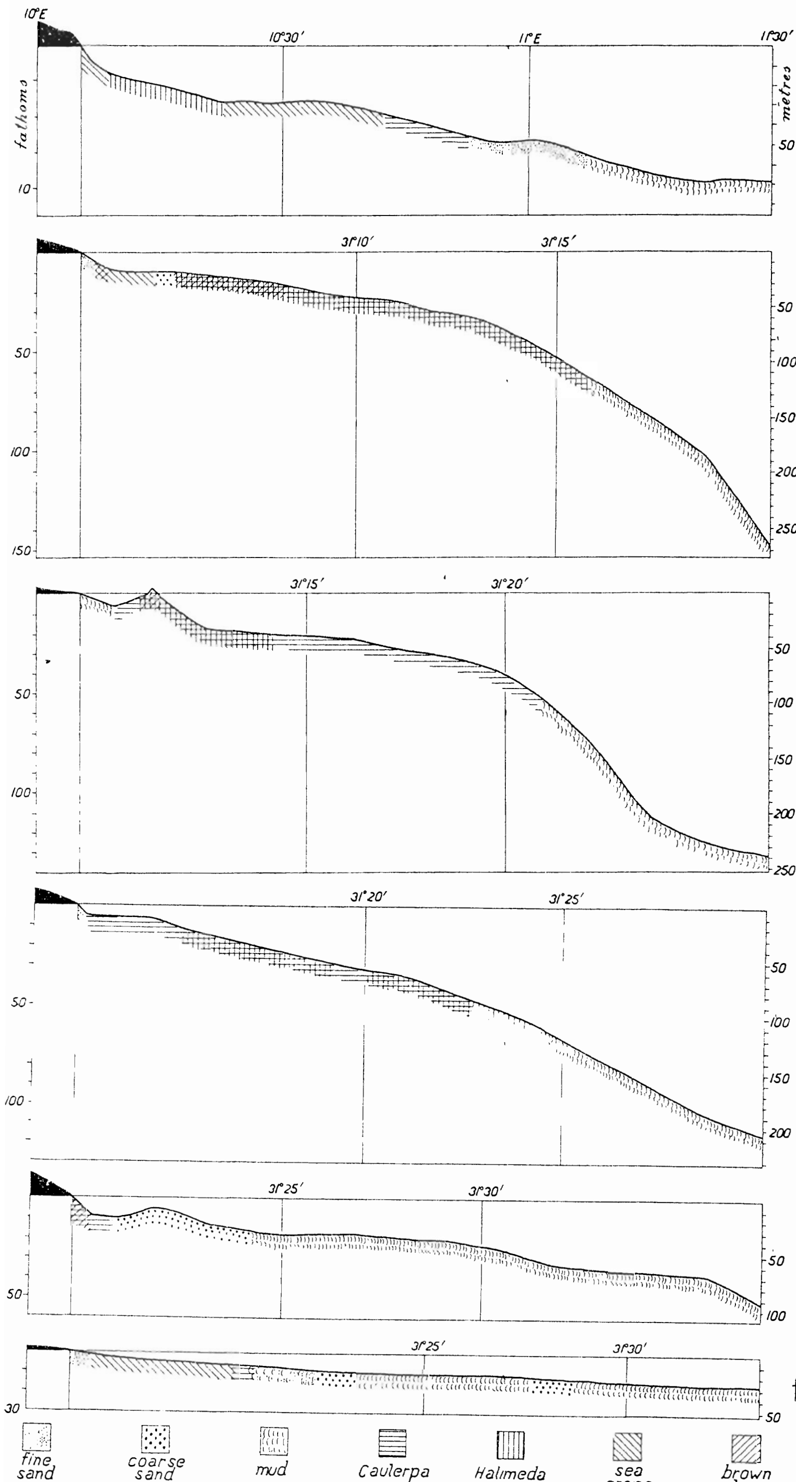

Fig 4. Bionomical profiles Sections through
(a) the gulf of Gabès E–W along 34° 10' N, after Le Danois 1925 somewhat modified,
(b–f) the coastal areas near Alexandria N–S,
(b) along 29° 40' E. L. (Western limit of the territory),
(c) along 29° 51' E. L. (Breakwater of West Harbour near El Aramil)
(d) along 29° 54' E. L. (Eastern edge of East Harbour near Silsila),
(e) along 30° 04' E. L. (In front of Abukir),
(f) along 30° 10' E. L (Connecting canal with Lake Edku).

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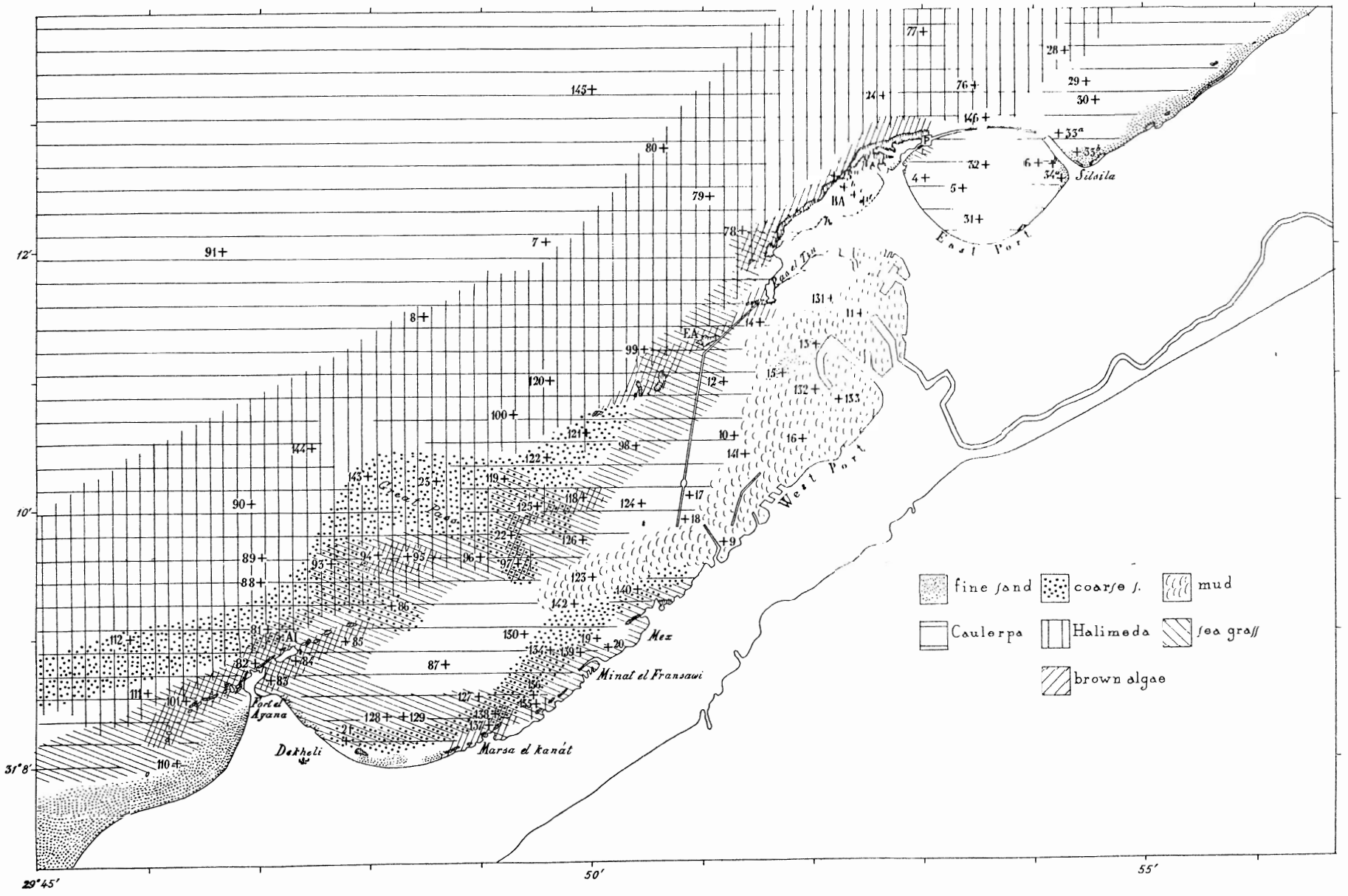

Chart I. Stations and bottoms of the near environment of Alexandria.
Al=Agami Island, BA=Bay Anfouchi, EA=El Aramil, FA=Fort Ada,
L=Laboratory, P=Pharo (=Fort Kayet Bey), Po=Barracks Ras el Tin.

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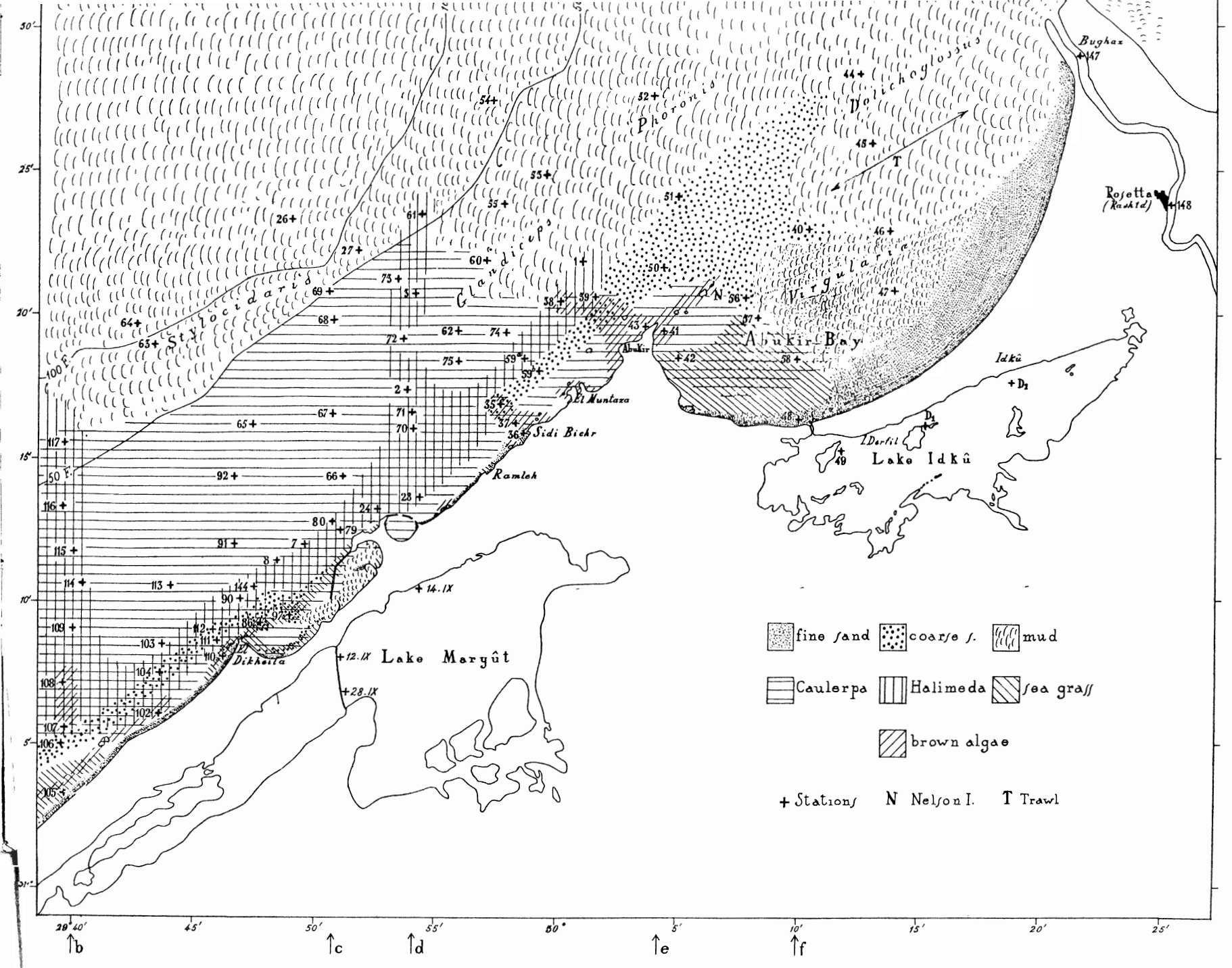

Chart II. Stations and bottoms of the far environment of Alexandria.
o–f Bionomical profiles (Fig. 4).