THE DISTRIBUTION OF CALCIUM CARBONATE
IN CONTINENTAL SHELF SEDIMENTS OF MEDITERRANEAN
SEA NORTH OF THE NILE DELTA IN U.A.R.

By

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ABSTRACT

Calcium carbonate is an important material necessary for building the skeletons of aquatic animals and is also considered as the chief source of ancient calcareous deposites.

The present studies have been undertaken to determine the nature and the distribution of carbonate content in the continental shelf sediments North of the delta, in relation to the topography of sea floor, the influceve of the river Nile draining into the sea and other environmental factors.

(A) *Preparation of samples for analysis* :

Fifty samples representing the area under investigation were analysed for carbonate content (Fig. 1) About 30 grams from each sample were soaked in distilled water, stirred and then let to stand overnight.   The supernatant liquid was then siphoned and the operation was repeated.   The samples afterwards were dried in an oven at 105ºC.   The washed and dried samples were finally powdered to pass through a 120 mesh sieve using an automatic mortar and were preserved in clean and well stoppered containers for analysis.

(B) *Method of analysis* :

The carbonate content (including both calcium and magnesium carbonate) was determined in the powdered samples according to the method described by U. S. D. A. 1954 and summarized as follows :

1.—Place 5 grams of the sample in 250 ml. beaker, add 100 ml. of 0.5 N Hcl by means of a pipette, cover with watch glass and boil gently for 5 minutes, cool, filter and wash all the acid from the residue with distilled water.

2.—Determine the amount of un-used acid by adding 2 drops of phenolphthaleine and back titrating with 0.25 N NaoH.

3.—The same procedure was carried out on a dried pure calcium carbonate instead of the sample and the amount of unused acid was determined which is equivalent to 100% of calcium carbonate.

Ca CO_3% in sample =

$$\frac{\text{The amount of un-used acid for sample}}{,, \qquad ,, \qquad ,, \qquad ,, \quad \text{pure Ca } CO_3}$$

(C) *Discussion of the results* :

The samples were divided into 3 divisions :

1.—fine sediments (less than 0.063 mm)

2.—coarse sediments (more than 0.063 mm)

3.—calcareous sediments (according to the type of deposits).

The first 2 divisions were divided according to the texture of the bulk sediments while the third was based on composition of bulk sediments. The data obtained for the carbonate content are listed in tables (1), (2), (3), for the five, coarse and calcareous sediments respectively. The results in these tables show that, the amount of calcium carbonate % for five samples varies between 5.69% and 13.60"% with an average of 7.53%. These samples are located at depths ranging from 10 to 60 meters. The percentage of calcium carbonate for coarse samples varies between 2.14% and 18.33% with an average of 7.2%. Such samples are located at depth ranging from 12 to 42 meters. The percentage of calcium carbonate in calcareous deposits varies between 26.78% and 69.83% with an average of 43.5%. Such samples are essentially formed of Bryozoa. tube worms, shells of Mollusca and Echinoderm and are mostly located at depths ranging from 59 to 98 meters, with the exception of one sample which is located at a depth of 38 meters representing shelly sand area.

There are two samples of calcareous deposits formed essentially of $CaCO_3$ with 30.12% and 84.77% carbonate content and located at 37 and 50 meters depth respectively to the Northeast of Alexandria.

Generally the calcium carbonate % in the bottom sediments in this area varies between 2.14% and 50.0% with an average of 12.85%. These are located at depths varying between 10 and 98 meters, with exception of 2 samples North-east of Alexandria formed mainly of calcium carbonate and located at depth 37 and 50 meters.

(D) *The statistical interrelation of Carbonate content* :

An attempt was made to find out the interrelations between the statistical constants derived from the chemical analysis for carbonate contents of the bottom sediments of the area investigated. Scatter diagrams ware made to find out the relations btween :

1.—depth and carbonate content.

2.—Log. Medium diameter and carbonate content.

1.— *The relations between depth and carbonate content* :

This relation is illustrated in Fig. (2). From this figure, it is clear that there is no relation between depth and carbonate content at depths less than 50 meters. However in areas deeper than 50 meters, the carbonate content increases with increase in depth.

2.—*The relation between Carbonate content and Log. median diameter* :

This relation is illustrated in Fig. (3). From this figure it is clear that there is no relation between Log. median diameter and carbonate content where the latter is less than 10%. However, where the carbonate% is greater than 10%, the log. median diameter increases with increase in carbonate %.

(E) *Areal Distribution of Carbonate Content.*

From the values of the calcium carbonate percentage at the corresponding stations, contours lines were drawn at intervals of 5% for contours larger than 10% In addition, contours representing 7% and 8% were also drawn as shown in Fig. (4).

This figure shows an increase in carbonate % seaward down to near the shelf edge but the rate of increase is not uniform.   It rises steadily from less than 7% near the shore to 15% at depths about 50 meters.   However in the area west of Boghaz el Borollus, there is a rapid increase seawards where contour 25 % meets an area of shelly sand with 69.84% calcium carbonate located at a depth of 38 meters.

Also there is an area North east of Alexandria with a high carbonate percentage.   The contour representing more than 15% calcium carbonate is present allover the area and shows a rapid increase of carbonate pecentage seawards down to the shelf edge.

TABLE 1.—PERCENTAGE OF CARBONATE IN FINE FRACTION

Sample No.	Depth in meters	Ca CO₃%	Type of Sediments
1	32	6.49	Fine
2	15	7.16	,,
3	10	6.54	,,
6	49	8.54	,,
7	16	7.96	,,
8	10	6.57	,,
12	36	9.30	,,
14	10	7.24	,,
16	13	7.45	,,
17	20	11.36	,,
18	20	8.45	,,
19	34	9.40	,,
23	33	7.36	,,
24	31	8.03	,,
26	25	8.56	,,
28	27	8.28	,,
30	40	10.80	,,
32	24	6.25	,,
37	15	8.41	,,
38	20	5.69	,,
40	14	8.06	,,
42	25	11.58	,,
43	15	7.90	,,
44	13	7.85	,,
46	14	7.95	,,
47	54	7.94	,,
49	60	13.66	,,
51	25	8.58	,,

TABLE 2.— PERCENTAGE OF CARBONATE IN COARSE FRACTION

Sample No.	Depth in meters	Carbonate %	Type of Sadiments
4	20	18.33	Coarse
25	15	4.71	,,
31	37	6.84	,,
33	12	2.72	,,
34	42	8.92	,,
39	28	2.14	,,
50	30	6.92	,,
53	25	6.41	,,
55	28	7.83	,,

Average carbonate %   7.2%

TABLE 3.— PERCENTAGE OF CARBONATE IN CALCAREOUS FRACTION

Sample No.	Depth in meters	Carbonate %	Type of Sediments
5	85	50.06	Bryozoa and Molluscs tubes
9	72	26.78	worms and echinoderms
10	90	50.09	,,
11	95	35.20	,,
21	59	34.23	,,
22	98	50.02	,,
27	70	34.68	,,
29	80	50.06	,,
35	60	34.23	,,
58	85	43.26	,,
36	38	69.84	Shelly sand
56	50	84.77	Calcareous deposits
57	37	30.12	,,

The interpretation of carbonate distribution :

In order to interprete the carbonate distribution in the area, it is necessary to take into account with the following factors :

1.—depths (Bottom Topography)

2.—Texture of the bottom sediments.

3.—The composition of the deposits.

4.—The distance from the drainage.

From Figure (4), it is clear that the calcium carbonate is present in lesser amounts near shore especially near the Rosetta, Damietta mouth and North east Boghaz el Borollus.   This observation can be explained as follows :

1.—The sediments derived from the River Nile have been shwon to contain very little carbonate content due to the solubility of calcium carbonate in fresh water. Accordingly the velocity of the Nile stream would be a factor governing the distribution of calcium carbonate in smaller amounts.   Therefore the carbonate contents increases with the increasing distance from the coast as well as from rivers branches and Boughazes of the lakes,

The rapid increase of carbonate seaward to the Northwest of Boughaz el Borollus, is due to the fact that the texture of the bottom is mainly sand which is considered a good environment of Mollusce and Echinoderms.   Also the presence 69.84% calcium carbonate at a depth of 38 meters in this area is due to the fact that the composition of the sediments is mainly shelly sand characterised by shells of Molluscs and Echinoderms and small amounts of tube worms.

The rapid increase in calcium carbonate seawards in lines nearly parallel to the coast may be due to :

1.—The increase of distance from the drainage (river branches and lakes).

2.—The composition of the sediments composed of Bryozoan and Mollusca, tube worms ... and pelagic forms.

3.— The configuration of the bottom shows that it slopes with an angle greater than the shore till 200 meter where the shelf breaks.

There is a large amount of calcium carbonate located north east of Alexandria. This may be due to the followings factors :

1.—The increase in the distance from the Nile (Rosetta branche.)

2.— The nature of the bottom here is calcareous and hence the deposit is purely calcium carbonate.

3.—The direction of the current from west to east prevents the precipitation of the Nile deposits in that area,

Summary and Conclusion :

The present study reveals that :

1.—The carbonate content of the bottom deposits is influenced by texture of the bottom, so it increases with the increase in grain size. Also calcium carbonate increases with the increase in depth. Thus there is a rapid increase of carbonate seawards down to near the shelf edge. The rate of increase is however not uniform.

2.—The relatively low amount of calcium carbonate in bottom sediments near shore may be due to the extreme dilution by enormous quantities of detrital brought by the River Nile and lakes.

3.—The marginal sediments of the Nile delta contain 5.69 — 13.66% Ca CO_3 These values are comparable to the carbonate content of the marginal deltas to that of Mississippi delta which contain 2 — 12% calcium carbonate (Shepard 1956) and to that of South Indian Deltas which contain 5 — 11% carbonate (M. Subba Rio 1958).

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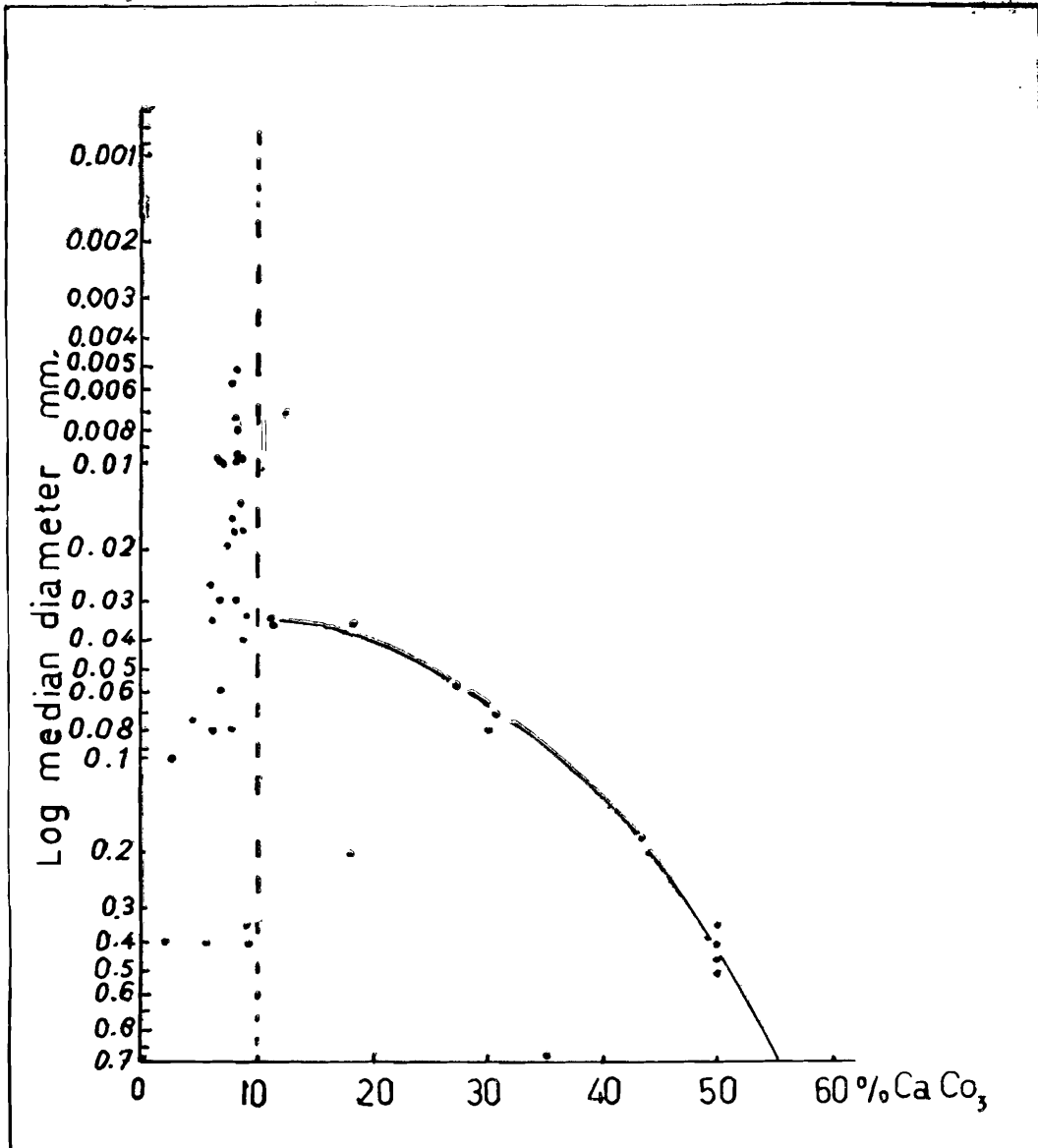
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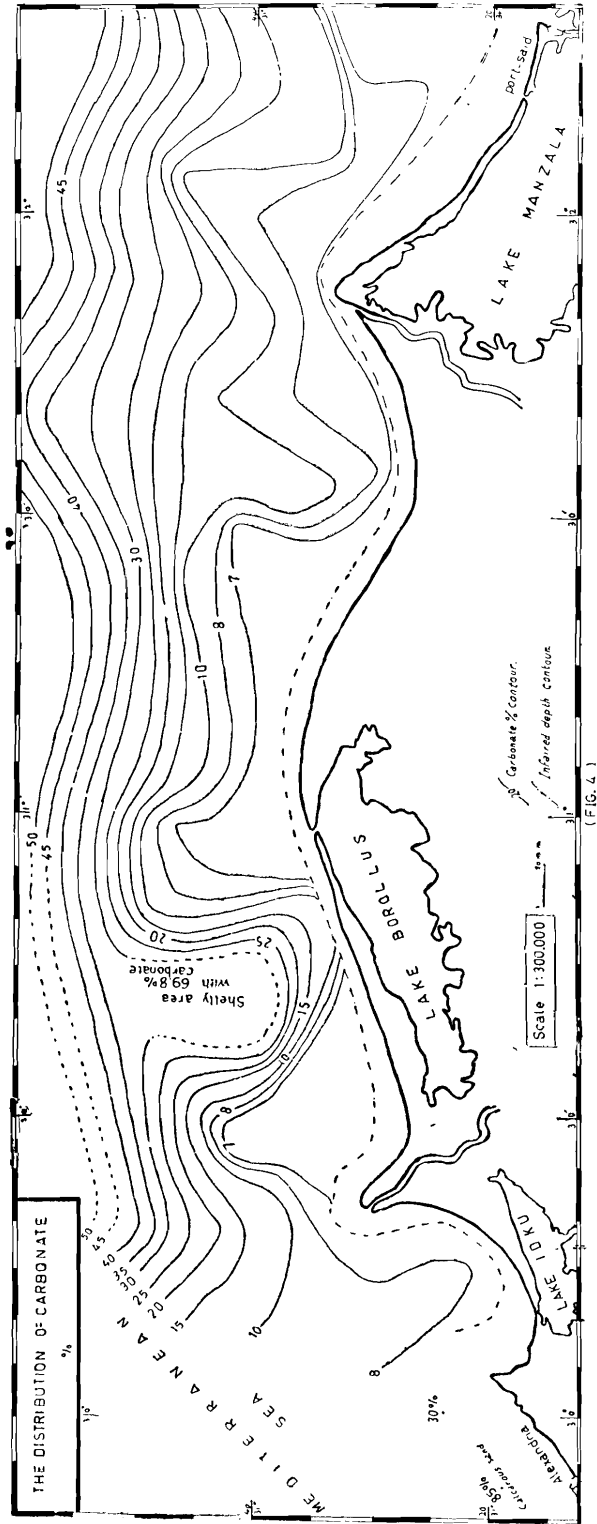200m

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(FIG. 1)
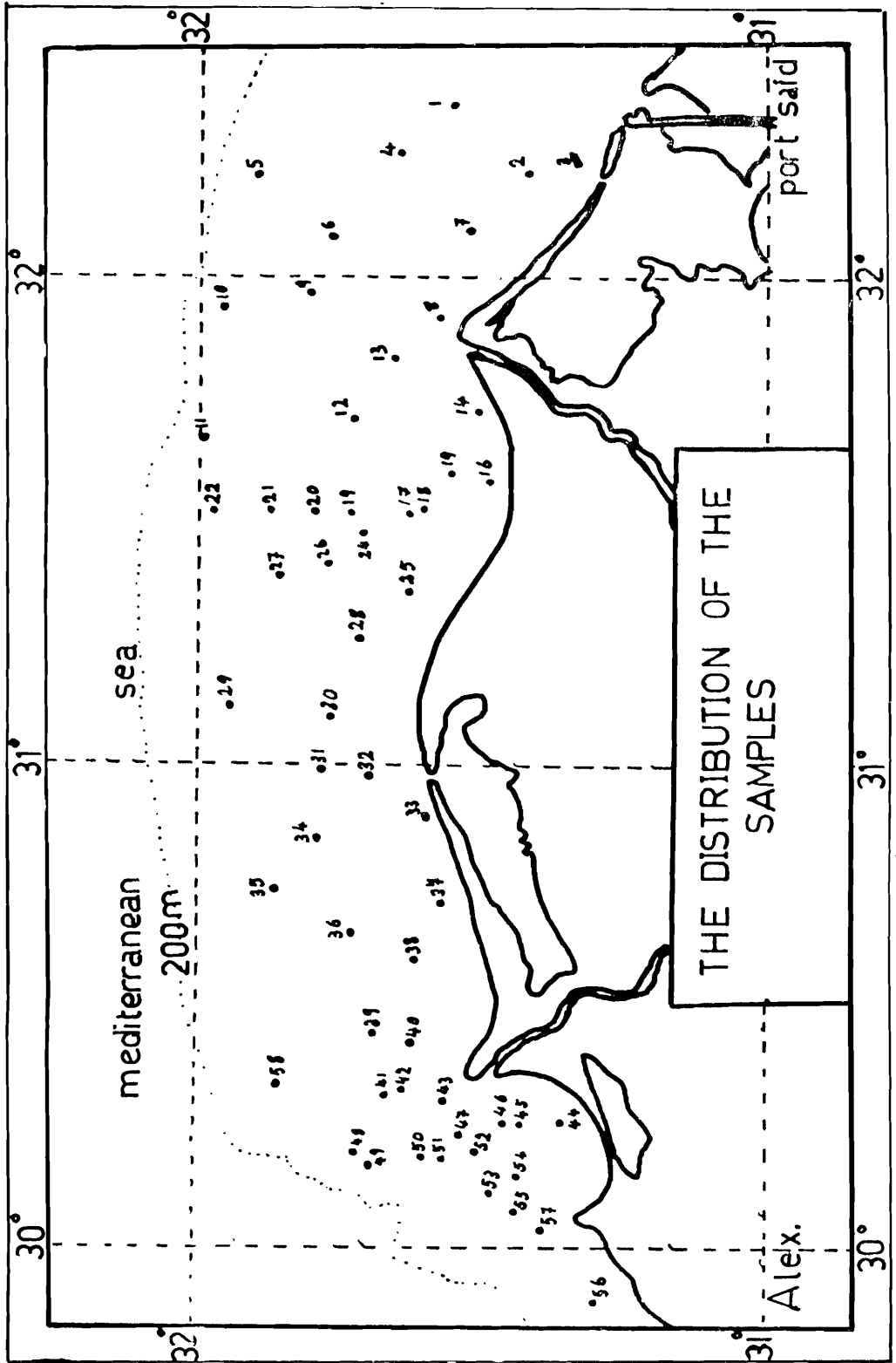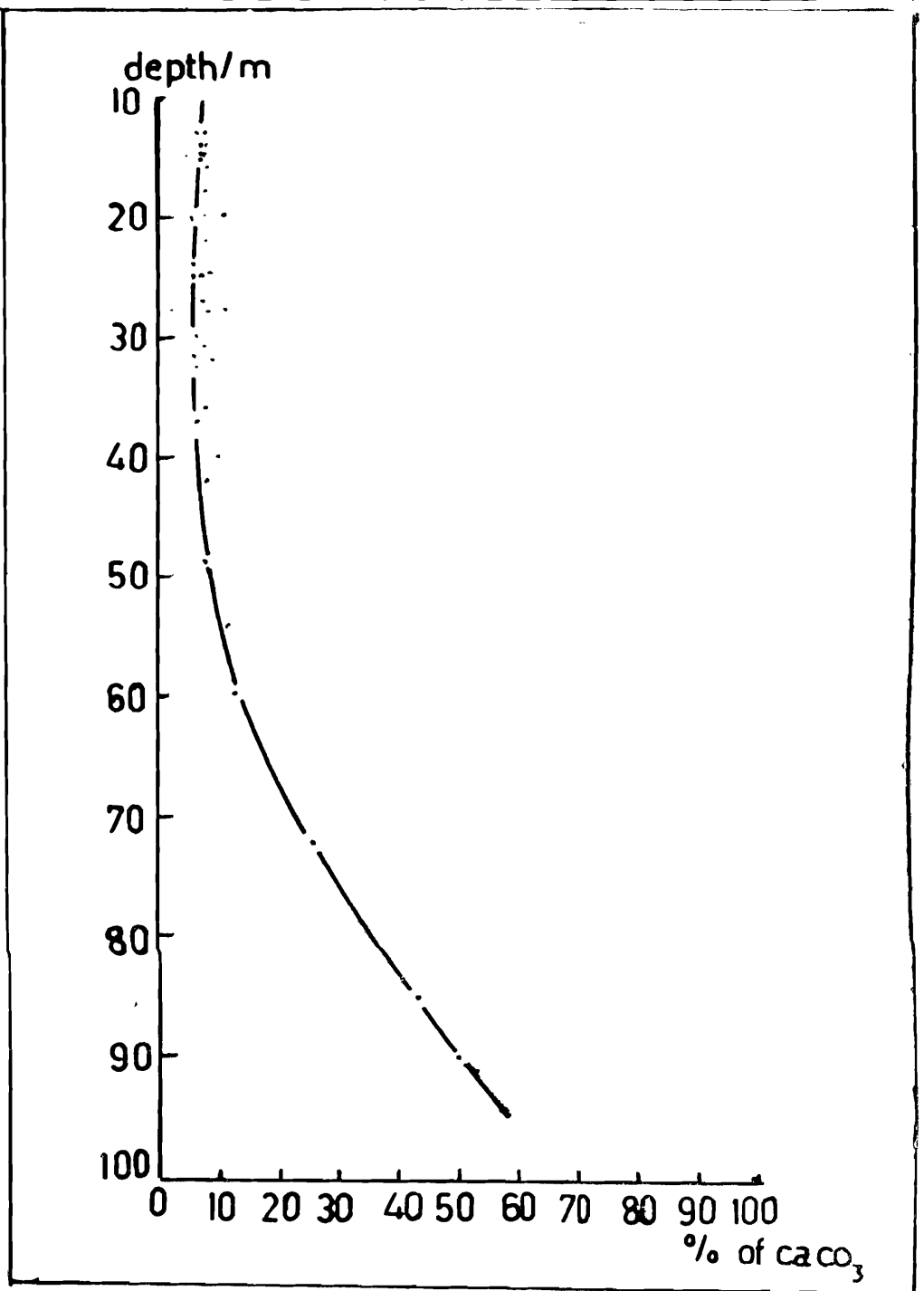
The Relation between Ca Co₃ contents & Depth
(FIG. 2)

The Relation between Median diameter & $CaCo_3$%

(FIG. 3)

(FIG. 4)

WATER POLLUTION IN SUEZ BAY

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ABSTRACT

To study the water pollution problem in Suez Bay it was necessary in the first place to study the hydrography of the Bay.   To do that seventeen trips were carried out in the Bay, in the period from May 1966 to June 1967, occupying eleven stations (fig. 1), and sampling the water at specific depths.   Standard methods were used for determining the salinity, temperature, oxygen concentration and currents.

INTRODUCTION

The Suez Bay area is subject to pollution from three main sources :

(1)   Industrial waste products which come from five great factories (three oil refineries, a fertlizer factory, and a paper mill).

(2)   Domestic drainage of Suez city.

(3)   Ships' oil and refuse.

Relevant facts about the industrial wastes, and domestic drainage appear in table (1).

TABLE (1)

Source of drains	Carrier	Volume of drains m³/h	Oil content p.p.m.	p.p. m/m³ of drains			
				Total hard.	Ca hard.	NaCl	T.D.S.
Fertlizer Co.	fresh w.	500	00	760	500	600	1200
Suez Pet.	saline w.	10,000	40	000	000	000	0000
Al–Nasr Pet. Co.	saline w.	10,000	35	000	000	000	0000
Misr Pet.	saline w.	1,000	35	000	000	000	0000
Kraft Co.	fresh w.	150	00	n.a.*	n.a.*	n.a.*	n.a.*
Domestic drainage	fresh w.	2,000	n.a.*	n.a.*	n.a.*	n.a.*	n.a.*

* n.a. = not available.

No reliable statistics about ships' pollution exists as the whole of the Red Sea is considered a closed area for refuse by international agreement.   Ships, however, wash their oil tanks and throw refuse surreptitiously in the Red Sea and Gulf of Suez.   When the prevailing wind is southern, as happened 22% of the year (Meshal 1967) all ships' effluents are piled up at the head of the Gulf viz. the Suez Bay.

Because the volume of the polluted waste cannot be ignored with respect to the total volume of the Bay, a study of the hydrography of the Suez Bay was made to enable making the best use of the Bay as a waste product sink, while preserving to the most its living resources.

Due to the Middle East war (June 1967), oil refineries in the Suez area got rid of a huge amounts of oil by throwing it in Suez Bay. causing serious oil pollution to both water and beaches.

Description of the Suez Bay :

The Suez Bay (fig. 1), is a shallow extension of the Gulf of Suez, roughly ellip-
tic in shape, with its major axis in the NE–SW direction. The average length
along the major axis is 13, 2 km, its average width along the minor axis is 8.8 km.
The mean depth is 10 m and the horizontal surface area is 77.13 km². The Bay
is connected to the Gulf of Suez through most of its south eastern side where a
channel is dredged to a depth of 12 m for navigational purposes. It is connected
to the Suez Canal by a dredged channel of 12 m depth through the same side. The
city of Suez and its major industries occupy the northern part of the Bay
(fig. 1).

Seasonal water movements in Suez Bay :

Meteorological conditions in the Red Sea–Indian Ocean region is the factor
that determines the seasonal variations of water in Suez Bay (Sverdrup 1942).
As a result of these conditions, water level in the Bay rises sharply during autumn,
reaching its maximum in September (Morcos 1960). It passes through its mean
level in May-June on its way down, and again during October-November as it rises.

The greatest exchange of water between the Red Sea and the adjacent parts
of the ocean takes place through the Straight of Bab-el-Mandeb. The exchange
through the Suez Canal is relatively minor. Great interest is attached to that
minor exchange however. It is an exchange which did not reach the equlibrium
state for salt flow, and it is between two essentially different regimes of water.

In the Suez region, northerly winds prevail during most of the year, in general
they are weak or moderate. When wind blows violently from NW, the water
in the northern 50 km of the Gulf of Suez does not agitate because it lies in the
wind shade of Ataqa Mountains on the western side of the Gulf. In winter, the
wind comes from the west most of the time, when they come from the SW they
become sufficiently strong as to produce high agitation in the Gulf of Suez.

The water circulation in Suez Bay, as well as the characteristics of water viz.
temperature and salinity are determined by four factors :

(1) The seasonal variation in water level in Suez Bay.

(2) The great salinity of Suez Canal water due to dissolution of the salt
layers of the Bitter Lakes. This water is usually driven into the Bay at the end
of summer season.

(3) The variation of level due to tides whose range varies between 80 cm at
neap tide and 140 cm at spring tide (Morcos 1960).

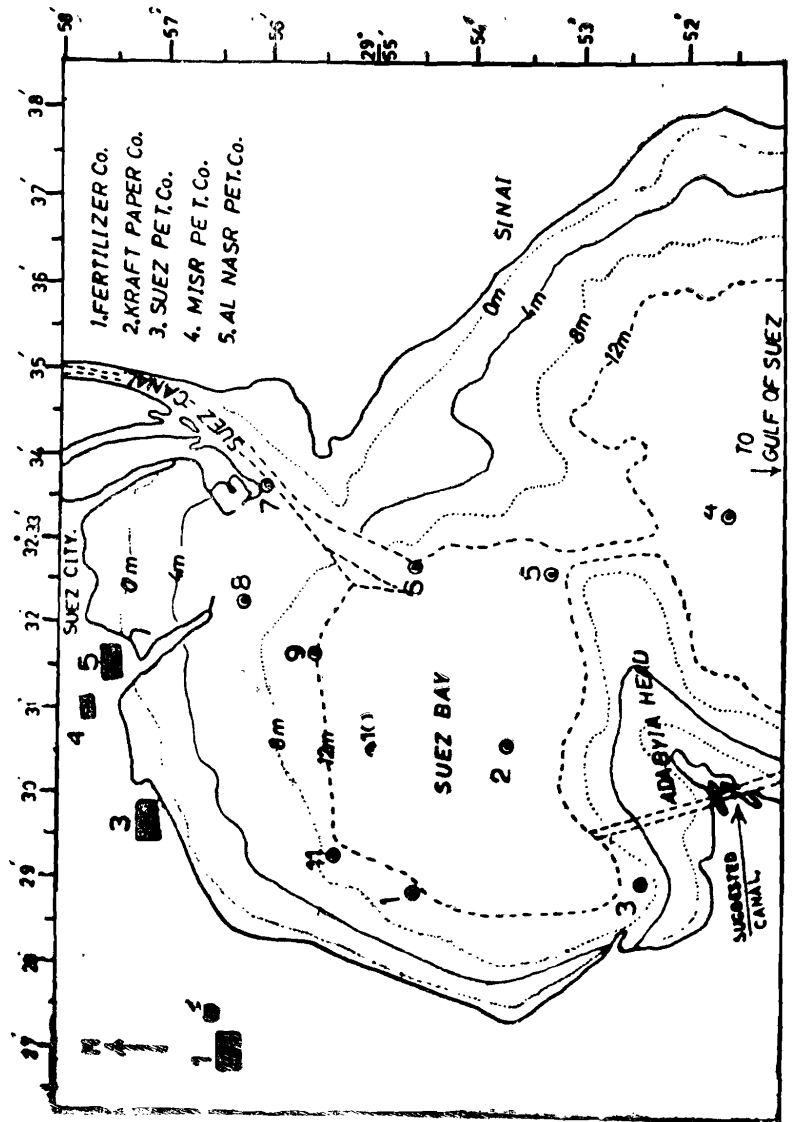(4) The prevailing local winds, and the daily cycle of heating.

FIG.1. SUEZ BAY, LOCATION OF STATIONS, SOURCES OF POLLUTION AND SUGGESTED CANAL.

The mean sea level is higher at Suez on the Red Sea than at Port Said on the Mediterranean Sea all the year except in July, August and September. Thus the surface flow is directed from the Red Sea to the Mediterranean Sea in all seasons except in July–September when it is reversed (Morcos (1960).

Results from hydrography of Suez Bay :

The Suez Bay has two sources of water: the Suez Canal and the Gulf of Suez. The circulation in the Bay can be followed generally by following the proper characteristics of the two water types. Observations showed that while salinity can be used as a tracer because the Canal water has a significantly higher salinity than the Gulf water, temperature is not suitable, as the temperatures of the two water bodies are near each other. Slight differences that occur between the Gulf water and Canal water diminish quickly as the water resides in the Bay.

From observations taken in the period from May 1966 to June 1967, (Meshal 1967), it was found that water from the Gulf of Suez enters the Bay on eastern side (Sinai side) while it leaves the Bay on the western side. Water from Suez Canal is generally deflected to the western coast. Therefore there is a persistent anticlockwise circulation in the Bay, as may result from Coriolis force, superimposed on any transient state. It also results in the maximum of salinity being found on the western side. The salinity and temperature do not vary appreciably with depth.

Due to the relatively great tidal range in the Bay, it was found that the currents were dominated by the tidal component. Currents at the entrance of the Suez Canal were always the strongest due to the constriction at the head of the Bay. Their direction was also confined to the direction of the Canal, either to or from. Thus the current observed at any station can be correlated more with the phase of the tide than with the permanent circulation in the seasonal situations.

Generally the oxygen concentration followed the temperature pattern being high at low temperatures and low at high temperatures. This is due to greater oxygen consumption at higher temperatures. Although the solubility of oxygen decreases with increasing salinity yet this factor does not produce any observable differences as the salinities over the whole Bay are not suffciently differentiated.

The discharge of water from factories did not appear to affect either the salinity, temperature, or the circulation, but it affected the oxygen concentration. The rejects of factories seemed to reduce its solubility and consume part of what was dissolved in water.

Maximum temperature was recorded in July/August, and minimum temperature in February (fig. 2). Maximum salinity was observed during September/October, and minimum during May. (fig 2).

During winter the water mass in the Bay became nearly uniform due to better mixing. Table (2) showes the differences between the maximum and minimum salinities and temperatures in winter months.
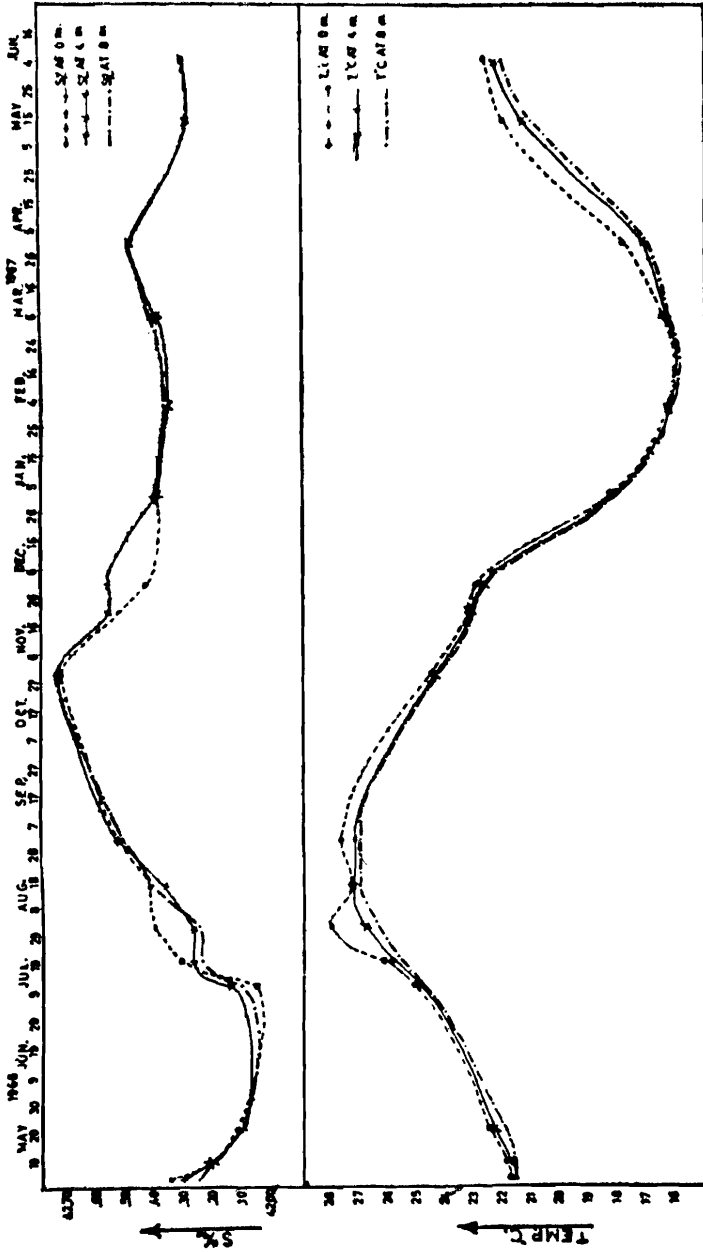
Fig. 2. MEAN VARIATION OF SALINITY AND TEMPERATURE IN SUEZ BAY.

TABLE 2.—DIFFERENCES BETWEEN MAX. AND MIN. SALINITIES
AND TEMPERATURES IN WINTER IN SUEZ BAY.

Month		Jan. 1967			Feb. 1967			March 1967		
Property Depth		0 m	4 m	8 m	0 m	4 m	8 m	0 m	4 m	8 m
Salinity ‰		0.05	0.05	0.10	0.15	0.10	0.10	0.15	0.15	0.15
Temp. C		0.50	0.45	0.30	0.90	0.90	0.90	0.30	0.50	0.35

Warm and less saline water from the Gulf entered the Bay in winter owing to the prevailing currents in the longtidunal direction of the Red Se and to the prevailing winds resulting in pilling of water at the northern end (Sverdrup 1942).. After February the salinity increased because the Bay had been filled with the Gulf water to its seasonal maximum, and the water of the Bay was subject to normal factors of winter evaporation which resulted in increasing the salinity. The temperature in the Bay decreased until an overturn started to happen in April and the water trapped in the Bay during winter time was released as cold saline water to the Gulf. Then the salinity of the Bay decreased again reaching its minimum in May (fig. 2).

The annual cycle begins again and the salinity increases, as is obvious from the upward trend showed by the salinity curve (fig. 2.)

The temperature variation followed a rough sinusoidal curve with maximum in summer and minimum in winter (fig. 2). In summer a significant difference was observed between the surface and subsurface layers as mixing was impeded due to the stability resulting from heating of the upper layers. But during autumn and winter this difference nearly disappeared due to mixing.

During summer months (July–September) the water level reaches its lowest value in the Bay. Owing to the prevailing wind blowing consistently on the Suez Canal from the north west, high salinity water from the Canal entered the Bay hugging the western side and raising the salinity of water in that side to its maximum value in the Bay.

The salinity in the eastern side and at the entrance to the Gulf is less than that in other parts of the Bay especially its western side and SW corner. Comparison between mean salinities during the year at both sides of the Bay appears in table (3).

As the main industries are found on the northern and northwestern coast of the Bay, the pollutants are carried by the Bay water along the western side to the south-western corner where the Adabyia Head forces the water to circumcirculate it to the Gulf.

TABLE 3.—MEAN SALINITIES $^o/_{oo}$ AT EASTERN
AND WESTERN SIDES.

Depth (m)	Eastern side	Western side	Diff.
0	42.26	42.52	0.26
4	42.28	42.48	0.20
8	42.28	42.48	0.20

The volume of the drainage amounts to about 24000 m³ per hour, while the volume of flow in and out of the Bay during a tidal cycle amounts to about 13.5 × 10⁶ m³ per hour.   The ratio of the first to the second is therefore 1.7 × 10⁻³. Thus the present volume of industrial drainages can be expanded in the Suez area to six times its existing volume before the pollutants reach 1/100 of the tidal flushing volume.   It is estimated that until that time is reached no real danger of polluting the Bay water exists by undue concentration of the industerial drainages.   The water circulation can easily transpoit the pollutants out of the Bay. The first area that will be affected by concentration will be the southwestern corner of the Bay west of Adabyia Head.

The tidal motion is assumed to take place within all the volume of the Suez Bay due to its shallowness as the average depth is about 10 m only.   The tidal volume in the Bay amounts to: 77.13 × 10⁷ m³, and the tidal prism volume is about: 77.13 × 10⁶ m³.   Therefore the mixing ratio: $a = 0.10$ per tidal cycle.

If the concentration of pollutants in the Bay be C, then the rate of change of the concentration is expressed by an equation of the form, (Gade 1963), :

$$\frac{dC}{dt} + aC = T$$

where T is the rate of supply of C per unit volume.   T is very small so its can be assumed as equal to zero.   The general solution of this equation is given by :

$$C = C_0 \, e^{-at}$$

where C_o is the initial concentration that is the concentration at $t = O$, and which is the constant of integration.   The half life time is given by:

$$\frac{C}{C_o} = e^{-at}$$

therefore $1/2 = e^{-at}$ that is :

$$t = \frac{0.6931}{a} = \frac{0.6931}{0.10} = 6.931 \text{ per tidal cycle} = 3.587 \text{ days}$$

The tidal prism concept has been used to evaluate the ability of the Bay to remove pollution. This method assumes that the volume of water entering on the flood is completely free from pollution. It becomes completely mixed with the water already present in the Bay before the tide is reversed. The mixed water leaving on the ebb tide is then completely removed. In general neither of these assumption is justified and the flushing effect may be only a fraction of the estimated from the tidal prism concept.

Conclusions and recommendations :

Water from the Gulf of Suez enters the Bay via the eastern side. It meets the Canal water which enters the Bay hugging the western side and reaches the south western corner where the Adabyia Head forces the water to circumcirculate it to the Gulf. Thus there is a permanent anticlockwise circulation in the Bay and a clockwise circulation around the Adabyia Head. This circulation fluctuates with the tidal cycle. The incomming current is strengthened during the rising phase of the tide and the outgoing current is strengthened during the falling phase. The tidal current is often sufficiently strong as to mask the permanent circulation.

Because the existing industry and the planned expansions in Suez area are found on the the northern and western coast of the Bay, beaches from Suez to Adabyia on the western side are doomed. This is not very serious as beaches on the eastern side of the Bay (Sinai side) are free from pollution. They should be developed as the natural recreational area for the industrial development in the Suez area. Any industry producing pollutants should not be allowed on the eastern side of the Bay However, if beaches on the northern and western coast are to be saved, better conditions can be obtained by digging a canal crossing the Adabyia Head. It would be capable of carrying an average of 5×10^5 m^3/h. down to the Gulf (fig. 1). This canal must be kept dredged. It will facilitate the outflow of the Bay water into the Gulf.

Inforcement of the international agreement of keeping the Red Sea as a closed area for discharge of oil should be more actively persued by the concerned authorities.

Petroleum factories in the area should use oil–water seperators which must be designed for the maximum flow expected.

At present, the oil pollution condition of beaches and water in Suez Bay area is very serious as a result of throwing huge amounts of oil in the Bay during the Middle East war in June 1967. It is recommended that methods suggested in appendices I and II for the treatment and disposal of floating oil and removal of oil from contaminated beaches should be applied in Suez Bay area.

APPENDIX 1

Methods Suggested for Treatment and Disposalof Floating Oil :

(A) *Covering the Floating Oil with Fibrous Material:*

Nearly complete removal of floating oil can be obtained by coating the patch with fibrous, cobweb–like threads of plastic material which are produced and applied by spraying a solution of plastic in a volatile solvent such as acetone. The oil and plastic form a monoeurable raft which can be gathered up manually or with the aid of a simple coveyer system.   This has been carried out successfully on a pilot scale and under practical conditions (Warren Spring Lab. RR/ES/40).

This method may be expensive, but costs can be reduced by replacing the plastic material by other natural and cheap fibrous materials such as sisal string, dry hay or rice straw.   The problem with this method is the provision of suitable spraying or distributing equipments.

(B) *Sinking With Powdered Solids* :

An apparently promising method for the treatment of floating oil is the distribution over the oil patch of a powder or fine granular solid of high true density which admixes with the oil, addheres to it and sinks it.   An essential requirement is that the solid material should so fix and retain the oil that once submerged no oil is released to renew the contamination.   Common and cheap materials such as sand, brickdust clinder, portland cement and limestone powder have been found to be equally effective for sinking oil (Warren Spring Lab. RR/ES/40, 1963).. If oil could be treated with sufficiently large quantity of these powders it might be permanently immobilised.   The most convenient time of the year is summer months especially June and July when there is no strong winds which may disturb the spraying and distributing of the powdered solid, as well as the water surface in Suez Bay in these months is completely calm.

The Suez Bay is not a fishing area, so there is no fear that the sunken oil is liable to foul fishing gear.   Distribution of the powdered solid is suggested by a helicopter.

(C) *Dispersion With Emulsifiers* :

Removing of floating oil can be achieved by spraying with an efficient solvent/ emulsifier mixture and subsequently agitating with a powerful jet of water.   An alternative procedure is to inject the emulsifier or cleanser into the hose stream itself using a branch pipe of the type used to inject a foaming agent into a fire house.   In this way the water jet acts as a distributer and mixer.

A very efficient dispersant is obtained by preparing a 10 % solution of a non–ionic emulsifier (of the nonylphenol–ethylene oxide condesate type) in an aromatic solvent such as coal–tarn naphtha.   The amount of cleanser required is from 25–50 per cent by volume of the oil depending upon the viscosity of the latter.

The major disadvantage of the use of emulsifier / solvent mixtures is their high toxity to shell fish at concentrations of the order of 10 p.p.m. in sea water (Warren Spring Lab. RR/ES/40, 1963).

It is preferably applied to Suez Bay in autumn and winter months when the sea surface is rough to allow great mixing.

Inview of the relatively great volume of water of Suez Bay, the tidal mixing that occurs twice a day and chosing the time of the year when the sea is rough, it is believed that even if large quantities were used the chance of serious damage to commercial fish or shell–fish would be very small compared with the advantages to the holiday and touring industry in cleaning water and beaches.

This method was succesfully applied in the Torrey Canyon disaster in Britain and it was concluded that there was little doubt that these chemicals cause considerable damage to the planktonic organisms which are present in the water to which they had been added (Simpson 1968).

(Condensed from:
Warren Spring Lab.
England, 1963, RR/ES/40.
with slight modification)

APPENDIX II

The Removal of Oil from Contaminated Beaches by Emulsifier Solvent Mixture :

It consists of spraying the contaminated area with the cleaning fluid at a rate which not, in most cases, exceeds a quarter of a gallon per square meter. The cleaning fluid should be applied not less than thirty minutes and not more than one hour before the tide reaches the area. This is nesessary to allow sufficient time for the fluid to penetrate the oil, but not long enough for the solvent to evaporate. Washing of beaches can be left to the action of the tide. It is strongly recommended that the area be hosed down with sea water as the tide approaches to allow the oil to disperse quickly into a large volume of water.

It is suggested that for the greatest economy a multinozzle spray lance should be used, this will enable the mixture to be applied uniformly over a reasonable width of beach. In rough surface beaches the use of stiff bruch during the hosing down process would facilitate the removal of oil. It is recommended that the process of cleaning Suez Bay area would be carried in summer days especially afternoon when the temperature is maximum for the day to allow contaminated oil to be free flowing.

In each case consulation with fisheries interests is needed before cleansers spraying is authorised either at sea or on the shore.

Condensed with slight modification from :

Warren Spring Lab. England, 1963. RR/ES/39.

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WATER-EFFECT ON DIFFERENT SYNTHETIC FIBRES AND TREATED COTTON USED AS NET MATERIAL IN U.A.R.

by

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INTRODUCTION

When nylon was discovered, it was called the miracle of science especially for fishing industires because it provides easier living for the fishermen. Numerous types of synthetic fibres have been discovered afterwards carrying the most important property of nylon which is its rot-proofness. This property was the main promotion which encouraged the fisheirman to use these synthetic fibres to make his nets replacing the natural fibres. V. Brandt (1944) reported that fyke nets made of Polyvinylchloride (Pe Ce) have been in continuous use for ever 15 years.

This does not mean that the synthetic fibres can be used continuously without deterioration. Studies have been done to know the characters of synthetic fibres from all points of view. The weathering effects tests gave some facts that synthetic fibres are affected by light. This effect varies according to different groups of fibres, morevoer to the types of fibres processed from the same group.

With regard to their resistance to light and weathering, synthetic fibres show extra-ordinary great difference in their degree of resistance to light and weathering, in contrast with the resistance of nets made of vegetable fibres which has been little observed (Klust 1957). These test fibres are affected by light and weathering in a small degree if it is compared with that caused by cellulose digesting microorganisms in water. This character - for the nautural fibres, especially cotton, is the main drawback which encouraged the fisherman to replace this natural material fibre nets with the synthetic ones.

Because of the higher initial cost of synthetic nets, it became necessary to gain knowledge about the all factors which could shorten the time of their usefulness. In U.A.R., cotton fibres are mainly used in net manufacture, because of its high quality among natural fibres and-at the same time-is of low price if compared with the prices of imported synthetic nets.

Taking into consideration the importance of cotton twines to net industry, the author found that it is important to carry out the following work to clarify these points :

(a) The sea water effect on the synthetic fibres of different groups and in the same time to test the different types of fibres of the same group, especially the polyamide one (PA) .

(b) The sea and brackish water effect on the treated cotton by the synthetic resins (Arigal)

(c) The sea and brackish water activity to rotting on the natural cotton fibres twisted in twines of the same strength nearly equal to that of treated cotton twines.

MATERIAL AND METHODS

To carry on the water effect tests, the following materials have been used :

1.—*Synthetic fibres* :

Trade name	*Group of fibres*
(*a*) Perlon staple Nm 20/9	Polyamides
(*b*) Anzalon, Td 210 × 15	,,
(*c*) Perlon monofilament 0.25×8	,,
(*d*) Trevira Nm 20/9	Polyester
(*e*) Nymplex. 0.25/0, 0.45 × 6	Polyethylene
(*f*) Fon Td 500 × 6	Polypropylene
(*g*) Newlon 20/18	Polyvenylalcahol

2.—Treated cotton under a trade mark Arigal which is produced by Ciba li
mited (Switzerland).

3.—Raw material of cotton locally manufactured in U.A.R. textile factories
as twines Ne. 20/9

The synthetic and treated cotton twines were grouped in bunches of 60 twi-
nes 30 cm in lenght. The test was carried under natural conditions (V. Brandt
1957) as the twines were immersed under water surface in the field.

The twines were left in the water and their resistance was tested on samples
of 5 threads, taken out at intervals varied from one month to four months.

The tests of rotting action of the water where the synthetic and treated cotton
twines tested was monthly determined by immersing the raw cotton twines Ne
20/9 on the first day of each month. Four bunches of 10 twines, were used in the
experiment. After one, two or three weeks and on the last day of the month,
one bunch was taken from the water to determine the average loss in breadking
strenght of the twines. This method was changed in water by higher rotting ac-
tivity, where 100 percent loss of breaking strength occured before the end of the
month, so the sample were replaced by new ones when they had lost approximate-
ly three quarters of their preaking strength. The losses in breaking strenght of
all samples were added up to establish the monthly rotting activity.

The resistance was measured by means of the strenght testing machine and the
data for loss or remain in strength were used to indicate the resistance to water-
effect for the different materials tested and the rotting action of the water where
these samples immersed.

Stations of experiments :

Two stations were elected to immerse the twines. One is the same station
chosen by the author in the Mediterranean region to test net material, synthetic
and preserved twines (Koura 1963). Another station was chosen in the   strait
connecting a lake with the Mediterranean Sea near Alexandria (Lake Edkou)
where there is continuous exchange of water between the lake and the sea. The
environment of this station is somewhat different than that of the sea station where
the salinity is always lower and the phosphate salts are higher than that of the sea
as its water is drained from an eutrophic lake.

II.—Water-effect on synthetic and treated cotton twines :

(a) Synthetic twines :

The samples have been immersed in the sea water station for a period of 488 days extending from 9-3-1963 to 9-7-1964. The remaining breaking strength and its percentage from the initial strength is shown in table (1) and figure (1).

The polyamide twines represented in different forms of fibres as Perlon staple, Anzalon continuous and Perlon monofilament show extraordinary great difference in their degree of resistance to water effect. Perlon staple was greatly injured and its wet strenght decreased gradually from 100 percent to 26 percent at the end of the experiment. Anzalon continuous, its strength was constant for a long time extended from 9-3 to 9-10-1963, then the strength began to decrease gradually afterwards until it reached 80% at the end of the period, but the Perlon monofilament, alghough was not affected at all for a long time but abruptly, its strenght fell down from 99 percent in 9-4 to 69 percent in 9-7 1964.

The trevira twines (Polyester group) was not affected at all as its strenght-after this period of immersion - remained the same, in contrast with the Nymplex from polyethylene group which is completely resistant to water-effect for a long time and then its strenght dropped to 48 percent in the last three months. The same behaviour was followed by polypropylene and polyvinylalcohol twines whose strength fell down to 50 and 68 percents respectively.

(b) Treated cotton by synthetic resin Arigal :

The cotton yarns treated with this material has been tested in the sea and brackish waters. In the sea station (Table 1 & Fig. 1) the immersion and strength tests were followed for the same period of syynthetic twines (488 days) but in the brackish station, unfortunately, was followed for four months only (from 31.5 to 30.7.1964) because of the loss of the material. In the sea water Arigal was not injured severely. Its strenght remained constant for a long time (from 9.3 1963 to 9.1.1964) then began to fall gradually in the last months of immersion until it reached 78 percent in 9.7 1964.

In the brackish water, the strenght of Arigal was not affected at all until the end of the four months.

(c) Untreated cotton :

The raw cotton material twisted as twines Ne 20/9 was used which of wet strength 4.6 kilogram. This srength was nearly equal to the strenght of treated cotton (Arigal) tested, which was 5.0 kilogram for sample tested in sea water and 4.6 kilogram for samples tested in brackish water.

These twines were tested monthly all the year round (see material and methods) to show the rotting activity of the water where the synthetic and treated cotton tested.

The behaviour of these twines in the sea water was completely different than that of the other materials. The rotting activity was determined monthly (Table 2 and Fig. 2). By following the data it is clear that the twines are highly affected

in July and August than in the period from November to March where the actual strength fell down under 50 percent which is the limit of use of the net.   The loss in strength may reach this percentage in the second or the third week.

In September–October and April-May periods, the rotting activity was low in these months when it is compared with the previons other months. The loss in strength did not fall under the 50 pereent level.   It might be due to the accumulation of water fauna and flora mainly of green algae which inhibited the activity of micro-organisms to digest the cellulose. This view is supported by the values of rotting activity in winter.   These values are more or less equal to that of summer months.   In winter the temperature falls to the minimum as it reached 15.6°C in February.

This temperature is considered to be favourable to micro-organisms especially bacteria to attack the cellulose. Klust and Mann (1954) estimated that the process of rotting does not stop until 4°C and the rate increases when the temperature increases.

Accordingly, it can be concluded that temperature, in our weters, is high enough all the year around and might not be taken as the main factor controlling the process of rotting but the fouling and decaying agaents which might reduce or increase the action of bacteria on cellulose material.   These two factors are limited in action, increase or decease, by the effect of water current.

The values of rotting activity of the water in station 1I (Brackish water) show that it is much higher all the year around (Table 3 & Fig. 3) than that of the sea water in the Mediterranean. It increases gradually from winter to summer months.   In autumn another unexpected increase was observed although the temperature tends to decrease.   This increase in rotting activity may be due to the Nile water flood effect which accelerates the activity of micro–organisms to digest cellulose.

Ball (1939) estimated a series of curves deduced from the analysis carried out by Mr.Mosseir, representing the annual courses of the variations in the gram equivalent of the principal bases and acids per hundred grames of the total dissolved solids in the Nile water at Cairo. It is clear from these curves that Calcium (Ca) concentration increases in flood months (August to November).

In addition, the phosphates of the inflowing Nile water to the hydrodrome (an impoundment near Alexandria) is of a very high concentration (Elster, Jensen & co–workers 1954–1956). The concentration of phosphates fluctuate between 0.2 to 0.4 PO_4=–P µg. at/L in the period from January to August and then increases gradually from about 0.5/µg at./L in September and reaches the maximum in October (1.00/µg at/L) then begins to decrease again until it reaches the normal value in January.

Klust & Mann (1954) determined that any increase in Ca ions in presence of phosphate ions activate the process of rotting.

Thus, it can be concluded that the higher rotting in brackish water than that of the sea water and the un–expected increase in this activity in the time of the Nile flood is due to the continuous rinsing for the twines and the decaying agents present in higher concentration than that of the sea water in the Mediterranean Sea and the additional increase in these salts in the time of flood.

DISCUSSION

Synthetic fibres have –in recent years–been used in increasing quantities in U.A.R because they are strong and light, absorb very little water besides the important character which is their rotproofness. Then the advantages of synthetic fibres greatly out weighed their disadvantages but there is one main drawback does not encourage the fisherman in Egypt to use them, which is the high price. Concerning the natural fibres especially cotton although cheaper than synthetic materials in general but has the main drawback which is not rot–proof.

This character caused great loss in cotton net material used, and the fisherman may pay in the price of several nets of cotton more than that on one synthetic similar net may be used instead. As we are a country considered to be a producer for the best types of cotton fibres from which the thinnest twines can be made, the cotton nets are traditionally used and the fisherman knows by experience what thickness of twines demanded, moreover, knows exactly its effect on the efficiency of his nets. So, it is difficult to replace the cotton μ aterial by synthetic ones abruptly.

The cotton fibres treated with Arigal C gave good results in these studies from the point of rot–proofness not less than the synthetic fibres tested (Fig.4). The process of imprignating the cotton yarns in this synthetic resin is done once forever and the twines used and donot require the repeated cutch treatment. Then the cutch imported in hard currency for fisheries industry will be stopped. The increase in price of the treated cotton will be compensated by the price payed for cutch. The fisherman will gain more than that, the duration of use for this nets made from this treated cotton.

These results for treated cotton tests will not prevent the authority to introduce the synthetic fibres in Egypt, because the efficiency of the gear will be an important promotive factor to replace this treated cotton with the suitable synthetic fibres such as the monofilament twines of high efficiency in the clear waters or to increase the efficiency of the dragged gear by increasing the process of filtration. This last problem is affecting the efficiency of the Italian Otter- trawl used in our waters.

The studies done to show the water effect on different synthetic fibres in the Mediterranean waters, may help us to choice the suitable material to be used in the coming steps to develop the trawl nets in Egypt. Polyamides continuous and monofilaments gave good water resistance more or less similar to Arigal, so the Polyamide continuous can be used in making trawl nets and purse seines to have benefit of its very high breaking strength, high abrasion resistance and high elasticity (Klust, 1957).

The polamide monofilament can be used to make trammel and gill nets fishing in clear waters especially in Lake Quaroun and Lake Nasser which in its way to be formed behind the High Dam. The use of these nets will be of great value to increase the efficiency of this type of nets when used in clear water of the Nile after the time of flood which extends from August to November every year.

TABLE 1.—THE STRENGTH OF SYNTHETIC AND TREATED COTTON TWINES TREATED IN U.A.R. SEA WATERS FROM 9.4.1963–9.7.1964

No.	Fibres	Trade Name	Wet strength (in kilograms)						
			9.3.63	9.4.63	9.6.63	9.10.63	9.1.64	9.4.64	9.7.64
1	Polyamide staple	Perlon staple, Nm 20 / 9	13.3 (100)	11.97 (90)	9.177 (69)	7.45 (56)	7.24 (54)	5.26 (40)	3.50 (26)
2	Poly. continuous	Anzalon Td 210 x 15	13.50 (100)	14.99 (111)	13.91 (103)	13.64 (101)	12.42 (92)	12.70 (94)	10.80 (80)
3	Poly. monofilament	Perlon 0,25 mm X8	13.10 (100)	13.23 (101)	12.05 (92)	12.83 (95)	12.86 (98)	13.00 (99)	9.10 (69)
4	Polyester	Trevira Nm 20/9	15.40 (100)	15.66 (102)	14.78 (96)	15.55 (101)	16.24 (105)	16.52 (107)	15.70 (101)
5	Polyethylene	Nymplex 0,25/0, 0.45 X 6	18.40 (100)	17.87 (97)	19.69 (107)	20.98 (114)	23.96 (130)	22.08 (120)	8.90 (48)
6	Polypropylene	Fon Td 500 X 6	16.40 (100)	16.73 (102)	15.42 (94)	16.73 (102)	16.74 (102)	16.26 (99)	8.30 (51)
7	Polyvinyl alcohol	Nelon 20/18	13.10 (100)	13.76 (105)	13.36 (102)	13.76 (105)	13.10 (100)	13.18 (101)	9.00 (69)
8	Cotton	Arigal	5.00 (100)	5.00 (100)	5.70 (114)	5.30 (106)	5.04 (101)	4.69 (94)	3.90 (78)

TABLE 2.—MONTHLY ROTTING ACTIVITY OF SEA WATER (STATION I)

(Egyptian Cotton Twines Ne 20/9. breaking strength 4.6 kg)

Year	Month	Loss in strength after				value per month	value per day
		1 week	2 weeks	3 weeks	4 weeks		
1963	July (7)	2.8 (39.1)	1.7 (63.0)	1.7 (63.0)	1.5 (67.0)	67.0	2.2
	August (8)	3.1 (32.6)	2.1 (54.3)	1.5 (67.4)	1.4 (70.0)	70.0	2.3
	Sept. (9)	4.4 (4.3)	3.9 (15.2)	3.3 (28.3)	3.2 (30.0)	30.0	1.0
	October (10)	4.4 (4.3)	3.9 (15.2)	3.5 (23.9)	3.1 (33.0)	33.0	1.1
	November (11)	4.6 (0)	3.0 (34.8)	2.2 (52.2)	2.1 (54.0)	54.0	1.8
	December (12)	3.5 (23.9)	2.8 (39.1)	2.3 (50.0)	1.5 (67.0)	67.0	2.2
1964	January (1)	3.3 (28.3)	3.2 (30.4)	2.6 (43.5)	1.5 (67.0)	67.0	2.2
	February (2)	4.0 (13.0)	2.6 (43.5)		1.6* (65.0)	65.0	2.2
	March (3)	5.1 —	3.2 (30.4)	lost —	1.9 (59.0)	59.0	1.9
	April (4)	4.8 —	4.5 (2.2)	lost —	2.9 (37.0)	37.0	1.2
	May (5)	4.3 (6.5)	4.1 (10.9)	3.9 (15.2)	2.8 (39.0)	39.0	1.3
	June (6)	4.4 (4.3)	3.9 (15.2)	2.8 (39.0)	2.0 (57.0)	57.0	1.9

* Period ten days
  Percentage of loss in strength
  between barentheses

TABLE 3.—MONTHLY ROTTING ACTIVITY OF BRACKISH WATER (STATION 11) (EGYPTIAN COTON TWINES Ne 20/9 BREAKING STRENGTH 4.6 KGM)

Year	Month		loss in strength after				value per month	value per day
			1 week	2 weeks	3 weeks	4 weeks		
1963	August	(8)	2.5 (146)	0.6 (87)	3.4* (26)	0.3* (93)	180	5.8
	September	(9)	2.4 (48)	0.8 (83)	1.7* (63)	0.0* (100)	183	6.1
	October	(10)	0.9 (80)	0.0 (100)	4.0* (91)	0.0* (100)	200	6.5
	November	(11)	1.6 (65)	0.0 (100)	2.4* (48)	0.0* (100)	200	6.7
	December	(12)	2.1 (54)	0.8 (83)	3.7* (20)	1.1* (76)	159	5.1
1964	January	(1)	3.6 (22)	0.6 (87)	3.3* (28)	2.2* (52)	139	4.5
	February	(2)	2.3 (50)	0.6° (87)		2.9* (37)	124	4.3
	March	(3)	2.2 (52)	0.8 (83)	3.7* (20)	1.1* (76)	159	5.1
	April	(4)	3.8 (17)	1.8 (61)	0.9* (80)	0* (100)	161	5.4
	May	(5)	4.3 (7)	2.5 (46)	1.1* (76)	0* (100)	146	4.7
	June	(6)	1.4 (70)	0.3 (93)	1.5 (67)	0 (100)	193	6.4
	July	(7)	3.2 (30)	0.0 (100)	2.5* (46)	0.4* (91)	191	6.2

(*) New material for one week period.
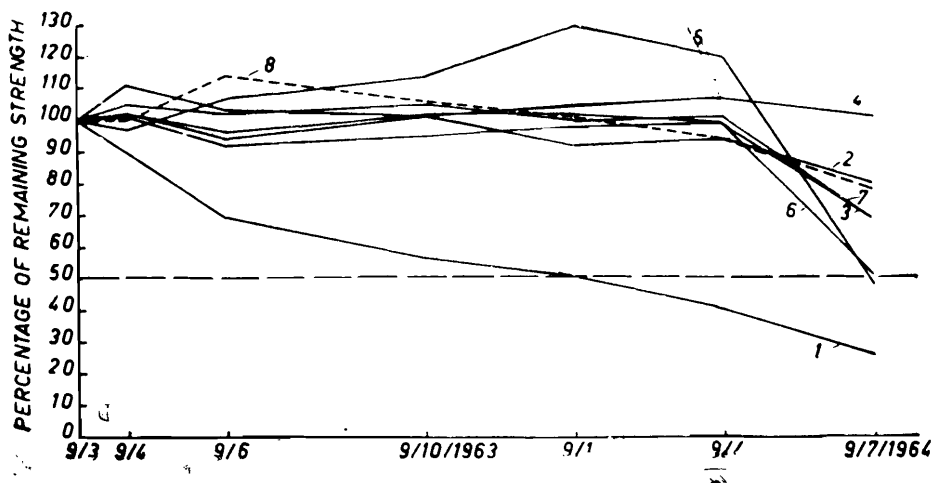(°) New material for ten days period.
    Percentage of loss in strength.

FIG. 1.—Synthetic twines of different groups and their behaviour in U.A.R. Sea Water (9.4.1963 – 9.7.1964).

1.—Polyamide (Perlon staple).

2.—Polyamide continuous (Anzalon Td 210 × 15).

3.—Polyamide monofilament (Perlon).

4.—Polyester (Trevira).

5.—Polyethylene (Nymplex).

6.—Polypropylene (Fon Td 500 × 6).

7.—Polyvinylalcohol (Newlon 20/18).

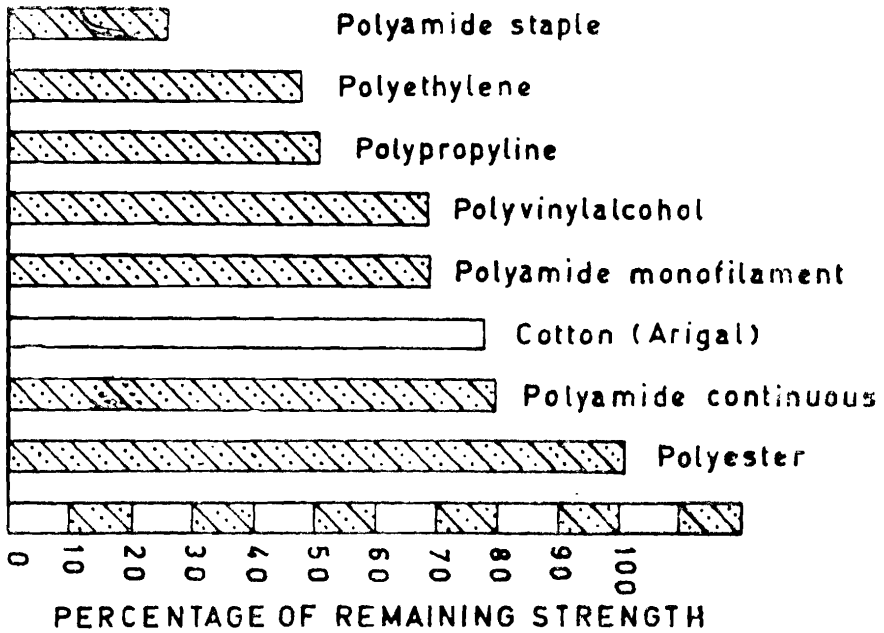8.—Arigal (cotton).

PERCENTAGE OF REMAINING STRENGTH

Fig. 4.—Relative resistance to water effect for synthetic and treated cotton fibres in Mediterranean Sea water (Alexandria station).

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