Effect of pollution on the sediments of Lake Mariut, Egypt

by

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Introduction

Lake Mariut, as it appears today, is the smallest of four shallow, brackish-water lakes adjoining the Mediterranean Coast of Egypt. The chlorosity of this lake water ranges between 1.09 and 2.63 g/l. The lake is now divided artificially into four parts (Fig. 1). The lake proper, which is chosen for the present investigation has an area of 6500 feddans (one feddan is equivalent to 4200 m^2). Its water depth varies between 90 and 150 cm.

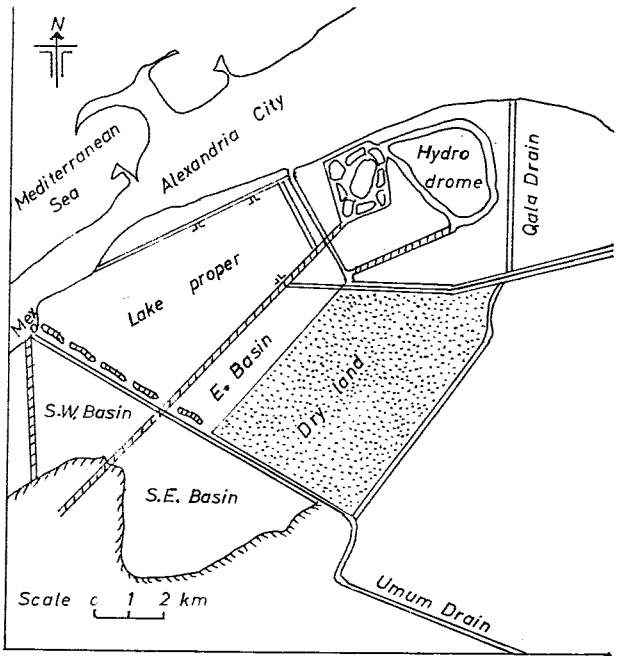

FIG. 1. — Morphometry of lake Mariut.

The lake proper may be considered as a reservoir, which receives drainage water mixed together with various kinds of pollutants from different resources. The Umum Drain and El-Oala Drain represent the main drains entering the lake. The Mex-pumps discharge the surplus water from the lake into the sea

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in order to maintain its water level at about 2.8 m B.S.L. The sewage and industrial wastes introduced into the lake have altered the nature of its bottom from its original condition.

The aim of the present study is to relate the effect of pollution upon the changes in the nature and composition of the bottom deposits. For this purpose the sediments of lake Mariut are compared with the adjacent unpolluted Hydrodrome sediments. Surface mud samples were collected by means of a modified *EKMAN* bottom sampler at 20 stations, which cover nearly the whole area of the lake proper. The methods used here were described by the author (1970).

Results and Discussion

The external and internal events may determine the quality and quantity of any material laid down in a unite area of the sediments. Samples were analysed into two main fractions : 1. ignitable substance (equal approximation to organic matter); 2. unignitable residue, which is further differentiated into calcareous material and allochthonous mineral substances plus diatoms shells.

Every substance mentioned in the present investigation is found in all samples, although it varies from the minimum to the maximum values. The minimum density of wet mud (1.09 g/cm^3) is mainly due to its maximum water content (9.8 K.g./m^2), and minimum dry matter (1.1 k.g./m^2). This low va ue of dry matter results from the great decrease in the allochthonous, calcareous and organic materials, which reach their minimum values of 0.2, 0.6 and 0.3 k.g./m^2, respectively.

The maximum density of wet mud (1.40 g/cm^3) is mainly attributed to the increase in the weight of dry matter, which reaches its maximum value (5.8 k.g./m^2), and the decrease in the amount of water content to reach its minimum value of 8.2 k.g./m^2. This dry matter consists principally of high amounts of calcareous and allochthonous materials; which reach their maximum values of 3.4 and 1.9 k.g./m^2 respectively. The organic matter in this sample is found also in a high amount (0.5 k.g./m^2). The density of the dry mud has a maximum value of 8.75 g/cm^3 and a minimum value of 2.17 g./cm^3. The presence of a direct relation between the density of wet mud and the weight of dry matter can explain the inverse relation of both to the water content in a unite area of the wet mud [PENNINGTON, 1943].

The great amounts of organic loads introduced into lake Mariut by means of sewage and industrial wastes increase the organic content of the lake. In addition, a thick layer of green phytoplankton is formed to cover the surface of the lake proper, especially in summer. Such phytoplankton abundance was also observed by OHLE [1954] in some German lakes. After death, the added autochthonous organic materials increase also the organic content of the lake.

It would be expected, that the high organic content of lake Mariut must be followed by somewhat similar high organic value of its sediments. The amount of organic matter found in the sediments was relatively too small. This low value is attributed mainly to the high intensity of mineralization of organic materials favoured by the special environmental conditions in the region [EL-WAKEEL, 1964]. The decrease in the organic content of the sediments may be also due to the increase in the rate of sedimentation of mineral matter in the lake.

It was evident that the nature of the lake bottom has been altered from its original condition. It is now covered with sludge due to the deposition of decaying organic wastes. Near the wastes outfalls sludge deposition increases remarkedly in depth to reach the water surface. The sludge creeps away from this area of deposition to cover most of the lake bottom. Its thickness on the bottom of the lake centre is thinner than its thickness near the wastes outfalls. The high organic constituents of this sludge deplete the lake water from its dissolved oxygen. Anaerobic bacterial decomposition of sludge is followed and hydrogen sulfide gas evolves. This condition causes the relative decrease in the organic content of the sediments. The anaerobic muds were also found by FOEHRENBACH [1969].

Comparison of Lake Mariut and Hydrodrome Sediments

The effect of pollution on the nature and composition of lake Mariut sediments can be better illustrated, if data from this lake are compared with those from the Hydrodrome. The latter unpolluted daughter lake was separated artificially from lake Mariut in 1939, and receives only unmodified Nile water. The difference in composition of both mother and daughter surface sediments is due mainly to the difference in external and internal events, although both lakes are very near to each other. SAAD [1968] has studied the surface sediments of the Hydrodrome, using the same methods of the present investigation. The results of both studies are used in the following comparison (Table 1).

Table 1. Maximum and minimum values of the content of some constituents in lake Mariut and the Hydrodrome sediments (k.g./m² wet mud).

	Lake Mariut		Hydrodrome	
	Max.	Min.	Max.	Min.
Water	9.8	8.2	9.4	6.5
Dry matter	5.8	1.1	10.3	1.9
Organic matter	0.6	0.3	0.8	0.2
Calcareous substances	3.4	0.6	5.0	0.7
Allochthonous materials	1.9	0.2	5.7	1.0

The maximum and minimum values of water contents in lake Mariut sediments are higher than those of the Hydrodrome sediments. Accordingly, the amount of the dry matter in Lake Mariut sediments is lower than that of the Hydrodrome sediments. The maximum value of the dry matter in the Hydrodrome deposits is nearly double that maximum value of lake Mariut deposits. The low amounts of the dry matter in Lake Mariut deposits reflect mainly the low values of both calcareous and allochthonous materials. The maximum and minimum values of calcareous and allochthonous materials in Lake Mariut deposits are lower than those of the Hydrodrome deposits. Generally, the increase in water content and the corresponding decrease in the amounts of both calcareous and allochthonous materials in a unite area of the mother lake sediments are attributed mainly to the changes in the nature of this lake surface sediments as a result (of pollution.

It is very interesting also to compare the organic contents of both types of deposits. In spite of the great quantities of organic loads introduced into lake Mariut by means of sewage and industrial wastes, and the high amounts of autochthonous organic materials resulting from dead algae, the maximum value of organic matter in lake Mariut deposits is lower than that maximum in the Hydrodrome deposits. Such decrease in the organic content of lake Mariut sediments may be mainly due to the rapid rate of mineralization of organic matter in lake Mariut deposits. This rate of mineralization must be greater than that of the Hydrodrome sediments. The complete depletion of dissolved oxygen observed at certain stations only in lake Mariut proves such strong intensity of mineralization.

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