Some aspects of the hydrographic conditions of the Eastern part of the Mediterranean Sea

by

S.H. SHARAF EL DIN

Oceanography Department, Faculty of Science, University of Alexandria (U.A.R.)

Hydrographic studies were started in the Eastern part of the Mediterranean Sea since 1889 by the Russian ship *Vityaz*. The last measurements were taken by the ship *Ichthyologue* during 1966 in front of the Egyptian Coast. The Northern parts of the Ionian and Levant seas and the Aegean and the Adriatic Seas were intensively occupied by research vessels more than any part of the East Mediterranean Sea.

The first explanation of the variation of the hydrographic aspects of the Mediterranean Sea were published by Nielsen 1912, using the data obtained by *Thor* expedition (1908-1910). The core method used by Wüst explained the limits of the intermediate high salinity layer between 200 to 600 m, in the Mediterranean Sea. The more recent work carried out by the Russian ship *Akademic S. Vavilov*, gave an idea about the variation of the hydrographic conditions in the Mediterranean Sea throughout the different seasons of the year.

The work which is presented in this paper depends on the data of about 300 stations taken in the Eastern part of the Mediterranean Sea from the research vessels, *Atlantis* (1948), *Calypso* (1956), *Akademic S. Vavilov* (1959-1964), and *Sudan* 1963 (Fig. 1).

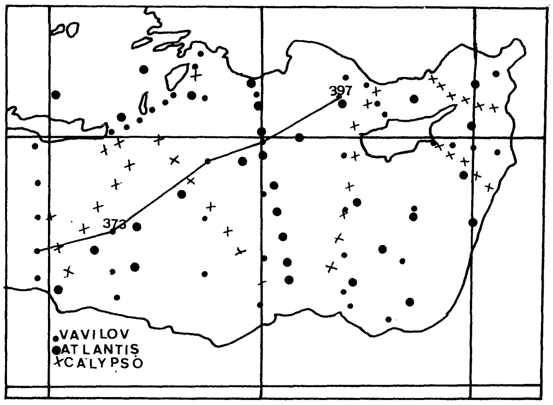

FIG 1

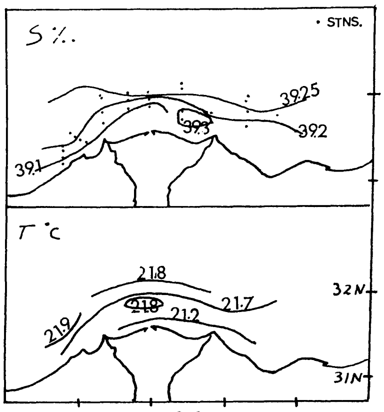

FIG 2

The Egyptian Coast

One of the most important features of the Egyptian coast was the effect of the Nile flood, on the circulation of the Mediterranean Sea. As it is well known, before the construction of the Aswan high Dam, the water flooded from the Nile during August-October, through its main branches, Rosetta and Damietta, and directed to the North East of the Mediterranean Sea. At that time of the year the salinity of the Mediterranean water decreases from about 39 ‰ to less 30 ‰ at the surface near shore.

Rapp. Comm. int. Mer Médit., **20**, 4, pp. 619-621, 5 fig. (1972).

In this area two kinds of data are presented :

1 - Data collected during the summer of 1959 from the 21st of September to the second of October, along two sections taken, one at 30° East, the other at 32°E, by *A.S. Vavilov*.

2 - Data collected during the early winter of 1963 from 6 to 12 December by the Egyptian research vessel " Sudan ". These were taken at eight sections perpendicular to the coast, lying between meridians 29°E, and parallels 31°N to 32°N. (Fig. 2).

During the summer, the salinity increased towards the sea, giving lower values at Rosetta branch than that at Damietta. This may be due to the large amount of fresh water flow coming from the Nile through Rosetta. The Nile flood takes a while to be effectively on the surface water offshore the Lebanese coast. The water coming from the Atlantic affects the surface circulation of the Mediterranean Sea at about 110 km from the Egyptian coast. During the summer time, the surface temperature decreases in a seaward direction, while in the vertical one it gives a big temperature gradient reaching about 12°C between surface and bottom at the offshore stations. The salinity decreases below 50 m and then starts to increase slightly at 150 m, giving a transition layer of thickness 100 m with lower salinity relative to that at the surface.

In winter, the salinity and temperature increases in seaward direction (Fig. 2), except for a few areas near shore. In the vertical directions, an intermediate layer of higher salinity was observed at depth 50 m with thickness of about 50 m. The temperature gradients between surface and bottom is small in comparison with summer, reaching a maximum difference of about 7°C.

The Ionian and Levant Seas

The surface circulation of the Eastern part of the Mediterranean Sea depends on four main factors :

1. The flow from the Atlantic ocean.
2. The flow from the adjacent seas.
3. The flow caused by the effect of the prevailing wind.
4. The effect of coolness in winter and evaporation in summer.

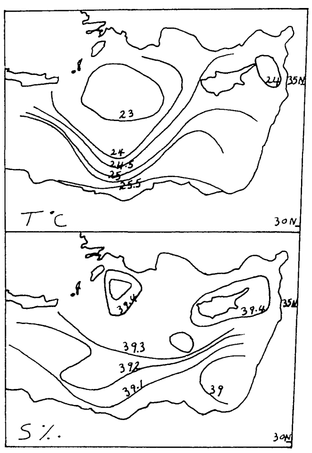
FIG 3

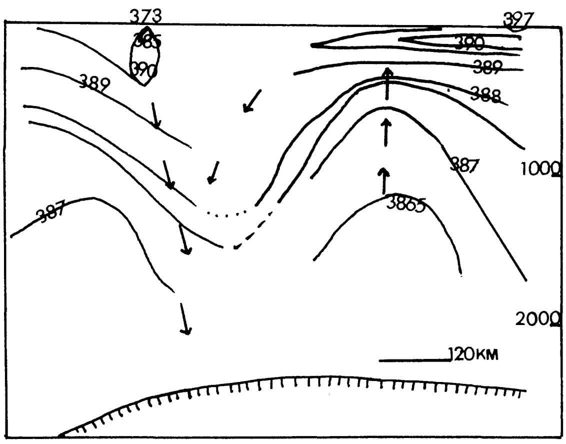

FIG 4

The effect of evaporation on the surface circulation is a minor factor. The flow of the Atlantic ocean coming through Gibraltar strait spreading everywhere to the Mediterranean Sea is about 1/10 of the flow coming by the prevailing wind. In general the surface circulation in the Mediterranean Sea is very complicated due to the cyclonic rotation at different parts during summer and winter. The Levant Sea is exposed to a number of cyclones during the different seasons, more than the Ionian Sea. The salinity and temperature distribution over the Levant Sea during the summer (Taken from *A.S. Vavilov* 1959) at 10 m depth below the surface are shown in Fig. 3.

The formation of the intermediate water of relatively high salinity occurred in winter (February and March) around Rhodes Island and along the South coast of Turkey. This water has a high salinity of about 39.1 p. 1000 and minimum temperature of 15°C. Due to coolness of winter, this water starts to sink by convection current to the intermediate layers. In summer when these intermediate waters gain some warmness they start to rise. The cycle of the formation and sinking of the intermediate high salinity layer is well expressed in Fig. 4. According to Ovschenekov, this layer lies between 150-250 m in the Levant Sea to about 300 m in the Ionian Sea. The water of high salinity formed around Rhodes spreads from there to every part of the Mediterranean Sea going through the Crete-Africa strait. In summer the intermediate current is weaker than in winter, but the circulation of the water in this layer has the same complicated character as that in the surface layer. Along a section between Crete and North coast of Africa (Fig. 5), low salinity was observed at station 367 which can be contributed to the flow coming from the sea of Crete as well as the adjacent flows. The formation of the water masses at this section gives an intermediate flow of high salinity between 100 to 350 m deep.

The deep waters in the western and central basins of the Mediterranean Sea are originally formed from the water coming from the Northern Seas. In the Eastern part of the Mediterranean Sea, the deep water is formed from the flow coming from the Adriatic Sea and the intermediate high salinity of Levant Sea.

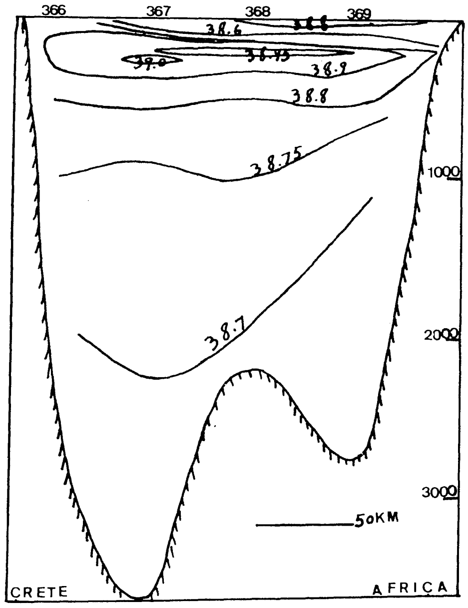

FIG 5

The flow of the Adriatic water is directed to the South to the bottom layers of the Ionian Sea, with a certain current through the strait of Otranto. After that it is directed to the Levant Sea through the central part of the African Coast off Crete where it circulates counterclockwise. This assumption was confirmed by a set of observations obtained from two anchored stations in Otranto strait, which show intensive water transfer from the Adriatic Sea at the layer 600 to 700 m, with a velocity reaching 28 cm/sec.

The deep waters gave nearly the same trend with temperature and salinity variation. The salinity and temperature limits in the Eastern and central part of the Mediterranean Sea, (13.5°C//T//13.7°C, 38.6 p.1000//S//38 p.1000), are higher than in the western ones.