Introduced July 10, 1961 by Mr. George P. Miller and referred to the Committee on Armed Services.

(Committee report No. 906, August 15, 1961, 4 p.)

Passed House August 21, 1961.

Other Reports—A series of general hearings on the oceanographic programs of the Government agencies was held by the Special Subcommittee on Oceanography of the Committee on Merchant Marine and Fisheries. They were: March 3, 10, 12, 17; April 21, 22, 24; June 1, 2, 23; July 13 and 14, 1959, ("Oceanography in the United States," 396 p., Committee on Merchant Marine and Fisheries, G.P.O., 1959); and February 9, 1960 ("Oceanography in the United States, Part II." 40 p., G.P.O., 1960).

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The Seasonal Cycle of Chlorophyll in the Florida Straits [1]

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SEASONAL STUDIES of primary productivity and associated features of the physical and chemical environment have been mainly carried out in regions well away from the tropics. The results of Menzel and Ryther (1960) from the Bermuda area most closely approximate the conditions found in more tropical waters. Bsharah (1957) reported on the distribution of zooplankton and nutrients in the Florida Straits from a station located at 25°33′N, 79°25′W, 40 miles east of Miami. During the years 1958 through 1960 a routine sampling program was continued at this station. Chlorophyll *a* measurements were added during the latter part of the program. This paper compares the seasonal cycle in the Florida Straits with those at the Fladen Ground in the North Sea (Steele, unpublished data) and at Bermuda (Menzel and Ryther, 1960[3]). A more complete report on the Florida Straits data will be presented elsewhere.

Figures 1, 2 and 3 depict the seasonal cycles of temperature, phosphate and chlorophyll *a* in the North Sea, the Sargasso Sea near Bermuda, and the Florida Straits respectively. Data from the North Sea indicate that during the production season the euphotic zone is 40-50 m deep. The nutrients required for the typical spring and autumn blooms in northern waters are provided by the complete mixing of the water column (140 m) from late fall to early spring. At Bermuda the euphotic zone is almost 100 m deep. For most of the year the mixed layer is 25-50 m thick but in winter the thermocline sinks down to a depth of 250-300 m and so permits some replenishment of nutrients in the upper waters. During this period the maximum chlorophll *a* concentration of 0.5 to 1.0 mg/m^3 were found.

In the Florida Straits the data show that although there is a deepening of

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[3]We are grateful to Drs. Menzel and Ryther for permission to quote their results.

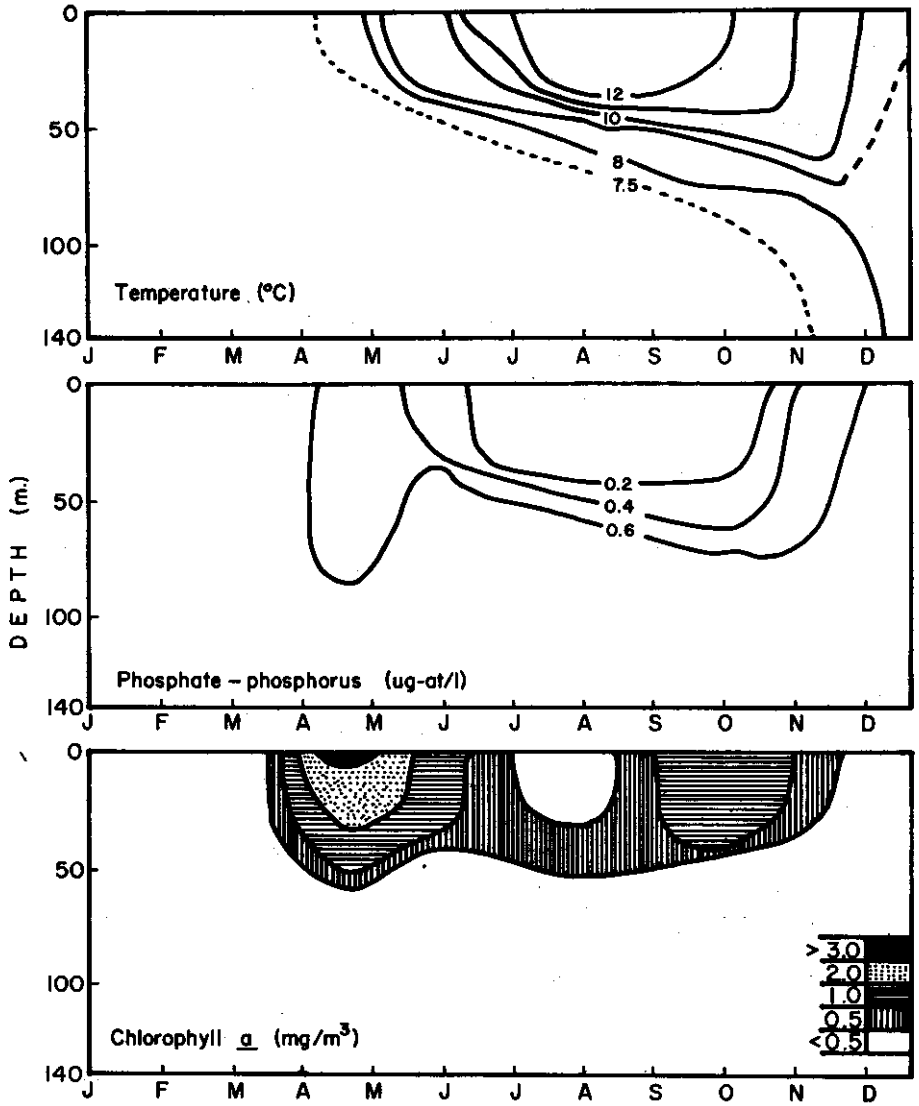

FIGURE 1. Seasonal Profiles during 1961 of Temperature, Phosphate Phosphorus and Chlorophyll *a* in the North Sea.

the thermocline in the winter the depth of the mixed layer does not exceed 120 m. Since the euphotic zone is about 100 m deep there can be very little exchange by mixing between the euphotic zone and the deeper waters. The phosphate concentrations were consistently low in the upper 200 m (generally less than 0.1 μg-at/L and it follows that the renewal of nutrients to the surface waters by vertical mixing is negligible. As at Bermuda the summer

concentrations of chlorophyll *a* were low except for occasional values of 0.4-0.5 mg/m³ in midwater. There is also a corresponding general increase during the winter but the maximum concentration of 0.0-0.3 mg/m³ is considerably less.

Discussion

Although the results presented here merely describe the observed changes at three particular positions in the North Atlantic the temperature data shown here demonstrate the effect of the decrease toward the tropics in the seasonal variation in solar energy and consequently in the temperature at the sea surface. Variation in the heat balance controls the depth of vertical mixing. Thus, the seasonal amplitude decreases until a point is reached where the

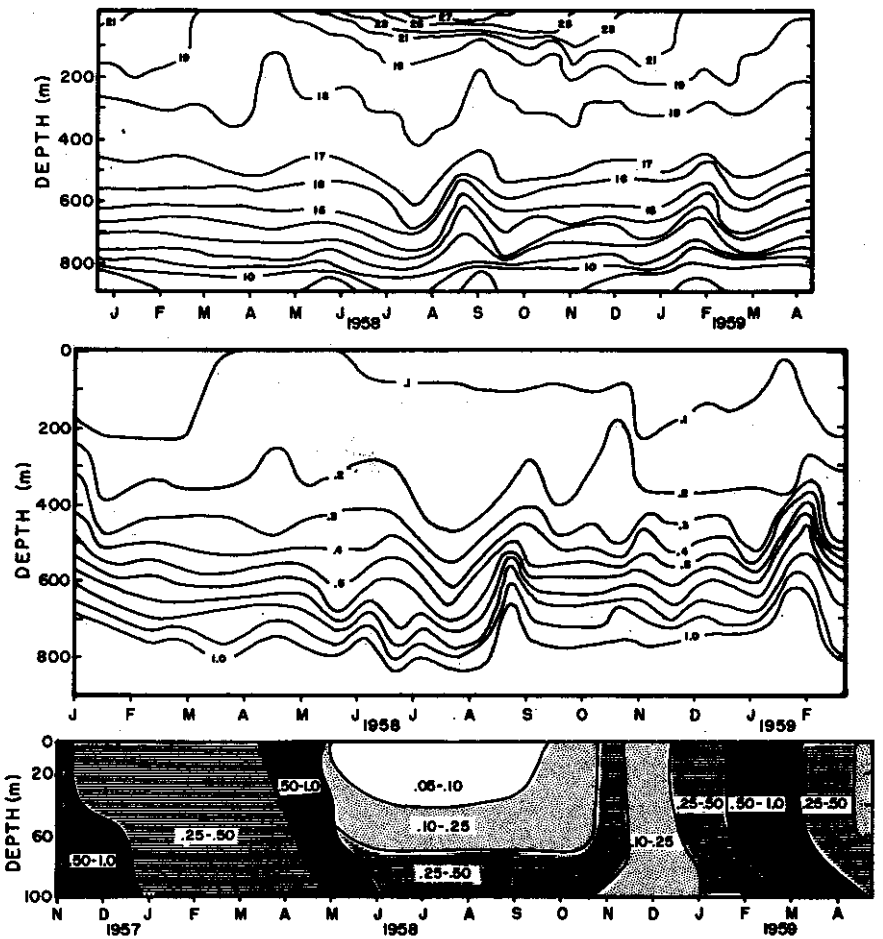

FIGURE 2. Seasonal Profiles during 1958 of Temperature, Phosphate Phosphorus and Chlorophyll *a* in the Sargasso Sea off Bermuda.

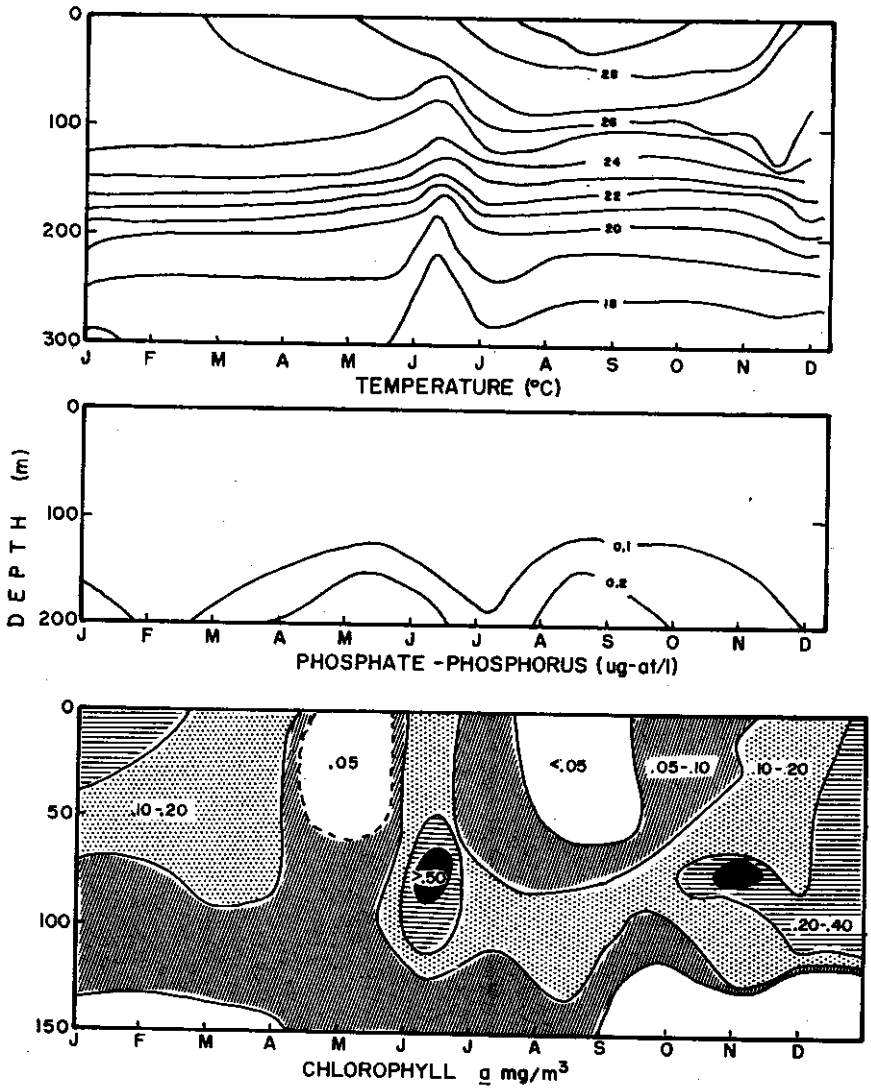

FIGURE 3. Seasonal Profiles during 1960 of Temperature, Phosphate Phosphorus and Chlorophyll *a* at Cat Cay, Bahamas.

greatest depth of vertical mixing is approximately equal to the depth of the euphotic zone and consequently the supply of nutrients to the euphotic zone by vertical exchange with the deeper waters becomes negligible. This coincidence in depth could be used to define the boundaries of those parts of the open ocean which are "tropical" from the standpoint of phytoplankton

productivity. The Cat Cay Station in the Florida Straits would lie on the edge of this biological region, whereas Bermuda would lie outside of it.

The obvious corresponding feature of the seasonal cycle of chlorophyll *a* is the decreasing amplitude of the cycle from 0.0-3.0 mg/m^3 in the North Sea to 0.0-0.3 mg/m^3 in the Florida Straits, with Bermuda intermediate. It is important to note, however, that even at the Cat Cay station there is a seasonal cycle with a small winter maximum. This increase, since it does not appear to have been caused by nutrient enrichment, may be partly a consequence of adaptation for lower light due to the greater depth of the layer in which the plants are mixed and to the somewhat lower solar radiation in the winter.

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What Oceanography Means to Fishermen

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Abstract

Oceanography has provided knowledge of average conditions in the ocean and the processes maintaining them in equilibria. Augmentation of oceanographic effort now under way may be directed in large part toward attaining prediction capability especially of departures from average conditions in the upper mixed layer and the thermocline. This may be accompanied by parallel research effort on the ecological requirements and behavior of food fish and shellfish to provide understanding of their responses to environmental change. Combined, these efforts will have practical meaning to fishermen if it enables them to eliminate time lost in scouting for fish and in fishing on less than optimal concentrations, and so lower their cost of fishing and keep their product competitive with agricultural products and imported fish.

FROM A DISTANCE OF SEVERAL THOUSAND MILES I have noted with admiration the growth of interest in, and advancement of, the studies of the ocean and its fishery resources in the Gulf and Caribbean and adjacent Atlantic that have occurred during the last several decades—stimulated, I am sure, by the annual meetings held by this Institute. I am grateful to have this opportunity of participating in this one.

Knowing that expansion of oceanographic effort has recently assumed a more important place in the national policy of this country and that one of the reasons, among many others, given for this is "to get more food from the