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AVERAGE MONTHLY SEA SURFACE TEMPERATURES OF THE WESTERN NORTH ATLANTIC OCEAN

BY

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AVERAGE MONTHLY SEA SURFACE TEMPERATURES OF THE WESTERN NORTH ATLANTIC OCEAN

This paper contains twelve charts of the North Atlantic Ocean west of the 60th meridian which show the average temperature of the surface water for each month of the year. Two additional charts show respectively the maximum and minimum values reached by the average temperature for any month. The next chart presents the yearly range, that is, the difference between the average temperature of the warmest and coldest months. The last chart of the series shows the depth of the virtually isothermal water during the summer and winter months.

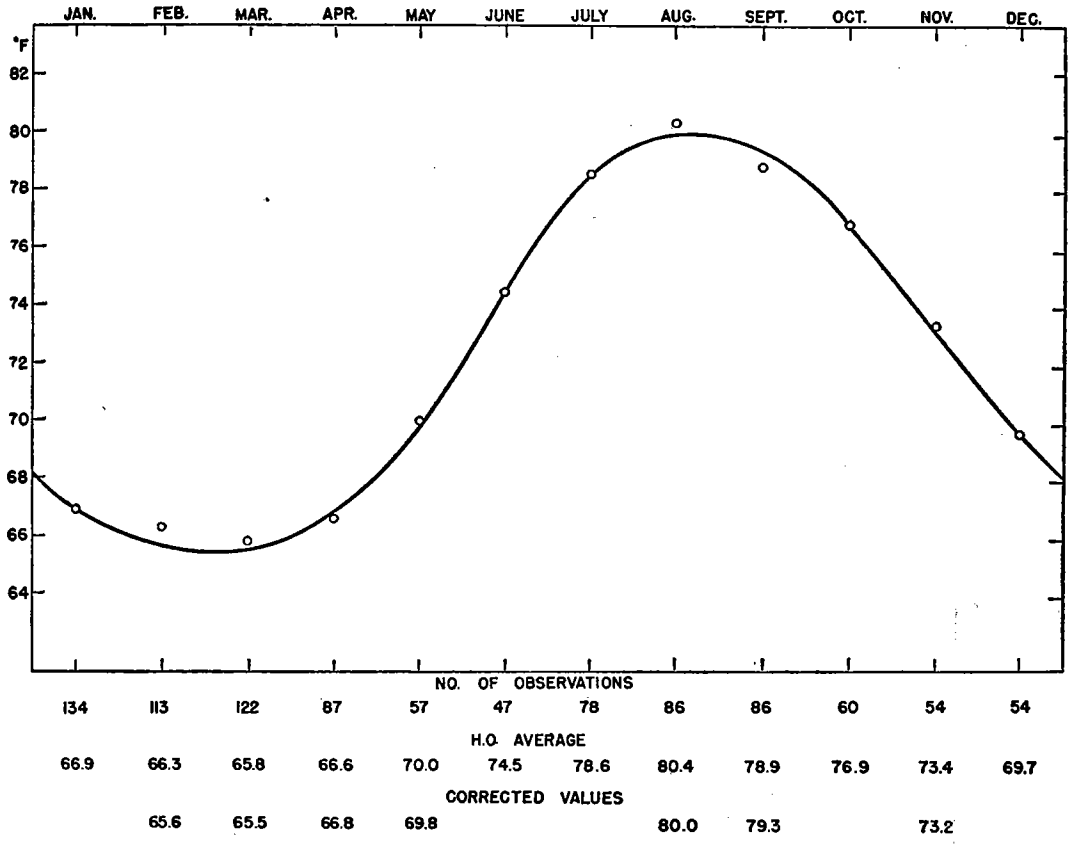

FIGURE 1. A sample of a seasonal curve drawn for a one degree quadrangle and the temperature corrections applied.

These charts were prepared in the course of work done for the Oceanographic Division of the Hydrographic Office, U. S. Navy Department, which has given permission for their publication.

The mean monthly temperatures of the surface water of the area have been shown as a part of charts for the entire Atlantic published in recent years by Böhnecke (1936)

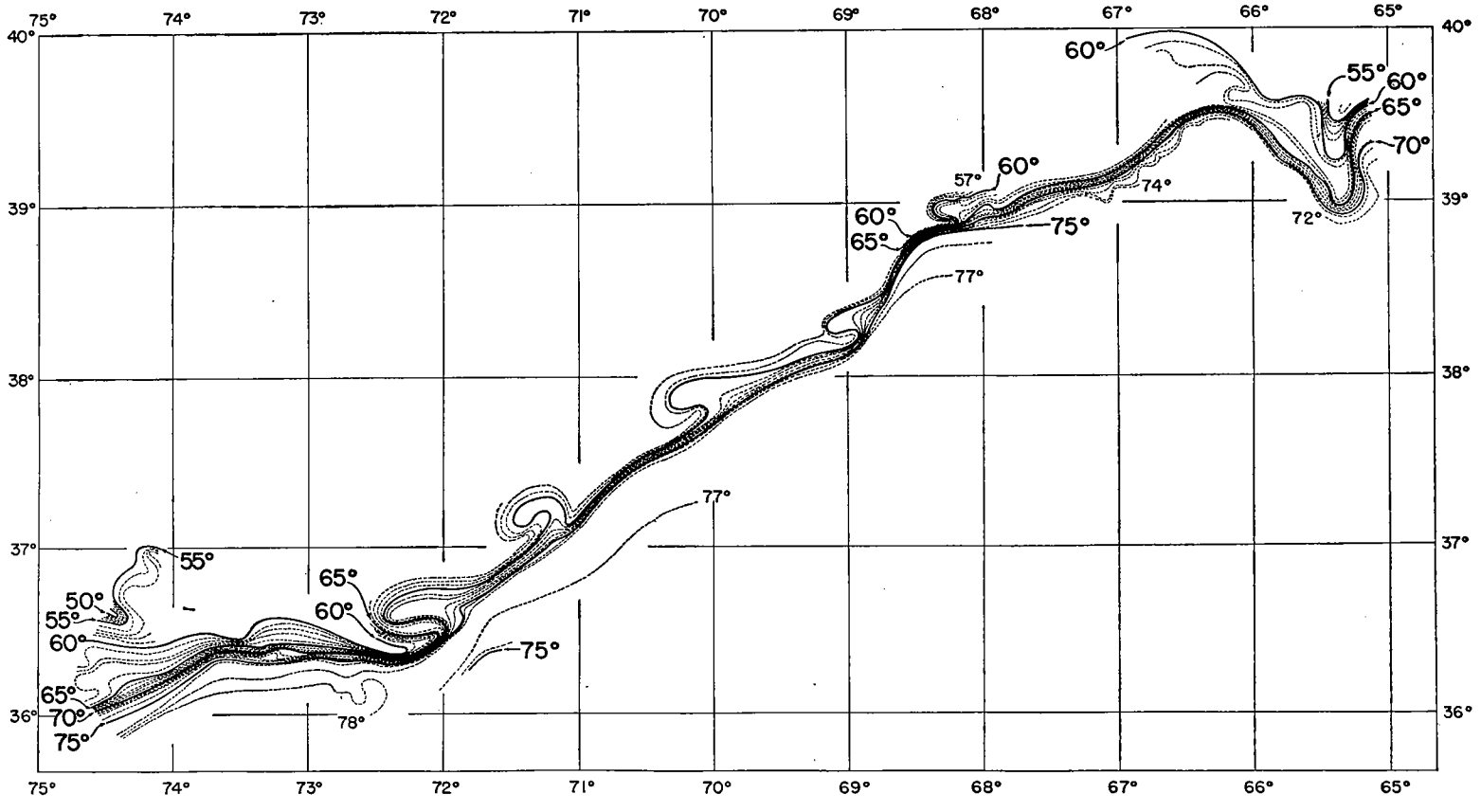

FIGURE 2. Surface isotherms along the northern boundary of the Gulf Stream, from data collected on the "Atlantis" cruise 141, May 24–29, 1946.

and by the Hydrographic Office, U. S. Navy Department (1944). Because of the scale required by the greater coverage of these publications the representation is inadequate as a description of the more limited area. By supplementing the data available in the Hydrographic Office with bathythermograph records in the file of the Woods Hole Oceanographic Institution and with observations made from lightships recorded by Rathbun (1887) and recently summarized by Parr (1933), improved detail has been achieved.

The Hydrographic Office work sheets, showing the average monthly temperature for one degree quadrangles and the number of observations, were used as the chief source of data. These work sheets were prepared by the Temperature and Current unit in the Hydrographic Office and kindly loaned to us by the Hydrographer. In general the distribution of observations on the H. O. work sheets was as follows: On the regular shipping lanes, such as New York to Bermuda and Cape Hatteras to the eastern tip of Cuba each one degree quadrangle contained approximately 300 observations for each month. Near New York, Hatteras, the Florida keys and other areas where the shipping lanes converge, the average was between 1,000 and 2,000 observations. Over the major part of the Western North Atlantic, the Gulf of Mexico and the Caribbean the average for each month was 50 observations while along the coast of South America, Central America and Mexico the average was 20 observations. For the Gulf of Maine and Georges Bank where the data in the files of this Institution outnumbered the data represented on the Hydrographic Office work sheets the former were used.

The procedure adopted in preparing the charts was as follows: the data for each one degree quadrangle were entered on the chart, and isotherms were drawn following the data as accurately as possible. It became immediately apparent that there were some inconsistencies and that the scarcity of data in some regions resulted in a very confused picture. In these cases the data available from each quadrangle for the entire year were plotted and curves were drawn showing the seasonal temperature cycle as in Figure 1. Over large areas the resultant curves for the quadrangles showed a close similarity; the occasional inconsistencies of the data were quite obvious. Approximately 30 per cent of the one degree quadrangles in the entire area were treated in this way and in most cases it was found necessary to apply some slight correction to the values in order to smooth out the data seasonally. These corrected temperatures were entered on the charts and the isotherms re-drawn. The next step was to smooth the data by area. The isotherms were re-drawn once more, smoothing irregularities that appeared to result from the scarcity of data in particular regions. Finally the temperatures of the shallow water along the coast of the United States, summarized by Parr (1933) were used in order to determine the inshore positions of the various isotherms.

These charts do not radically change the picture as presented by the previous Hydrographic Office Charts of surface temperature, such as H. O. 225, except in the Gulf of Maine and Georges Bank area and, to a lesser degree, along the coast south to Florida. The use of one degree isotherms, instead of the 2.5 degree isotherms employed in H. O. 225 does not imply any greater accuracy but helps to show more clearly the zones of strong horizontal gradient and to describe the gradual seasonal changes that take place in such areas as the Caribbean.

Abrupt as some of the gradients appear on these charts they still do not show how sharp the transitions are in actuality. When observations are averaged for a region as large as a one degree quadrangle and for a period as long as one month it is obvious

that sharp gradients will be spread over a larger area than would be the case on a synoptic chart. In May 1942 the "Atlantis" made a run from Cape Hatteras to a point southeast of Georges Bank. Sixteen sections were made crossing into and out of the Gulf Stream. Figure 2 shows the surface isotherms as plotted from the data obtained on this cruise. Comparing this figure with the average temperatures for May and June we find that, at the time of this cruise, the water in the Stream was warmer than the average for June, and the gradient, which on the charts covers a distance of approximately 150 miles, here occurred in a distance of only 5 miles.

The "Maximum" and "Minimum" average surface temperature charts show the extremes of the average monthly temperatures, combined regardless of month. They do not represent the actual maximal or minimal temperatures recorded which would be respectively greater or less than the average for any month. It would be of value to have a chart showing the average of the minimal temperatures recorded for a number of years, but the minimal observed temperatures as shown on the H. O. work sheets probably include so many inaccurate readings that such a chart based on these data would not be very reliable. The next chart in order shows the difference in the average temperature for the warmest and coldest months.

The average surface temperature as shown on these charts can be used to a limited extent in estimating sub-surface temperatures. This is particularly true during the winter months. In general the waters on the Continental Shelf are isothermal, or nearly so, from surface to bottom during the coldest months. When the water starts to warm in the spring, the average surface temperature then applies only to the upper meter or two, except in those areas where vigorous tidal mixing takes place as on Georges Bank. As the seasons advance, the surface mixed layer deepens slightly. In late September with surface cooling and in general stronger winds the water mixes more rapidly until in January it is again isothermal to the bottom. In the main body of the ocean the same conditions can be said to prevail if we substitute "strong oceanic currents" for "tidal mixing" and "the top of the permanent thermocline" for the "bottom". The average depth of the virtually isothermal layer for winter and summer in the Western North Atlantic is shown in Plate 16. These charts are based on bathythermograph and other hydrographic data in the files of the Woods Hole Oceanographic Institution.

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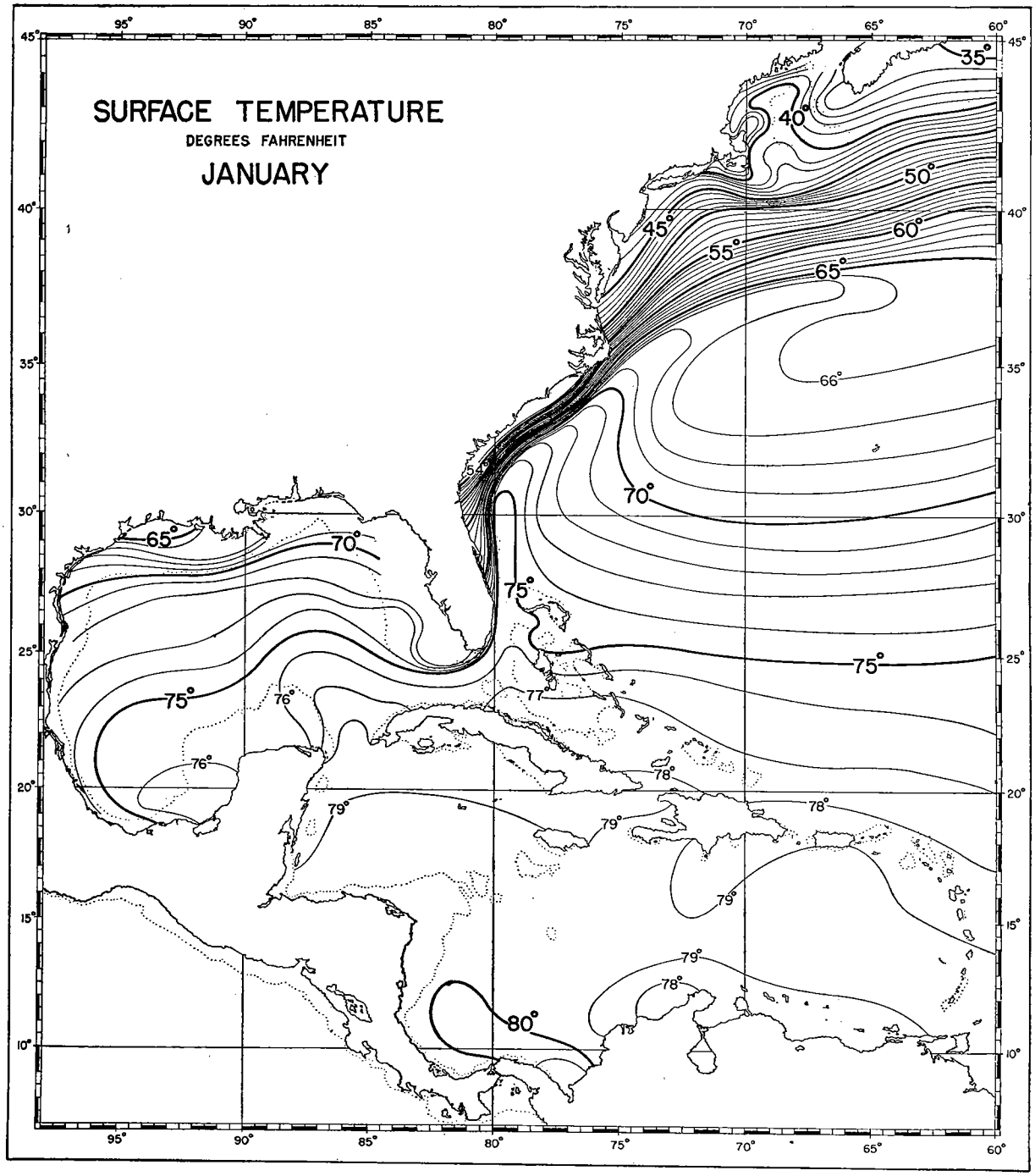

PLATE 1. Average sea surface temperatures for January.

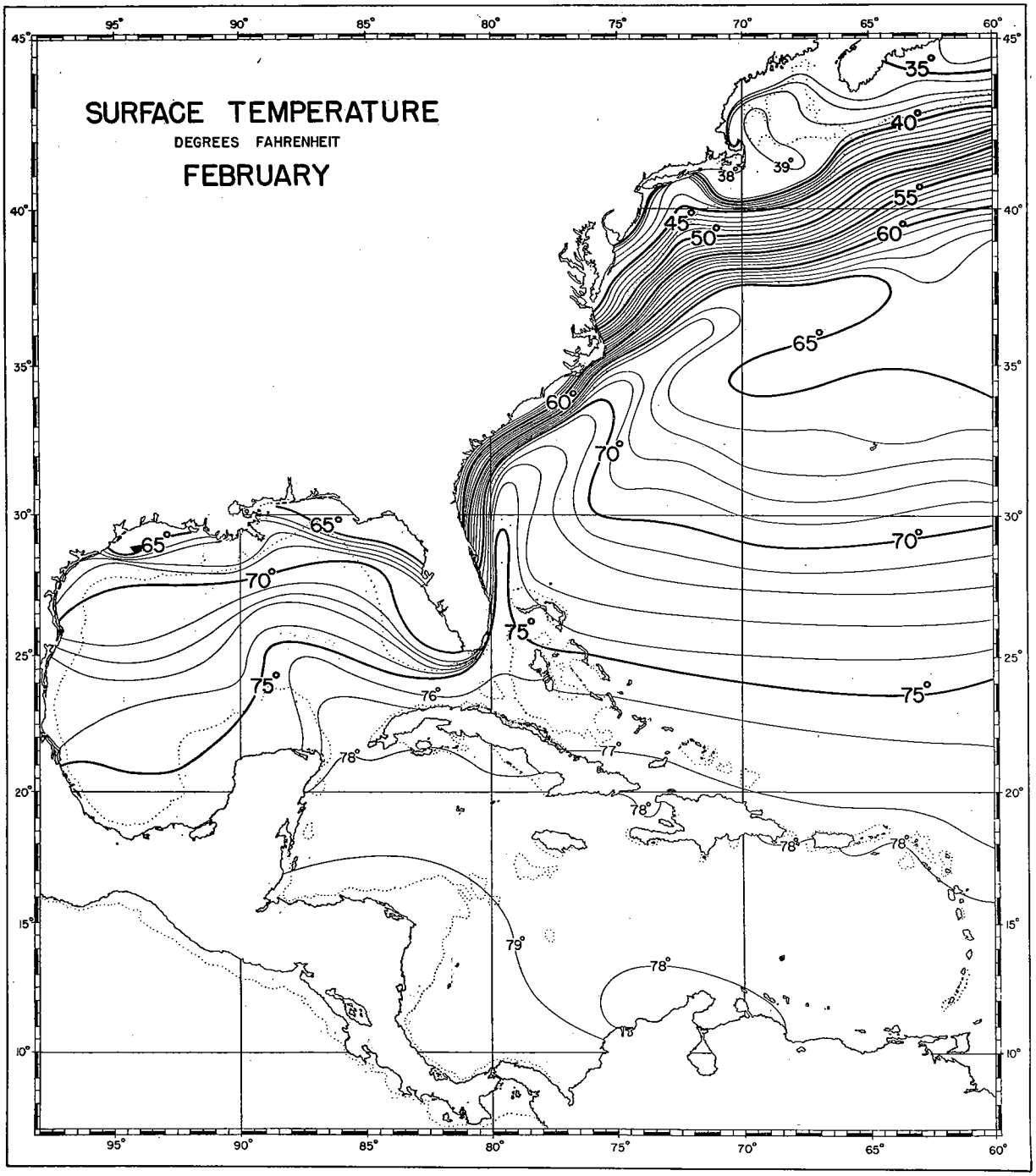

PLATE 2. Average sea surface temperatures for February.

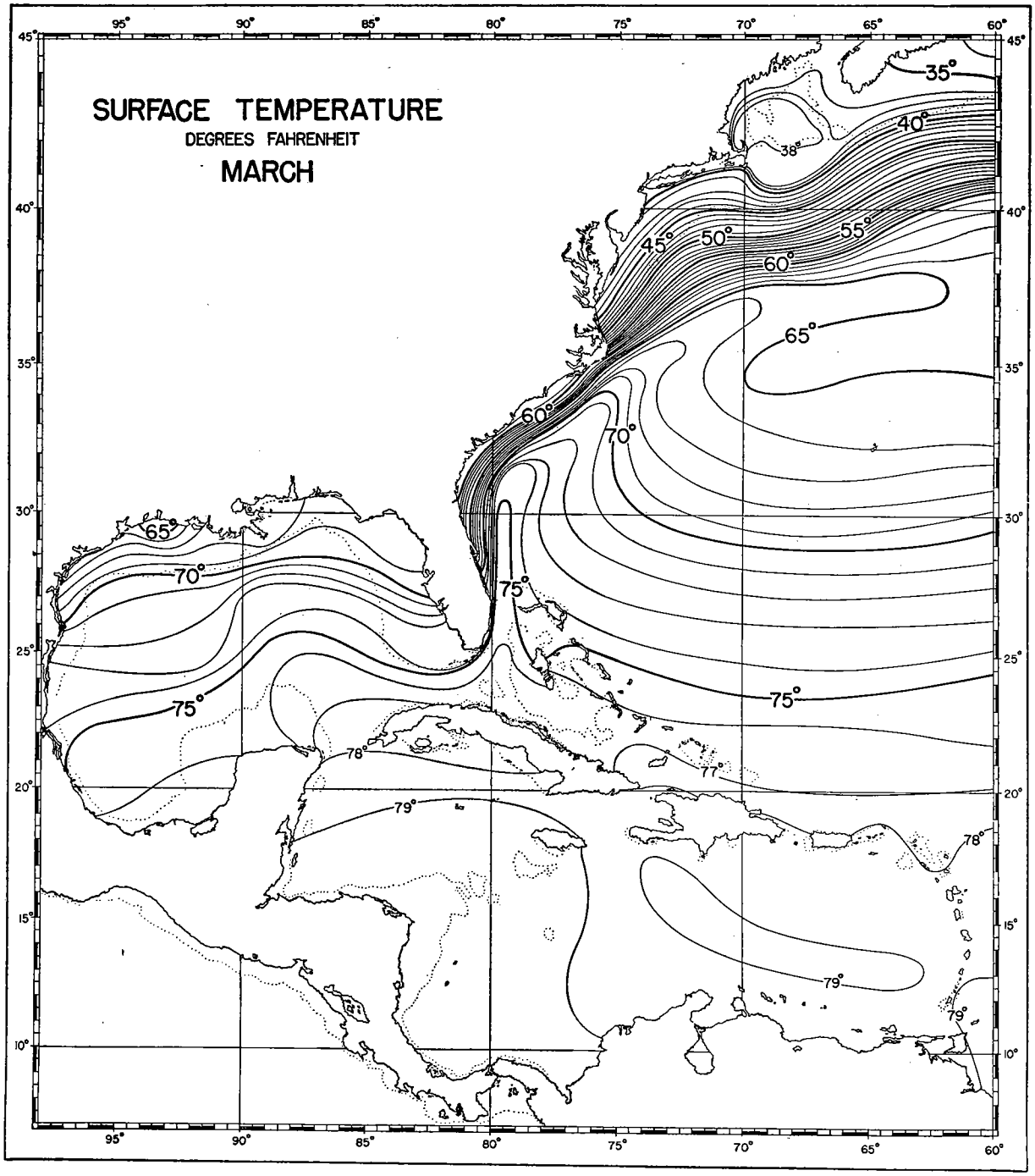

PLATE 3. Average sea surface temperatures for March.

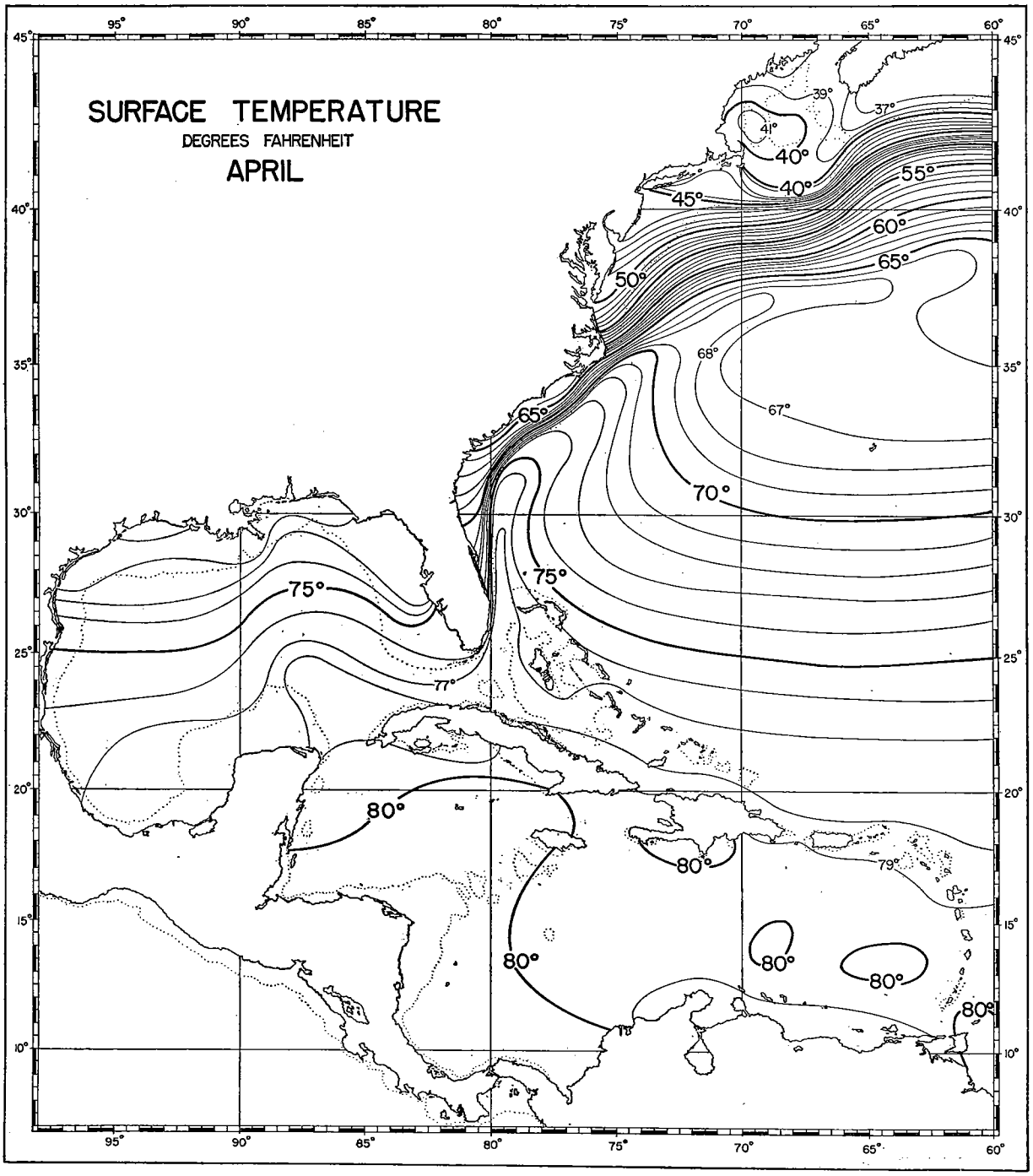

PLATE 4. Average sea surface temperatures for April.

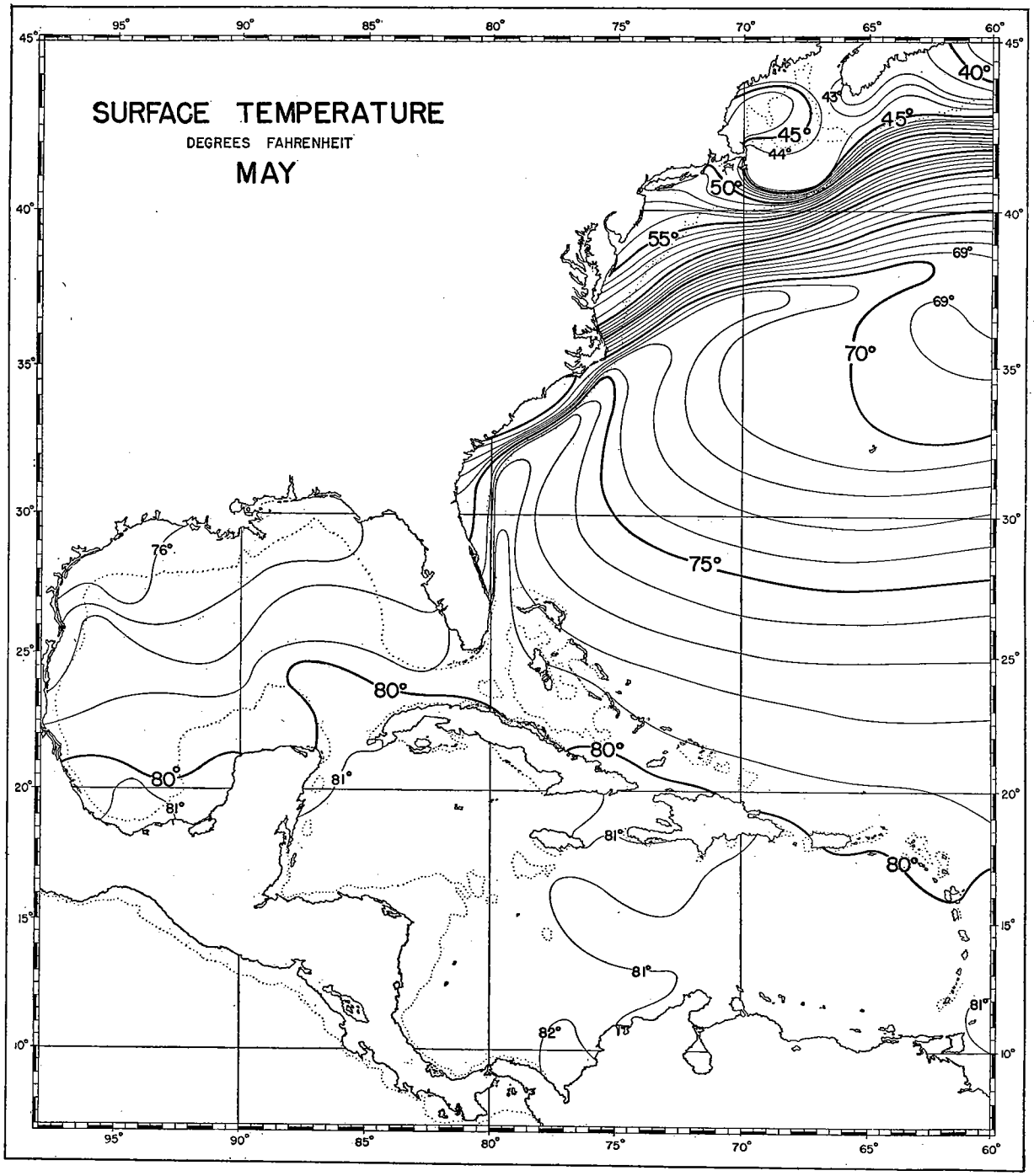

PLATE 5. Average sea surface temperatures for May.

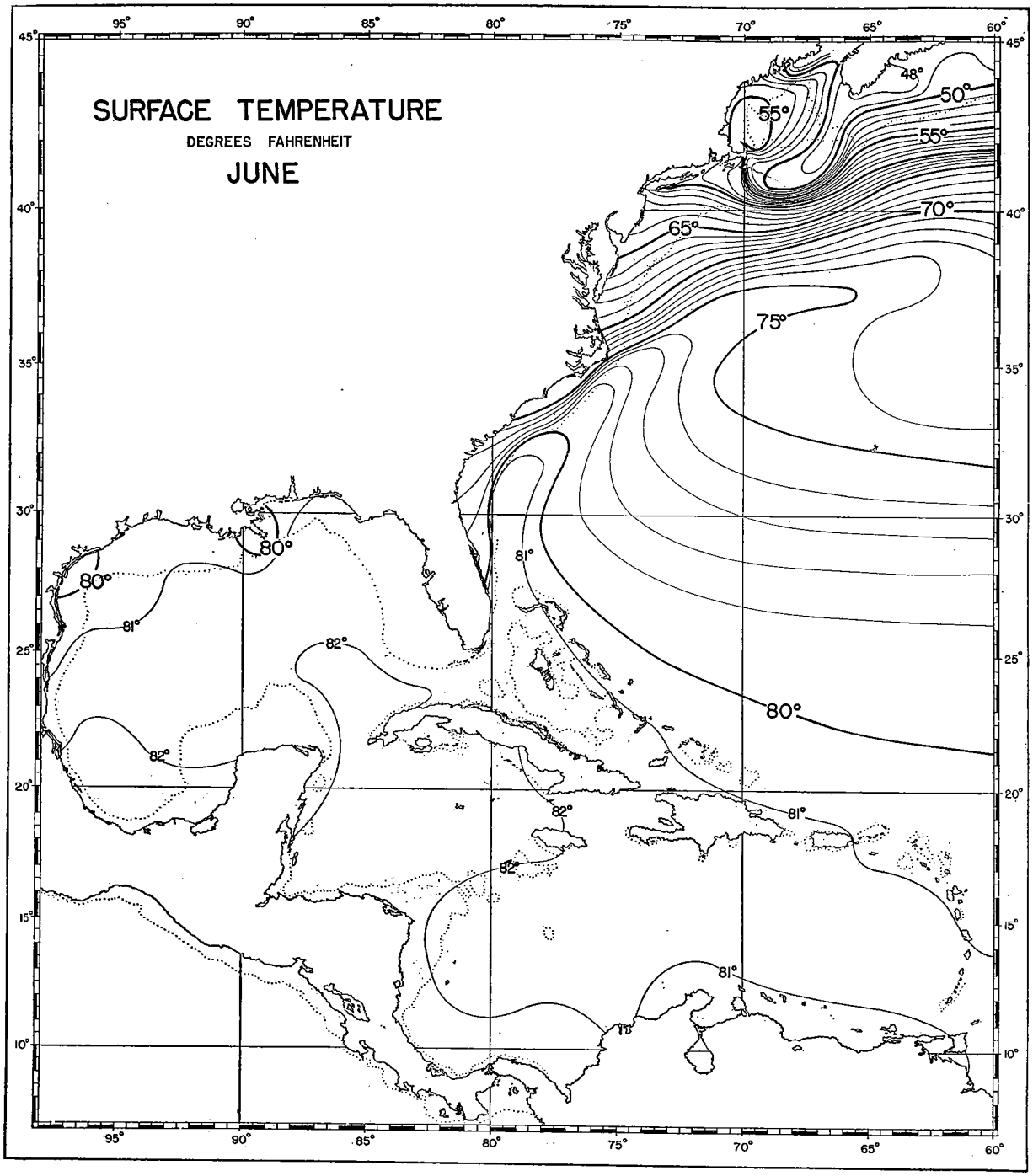

PLATE 6. Average sea surface temperatures for June.

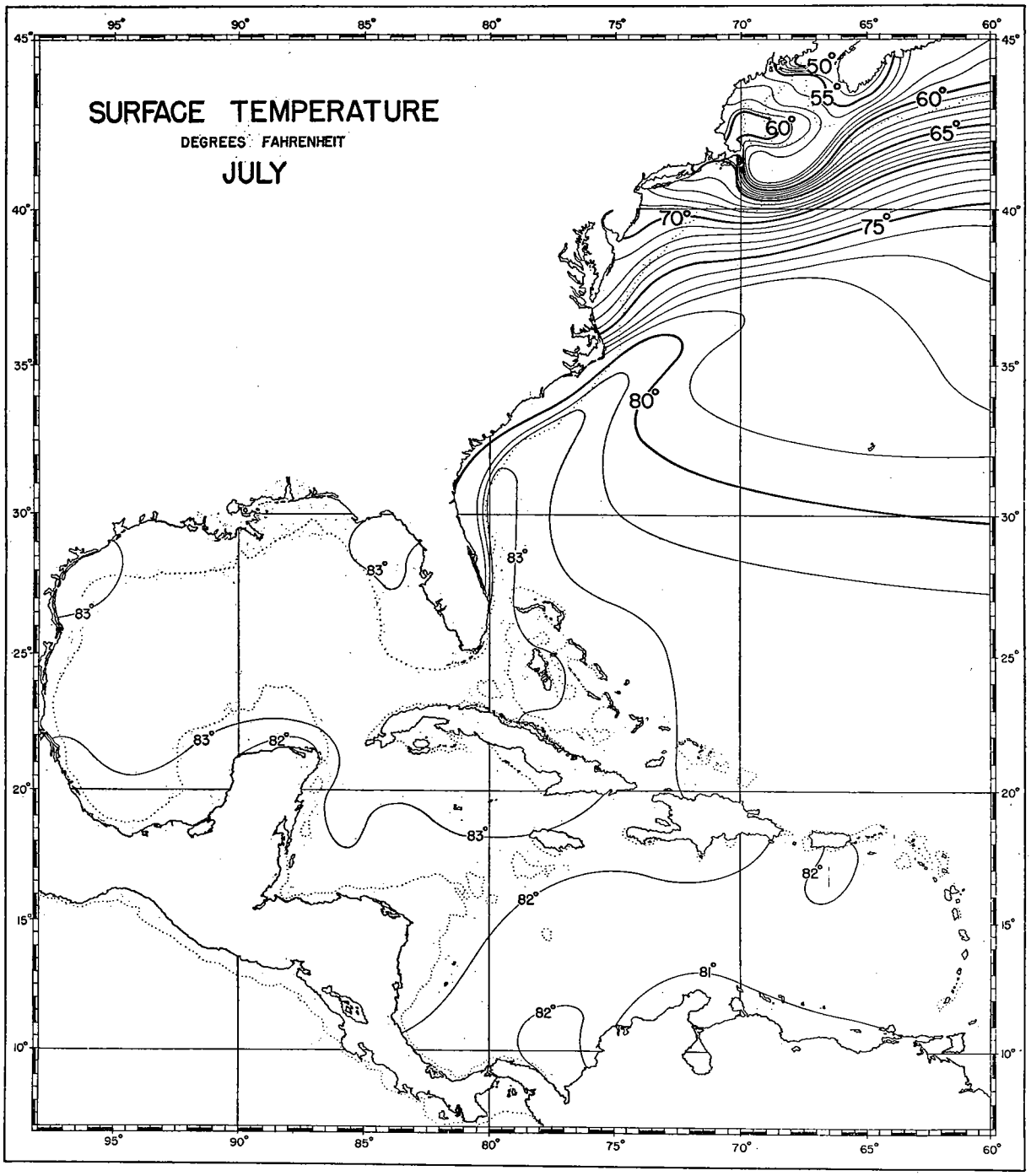

PLATE 7. Average sea surface temperatures for July.

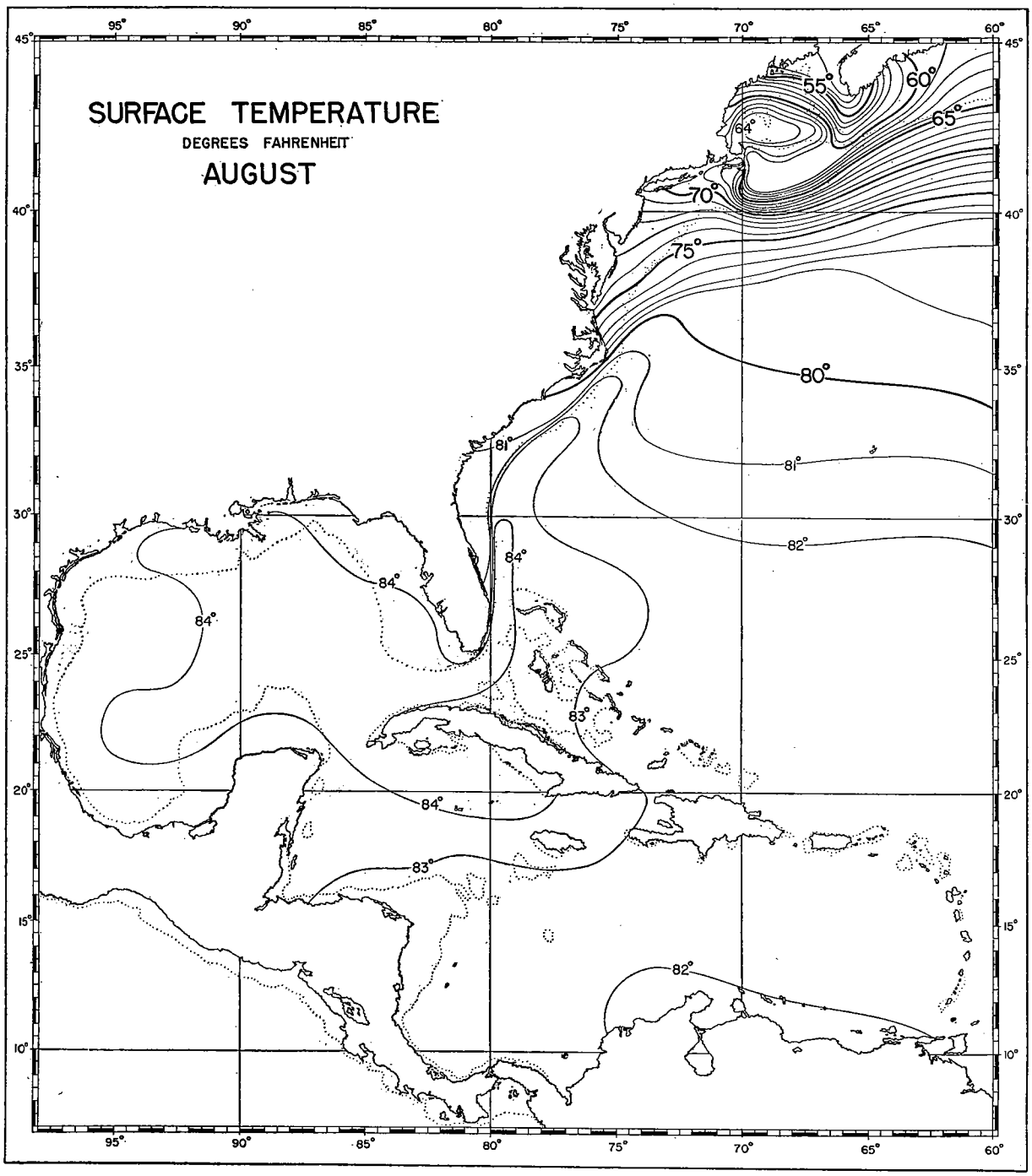

PLATE 8. Average sea surface temperatures for August.

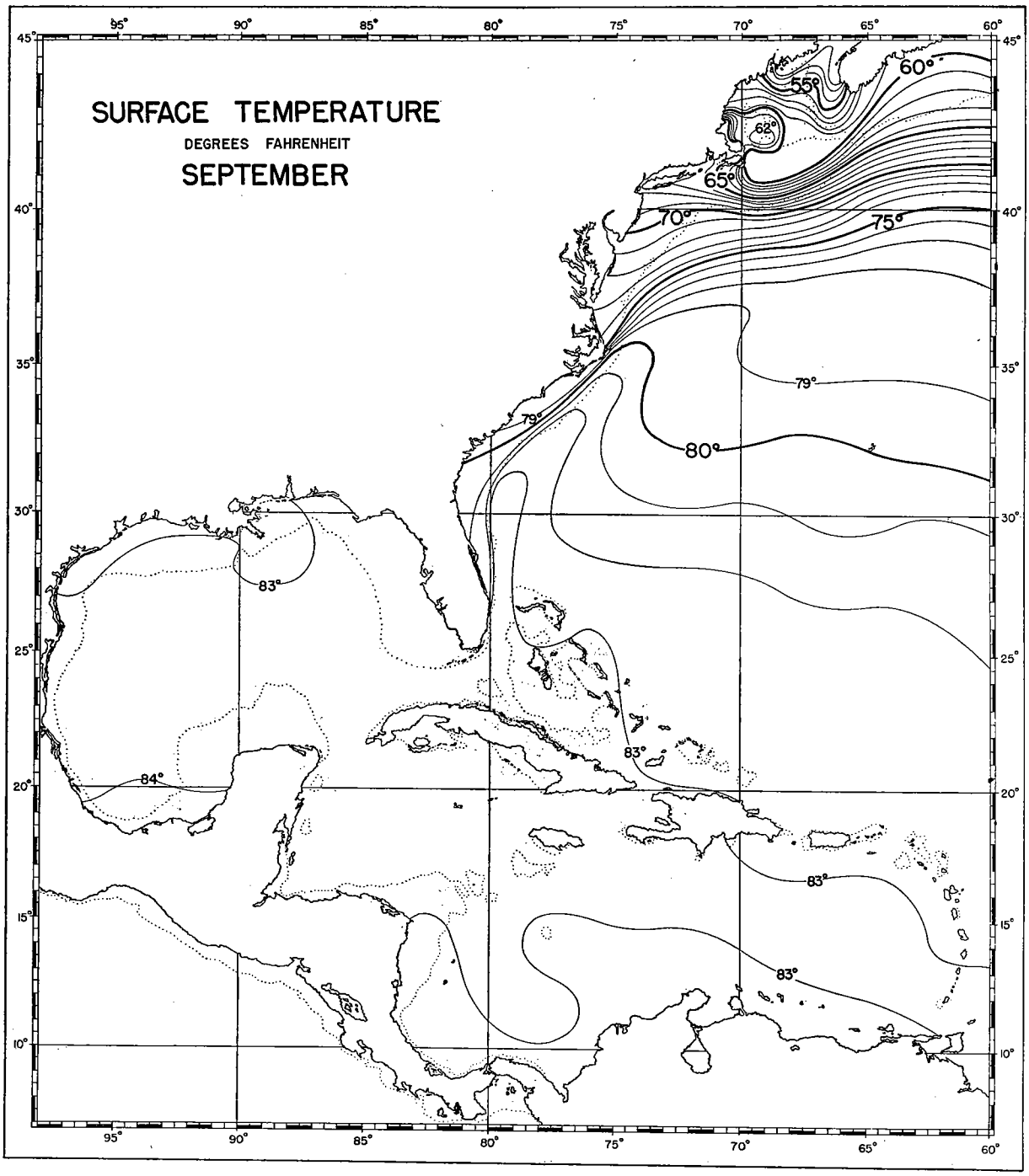

PLATE 9. Average sea surface temperatures for September.

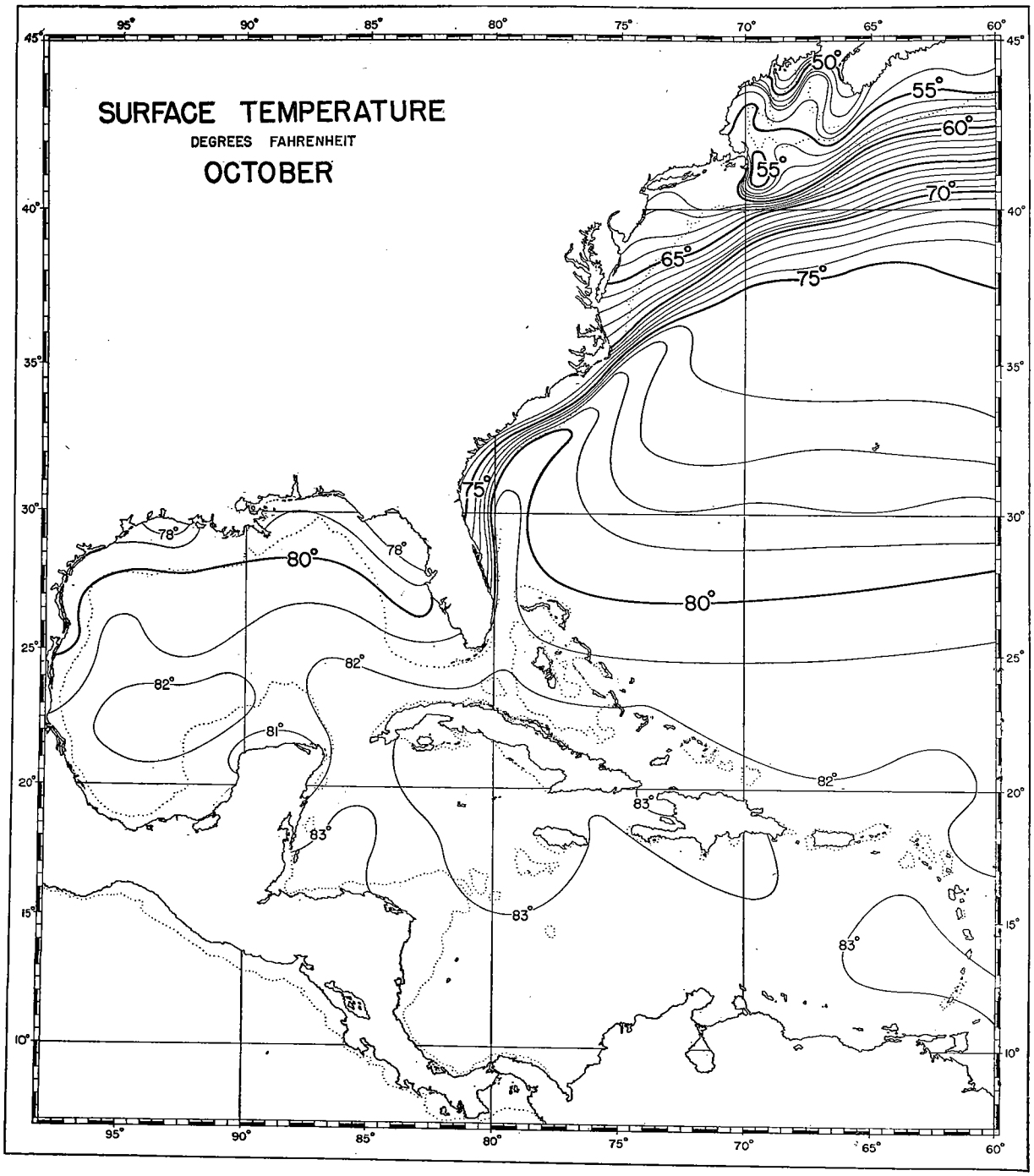

PLATE 10. Average sea surface temperatures for October.

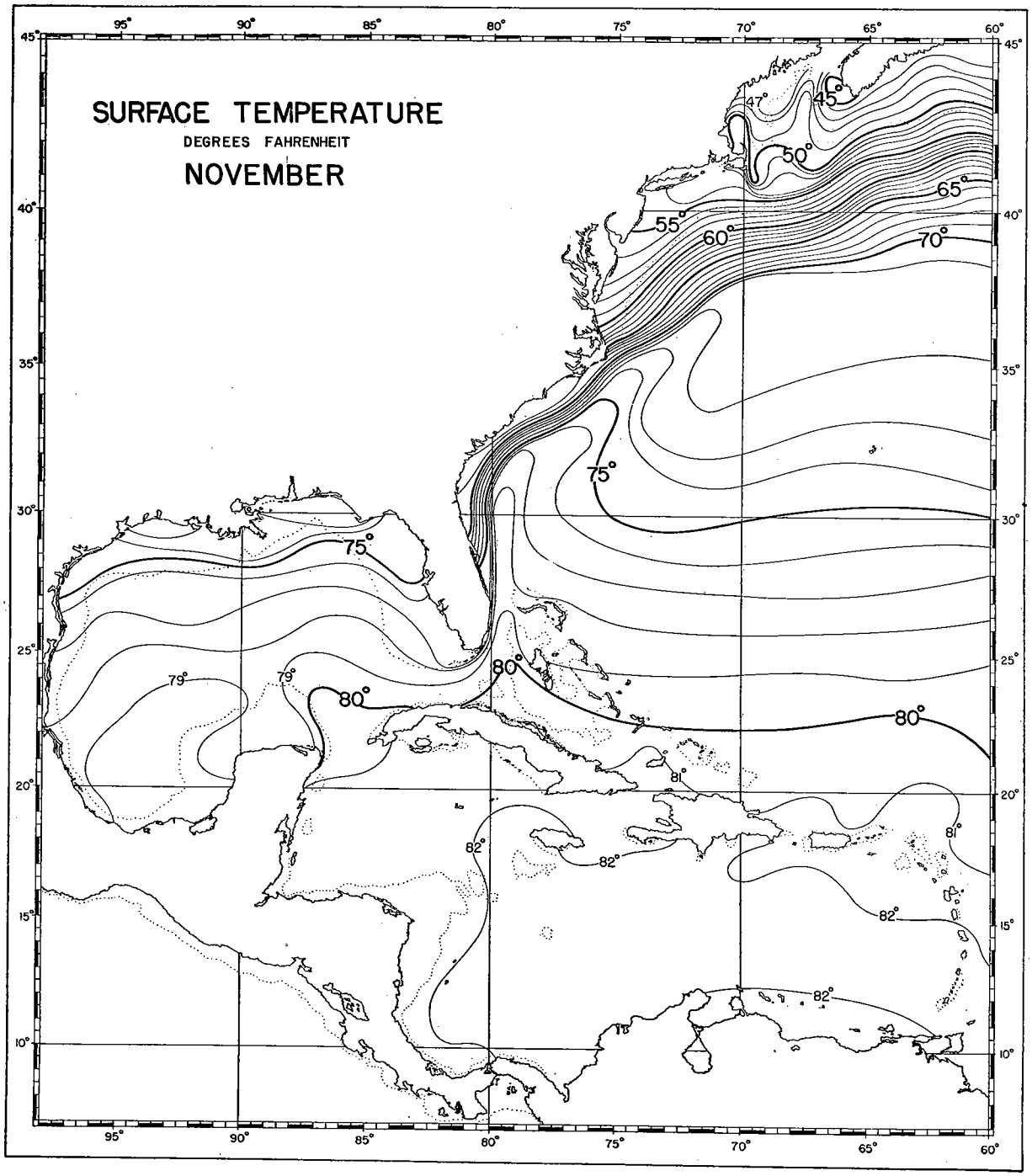

PLATE 11. Average sea surface temperatures for November.

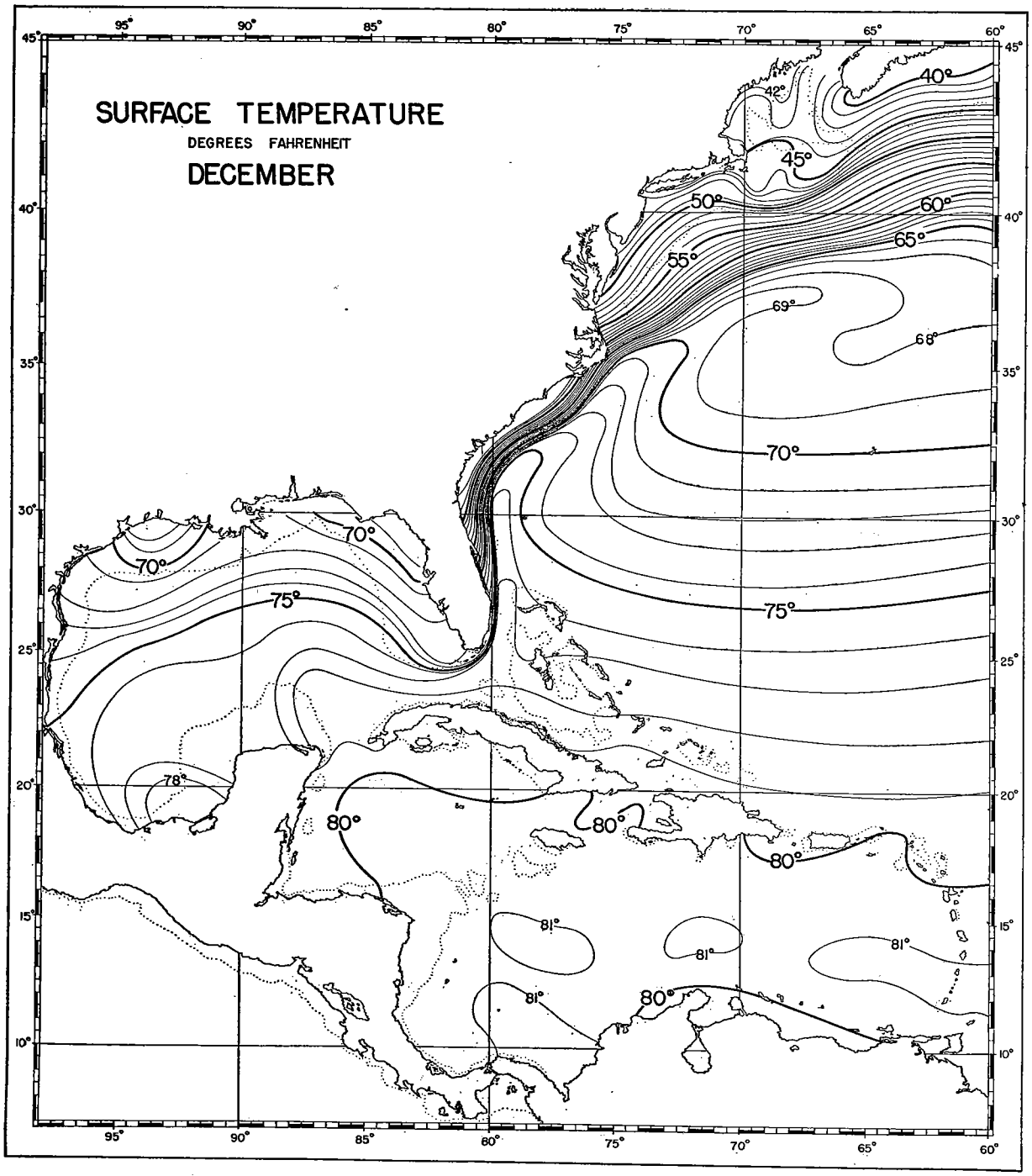

PLATE 12. Average sea surface temperatures for December.

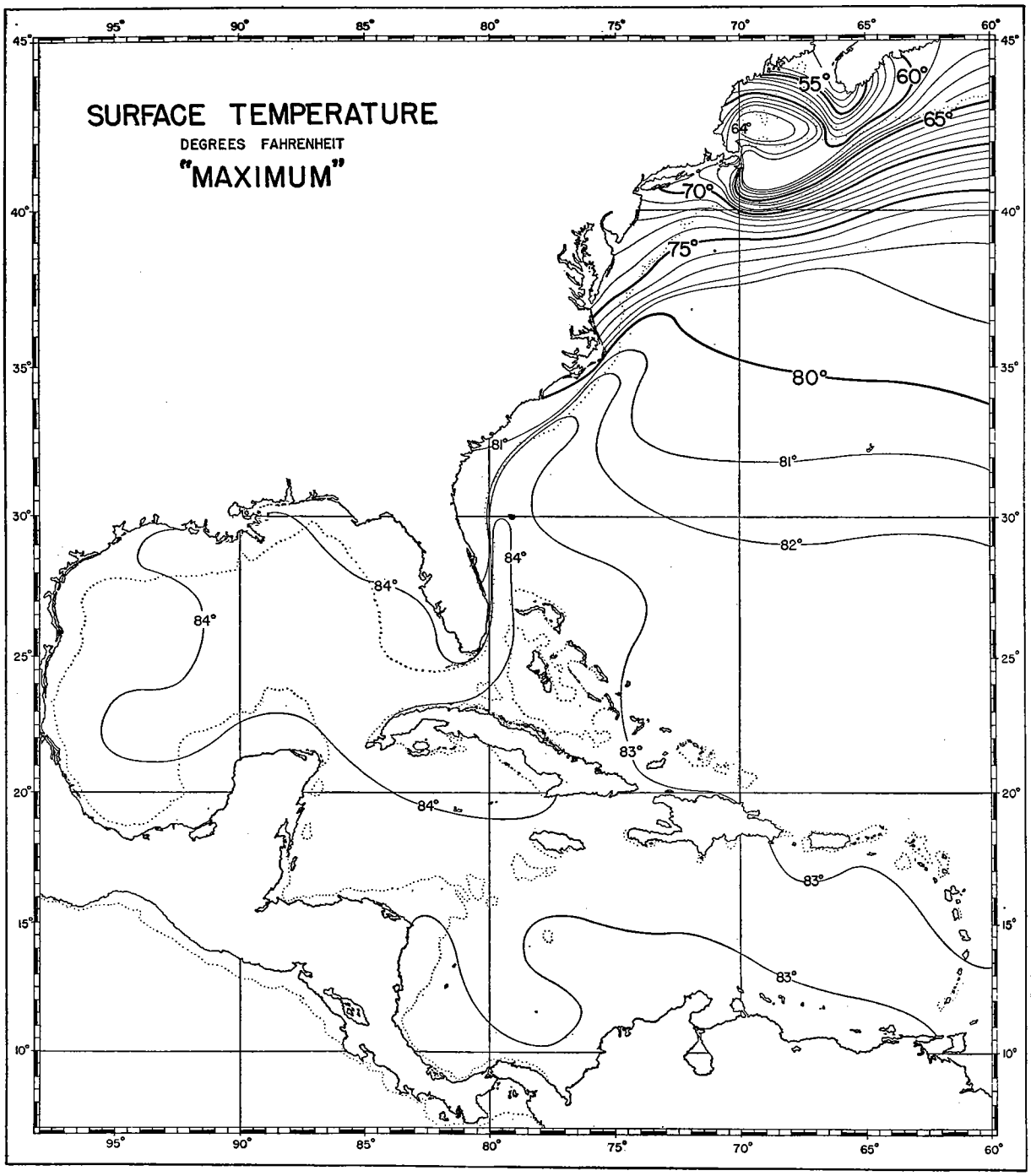

PLATE 13. Maximum average sea surface temperature for the year.

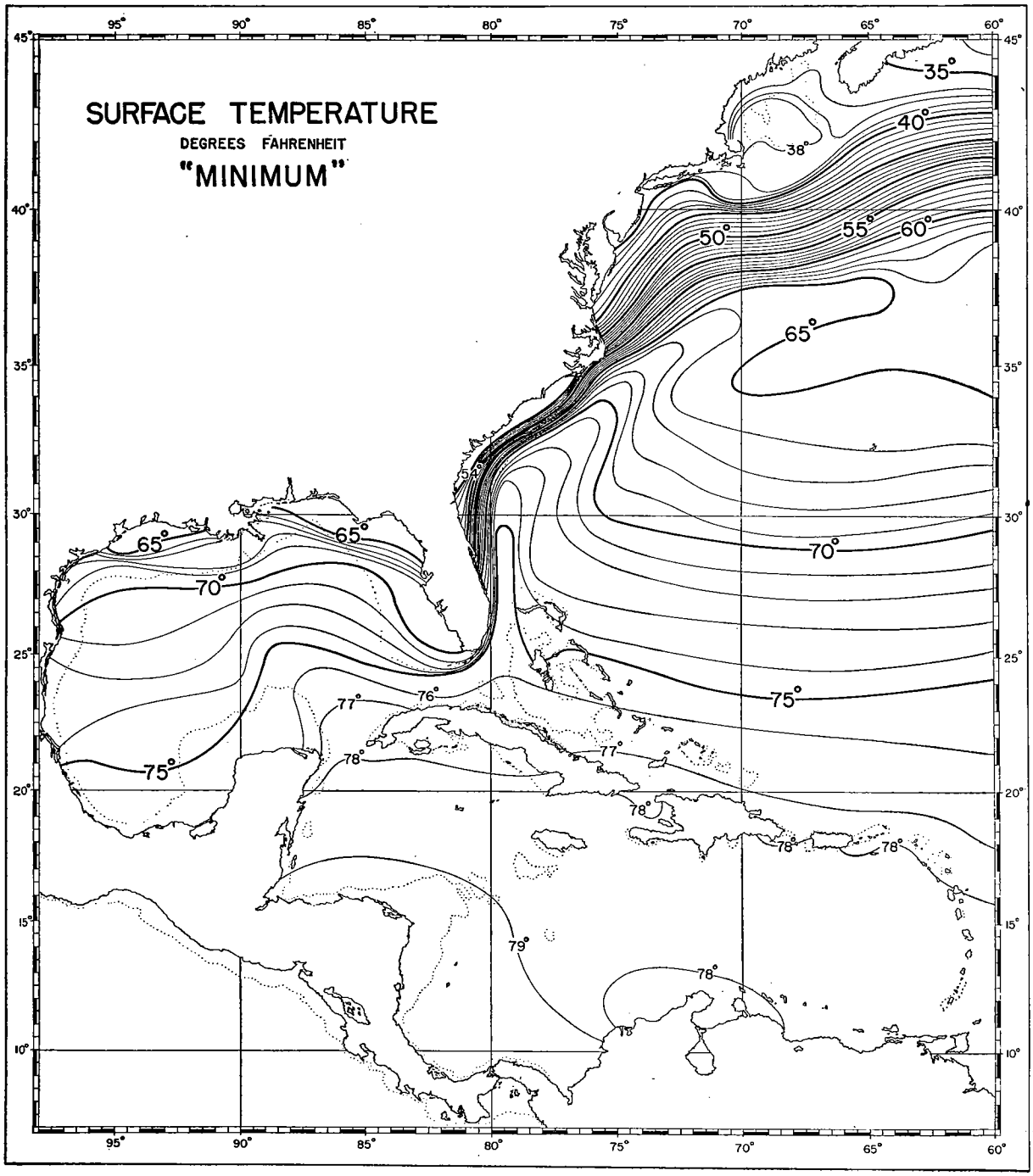

PLATE 14. Minimum average sea surface temperature for the year.

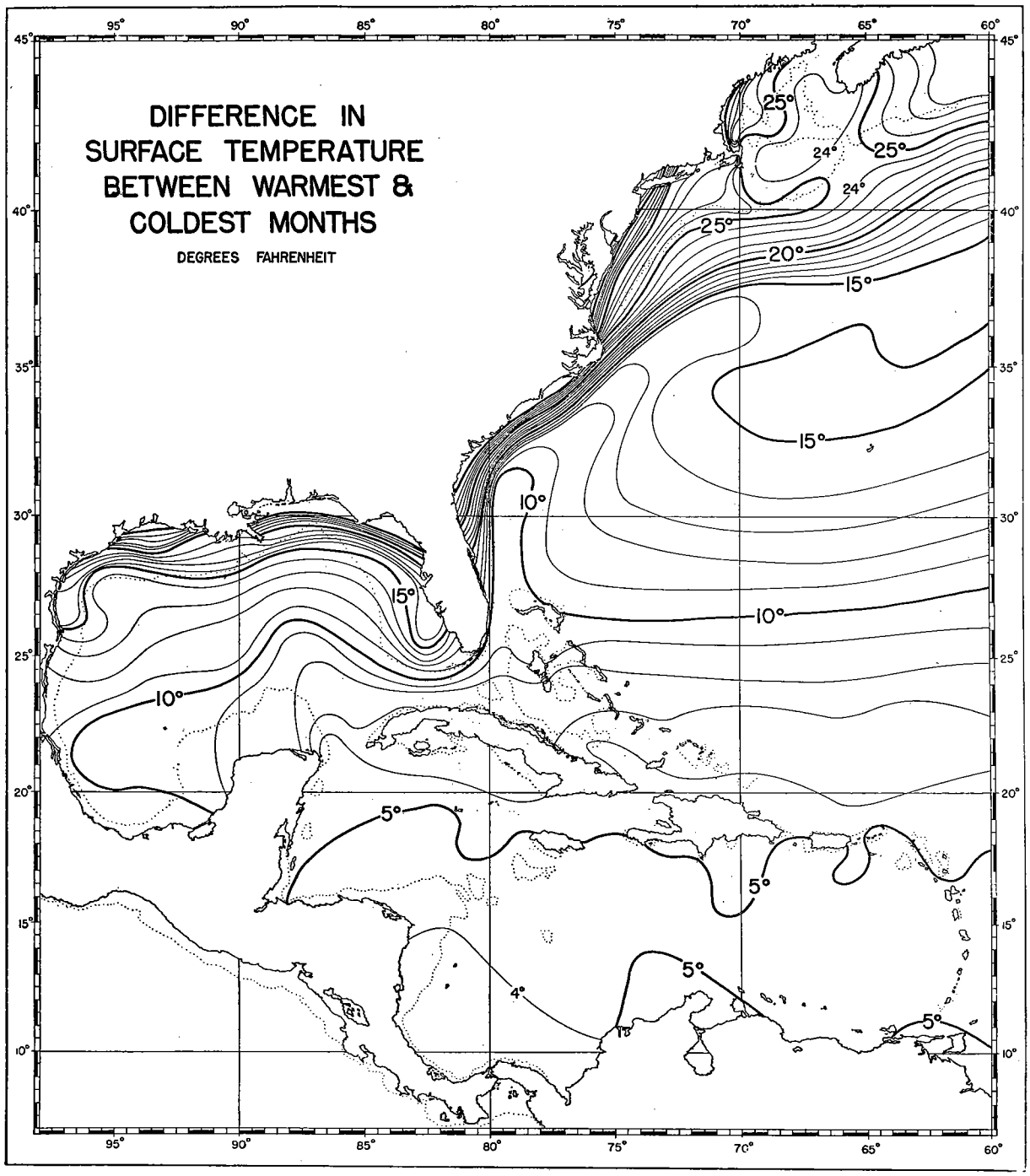

PLATE 15. Difference in surface temperature between the warmest and coldest months.

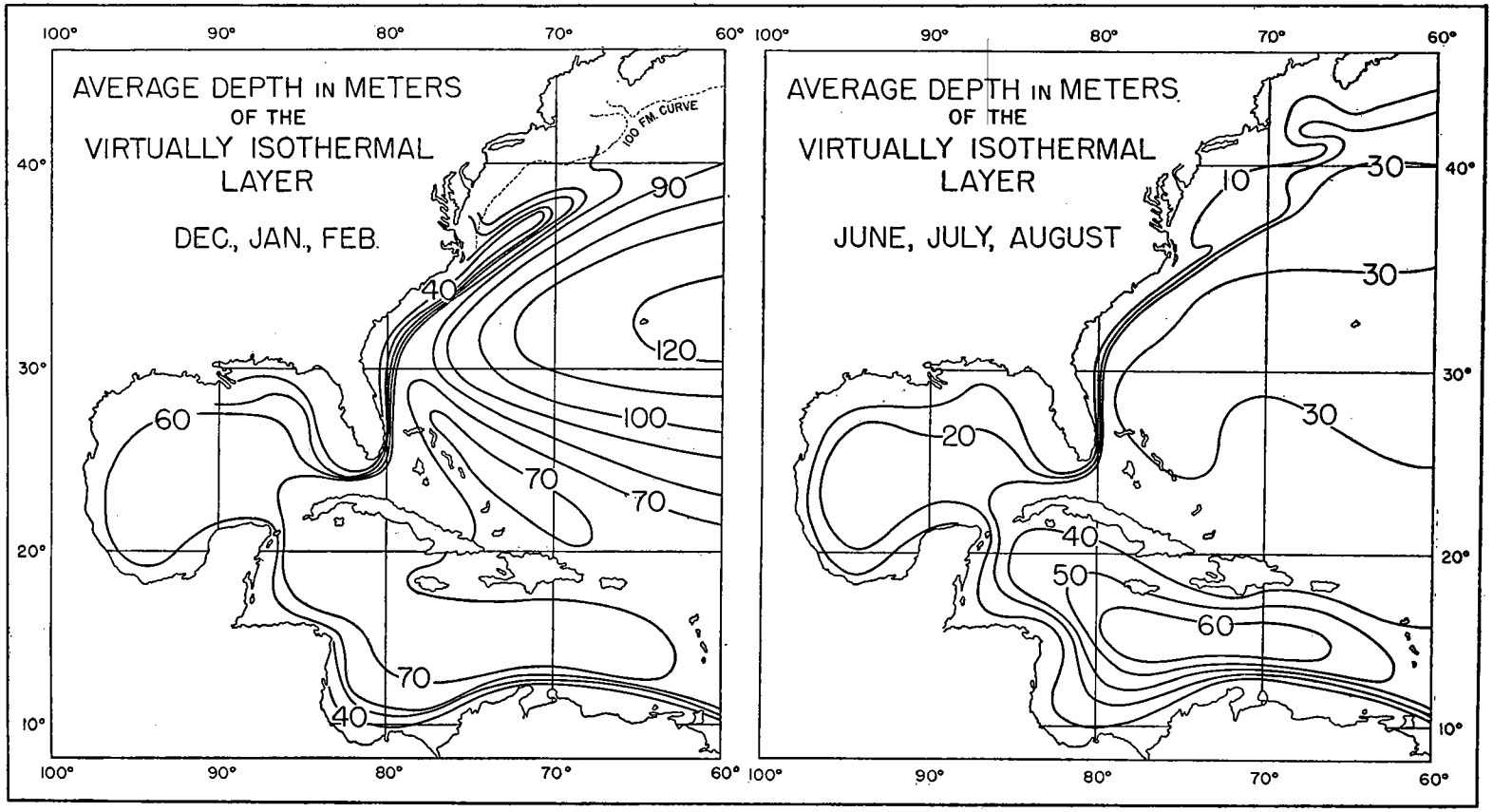

PLATE 16. Average depth of the virtually isothermal layer for winter and summer.