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ATLANTIC OCEANOGRAPHIC GROUP

St. Andrews, N. B.

#397

VERTICAL TEMPERATURE DISTRIBUTION IN THE GREAT LAKES

by

H. B. Hachey

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Introduction:

In June, July and August of 1948 ships of the R.C.N. made periodic observations of the vertical temperature distribution in Lake Ontario, using bathythermographs for this purpose. In addition, one series of temperature observations was made in a cruise of the H.M.C.S. "Portage" from Lake Ontario to Lake Superior. These temperature observations form the subject matter of this report.

Some Temperature Distributions

Some illustrations of vertical temperature distributions in Lakes Ontario, Huron and Superior are shown in Figure 1. The series of observations in Lake Ontario is shown for June 11, July 3, July 8, July 23 and August 8, and the summer development of the surface layer above the thermocline is thus illustrated. The main feature is the increasing stability of the surface layer with respect to the deeper water as the thermocline becomes fully developed, with a surface temperature of 70°F., a temperature of 66°F. at 40 feet, and a temperature of 40°F. at 50 feet. The main thermocline is thus contained between depths of 40 and 50 feet with a temperature gradient of twenty-six degrees. The lowest temperature recorded to a depth of 300 feet was approximately that of the temperature of maximum density of fresh water.

The illustrations of vertical temperature distribution in

Lake Ontario for July 13, July 20, August 10 and July 16 were chosen to illustrate variations in the structure of the surface layer with time and place, and the factors associated with these illustrated features require more information than is at hand.

In Lake Superior, a series of observations was taken as the ship proceeded from Sault Ste. Marie to the head of the lake. In particular, it will be noted that on July 29 at Latitude 47 51 N. and Longitude 87 29 W. the temperature was 39°F. from surface to a depth of 250 feet. This temperature is that of the maximum density of fresh water, and it would seem that the surface layer has been entirely removed, allowing upwelling of the deeper water. It may be assumed that the shifting of the surface layer, resulting from wind action, atmospheric pressure distribution, and/or seiches, is one of the important phenomena of some of the Great Lakes, and in particular, Lake Superior.

Vertical Temperature Sections in Lake Ontario

Data are available for the plotting of two vertical temperature sections in Lake Ontario to a depth of 150 feet. These sections are shown in Figure 2, the observations in Section A being taken on July 16 and 17, and those in Section B on July 18 and 19. The depth of the thermocline is indicated for each section. While the depth of the thermocline in Section A varies from 20 feet at Station 3 to approximately 7 feet at Station 11, the depths in Section B vary from approximately 7 feet at Station 3 to 35 feet at Station 9. This variation in the depth of the thermocline, both with time and position, is probably the

outstanding hydrographic phenomena of the summer season in Lake Ontario and is probably associated with oscillation in the upper layer of water. The 40°F. isotherm which is found at depths between 60 and 90 feet, limits the upper boundary of the deeper waters which approximate the temperature of maximum density of fresh water.

Discussion:

From the hydrographic point of view the waters of the Great Lakes offer some interesting aspects for further study. In general, more information is needed for each individual lake in order to determine the details of the temperature cycle at all depths. In particular, the dynamics of the surface layer is a field of considerable interest from the physical point of view, and probably of primary importance to studies of fish life in these waters.

Summary:

On the basis of temperature observations made in the months of June, July and August it may be concluded that:

(a) the maximum depth of the thermocline in the Great Lakes does not exceed 50 feet;

(b) the temperature gradient within the thermocline may be as much as twenty-six degrees Fahrenheit;

(c) the thickness of the surface layer, while not exceeding 50 feet during the summer months, varies considerably with time and position, and can, under certain circumstances, be entirely removed from an area;

(d) the temperature of the deeper waters approximates to that of the maximum density of fresh water.

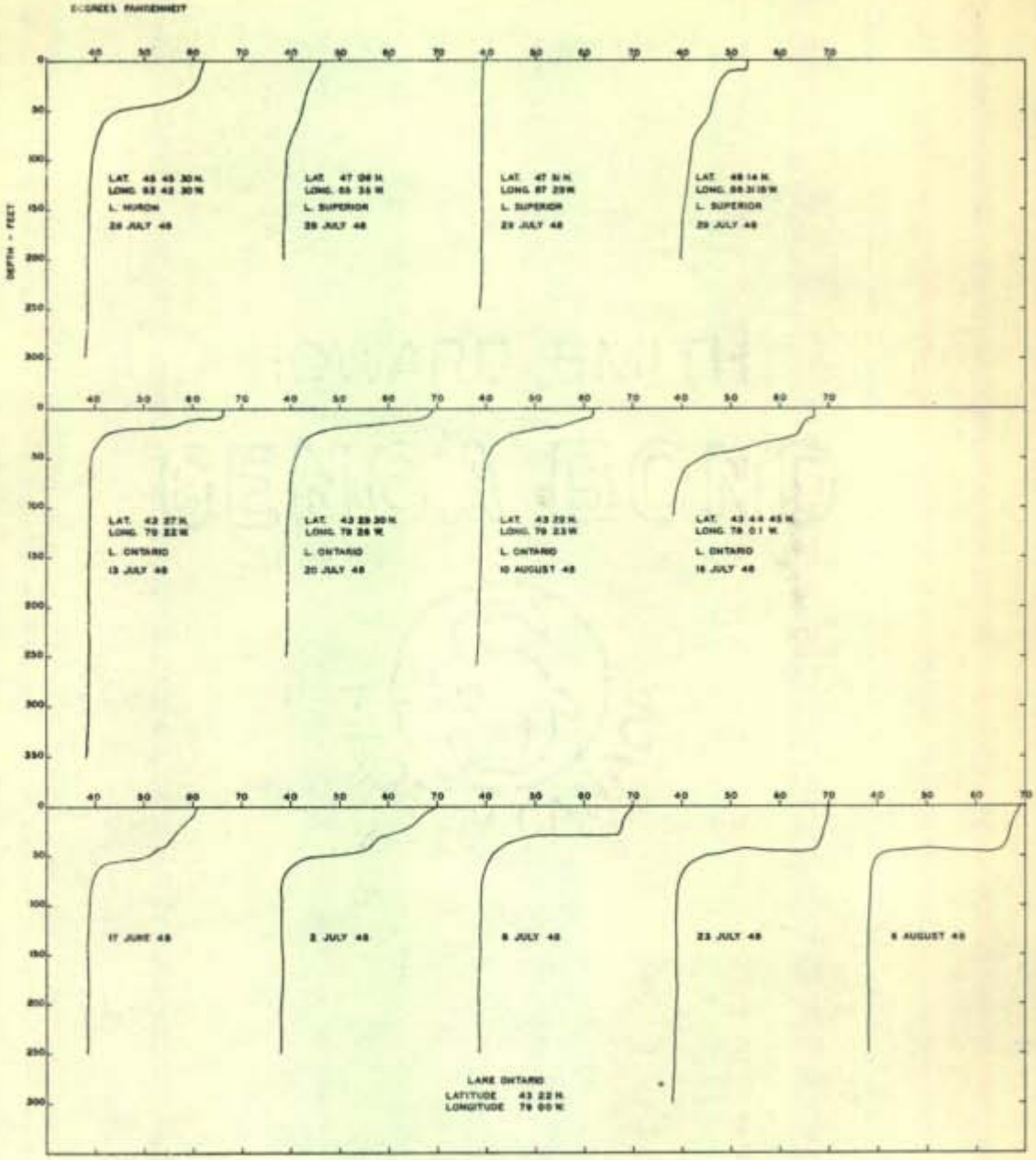

Fig 1. **Vertical Temperature Distribution in the Great Lakes**

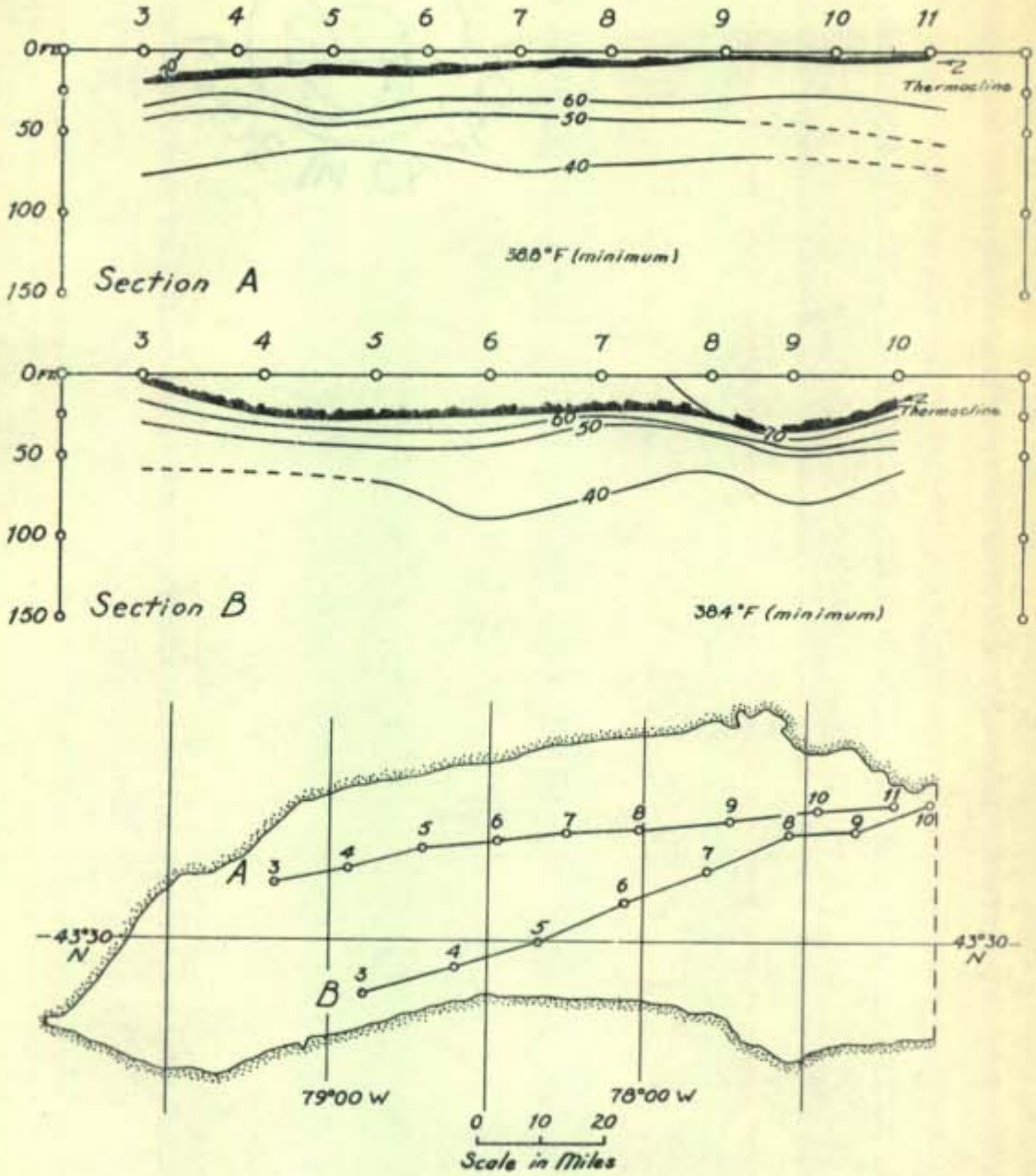

Figure 2. Temperature Distribution in Vertical Sections - Lake Ontario