

THE VERTICAL TEMPERATURE STRUCTURE OF THE LABRADOR CURRENT

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Abstract

The observations discussed were collected during the "Northern Cruise" of H. M. C. ships in September, 1948 while in the Labrador Current. The vertical temperature structure of the waters of the Labrador Current in the main water mass is shown to be quite stable and fairly uniform in temperature characteristics, undergoing only normal seasonal changes in the surface layers within the month of September.

INTRODUCTION

Written accounts of explorations of the Labrador Sea date back to 1266, recording details of a Norse expedition which reached the region of Smith Sound. The first recorded crossing of the Labrador Sea was by Frobisher in 1576, and, in the latter half of the nineteenth, and the early part of the twentieth centuries, considerable detailed oceanographic observations were made in this area.

It was not until the "Chance" expedition of 1926 that an attempt was made to study the detailed physical and chemical structure of the Labrador Current (Iselin, 1927). In the period 1928-35, the "Marion" and "General Greene" expeditions, sponsored by the U. S. Coast Guard, made intensive and detailed study of the waters of the Labrador current (Smith, Soule and Mosby, 1937).

In 1948 a northern cruise of H.M.C. ships provided the opportunity of making certain limited observations in the Labrador Current while on board H.M.C.S. "Haida" under Lieut-Commander Pickard. While in the Labrador Current, ten hydrographic stations were occupied by the "Haida", seven while proceeding northward and three on the return journey. At each hydrographic station water samples and

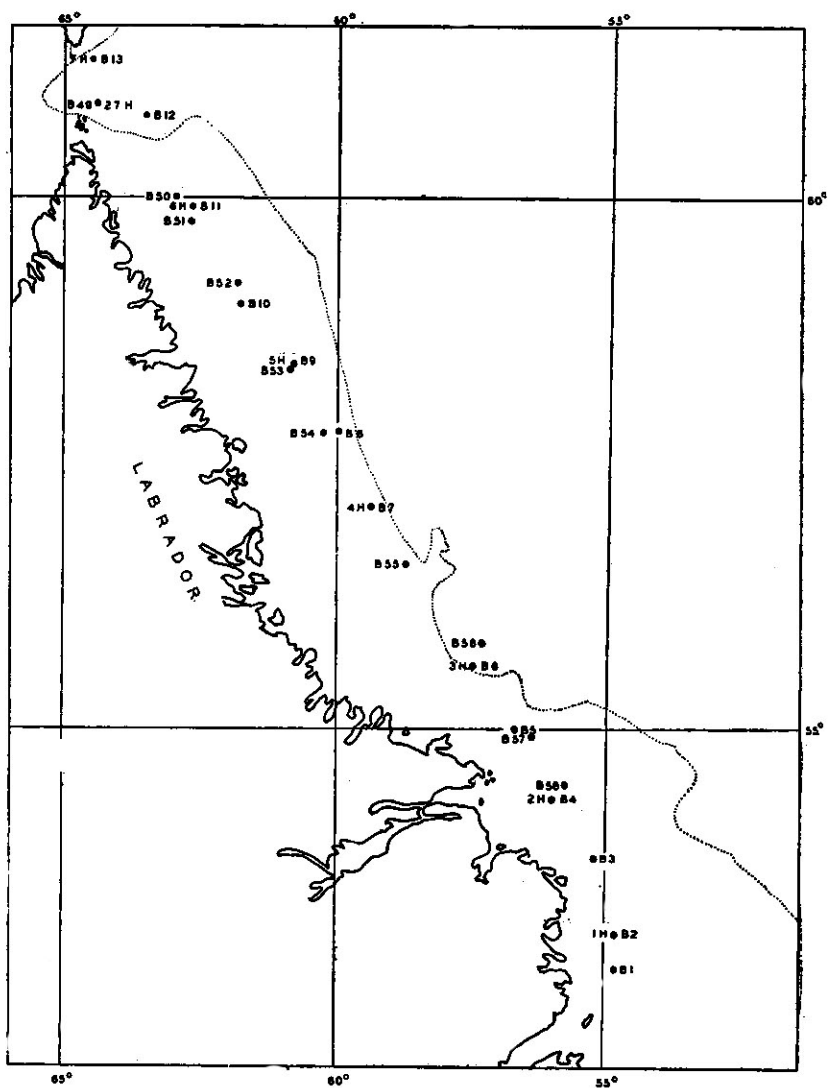


Figure 1. Labrador coastal waters showing the positions of "Haida" observations in September, 1948.

temperatures were obtained at depths of 0, 10, 25, 50, 100, 150, 200 and 250 metres. Throughout the cruise, bathythermographic observations were taken at intervals of approximately 50 miles, to depths of 150 metres. A map of the Labrador coast given in Figure 1 shows the hydrographic stations and the positions of bathythermograph observations during September, 1948.

The Labrador Current

The Labrador Current has been described (Iselin, 1927) as a cold water stream which flows southward over the continental shelf inside of the comparatively motionless homogeneous mass of North Atlantic water. As compared with the main body of water in the Labrador Sea, the current is characterized by its low salinity and temperature. As a result of the investigations of the "Marion" and "General Greene" expeditions (Smith, Soule and Mosby, 1937), the Labrador Current is found to have its origin in the vicinity of Cumberland Sound where the West Greenland and Baffin Land Currents join.

The Labrador Current may be divided into two streams, an inshore and an offshore one. The inshore stream contains the greater volume of the cold water and is confined to the continental shelf. This stream enters Hudson Strait on the Baffin Land side, and flows as far as Big Island before it recurves southward to mix with the waters flowing out of Hudson Bay, and flows out past Cape Chidley (Smith, Soule, and Mosby, 1937). The offshore stream which contains waters that are characteristic of the warmer West Greenland Current, tends shorewards near the mouth of Hudson Strait, but does not enter, and continues to flow southward over the continental slope (Smith, Soule and Mosby, 1937). Continuing down the coast, the Labrador Current follows an easy sinuous course which exhibits two major bends, the one between Cape Hargigan and Cape Harrison, Labrador, and the other between

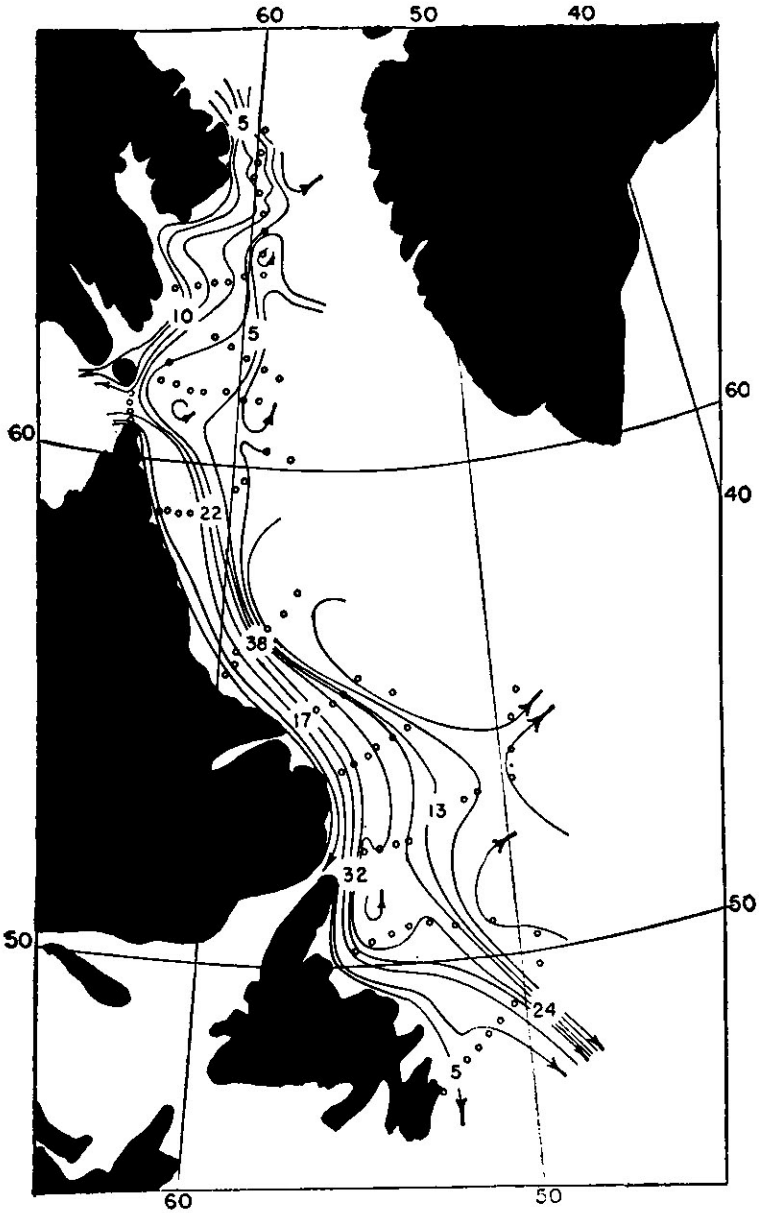


Figure 2. Labrador Current July 22-September 17, 1928. The velocities shown in miles per day indicate the axis of maximum flow

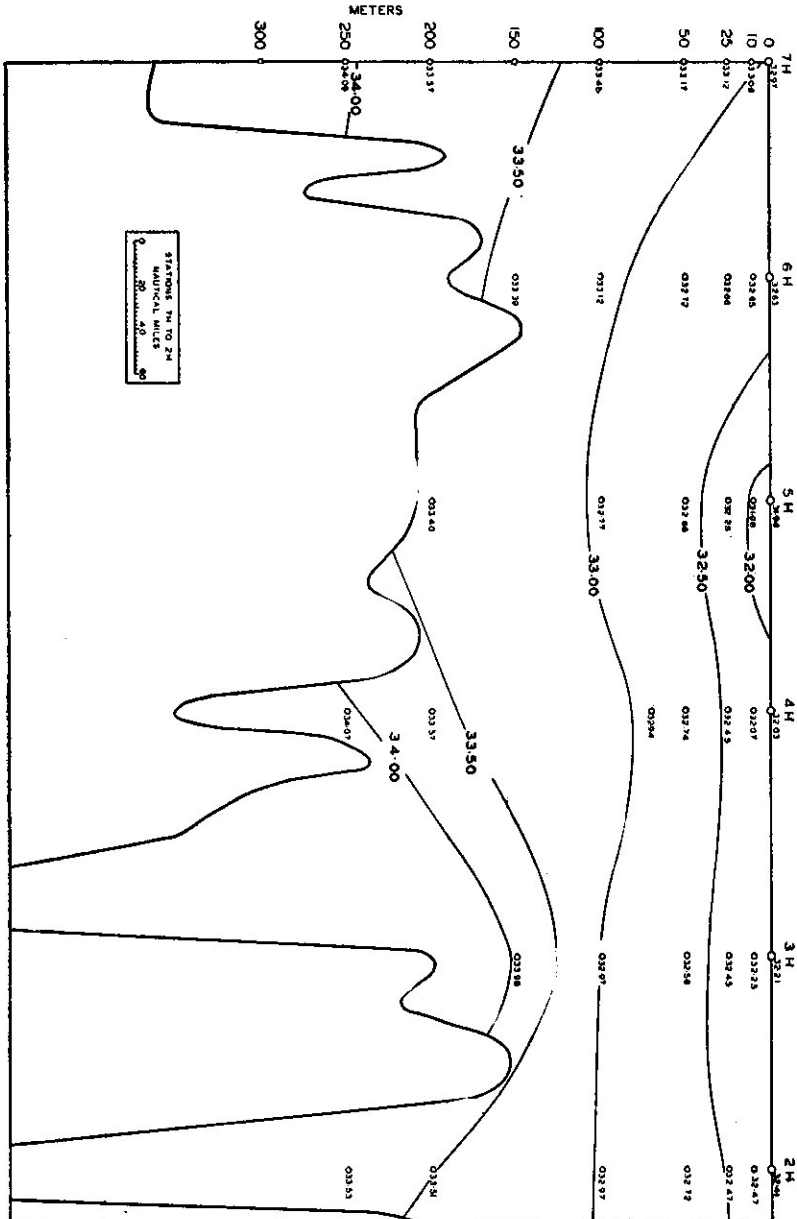


Figure 3. Temperatures in section September 4-6, 1948, running north-west up the Labrador Coast.

Cape Bauld and Funk Island, Newfoundland (Smith, Soule and Mosby, 1937).

The characteristic low temperatures of the Labrador Current persist as the water flows southward, the great stability of the water layers preventing the penetration of solar heat by convection. On reaching the vicinity of Belle Isle Strait, water from the inshore stream is carried, at times, through Belle Isle Strait, water moving outward along the southern side of Belle Isle Strait entering into the southward flow of the Labrador Current. Continuing southward of Belle Isle Strait, the Labrador Current meets the northern face of the Grand Banks in the latitude of St. John's, and is split, the slope branch continuing down the edge of the Grand Banks, while an inshore branch follows the fully past Cape Race (Smith, Soule and Mosby, 1937).

A velocity diagram of the Labrador Current (Smith, Soule, and Mosby, 1937) is shown in Figure 2, and the axis of maximum flow is indicated by the velocities shown in miles per day.

In section, from southeast to northwest, the distribution of temperature and salinity in the Labrador Current in September is shown in Figures 3 and 4, the locations of the hydrographic stations occupied being indicated in Figure 1.

Near the axis of the Current, the main water mass constituting the Labrador current between depths of 25 and 250 metres has temperatures from 2.0 to -0.4° C. and salinities ranging from 32.50 to 33.50 ‰. To some extent, the surface layer to depths of 25 metres is influenced by surface warming and land drainage, with temperatures greater than 4.0° C. and salinities less than 32.00 ‰.

A large body of cold water of temperatures less than 0.0° C. and salinities between 33.00 to 33.50 ‰ is located in the southern portion of the section. This is arctic water which, on the basis of salinity, is either continuous with an offshore water moving southward along the edge of the shelf, or the last vestiges of the southerly movement of Arctic water masses

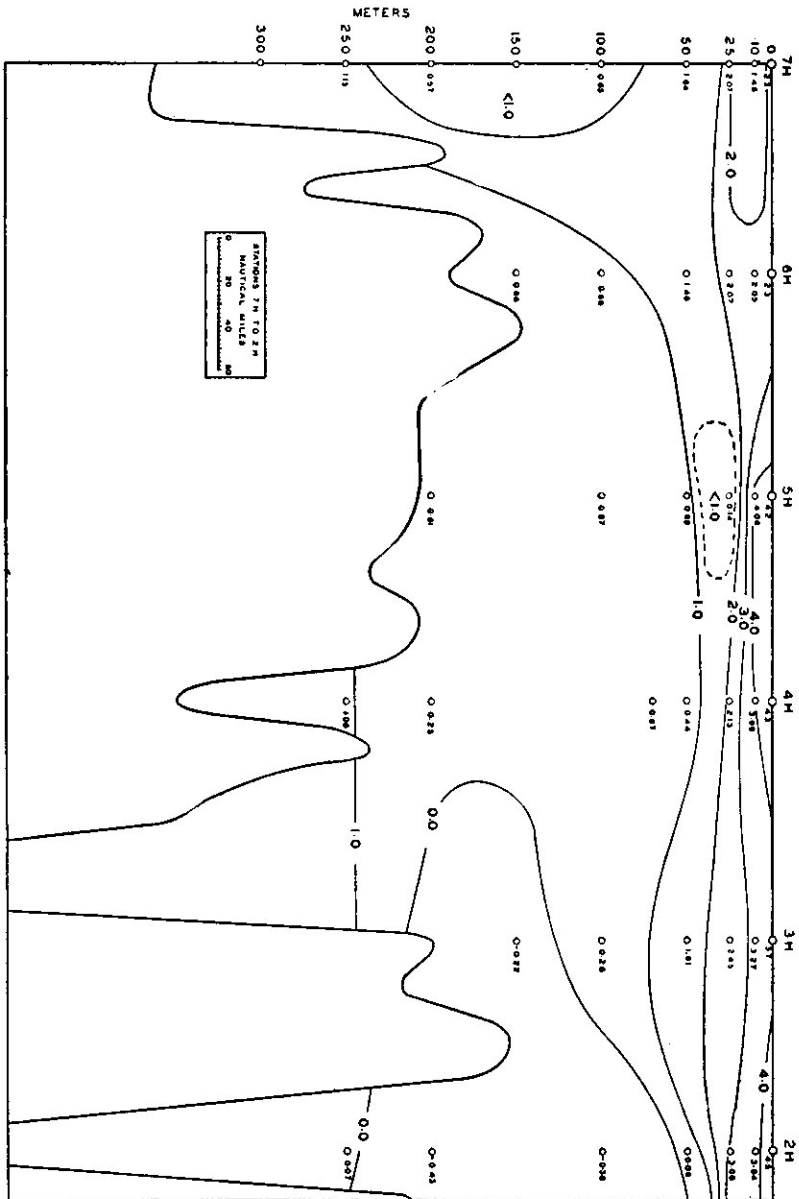


Figure 4. Salinities in section September 4-6, 1948, running northwest along the Labrador coast.