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Temperatures and salinities in the eastern Newfoundland area in 1973

by

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INTRODUCTION

The six standard monitoring hydrographic sections across the Labrador Current east of Newfoundland were taken by the *Cape Freezs* at approximately the usual dates in July and August. Station 27, off Cape Spear, was occupied monthly or oftener during the year. The 1973 section temperatures were compared with the highest, lowest and average temperatures at each station and depth taken at the same time of year in the period 1951-71 for the Flemish Cap section and for the period 1951-65, 69-71 for the remaining sections. In both cases, for brevity they will be called the 1951-71 period. For a more detailed comparison of the 1973 temperatures for the 6 sections with those of the 1951-71 period see Templeman (MS 1974). Salinities in these sections and in Station 27 in 1973 are also compared with those of some of the previous years. In the sections, apart from surface temperatures and salinities which for lack of space may not always be placed in their correct vertical location, the position of the decimal point in an inserted temperature or salinity indicates its level and position. In difficult parts of the section, bathythermograph records taken between the regular stations were used to improve the location of isotherms but not for the actual temperature records.

SECTIONS ACROSS THE LABRADOR CURRENT IN JULY-AUGUST

Temperatures

In 1973 in the southern Labrador section (Section A) from off Seal Island across Hamilton Inlet Bank (Fig. 1A), surface temperatures were above average

at all stations and at the most coastward 5 stations higher than any previously encountered. Most temperatures in the colder intermediate-level portion of Section A were lower than those of the 1951-71 period (Templeman MS 1974), but not as low and the volume of water below -1.5°C not nearly as great as in 1972 (Templeman 1973). In 1973, temperatures in the deep slope water east of Hamilton Inlet Bank, influenced mainly by the West Greenland Current, were lower than in 1972 and, at the greatest depths comparable with or lower than the lowest of the period 1951-72.

In the Cape Bonavista section (Section B) in 1973 (Fig. 2A), surface temperatures were above average in 6 of 8 stations but none were the highest or lowest of the 1951-73 period. Temperatures from 25 to 200 m and deeper at the western stations were usually below the averages and often below the lowest of the 1951-71 period, and many were the lowest of the 1951-73 period. The lowest temperatures were below those of 1951-71 and similarly low as in 1972. At the coastward stations, lower temperatures below -1°C and below 1°C extended more deeply than in any previous year of the 1951-73 period. In the offshore deep water of 400 m and deeper at the continental slope, temperatures were below average but not the lowest of the 1951-73 period.

In the St. John's to Flemish Cap section (Section C) in 1973 (Fig. 3A), surface temperatures were above the averages for the 1951-71 period except at one station where they were equal, but all were below the highest of the period. There was more cold water below -1.5°C in the Avalon Channel, reaching bottom over more area and extending farther seaward over Woolfall Bank to the Grand Bank, than in any previous year of the 1951-73 period. Low temperatures of -1.4 to -1.5°C covered the surface of the Grand Bank along the 47° latitude line of the section. This was the only year of the 1951-73 period when near-bottom temperatures over Woolfall Bank fell below -1.1°C and over the surface of the Grand Bank in the line of the section, below -0.9°C . The core of the eastern cold-water branch of the Labrador Current at the eastern edge of the Grand Bank was lower in temperature than in any year of the 1951-71 period but not as low as in 1972. There was also colder water and more water below 2°C above Flemish Cap than in any year of the 1951-73 period except 1972.

In Section D from St. John's to the Southeast Shoal and slope of the Grand Bank in 1973 (Fig. 4A), all surface temperatures were below the averages for the 1951-71 period and at Station 33F slightly below the lowest of the 1951-71 period but not as low as in 1972. Lower temperatures were present in the Avalon Channel, and especially near bottom, than in any previous year. The most comparably cold year was 1972. On the western slope of the Grand Bank at Stations 29-31, near-bottom temperatures were much lower than in any previous year and near-bottom temperatures on the Southeast Shoal were also much lower than usual. In agreement with the unusual appearance of water below 1°C and a large amount below 2°C above Flemish Cap, there was an unusually large volume of cold Labrador Current water below 0°C and some

below -1°C east of the Southeast Shoal but separated from and extending well to the east of the usual cold Labrador Current water fringing the eastern side of the Grand Bank.

In Section E from Green Bank to southeast Grand Bank in 1973 (Fig. 5A), all surface temperatures, except those at Stations 26D and 26F, were below the 1951-71 averages and 3 were the lowest of the 1951-73 period. The 2 higher-than-average temperatures were not the highest of the period. There was colder water near bottom on Green Bank and in the Haddock Channel than in any previous year of the 1951-73 period. The cold water in the Haddock Channel is part of the cold-water branch of the Labrador Current which has passed through the Avalon Channel and naturally turns to the western wall of the Haddock Channel. There was also colder water near bottom than in any previous year of our records on the western Grand Bank at Stations 20-22 near the Haddock Channel. Temperatures in the eastern branch of the colder part of the Labrador Current were lower than usual but not as low as in 1972.

In Section F, from St. Pierre Bank along the southwestern slope of the Grand Bank in 1973 (Fig. 6A), surface temperatures were below the 1951-71 averages at 6 western stations but none were below the lowest of the 1951-71 period. At Station 19, the surface temperature was above average but not the highest for the above period. Temperatures of the intermediate western cold layer were the lowest of the 1951-73 period. In the eastern cold intermediate layer, temperatures were below average but not as low as in 1972 and only at one point below the lowest of the 1951-71 period. Temperatures of the intermediate warmer slope-water intrusion centrally between the eastern and western cold water were close to the averages of the 1951-71 period. Temperatures in the near-bottom water at 250-275 m were also close to average levels and lower than in 1972.

Salinities

In these comparisons of salinities, little attention has usually been paid to the upper water levels where salinities are too much influenced by local and temporary precipitation and runoff to be very useful for year to year comparisons.

In the Seal Island section in 1973 (Fig. 1B), salinities in Hawke Channel were slightly higher than in 1972, 1971 and 1969 (Templeman 1973, 1972, 1970) and lower than in 1970 (Templeman 1971). Surface and near-surface salinities at the stations nearest the coast showed the usual influence of the low salinity water emerging from Hamilton Inlet and flowing southward. There was a considerable smaller volume of water below 33.5‰ than in 1972. In the offshore Labrador Current deep water of the continental slope at 400 metres and deeper, related to the West Greenland Current, salinities were slightly higher than in 1972 at Stations 55A and 56 and

slightly lower at Station 57. Salinities at these stations and depths were higher at all levels than in 1971 but mainly slightly lower than in 1969 and lower than in 1970 when deep-water salinities at the continental slope from 600 to 1000 m were the highest in our records.

In Section B off Cape Bonavista in 1973 (Fig. 2B), salinities over the Northeast Newfoundland Shelf were little different from those of 1972 and near bottom over this shelf usually lower than in 1971 and lower than in 1970. Deepwater salinities at 400 m and greater at the continental slope were mostly higher than in 1972, similar to those in 1971, below those of 1970 when salinities at these stations and depths were the highest or among the highest in our records, and usually higher than in 1969.

In Section C from St. John's to Flemish Cap in 1973 (Fig. 3B), salinities in Avalon Channel and over the surface of the Grand Bank were little different from those in 1972, slightly higher in the Avalon Channel and slightly lower on the Grand Bank than in 1971, lower than in 1970 when these salinities were well above average and except at Station 29 lower than in 1969. In Flemish Channel, the deepwater salinities were little different from those of 1971 and 1972, lower than in 1970, when salinities in the Channel were above 35‰ and were the highest in our records, and also lower than in 1969. In the deep water seaward of Flemish Cap, salinities were close to those of 1972, a little higher at the shallower and a little lower at the greater depths, but were lower than in 1971 and 1969 and especially lower than in 1970 when salinities east of Flemish Cap were generally above 35‰ and were the highest in our records.

In Section D from St. John's to the Southeast Shoal of the Grand Bank in 1973 (Fig. 4B), salinities in the Avalon Channel were little different from those in 1972, but were higher than in 1971 and mainly higher than in 1970. In the deep water east of the Grand Bank, salinities in 1973 were little different from those of 1972-69.

In Section E from Green Bank to southeastern Grand Bank in 1973 (Fig. 5B), salinities in the upper layers in the portion above the banks were lower than in 1970-72. Near-bottom salinities over the shallower parts of the banks were fairly similar to those of 1972. East of the Grand Bank at the continental slope in 1973, lower salinities extended farther eastward down to 250 m and only at depths of 400 m and greater were salinities as high as in 1972. At the greatest depths sampled, 500-1000 m, salinities were slightly higher than in 1972 and slightly lower than in 1971-69 when salinities at these depths were slightly over 35‰ and among the highest in our records.

In Section F along the slope of the southwestern Grand Bank to St. Pierre Bank at about 275 m in 1973 (Fig. 6B), low salinities prevailed as usual in the western and especially in the eastern cold sectors of the Labrador Current. The low-salinity effect in the eastern cold sector lowered

the salinities considerably as far as the bottom at Station 19 as was also the case in 1972, 1971 and 1969 but not in 1970 when the lower salinities at bottom provided by the Labrador Current cold water were further west under Station 18. Near-bottom salinities at 275 m were fairly similar to those of 1971, considerably lower than in 1972 and 1970 except at Station 19 in 1972 and Station 18 in 1970 where they were lower. The salinities of the central midwater portion of the intrusion of warm slope water under Stations 15 and 16, with highest salinity 34.52‰ in 1973, were lower compared with 1972 and especially 1971 and 1970 when temperatures in this intrusion were higher and the highest mid-water salinities in the central area of the section at 200 m and shallower were 34.79, 34.93 and 34.85‰. Salinities at the deepwater Stations 26D and 26F have already been discussed as part of Section E, Fig. 5B.

STATION 27

At Station 27 off Cape Spear (Fig. 7), temperatures in 1973 (apart from upper layer and surface temperatures after mid-June which were little different) were considerably lower at most levels throughout the year than the averages for 1950-62 (Templeman 1965). Surface temperatures were lower in January and March-May, approximately equal in February and generally higher from July to December than in 1972. Temperatures from surface to bottom in January and bottom temperatures from January to April were much lower in 1973 than in 1972 and lower temperatures were more consistently present than in 1972 throughout most of the year from midwater to near bottom. The average temperature over the year at midwater and especially near bottom was lower in 1973 than in any recent year, including 1972 and 1967 which was the coldest recent year at Station 27 apart from the still colder 1972 and 1973. In January-February 1973, temperatures from surface to bottom were the lowest in these months for 1967-73 (Templeman 1968-73).

The salinity picture at Station 27 does not differ greatly from year to year, because the Avalon Channel is not deep enough to allow high salinity water to penetrate to Station 27, and was fairly similar in 1973 to that of 1972. There were typically higher winter salinities in the upper layers. These upper-layer salinities decrease and low salinities reach increasingly greater depths with melting ice and increasing runoff and late summer and autumn rains, mixing by storms and water overturn, and increase again the following winter.

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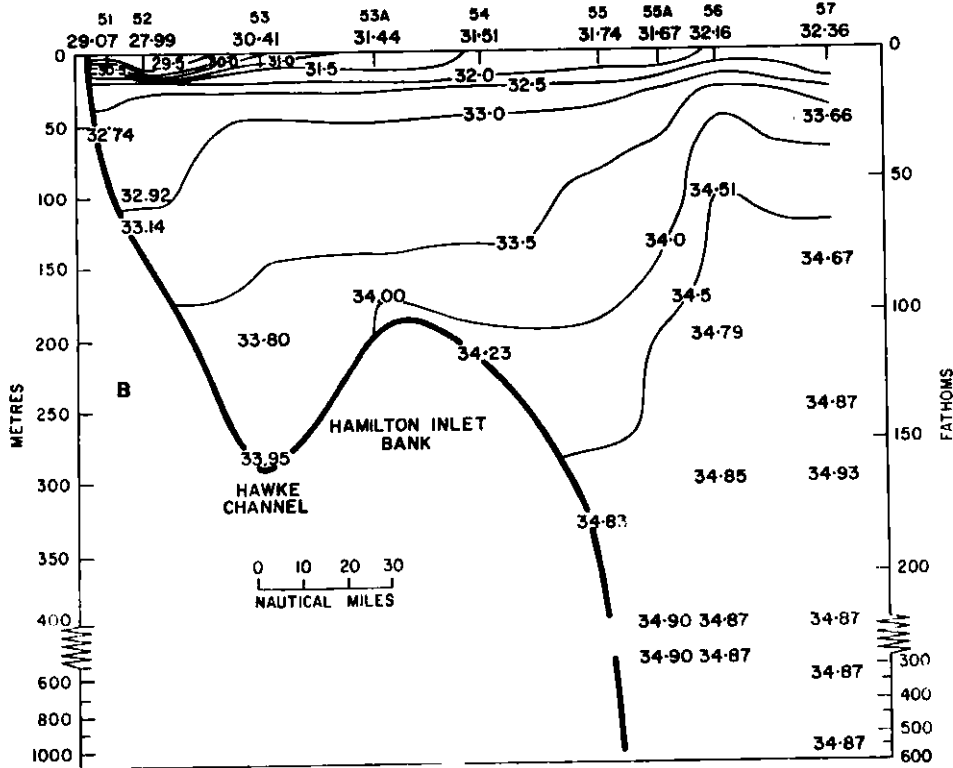
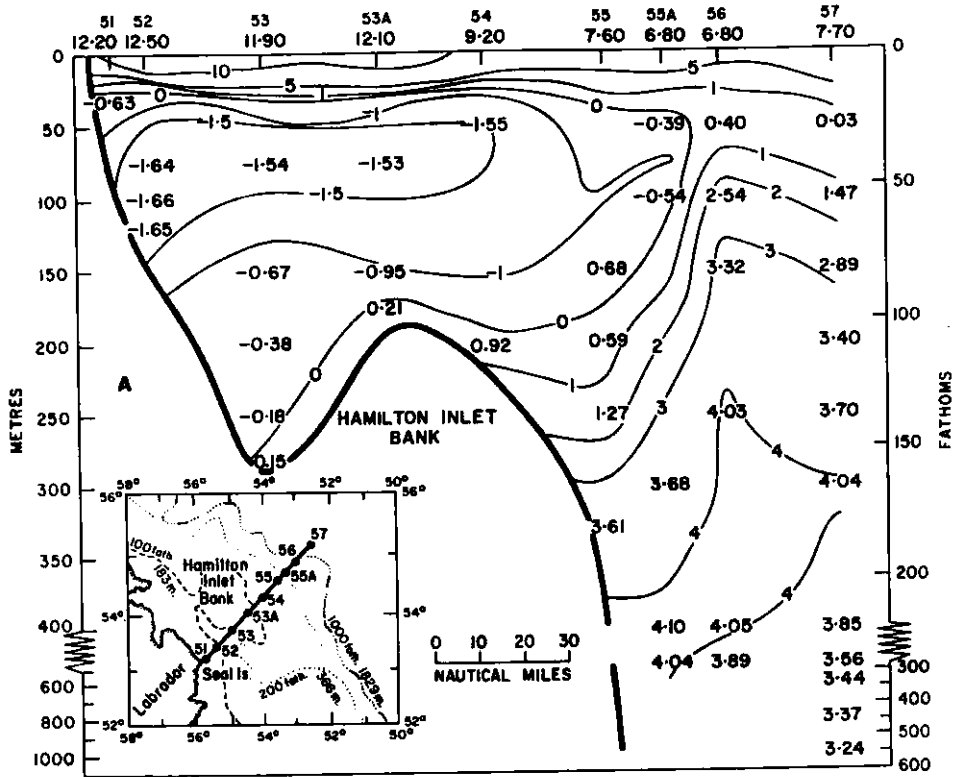


Fig. 1. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, Section A, Seal Island-Hamilton Inlet Bank, 31 July-1 August 1973.

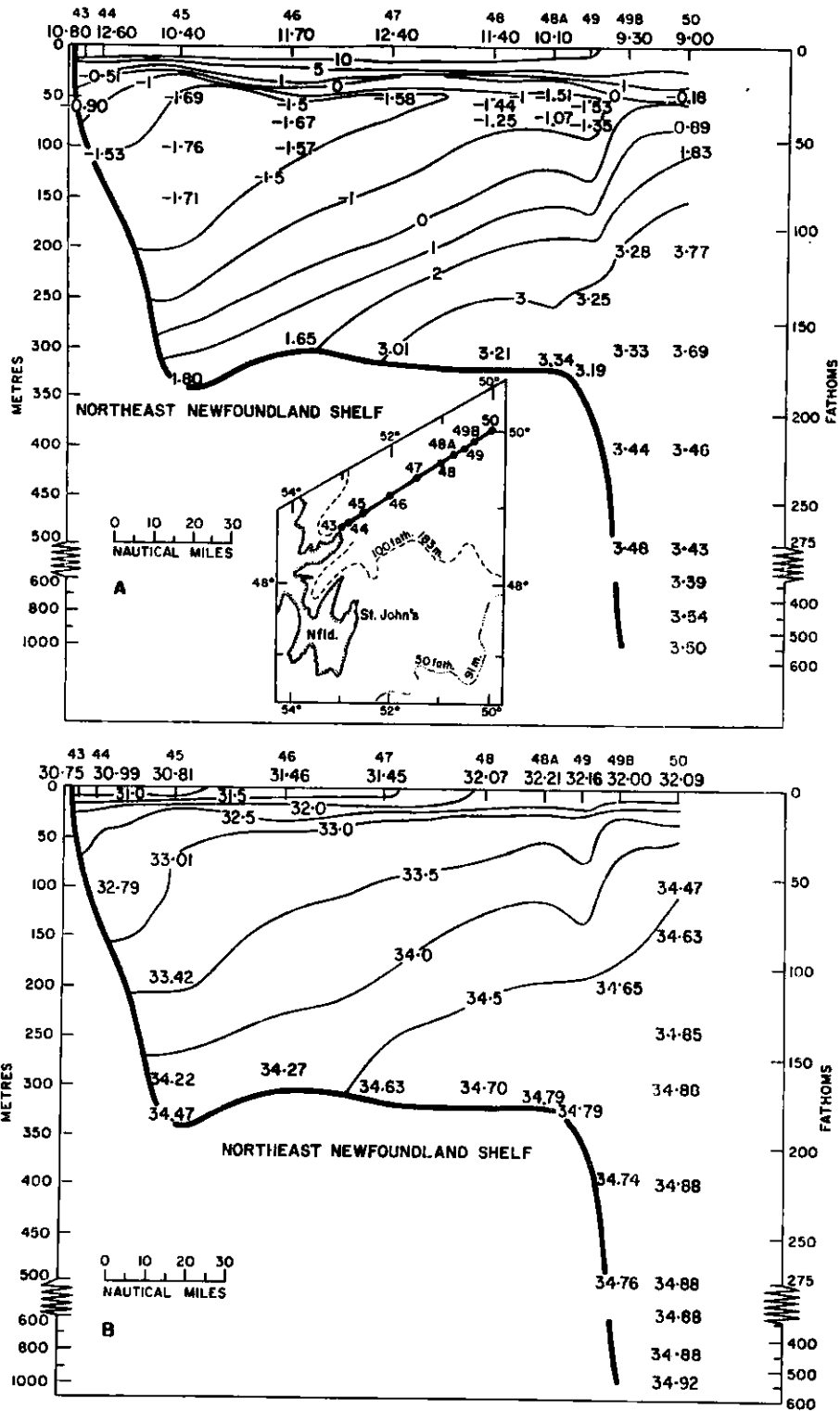


Fig. 2. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, Section B, off Cape Bonavista, 29-30 July 1973.

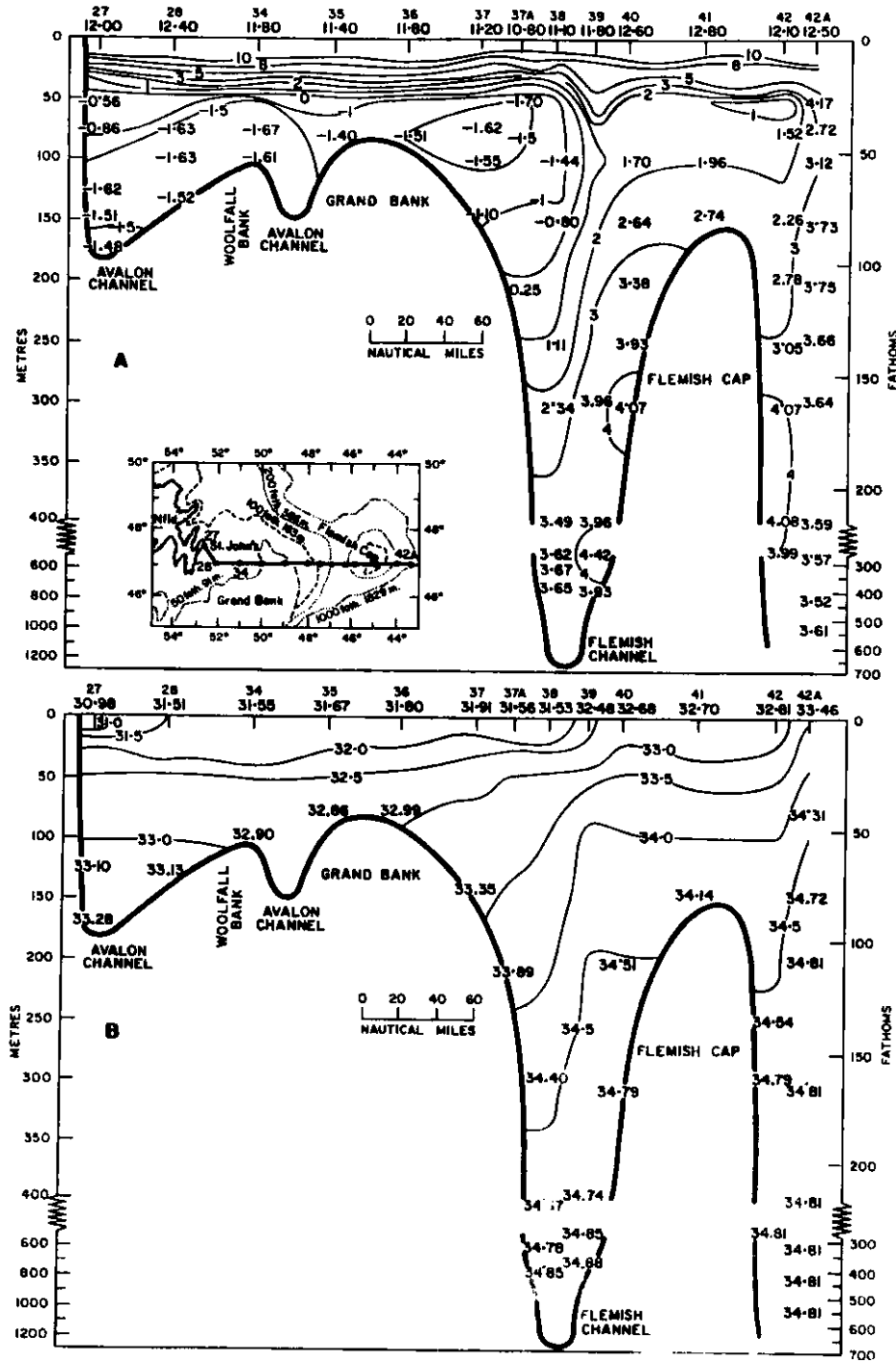


Fig. 3. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, Section C, St. John's-Flemish Cap, 25-27 July 1973.

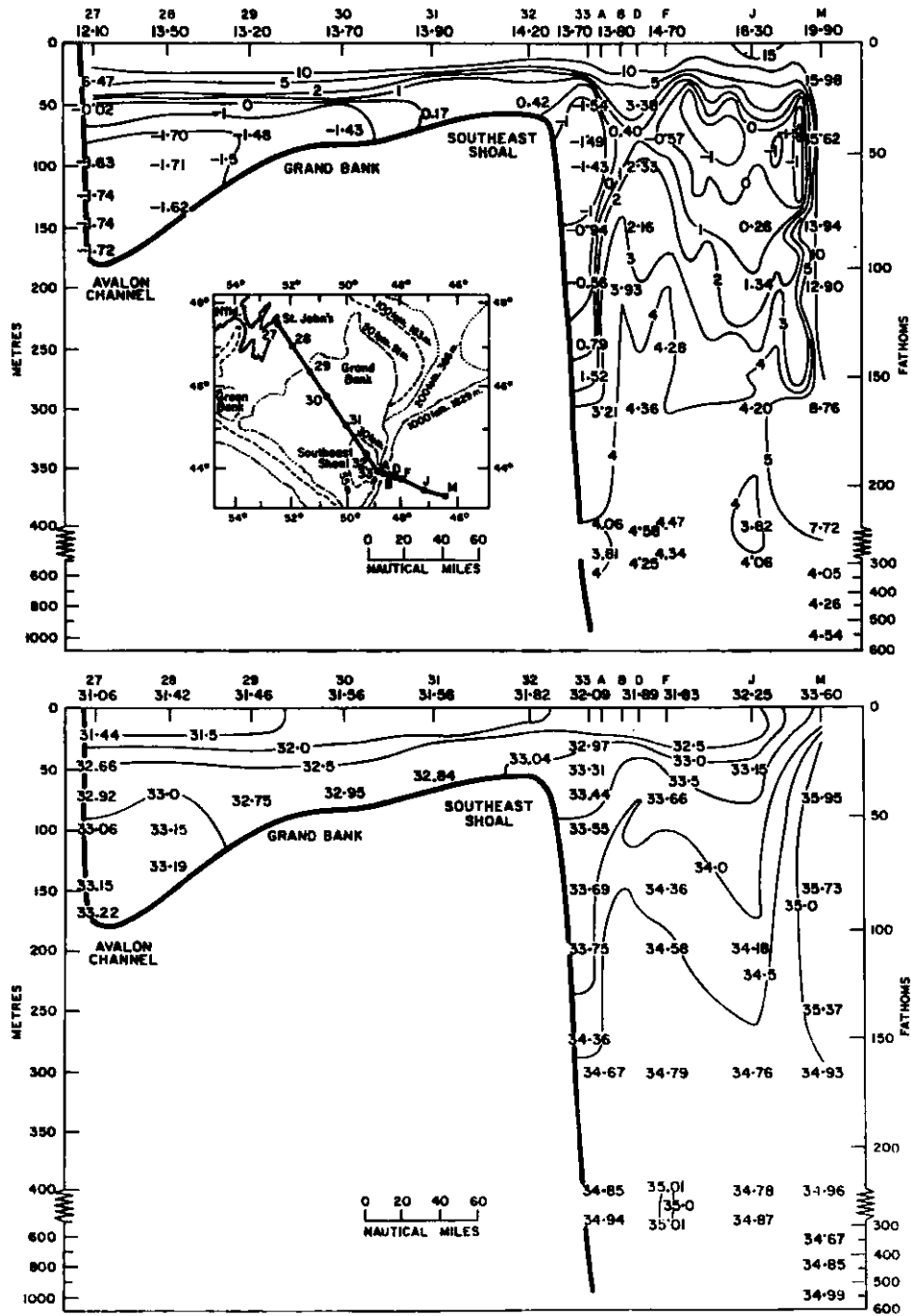


Fig. 4. Temperature (°C) above and salinity (‰) below, Section D, St. John's-southeast slope Grand Bank, 15-17 August 1973.

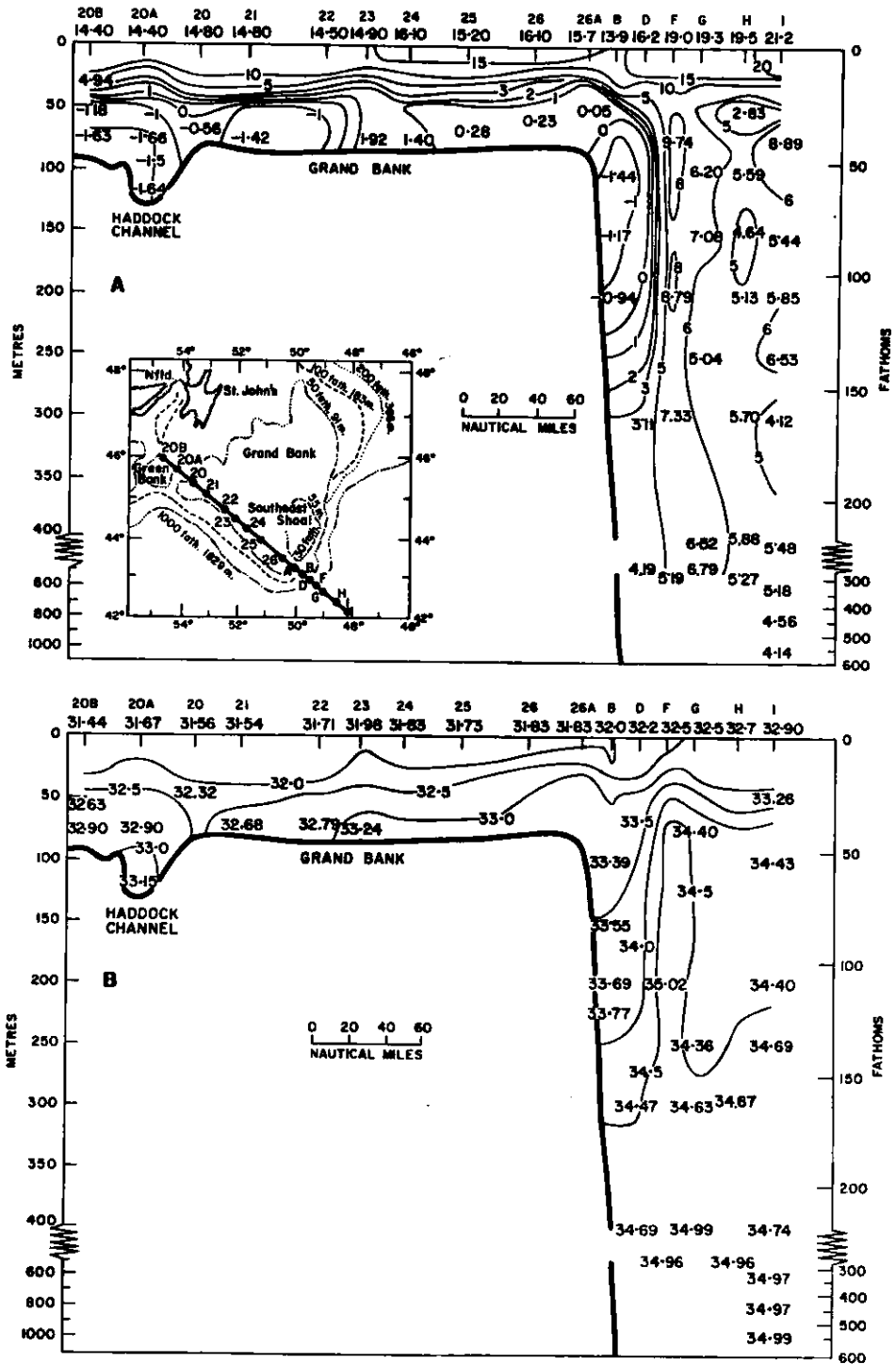


Fig. 5. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, Section E, Green Bank-southeast Grand Bank, 17-21 August 1973.

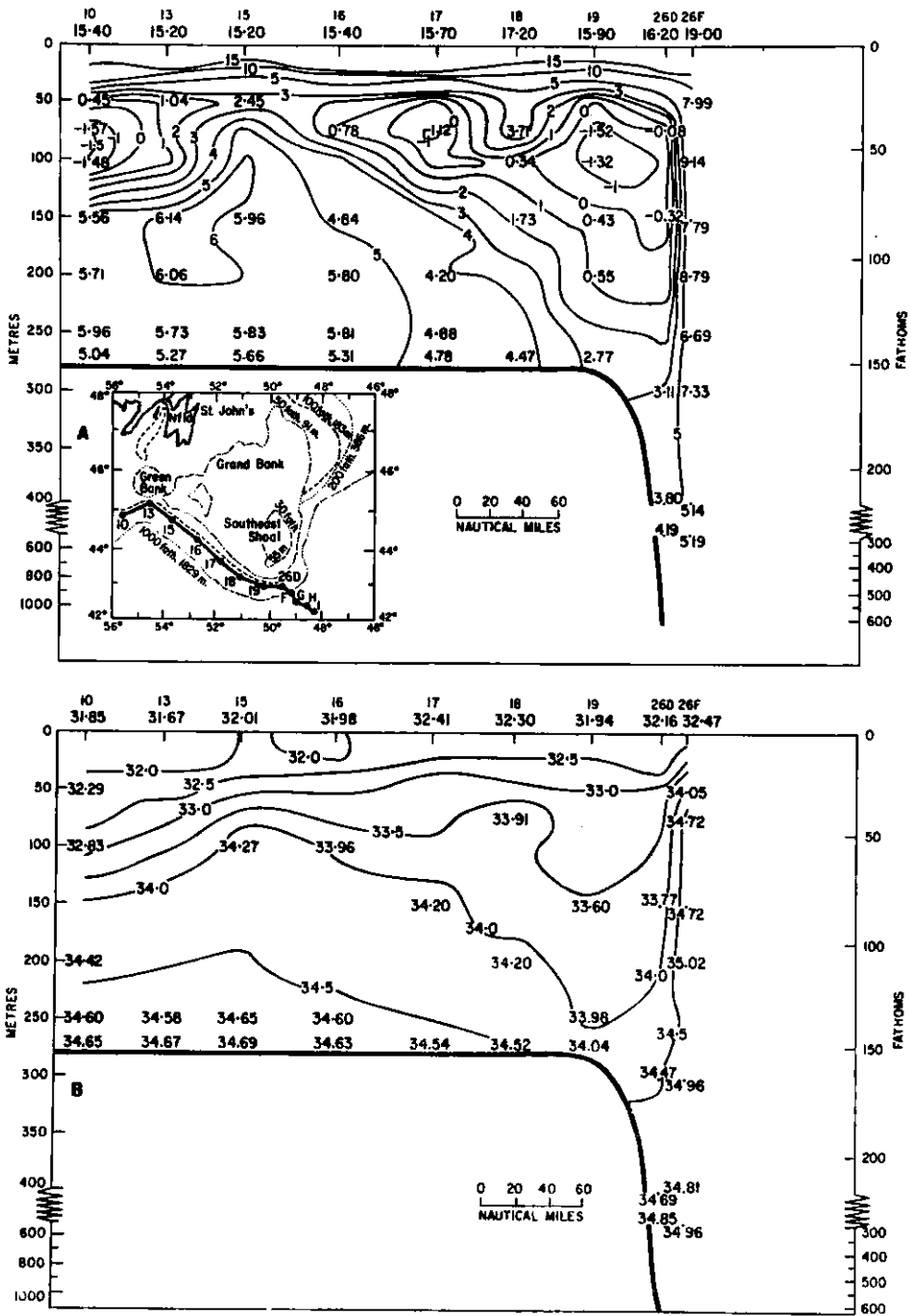


Fig. 6. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, Section F, southwest slope Grand Bank-St. Pierre Bank, 18-20 August 1973.

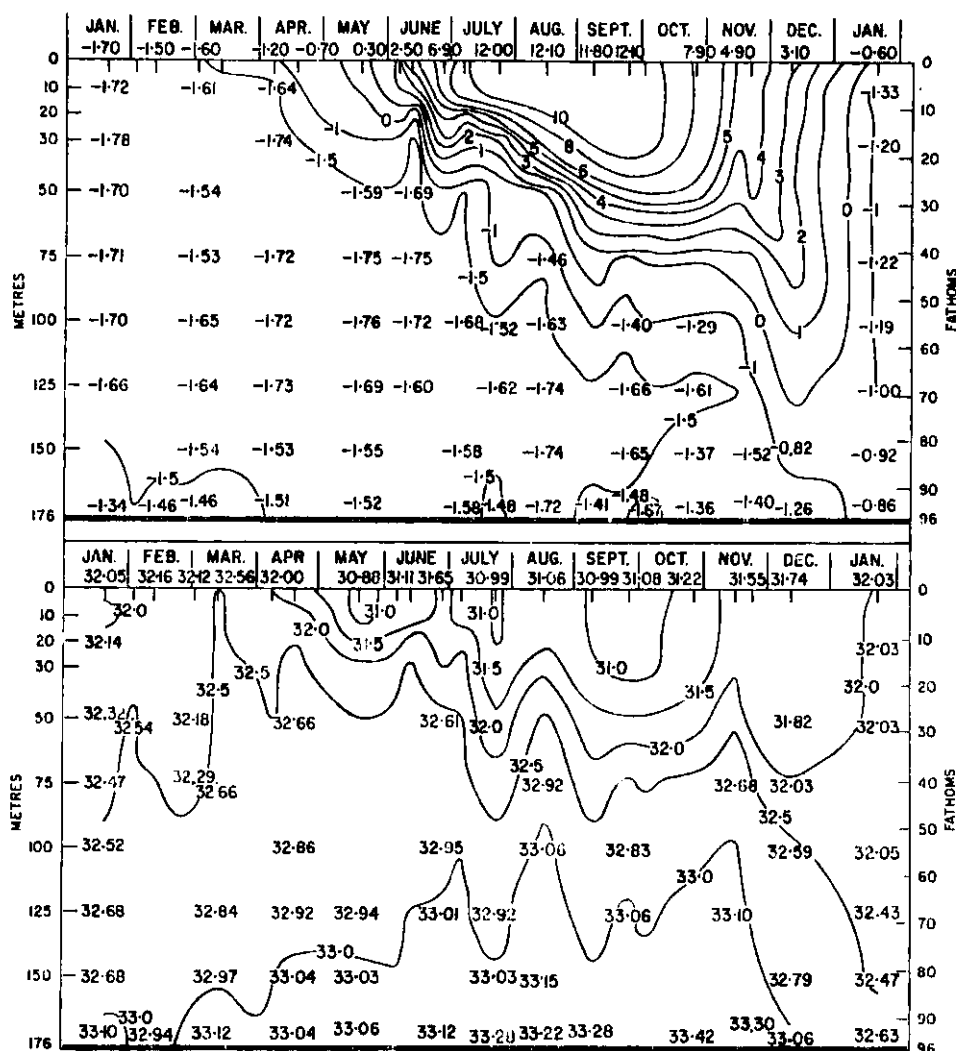


Fig. 7. Temperature ($^{\circ}\text{C}$) above and salinity (‰) below, January 1973 to January 1974, from surface to bottom at Station 27 (See Fig. 3, 4 inset), 2 nautical miles off Cape Spear near St. John's.

