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Hydrological Conditions in the Labrador and Newfoundland Areas in 1967

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Introduction

In 1967 oceanographic observations were carried out on board the R/V *Sevastopol*, *Novorossiisk*, *Kreml*, *Rossiia* and *Volgograd* in ICNAF Subareas 1, 2 and 3. The first two ships conducted investigations on the distribution of temperature, salinity, oxygen and biogenic elements on standard hydrological sections (Fig. 1) and at trawling stations. Scouting vessels made observations from time to time.

Table 1 shows cruises carried out in 1967.

Water Temperature Fluctuations of the Labrador Current

Burmakin (1967) showed that, in January 1967 on Section 8A across the Hamilton Bank (Fig. 1), the average temperature in the 0-200 m layer between 54°44'N and 54°57'W was 1.30°C, i.e. 0.75° higher than it was observed in the same month 1964 but 0.89° lower compared to 1966.

In February 1967 inner waters of the Labrador shelf were also colder than at the same time in the previous year. However the temperature of the warm part of the Labrador Current was considerably higher in 1967 than in 1966 (Table 2, Fig. 1).

As the table shows, warm waters of the Labrador Current can enter its cold part and as a result late in February a sharp heating occurred especially in the near-bottom layers of Hamilton Bank.

In March observations were carried out on Sections 6A and 2A.

Earlier a comparison between average temperatures and the standard (Burmakin, 1967) showed that in March 1967 the temperature in the 0-200 m layer was below the standard (-0.23°) in the cold part of the Labrador Current (Stations 1-3, Fig. 1) and it was 0.19° and 0.06° above the standard (Stations 4-6 and 7-9 respectively) in warm mixed waters.

Thus, in the Labrador and Newfoundland areas the water temperature of the main (cold) branch of the Labrador Current was below the standard of 1960-1967 and 1966 and in warm mixed waters it was higher than this standard in winter and spring 1967. Therefore, the strengthening of both the cold and warm components of the Labrador Current occurred simultaneously.

No observations were carried out in summer. In autumn investigations were conducted in September, October and November mainly in the Labrador and North Newfoundland Bank areas.

We had the possibility to compare data on water temperatures on Section 8A carried out in September 1967 with temperatures taken in the same month 1964 (Table 3, Fig. 1).

As is evident from the table, the surface (0-50 m) layer was warmed to a greater extent in 1967 than in 1964 and this affected the temperature of the active layer (0-200 m). On the other hand, the cold part (AB) of the waters (that were affected by the heating insignificantly) in the 50-200 m layer was warmer (approximately by 1°) and the warm part (C) was colder (by 0.4°) in 1967 compared to 1964.

In September 1967 in the near-bottom layers (200-500 m) the temperature was also 0.2-0.5° higher than in September 1964.

In October and November 1967 temperatures observed on Section 8A are similar to those in 1958, 1962, 1964, 1965 and 1966 (Table 4).

These data show that in October 1967 waters in the coastal branch of the Labrador Current were very warm (the average anomaly is +0.5) and those in the main branch were colder than in 1962 and 1966 but warmer compared to 1964 (the average anomaly -0.4). Consequently, the water temperature of the Labrador Current (AB) was insignificantly (+0.1°) higher than the standard of 1962-1967; in the warm stream (C) the temperature was lower than in 1962, 1964 and 1966. In November 1967 the warming occurred: near-bottom warm waters moved on the slope to the inner part of the Labrador shelf and as a result their temperature increased by 2-3° compared to that observed in October and reached 3-4°. Similar warming was observed from January to February 1967 (see above) and also since October to November 1962 (Table 4). If we consider that temperature maxima in near-bottom layers off Greenland are always observed in February and November (see the data collected on the Godthaab station in papers by Hermann, ICES Ann. Biol. for 1947-1966) then one can assume that these warmings are due to one general reason, namely to the temperature maximum in August in the Gulf Stream system in middle latitudes in the area occupied by the weather ship DELTA. In November 1967 in near-bottom layers (200-500 m) the temperature was 0.1° higher than that in 1958 but almost 1° lower compared to 1962 and 1965.

Horizontal Distribution of Near-Bottom Temperatures in Winter 1964-1967

Figure 2 A,B,C,D shows charts of the horizontal distribution of near-bottom temperatures off Labrador and on the Grand Bank in winter 1964-1967. These charts are drawn from observations carried out in cruises while determining the abundance of young fish from on board the R/V *Sevastopol*, *Pobyeda* and *Novorossiisk* on standard hydrological sections and trawling stations. As shown, the greatest occurrence of cold waters with a negative temperature of the Labrador Current eastwards and southwards of the Grand Bank was found in winter 1964 and 1965; in 1967 it was not so great and in winter 1966 it became very warm and no negative temperatures were observed off South Labrador and on the Grand Bank. Warm waters intensively invaded the slopes of the Labrador shelf and Grand Bank in 1965 and 1967.

These observations as well as mean water temperatures confirm that it was colder in winter 1967 than in 1966 but it was warmer compared to the winter 1964 and 1965.

Location of the Polar Front in the Southern Grand Bank in May 1956-1959, 1961-1962 and 1967

It is well known that, to the south of the Grand Bank, the Gulf Stream is observed within 42-43°N. An attempt was made to track the position of the 5° isotherm on Section 2A in May 1956-1959, 1961-1962 and 1967 (Fig. 3). Figure 3 indicates that in May 1958 and 1967 the Gulf Stream was very close to the "tail" of the Grand Bank. It is known that 1958 was a warm hydrological year; 1967 was not so warm as 1958 owing to the fact that the northern boundary of the Gulf Stream was found more to the south.

Temperature Distribution off Labrador and North Newfoundland Bank in Autumn 1967

From observations carried out in October-November 1967 on board R/V *Novorossiisk*, diagrams were constructed of the vertical distribution of water temperature on the following sections: 14AD across the North Labrador shelf, 8A' across the Central Labrador shelf, 8A across the Hamilton Bank and 7A across the North Newfoundland Bank (Fig. 4, A,B,C,D).

As is evident from Fig. 4, in autumn 1967 almost no negative temperatures were registered over the whole area of the Labrador shelf and North Newfoundland Bank.

In autumn 1962 it was also warm in the Labrador shelf area. Observations by Ramster (1964) showed that in November-December 1962 as well as in November 1967, waters with a negative temperature were not met off Labrador.

Summary

1. Near Labrador and Newfoundland it was colder in winter and spring 1967 than in the previous year but it was warmer than in 1964. The strengthening of both the warm and cold components of the Labrador Current took place simultaneously. In September 1967 the temperature was about 1° higher than in 1964. In October and November it was colder than in 1965 and 1966 but it was warmer compared to 1962 and 1964.

On the whole, the thermal conditions in 1967, as in the previous two years, remained above the long-term standard; however a cooling tendency was observed compared with 1965 and especially since 1966.

2. In the area of Labrador-North Newfoundland Bank two temperature maxima were recorded: one in February and the other in November 1967.

3. Conclusions drawn by Ramster (1962) that in November waters with a negative temperature were not met in the Labrador and North Newfoundland Bank areas were corroborated.

References

Burmakin, V.V. 1967. Hydrological conditions in the Labrador and Newfoundland areas 1965-1966. ICNAF Res.Doc.67/116.

Ramster, J. 1964. Hydrographical conditions off the coast of Labrador and Newfoundland in November-December 1962. ICNAF Res.Bull. No.1, 1964, p.85.

Table 1. Oceanographic cruises and observations carried out in 1967.

Ser. No	Cruise No	Vessel	Date of Observations	Area of Investigations	Sections	Kind of Observations
1	-	<i>Kreml</i>	Dec 1966- Feb 1967	Flemish Cap Bank, Southern Grand Bank, South Labrador	6A 2A	t°, s‰, O ₂
2	8	<i>Rossiia</i>	Dec 1966- Apr 1967	South and Central Labrador	8A	t°, s‰, O ₂ , P, N
3	21	<i>Novorossiisk</i>	Jan-May 1967	Labrador, North Newfoundland Bank, Iceland	14-15A 8A, 7A	t°, s‰, O ₂ , P, N
4	26	<i>Sevastopol</i>	Feb-May 1967	North Newfoundland and Grand Bank, Cabot Strait	7A,6A,4A 3A,2A,1A 1A up to 45°	t°, s‰, O ₂ , P, N
5	-	<i>Kreml</i>	30 Mar-18 May 1967	North Newfoundland and Grand Bank	-	t°, s‰
6	-	<i>Volgograd</i>	17 July- 18 Oct 1967	Iceland, West Greenland, Labrador and Grand Bank	10A 8A	t°, s‰
7	22	<i>Novorossiisk</i>	12 Aug-1 Dec 1967	Iceland, Davis Strait, Labrador, North Newfoundland Bank	14AD 14-15A 8A,7A Survey of Davis Strait	t°, s‰, O ₂ , P, N

Table 2. Average temperature (°C) at four stations of Section 8A

Depth (m)	Date	No of Station			
		6	7	8	9
0-50	10 Feb 1966	0.20	-1.68	0.24	-0.32
	10 Feb 1967	-0.91	-1.55	-0.64	2.92
	26 Feb 1967	-1.49	-0.95	0.94	2.53
0-200	10 Feb 1967	-1.48	0.47	2.10	1.48
	10 Feb 1967	-1.64	0.13	1.54	3.66
	26 Feb 1967	-0.50	1.28	2.06	3.46

Table 3. Average temperature ($^{\circ}\text{C}$) on Section 8A in coastal (A), main (B) and warm (C) streams of the Labrador Current in September 1964 and 1967.

Depth (m)	Date	Parts of the Section				
		A	B	C	AB	ABC
0-50	4 Sept 1964	2.65	1.75	4.92	2.33	2.49
	11 Sept 1967	4.53	3.24	6.32	3.75	3.90
0-200	4 Sept 1964	0.28	0.33	4.00	0.27	0.50
	11 Sept 1967	1.34	1.59	4.08	1.18	1.35
50-200	4 Sept 1964	-0.78	-0.13	3.70	-0.46	0.39
	11 Sept 1967	0.48	1.05	3.34	0.53	0.70
200-500	4 Sept 1964	-	1.24	4.12	-	-
	11 Sept 1967	-	1.71	4.30	-	-

Table 4. Average temperatures ($^{\circ}\text{C}$) in the 0-200 m layer in the coastal (A), main (B) and warm (C) streams of the Labrador Current in October and November 1958-1967.

Date	Streams					Date	Streams		
	A	B	C	AB	ABC		A	B	AB
16 Oct 1962	0.62	1.76	4.61	1.08	1.89	24 Nov 1958	1.15	1.34	1.25
24 Oct 1964	0.05	0.41	4.23	0.17	1.07	26 Nov 1962	1.70	3.60	2.20
16 Oct 1966	0.93	2.27	5.25	1.46	2.40	13 Nov 1965	0.80	2.11	1.38
21 Oct 1967	1.07	1.12	4.22	1.10	1.71	11 Nov 1967	1.42	1.22	1.28

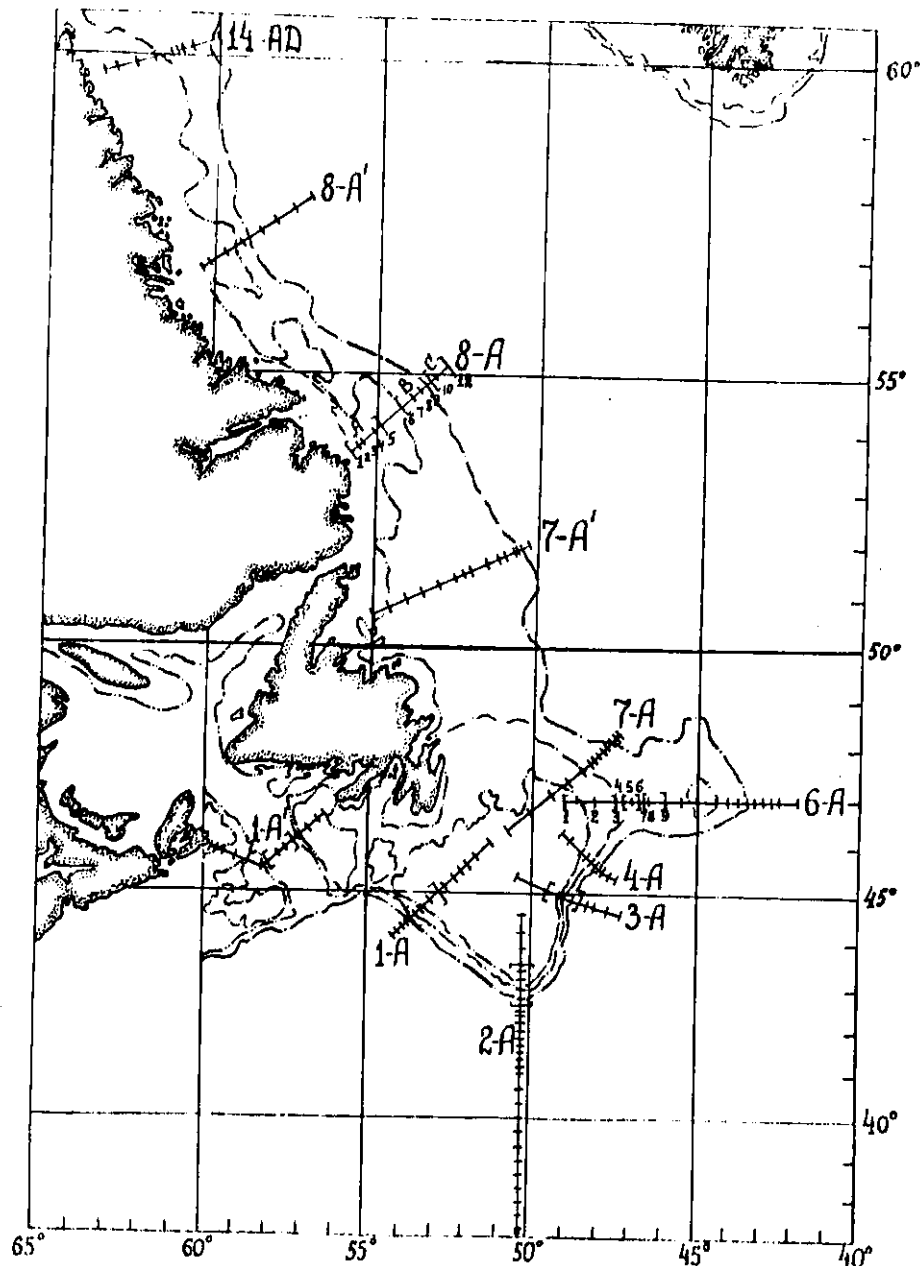


Fig. 1. Location of standard hydrological sections in the Labrador and Newfoundland areas.

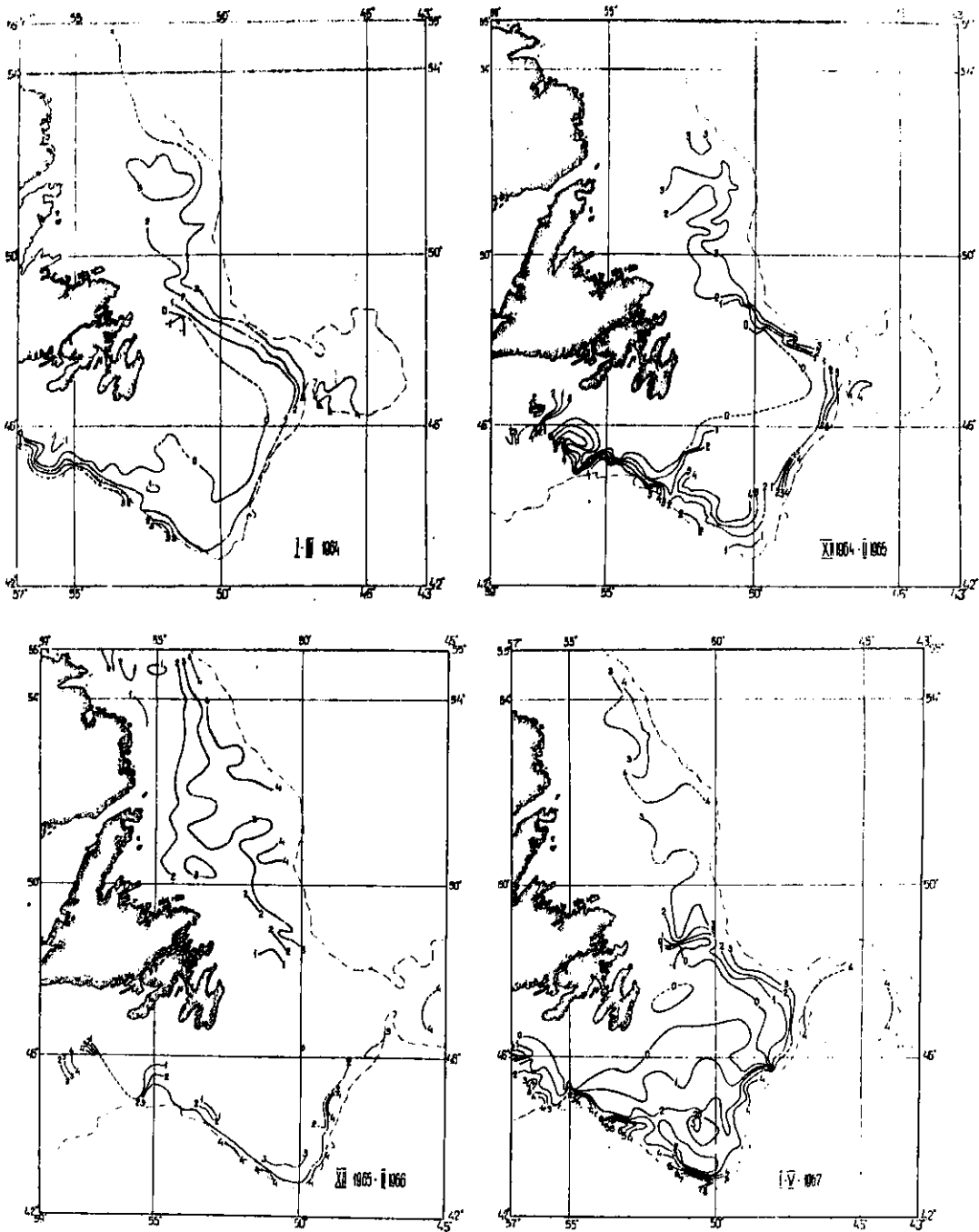


Fig. 2. Horizontal distribution of water temperature off Labrador and Newfoundland in near-bottom layers in winter 1964, 1965, 1966 and 1967.

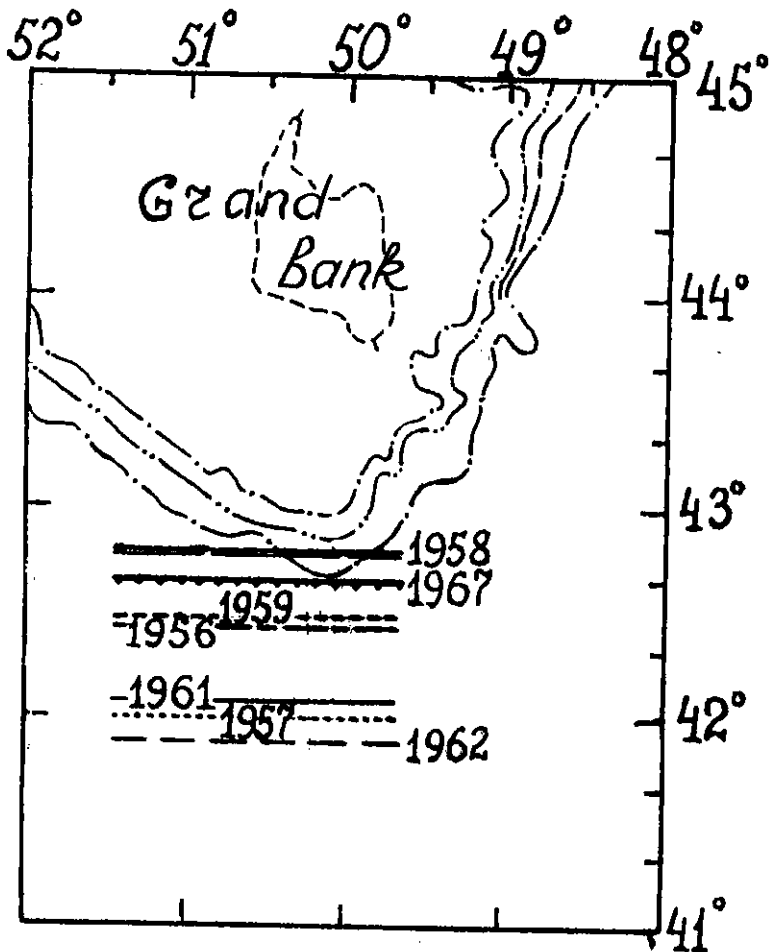


Fig. 3. Position of the 5° isotherm in the southern Grand Bank (Section 2A) in May 1956-1959, 1961-1962 and 1967.

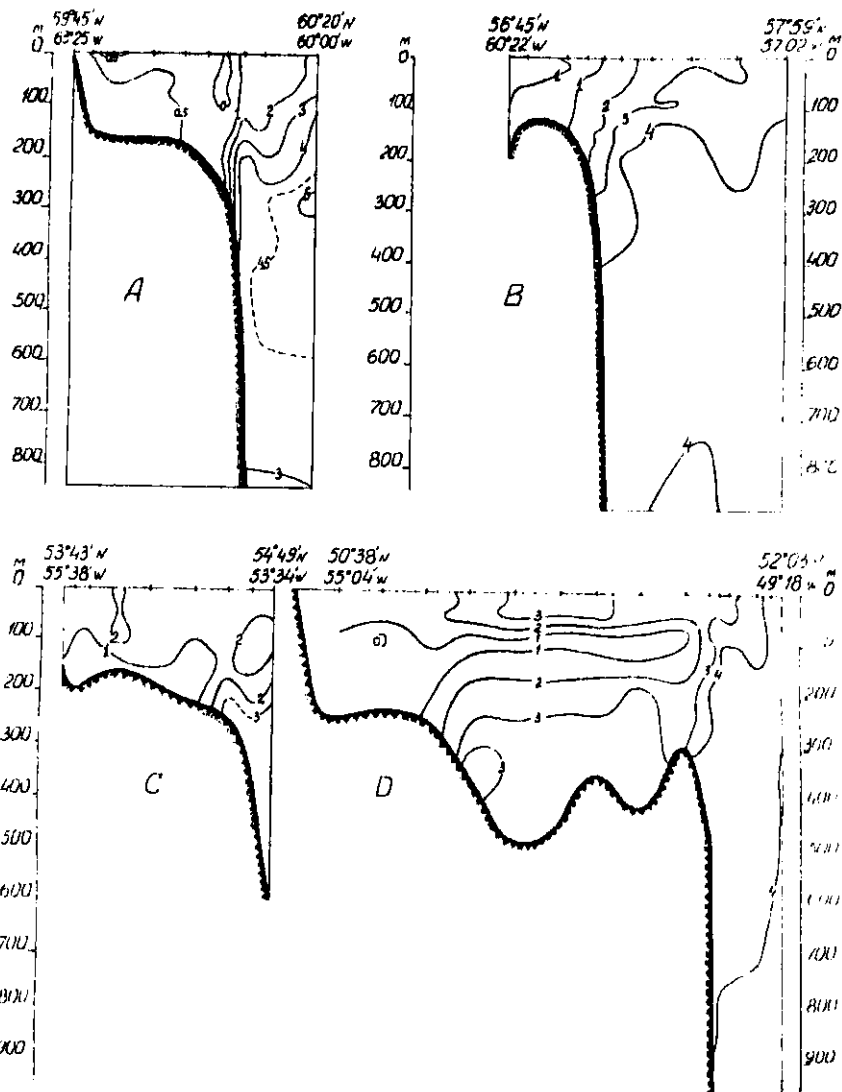


Fig. 4. Vertical distribution of water temperature on sections: 14AD across the North Newfoundland shelf (A), 8A' across the Central Labrador shelf (B), 8A across the Hamilton Bank (C) and 7A across the North Newfoundland Bank (D) in October-November 1967.