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Water temperatures in Newfoundland, Labrador, and Baffin Island areas in 1977

by

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A B S T R A C T

Water temperatures of the Labrador Current registered at standard hydrological sections in Newfoundland, Labrador and Baffin Island Areas in spring, summer and autumn 1977 were compared both to the long - time average and to the last year temperatures. Positive anomalies from $0,2^{\circ}$ up to $1,9^{\circ}$ were observed in the northern areas (Baffin Island, Labrador, northern part of the Grand Bank), the negative ones in the range from $-0,1^{\circ}$ up to $-3,2^{\circ}$ in the southern areas (eastern, south-eastern and south-western slopes of the Grand Bank). The maximum positive anomalies were found in 50 - 200 m layer, the maximum negative ones - in 200 - 500 m layer. The first ones were caused by the flowing over of warm Atlantic waters to the slope and the shelf of Labrador and Baffin Island, the second ones - both by the intrusion of cold waters of the ashore branch of the Labrador Current into the area of the south - western slope of the Grand Bank and by the Gulf Stream meandering.

I N T R O D U C T I O N

This report was aimed to reveal the temperature condition of water masses in Newfoundland, Labrador and Baffin Island Areas in 1977. As previously (Elizarov, 1962; Burmakin, 1972), the analysis was conducted by the average temperature of different water layers and branches of the Labrador Current along the standard

hydrologic sections (Fig. I). In January - February, 35 near trawl hydrologic stations were completed in the Labrador area (the 17th trip of the research scouting vessel "Persey III"), during the period from April to July - 398 stations were completed (285 - near trawl ones and 113 stations were made along the hydrological sections) in the areas of Grand, North Newfoundland and Flemish Cap Banks (18th trip of the research scouting vessel "Persey III"), in October - December - 95 stations were accomplished, they were the neartrawl ones and those made along the sections off Labrador and Baffin Island (19th trip of "Persey III"), and in November - December, 150 stations were completed along the sections through North Newfoundland, Grand and Flemish Cap Banks (16th trip of the expeditional vessel "Protion"). In total, 678 hydrological stations were made there. The observations were conducted by standard horizons up to 2000 m depth.

METHOD USED IN TIME OF INVESTIGATIONS

TEMPERATURE

The average water temperature was calculated by 0 - 50, 50 - 200, 0 - 200, 200 - 500 and 0 - 500 m layers for the planned parts of the sections (Fig. I). The temperature anomalies on the date of observations for 0 - 200 and 200 - 500 m layers were taken in the graphs of the normal (mean) annual run (Burmakin, 1972; 1976). The mean temperature of some sections was adjusted to certain dates according to intermonth rate of temperature fluctuations (Burmakin, 1969), and the anomalies were determined compared to the average rate.

The results of observations

On the base of the earlier determined quasi-four years periodicity (Elizarov, 1962; Burmakin, 1972) one could suggest that in 1977, the water temperatures might be higher and reach 1965 - 1966 level.

The observations conducted in 1977 showed that in fact the water temperatures became sharply higher especially in autumn in the Labrador Current northerner the Grand Bank (Tables I - 3).

In April - June and November - December, the temperature anomalies were, mainly, higher than the long - time average rate by $0,1 - 0,6^{\circ}$ along the section 8-A, triangle, and the section 7-A, whereas the negative anomalies were found southerner along the sections 6-A, 4-A, 3-A, 2-A and 1-A, they reached $1,65^{\circ}$ in 0 - 200 m layer and $3,16^{\circ}$ in 200 - 500 m layer in the south - western slope of the Grand Bank (Tables I and 2). Such differences in the anomalies could be caused by the water flowing over of a warm Atlantic component of the Labrador Current in the northern areas, i.e. Labrador and the Northern Newfoundland Bank from one part and by meandering of the Gulfstream - from the other one.

The analysis of the facsimile charts of the surface sea temperature shows that the availability of the negative anomalies at the sections in the southern part of the Grand Bank is a shortterm phenomenon (Fig. 2). The frontal zone and its center along the characteristic isotherm (12°) were lying much southerner the southwestern slope of the Grand Bank than usually during the period from 13 up to 19 June and from 20 up to 26 June correspondingly. Just at this period the negative anomalies were registered along the section I - A completed on 22 June (Fig. 2, Tables I - 2). But, the next week, i.e. from 27 June up to 3 July the frontal zone along the characteristic isotherm (the center of the frontal zone) was observed much northerner up to the section I-A. Such fluctuations in the frontal zone caused by the shifting of the Gulf Stream meanders in the south of the Grand Bank were already mentioned by the author some earlier (Burmakin, 1976).

The temperature of 0 - 200 m layer adjusted to certain dates and its anomalies for the sections 8-A, 7-A, 6-A, 4-A, 3-A, the triangle for 1977 are shown in Table 3. In May, June and November one can see there high positive anomalies as well in the areas northerner the Grand Bank and the positive ones in the south of this Bank.

In spring and autumn, an intrusion of cold water of the ashore branch of the Labrador Current was registered in the south - western part of the Grand Bank, that can be surveyed on the

charts of the temperature distribution at 100 m and near - bottom horizons (Fig.3).

In June 1977, a considerable rise in the water temperature for all the layers estimated (by 1° and higher) was observed along the north - western and south - eastern sides of the "triangle" section effected by a warm component of the Labrador Current (Table 4) compared to that one in 1976. Water temperature was lower by 0,07 - 0,69° in the south - western part of the "triangle" crossing a cold ashore branch of the Labrador Current compared to 1976.

On 1 November 1977, the temperature of the Labrador Current nucleus became 2° and more higher along the section 8-A (50 - 200 m layer) compared to 1976. The deviations from 1964 - 1977 long - time average rate were within the range from 0,31° in 0 - 50 m layer of the ashore branch in the Labrador Current (A) up to 2, 12° in 0 - 500 m layer of its cold component (AB), and, the anomalies were negative - 0,35° only in 200 - 500 m layer of its warm component (C), Table 5. This phenomenon is connected to the anomalous cooling of Atlantic waters observed in 1976 (Burmakin, 1977).

A considerable cooling registered for the section 8-A on the South Labrador Shelf was also observed in the Baffin Land and the North Newfoundland areas, it was caused by the flowing over of Atlantic waters from the warm component of the Labrador Current to the shelf area that can be surveyed on the charts of the surface and bottom distribution of water temperatures in November and December (Fig. 4).

C o n c l u s i o n

In spring, summer and autumn 1977, the temperature of the Labrador Current waters became 1 - 2° higher than the long - term average rate and than the last year temperatures along the standard hydrological sections in Newfoundland, Labrador and Baffin Land areas.

Short term negative anomalies were observed in waters of the southern slopes of the Grand Bank.

The maximum positive anomalies were registered in 50 - 200 m layer, the maximum negative ones - in 200 - 500 m layer. The warming was caused by the flowing over of warm Atlantic waters on the Labrador - Baffin Land slope and shelf, and the cooling - by the intrusion of cold waters from the ashore branch of the Labrador Current to the south - western slope of the Grand Bank and the meandering of the Gulfstream.

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Table 1. Temperature anomalies of 0-200 m layer in 1977.

Section and date	April	May	June	November	December
8-A (B) I and I6				1,63	
November				1,00	
triangle (NW) 15 June, 25 November			0,73	0,56	
triangle (SW) 11 June, 28 November			0,16	-0,08	
triangle (SE) 13 June, 29 November			0,63	0,39	
7-A, 19 May, 2 December		0,18			0,08
6-A (G) 26 April, 5 June, 5 December	-0,35		-0,93		0,18
4-A 23 May		-0,28			
3-A 12 May		-0,40			
2-A 7 May		-0,90			
I-A 22 June			-1,65		

Table 2. Temperature anomalies of 200-500 m layer (°C) in 1977.

Section and date	April	May	June	November	December
8-A (B) I and I6 November				1,25 1,28	
triangle (NW) 15 June, 25 November			0,19	0,65	
triangle (SE) 13 June, 29 November			0,21	-0,08	
7-A 19 May, 2 December		-0,13			0,30
6-A (G) 26 April, 5 June, 5 December	-0,42		-0,64		0,00
4-A 23 May		-0,61			
3-A 12 May		-0,38			
2-A 7 May		-0,77			
I-A 22 June			-3,16		

Table 3. Mean temperature of 0-200 m layer (°C), adjusted to certain dates and its anomalies in 1977.

Section	I I	15 May	I I	15 June	I I	1 November
8-A (A)						1,80 (1,28)
8-A (B)						2,85 (1,63)
8-A (C)						4,21 (0,51)
8-A (AB)						2,34 (1,53)
8-A (ABC)						2,87 (1,47)
triangle (SE) shelf				0,43 (0,19)		
triangle (SE) slope				0,79 (1,25)		
7-A		0,58 (0,28)				
6-A (G)		0,97 (-0,13)				
4-A		1,16 (-0,27)				
3-A		0,08 (-1,37)				

The averaging period		1968-1974 1976-1977		1971-1977		1964-1977

Table 4. Temperature of the Labrador Current by sides of the "triangle" section in June 1976-1977.

"Triangle" section side	I I	Date	L a y e r , m				
			I I	50-200	I I	0-200	I I
NW		18.YI-76	1,20	-0,48	-0,07	1,80	
		13.YI-77	2,35	0,70	1,12	2,29	
SW		19.YI-76	2,16	-0,48	0,36	-	
		12.YI-77	2,09	-1,17	0,10		
SE		20.YI-76	1,70	0,17	0,66	2,78	
		13.YI-77	2,71	1,10	1,66	3,07	

Table 5. Water temperature at the section 8-A in different branches and layers of the Labrador Current on 1 November 1976 - 1977 and the long-term average annual, 1964 - 1977.

Part of the section 8-A	Year	l a y e r , m									
		0 - 50		50 - 200		0 - 200		200 - 500		0-500	
		°C	Rate	°C	Rate	°C	Rate	°C	Rate	°C	Rate
A	1976	0,80	1,25	-0,18	0,22	0,13	0,52	-	-	0,16	0,53
	1977	1,56		1,90		1,80		-		1,90	
B	1976	0,75	1,32	0,69	1,19	0,70	1,22	1,51	1,96	1,13	1,58
	1977	2,15		3,05		2,85		3,21		3,00	
C	1976	3,29	3,67	3,40	3,65	3,37	3,70	3,46	4,03	3,43	3,91
	1977	4,45		4,13		4,21		3,68		3,92	
AB	1976	0,74	1,30	0,20	0,60	0,36	0,81	1,51	1,96	0,68	1,12
	1977	1,78		2,52		2,34		3,21		3,24	
BC	1976	1,82	2,22	1,86	2,22	1,85	2,22	2,41	2,84	2,42	2,91
	1977	3,22		3,53		3,47		3,44		3,54	
ABC	1976	1,33	1,81	0,96	1,26	1,07	1,40	-	-	1,82	2,18
	1977	2,53		2,97		2,87		-		3,14	

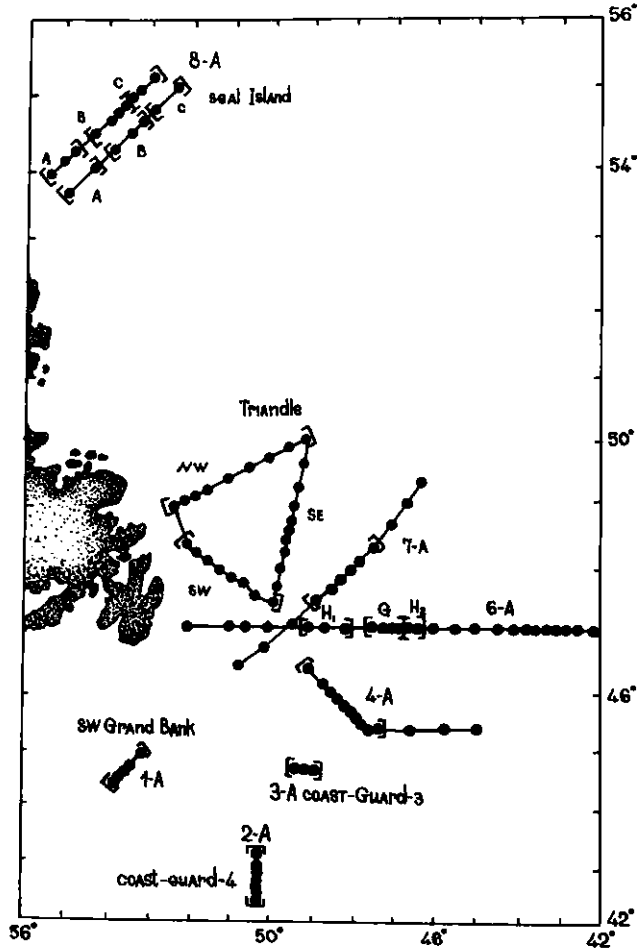


Fig. 1. The location of standard hydrologic sections in Labrador and Newfoundland areas completed in 1977 (square brackets were used for the parts of sections for which mean temperatures were calculated).

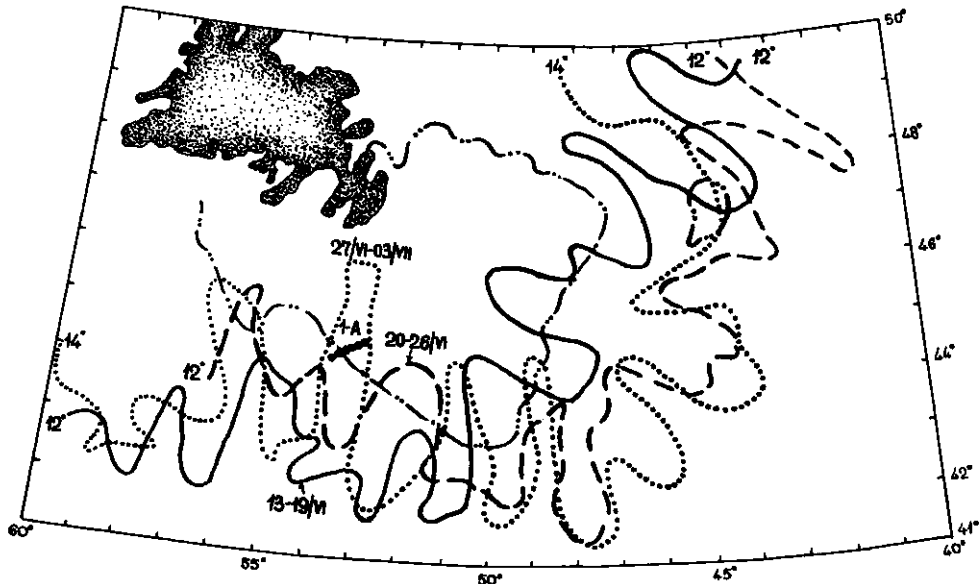


Fig. 2. The location of the frontal zone on the sea surface by facsimile Halifax charts:
1 and 2 - 12° isotherm characteristic for the frontal zone, periods 13-19 June and 20-26 June 1977;
3 - 14° isotherm characteristic for the period 27 June-July 1977.

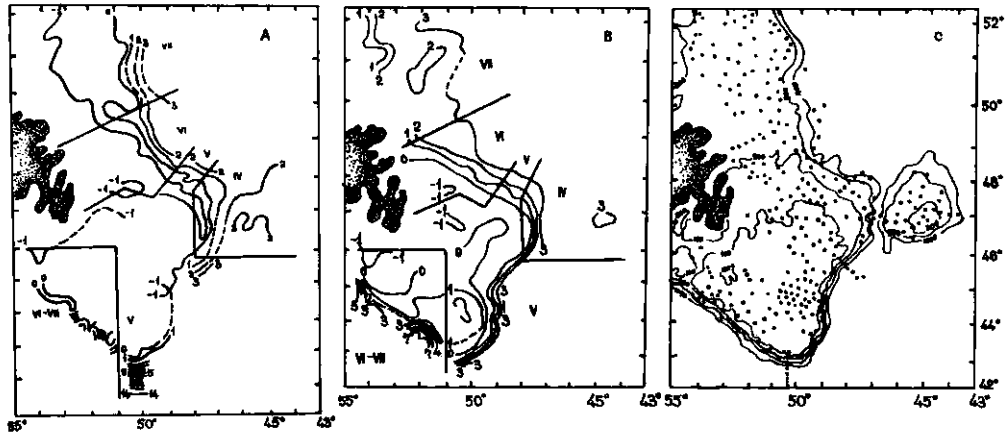


Fig. 3. The distribution of water temperatures at 100 m (A) and near bottom (B) horizons and the location of hydrological stations (C) at the time of the 18th cruise of the research scouting vessel *Persey III* (April-July 1977).

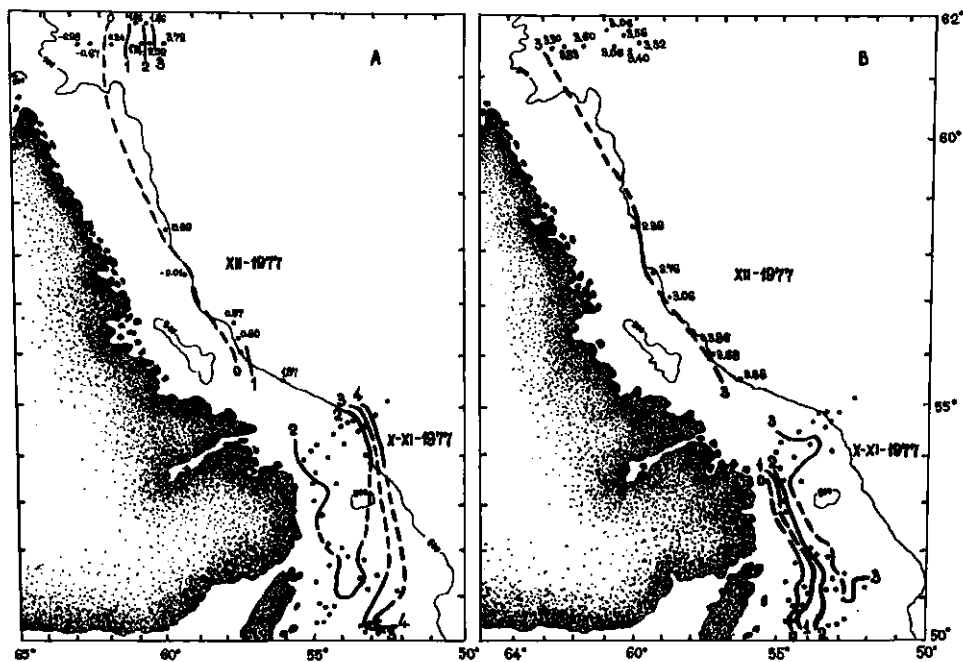


Fig. 4. Horizontal temperature distribution in the surface layer (A) and in the near-bottom one (B), November-December 1977 (19th cruise of the research scouting vessel *Persey III*).