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# RESULTS OF SOVIET HYDROLOGICAL INVESTIGATIONS IN THE ICNAF AREA DURING 1961

## I. Hydrological Conditions in ICNAF Subarea 1

by V.V. Burmakin and I.I.Svetlov

In 1961 hydrological investigations in ICNAF subarea 1 were carried out aboard the research vessel "Topseda" during May-June and August-September, and aboard the RT "Novorossiisk" during September (see Fig. 1). The r/v "Topseda" made two detailed hydrological surveys, whereas the RT "Novorossiisk" took only trawl hydrological stations accomplishing a curtailed program. In addition, some hydrological observations were made aboard the RT "Stalingrad" during April.

In 1961 the ice situation in the Davis Strait was quite favourable which affected the distribution of temperatures in 0-50 metre layer (see Figs. 2 and 3). Warming up was observed earlier than in the years 1959 and 1960.

Early in May the temperature of surface water along the coastline north of Frederikshaab was from 1° to 2° (see Figs 2 and 3).

Negative temperatures associated with accumulation of ice brought by the West Greenland Current, were locally observed at that time in the southwestern sector of the area. The cold waters of the Canadian Current (at temperatures of -1° to -0°) were nearest to the area investigated at the point north-west of Holsteinsborg; then their boundary extended south-westwards. Over the rest of the area prevailed the warm waters of the Irminger component of the West Greenland Current, at temperatures of 3° to 4°.

Fig. 3 shows the waters of this current flowing in a wide stream towards north-west.

The Arctic component in 1961 was not as well developed as in previous years. Its waters occupied a rather narrow zone fringing the coastline. Their temperature in May was from 0° to 1°, in September from 2° to 3°.

The temperature of waters of the Irminger component of the West Greenland Current in September reached 7° - 8°. The waters of this current invaded banks, flowing up their slopes toward the tops. The 6° isotherm, as it is shown on the attached map (see Figs. 2 and 3), reached the area of Godthaab, whereas the temperature along the coastline was uniformly above 4°.

Here is a description of the hydrological conditions observed on various fishing banks in 1961.

Fig.4 shows the temperature distribution in the sections through the Store-Hellefiske and Lille-Hellefiske banks. In April and May, despite advanced surface heating and thin intermediate cold layer, the temperature of the warm stream of the current on the Lille-Hellefiske bank was lower than that observed in the same period of 1959 and 1960. That, apparently, should be accounted for by the fact that the warm waters flowing up the slope of the bank had not reached its top yet, or that these waters had already warmed up the cold intermediate layer and lost temperature as a result of heat transfer.

In 1961 the cold waters on these banks could be tracked down to the depths of 50 to 100 metres. On the Little-Hellefiske bank the average temperature of the 0-50 metre layer was 0.63° in April, and 1.04° in May. That was 0.5°-0.6° above the corresponding temperatures observed in previous years.

As it can be seen from the sections presented in Fig. 4, the surface temperature over the tops and slopes of these banks was from 0.5° to 1.5°, and at depths of 150-200 metres reached the point of 2°, whereas in the years 1959 and 1960 the corresponding temperature observed in the same season and at the same depths was from 3° to 4°.

On the Fullas bank (Fig. 5) in May 1961 the temperature of water alongside the slope, at a depth of 250 metres, was 1.5°, rising above 3° only as deep as 300-400 metres. In September 1961 the temperature over the slope and the top of this bank reached the level of 3° to 5°, exceeding the June temperature by 2°. In the section presented in Fig. 5, the 3° isotherm appeared in 300 metres depth in May, and shifted to 50-150 metres depths in September.

On the slope of the Fiskenaes bank (see Fig. 6) in May 1961 the temperature was below 2°; in September it went up to 3°-4°. In 1961 the flow of the Irminger component approached the slope of this bank closer than in previous years.

On the Frederikshaab bank (see Fig. 7) in June 1961 surface waters were heated to the temperature of only somewhat above 1°, whereas in 1960 their temperature exceeded 2° as early as in April. In September the temperature of the near-bottom layers increased to 4°-5°.

The course of the temperature increase observed in the period from May to September 1961 can be also traced on the maps on temperature distribution near the bottom (see Fig. 8).

In September the coastal zone from Cape Farewell to Godthaab was filled with waters at temperatures of 0.5° to 2.0°. At that time the warm Atlantic waters did not yet advance far up the banks, whereas in September they had almost reached the shores. In September the temperature on the banks increased to 4°-5°, and in the southwestern sector - to 6°.

Thus in autumn the temperature of water over the banks increased with the increase in the influx of warm waters, reaching its maximum in winter time. The minimum temperature in the near-bottom layers was observed in spring and early summer. In 1961 the minimum summer temperature on the Lille-Hellefiske bank was somewhat lower than in previous years, while on the other banks it remained within the normal range.

The salinity of the waters of the West Greenland current ranged from 34.1°/oo to 35.08°/oo during 1961. In May 1961 the salinity of waters over the slopes and tops of the banks, at depths of 50 to 100 metres, was from 34.2°/oo to 34.3°/oo (see Fig. 4). With the increase in depth their salinity increased up to 34.7°/oo. The salinity of the waters of the cold intermediate layer varied from 33.5°/oo to 33.7°/oo

The salinity of waters alongshore from Cape Farewell to

Godthaab during May and June 1961 varied from 33.0‰ to 33.5‰ (see Fig. 9). The 34.0‰ isohaline which, according to Kiilerich, is the conventional boundary of the Arctic current, extended along the banks up to the area north of Godthaab. A focus (zone of concentration) of low-salinity waters (33.6‰), formed as a result of thawing of ice and inflow of cold waters of the Canadian current, was defined northwest of the Store-Hellefiske bank.

In September the surface salinity decreased throughout the entire area investigated. It was particularly low (less than 32‰) within the coastal strip extending from Cape Farewell to Godthaab. During May and June 1961 salinities below 34‰ in the near-bottom layer were observed only in the area of Godthaab and Ivigtut.

Over the rest of the area investigated it ranged from 34.2‰ to 34.9‰.

In September 1961 maximum salinities, up to 35.08‰, were observed in the south, in a warm current stream, and minimum, 31.5‰, - on the surface of the narrow coastal strip between Ivigtut and Godthaab.

Data from the two oceanographic surveys made by the research vessel "Topseda" permitted to construct dynamic topographies for 0-200 metre layer. Dynamic horizontals on the maps are spaced at intervals of 10 dynamic millimetres (see Fig. 10).

Fig. 10 indicates that in September 1961, when the temperature stratification took place, the West Greenland current became steadier than it was during May and June 1961.

In September current lines were more strictly directed northwards. Dynamic horizontals became denser within the coastal strip on the banks off Cape Farewell, in the area of Ivingtut and Godthaab, indicating the places of increased velocities of currents.

A cyclonic gyral was observed west of Godthaab, with its centre in latitude 63°20' N and longitude 55°00' E. Its appearance was, probably, caused by the configuration of bottom and wind current. The velocities in the gyral were low, from 2 to 5 cm/sec.

In spring, a comparatively steady current could be tracked on the map only in the area between Cape Farewell and Ivigtut, and northwest of the Store-Hellefiske bank where the cold Canadian current made its way to the south invading the shallow regions on the banks.

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## REFERENCES


1. ADROV, M.M., 1960 — Hydrological conditions in the West Greenland area. A booklet. Fishing directions for the area of the West Coast of Greenland. Murmansk, 1960.

2. ADROB, M.M., 1960 — Variability of hydrological conditions and their effect on fishing in the area of West Greenland banks. Scientific Technical Bulletin, No. 1 (11). Polar Research Institute, Murmansk.

3. KIILERICH, A. — The hydrography of the West Greenland. Fishing Banks Meddelelser fra Komissionen for Danmarks Fiskeri og Havunderögerser Serie. Hydrography, Bind III, No. 3, 1943.

4. HERMAN, F. — Hydrographical conditions in the Davis Strait in 1959. International Commission for the Northwest Atlantic Fisheries. Annual Proceedings, vol. 10 for the year 1959-1960, Halifax, Canada, 1960.

## II. Hydrological Conditions in ICNAF Subareas 2 and 3

by Yu. I.Buzdalin and A.A.Elizarov

In 1961 hydrological investigations in ICNAF subareas 2 and 3 were carried out aboard the "Odessa", during July - August, and aboard the "Topseda", during July-September (see Fig. 1). In addition, several scouting trawlers kept taking near-bottom and surface temperatures at trawling stations, throughout the year.

In subarea 2 (Labrador) standard hydrological section 8A (Cape Farewell - South Wolf Island) was taken late in July. On July 15 average temperature of the 0-200 metres layer, calculated from the Labrador current section, at stations 5855/5865, was 0.90°. That was very close to the average temperature obtained for this section for 15 successive years, (1936, 1938-1941, 1948-1957, and 1961), i.e., 0.91°.

In July 1961 the waters of the coastal stream of the Labrador current were heated to a somewhat higher temperature than the waters of its main stream. An analysis of distribution of specific volumes of seawater over the shelf, and results of dynamic treatment of section 8A, indicated that the velocities of the Labrador current in subarea 2 off the shelf were not high in the year 1961. On the surface of the sea they varied from 5 to 20 cm/sec; in a few cases inconsiderable countercurrents, whose velocities never exceeded 2 cm/sec, were observed. The highest velocities, up to 50 cm/sec, were marked over the continental slope, over the depth of about 500 metres. Such velocities are distinctive of the warmer water zone of the Labrador current (Elizarov, 1960).

In the summer of 1961 the temperature of these waters was abnormally high. The waters of the cold core of the Labrador current in July 1961 were somewhat colder than usual, which later on affected the hydrological conditions in the area of the Newfoundland banks (subarea 3).

Hydrological investigations carried out in subarea 3 (the Newfoundland banks) revealed that in the summer of 1961 the Labrador current was not as well developed as in 1960.

In July 1961 the current velocities in section 7A, across the northeastern slope of the Grand Banks, calculated by use of dynamic method, never exceeded 23 cm/sec, whereas in the summer of 1960 they reached 33 cm/sec, and in 1959 - 50 cm/sec. The average temperature of the 0-50 metre layer in section 3A, across the eastern slope of the Great Newfoundland bank, on July 5, 1961 was 5.00°, as compared to 4.74° on July 31, 1960.

The average temperature of the 0-200 metre layer, calculated from three stations in section 3A, which are supposed to define the cold core of the Labrador current (A.A. Elizarov, L.A. Zotov, 1960), on July 5, 1961 was 1.83°. Although we have not got the necessary information on July temperatures for comparisons, it still can be concluded that the intensity of cold waters transport by the Labrador current had considerably decreased.

Indeed, the average temperature for the above mentioned stations on July 15 was 0.83°, and the rate of seasonal changes of average temperatures never exceeded 0.02°-0.03° a day.

A number of other hydrological observations confirmed the hypothetical decrease in the intensity of the cold Labrador current in the summer of 1961.

In the beginning of August 1960 the temperature in the near-bottom layer of the shallow waters on the Grand Banks, at 50 metre depth, was 1.8°, whereas in 1961 it exceeded 2° as early as on the first days of July. In July 1960, water at a temperature near the bottom below -1° extended down the eastern slope of the bank southward to latitude 45°N; in 1961 no such phenomenon was observed even in the northeast of the Grand Banks.

The absolute oxygene content in the summer of 1961 was lower than in the summer of 1960, almost never exceeding 9 ml/l. As it is generally known, colder waters, as a rule, are associated with higher oxygen contents.

Late in July a certain intensification of transport of the cold waters of the Labrador current within the Newfoundland banks area began to show. On the eastern slope of the Grand Banks near-bottom temperatures early in July were above -0.97°; but a month later this area was largely cover by waters at temperatures below -1°.

REFERENCES

1. Elizarov, A.A., Zotov, L.A., 1960 — Collected articles "Soviet Fishing Investigations in North European Seas", published by "Rybnoe Khozyaistvo", M.

2. Elizarov, A.A. 1960 — Results of Soviet Oceanographic Investigations in the Labrador and Newfoundland Areas, ICNAF, ann. proc., vol. 10.

## III. DISTRIBUTION OF DISSOLVED OXYGEN IN THE WATER MASSES IN THE NEWFOUNDLAND AREA

by M.A. Istoshina

Hydrochemical studies were carried out in all sections (see Fig. 1) in the area of continental shelf, in latitude between 41° and 53° N, as well as beyond the continental slope over greater depths, aboard the research vessel "Topseda" and the "Odessa", during July and mainly August 1961.

The well-known methods described by Bruevich (1), were employed for analyses of the hydrochemical samples obtained.

It is common knowledge that the hydrological regime in the Newfoundland sea area is determined by interaction between the arctic waters of the Labrador current and the waters of the North Atlantic current.

As a result of their interaction a third mixed type of water is produced.

The three types of water differ in contents of hydrochemical elements.

The cold waters of the Labrador current have a high content of dissolved oxygen, from 8.0 to 8.5 ml/l. In the warm waters of the North Atlantic current the content of $O_2$ is around 5 ml/l. Mixed waters are characterised by the intermediate values of $O_2$ content (see Fig. 15).

Fig. 16 presents the distribution of dissolved oxygen in the surface layer during summer.

The bulk of the surface waters in the area investigated should be classified as mixed waters, except for the northeastern sector of the area where the isoxygen outlines distinctly the narrow wedge of the waters of the Labrador current extending down to latitude 51°30' N. Farther southward the Labrador waters are getting gradually transformed, losing their original characteristics. The course of isoxygens on the map indicates, however, their presence alongside the eastern slope of the Grand Newfoundland Bank, up to the zone of their junction with warm Atlantic waters (43° N - 49°50' W) having oxygen content of about 5 ml/l, whose influence can be observed in the areas of southwestern and southern slopes on the Grand Banks, as well as on the southern slope of the Flemish Cap bank.

Gradual decrease in oxygen content caused by physical and biochemical processes is illustrated by the following figures:

| Latitudes | 52°40' N | 50°20' N | 47°00' N | 44°56' N | 43°10' N |
|---|---|---|---|---|---|
| $O_2$, ml/l | 8.05 | 7.11 | 6.23 | 5.98 | 5.87 |

The content of dissolved oxygen in the surface waters over the Grand Banks never exceeds 5.7-6.1 ml/l, and in the waters over the Flemish Cap bank it ranges from 6.1 to 6.5 ml/l.

The relative $O_2$ content in the surface layer varies between 100% and 108%, except for the cold Labrador waters where oxygenation reaches 118%, which, apparently, should be explained by later phytoplankton "flowering".

"Flowering" of phytoplankton in the cold waters of the Labrador current, apparently, begins earlier somewhere farther south and moves gradually northwards.

The summer season is characterised by a higher content of dissolved oxygen, reaching 9 ml/l, at the depth of the discontinuity layer which in most cases is located at 25 metre level being formed as a result of powerful radiation heating (see Fig. 16).

It can be assumed that the high oxygen contents obtained in the process of phytoplankton "flowering" are maintained in the zone of the discontinuity layer, since the processes of exchange between this zone and underlying layers are impeded, whereas on the surface the $O_2$ content naturally decreases with the progress of heating.

A similar picture of oxygen distribution was also observed in the year 1960.

In the near-bottom waters the values of oxygen content are usually varying within the range of 5.7 - 7.5 ml/l (71-93%). In the southwestern area of the Great Banks the $O_2$ content is from 5.9 to 6.8 ml/l (71-84%), in the south-east - from 6.6 to 7.1 m ml/l (84-90%), in the southern portion of the bank - from 7.1 to 7.3 ml/l (87-92%), and over the Flemish Cap bank - from 5.7 to 6.3 ml/l (77-88%). (See Fig. 17).

The picture of the vertical distribution of dissolved oxygen during summer reveals the following peculiarities:

a. Relatively low $O_2$ content in the surface layer as compared to that at the 25 metre level.

b. Maximum oxygen content in the zone above the discontinuity layer.

c. Abrupt decrease in oxygene content below the discontinuity layer (see Fig. 17).

d. Minimum oxygen content at 200-500 metre levels (from 4.5 to 5.9 ml/l, or 64-82%) in the areas influenced by the North Atlantic current (see table below).

| Horizons, m | Co-ordinates | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 44°00' N 54°20' N | | 44°14' N 53°59' W | | 41°24' N 50°15' W | | 44°53' N 48°30' W | | 45°20' N 47°22' W | |
| | $O_2$ ml/l | % | $O_2$ ml/l | % | $O_2$ ml/l | % | $O_2$ ml/l | % | $O_2$ ml/l | % |
| 0 | 5.71 | 101.8 | 5.92 | 104.2 | 5.15 | 100.0 | 5.73 | 102.2 | 5.56 | 98.6 |
| 25 | 7.67 | 114.3 | 6.52 | 113.4 | 6.77 | 115.3 | 7.32 | 116.6 | 8.19 | 115.2 |
| 50 | 6.66 | 92.2 | 7.29 | 102.8 | 6.85 | 108.7 | 8.06 | 103.6 | 7.05 | 95.5 |
| 200 | 5.56 | 79.0 | 4.95 | 71.3 | 4.69 | 74.1 | 5.69 | 81.5 | 4.46 | 64.4 |
| 500 | 5.71 | 79,5 | - | - | 4.83 | 68.7 | 5.93 | 82.0 | 5.57 | 77.9 |
| 1000 | 6.16 | 85.0 | 6.12 | 84.2 | 6.48 | 88.0 | 6.36 | 86.5 | 6.08 | 83.6 |

REFERENCES


1. Bruevich, S.V. — Chemical Oceanography Methods. M. 1933

2. Adrov, M.M. — Hydrological Regime in the Southern Sector of the Grand Newfoundland Bank. Scientific-Technical Bulletin, Polar Research Institute, No. 4. M. 1957

3. Bogdanov, D.V. — Peculiar Features of the Hydrological Regime in the Devis Strait, Labrador Basin and Newfoundland Bank Area. Transactions of the State Oceanographic Institute (GOIN). No. 37. L.1959

4. Buzdalin, Yu. I., Elizarov, A.A. — Hydrological Conditions in the Area of the Newfoundland Banks and Labrador in 1961. (In print)

5. Zaitsev, G.N. — The Newfoundland Bank M. 1959

## IV. HYDROLOGICAL CONDITIONS IN ICNAF SUBAREA 5

by A.A. Klimenkov and V.I.Pakhorukov

Three oceanographic surveys were made in the area of the Georges bank during the year 1961. In June and Decembers observations were carried out aboard vessels of the Polar Research Institute alone, and in October - in cooperation with vessels of the Baltic Research Institute. The surveys covered the oceanographic stations in standard meridional sections 10' apart. The area from the central part of the Gulf of Maine in the north, to the warm Atlantic waters south of the Georges bank in the south, and between longitude 65° and 70° W, was surveyed (see Fig. 19).

The hydrological data being inadequate, a detailed description of the hydrological regime in the area of the Georges bank does not seem to be possible. Therefore the present paper is limited to the discussion of the hydrological conditions as observed in the summer and autumn-winter seasons of 1961.

Sketch maps of surface currents for the summer and autumn-winter seasons, based on the results of dynamic treatment of hydrological observations, were constructed (see Fig. 20). These maps represent only qualitative characteristics of the water masses movement in the area investigated. The quantitative indices for permanent currents are liable to be questioned, as they were produced without giving consideration to the effects of heavy tidal-ebb currents influencing this area. The prepared sketch maps, however, appear to be in good agreement with the results of drift-bottle experiments conducted from the US research vessel "Atlantis" in June 1933 (see Fig. 21).

An analysis of the maps on permanent surface currents revealed the following two features: 1) the currents over the bank were of anticyclonic nature and followed the contour of the bottom; 2) a complex interaction of water masses took place in the area of the Georges bank.

The centre of anticyclonic movement of waters was observed over the elevated northern part of the bank. Its location changed with the season. In June, e.g., it was observed over the northern part of the bank; in October it shifted a little towards southwest; in December it shifted southwards and was poorly defined. The changes were caused by the prevailing northern wind. According to foreign authors, (Day, 1958), this system could be even completely destroyed by long-lasting north-western winds.

The velocities of the anticyclonic movement over the Georges bank were also subject to seasonal changes. The results of dynamic treatment of the observations revealed, that the velocities in the central part of a radius of the gyral were 18 cm/sec in June, 9 cm/sec in October, and from 3 to 4 cm/sec in December. In the peripheral zone of the gyral, where the waters of the system interacted with waters of diverse origin, their velocities increased. In the northeastern sector they were 32 cm/sec in June, 50 cm/sec in October, and 40 cm/sec in December.

Waters of diverse origin interacted in the area of the Georges bank. There were slope waters formed as a result of mixing of the cold waters of Labrador origin with the diluted waters from the Gulf of Saint Lawrence, and with Atlantic of high salinity. They arrived from the direction of the Browns bank. A portion of the slope waters, fringing the Browns bank from southwest, entered the Gulf of Maine through the trench between the Georges bank and the Browns bank, at 0-100 metre depths. Within the Gulf of Maine it joined the stream fringing the northern slope of the Georges bank. Another portion of the slope waters extended alongside the southern slope of the Georges bank. With north-eastern winds, the bulk of the slope waters flowed along the continental shelf.

A branch of the Gulf Stream was observed over the south-western slope of the Georges bank.

The northern and northwestern slopes of the Georges bank, from surface to 50-60 metre depth, were covered with waters from the Gulf of Maine. The layer from 60 metre depth to bottom was composed of water formed as a result of interaction between transformed Atlantic waters and the waters from the Gulf of Maine.

The central part of the bank was covered with bank waters proper, - a product of mixing of Atlantic waters with slope waters and with waters from the Gulf of Maine, which took place under the action of the anticyclonic system.

Hydrological and hydrochemical observations were also conducted before the surveys began, from April 17 to June 28, and after the completion thereof, from Ocrober 12 to December 28, 1961. It was noted that during the period from the middle of April till the end of June the surface temperature increased from $3.7^{\circ}$ to $12^{\circ}$. In summer, on sunny days, the rate of temperature increase some times was an high as $0.5^{\circ}$ a day. Recurrent thick fogs with southern component winds impeded the process of warming of waters in summer. Maximum surface temperatures (up to $19^{\circ}$) were observed from fishing vessels on sunny calm days in August. In the autumn-winter season, with cold northern winds, abrupt fall of the temperature of air, from $6^{\circ}$ to $-3^{\circ}$, and of surface water to $0.3^{\circ}$, was occasionally observed in the course of a day.

Figs 22 and 23 represent horizontal distribution of temperature and salinity, for 0 metre depth, 50 metre depth and near-bottom layer, as calculated from the data of three oceanographic surveys. They show that hydrological and hydrochemical characteristics of various sectors of the Georges bank were not uniform.

In the central sector of the bank waters were mixed all way down to the bottom in June, as well as in October and December. Their temperature was from $7^{\circ}$ to $8^{\circ}$ in June, $12^{\circ}$ in October, and $7^{\circ}$ in December; the salinity from 32.2 to 32.6‰ in June, 32.4‰ in October, and from 32.6 to 32.7‰ in December.

In the area off the southern and south-western slopes of the bank the presence of Atlantic waters, rising in several homogenous tongues up to the 80 metre isobath, was observed. South-western winds assisted in the intrusion of Atlantic water masses. The temperature of the Atlantic waters was from $10^{\circ}$ to $13^{\circ}$ in June, from $16^{\circ}$ to $18^{\circ}$ in October, and from $14^{\circ}$ to $16^{\circ}$ in December; their salinity was subject to slight seasonal changes within the range from 35.0 to 35.8‰. High temperature (up to $0.3^{\circ}$ per mile) and salinity (up to 0.2‰ per mile) gradients, caused by convergence of heterogenous waters, were observed in this area.

The eastern and southeastern slopes of the Georges bank were fringed with rather cold circumfluent slope waters, extending from the direction of the Browns bank and from the Gulf of Maine southwestwards, along the line of the continental shelf (see Fig. 24). The water temperature in the Gulf of Maine was from $6^{\circ}$ to $7^{\circ}$ in June, $10^{\circ}$ in October, and $6^{\circ}$ in December; the salinity during the summer and autumn-winter seasons ranged from 32.0 to 32.3‰. The temperatures and salinities of slope waters were

somewhat lower; at 50 metre depth the temperature in June was 1°, in October 6°, and in December 2°. The upper layer in the summer-autumn season was heated to the depth of 25 metres (up to 6° in June, 12° in October, and 6° in December).
The salinity of slope waters, up to a depth of 50 metres, was 31.44°/oo in June, 31.14°/oo in October, and 31.53° in December; in the near bottom layer the salinity varied from 32.05°/oo to 32.99°/oo.

The greatly transformed Atlantic waters extended northwestwards along the near-bottom layer (at a depth of 150-200 metres) of the trench between the Georges and the Browns banks, filling the deep in the central sector of the Gulf of Maine. The extension of these waters was limited by, approximately, 200 metre isobath.

On the northern slope of the Georges banks the waters of Atlantic origin, interacting with the waters from the Gulf of Maine, formed a frontal zone with temperature gradiant of 0.1° per mile, and salinity gradient of 0.1°/oo per mile. The slope waters entering the Gulf of Maine through the trench on the side of the Browns bank, differ only inconsiderable from local waters in temperature and salinity ranges in the 0-100 metre layer (their temperature was from 4° to 5° in June, from 8° to 10° in October, and from 5° to 6° in December; the salinity-from 32.0 to 32.8°/oo in June, from 32.3 to 33.0°/oo in October, and from 32.4 to 33.0°/oo in December.

## CONCLUSIONS

## (SUMMARY)

1. The area off the Georges bank is the area of complex interaction of three water masses: the Atlantic waters, the waters from the Gulf of Maine, and the slope waters.

2. The central sector of the bank is covered with the bank waters proper, which are derivatives of the waters named above. The anticyclonic gyral in the centre of the bank is, apparently, the mechanical force assisting in formation of these waters.

3. The water dynamics in the area off the Georges bank are most strongly influenced by northeastern, northwestern, and southwestern winds. The northeastern winds intensify the flow of slope waters along the line of the continental shelf and can completely destroy the anticyclonic gyral over the bank. The southwestern winds intensify the intrusion of the high-salinity Atlantic waters into the area off the banks.

4. For the reccurence of fogs in summer time the area off the Georges bank is second only to the Newfoundland Bank. The highest rate of reccurence and duration of fogs is observed in May and June, with southern winds, in the zone of junction of warm and cold currents. During the first half of summer thick fogs impede the process of warming up of waters.

5. The surface temperatures on the bank are varying in the course of a year from $2^{o}$ to $19^{o}$, the maximum degree of heating being observed in August and September.

6. The maximum degree of freshening of waters in the area off the bank was marked in the second half of summer ($32.18^{o}/oo$).

REFERENCES


1. Day, Charles Godfrey — Surface circulation in the Gulf of Maine as deduced from drift bottles. Woods Hole Oceanographic Institution, Contr. No. 977. Fishery Bulletin 141, volume 58

2. McLellan, H.; Lanzier, L; Bailey, N. — The slope water off the Scotia Shelf. Journ. Fish. Res. Bd. Canada, vol. 1C, No.4, 1953

3. Godfrey, C.D. — Oceanographic observations, 1959, East Coast of the United States. Sp. Sci. Report Fisheries, No.359, 1960

## KEY TO FIGURES

"Results of Soviet Hydrological Investigations in the ICNAF Area in 1961"

Report to be presented at the 12th Session of ICNAF

Fig. 1 Sketch map of the hydrological sections and stations worked by Soviet vessels in ICNAF subareas 1,2 and 3, in 1961.

Fig. 2 Surface temperatures in the West Greenland area

a) May - early June; b) early September;
c) September - early October
1961

Fig. 3 Temperatures at 50 m depth

a) May - early June; b) early September 1961

Fig. 4 Temperature and salinities

a) Section through Lille Hellefiske Bank (10a), April 23
b) Section through Lille Hellefiske Bank, May 24
c) Section through Store Hellefiske Bank, May 20
d) Section through Lille Hellefiske Bank across the strait (10a), September 3-5

Fig. 5 Temperatures and salinities in the section through the Fullas Bank (11a)
a) June 1; b) September 6-7

Fig. 6 Temperatures and salinities in the section through the Fiskenaes Bank

a) June 4-5; b) September 7-9

Fig. 7 Temperatures and salinities in the section through the Frederikshaab Bank

a) June 6-7; b) September 9

Fig. 8 Near-bottom water temperatures in the area of West Greenland

a) May - early June; b) early September;
c) September - early October
1961

Fig. 9 Salinities in the surface and near-bottom water layers in the area of West Greenland

Fig.10 Dynamic topographies of currents, for 0-200 m, in the area of West Greenland

a) May - early June; b) September 1961

Fig. 11 Near-bottom temperatures in June 1961

Fig. 12 Salinities a) surface; b) near bottom
June 1961

Fig. 13 Temperatures in standard hydrological sections in the area of Newfoundland Banks
Middle of August 1961

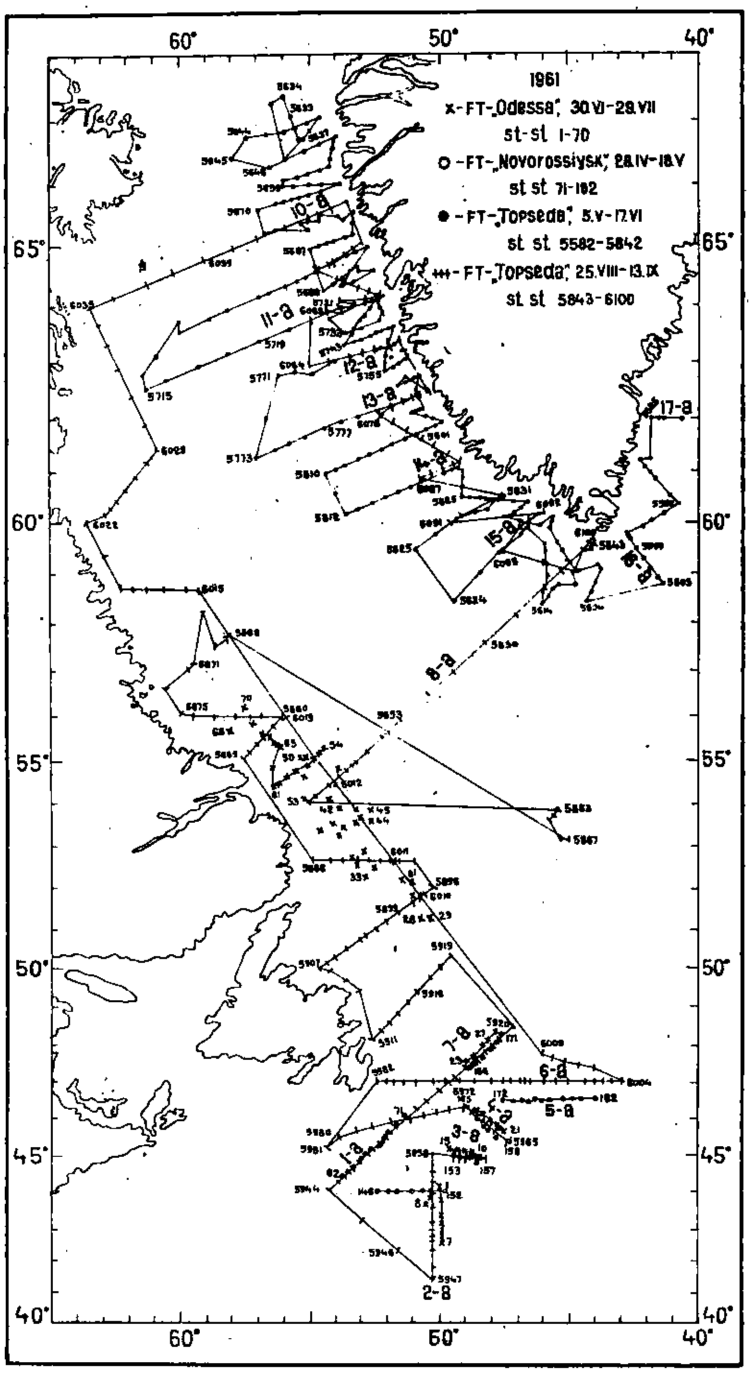


Fig. 1 Sketch map of the hydrological sections and stations in ICNAF subareas 1, 2 & 3, worked by Soviet vessels in 1961

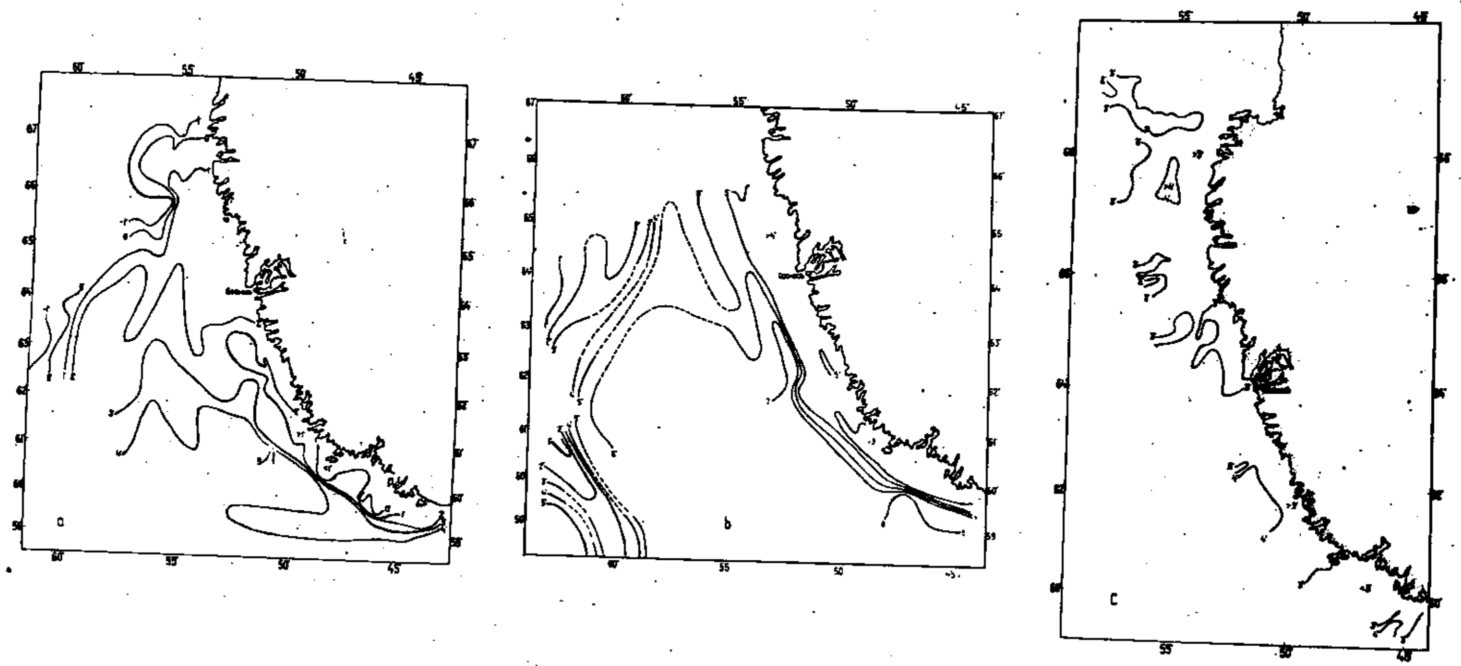

Fig. 2 Surface temperatures in the West Greenland area
a. May - early June ; b. early September ; c. September-early October
1961

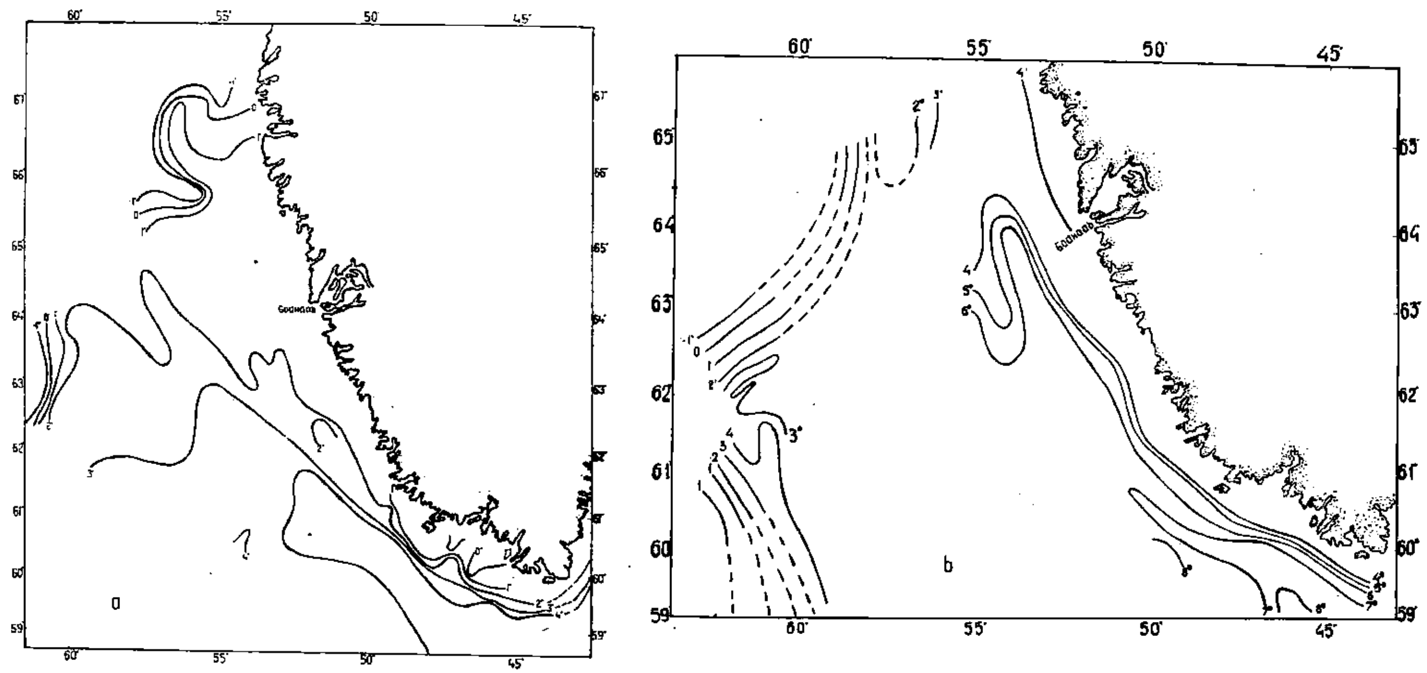

Fig. 3 Temperatures at 50 m depth
a. May - early June ; b. early September 1961

B 7

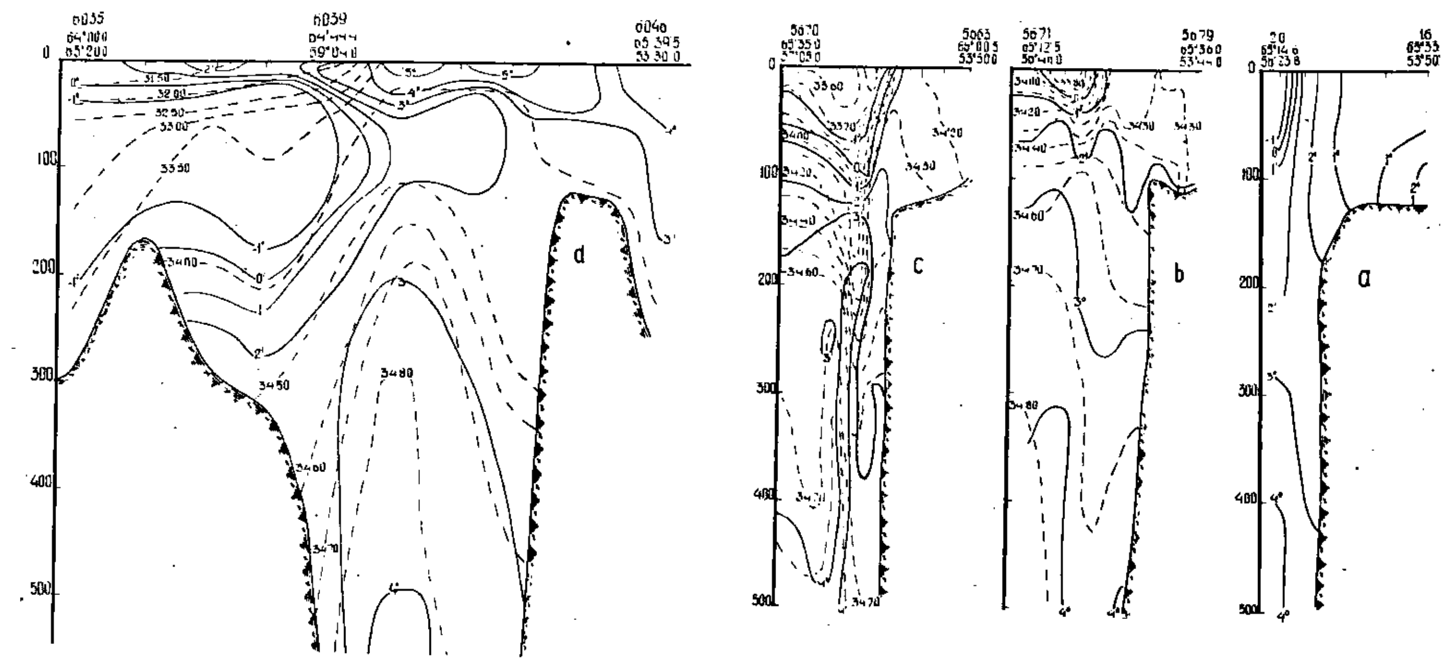

Fig. 4 Temperature and salinities
a. Section across Lille Hellefiske Bank ( 10a), April 23;
b. Section across Lille Hellefiske Bank (10a ), April 24;
c. Section across Store Hellefiske Bank , May 20;
d. Section across Lille Hellefiske Bank and the strait (10a), September 3-5

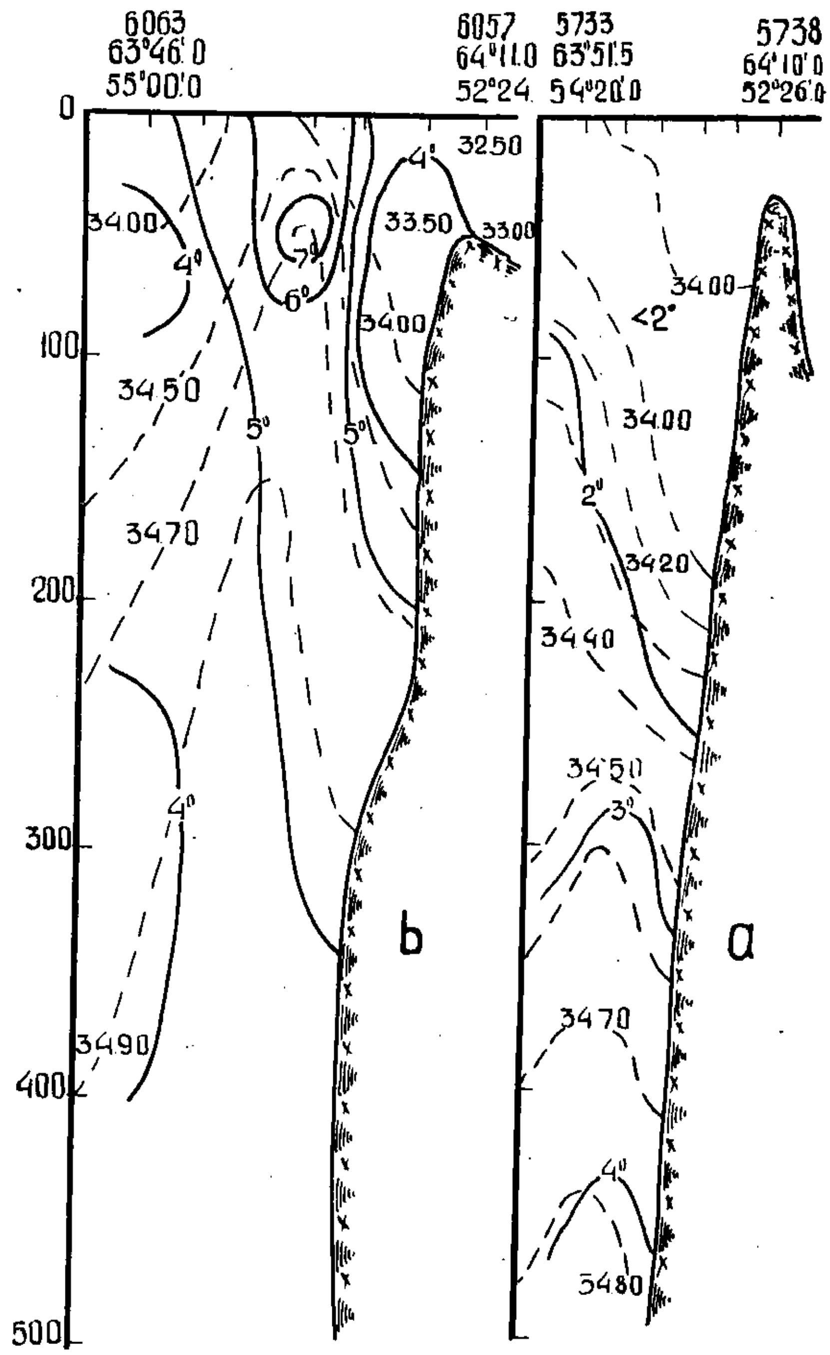


Fig. 5 Temperatures and salinities in the section across the Fullas Bank (11a)
a. June 1; b. September 6-7

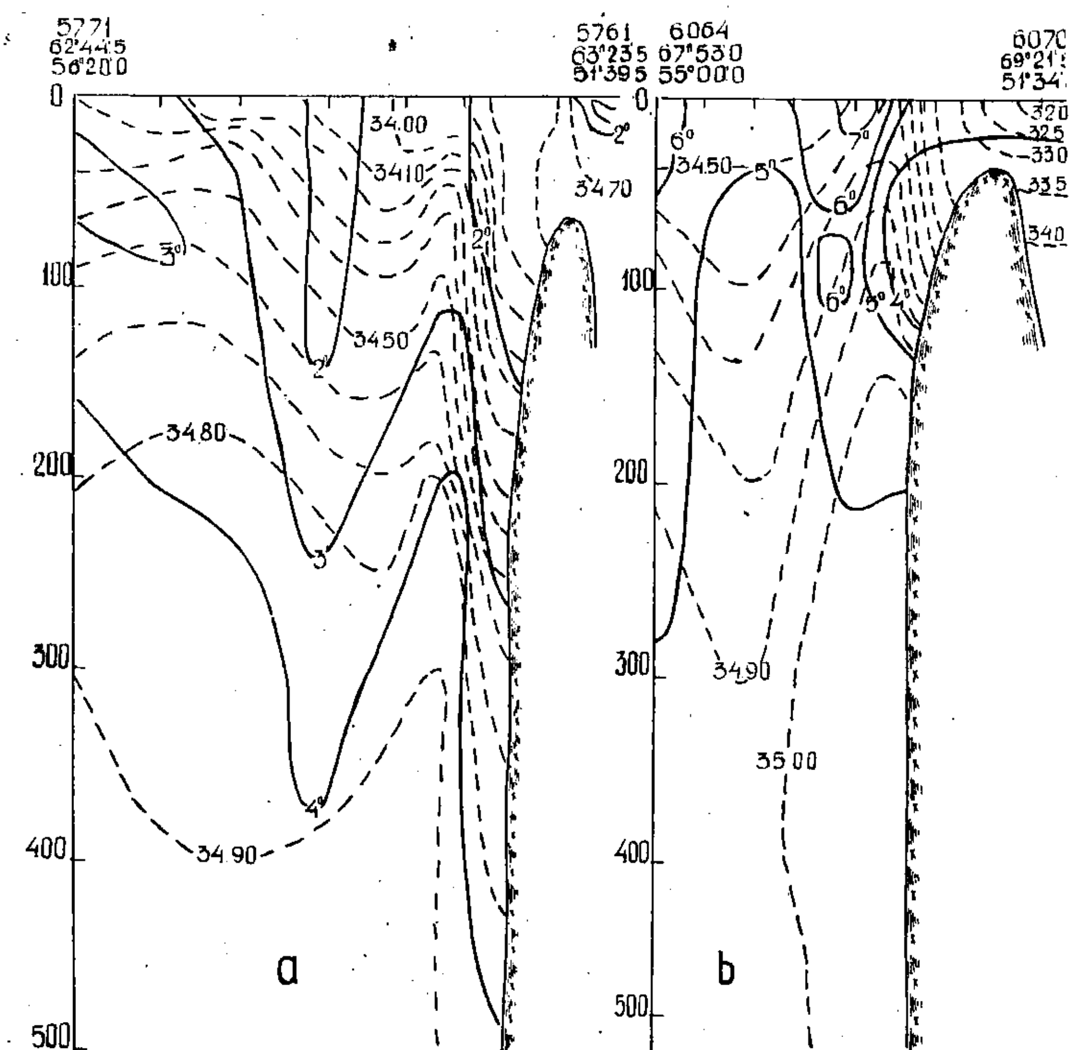


Fig. 6 Temperatures and salinities in the section acroos the Fiskenaes Bank

a. June 4-5; b. September 7-9

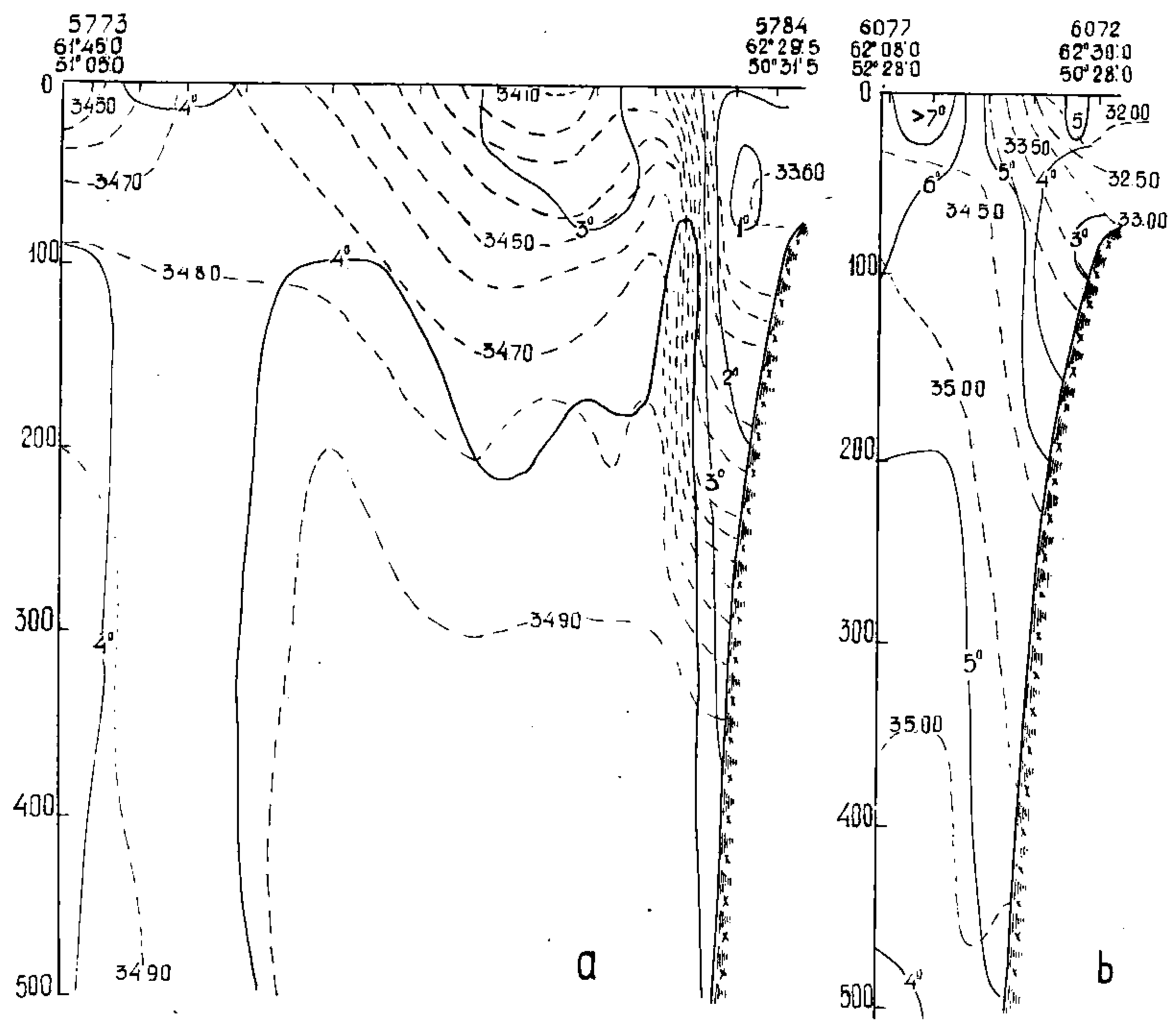


Fig. 7 Temperatures and salinities in the section across the Frederikshaab Bank
a. June 6-7 ; b. September 9

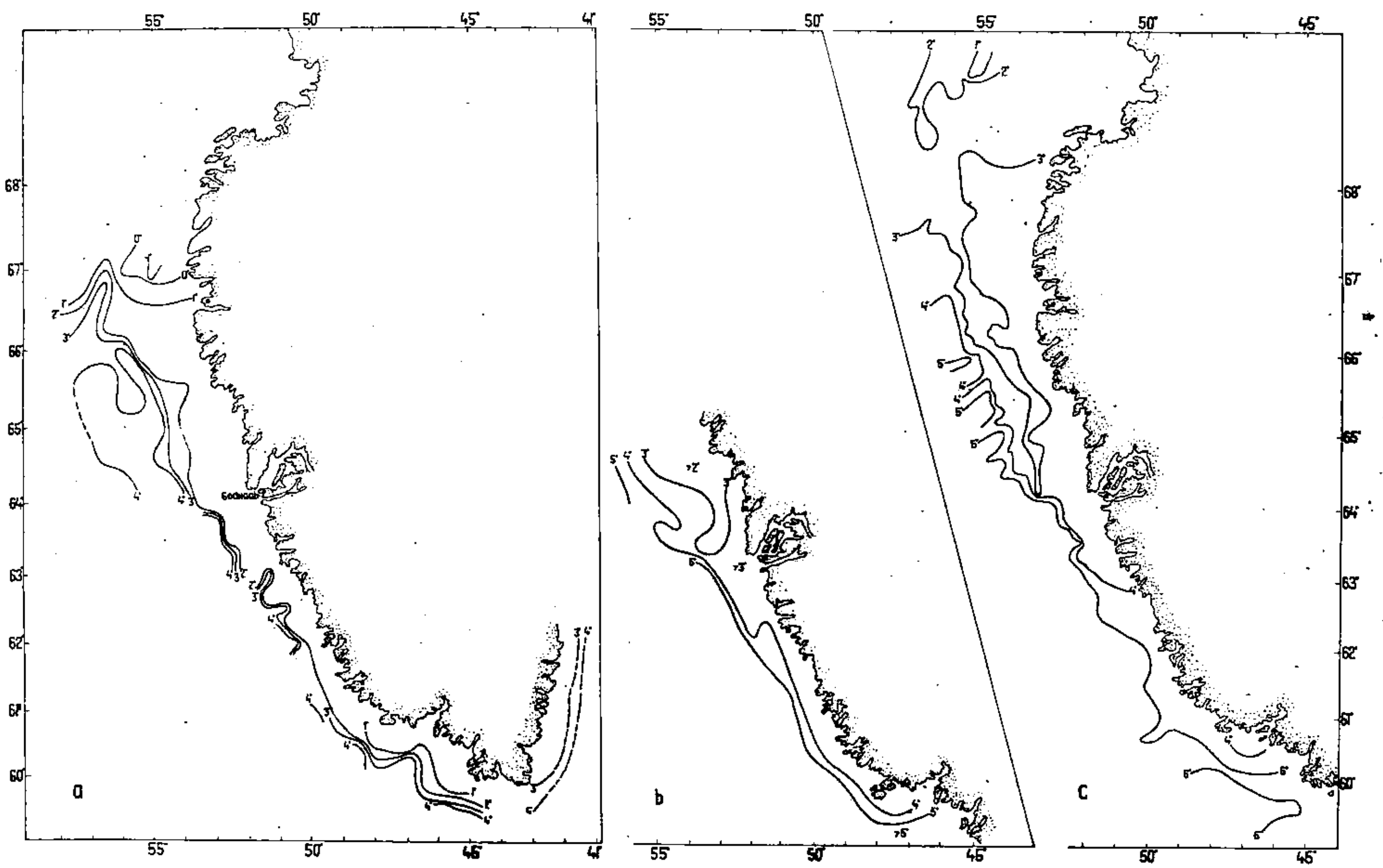


Fig. 8 Near- bottom water temperatures in the West Greenland area
a. May- early June ; b. early September ;
c. September - early October

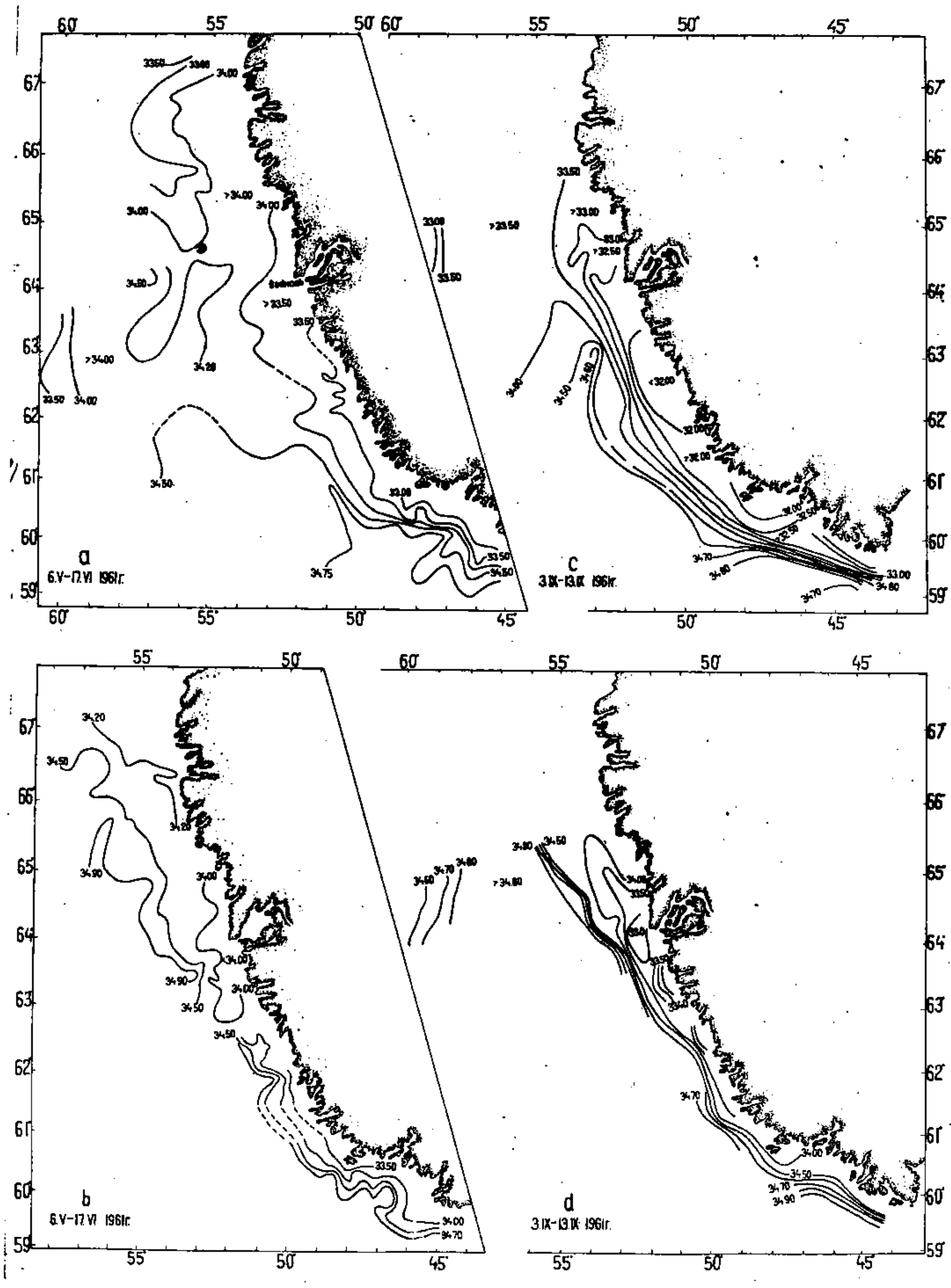

Fig. 9 Salinities in the surface (a,b) and near-bottom (c,d) layers in the West Greenland area

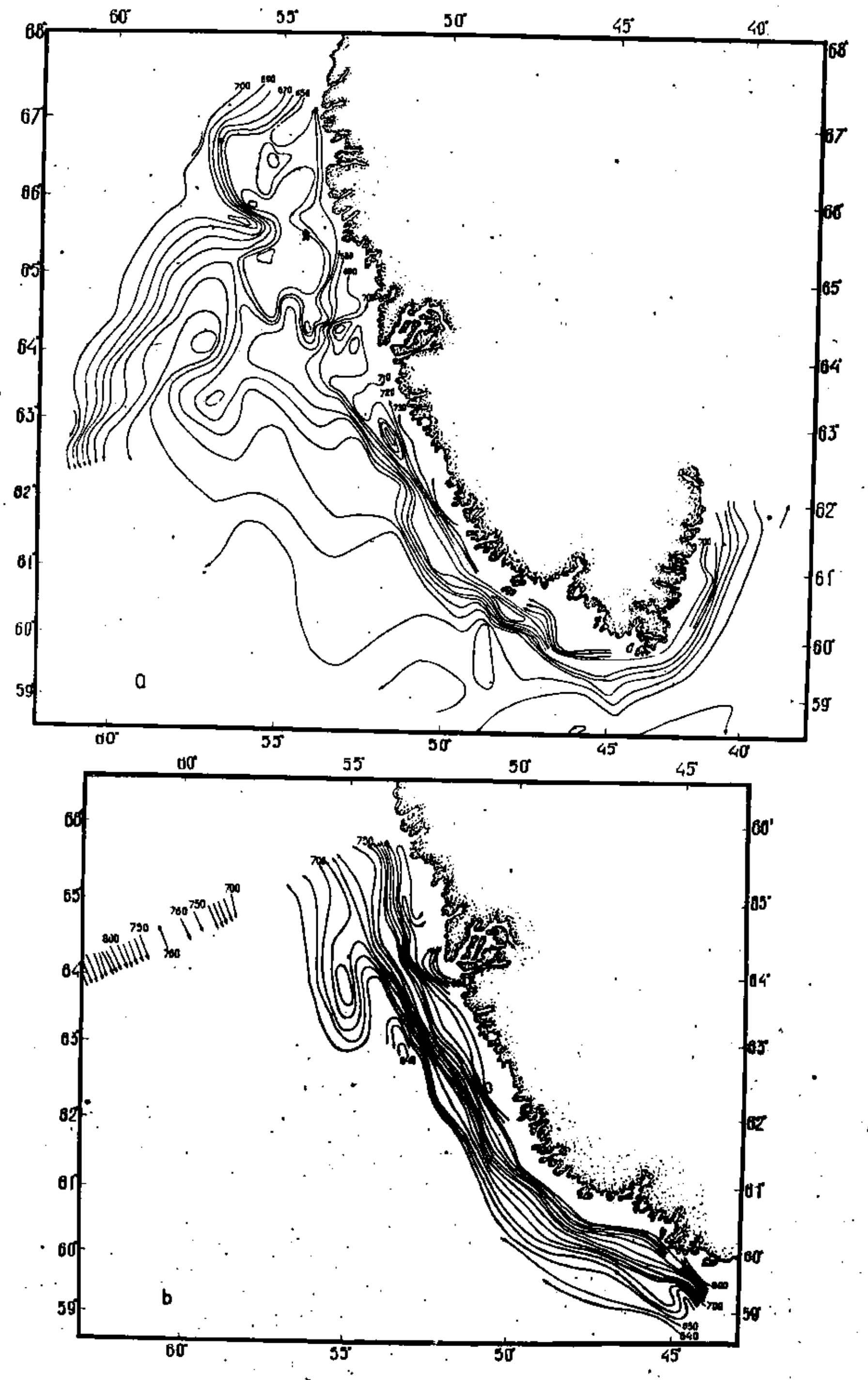

Fig. 10 Dynamic topographies, 0-200 m, in the West Greenland area
a. May-early June; b. September

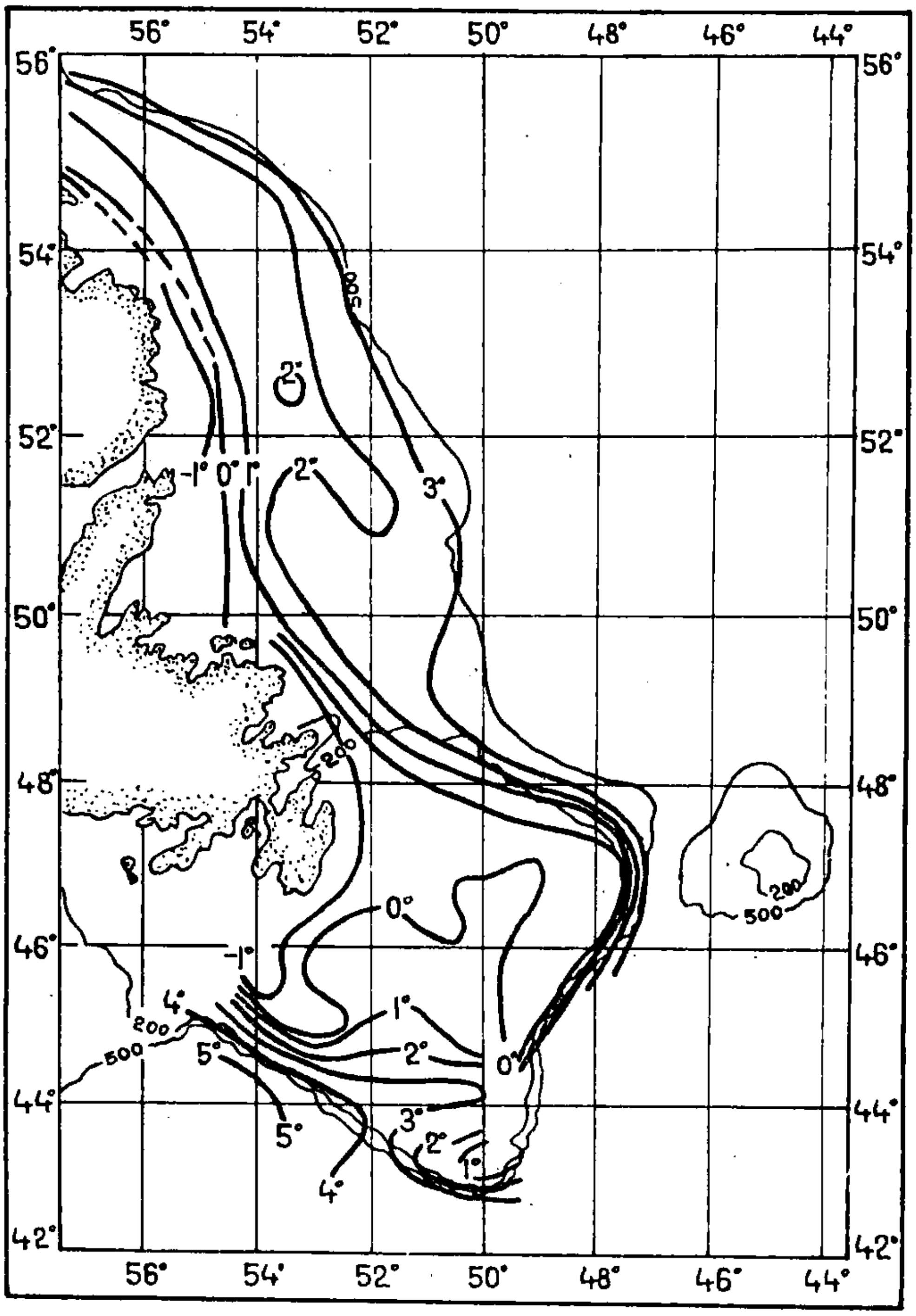


Fig. 11 Near-bottom temperatures in June 1961

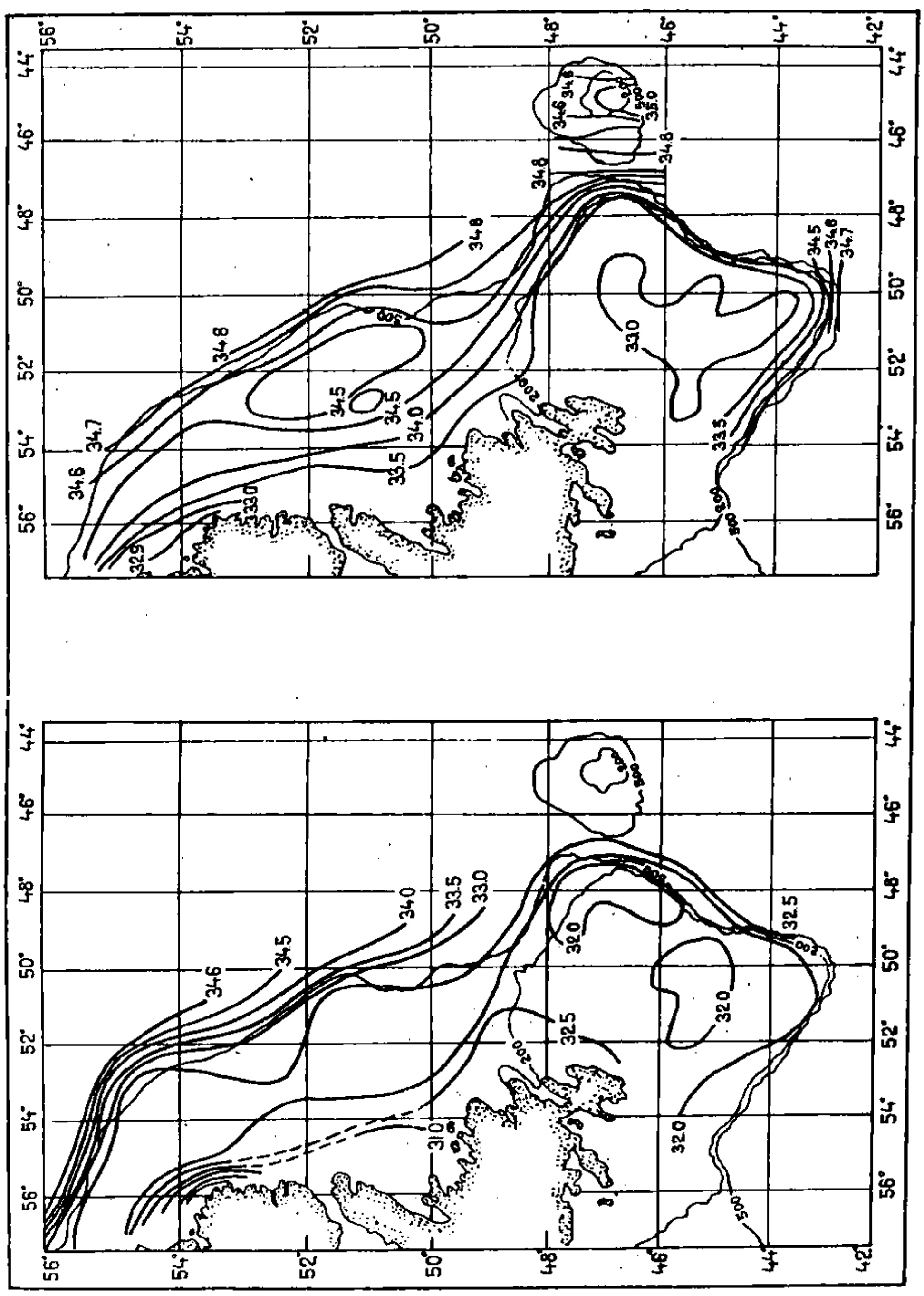


Fig. 12 Salinities ; a. surface ; b. near- bottom
June 1961

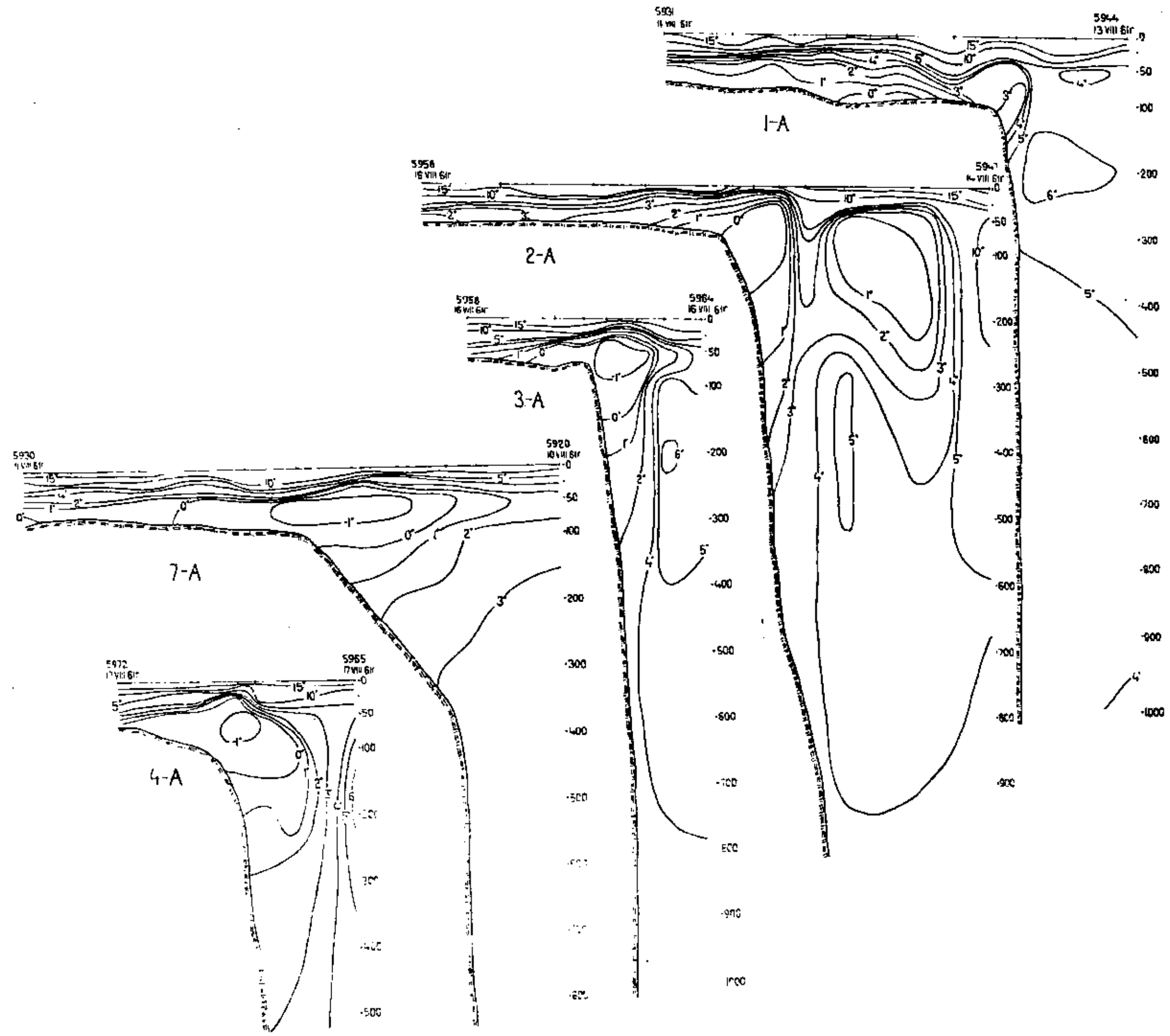


Fig. 13 Temperatures in standard hydrological sections in the area of the Newfoundland Banks Middle of August 1961

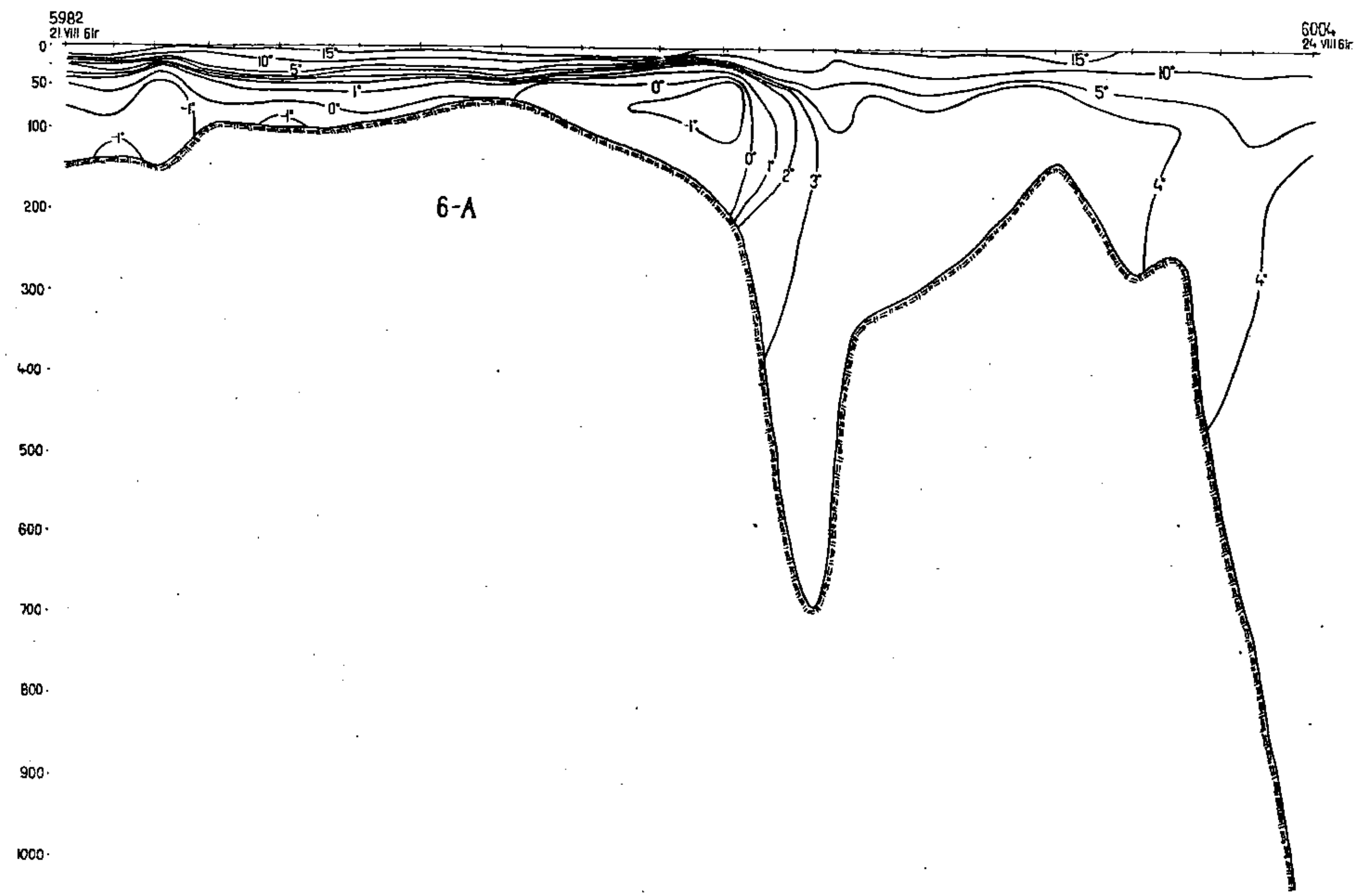


Fig. 14 Temperatures in standard section 6-A
August 21-24, 1961

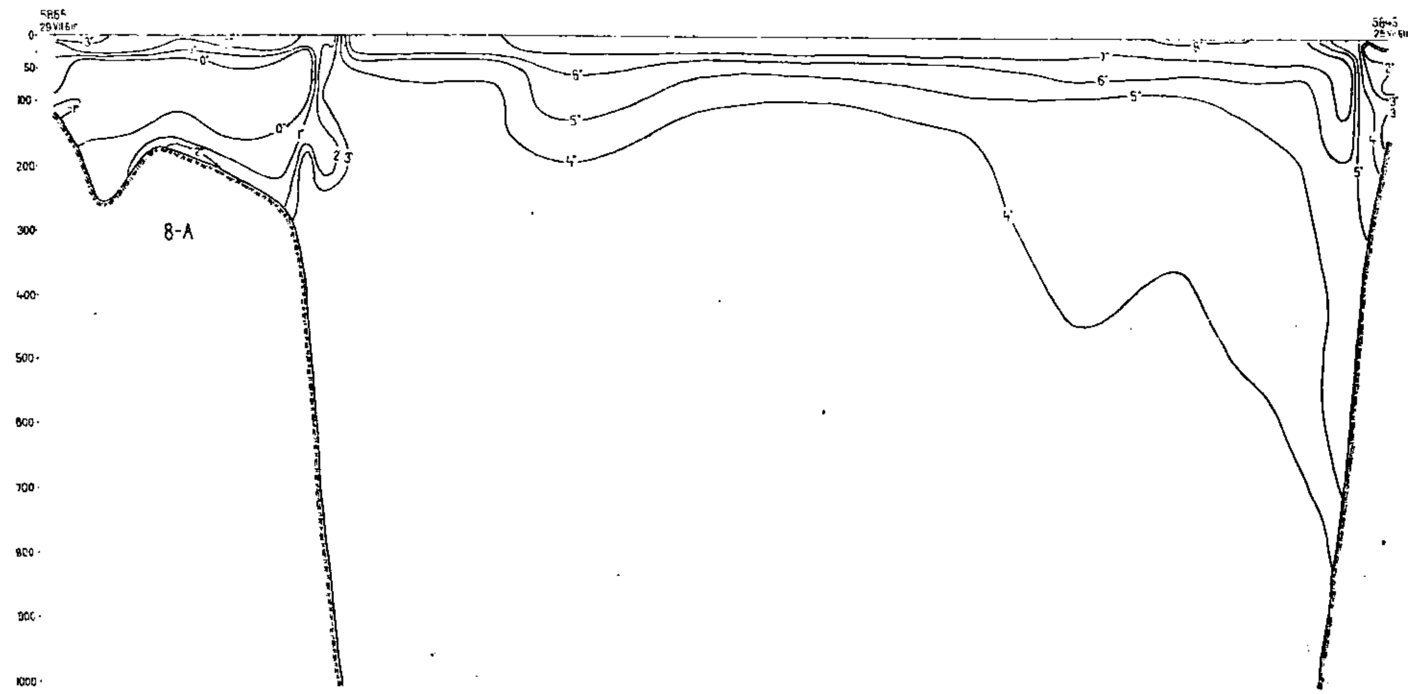


Fig. 15 Temperatures in standard section 8-a
August 25-29, 1961

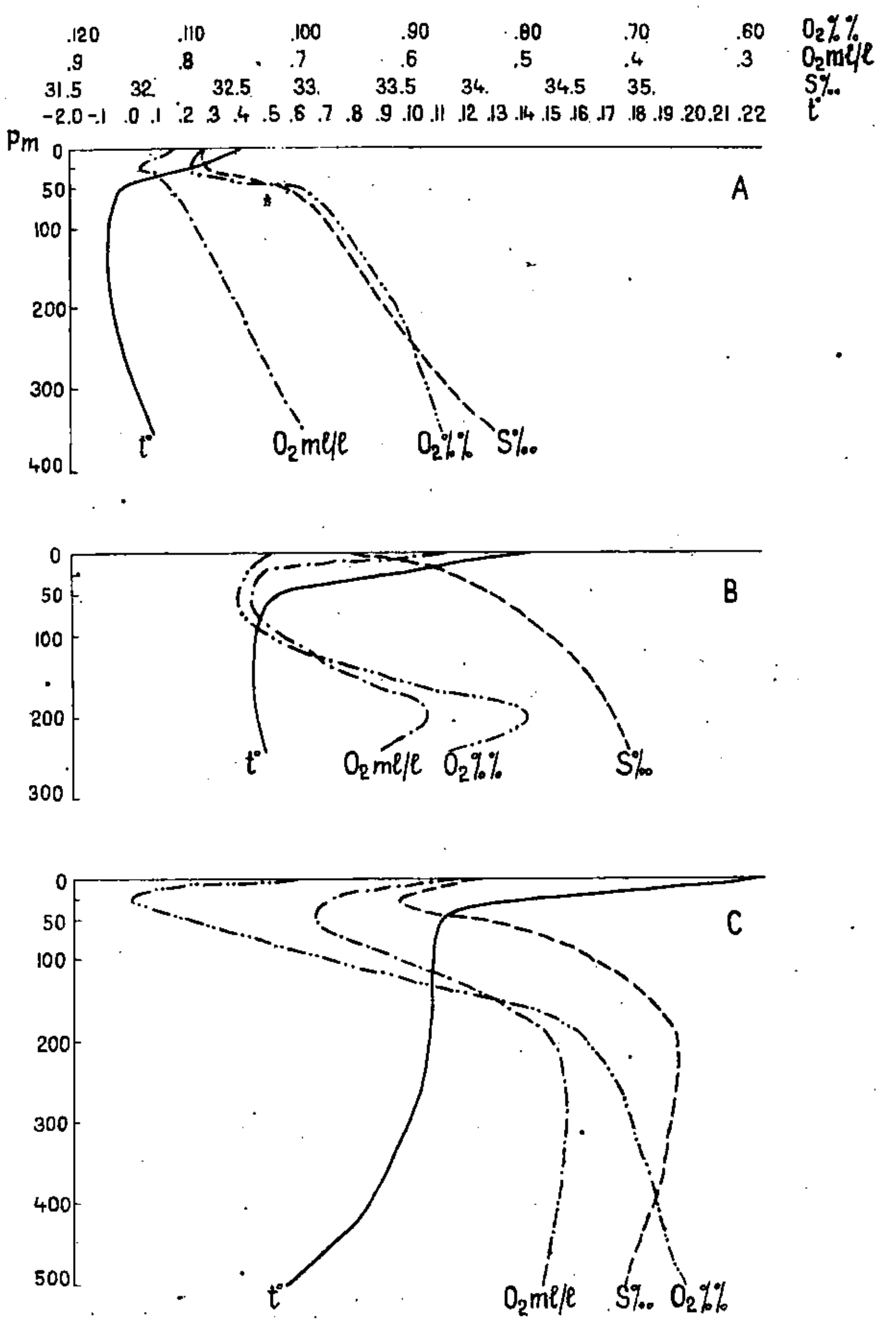


Fig. 16 Vertical courses of temperature, salinity and oxygen content

a. Labrador Current; b. mixed waters;

c. Atlantic waters

August 1961

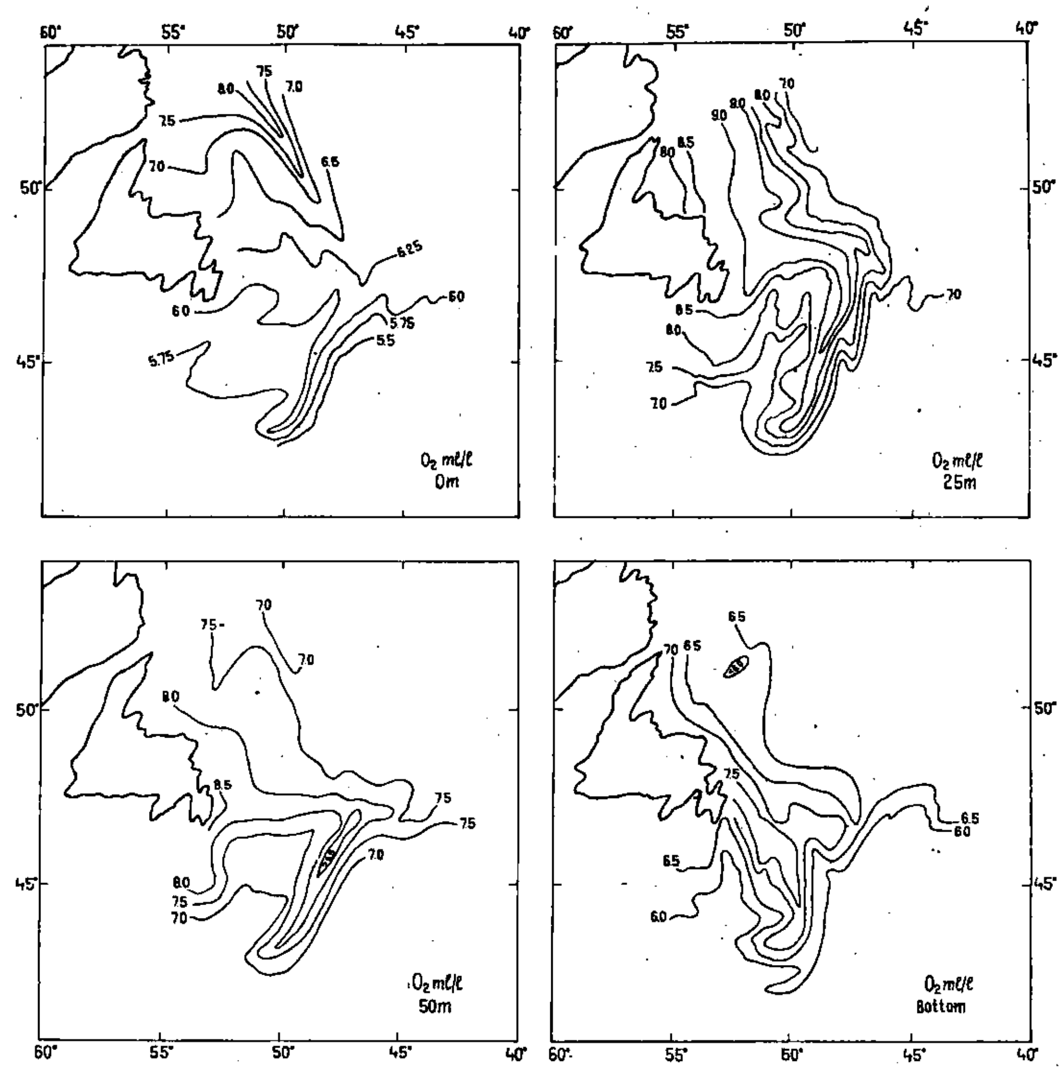


Fig. 17 Horizontal oxygen distribution, ml/l, in the area of the Newfoundland Banks August 1961

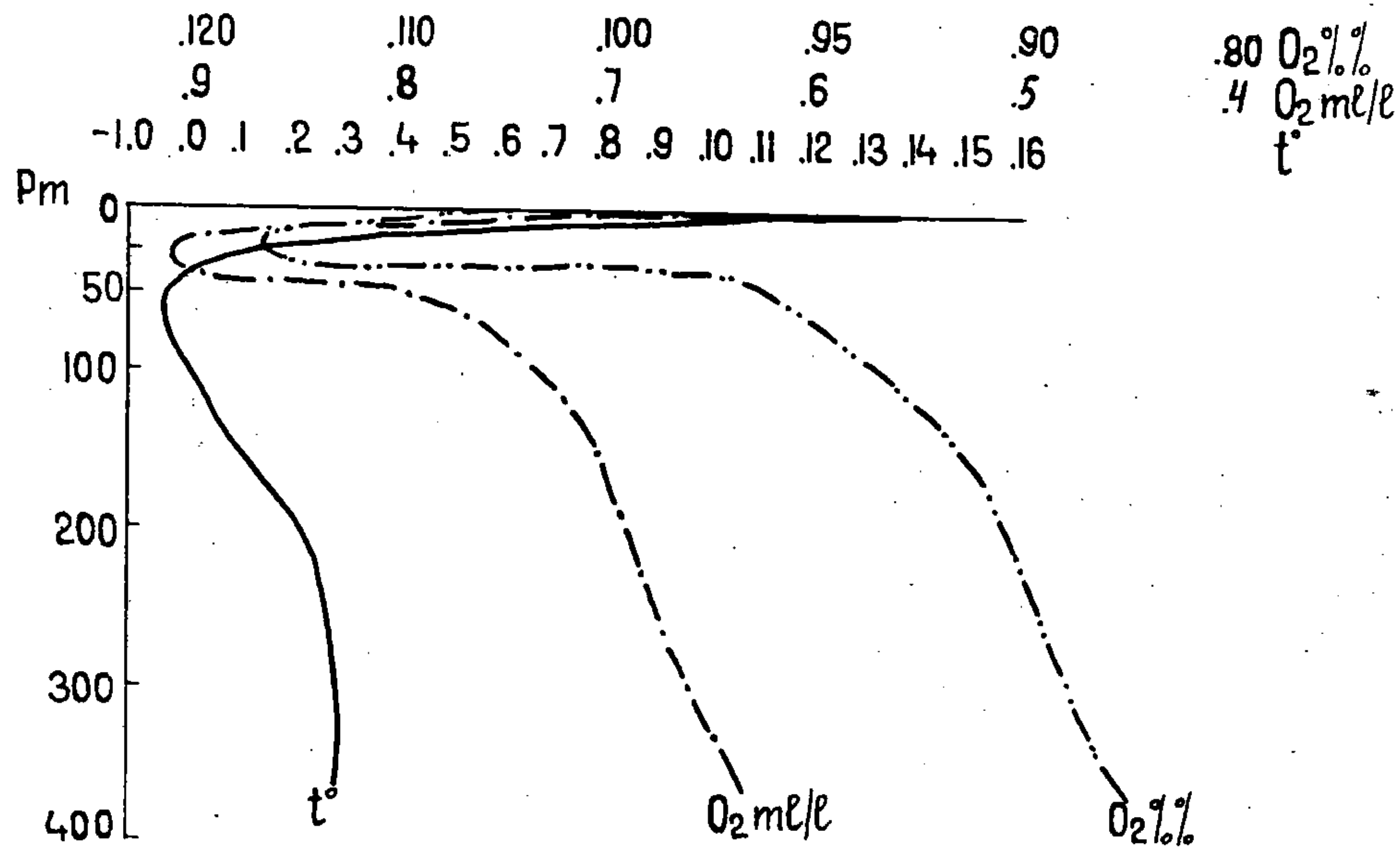


Fig. 18 Vertical courses of temperature, salinity and oxygen content, ml/l, station 5922 August 1961 ( See fig. 1 )

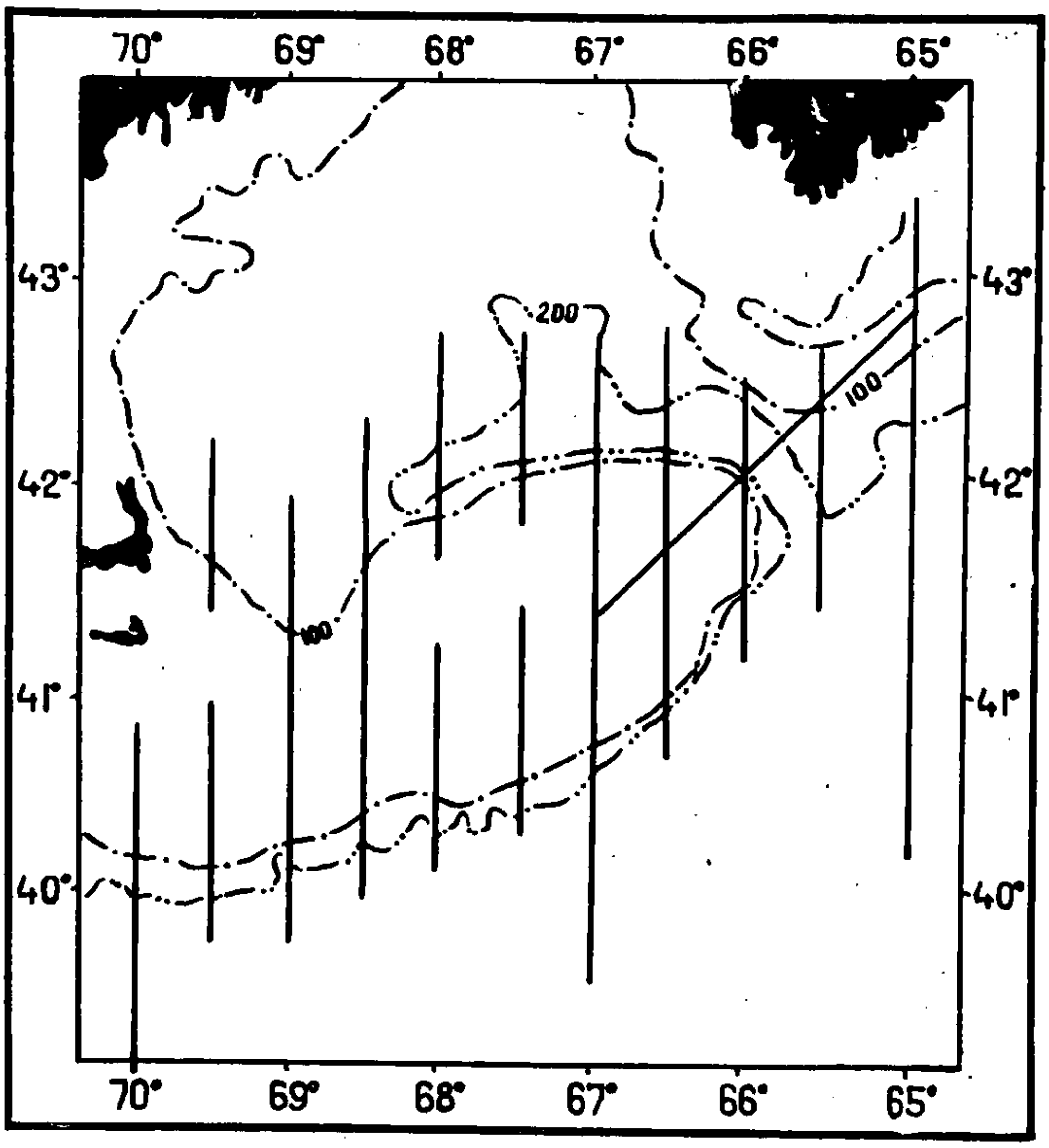


Fig. 19 The oceanographic sections in ICNAF subarea 5 worked by the r/v "Balaklava" and the r/v "Boguchar" in 1961

C 9

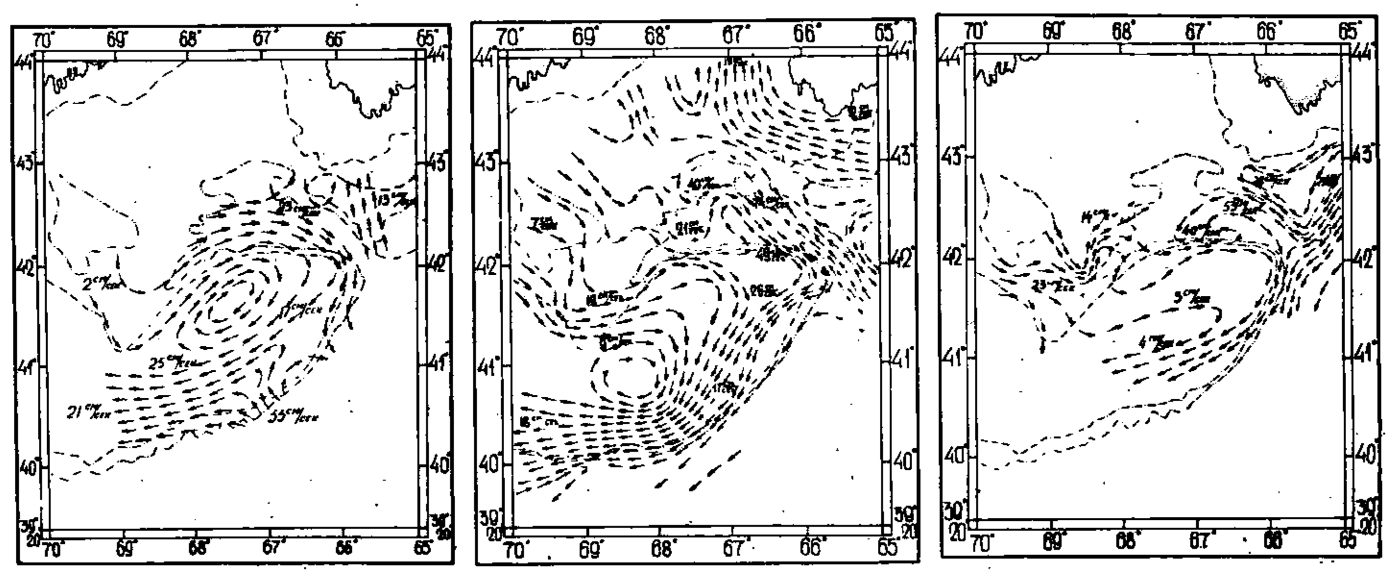


Fig. 20. Sketch maps on permanent surface currents over the Georges Bank for June, October and December 1961

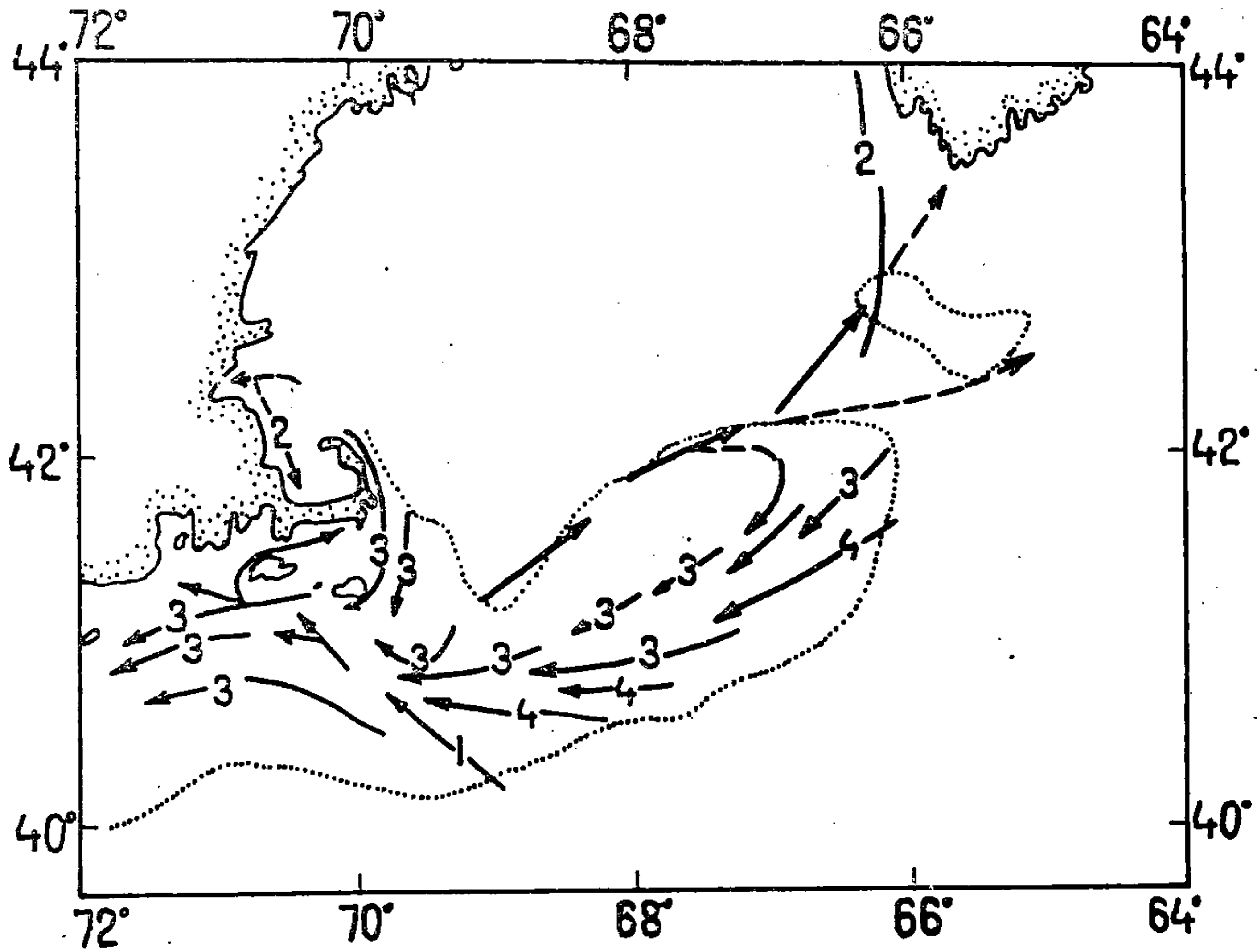


Fig. 21 Course of drift bottles on the Georges Bank in June 1933, as June 1933,
as observed from the US r/v " Atlantis "
( velocities in miles / day)

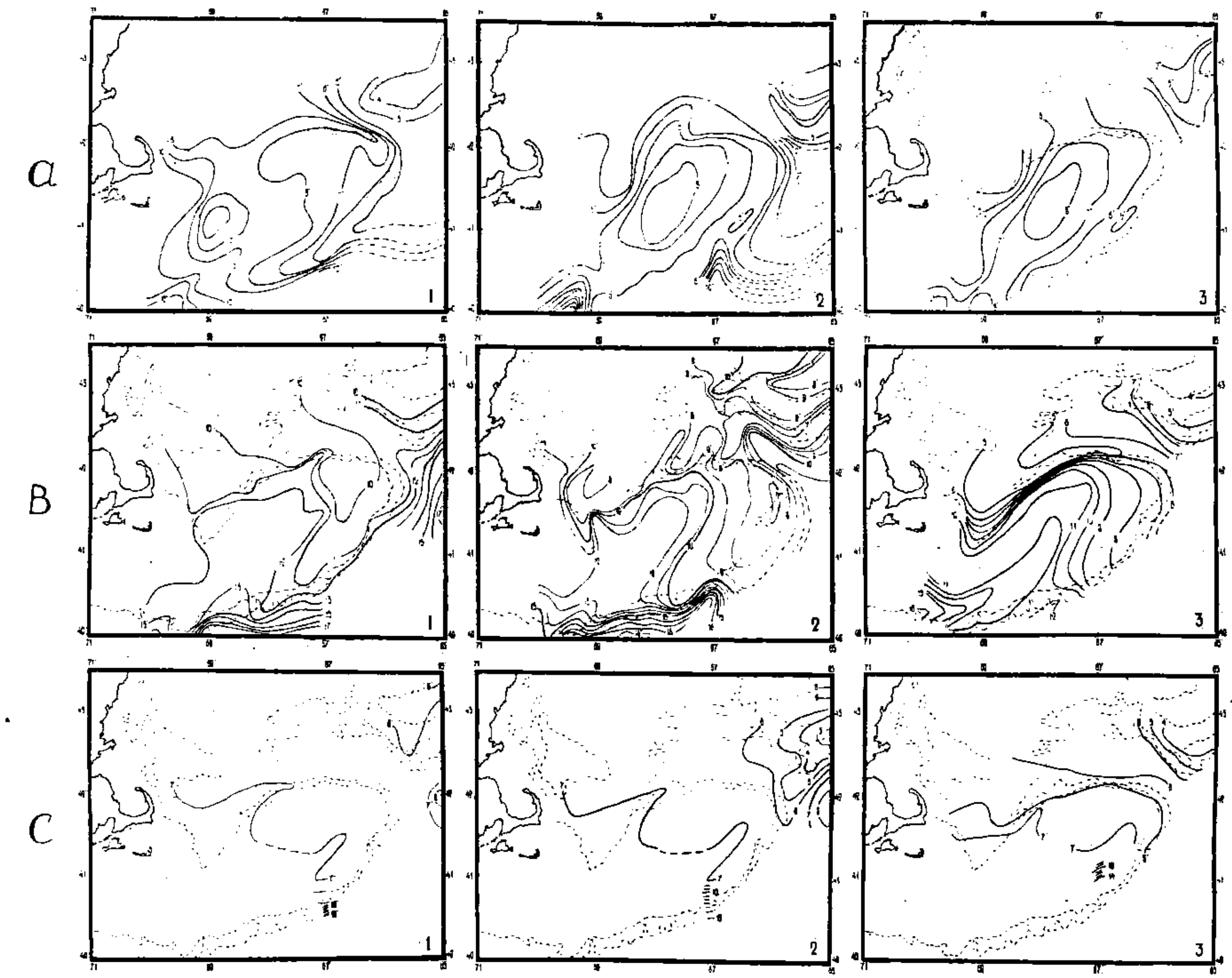


Fig. 22 Isotherms for various sea levels in the area of the Georges Bank

a. June ; b. October ; c. December 1961
1. o m; 50 m; 3. near- bottom layer

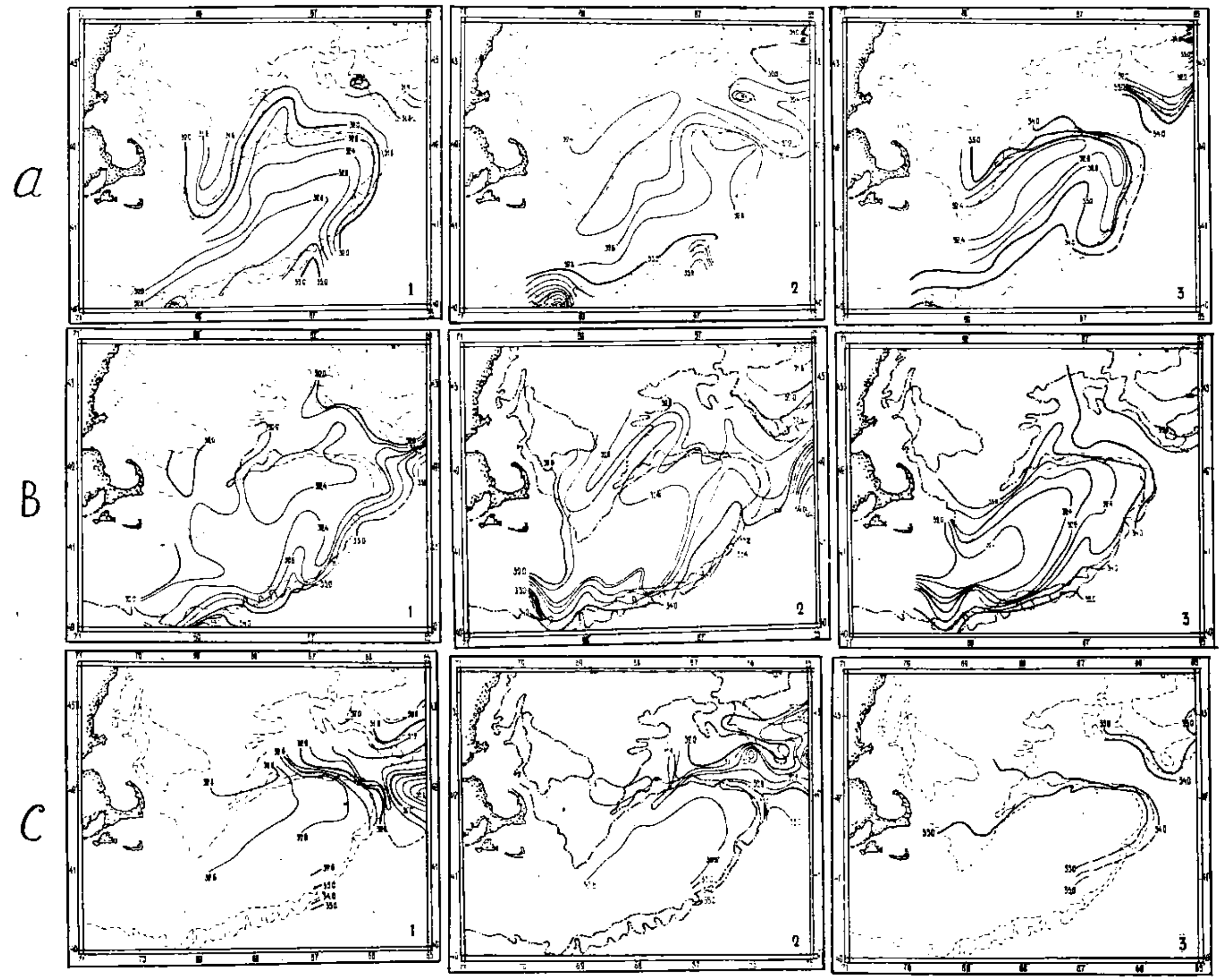


Fig. 23. Isohalines for various sea levels in the area of the Georges Bank.
a. June; b. October ; c. December 1961.
1. 0 m ; 2. 50 m ; 3. near- bottom layer

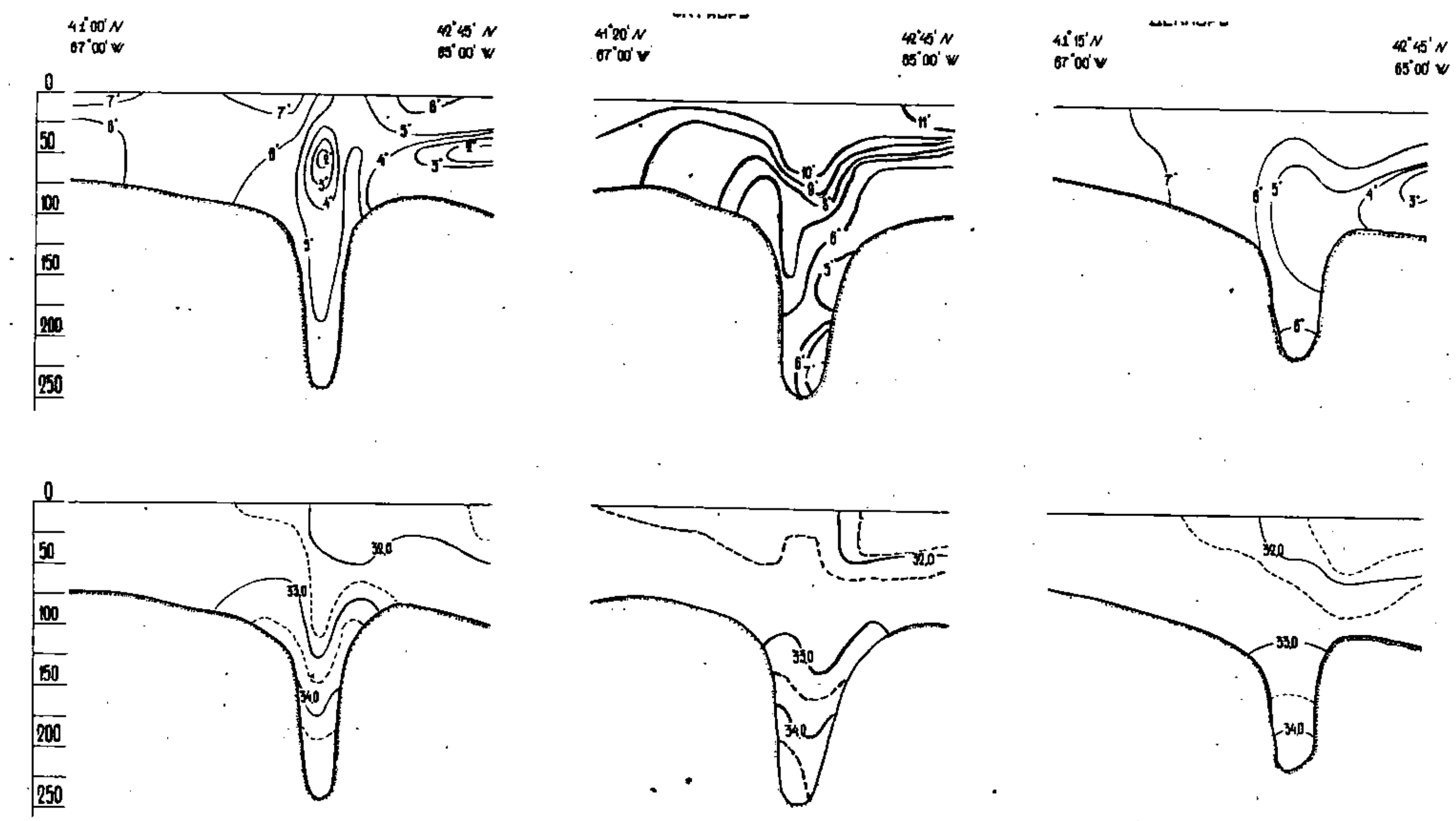


Fig. 24. Temperatures and salinities in the section across the trench between the Georges and Browns Banks a. June; b. October; 3. December 1961.