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U.S. TREASURY DEPARTMENT - UNITED STATES COAST GUARD

BULLETIN No. 18

INTERNATIONAL ICE OBSERVATION AND ICE PATROL SERVICE IN THE NORTH ATLANTIC OCEAN - [SEASON of 1929]

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IN THE

NORTH ATLANTIC OCEAN

Season of 1929

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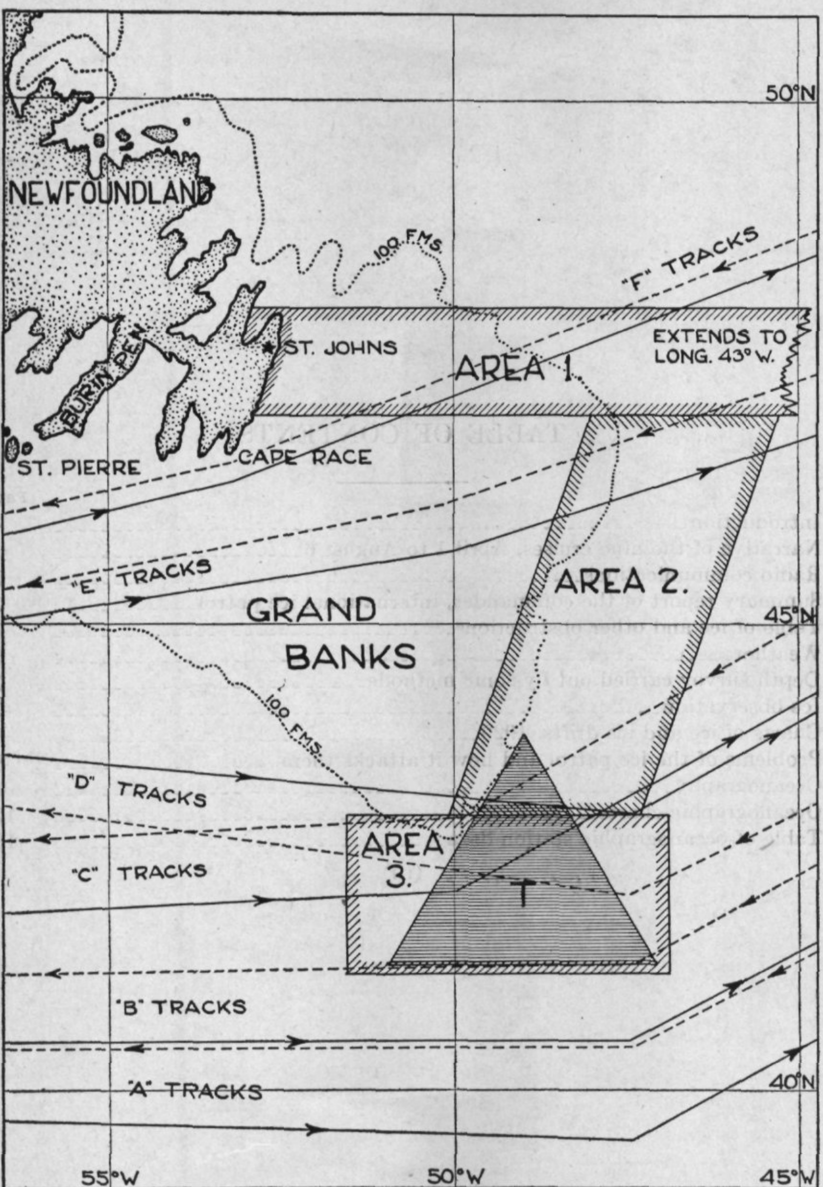


FIGURE 1.—The scene of the principal activities of the International Ice Patrol. Tracks A, B, and C are routes to and from United States ports. Tracks D, E, and F are routes to and from Canadian ports. Areas 1, 2, and 3 make up the "melting area" described in the chapter on oceanography. Fully 90 per cent of the icebergs that drift south of the 48th parallel each year disintegrate in this "melting area" covering in all some 74,000 square sea miles. The triangle "T" is a very critical area and must be frequently searched out for ice by the patrol vessels themselves

INTRODUCTION

In 1855 Matthew F. Maury, later to be known as "The Pathfinder of the Seas," was a lieutenant in the United States Navy and in charge of the Naval Observatory at Washington, D. C. In January of the above year he began strenuously advocating in the interests of safety separate travel lanes for eastbound and westbound traffic between Europe and America. The cause of the great concern was a disastrous collision between eastbound and westbound vessels, in which 300 lives were lost. There was some opposition at first, but in the course of a few years a mounting list of disasters through collision forced such a system of tracks to be put into effect. Although the danger of collision between vessels was thus greatly lessened, there remained the problem of the ice menace that threatens in the vicinity of the Grand Banks off Newfoundland each spring.

In 1890 Hugh Rodman, then an ensign in the United States Navy, was ordered to proceed to Newfoundland and Nova Scotia to make investigations relative to the ice. The information that he obtained was combined with that accumulated through reports for many years from shipping and was published by the Hydrographic Office as a pamphlet entitled "Report of Ice and Ice Movements in the North Atlantic Ocean." A partial list of disasters contained therein shows that from March 19, 1882, to April 16, 1890, there were no less than 14 vessels lost and about 40 vessels seriously damaged in the North Atlantic due to ice. Among these were many trans-Atlantic steamers that had collided with icebergs. The Hydrographic Office admitted that if reports had been received of all the fishing and whaling vessels lost or damaged the list would have been much larger.

A study of the records up to 1890 clearly showed that the ice came down from the north in larger amounts and extended farther to the southeast of Newfoundland in some years than in others. The heavy ice years were the ones when the greatest toll of trans-Atlantic vessels was taken. Continual efforts were made to gather reports of ice conditions, and the United States Hydrographic Office gave out its information to the shipping interests as quickly and in as much detail as possible. Other than accumulating ice reports on shore from shipmasters, nothing new was done to combat the danger until after the world had been horrified by the *Titanic* disaster of April 14, 1912, in which over 1,500 persons lost their lives. The *Titanic* sank on her maiden voyage shortly after collision with an iceberg in latitude 41° 46′ N., longitude 50° 14′ W.

Resolved to prevent the repetition of such a tragedy and to meet the almost universal demand for a patrol of the ice zone to warn passing vessels of the limits of danger from day to day during the ice season, the United States Navy scout cruisers *Birmingham* and *Chester* were ordered to inaugurate such a service that was to continue until the end of the ice season of 1912. Very opportunely, radio had been developed and brought into use by this time, so that much more information could be gathered and disseminated by a ship on patrol in 1912 than would have been possible even a few years earlier. During the season of 1913 the patrol was undertaken by the Treasury Department and performed by the Coast Guard cutters *Seneca* and *Miami*.

At the International Conference on the Safety of Life at Sea, signed at London on January 20, 1914, the high contracting parties provided for the inauguration of an international service of ice observation, ice patrol, and ocean derelict destruction in the North Atlantic. The Government of the United States was invited to undertake the management of this triple service, the expense to be defrayed by the high contracting parties in a fixed proportion. The proposition was favorably considered by the President, and on February 7, 1914, he directed that the (then) Revenue Cutter Service begin as early as possible in that month the international ice-observation and ice-patrol service. Each year since then, with the exception of the years 1917 and 1918, a patrol has been maintained by the Coast Guard. Two of the largest and best equipped of the United States Coast Guard cutters have been ordered from their home stations and detailed to keep close watch on the ice so as to be able to warn shipping promptly and effectively of the position and movements of the menacing bergs and floes. The cutters inaugurate the patrol very early in the spring, as soon as the ice begins to push south along the eastern edge of the Grand Banks, and one of the two always remains on duty in the ice area until summer time conditions so melt back the limits of ice that it no longer constitutes a serious menace to the trans-Atlantic lane routes.

The three southernmost pairs of tracks between North America and Europe (see fig. 1, United States Coast Guard Bulletin No. 17) carry the fastest as well as the largest amount of traffic and are the lanes that the ice patrol strives particularly to guard. They are laid down well to the south of the usual limits of field ice, so the patrol does not have to contend with that sort of ice itself or to warn the United States-Europe traffic of it to any great extent. The ice patrol's great problem is berg ice from the Greenland ice cap. The solid, massive bergs persist in the ocean much longer and extend to far lower latitudes before they melt than does the field ice. For instance, about 1,000 miles east of the American coast in 1928 one berg drifted to the latitude of Washington, D. C., just south of the thirty-ninth parallel, before it disappeared. During the same year the most southerly report of field ice, outside of that which was reported from the approaches to the Gulf of St. Lawrence, was far to the north of the latitude of Portland, Me., or Halifax, Nova Scotia. The field ice of the Grand Banks region is broken off from the outer limits of the Arctic pack ice, or is formed locally on the surface of the sea along the North American coast to the northward of Cape Race, Newfoundland. Bad as it is for shipping north of the forty-seventh parallel at times, it is, when compared with the bergs, a relatively short-lived ephemeral affair, even along the northern tracks that run across the Grand Banks.

The patrol vessels do not attempt to destroy the bergs, as many people have been led to think through reading erroneous statements that sometimes get into newspapers and news reels after demolition experiments have been carried out on the ice. Except under very favorable conditions, bergs are dangerous to board in the open ocean because of the wash of the sea against their hard steep sides. The risks are augmented by the fact that the sea about them is usually icy and boisterous in early spring. Later on when conditions have ameliorated the bergs are much more frequently cracking up, dropping off large overhanging ice masses, and turning over.

The ice patrol's experiments have shown that mining operations with high explosives, in the few cases when they are practicable are almost useless. The large bergs are so deep lying, massive, and hard that the explosion of a hundred pounds, more or less, of T. N. T. has very little effect other than to increase the size of the hole in which the charge is placed and to shake off a few pieces of ice already about to fall. Gunfire is even more futile than mining. Well placed shots will sometimes bring down a few tons of ice into the sea, but when it is considered that 500,000-ton bergs are not uncommon and that only about one-fourth to one-sixth of the mass of a berg projects above water to serve as a target, the futility of this method of attack becomes apparent.

The series of experiments on the destruction of bergs undertaken by Prof. H. T. Barnes, of McGill University, have been followed by the ice-patrol authorities with interest. His thermite charges seem to give a little more promise of success than any other method evolved to date, but there are grave practical difficulties connected with placing the thermite in the heart of the bergs where it can act most effectively. Up to the present time, at least, it would seem that the only practicable thing that can be done is to watch, and to keep shipping advised of the changing positions of the various southernmost bergs and ice fields until in the natural course of events they melt. They disappear rather rapidly as they drift south into warmer waters during the advance of spring. As stated above, the field ice is disposed of very rapidly in the open ocean about the Grand Banks. Even the bergs have a comparatively short life there. Each one of the latter presents a special problem of melting, depending on its size, shape, and solidity, as well as on the sort of weather and water that it encounters. Along the northern edge of the Gulf Stream the accumulated observations of the ice patrol show that the largest and most resistant bergs can last only about two weeks.

The thing that most hampers the patrol in its service of information is the prevalence of fog in the ice-infested regions. Experience shows that quick advantage must be taken of every spell of good weather if anything approaching an efficient information system is to be maintained. The critical areas just north of the southernmost steamer lanes must be searched again and again for ice during the course of the season. At night, and also when dense Grand Banks fog closes in, the patrol vessels usually stop and drift. This procedure not only insures that no bergs are passed unnoticed because of bad visibility, but also conserves fuel, which permits higher speed cruising when the weather is clear and bright.

Much scientific work has been done in conjunction with the ice patrol and much statistical data regarding the ice has been gathered and published in the annual ice-patrol bulletins. A great deal more is now known about the Labrador Current and the Gulf Stream in the vicinity of the Grand Banks than was known when the *Titanic* went down. There is still much work to be done before the great variation in the severity of the ice seasons from year to year can be fully explained, however, and before the final drift tracks of bergs that are seen off the eastern edge of the Grand Banks can be predicted with confidence.

The international ice patrol for the season of 1929 was carried on by the United States Coast Guard cutters *Tampa* and *Modoc*. The *Mojave* acted as the stand-by vessel, but she was not called upon for active duty on patrol. Commander Thomas M. Molloy, in addition to being in command of the *Tampa*, was commander, international ice patrol. Commander Philip F. Roach was in command of the *Modoc*. Lieut. Commander Noble G. Ricketts was detailed as ice observation officer and remained at sea with two enlisted men as assistants throughout the patrol season in order to aid the commanding officer of the vessel actually on duty in ice-patrol matters and to keep a continuous and uniform record of the year's work for this annual report.

Halifax, Nova Scotia, was the base for fuel and supplies during the ice season. The *Tampa* and *Modoc* made alternate cruises of about 15 days each in the ice regions, this time being exclusive of the five or six days occupied in going to and from the base.

Eight times each day radio broadcasts giving locations or limits of all known ice in the North Atlantic were transmitted for the benefit of shipping approaching the ice-patrol area. The different bergs, if not again sighted or reported, were kept from five to seven days in the broadcasts before they were dropped.

The probable drift tracks of critical bergs were indicated when possible. The surface isotherms were very successfully used to estimate probable berg drift tracks and to determine limits of ice areas to be searched. The isotherm curves were drawn partly from information obtained by the ice-patrol vessels themselves, but mainly from careful plotting and analysis of the surface water temperature reports received by radio from cooperating vessels. The value of these reports can not be overestimated, and it is hoped that their number will increase annually. When every vessel crossing the ice-patrol area, particularly those off the most usually traveled routes, reports regularly to the patrol, then the latter will be able to render the most efficient and useful service possible.

Special messages were drafted and sent to any ship that inquired for special information relative to ice, weather, routes, and similar matters. The successive positions of vessels as plotted from their water temperature reports were carefully watched. Whenever it was apparent that a ship was following a course leading toward danger the master was warned, safer courses or other suitable precautions being suggested. Once each day a compilation of all ice sighted or reported during the previous 24 hours was transmitted by radio direct to the United States Hydrographic Office at Washington, D. C. These reports were given wide dissemination among shipping circles by the hydrographer of the United States Navy.

The scientific work carried on by the patrol in 1929 was similar to that of previous years. Deep-sea soundings were obtained by the echo method at frequent intervals for the purpose of improving the bathymetrical charts of the ice-patrol area. Surface and subsurface temperatures and salinities were determined at numerous oceanographic stations. By the latter means it is possible to study the local currents generated where the Labrador Current meets the Gulf Stream, and to compare conditions prevailing in the different localities cruised over with those that prevailed there during former months and years. To facilitate reference and comparison the various sections of this bulletin are on the same subject matters and have been arranged in the same order as those in the 1928 Ice Patrol Bulletin, the 1928 publication itself being modeled on the form that has practically become standard during recent years.

CRUISE REPORTS

THE FIRST CRUISE, "TAMPA," APRIL 1–19

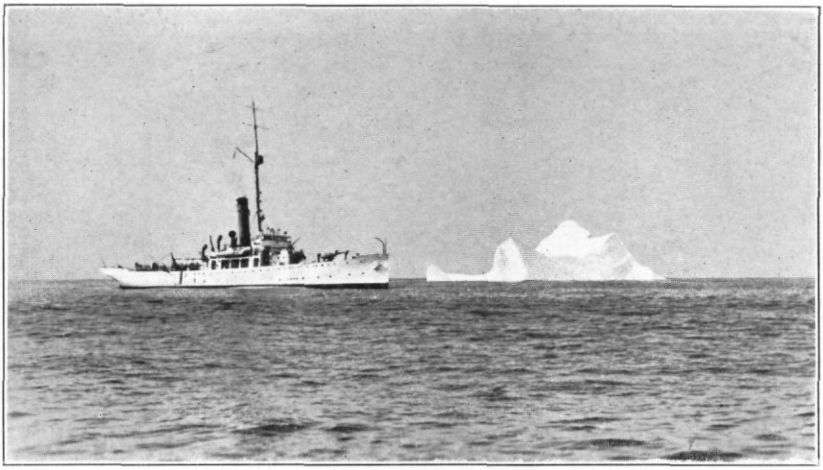
The *Tampa* left Boston, Mass., to inaugurate the 1929 international ice patrol at 12.30 p. m. on April 1. The 950-mile run to the Tail of the Grand Banks consumed four days. On April 6 a search to the northeastward for ice was started from a point about 50 miles south of the Tail, two bergs and several growlers being located in the vicinity of 42° 40′ N. 49° 30′ W. before night. Detailed reports of ice received from the Cape Race radio station and from steamers crossing the Banks showed that ice conditions were extremely bad north of the forty-fourth parallel.

April 11 saw completed the search of the cold current lying off the eastern edge of the Grand Banks between the forty-fourth parallel and the "B" United States-Europe tracks, then in effect. Four additional bergs and several growlers were located and numerous sail of the French fishing fleet were sighted. The fishermen, all about 30 days out from France, were heading west toward the Banks. Upon request, four of these vessels with sick or injured men on board were visited by the *Tampa's* medical officer.

Until the 14th the patrol remained near 42° 13′ N. 49° 33′ W., guarding the southernmost ice. During this time the first oceanographic stations of the year were occupied southeast of the Tail. On the 12th the scientific work was interrupted by a short search for the French fishing vessel *Sylvanna*, which, according to radio advices, had been abandoned on fire about 40 miles northeast of the *Tampa*. She must have sunk shortly after her entire crew of 32 had been rescued by the Swedish steamship *Malmen*, for the patrol never found other trace of her than a few charred timbers.

On April 14 the *Tampa* cruised northward up the cold current to see what ice was coming down. No new bergs were located, but patches of slush ice were seen near 43° 10′ N. 49° 45′ W. From the latter point courses were run to search out the area southwest of the Tail, where a berg was located in 42° 16′ N. 51° 04′ W. on the 15th. The next two days showed that its drift was about 6 miles per day toward the southeast. Word was received on the 16th that the Canadian ice patrol in the Gulf of St. Lawrence had been inaugurated by the ice breaker *Miquela*. The 18th and 19th were spent drifting southwest of the Tail in the first prolonged dense fog of the season. The *Modoc* arrived at a rendezvous in this area at 12.55 a. m. on April 20 and received the ice-observation party and the patrol records.

PLATE I.—Icebergs often keep their sides clifflike and perpendicular by repeated calving. When undercutting along the water line reaches a certain point the overhanging ice masses fall down into the sea, leaving a rough surface like this. Taken from a ship's boat July 15, 1929, in latitude 41° 34′ N., longitude 48° 58′ W.



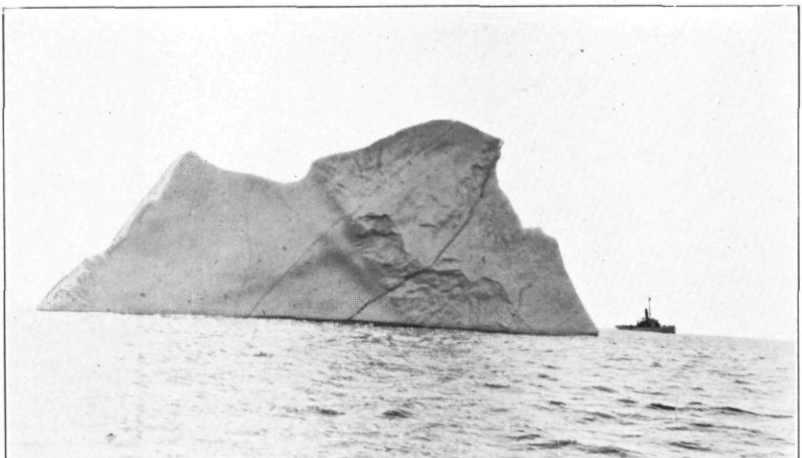


PLATE II.—The *Modoc* and a 500,000-ton iceberg. Difference in relative size of vessel and iceberg is due to the fact that in one case the ship is beyond iceberg and in other the iceberg is beyond ship. Taken from ship's boat on July 18, 1929, in latitude 42° 28′ N., longitude 50° 05′ W.

Numerous reports from passing vessels on the 17th and 18th showed that the "B" tracks were seriously threatened by a southeastward push of scattered bergs toward 42° 40′ N. 44° 50′ W. Besides mentioning this new development in the regular broadcasts, special warnings were sent out at appropriate times. Recommendation to shift the United States-Europe tracks 60 miles south from the "B" to the "A" lanes was radioed to Coast Guard headquarters on the 19th.

Earlier in the cruise the shift north of the Canadian tracks from "D" to "E" on the regular scheduled date of April 10 had been viewed with concern because heavy field ice and many bergs were known to be along the "E" tracks between the forth-seventh and forth-ninth meridians. On the 4th the *Tampa* had advised against the putting into use of these tracks until further notice. As a matter of fact they remained almost impassible until the end of the first cruise. Many liners, instead of attempting to follow them, detoured around the southern end of the heavy field ice that extended to near 45° 00′ N. 48° 30′ W. Those vessels that did use them were generally subjected to considerable delay and, it is believed, to no little danger.

About 75 different bergs drifted south of the forty-fifth parallel during the first cruise, the majority keeping within 75 miles of the eastern edge of the Grand Banks. The patrol vessel guarded particularly the southern extension of these bergs to make sure that the "B" tracks south of the Tail would not be crossed by unreported ice. All the bergs watched south of the forty-third parallel were small water-glazed ones near the end of their careers.

The weather in general was rather boisterous, with many strong breezes and a few southwesterly gales. Visibility was remarkably good throughout most of the period. Overcast nights were the rule, but the sun nearly always penetrated the cloud blanket from late morning to midafternoon.

Altogether eight oceanographic stations were occupied in scattered locations. The salinities were determined in the electric salinometer and the stations were fully computed before the relief by the *Modoc*. Dr. R. MacDonald, a marine biologist from Harvard University, accompanied the *Tampa* on the first patrol cruise for the purpose of collecting specimens from surface and intermediate levels with townets. He made 11 successful hauls at favorable times and places, the results of which will be used by him for furthering knowledge of the North Atlantic fauna.

One hundred and sixty reports of ice were received by radio from ship and shore stations. In addition the patrol vessel herself sighted and recorded the position of ice fifteen times. Ten vessels were given special ice information. This was usually sent on request, but on the 12th the *Gripsholm*, observed from her water temperature reports, to be running toward danger in darkness, was warned on the initiative of the patrol.

The isotherm curves on the cruise chart were made up in large part from 908 sea water temperature reports received by radio from 149 different vessels. The *Tampa's* own hourly readings were used to supplement the 908 values received from shipping crossing the ice-patrol area. Unusually cold surface water, as low in temperature as 28° F., was repeatedly encountered in the area just south of the Tail of the Grand Banks. The southerly extension of cold water and ice, particularly the latter, was greater than during the corresponding period last year.

THE SECOND CRUISE, "MODOC," APRIL 19–MAY 3

The *Modoc* left Boston, Mass., at 10.30 a. m. on April 15, 1929, to relieve the *Tampa* on ice patrol. Dense fog prevailed at the rendezvous in 42° 30′ N., 51° 40′ W., on the night of April 19, but radio-compass bearings enabled contact to be made readily and searchlights penetrated the fog sufficiently to enable the ice-observation party and the patrol records to be transferred by boat as soon as the two ships met.

On the morning of April 20 word was received of the French fishing vessel *Eskualduna*, abandoned in sinking condition at 43° 40′ N., 51° 15′ W. The report being very recent and the location within eight hours' run, course was shaped for the derelict. By the evening of April 21 the area within 30 miles of the reported position had been searched. Good visibility had prevailed, but no wreckage was seen. It is believed that the vessel sank.

The French fishing vessel *Notre Dame de Bizeux* was spoken to on the Banks northwest of the Tail on the morning of April 22. She had not seen the *Eskualduna* nor heard of her abandonment, but she did have on board the master and 17 men of the *Chevalier Bayard*, a French fishing vessel that had foundered on the 16th due to taking water and to inability to run the pumps. The 18 other members of the crew of the lost vessel were distributed among three more vessels of the fishing fleet in the vicinity. The master of the *Notre Dame de Bizeux* desired the *Modoc* to take the rescued fishermen ashore from his vessel. Upon being informed that the *Modoc* could not land the men for two weeks on account of ice-patrol duties, he drafted a radiogram for transmission to the French hospital ship *Ste. Jeanne D'Arc*, requesting that vessel to relieve him of the extra men for whom he had no suitable accommodations. Continuing south, the *Modoc* on the 22d sighted seven bergs and several dozen growlers in the cold water just west of the Tail. The North Atlantic track agreement shifted from track "B" to track "A" on the 22d. Much field ice and many bergs were reported during the first three days of the cruise from along the "E" tracks.

As April 23 was foggy all over the patrol area, no searching could be done and no ice reports were received by radio. Two oceanographic stations were taken. Advantage was taken of the fine clear weather of the 24th, 25th, and 26th to search for ice between the Tail of the Banks and the westbound "B" tracks. None was seen and none was reported in this area. On the 24th a very rough sea remained from the storm of the night before, but this gradually flattened out. On the 25th and 26th a current of 2.7 knots setting to the northeast was encountered along the forty-second parallel between the forty-ninth and fifty-first meridians. This was along the cold wall where the sea temperatures were observed to be varying between 58° F. and 38° F. within a very few miles.

No searching could be done and there was very little ice reported on the 27th, 28th, 29th, and most of the 30th because of fog. This thick weather prevented the ice-patrol vessel from supplementing with her own observations the reports made by passing vessels during the first cruise of ice in the southeastern sector.

On May 1, the visibility again being excellent, a search was started in the cold water just south of the Tail. The next day courses were run well offshore up the eastern edge of the Banks. Six bergs were sighted between the forty-eighth and fifty-first meridians north of the forty-third parallel on the two days. During the fine clear weather of the 2d no less than 56 reports of ice, all from north of the forty-third parallel, were received from other vessels. Phenomenal visibility prevailed on the second, for a medium-sized berg that later proved to be approximately 40 miles to the northeastward, was visible from the bridge at noon.

May 3 was spent searching southwestward from the forty-fourth parallel along the 100-fathom curve of the Banks. In general good visibility continued during this day, though fog banks were met at times as the ship proceeded toward a rendezvous with the *Tampa* in 42° 40′ N., 51° 40′ W. Contact was made some hours before dawn on May 4 and the relief of patrol was effected at once in the usual manner.

During the second cruise the southernmost ice was located for the most part along and just offshore of the 100-fathom curve of the eastern edge of the Grand Banks. It was in great amount north of the forty-fourth parallel. Early in the cruise field ice was reported along with the bergs as far south as latitude 44° 40′ N. By the end of the second cruise, however, the limits of the field ice had retreated to the forty-eighth parallel. Strong Gulf Stream effects prevented any bergs from drifting south of the forty-second parallel. The warm water during the cruise also removed the menace to the "B" tracks that was threatening on April 18 in the vicinity of the forty-fifth meridian. A few bergs were reported from positions well over on the Banks. Such ice as reached the latitude of the Tail was forced close around it to the west. Although the threatening situation that existed for the "B" tracks at the beginning of the second cruise seemed to have passed for the time being, the bergs remained in such great quantities along the eastern edge of the Banks until the last of the cruise that it was thought inadvisable to recommend a shift of tracks north from "A."

Six oceanographic stations were taken and computed during the cruise. The salinities of the samples of sea water were determined on board quite satisfactorily by the method of chemical titration. As was done on all cruises, frequent soundings were made by the echo method.

Considerable fog was experienced during the second cruise, but there were also long intervening periods of fine, clear weather. During the cruise a marked transition from blustery spring conditions to more moderate summer conditions with predominating light southerly breezes took place. In the ice-patrol area the sun's rays increased in strength noticeably and commenced to warm effectively the surface layers of the sea on clear days.

Special ice information was sent to seven vessels; 957 temperature reports were received from 134 cooperating vessels. The water temperature and weather reports in addition to showing the location of the cold and warm currents, helped the patrol vessel to tell just what sections were being effectively searched by shipping and enabled her to devote her own efforts to the critical areas and to areas from which no reports were being received. During the second patrol period 203 reports of ice were received from ship and shore stations.

THE THIRD CRUISE, "TAMPA," MAY 4–19

After the *Tampa* took over the ice-patrol duty low visibility due to mist and fog patches prevailed until the 5th, on which date a search for ice was started up the eastern edge of the Banks from the latitude of the Tail. Six bergs were located in the cold stream south of the forty-fourth parallel. On the 6th the largest of these, when revisited, was found to have drifted 24 miles, 160° true, in 24 hours to 43° 04′ N., 48° 49′ W.

The 7th and 8th were foggy, but on the 9th visibility was good again. No search was started on this day, however, because a member of the crew had been operated upon for appendicitis on board the evening before and it was desired to keep the ship as steady as possible for his benefit. He rapidly recovered without complications. Twenty-five ice reports came in from north of the forty-fourth parallel during the day. One of the bergs along the eastern edge close to the forty-sixth parallel was said to be 300 feet high.

On May 10 a second thorough search was made of the axis of the Labrador Current between the forty-fourth and forty-third parallels. One large berg was found in 43° 00′ N., 49° 20′ W. As it was drifting rapidly southward at first, it was trailed closely until the night of the 15th, when it was lost during a southerly gale with fog. Even while in waters about 34° F. in temperature this berg was seen to turn over completely at least once a day, and more frequently to list deeply. It must have been so finely balanced that slight uneven melting was sufficient to cause it to change position. Being massive and rounded, very few pieces were detached as it rolled. The southerly drift was checked at about 42° 20′ N., 49° 30′ W., from which position the movement of the berg was to the westward past the Tail, always a number of miles north of the cold wall.

From 42° 48′ N., 50° 47′ W., the drift of this berg was southward again. When lost on the 15th it was approximately in 42° 15′ N., 50° 40′ W., only 40 miles north of the westbound "B" tracks, but presumably about to be carried eastward along the cold wall. The failure of the above berg to drift south along the forty-ninth meridian into the Gulf Stream on the 11th made it seem certain that the "B" tracks were safe for the time being. Accordingly, on the evening of the 12th a message was sent to Coast Guard headquarters recommending that the United States-Europe tracks be shifted north from "A" to "B" until further notice. On the night of April 15 word was received from the Hydrographic Office that track "B" would become effective westbound on May 18 and eastbound on May 25.

During the third cruise an unusually large number of bergs were reported as between the forty-sixth and forty-eighth parallels, between longitudes 46° W. and 48° W. There were at times some remnants of field ice in the central portion of this area. Field ice and many bergs and growlers were reported by the few vessels that crossed the ice area north of the forty-eighth parallel. South of the forty-fifth parallel the bergs were comparatively few in number and widely scattered. The ones observed by the patrol decreased in size but slowly because the water around them was only 2° to 4° above the freezing point of fresh water. Eight oceanographic stations were taken and worked out during the cruise.

The fog that caused the patrol vessel to lose the berg trailed from the 10th to the 15th cleared at 2.30 p. m. on the 17th. The remainder of that day and all of the 18th were spent searching south of the Tail to relocate the southernmost known ice. The berg of the 15th could not be found again, but another berg was sighted late in the afternoon. A feature of the last two days of the patrol was a flood of reports from between the forty-eighth and forty-ninth parallels along the "F" or Cape Race tracks, which began to be used on the regular scheduled date, May 16. Fog and rain on the "F" tracks on the 17th caused many liners to stop and drift and cut down somewhat the extraordinary number of these ice reports.

At 12.30 a. m. on May 19 the *Modoc* was met at 42° 55′ N., 52° 25′ W. There the ice-observation party and the patrol records were transferred and the relief of the patrol was effected.

Weather during the third cruise was remarkably fine and moderate on the average. There were no gales until the moderate westerly one of the 14th, which was accompanied by high barometer and clear skies. A depression that passed to the north of the patrol on the 16th caused a few hours of southerly gales with fog. Fine visibility with a clear-cut horizon was the rule, fog being experienced during but 22 per cent of the time.

One thousand and eighty-two surface water temperature reports were received from 180 vessels. These were, as always, of great value for use in planning the patrol's searching, for estimating the probable drift and life of ice, and for keeping track of shipping crossing the ice-patrol area. Two hundred and ninety-eight ice reports were received from ships and shore stations. Seventeen vessels were given special ice information.

THE FOURTH CRUISE, "MODOC," MAY 19–JUNE 2

Search courses on May 19 revealed two bergs south of the Tail. The one found in 42° 44′ N., 51° 13′ W., had drifted west-southwest at the rate of 1.3 knots since left by the *Tampa* on the 18th. On the 20th fog prevented continuance of the search for the southern limits of the cold-water area, but on the 21st fine visibility again prevailed, with the result that the ice patrol and cooperating vessels practically cleared up, for the time, the existing ice situation in the waters south of the forty-third parallel. Four bergs and one growler were believed to constitute all the ice south of the Tail, and all of these on the 21st were north of latitude 42° 30′ N. On the 21st no less than 76 reports of ice were received, a new high record for one day, proving that extremely bad ice conditions were persisting north of the forty-sixth parallel.

Unfortunately, dense fog on the 22d prevented the *Modoc* from relocating the southwesternmost ice and determining its drift toward the westbound "B" tracks. Word was received during the day from Cape Race that Cabot Straits and the Gulf of St. Lawrence were clear of ice.

When the fog cleared on the morning of May 23 another search of the southwestern portion of the cold-water area was started. Visibility gradually improved as the day went on, but no ice was located north of the "B" tracks. The 24th and 25th were spent searching for ice in the cold water southwest of the Tail. A growler in 42° 53′ N., 51° 13′ W., was all that could be found, although visibility was good. The 26th was foggy, but on the 27th, 28th, 29th, 30th, and 31st the scouting in the cold water was continued with the idea of covering the ground thoroughly and definitely relocating the southern, western, and eastern limits of the ice.

On May 31 four large bergs were sighted close to the forty-ninth meridian between 42° 55′ N. and 43° 20′ N. One of these was a solid, massive, block of ice 115 feet high and about 400 feet square. Another large berg was seen in 43° 05′ N., 49° 29′ W. At daylight on June 1 visibility was not more than 3 miles, but it gradually increased during the day until shortly after noon it was 20 miles. The same five bergs were again sighted, although in much altered relative position due to varying currents. Dense fog prevailed on June 2 and the patrol vessel drifted.

On the morning of June 3 the fog cleared slowly. A search for ice was started to the southward, but none was seen. At 2.30 p. m. the *Tampa* relieved the *Modoc* in 42° 33′ N., 50° 20′ W.

In general, bergs continued to be unusually numerous north of the forty-fifth parallel. The only field ice heard of was that reported from north of the forty-eighth parallel by vessels on the "F" tracks. The surface water was unseasonably cold in many parts of the heavy ice area between the forty-fifth meridian and Newfoundland. The easternmost berg was reported on the 21st from 46° 50′ N., 40° 31′ W. South of the Tail of the Banks, where the *Modoc* worked most of the time, there was very little ice and the "B" tracks were not menaced.

Very few vessels reported crossing the eastern edge of the Banks between the forty-third and forty-seventh parallels. This is an important area, often called the gateway into the Atlantic for bergs. Water temperature, current, and ice conditions prevailing in it were not well known, but the patrol's duty to remain with the southernmost ice permitted but one excursion into it, and that into its extreme southern part only. Presumably very little ice was between the forty-fifth and forty-third parallels in the area concerned.

Eight oceanographic stations were taken in separated positions south of the forty-third parallel, the salinities of which were obtained at sea by the titration method without difficulty. No gales or even strong breezes were experienced on the fourth patrol cruise. Fog and visibility of less than 1 mile prevailed only 28 per cent of the time, but visibility was less than 4 miles 50 per cent of the time.

THE FIFTH CRUISE, "TAMPA," JUNE 3–18, 1929

Upon relieving the *Modoc* the *Tampa* immediately resumed the search between the Tail of the Banks and the "B" tracks to relocate the southernmost ice. On the 4th three bergs were found between the forty-ninth and fiftieth meridians, the southernmost being a large one in 42° 33′ N., 49° 48′ W. These bergs had been sighted by the *Modoc* on the 1st, when they were located some 40 miles to the northeastward. On the 5th the southernmost berg was left to run search courses westward. Three new bergs west of the fiftieth meridian were found, but as they were no closer to the "B" tracks than the large berg in the position mentioned above, they were left and the latter closely guarded until nearly noon on June 7. From the 4th to the 7th it remained in practically the same location, disintegrating steadily but rather slowly under the influence of 38° to 42° surface water. Very many ice reports were received from all over the patrol area during this time.

The *Tampa* stood to the southeast on the 7th because of the report of a very large berg in 41° 38′ N., 48° 56′ W. All of the 8th and parts of the 7th and 9th were spent searching the vicinity of this southernmost ice when visibility permitted. It could not be found, but a current setting southeast over 48 nautical miles per day was observed near its reported position. This was along the junction of 48° mixed water and 64° Gulf Stream water. The berg was probably carried to the southeast, then east, and finally northeast clear of the "B" tracks in this swift stream, for it was never sighted and it was not reported again after the 7th.

The afternoon of June 9 was spent running northwest toward the ice known to be south of the forty-third parallel. Ten bergs of this group were reported during the day by the *Tyrifjord* from near 42° 40′ N., 49° 10′ W. On the 10th the southernmost of these bergs was reached. It was the one first sighted by the *Modoc* nine days earlier and later watched by the *Tampa* until the 7th. It had remained in practically the same location for six days. The remainder of the 10th, a day of fine visibility, was spent searching to the northwestward. Four additional bergs were located near the Tail of the Banks.

On June 11 the *Tampa* cruised to the eastward near latitude 42° 40′ N. All five bergs sighted on the 10th were cut in by bearings as the vessel steamed along, as visibility remained excellent all morning. Seven additional bergs were sighted also, making a total of 25 known bergs south of 43° 10′ N. At 4.30 p. m. the patrol stopped in haze and rain near a berg in 42° 48′ N., 48° 51′ W. Nothing was seen on the 12th because of dense fog. On the 13th six bergs were sighted along the forty-third parallel between the forty-ninth meridian and the Tail. The 14th was foggy, but late on the morning of the 15th the fog cleared so that search for the southern limits of the ice could be resumed. Observations showed that during the thick weather the *Tampa* had been carried southwest past the Tail at the rate of about 1 knot by the current. One large berg was sighted on the 15th in 42° 17′ N., 49° 23′ W.

No ice was sighted on the 16th or 17th because of dense fog. The *Tampa* drifted on those days near the southernmost known berg waiting for clearing weather and the arrival of the *Modoc*. The bad visibility was widespread over the Labrador Current, cutting down the ice reports to practically nothing on the 17th. On the 18th, which was also foggy over large areas, the two cutters steamed slowly toward each other, sighting several bergs and growlers on the way.

Relief of patrol took place in dense fog at approximately 42° 40′ N., 50° 05′ W., at 5 p. m. on June 18. The weather was so thick that the annual surfboat race between the cutters could not be held until dusk, by which time a sufficient distance had been run to the southwest to get out of the fog area and into an area of good visibility over waters warmed by the Gulf Stream.

The fifth cruise was marked by the large number of bergs between the forty-second and forty-third parallels. They did not cross the westbound "B" tracks, but seemed to spread out east and west just south of the Tail between longitudes 48° 30′ W. and 52° 30′ W., keeping, except for the berg of the 7th reported from 41° 38′ N., well to the north of the warm Gulf Stream water and north of the forty-second parallel. Throughout the cruise occasional reports of ice came in from the few vessels crossing the ocean between the Tail of the Banks and Flemish Cap. This showed that there was still ice in the Labrador Current between 43° N. and 47° N. some of which could be expected to drift below the latitude of the Tail. Bergs were unusually numerous in the much traveled waters north of the forty-seventh parallel, but they were somewhat fewer there than during the previous patrol cruise, and they were on the average distinctly farther to the westward in the ocean.

The fifth cruise saw a general rise of sea temperatures throughout the ice patrol area; 34° water was not reported from anywhere to the patrol during the last 10 days of the period, but, even so, the surface temperatures in most localities averaged from 2° to 4° colder north of the forty-second parallel than on the corresponding dates in 1928. The oceanographic equipment worked excellently throughout the fifth cruise, 10 stations being occupied and computed.

On June 7 because of the number of bergs between 42° N. and 43° N., because of the southward push of cool mixed water down to 41° 30′ N., and because of the berg reported from 41° 38′ N., 48° 56′ W., the patrol recommended that traffic be shifted from tracks "B" to tracks "A" immediately. On June 12 word was received that "A" tracks were being put into effect.

The weather was extremely moderate throughout practically all the fifth cruise, only 6 hours of gales and 10 hours of strong breezes being experienced. At night and on cloudy days the unusually cold surface water caused some comparatively low air temperatures to be noted. The dry bulb on the bridge frequently stood at 38° F., while the ship was cruising in the cold current near the Tail.

Four hundred and thirty-six reports of ice were received and twelve vessels were sent special ice information on request. There were, as usual, a number of reports of drifting buoys and spars. The isotherms on the fifth cruise chart are based on 150 observations of the patrol supplemented by just over 1,000 values sent in by 163 different co-operating vessels.

THE SIXTH CRUISE, "MODOC," JUNE 18–JULY 2

At daylight on June 19 the *Modoc* started searching toward the southeast for a berg reported the day before from 42° 10′ N., 48° 12′ W., but this berg could not be found although search was continued throughout the 20th for it.

The 21st, 22d, and 23d were spent searching northwestward to and past 43° 00′ N., 52° 00′ W. Excellent and at times phenomenal visibility prevailed. On the 23d the *Modoc* sighted 18 bergs to the southwest, west, and northwest of the Tail. When cooperating vessels reported six additional bergs south of the forty-third parallel on the 23d and 24th it was felt that every berg comprising the southern, western, and eastern limits of the ice at the time was located and known, for reporting vessels and the *Modoc* had thoroughly covered the entire critical area.

On the 24th courses were run to the southeast for a berg reported in 42° 00′ N., 50° 00′ W. A small berg 18 miles to the northeast of this position was sighted, but no large berg could be found. During the night the *Modoc* experienced a 2-knot current setting eastward in the warm water. The rapid and varying currents so frequently found along the junction of the Gulf Stream and the Labrador Current probably account for much of the difficulty experienced in trying to find bergs in the southeastern sector, even when the searches are based upon ice reports less than 24 hours old.

The 25th and 26th were devoted to searching in the southeast branch of the cold stream for the southeastern limits of the ice. No bergs were sighted. Due to fog patches that at times interfered with visibility, the search plans had to be frequently altered and occasionally the patrol had to drift until conditions improved. As the 27th was foggy a large part of the day, little could be done other than to retain position against the strong current setting eastward along the temperature wall. Few ice reports were received on the 26th and 27th on account of the fog. The 28th commenced foggy, but northwest breezes cleared the weather over the cool water before noon, permitting a large area along the forty-second parallel between the forty-eighth and fiftieth meridians to be covered before dark. Again no bergs were found.

On the 29th fog patches were once more in evidence and interfered seriously with the search for ice. One berg was sighted at 42° 26′ N., 50° 12′ W. During the afternoon the wind increased to a moderate east-southeast gale, with rain and low visibility. The *Modoc* was stopped just west of the Tail for the night and remained stopped there throughout the 30th due to fog.

On July 1 an attempt was made to examine the area over and just south of the Tail, but fog prevailed over the cold water. The fog still persisting at 3 p. m., the attempt to search the area just south of the Banks was given up and search of the warmer southwestern area was commenced. Considerable cruising was done on the 2d, but no bergs were sighted. The *Modoc* was relieved by the *Tampa* at 42° 55′ N., 52° 19′ W., at 12.30 p. m., on July 3.

During the sixth cruise bergs were reported in considerable numbers from near the Newfoundland coast in the vicinity of St. Johns. They extended farther southwest past Cape Race than on the previous patrol cruise. Bergs were still present in large numbers just north of the Grand Banks, where at least 125 different ones, many of them large, were reported from between the forty-seventh and fifty-second meridians. From along the eastern edge of the Grand Banks there were reported no less than 50 different bergs. Between corresponding dates in 1928 there was but one berg reported and none sighted along the eastern edge and no bergs were south of the Tail.

In the latitude of the Tail, where the *Modoc* cruised and made observations, there were numerous bergs between the forty-eighth and fifty-third meridians. More than three-fourths of the bergs to reach the forty-third parallel during the sixth cruise were curved to the west and northwest around the Tail in an extension of the Labrador Current. A number of bergs drifted south along the fiftieth meridian, however, and into the Gulf Stream influence noted previously to be flowing eastward strongly near the forty-second parallel. These bergs were carried southward to a limit near 42° 00′ N., 48° 00′ W., by tongue-like pushes of cool water that extended well into the Gulf Stream drift.

In the southern sector the *Modoc* saw that disintegration of the bergs went on rather rapidly under the influence of warm sun and warming surface water. The incoming temperature reports showed higher surface temperatures in all of the ice-patrol area than during the preceding cruise period. Besides the normal seasonal warming of the surface waters there was noted considerable encroachment of Gulf Stream water over areas that during the previous cruise were occupied by cool mixed water. As the end of the cruise approached it was apparent that great changes in the distribution of surface temperatures were taking place. Warm water had pushed northeastward to the Tail, a very favorable condition for preventing any more bergs from curving around it and drifting to the west.

Seven oceanographic stations were taken. Accidental breaking of a glass carboy containing all the silver nitrate solution of the patrol prevented the immediate determination of the salinities of the water obtained, so the cases of water samples were taken to the *Tampa* for analysis in the electric salinometer on board that vessel.

Weather was again extremely moderate and seas were generally smooth. There were only four hours of winds of gale force and seven hours of strong breezes. Fog was recorded 23 per cent of the time, and visibility of less than 4 miles 39 per cent of the time.

Three hundred and seventy-two ice reports were received from ship and shore stations. Special ice information was sent on request to 10 vessels. The cruise isotherm chart is based on the observations of the *Modoc*, as supplemented by 829 temperature reports received by radio from 151 cooperating vessels.

THE SEVENTH CRUISE, "TAMPA," JULY 3–18

The region southwest of the Tail having just been well searched by the *Modoc*, the *Tampa* on taking up the ice-patrol duty on July 3 steamed eastward slowly through dense fog to a position from which to search south and east of the Tail as soon as visibility permitted.

The opportunity came the next morning and advantage was taken of the good weather by running under forced draft during all daylight hours on the 4th and 5th. The southeastern limits of water less than 50° F. at the surface were accurately determined, and the southeast sector was carefully searched for ice. Two small bergs and one large one were all that could be found south of the forty-third parallel and east of the fiftieth meridian. The warm water seemed to be crowding north rapidly, and very little water cooler than 60° F. at the surface was left south of the forty-second parallel.

Visibility being good at times on the 6th, the patrol was enabled to search north to the Tail and thence east along the forty-third parallel to the forty-ninth meridian. One berg in 55° water at 42° 24′ N., 49° 51′ W., was the only ice sighted. In view of steadily improving conditions existing in all parts of the patrol area, word was sent the Coast Guard headquarters that the steamship tracks could be safely shifted north from "A" to "B" lanes. The latter tracks began to be used on July 13. This recommendation, as will be seen later, proved premature, but at the time made it seemed thoroughly sound.

The 7th and 8th were days of very extensive dense fog, and the *Tampa* was forced to drift, waiting for good visibility before resuming the search for the southern limits of ice and cold water. No ice was either sighted or reported on the 7th. A few reports came

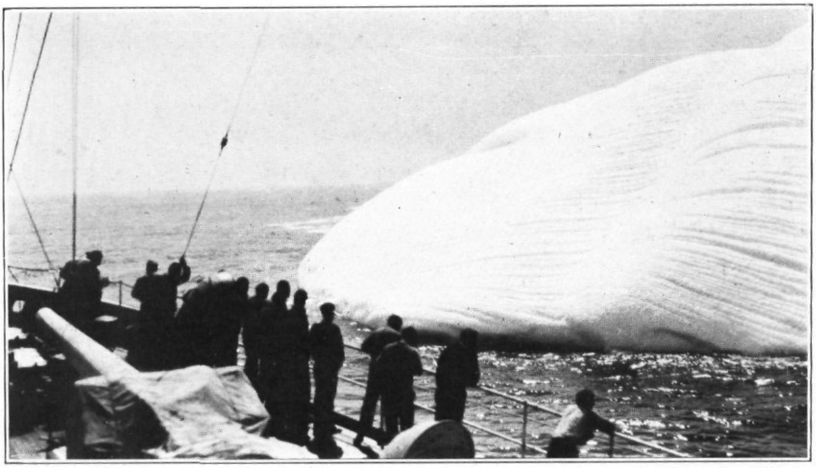


PLATE III.—The *Tampa* passing close to iceberg. In bright sunshiny weather the underwater ledges that project for short distances from some icebergs can usually be seen well enough to be avoided by a vessel moving at low speed

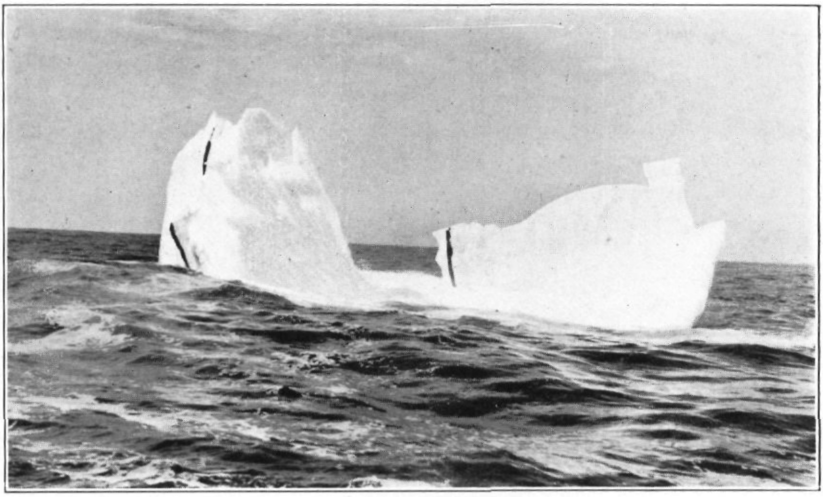


PLATE IV.—An iceberg containing a layer of black dirt-impregnated ice. Taken from height of 18 feet on patrol ship, July 16, 1929, latitude 41° 46′ N., longitude 48° 50′ W.

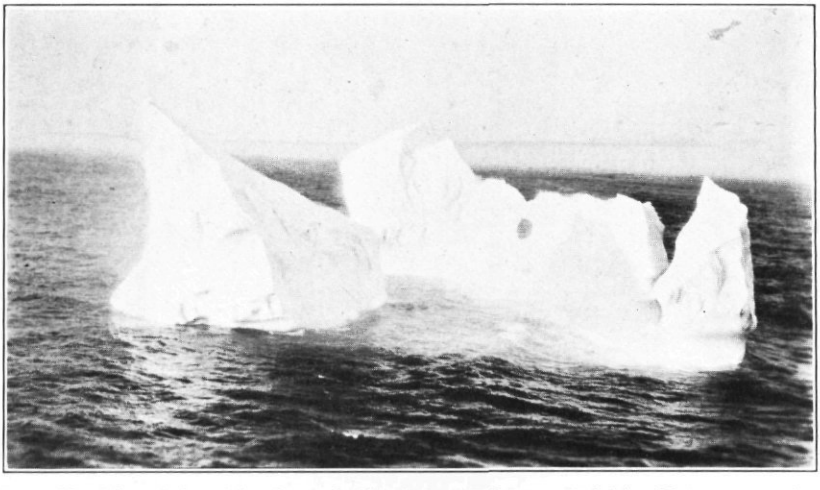


PLATE V.—A large iceberg taken from a height of about 90 feet on patrol ship. Note vapor coming from the melting ice, hole appearing in wall in center, and undercutting about water line of pinnacle at right. July 11, 1929, latitude 41° 34′ N., longitude 49° 00′ W.

in on the 8th from north of the Banks, however, due to breaks in the fog blanket over that region.

The 9th was foggy until 2.30 p. m., when it cleared sufficiently to permit a search north to the forty-fourth parallel. Two bergs were sighted about 40 miles east of the Tail. The next morning while running south to search again in the southeast sector, these bergs were sighted a second time and were found to have drifted southwest at a 1-knot rate. This rather rapid drift was probably due to the fresh to strong northerly breezes which cleared up the weather having temporarily accelerated the flow of the Labrador Current along the eastern edge of the Banks.

Five more bergs were sighted before dark on the 10th. One was a small one in 42° 35′ N., 49° 52′ W. The other four were large ones just south of the forty-second parallel between the forty-ninth and fiftieth meridians. The southeasternmost ones were a pair of high dry-dock type bergs located in 41° 44′ N., 49° 00′ W. These bergs were watched on the 11th and 12th, but intermittent fog and overcast weather prevented the exact determination of their drift. As the bergs were in the narrow band of water between 50° and 56° F. at the surface, they were melting rapidly. From their thin walls vapor was curling in wisps.

On the afternoon of the 11th many tons of finely cracked ice were brought down into the sea from one of these bergs by means of eleven 6-pounder shells fired for experiment into pinnacles and vertical walls. On the 13th the only one of the bergs that remained in sight broke up into a larger and a smaller part. By noon the sights showed that the larger piece was drifting rapidly north away from the "B" tracks. Accordingly, it was left for a more southerly report of ice from 42° 03′ N., 48° 41′ W. This last ice, though less than 20 miles away, was not moving northeast, but was in a south-setting eddy. On the morning of the 14th a small and a large growler, all that remained of it, was in 41° 44′ N., 48° 44′ W. This ice was left before noon for a large berg reported in 41° 34′ N., 48° 11′ W. A small smooth berg found very close to this last position was watched the remainder of the day. It rolled about frequently in melting and gave off vapor continually to the damp air.

On the 15th two bergs reported from farther to the west were approached. They were found in 41° 34′ N., 48° 58′ W. in 56° surface water, and, proving to be large ones, were closely watched throughout the 15th. Their drift was 80° true at the rate of about 1 knot. During the day several steamers passed on the westbound "B" tracks within sight of the patrol and the bergs. Conditions had materially changed for the worse since these tracks were recommended 9 days earlier, the southernmost ice being now practically on the new lanes.

The 16th was spent watching the same two bergs as they continued to move northeastward away from the tracks. By the morning of the 17th they were drifting a little south of east, however, being at 6.30 a. m. near 41° 45′ N., 48° 35′ W. The smaller of the two, marked by a layer of dirty black ice, was by this time much reduced in size and so much cut up by wave action as to be ready to break up into three pieces at any time. At 7.40 a. m. course was set for a large berg with growlers reported from 42° 07′ N., 50° 11′ W. Visibility was excellent, but no unreported ice was sighted on the way. The berg proved to be a very large, solid one over 125 feet high, floating in 58° surface water. From this berg westerly courses were steered to a rendezvous with the *Modoc* in 42° 00′ N., 52° 00′ W., near which position relief of patrol was effected at 1 a. m. on July 18, 1929.

Bergs did not curve around the Tail to the westward during the seventh cruise as they did during earlier ones. The ice, blocked from the southwest sector by a warm tongue, was carried by a push of cold water between the forty-eighth and fiftieth meridians farther south than at any other time during the year. Two or three different bergs were reported as south of 41° 30′ N. and six or eight different bergs drifted below the forty-second parallel. Throughout most of the seventh cruise the *Tampa* guarded these southeastern bergs and watched their disintegration.

There were about 20 bergs reported from along the eastern edge of the Banks and 60 from along the "F" tracks north of the Banks between 47° west and Cape Race. This was an unseasonably large number, but nevertheless it marked a considerable falling off as compared with the sixth cruise. The number of different bergs south of the forty-eighth parallel during the seventh cruise was only about half that during the sixth cruise, while the sixth cruise recorded about half as many as the fifth. It was evident that the ice was melting at higher and higher latitudes and that the arrival of the date when bergs would no longer be a menace to the "B" tracks would only be a matter of a short time.

The salinities of water samples from the seven stations taken on the *Modoc* were determined in the salinometer on the first two days of the *Tampa's* cruise. Nine oceanographic stations were taken on the seventh cruise, usually near bergs after the vessel was through cruising for the day. These salinities were determined also and all the stations were worked out before the *Modoc* was met on July 18. The oceanographic apparatus worked well. It was found that the warmth in the Labrador Current was confined to the surface layers. Even south of the forty-second parallel where the water was 56° to 64° F. at the surface, 37° and 38° water at the 125-meter level was found at all stations. Farther north the cold water was encountered closer to the surface, sometimes at the 25-meter level and sometimes at the 50.

Winds of gale force were entirely absent during the seventh cruise and there were but two hours of strong breezes, the period being marked by fine moderate weather as a rule. On July 9 and 10 air temperatures of 44° and 43° F. were recorded while cruising in the 44° and 43° surface water to the east and northeast of the Tail. Throughout the greater part of the cruise air temperatures were in the 50's and 60's, however. Fog prevailed 29 per cent of the time and visibility of less than 4 miles 34 per cent of the time.

During the seventh cruise 131 ice reports were received from ship and shore stations. Eight vessels were sent special ice information on request. Eighty-four different vessels sent in 670 water temperature reports, which were invaluable for use in supplementing the *Tampa's* own records. The combined observations permitted an excellent idea of the distribution of Gulf Stream and Labrador Current water to be had.

THE EIGHTH CRUISE, "MODOC," JULY 18–AUGUST 1

When the *Modoc* relieved the *Tampa* on July 18 southwest of the Tail courses were laid to the eastward to examine bergs threatening the tracks between the forty-eighth and fiftieth meridians. Before dark, a medium-sized berg was sighted at 42° 28′ N., 50° 05′ W., and a larger berg of at least 500,000 tons mass at 42° 03′ N., 49° 31′ W. The latter was the one sighted by the *Tampa* on the 17th about 10 miles to the westward. The night was spent in 61° surface water near this big berg. During the hours of darkness it must have calved heavily, for it was surrounded by growlers and small pieces when it was left early on the 19th for the southeasternmost ice.

Only one of the two reported southeastern bergs was found by the *Modoc* on the 19th, and on the morning of the 20th a growler was all that remained of the one found. At 2.45 p. m. it was no longer a menace to navigation and was left for a small berg reported in 41° 09′ N., 48° 43′ W., about 60 miles to the southward. Systematic search failed to reveal this southernmost berg of the year. It probably melted quickly in the 56° to 60° surface water of the vicinity, for it was not reported again.

On the 22d, a northwesterly course was run for the British tanker *Vimeira,* of Glasgow. That vessel had struck a berg and become disabled in 42° 40′ N., 49° 44′ W., about 135 miles north of the eastbound "B" tracks, then in effect. She was reached at 5.30 p. m. and boarded. The master stated that while making 11.5 knots on an easterly course at 11.50 p. m. on July 20 his ship ran suddenly out of clear weather with bright moonlight and into a fog bank. Before speed could be reduced or he could be called she struck with her port bow a berg that was in the fog. The berg scraped aft along the port side and bent one of the propeller blades to such an extent that the screw could not be turned over. The stem was bent and the port bow stove in from the forecastle deck to well below the water line. Only the forepeak tank was flooded, however, and the vessel was in no danger, either immediate or prospective. Many tons of ice from the berg had been forced into the forecastle through the openings made between the plates. Fortunately, the watches were being changed when the collision occurred and the bunks inside the portion of the bow that was damaged were unoccupied at the time; therefore, no person was injured.

Before the *Modoc* departed to return to the southernmost ice the master of the *Vimeira* had made arrangements by radio with the steamship *Olna* for a tow to Halifax, Nova Scotia. When the patrol vessel left the scene the berg that had caused the damage was still in sight on the horizon to the southwest.

The *Vimeira* on previous trips this year had crossed the ice-patrol area well to the southward of the Grand Banks to avoid bergs. During this last trip also she received the ice-patrol broadcasts regularly. The broadcast on the evening on which the vessel struck the berg reported a berg as on the 16th in 43° 51′ N., 49° 15′ W., and also reported a large berg as on the 17th in 43° 35′ N., 49° 14′ W., which the message stated, had probably drifted south-southwest. In all probability these two reports were on the same berg. As bergs often drift to the southward along the eastern edge of the Grand Banks at the rate of about 20 miles per day, the probable latitude of the berg on the 20th was 42° 40′ N., and it is likely that the berg struck by the *Vimeira* was the one that was on the 17th in 43° 35′ N., 49° 14′ W. The master doubtless plotted the positions of all the southernmost bergs reported in the broadcast and, noting an apparent clear space on his chart, shaped course through it. Masters should note the date of all ice reports in the broadcasts and give careful consideration to the date as well as the position of reported bergs in shaping course across the ice regions. To be certain of clearing all reported bergs due allowance must be made for their possible drifts.

On the 23d, at 7 a. m., the berg of the 17th and 18th was passed in 42° 10′ N., 49° 30′ W., still in approximately the same location as on the 17th. It had decreased considerably in size since last seen. By 9 a. m. a small berg about 30 feet high in 41° 49′ N., 49° 20′ W., the southernmost known ice, was reached. As search to the southward and westward for more ice proved unsuccessful, the patrol vessel returned to this berg late in the afternoon, finding it diminished to about 15 feet in height. When left on the morning of the 24th it was a small growler not over 3 feet high, the last trace of which must have disappeared early in the afternoon.

The berg of the 17th and 18th, being the southernmost ice remaining, was closely watched from the 24th to the 26th. On the afternoon of the 24th it calved heavily. On the 26th a few growlers were all that remained of the berg and these melted entirely shortly after dark.

The 27th and 28th were spent searching to the north for the new southern limit of the ice. The area between the forty-ninth and fifty-first meridians was covered as far as the forty-third parallel by nightfall on the 28th, but no ice was seen. The 29th, 30th, and 31st, days of dense fog, were spent just off the eastern edge of the Banks in a position to continue search northward up the cold current should good seeing weather return.

August 1 was spent running to the westward toward the *Tampa*. As soon as the warm water west of the 50-fathom curve of the Banks was reached the fog was left behind. The *Tampa* was met at 2 a. m. on August 2 in 43° 00′ N., 51° 30′ W., where the relief of patrol was effected.

Ten stations were taken during the eighth cruise. As there remained no means for determining sea-water salinity on board, the water samples were saved for analysis on the *Tampa*. Sustained winds of gale force and strong breezes were absent during the eighth cruise, which was marked by fine moderate weather. There were some sharp rain squalls, with lightning and wind, over the warm water and much fog over the cool water farther north. Fog was experienced 34 per cent of the time and visibility was less than 4 miles 46 per cent of the time.

During the eighth cruise 67 ice reports were received from ship and shore stations. Seven vessels were sent special ice information on request. Eighty-nine different cooperating vessels sent in 651 sea-water temperature reports. The isotherm chart based on these values and those obtained by the *Modoc* shows continued slow general solar warming of the surface layers. In the vicinity of 41° 00′ N., 49° 00′ W., there was a push of cold water farther south than during the last cruise, but upon the melting of the southernmost bergs the possible supply of ice for this area was cut off.

During the eighth cruise the 1929 ice menace to the Europe-United States "B" tracks definitely appeared to end. After the melting of the four bergs that were south of the forty-second parallel during the first half of the cruise the ice limits retreated steadily northward. As berg after berg of the southernmost ones melted in the summer air and sea temperatures prevailing, they failed to be replaced from the north due to lack of supply in that quarter and to probable weakening and narrowing of the Labrador Current. Persistent fog over the cold water blocked effective searching during much of the latter part of the eighth patrol period, however, and prevented a thorough clearing up of the ice situation or a definite recommendation regarding the discontinuance of the patrol.

THE NINTH CRUISE, "TAMPA," AUGUST 2–4

Upon relieving the patrol on August 2 the *Tampa* instituted a final search for the southernmost ice. By 10 a. m. the southern end of the cold current with surface temperatures between 55° and 58° F. just southeast of the Tail was entered. It was found to be but 20 miles wide, being bounded on the west, south, and east by water 60° and higher in temperature. Good visibility prevailed until the search had been carried north along the eastern edge of the Banks to 43° 30′ N. Here 52° water covered with a low fog was met. At 7 p. m. on the 2d the *Tampa* was stopped for the night in 43° 42′ N., 49° 05′ W.

The *Modoc* had watched all the bergs south of the forty-third parallel break up during the previous cruise, and only two other bergs south of the forty-eighth parallel had been reported since July 22. The more southern of these was in 44° 52′ N., 48° 34′ W., on July 27. When no ice was found in the cold water south of 43° 30′ N. by the patrol it became evident that this berg had either melted or drifted off to the northeast. It seemed a practical certainty that the ice menace for the 1929 season was absolutely over so far as the "B" tracks were concerned, and fairly certain that no more bergs could get south of the forty-third parallel before the spring of 1930. Accordingly, a message summarizing the situation and recommending the discontinuance of patrol was transmitted to headquarters on the evening of August 2.

On the 3d a southwesterly course was run across the Tail. Fine visibility prevailed over the shoal water, which was warmed to from 60° to 64° at the surface, but fog continued over the cold stream off the eastern edge. On the afternoon of the 3d, when information was received that the 1929 international ice patrol was discontinued, a course was laid for Boston, Mass. The last broadcasts of the season were transmitted on the evening of the 3d and on the morning of the 4th. They contained a notice of appreciation for the valuable assistance in the way of reports received from shipping. Port was reached without incident, and the *Tampa* moored at the Boston Navy Yard at noon on August 6, 1929, thus ending the longest ice-patrol season on record.

One oceanographic station was occupied during the ninth cruise. The water from it and from the 10 stations last taken on the *Modoc* was run through the salinometer before noon on the 4th and all stations were computed before Boston was reached. The isotherms on the cruise chart for the short ninth cruise are based on 148 values sent in by 16 different vessels and on 102 readings taken from the log of the *Tampa*. The curves show some continuation of warming in the surface layers. There was only one ice report received; one vessel given special ice information.

During the ninth cruise southwesterly breezes prevailed in the ice-patrol area, making the weather damp and muggy over the 55° to 65° water and persistently foggy over the 50° to 55° water. There were no gales, but the patrol before reaching Boston experienced some strong breezes due to the influence of two disturbances whose centers traveled across the Gulf of St. Lawrence.

RADIO COMMUNICATIONS

The radio apparatus used on the *Tampa* and the *Modoc* during the 1929 ice-patrol season was practically the same as that used by the patrol vessels during the 1927 and 1928 seasons. The main changes on each ship were the substitution of improved receivers for older types. Each ship in 1929 had for transmitting purposes one T–2 2-kilowatt tube transmitter, using either CW or ICW or phone transmission; one T–4 200-watt tube transmitter using either CW or ICW transmission; and one 500-watt XA crystal-control high-frequency transmitter. The latter type of set was very useful for clearing at scheduled times a large volume of direct traffic with NAA, the United States naval radio station near Washington, D. C. The distance between the patrol vessel on duty and that station averaged about 1,350 sea-miles.

The receiving apparatus on each ship consisted of one special high-frequency screen-grid receiver, type CGR–24, and one low-frequency receiver, type CGR–25, also screen grid. These receivers were recently manufactured for the United States Coast Guard and were the most up-to-date instruments in the service, being a big improvement over old types. They gave very satisfactoiy results on ice-patrol work. The 1929 receiving equipment included, in addition, the latest type direction finder or radio compass, which was invaluable for making quick and sure contact with the vessel coming out to relieve the patrol. Each vessel had also one CGR–1 receiver for use on the Coast Guard frequency band.

During the season there were no serious breakdowns of either sending or receiving sets. Free use of the good supply of spare parts and immediate rectification of all small troubles that developed combined to keep all apparatus in the radio department close to perfect operating condition at practically all times.

Normally United States Coast Guard cutters of the *Tampa* class carry four radiomen. While on ice-patrol duty this year, however, each patrol vessel carried in addition one radio electrician. This policy provided the services of an experienced supervisor on each vessel, which proved to be of great benefit, for the year 1929 had not only the longest ice-patrol season to date, but also, from a communications standpoint, by far the most arduous one on record. Due to extreme heaviness of schedule traffic, to the great number of ice reports coming in between schedules, and to the increase in number and activity of vessels cooperating by sending in water temperatures and weather reports, the radio department was far busier in 1929 than ever before.

The figures given below indicate how the communication work of 1929 compared with that of 1928 which was a good average ice year, and, due to increasing cooperation from passing steamers, the former record year for total volume of radio traffic.

	1928	1929
Routine broadcasts transmitted	760	984
(Broadcasts averaged about 300 words each in 1928 and about 400 each in 1929.)		
Water temperature and weather reports sent in by cooperating vessels	6,534	7,225
Total number of cooperating vessels	489	539
Number of ice and obstruction reports received by radio	644	2,255
Total number of words transmitted and received by radio	450,460	807,737

The following tabulation shows the times when the most important special ice-patrol traffic schedules were kept. The times given, which are all in Greenwich mean civil times, will doubtless be used during the 1930 season also, though there may be some slight changes necessary to make them fit in with prevailing traffic conditions at the various shore stations.

Time	Remarks
0000.	Radiobroadcast to shipping on 175 kilocycles.
0030.	To Hydrographic Office, Washington, giving latest ice news, followed by report to Weather Bureau, Washington, giving meteorological information.
0100.	Schedule with naval radio station at Bar Harbor, Me.
0230.	Receive from NAA, near Washington, D. C., traffic on hand for ice patrol.
1100.	Radiobroadcast to shipping on 425 kilocycles.
1148.	Report to Weather Bureau, Washington, giving meteorological information.
1200.	Radiobroadcast to shipping on 175 kilocycles.
1300.	Schedule with naval radio station at Bar Harbor, Me.
2300.	Radiobroadcast to shipping on 425 kilocycles.

SUMMARY REPORT OF THE COMMANDER, INTERNATIONAL ICE PATROL

Commander Thomas M. Molloy

The *Tampa* left Boston, Mass., on April 1, to inaugurate the 1929 ice patrol. The *Tampa* and the *Modoc* each spent four full 15-day periods in the ice regions during the season. The patrol was discontinued at word received from Coast Guard Headquarters on August 3, when the *Tampa* was on the second day of the ninth patrol period. Halifax, Nova Scotia, was used as a base for fuel and supplies, as in previous years. During the season the two patrol vessels cruised a total of 23,249 nautical miles, which figure includes the distance run while going to and from the base.

The weather, as is usually the case, was raw and boisterous the first patrol cruise, but it steadily improved as the season progressed, so that during the last half of May and all of June there were but nine hours of gales. During the last month of the patrol season unusually moderate conditions prevailed, there being no gales whatever. The normal large amount of Grand Banks fog was experienced. The full season was about equally divided in point of time by foggy, clear, and overcast weather conditions.

Sixty-nine oceanographic stations were occupied during the season from time to time as opportunity offered. The salinities of the water samples were all determined on board ship and the dynamic computations were all worked out before the end of the active season. If the work of ice scouting and trailing had permitted the station work would have been more extensive and systematic. As it was, unprecedentedly heavy ice conditions required the patrol to concentrate on the practical work of watching the southernmost ice and on the service of information rather than on a comprehensive oceanographical program. Frequent soundings were taken with the fathometers, the results being tabulated for future correction and hydrographic use whenever the ship's position was well fixed by observations.

Ice was rather late in appearing in the Atlantic off the Grand Banks in 1929, and April 1, when the first vessel departed on patrol, marked a later starting of the active season than in any year since 1920, when the first vessel left New York on April 3. Because of the heaviness and persistence of the ice once it began to come down, however, the season proved an extremely long one, lasting 128 days. Word to discontinue the 1929 patrol was not received until August 3, a full

20 days later than the same word was received in 1925. Until this season 1925 had been the record year for late continuance of patrol.

Very early in the season it became evident to the patrol that the ice year was an unusual one. On the first cruise, April 1 to 19, numerous bergs were sighted and reported off the eastern edge of the Grand Banks between the forty-fifth and forty-second parallels as was to be expected, but north of 45° reports showed that ice conditions were extremely bad. One vessel that tried to use the Cape Race tracks westbound early in April was forced to skirt the edge of field ice and bergs southward for 250 miles near the forty-eighth meridian. She reported from the northern sectors "solid packed bergs and growlers extending as far as can be seen to the north, west, south, and southeast."

In view of the extremely heavy field ice and berg conditions prevailing between the forty-seventh and fiftieth meridians, the shifting north of the Canadian routes from "D" to "E" on the regular date, April 10, seemed very inadvisable to the patrol. Conditions were so bad along the "E" tracks when they were put into effect that many vessels for weeks did not try to force passage on them, but detoured to the south 80 to 100 miles so as to pass around the southern end of the field ice of the Labrador Current.

From April 20 to June 1 the field ice retreated until it was all north of the forty-ninth parallel and no longer being reported to the patrol. The bergs, however, remained in enormous numbers. They did not gain any extreme southerly positions, as nearly all of them that reached the forty-third parallel were curved to the westward around the Tail of the Banks. During June the bergs south of latitude 48° N., though still above normal in numbers, began to thin out. It is impossible to give exact figures of the numbers of bergs in any year because of great duplication of reports from near the Canadian tracks and of scarcity of reports of ice from other areas. Taking all known factors into consideration, however, it is always possible to make very fair estimates. In 1929 it is estimated that there were 460 different bergs south of the forty-eighth parallel during May and 376 different bergs during June. When it is realized that 386 bergs constitute the average number to drift south of the forth-eighth parallel during the whole of a normal ice year the severity of the 1929 season from an ice standpoint is at once apparent.

Throughout the season it was noted that the surface water was 2° or more colder than average for the date in most of the ice-patrol area north of the forty-second parallel. The amount of water just in the wave-mixed surface layers of the area concerned is so great that it is hardly conceivable that even the large number of icebergs which drifted south of the forty-eighth parallel chilled the water measurably in melting. The probabilities are that the reason for much ice and colder water than usual in the northern half of the ice-patrol area must be searched for in some combination of causes operating to produce an unusual outpouring from the far north. The discharged waters were probably only incidentally studded with icebergs in the Grand Banks region, where, conserved by the cold water and protected against attrition by strength of numbers, they persisted to a very late date and, as mentioned above, kept the patrol in effect longer than ever before.

During June the southern part of the Labrador Current, instead of flowing westward around the Tail, as it did earlier, was split into two main branches. One of these continued to flow westward around the Tail and carried large icebergs to 43° 00′ N., 53° 00′ W., but the other branch flowed strongly southeast to 40° 00′ N., 47° 00′ W. During July the western branch noted above was wiped out and practically all the ice that got below the Tail was taken charge of by the southeast flowing stream. At least eight different bergs were carried in the latter circulation south of the forty-second parallel and close to the westbound "B" tracks during the month. The last of these bergs melted to nothing under the eyes of the patrol on July 22, and on the 26th of July the last ice south of the forty-third parallel was also observed to melt. By the latter date bergs were very sparse south of the forty-eighth parallel on account of their melting in higher and higher latitudes due to the advancing summer conditions and also to the probable shrinking and weakening of the Labrador Current.

All the bergs that were watched during the latter part of the season broke up rapidly. To illustrate the rate at which bergs can melt in warm water the case of a large berg of at least 500,000 tons mass can be given. It was first seen near 42° 00′ N., 49° 00′ W., in 61° water on July 17. In just nine days the last traces of it were closely watched as they disappeared. Such rapid disintegration is not caused by melting alone, but is greatly speeded up by frequent calving, sluffing, and division.

By the evening of August 2 it was decided that the ice menace for the "B" tracks was definitely over, and recommendation for the discontinuance of the patrol was sent to Coast Guard headquarters. This recommendation could probably have been made four or five days earlier if the ice patrol's worst enemy—fog—had not effectively and continuously blanketed nearly all the critical cold-water regions during the last week of the patrol. Permission to discontinue the patrol was received on the afternoon of August 3 and the *Tampa* reached Boston, Mass., just before noon on August 6.

It should be kept in mind that radio communication is the one thing that is of utmost value to the patrol. Without radio practically no late information could be given out and comparatively little could be gathered. In spite of the great volume of traffic caused by the unusually long and heavy ice season, the radio apparatus and personnel stood up excellently. Every effort is made before the season starts to see that all radio equipment is ready for the strain that will come upon it and to have the latest improvements for the sets installed. The magnitude and importance of the communication work of the patrol can be grasped in part by a study of the figures relating to volume of traffic shown on page 26 of this pamphlet.

On the night of July 20 the British tanker *Vimiera* struck a berg at 42° 40′ N., 49° 44′ W., some 70 miles north of the westbound "B" tracks, which were then in effect for passenger vessels. She was badly stove in forward and her propeller was totally disabled by the bending aft of one of its blades as the ship scraped by the berg. Fortunately, there was no loss of life or even injury to anyone. Her case should serve as a warning to the masters of other vessels to proceed cautiously when in the ice regions during all times of low visibility. Recent comparative freedom from disaster seems to be causing a growing carelessness, for the patrol noted in 1929 no less than 100 cases of failure on the part of passenger vessels to adhere to the tracks prescribed by the trans-Atlantic track agreement. Every ship that crosses the iceberg area at a speed greater that that at which she can either turn or stop before striking a berg seen ahead under the conditions of visibility prevailing is playing a game of chance.

Thanks particularly to improved radio and to more effective cooperation from shipmasters, much progress has been made during the past 14 years, and it is believed that a more efficient patrol can be maintained now than then, but it must not be thought for an instant that the ice patrol is infallible or that it is all-seeing. Broadcasts listing the positions of all the southernmost ice of which the patrol has knowledge are regularly sent out, but shipmasters must always realize that ice can move rapidly and seemingly erratically when it is off the eastern edge of the Grand Banks and still faster and more incomprehensibly when it is south of latitude 43° N. The dates given with all berg positions in the broadcasts show the freshness of the several reports. Possible drifts since time of report must be considered by shipmasters most carefully.

In view of the increasing speed and importance of trans-Atlantic travel, this summary of the 1929 ice-patrol season can not end better than by sounding a final warning by means of the words with which Capt. F. A. Levis, of the *Seneca,* closed his summary of the 1915 ice-patrol season. These words are as true now as they ever were and they will in all probability always remain true. Captain Levis said: "*Of course there is always a chance that a berg will reach the steamer tracks without being seen or reported, on account of prolonged periods of fog,* but the presence of the ice-patrol vessels near the danger zone assures passing vessels that assistance is near by in case of disaster."

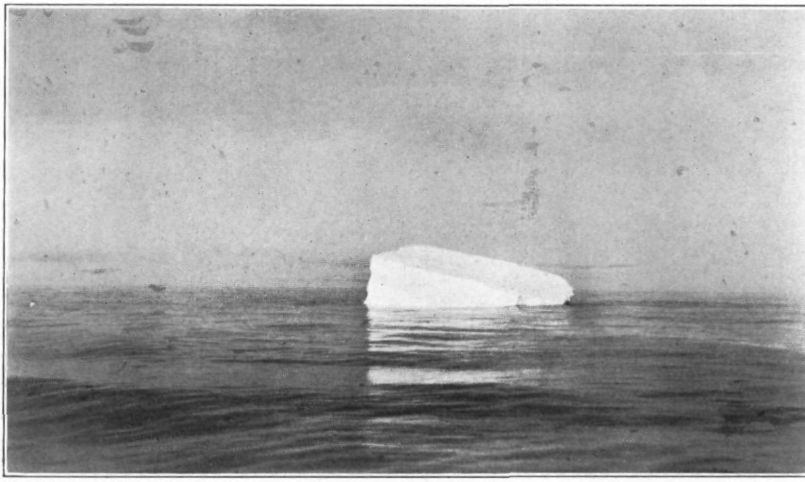


PLATE VI.—A tabular iceberg such as is frequently seen north of the forty-third parallel. This sort of berg is usually very stable

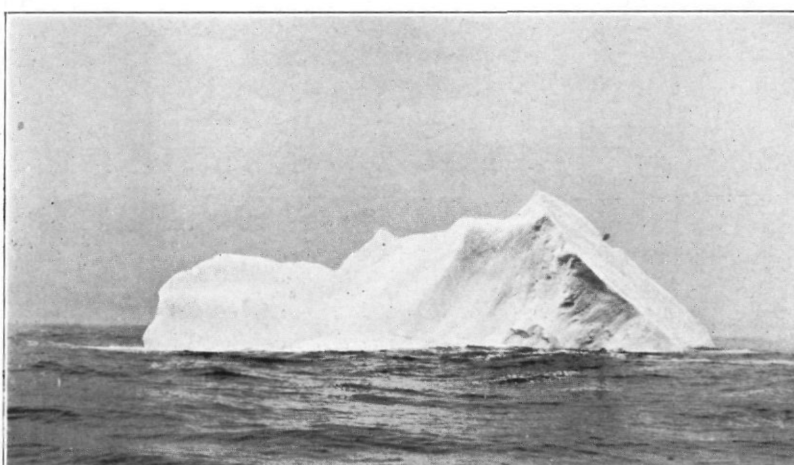


PLATE VII.—A tabular iceberg nearing its end as such. The flat surface which was formerly the top is being slowly submerged, and the wave-cut terrace at the left is being slowly elevated due to the particular manner in which the underwater body is melting

PLATE VIII.—A Greene-Bigelow water bottle clamped to the sounding wire. Seven such metal bottles are clamped on at different points and lowered into the sea at each oceanographic station. The upper bottle is tripped when a messenger is slid down the wire. In tripping, a messenger is released from the bottom of the bottle to slide down to the next one in the series, and so on

PLATE IX.—Reading the reversing thermometers in a Greene-Bigelow water bottle that has been tripped on the wire at a known depth and then hoisted up and taken aboard. The cylinder fitted with two pet cocks contains over a quart of sea water from the level at which the bottle was tripped

TABLE OF ICE AND OTHER OBSTRUCTIONS, 1929

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Jan. 11	1	Cape Race Station	50 38	45 36	Berg.
24	2	do	45 28 to 45 23	59 18 to 58 08	Field ice.
25	3	do	45 00 to 45 10	59 15 to 58 20	Scattered field ice.
26	4	do	45 06 to 44 58	58 27 to 59 22	Loose field ice.
26	5	do	44 24	61 20	Slob ice.
28	6	do	45 09	59 26	Field ice in band 4 miles wide stretching north and south.
Feb. 1	7	do	45 30 to 44 45	59 10 to 60 20	Field ice covering large area.
2	8	do	44 56	60 20	Field ice.
6	9	do	44 40 to 44 45	60 37 to 59 35	Pancake ice.
14	10	do	48 11	49 50	Sludge ice.
14	11	do	44 45	59 50	Field ice.
17	12	do	47 45	51 05	Growlers extending northward.
17	13	do	44 41 to 44 39	59 49 to 60 06	Heavy field ice.
18	14	do	47 45 to 47 45	52 30 to 51 30	Light open field ice.
20	15	do	47 16 to 47 35	51 57 to 51 20	Open field ice.
20	16	do	47 35 to 47 58	51 20 to 50 43	Sludge ice.
25	17	do	47 00	52 30	Slush ice.
26	18	do	47 25 to 47 52	51 30 to 50 45	Heavy field ice.
26	19	do	48 30	49 30	Field ice.
27	20	do	46 45	51 10	Heavy field ice.
27	21	Drottningholm	47 01 to 47 07	50 01 to 49 01	Heavy patches field ice and numerous growlers.
27	22	Arnold Maersk	48 08 to 46 50	48 50 to 51 20	Heavy to light field ice.
28	23	Cape Race Station	47 02 to 46 25	47 50 to 47 40	Drift ice and growler.
Mar. 1	24	Gripsholm	45 53	47 54	Scattered growlers.
5	25	Vela	48 00	51 35	Close field ice.
10	26	Wytheville	47 14	47 34	Small growlers.
10	27	do	47 09	47 54	Large growler.
11	28	Cape Race Station	48 48 to 48 25	48 18 to 48 20	Large growlers and small pieces of ice.
11	29	do	48 25	48 20	Small berg and growlers.
11	30	do	48 04	48 12	Small berg, large growlers.
11	31	do	46 59	47 56	Small growler.
11	32	do	47 04	48 33	Small berg.
11	33	do	47 20	47 30	2 large growlers.
11	34	do	47 25	47 20	Small growler.
14	35	do	47 54 to 47 25	47 02 to 47 21	Heavy field ice, numerous growlers.
1	36	do	49 03	50 04	Heavy field ice and growlers.
2	37	do	44 35	48 34	Several growlers.
3	38	do	45 45	47 46	Several small growlers.
5	39	do	45 30	48 10	Scattered growlers.
5	40	do	47 10	49 30	Very heavy field ice.
6	41	do	45 41 to 46 10	48 46 to 47 50	Several growlers, small ice.
7	42	do	48 43	50 00	Large growlers and small ice.
8	43	do	48 43 to 47 20	50 00 to 51 40	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Mar. 10	44	Cape Race Station	47 13	48 36	Small growlers.
10	45	do	47 09	47 54	Large growler.
11	46	do	48 04	48 33	Small berg.
14	47	do	47 54 to 47 25	47 02 to 47 21	Heavy field ice, numerous growlers.
15	48	do	46 46 to 46 44	50 27 to 51 15	Heavy field ice.
16	49	Ernst Hugo Stinnes II	47 43	44 53	4 bergs with drift ice.
17	50	Lituania	48 25 to 46 39	49 51 to 52 52	Several small bergs, numerous growlers, field ice.
17	51	do	45 18	58 09	Loose field ice.
17	52	Cape Race Station	48 44 to 48 05	48 55 to 50 40	Heavy field ice, numerous growlers, and bergs.
17	53	do	46 16 to 46 10	47 38 to 48 10	Field of ice consisting of numerous growlers surrounded by heavy packed ice.
17	54	do	46 10	48 12	Low berg.
22	55	do	48 04	48 11	Small berg.
22	56	do	48 57	48 16	Small bergs.
22	57	do	48 01	48 18	Do.
22	58	do	48 02	48 21	Large growlers.
22	59	do	48 03	48 27	Small berg.
22	60	do	48 04	48 25	Small berg, open drift ice, growlers.
23	61	do	48 04 to 47 45	48 11 to 48 38	Belts of drift ice with bergs and growlers.
23	62	do	48 06	47 20	Small berg.
23	63	do	46 30	47 04	Growlers and small pieces of ice to the northwest.
23	63a	do	46 08	48 20	Small berg.
23	64	do	46 30	47 04	Growlers and small ice to northwest.
28	65	do	46 15	46 18	Large berg, small ice.
28	66	do	45 45 to 45 16	47 07 to 48 20	Several bergs, belts of field ice.
28	67	do	45 15	48 30	2 bergs.
28	68	do	46 10 to 45 30	46 30 to 47 20	Large ice field, high bergs.
28	69	do	46 15	46 18	Berg, same as 65.
28	70	do	44 54 to 44 48	58 15 to 57 20	Heavy field ice to northward.
23	71	Estonia	48 04 to 47 45	48 11 to 48 38	Belts of drift ice, small bergs, and growlers.
29	72	Cape Race Station	46 10	46 08	Berg, same as 65.
30	73	do	46 55	46 14	Heavy field ice, growlers, and bergs.
30	74	do	46 39	46 39	Berg.
30	75	do	46 30	47 27	Do.
30	76	do	46 00	47 20	Do.
30	77	do	44 40 to 44 30	48 53 to 49 15	Heavy drift ice, growlers, and 2 bergs.
31	78	do	44 30	49 00	Soft field ice with some large pieces.
31	79	do	44 46	58 18	Large patches field ice to north and northeast.
Apr. 1	80	do	46 05 to 45 08	48 18 to 48 30	Heavy field ice, numerous bergs.
1	81	do	46 04 to 47 00	50 36 to 48 45	Do.
1	82	do	43 22	49 07	Several growlers.
2	83	do	43 19	49 05	Large growlers, small bergs, small pieces.
2	84	do	43 38	48 50	Several small growlers.
2	85	do	43 10	49 00	2 small bergs, broken ice, growlers.
2	86	do	47 00 to 47 23	48 45 to 47 43	Large fields drift ice, scattered growlers, several bergs.
3	87	Hellig Olaf	45 57	47 58	Small berg and several pieces of ice.
3	88	Eastern Dawn	42 59	49 21	Large berg, several growlers.
3	89	do	43 06	49 00	Berg.
3	90	Cape Race Station	40 09	48 15	Large piece wreckage.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Apr. 3	91	Cape Race Station	43 58 to 43 54	48 51 to 49 31	Numerous growlers and small ice.
3	92	do	44 59	49 21	Large berg, several growlers.
3	93	do	48 30	49 40	Heavy packed field ice, several bergs, numerous growlers.
3	94	do	47 38	48 40	4 large bergs.
3	95	Hellig Olaf	43 34	48 56	Large berg.
3	96	do	43 26	49 09	2 large bergs, many growlers, much drift ice.
4	97	American Merchant	42 49	49 22	Large growler with 4 small ones.
4	98	do	42 43	50 31	Growler, several more 3 miles north-northwest.
4	99	do	42 49 to 42 46	49 22 to 49 44	5 small growlers.
4	100	Ilsenstein	49-30	49 40	Solid packed bergs and growlers extending north, west, south, and southeast.
4	101	do	49 30 to 47 38 to 45 20	49 40 to 47 30 to 47 50	Field ice, numerous growlers, and about 40 large bergs.
4	102	do	45 20 to 44 54	47 50 to 48 29	Field ice and growlers.
5	103	MacFarlane	44 40	48 11	3 large, 1 small berg.
5	104	do	44 18	48 32	2 bergs.
5	105	do	44 43	48 47	Do.
5	106	do	44 14	48 44	Large berg.
5	107	Peoria	45 14	48 00	Small berg, several growlers.
5	108	do	45 09	48 30	Heavy field ice, growlers, 2 bergs.
5	109	Kerhonkson	44 03 to 43 49	48 10 to 48 36	1 berg, numerous growlers.
5	110	Cairnmona	44 33	48 17	2 large bergs.
5	111	do	44 32	48 23	Berg and growlers.
5	112	do	44 33	48 26	Do.
5	113	do	44 03 to 43 47	48 29 to 49 15	Several bergs and growlers.
6	114	New York City	43 58	49 16	Large berg.
6	115	Manchester Corporation	43 05	49 25	Small berg.
6	116	do	42 58	49 21	Growler and small pieces.
6	117	do	43 00	49 06	Very large berg.
6	118	Santa Inez	44 25	47 45	Small berg.
6	119	do	44 13	48 00	Several growlers.
6	120	do	44 08	48 06	Berg.
6	121	do	43 55	48 18	Very large berg, several more bergs to northward.
6	122	New York City	43 47	48 48	Large berg.
6	123	do	43 42	49 10	Small berg.
6	124	Ice patrol	43 00	49 15	Berg, same as 115.
6	125	do	43 05	49 25	Small berg and growler.
6	126	do	42 54	49 19	Growler.
6	127	do	42 44	49 39	Growler and small pieces.
6	128	Melmore Head	44 00	48 10	2 large bergs, same as 121.
6	129	do	43 45	48 20	Berg, same as 121.
6	130	do	43 42	48 30	Berg and growlers.
6	131	do	43 38	49 38	Berg.
6	132	do	43 46	49 00	Do.
6	133	Pere Pierre	43 12 to 44 35	48 10 to 48 00	15 bergs.
7	134	Topdalsfjord	44 58	48 50	Berg.
7	135	do	45 10	48 08	Berg and growlers.
7	136	do	45 16	48 05	Small berg.
7	137	Ice patrol	42 56	49 10	Berg, same as 124.
7	138	do	43 33	48 39	Berg, same as 131.
7	139	do	43 41	48 27	Berg, same as 130.
7	140	Topdalsfjord	45 12 to 45 20	47 53 to 47 10	Several growlers and small pieces.
7	141	Dutchess of York	42 46	49 20	2 growlers and several pieces of ice.
8	142	Canadian Inventor	44 12	47 42	Small berg, same as 118.
8	143	do	44 14	48 06	Large berg.
8	144	do	44 12	48 15	2 large bergs, same as 80.
8	145	Ice patrol	42 38	49 29	Berg with growlers to northward.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north ° ′	Position: Longitude west ° ′	Nature of ice or obstruction
Apr. 8	146	Ice patrol	42 50	49 07	Large growler.
8	147	Emanuele Ackame	46 00	45 57	Small berg.
8	148	do	46 02	45 59	Large berg and growlers.
8	149	Consul Corfitzon	44 03	46 02	Growler.
8	150	do	44 05	46 15	Small berg.
8	151	do	43 59	46 18	Berg.
8	152	Emanuele Ackame	45 48	47 00	Berg and growlers.
9	153	City of Fairbury	42 43	49 30	Small berg, same as 145.
9	154	Athenia	43 13	49 07	Small berg.
9	155	Carmia	43 17	49 16	Berg.
9	156	Cameronia	42 25	49 34	Small berg.
9	157	Commercial Trader	42 30	49 29	Do.
9	158	do	42 23	49 29	Small berg, same as 156.
9	159	Sparreholm	43 49	46 18	Small berg, same as 150.
9	160	De Grasse	42 22	49 32	Growler, same as 158.
9	161	London Merchant	42 37	49 11	Berg and growler.
9	162	Commercial Trader	42 41	49 02	Large berg and 5 growlers.
9	163	Grey County	44 18	46 40	Berg.
9	164	Kolsnaren	46 00	45 30	3 large growlers.
9	165	Athenia	43 26	48 06	2 bergs, same as 133.
9	166	do	43 32	47 44	Berg.
10	167	Hada County	43 53	48 40	Do.
10	168	Grey County	42 52	49 52	Very large berg.
10	169	United States	42 20	49 43	Small berg.
10	170	Newfoundland	45 56	45 58	Medium-sized berg, same as 147.
7	171	Arlington Station	44 20	59 56	Broken mast projecting 7 feet.
10	172	Canadian Hunter	43 33	48 11	Small berg large growler.
10	173	Newfoundland	45 51	46 10	Medium berg and growler.
10	174	do	45 43	46 18	Large berg, growlers to north.
10	175	do	45 40	46 34	Large berg.
10	176	do	45 38	46 38	Do.
10	177	do	45 31	46 54	Do.
11	178	do	45 09 to 45 09	47 45 to 47 52	4 large bergs.
11	179	do	45 09	48 16	Large berg.
11	180	do	44 53	48 38	Field ice, numerous bergs and growlers for 33 miles to the north-northeast.
11	181	do	44 33	48 45	Growlers and field ice to northward.
11	182	Ice patrol	42 13	49 33	Small berg.
11	183	Caledonia	42 33	49 04	Large berg.
11	184	Oscar II	43 55	48 30	Do.
11	185	do	44 12	48 35	Do.
11	186	do	44 12	49 02	Do.
12	187	Scythia	44 16	48 49	Berg.
12	188	do	44 14	48 46	Field ice and growler.
12	189	Cape Race Station	42 37	48 34	French fishing vessel Sylvana abandoned on fire.
12	190	Malmen	42 20	49 16	Small berg.
12	191	Gripsholm	45 10	46 17	Large berg.
12	192	do	44 55	46 17	Berg 160 feet high.
12	193	do	44 52	46 28	Berg.
12	194	Whale	43 25	48 13	Berg, same as 172.
12	195	Ice patrol	42 34	48 52	Berg.
12	196	Whale	43 43	48 00	2 small bergs.
12	197	Gripsholm	44 40	47 10	Berg.
12	198	Bloomserdyk	40 32	49 42	Large tree, dangerous to navigation.
12	199	Gripsholm	43 45	48 11	Berg.
12	200	do	44 25 to 44 12	47 48 to 48 20	Numerous growlers.
12	201	Nova Scotia	44 05 to 44 15	48 45 to 48 18	3 bergs, 1 growler.
13	202	Ice patrol	42 32	48 38	Berg, same as 195.
13	203	Airthria	45 10	46 50	Berg.
13	204	do	44 51	47 30	3 bergs.
13	205	do	45 13 to 44 30	46 50 to 48 06	Numerous growlers.
13	206	do	44 21	48 22	2 bergs.
13	207	do	44 30	48 29	Berg.
12	208	Malmen	42 37	48 19	French fishing vessel Sylvana badly burnt and abandoned in sinking condition.
14	209	Kiel	44 29	45 57	Berg 100 meters high and 400 meters long.
14	210	Ice patrol	43 10	49 45	Small patches of sludge ice.
14	211	Canadian Planter	45 47	48 33	Bergs.
14	212	do	45 50	48 28	Berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Apr. 14	213	Canadian Planter	46 00 to 46 05	48 48 to 48 20	5 bergs.
14	214	do	45 53	48 20	Large berg.
14	215	do	45 55 to 46 15	48 20 to 47 37	Light scattered field ice on Track "E" becoming closely packed and heavy to southward.
14	216	do	46 15	47 35	Loose scattered ice north and south of Track "E," heavy field ice along edge of Banks.
15	217	Ice patrol	42 16	51 03	Berg with growler 5 miles to southeast.
15	218	do	42 08	50 52	Growler.
16	219	Beaver Hill	43 16	46 26	Large berg.
16	220	Kearny	43 47	45 45	Berg.
16	221	Passat	43 17	45 27	Large berg.
17	222	Quaker City	43 38	48 47	Do.
17	223	Hellig Olaf	42 53	46 05	Do.
17	224	Seattle Spirit	42 08	51 00	Berg, same as 217.
17	225	Boschdyk	42 04	51 00	Do.
17	226	Hellig Olaf	43 25	45 33	Large berg.
17	227	do	43 30	45 35	2 bergs, 1 growler.
17	228	do	43 30	45 10	Berg.
17	229	Stavangerfjord	44 23	44 06	Small berg and growlers.
18	230	Antonia	45 49 to 45 54	48 55 to 48 37	4 bergs.
18	231	do	45 58	48 33	Extensive field of ice.
18	232	do	45 54 to 46 08	48 31 to 48 28	Pack ice extending as far north and south as could be seen.
18	233	Frederick VIII	42 58	44 47	Berg.
18	234	do	42 58	45 35	Berg and growler.
18	235	California	43 02	45 01	Growler.
18	236	Frederick VIII	42 41	45 11	2 small bergs.
18	237	Antonia	45 23	48 34	Edge of field ice extending north and south.
18	238	Winona County	43 04	43 49	Large berg.
18	239	Cedric	46 28	48 23	Field ice.
19	240	do	46 35	48 26	3 large bergs, also much field ice.
19	241	Pennland	46 44	48 12	Field ice all around.
19	242	do	46 34 to 46 45	47 55 to 48 10	Some small ice, not dangerous.
19	243	Antonia	45 33	49 11	Field ice.
19	244	Cedric	46 09	49 08	4 bergs, many growlers.
19	245	Caronia	45 40	47 53	3 bergs.
19	246	do	45 15	48 06	Much field ice to northwest and southwest.
19	247	Antonia	45 24	28 55	Many bergs, field ice to the south and east.
19	248	Salacia	47 49	48 15	Isolated pieces of field ice.
19	249	Pennland	46 44	48 30	Heavy drift ice.
19	250	do	46 18	49 58	Several large bergs.
19	251	do	46 50 to 46 50	48 24 to 48 36	Very heavy pack ice, numerous growlers, several bergs.
19	252	do	46 50	48 24	Large patches light field ice to east.
19	253	Antonia	45 18	48 57	Western edge of ice pack.
19	254	Egham	46 41 to 46 36	48 00 to 48 17	Field ice with bergs and growlers.
19	255	Montcalm	46 30	49 00	Field ice.
19	256	Caronia	44 45	48 32	Southern end of field ice.
19	257	Egham	46 00	49 18	Large bergs—3 to north, 1 to west.
19	258	Cape Race Station	43 40	51 15	French sailing vessel Eskualduna abandoned in sinking condition.
19	259	do	46 35 to 45 58	48 26 to 49 27	4 bergs, numerous growlers.
19	260	Salacia	47 54	49 19	Field ice and several bergs to north and south.
20	261	West Arrow	44 38	47 17	Small berg.
19	262	Amasiddei	42 11	43 51	Log 1 foot diameter, 16 feet long with bolts.
20	263	West Arrow	43 44	49 14	Small field ice.
20	264	Antonia	44 42	48 23	Berg.
20	265	do	44 34	48 18	Large berg.
20	266	do	44 39	48 23	Several growlers.
20	267	do	44 46	48 10	Large berg.
20	268	do	44 33	48 10	Do.
20	269	Tyrifjord	44 42	48 38	Several bergs and growlers.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Apr. 20	270	Tyrifjord	45 32 to 45 03	49 11 to 49 18	Field ice with growlers.
20	271	do	45 03 to 44 46	49 18 to 49 04	Do.
20	272	Canadian Aviator	43 30	48 50	Small berg.
20	273	do	43 31	48 45	String of open field ice ½ mile wide.
20	274	Montcalm	46 18	49 45	Berg, same as 250.
21	275	Antonia	45 29	45 17	Small berg.
21	276	Melita	44 15	48 40	2 growlers.
21	277	Surichco	42 34	50 36	Large berg.
21	278	Stockwell	45 20	48 55	Field ice.
21	279	Melita	44 27	48 17	Small berg.
21	280	do	44 27	47 52	Large berg.
21	281	Stockwell	44 44	48 44	Do.
21	282	Cornerbrook	47 45 to 47 03	49 13 to 52 10	Field ice, heavy at times; numerous growlers and bergs.
21	283	Stockwell	44 44	48 03	2 bergs.
21	284	Bannack	44 39	48 46	Large berg.
21	285	do	44 24	48 31	Low-lying berg.
21	286	Montrose	43 23	48 46	Flat berg with growlers.
22	287	do	43 33	47 31	Large growler.
22	288	Ice patrol	43 03	50 37	Berg.
22	289	do	43 00 to 42 47	50 36 to 50 33	5 bergs; dozens of growlers.
22	290	Estonia	47 10	48 15	Open drifting pack with growlers.
22	291	do	47 10	48 30	Large berg.
22	292	do	47 03	48 35	Large berg 250 feet high.
22	293	do	46 53	48 43	Large berg.
22	294	Ice patrol	42 41	50 41	Berg.
22	295	Estonia	46 41	49 10	Large berg.
22	296	do	46 35	49 23	Do.
22	297	do	46 35	49 41	Small berg.
22	298	do	46 29	49 46	Do.
22	299	do	46 24	49 42	Large berg surrounded by growlers.
22	300	Melmore Head	43 08	51 10	Large berg.
22	301	do	43 08 to 43 08	51 38 to 51 10	Pieces drift ice and growlers.
24	302	Dutchess of York	47 19 to 46 25	47 33 to 48 41	Many dangerous growlers and scattered pieces.
24	303	Montclare	46 20 to 46 14	48 34 to 48 45	Field ice, low bergs, and growlers stretching to south-southwest.
24	304	do	46 27	48 17	Field ice.
24	305	do	46 07	49 20	Growlers.
24	306	Ice patrol	42 53 to 42 51	50 56 to 50 23	3 bergs, 3 growlers.
24	307	Oscar II	46 13 to 46 18	48 36 to 48 16	Numerous growlers and bergs, field ice.
24	308	Brandon	46 55 to 46 08	47 25 to 48 34	Numerous bergs, growlers, field ice, and heavy rafts.
25	309	Columbialite	47 00	48 00	Numerous growlers.
25	310	Regina	47 08 to 47 01	47 20 to 47 44	Field ice and growlers. Field ice, low lying and breaking up.
25	311	do	46 46	48 05	Berg.
25	312	Cairnglen	47 54 to 48 12	50 40 to 50 42	Numerous bergs and growlers.
25	313	Regina	46 44	48 20	Small berg.
25	314	Ascania	46 25	47 55	Numerous growlers in vicinity.
25	315	Minnedosa	47 18 to 47 07	47 10 to 47 36	Numerous growlers and large pieces of ice.
25	316	Cape Race Station	47 19 to 46 10	47 33 to 48 50	Open field ice.
25	317	do	47 50 to 48 20	50 25 to 49 00	Numerous bergs and growlers with strings of heavy field ice to northeast.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
Apr. 25	318	Minnedosa	47 07 to 46 54	47 36 to 47 52	Patches and strips of field ice and growlers to north and south of track as far as could be seen.
25	319	do	46 49	48 06	Large berg.
25	320	do	46 42	48 18	Berg and growlers.
26	321	Coelleda	43 48	45 10	Small berg.
26	322	Jeanne d'Arc	45 35	48 30	Berg, broken ice.
26	323	Beaverbrae	46 34	48 04	Berg.
26	324	do	48 38 to 46 34	47 51 to 48 04	Heavy open field ice.
26	325	Athenia	45 00 to 45 00	48 18 to 48 44	Pieces of ice.
26	326	Coelleda	43 25	46 00	Large growlers.
26	327	Calgaric	46 55	47 11	Several growlers.
26	328	do	47 00 to 46 30	48 01 to 48 11	Do.
26	329	do	46 32	48 01	Berg.
26	330	do	46 42	47 55	Do.
27	331	Cape Race Station	48 05 to 48 00	47 35 to 48 07	Field ice growlers and numerous bergs.
26	332	do	47 05 to 46 54	47 39 to 47 31	Patches and strips of field ice and growlers.
27	333	do	47 38 to 47 25	48 35 to 50 06	Scattered growlers and small bergs.
26	334	do	47 15	50 00	6 growlers.
27	335	do	46 50 to 46 30	47 16 to 48 11	Small pieces and growlers.
26	336	do	48 20 to 47 45	50 00 to 48 51	Heavy field ice.
26	337	do	47 45 to 47 30	48 51 to 49 10	Numerous bergs and growlers.
27	338	West	41 30	47 19	Spar, 3 feet long, standing upright.
27	339	Cape Race Station	47 56	48 26	Large berg 160 feet high 440 feet long.
27	340	do	46 59	47 07	Small growler, same as 327.
27	341	do	46 50	47 16	2 growlers.
28	342	Argosy	47 22	42 35	Spar projecting 6 feet out of water apparently attached to submerged wreckage.
28	343	Capulin	42 03	65 48	Red gas buoy marked "H," light burning.
28	344	Laval County	47 00 to 46 40	47 00 to 48 00	Numerous growlers and small pieces.
28	345	do	46 38	47 46	Large berg.
28	346	do	46 28	48 18	Small berg.
28	347	Cape Race Station	47 30	46 50	Several growlers.
28	348	do	47 30 to 46 52	46 44 to 47 10	Heavy open field ice and numerous heavy growlers.
28	349	do	46 52 to 46 17	47 10 to 47 40	Several growlers.
28	350	do	46 40	48 00	Large berg.
29	351	West Noska	42 52	50 45	3 bergs.
29	352	Cape Race Station	46 45	47 08	Small berg and several growlers.
May 1	353	Newfoundland	48 23 to 48 16	50 33 to 50 44	Numerous growlers and pieces of field ice.
Apr. 30	354	Cape Race Station	48 09	51 00	Large berg.
May 1	355	Ice patrol	43 07	50 52	Berg and growlers.
1	356	New York City	43 22	50 10	3 bergs many small pieces.
Apr. 30	357	Cape Race Station	48 50	49 46	Berg and growlers, field ice to southwest.
May 1	358	Airthria	45 35	48 39	Berg.
1	359	do	45 41	48 26	Do.
1	360	do	45 36	48 25	Growlers.
1	361	do	45 45	48 08	Berg.
1	362	do	45 49	47 59	Do.
1	363	do	46 01	47 20	2 bergs several growlers.
1	364	do	45 56	47 06	2 growlers.
1	365	New York City	43 54	48 35	Large berg.
1	366	Montroyal	47 10	47 12	Growler.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 1	367	Montroyal	47 09	47 16	Growler.
1	368	do	47 01	47 13	Large berg, numerous growlers.
1	369	Far North	45 34	48 43	Large berg, same as 358.
1	370	Montroyal	47 12	47 31	Large berg.
1	371	do	46 59	47 22	Medium berg.
1	372	do	47 04 to 46 55	47 27 to 47 50	Numerous bergs and growlers.
1	373	do	46 54	47 49	Large berg.
1	374	do	46 51	47 41	Berg.
1	375	do	46 42	48 09	Growlers.
1	376	Beaverdale	46 30	48 01	Growlers to the northeast.
2	377	Ice patrol	43 11	50 10	2 bergs.
2	378	do	43 05	49 47	Growler.
2	379	Lehigh	45 01	48 16	Berg.
2	380	do	45 00	48 33	Do.
2	381	Laurentic	47 03	47 25	Growler.
2	382	do	47 01	47 29	Do.
2	383	do	46 41	47 49	2 large bergs, same as 372.
2	384	Ice patrol	43 04	49 40	Growler.
1	385	Cape Race Station	44 52	49 32	Low-lying berg.
2	386	do	47 24	47 12	Large berg.
2	387	do	47 16	47 11	Small growler.
2	388	do	46 40	47 40	Berg.
2	389	do	46 41	47 49	2 small bergs, same as 372.
1	390	do	45 34	46 43	Large berg.
2	391	Kentucky	45 53	47 38	Growler.
2	392	do	45 53	47 41	Do.
2	393	do	45 49	47 59	Berg.
2	394	do	45 32	48 22	Large berg.
2	395	do	45 32	48 25	Growler.
2	396	do	45 30	48 37	Large berg, same as 359.
2	397	Alaunia	47 00	46 41	Berg.
2	398	do	46 42	47 04	Growlers.
2	399	do	46 43	47 07	Large berg.
2	400	do	46 40	47 16	Growlers.
2	401	Ice patrol	43 40	48 30	Berg.
2	402	do	43 42	48 19	Do.
2	403	do	44 05	48 35	Do.
2	404	Arabic	46 54	47 11	1 large, 2 small, low-lying bergs.
2	405	do	46 53	46 47	Small berg.
2	406	do	46 46	47 35	Large low-lying berg.
2	407	do	46 39	47 43	2 bergs, several growlers.
2	408	Estonia	47 23	47 52	Growler.
2	409	do	47 30	47 53	Berg.
2	410	do	47 25	47 37	Growler.
2	411	do	47 28	47 41	Large berg.
2	412	do	47 36	47 49	Small berg.
2	413	do	47 33	47 41	Growler.
2	414	do	47 34	47 36	Do.
2	415	do	47 37	47 34	Do.
2	416	do	47 36	47 29	Do.
2	417	Norefjord	48 02 to 48 35	49 11 to 48 15	Field ice, small bergs, and growlers to northwest.
1	418	do	48 35 to 48 11	48 15 to 48 54	Do.
1	419	Cairnross	48 45 to 48 40	49 40 to 49 25	Field ice to westward heavy in places and containing bergs and growlers.
1	420	do	48 40 to 48 15	49 25 to 48 20	Do.
1	421	do	48 30 to 47 50	48 20 to 48 20	Several bergs and growlers.
2	422	Hjelmaren	48 46 to 48 30	46 52 to 47 54	Drift ice with about 100 growlers and 20 bergs.
2	423	do	48 28	48 00	Berg.
2	424	do	48 25	48 01	Do.
2	425	do	48 24	48 05	Do.
2	426	do	48 23	48 06	Do.
2	427	do	48 22	48 08	Do.
2	428	do	48 24	48 14	Berg 100 feet high.
2	429	do	48 19	48 26	Berg.
2	430	do	48 18	48 36	Large berg and growler.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north °	′	Position: Longitude west °	′	Nature of ice or obstruction
May 2	431	Hjelmaren	48	11	48	31	Large berg.
2	432	do	48	14	48	42	Do.
2	433	do	48	11	48	44	Pyramidal berg 155 feet high.
2	434	do	48	10	48	49	Large berg.
2	435	Carmia	47	24	47	07	Berg and growlers.
2	436	do	47	22	47	18	Growler.
2	437	Kentucky	45	41	50	21	Spar projecting 6 feet, apparently attached to submerged wreckage.
3	438	Albertic	47	24	46	54	Growlers.
3	439	do	47	24	47	06	Berg.
3	440	do	47	17	47	11	Do.
3	441	do	47	18	47	16	Do.
3	442	do	47	14	47	19	Do.
3	443	do	47	18	47	19	Do.
3	444	Ice patrol	43	56	48	48	Berg, same as 403.
3	445	do	43	50	49	21	Berg.
3	446	Eberstein	48 to 49	45 to 00	49 to 48	00 to 22	Fields of growlers.
3	447	Ice patrol	43	34	50	04	Berg.
3	448	do	43	28	50	10	Berg and growlers.
3	449	do	43	25	50	08	Low-lying berg.
3	450	do	43	15	50	38	Berg.
3	451	Eberstein	48	00	50	10	Field of heavy growlers and several bergs.
2	452	Cape Race Station	47	53	49	00	Berg.
2	453	do	47	50	49	02	Do.
2	454	do	47	52	49	03	Do.
2	455	do	47	48	49	00	Do.
2	456	do	47	48	49	05	Berg 600 feet long and 40 feet high.
4	457	Montclare	46	51	57	11	Patches of scattered field ice.
4	458	(IIBC)	41	27	54	48	Red buoy marked "2 AF" projecting about 6 feet.
5	459	Ice patrol	43 to 43	24 to 28	49 to 48	04 to 33	4 bergs, several growlers.
5	460	do	43	47	48	42	Small berg.
5	461	Montclare	46	49	47	25	Medium berg.
5	462	do	46	53	47	24	Do.
5	463	do	46	54	47	20	Very large berg.
5	464	do	46	44	47	20	2 low-lying medium bergs.
5	465	Lord Downshire	47	14	46	34	Small berg.
5	466	do	47	10	46	37	Berg and several pieces.
5	467	Ice patrol	43	45	49	17	Small berg.
5	468	Montclare	46	55	47	05	Berg.
5	469	do	46	44	46	56	Very large berg.
5	470	do	47	06	46	05	Small growlers.
5	471	Lord Downshire	47	03	47	14	Berg.
6	472	Vallemare	45	08	46	51	Small berg.
6	473	C. A. Larsen	43	02	48	50	Large berg, same as 459.
6	474	do	43	19	48	35	Do.
6	475	Lord Downshire	46	48	47	30	Large berg 160 feet high.
6	476	do	46	50	47	40	Small low berg and several growlers.
5	477	Cape Race Station	46	52	47	30	Growler.
6	478	Ice patrol	43	04	48	49	Berg, same as 473.
6	479	Vallemare	45	11	47	12	Small berg.
6	480	Keret	46	12	47	42	2 bergs.
6	481	Vallemare	45	17	48	23	Berg and 2 growlers.
6	482	Calgaric	46	12	47	33	Berg.
6	483	do	46	16	47	41	Low berg, same as 480.
6	484	do	46	11	47	32	Growler.
6	485	do	46	12	47	28	Do.
6	486	Cairnes	47	19	46	33	Small berg and numerous pieces.
6	487	Calgaric	46	05	47	13	Berg.
6	488	do	46	15	47	07	Growlers.
6	489	do	46	09	47	11	Do.
6	490	do	46	13	46	56	Large bergs.
6	491	do	46	26	46	55	Berg.
6	492	do	46	12	46	43	Do.
6	493	do	46	29	46	27	Large berg.
6	494	do	46	22	46	21	Berg.
6	495	do	46	29	46	24	Do.
6	496	do	46	11	46	28	Large berg.
6	497	Nieu Amsterdam	46	35	46	25	Small berg and growlers.
6	498	do	46	30	46	44	Large berg and several growlers.
7	499	do	46	22	47	10	Large berg and growlers.
7	500	Ascania	46	16	47	08	Large berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 7	501	Brighton	46 30 to 46 30	46 30 to 47 20	Numerous growlers and 1 large berg.
7	502	Vulcania	40 31	44 55	Red iron cylinder 40 feet long 6 feet high.
7	503	Athenia	47 11	47 05	Scattered growlers and heavy pieces of field ice.
7	504	Flensburg	47 44 to 47 40	47 12 to 47 25	Numerous growlers and scattered pieces of ice.
7	505	do	47 40 to 47 30	47 25 to 47 25	Eastern edge of field ice and growlers impossible to cross; 1 berg seen in field.
7	506	do	47 30 to 47 30	47 25 to 47 35	Field ice and growlers.
7	507	do	47 38	46 04	Berg.
7	508	do	47 40	46 27	Berg and growlers.
7	509	Arizpa	40 38	42 36	Spar floating upright projecting 5 feet apparently attached to submerged wreckage.
7	510	do	40 38	42 34	Log about 15 feet long.
7	511	Flensburg	47 20	47 36	15 bergs and numerous growlers.
7	512	Regina	46 43	47 19	Berg.
7	513	do	46 20	47 45	Growler and small pieces.
7	514	do	46 40 to 46 43	47 29 to 47 19	1 small berg several growlers.
8	515	Flensburg	47 20 to 47 20	47 36 to 48 15	2 bergs numerous growlers.
8	516	Regina	46 44	47 21	Large berg, several growlers.
8	517	Minnedosa	47 23	46 58	Medium berg.
8	518	do	47 26	46 50	Large berg and 3 growlers.
8	519	do	47 22	47 00	Berg.
8	520	do	47 29	46 44	2 bergs, 2 growlers.
8	521	do	47 33	46 36	Field ice stretching east and west 5 miles, 1 berg, and numerous growlers.
8	522	Flensburg	47 56	49 19	8 large bergs.
8	523	do	47 58	48 56	2 very large bergs.
8	524	do	48 00	49 56	Large berg.
8	525	Minnedosa	46 27	46 47	Do.
8	526	Aurania	46 12	47 29	Low berg.
9	527	do	46 10 to 46 03	47 32 to 47 44	5 small growlers.
9	528	do	46 04	47 43	Small berg.
9	529	Dutchess of Richmond	44 00	48 49	Do.
9	530	Doric	47 29	46 35	Bergs and numerous growlers, same as 521.
9	531	do	47 25	46 44	Large berg, may growlers, same as 520.
9	532	Melita	47 06	57 05	Several small pieces of field ice.
9	533	Flensburg	47 56 to 47 56	49 19 to 49 54	Numerous bergs.
9	534	Dubhe	48 10 to 48 03	47 00 to 47 53	7 bergs, many growlers, much field ice.
9	535	Doric	47 25 to 47 11	46 44 to 47 19	Several large bergs and many growlers.
9	536	Montrose	46 54 to 47 11	47 08 to 46 23	Numerous pieces of ice.
9	537	Megantic	46 59	46 39	1 growler, several pieces.
9	538	do	46 55	46 49	1 small berg.
9	539	Beaverbrae	45 59	48 13	Large berg 300 feet high.
9	540	do	46 02	47 52	Large berg, 4 growlers.
9	541	do	46 02	47 49	Small berg, 6 growlers.
9	542	do	46 06	47 40	Large, low berg.
9	543	Letitia	47 31	45 05	Growlers.
9	544	do	47 35 to 47 23	45 53 to 46 10	Field ice, growlers, and heavy broken pieces.
9	545	Salacia	45 51	48 06	Large berg and several growlers.
9	546	Dutchess of Richmond	44 57	44 55	Berg 100 feet high.
9	547	Heronspool	45 41	47 24	Small berg.
9	548	Flensburg	47 56 to 48 18	49 54 to 51 02	8 large bergs and some growlers.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position		Nature of ice or obstruction
			Latitude north	Longitude west	
			° ′	° ′	
May 9	549	Beaverbrae	46 23	46 45	Berg.
9	550	Letitia	47 20	46 23	Do.
9	551	do	47 03	46 40	Growler.
10	552	Empress of Scotland	46 18	47 40	Small growlers.
10	553	Ice patrol	43 14	49 21	Berg.
10	554	Melita	47 28	46 34	Several growlers and small pieces.
10	555	do	47 26 to 47 20	46 37 to 46 50	Open field ice and growlers.
10	556	Empress of Scotland	46 35	46 44	Large berg with numerous growlers.
10	557	Sagauche	43 00	49 20	Berg, same as 560.
10	558	Malmen	45 50	44 47	Berg and 4 growlers.
10	559	Perseus	43 34	47 52	Large berg.
10	560	Ice patrol	42 59	49 20	Berg, same as 553.
10	561	Salacia	45 51 to 46 14	47 43 to 46 43	5 bergs and several growlers.
10	562	do	46 20 to 46 42	46 13 to 45 10	Several growlers.
10	563	Cape Race Station	47 34 to 47 11	46 24 to 47 19	Numerous bergs and many growlers.
10	564	Beaverford	46 51	46 45	Berg.
11	565	do	46 54	46 46	Large berg.
11	566	do	46 47	46 54	Berg.
11	567	Barom Elibank	47 25 to 47 00	45 55 to 47 00	13 large bergs and several growlers.
10	568	Cape Race Station	47 03	46 45	Growler.
11	569	Wytheville	42 03	45 16	Large spar projecting 3 feet out of water apparently attached to submerged wreckage.
11	570	Vallarparosa	43 43	48 41	Large berg.
11	571	do	43 56	49 04	Small berg.
11	572	Humber Arm	48 45	49 00	Field ice running north and south, also 2 bergs.
11	573	Vallarparosa	43 30	47 50	2 bergs and growlers.
11	574	Humber Arm	48 45 to 48 29	49 00 to 49 33	18 large bergs.
11	575	Nevisian	48 29	44 15	Small berg and growler.
11	576	Vallarparosa	44 06	49 33	Small berg.
11	577	Flensburg	48 18 to 47 50	51 02 to 52 45	10 bergs.
11	578	Humber Arm	48 38	49 15	Field ice.
11	579	do	48 17	50 07	Berg.
11	580	do	48 21	50 14	Do.
11	581	do	48 10	50 35	Do.
11	582	Nevisian	48 19	44 49	Growler.
12	583	do	47 45	45 50	Growlers and field ice.
12	584	do	47 36	45 58	Berg on southern end field ice.
12	585	do	47 39	45 58	Do.
12	586	Concordia	47 40 to 47 38	45 46 to 46 05	Detached growlers and small pieces of ice.
12	587	Nevisian	47 32	45 58	3 bergs.
12	588	do	47 17	46 18	5 growlers.
12	589	do	47 18	46 20	Berg.
12	590	do	47 17	46 43	Do.
12	591	Ice patrol	42 46	49 55	Berg, same as 553.
12	592	Concordia	47 38 to 47 22	46 05 to 46 47	Small bergs and growlers on each side of track.
12	593	do	47 22 to 47 05	46 47 to 47 00	Numerous bergs and growlers mostly north of track.
12	594	Nevisian	47 13 to 47 00	46 43 to 47 18	8 large and 4 small bergs, also 4 growlers.
12	595	Bothwell	46 12	48 07	Berg.
12	596	do	46 07	48 02	Do.
12	597	do	46 18	47 40	Do.
12	598	do	46 29	47 02	Do.
12	599	do	46 37	46 54	Do.
12	600	do	46 32	46 53	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 12	601	Kastalia	47 02 to 46 42	46 10 to 47 11	8 bergs and 8 growlers and small pieces.
12	602	Concordia	47 05	47 22	Berg.
12	603	Cape Race Station	46 57 to 46 43	46 17 to 47 07	8 large, 6 small bergs, and 12 growlers, same as 567.
12	604	Bothwell	46 35	46 27	Berg.
12	605	do	46 44	46 26	Do.
12	606	do	46 53	45 52	Do.
12	607	do	46 52	45 49	Growlers.
13	608	Mount Royal	46 22	48 03	Berg.
13	609	Hardenberg	44 52	45 00	Do.
13	610	Laponia	49 00 to 48 50	49 50 to 50 10	Numerous growlers and heavy field ice.
13	611	do	48 45 to 48 36	50 28 to 50 50	Several bergs and growlers.
13	612	Montroyal	47 09	46 35	1 large, 1 small berg with growlers, same as 567.
13	613	Laponia	48 46	50 30	Large berg.
13	614	Montroyal	47 23	46 05	Berg and growler, same as 592.
13	615	Federal	32 57	47 15	3-masted derelict schooner Quaco Queen, bowsprit and about 40 feet of mizzenmast standing.
13	616	Ice patrol	42 48	50 47	Berg, same as 553.
13	617	Nova Scotia	48 52	44 42	Growler.
13	618	Andania	46 49	46 59	Berg, same as 594.
13	619	do	46 58	46 36	Small berg, same as 594.
13	620	Nova Scotia	48 36	45 24	Several small growlers.
14	621	Andania	47 22	45 43	Growlers.
14	622	Nova Scotia	48 23	46 05	Berg.
14	623	do	48 20	46 07	Growlers.
14	624	do	48 20	46 15	Do.
14	625	do	48 15	46 19	Large berg.
14	626	do	48 13	46 31	Do.
14	627	do	48 09	46 34	Small berg and growlers.
14	628	do	48 08	46 52	Small berg.
14	629	Veendam	47 08	45 12	Growler.
14	630	do	47 04	45 22	Small berg.
14	631	Cape Race Station	46 39	45 43	Large berg, same as 634.
14	632	do	46 42	45 42	Large berg and many small pieces.
14	633	Nova Scotia	47 44 to 47 40	47 23 to 46 41	8 bergs and 2 growlers.
14	634	Veendam	46 35 to 46 50	46 53 to 46 53	9 bergs and 4 growlers.
14	635	Nicoline Maersk	41 28	45 00	Log 40 feet long 12 inches square.
14	636	Nova Scotia	47 42	47 45	Berg.
14	637	Laurentic	46 26 to 47 12	47 44 to 46 24	24 bergs and growlers on both sides of track.
14	638	Veendam	46 10 to 45 40	46 53 to 48 08	7 large bergs, same as 539–542.
14	639	Hardenberg	44 45	47 53	Growler.
14	640	Laurentic	47 12 to 47 45	46 24 to 45 34	4 bergs and numerous growlers.
14	641	do	48 00	44 55	Growler.
14	642	do	47 56	44 37	Small berg and growler.
15	643	Polonia	46 07	47 51	Berg.
15	644	do	46 19	47 53	Berg 50 feet high.
15	645	Ice patrol	42 21	50 50	Berg, same as 616.
15	646	Hardenberg	44 48	48 31	Medium berg.
15	647	Polonia	46 34	47 30	Berg, same as 637.
15	648	do	46 31	47 08	Do.
15	649	do	46 33	47 04	Do.
15	650	do	46 35	46 56	Do.
15	651	do	46 41	47 00	Do.
15	652	Kenmore	47 32 to 47 20	46 46 to 47 40	Numerous bergs, same as 637.
15	653	Polonia	46 40 to 47 05	47 10 to 46 05	20 bergs and growlers.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 15	654	Carmia	48 02	49 18	Berg.
15	655	do	48 06	49 15	2 bergs, numerous growlers.
15	656	do	48 14	48 57	Berg.
15	557	Carmia	48 14	48 48	Do.
15	558	do	48 17	48 44	Growlers.
15	659	do	48 37	47 56	Berg.
15	660	Cameronia	46 28	47 15	Small berg.
15	661	Hangirland	47 48	52 54	Large berg and several growlers.
15	662	Polonia	47 40	45 02	3 large and 3 small bergs and several growlers.
15	663	Cameronia	46 57	47 25	Large berg, same as 637.
15	664	do	46 36	46 48	Berg, same as 637.
15	665	do	47 00	47 00	Large berg, same as 637.
15	666	do	47 03	46 48	Do.
15	667	do	47 19	46 50	Do.
15	668	do	47 05	46 25	Small berg and growler, same as 637.
15	669	do	47 12	46 27	Berg, same as 637.
15	670	do	47 10	46 20	Do.
15	671	do	46 40	46 58	Low berg, same as 637.
15	672	do	46 47	46 40	Do.
15	673	do	46 59	46 58	Berg, same as 637.
15	674	do	47 00	46 48	Growler, same as 637.
15	675	do	47 08	46 30	Do.
15	676	do	47 05	46 22	Do.
15	677	do	47 00	46 18	Berg, same as 637.
15	678	do	47 10	46 12	2 bergs, same as 637.
15	679	do	47 18	46 05	10 bergs and numerous growlers within 10 miles radius, same as 637.
15	680	Cairnross	48 20	49 15	Small berg.
15	681	do	47 45 to 48 40	50 30 to 48 50	28 bergs and numerous growlers to southward.
15	682	Topsdalsfjord	48 45 to 48 10	48 15 to 50 15	Field ice for about 10 miles and then several large bergs and numerous growlers.
16	683	California	48 17	45 13	Small low berg.
16	684	do	48 03	44 48	2 bergs.
16	685	do	47 55	45 40	Do.
16	686	do	47 50	45 56	Berg.
16	687	do	47 46	45 55	Berg, same as 652.
16	688	do	47 38	46 30	Do.
16	689	do	47 29	46 42	Large berg, same as 652.
16	690	do	47 29	46 48	Large low berg, same as 652.
16	691	do	47 10	47 09	2 large bergs, same as 652.
16	692	do	47 30	46 37	7 bergs, same as 652.
16	693	do	47 12	47 07	4 bergs, same as 652.
16	694	Ausonia	48 42	44 30	Several growlers.
16	695	do	48 45	44 31	2 bergs.
16	696	Cameronia	47 30	45 38	Berg.
16	697	do	47 37	45 15	Small berg.
16	698	do	47 43	45 08	Do.
16	699	do	47 44	45 28	Growlers.
16	700	do	47 48	44 55	Large berg and growler.
16	701	Cairnross	48 20	49 15	Small ice field.
15	702	Cape Race Station	47 40	52 40	Berg aground.
16	703	Antonia	48 36 to 48 18	48 18 to 48 37	3 small bergs and line of growlers and small pieces of ice.
16	704	Beaver Hill	47 47	44 40	Berg.
16	705	do	47 41	45 12	Large berg and numerous pieces.
16	706	do	47 50	45 12	Berg.
16	707	do	47 48	45 30	Do.
16	708	do	47 37	45 41	Growlers.
16	709	Metagama	48 37	44 44	Berg.
16	710	do	48 34	44 56	Growler.
16	711	do	48 22	45 28	Large berg.
16	712	do	48 23	45 32	Do.
16	713	do	48 23	45 33	Berg.
16	714	do	48 26	45 38	Do.
16	715	do	48 22	45 48	Large berg.
16	716	do	48 23	45 48	3 growlers.
16	717	do	48 21	45 49	Growler.
16	718	do	48 20	45 50	Berg and pieces.
16	719	do	48 19	45 50	Berg.
16	720	Antonia	48 09	48 55	2 small bergs.
16	721	Ausonia	48 35	45 08	Berg.
16	722	do	48 34	45 38	2 growlers and 4 large pieces
16	723	do	48 30	45 45	3 growlers.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north (° ′)	Position: Longitude west (° ′)	Nature of ice or obstruction
May 16	724	Ausonia	48 24	45 49	2 small bergs.
16	725	do	48 26	45 53	1 berg.
16	726	do	48 26	46 00	1 berg, 1 growler, and several pieces.
16	727	do	48 21	46 03	1 growler.
16	728	California	48 21 to 46 57	45 29 to 47 45	8 bergs, 19 growlers, and numerous pieces.
16	729	Penland	47 06	45 26	Large berg, 3 growlers to eastward.
17	730	California	47 54	46 07	Large berg.
17	731	Penland	47 00	45 47	Do.
17	732	do	46 54	46 07	Do.
17	733	Beaver Hill	47 38	45 50	Do.
17	734	do	47 31	46 47	Berg.
17	735	Metagama	48 02	47 10	2 bergs.
17	736	do	47 58	47 30	Large berg.
17	737	do	47 51	47 45	Berg.
17	738	do	47 49	47 55	Numerous growlers.
16	739	do	48 21	45 49	Berg.
16	740	do	48 16	46 07	Large berg and growler.
16	741	do	48 10	46 20	Large berg.
16	742	do	48 06	46 34	Large low berg.
16	743	do	48 05	46 41	Large berg.
16	744	do	48 05	46 48	Medium berg.
16	745	do	48 06	46 55	Large berg.
16	746	do	48 04	46 55	Do.
16	747	do	48 03	47 01	2 bergs.
16	748	do	48 02	47 07	Berg.
16	749	do	47 58	47 20	Very large low berg.
16	750	Antonia	48 00	49 12	Growler.
16	751	do	47 58	49 14	Large berg.
16	752	do	47 57	49 22	Medium berg.
16	753	do	47 57	49 27	Large berg.
16	754	Ausonia	48 13	46 10	Growler.
16	755	do	48 12	47 26	Small bergs, numerous pieces.
16	756	do	48 10	46 40	1 large, 2 small bergs, and pieces.
16	757	do	48 08	46 50	Large berg.
16	758	do	48 05	47 00	Do.
16	759	do	48 07	47 08	Do.
16	760	do	48 05	47 13	2 large bergs.
16	761	do	48 03	47 20	Large berg and several growlers.
16	762	do	47 58	47 34	Large berg.
17	763	do	47 47	48 21	Do.
17	764	do	47 44	48 27	Do.
17	765	do	47 42	48 35	Do.
17	766	do	47 42	48 36	Small berg.
17	767	do	47 43	48 39	Large berg.
17	768	Metagama	47 35	48 40	Do.
17	769	do	47 40	48 50	3 bergs.
17	770	do	47 33	48 50	Berg.
17	771	Beaver Hill	47 22	48 31	Do.
18	772	Drottningholm	42 43	51 16	Large berg and several growlers.
18	773	Carlsholm	44 38	45 44	Large berg.
17	774	Cape Race Station	48 42 to 47 43	44 30 to 48 39	Numerous bergs and growlers and small pieces of ice on both sides of track.
18	775	do	48 40	49 31	4 bergs and hundreds of growlers.
18	776	Ice patrol	42 47	50 49	Berg and growlers.
18	777	Spilsby	44 44	45 33	Berg.
18	778	Balsam	42 53	49 53	Large berg.
18	779	Cape Race Station	48 36	49 34	6 bergs.
18	780	Grandon	42 40	43 59	Log 3 feet diameter 20 feet long.
18	781	Firpark	45 55	45 34	Small berg and growler.
18	782	Balsam	42 44	50 54	Large berg same as 776.
19	783	Quaker City	42 48	50 22	Growler.
19	784	do	42 43	51 13	Berg and several growlers, same as 772.
19	785	Ice patrol	42 44	51 13	Berg, same as 772.
19	786	Henrik Ibsen	45 14	48 07	Berg.
19	787	Firpark	45 47	47 44	One high and one low berg.
19	788	Ice patrol	42 54	50 08	Berg.
19	789	Montrose	48 03 to 47 40	46 13 to 48 06	About 40 bergs on both sides of track.
19	790	Magantic	47 39	47 24	Berg.
19	791	do	46 56	46 19	Large berg.
19	792	do	48 02	45 38	Small berg and 4 growlers.
19	793	Montrose	47 58 to 48 17	46 39 to 45 00	6 bergs, numerous growlers.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 19	794	Montrose	48 11	45 20	Berg.
20	795	Magantic	48 15	44 44	Do.
20	796	Molita	47 53 to 48 11	49 59 to 49 17	8 bergs and several small pieces.
20	797	Aurania	47 43	48 24	Very large berg.
20	798	Seattle Spirit	45 23	45 40	Small berg.
20	799	Aurania	47 47	48 09	Large berg and growlers.
20	800	do	47 53	47 56	Do.
20	801	do	47 47	47 55	Do.
20	802	do	47 24	47 49	Do.
20	803	do	47 53	47 48	Do.
20	804	do	47 31	47 48	Do.
20	805	do	47 47	47 49	Do.
20	806	do	47 44	47 42	Do.
20	807	do	47 49	46 43	Large berg and growlers, same as 789.
20	808	do	47 46	46 40	Do.
20	809	do	47 49	46 35	Do.
20	810	do	47 54	46 33	Do.
20	811	do	47 59	46 32	Large berg, same as 789.
20	812	do	47 54	46 30	Small berg, same as 789.
21	813	Letitia	47 09	45 16	Berg.
21	814	do	47 17	44 57	Do.
21	815	do	47 27	44 19	Do.
21	816	do	46 45	46 26	2 bergs.
21	817	do	46 50	46 25	Large berg.
21	818	do	46 52	46 21	Berg.
21	819	do	46 52	46 10	Do.
21	820	do	47 07	45 49	Do.
21	821	do	46 25	47 37	Large berg.
21	822	do	46 37	47 30	Do.
21	823	do	46 27	47 00	Do.
21	824	do	46 32	47 10	Do.
21	825	do	46 40	47 00	Do.
21	826	do	46 40 to 47 00	46 45 to 46 30	8 bergs.
21	827	Aurania	48 03	45 44	Small low berg.
21	828	do	48 06	45 38	Growler.
21	829	Pajola	47 40 to 47 53	47 11 to 46 08	31 bergs close to track, same as 789.
21	830	Seattle Spirit	45 16	46 41	Berg.
21	831	Ice patrol	42 38	50 40	Small berg.
20	832	Cape Race Station	45 27	47 56	2 bergs.
20	833	do	47 44	52 10	Do.
20	834	do	47 51	52 13	Berg.
20	835	do	48 10	52 17	Do.
20	836	do	47 58	52 16	Do.
20	837	do	47 58	52 21	Do.
20	838	do	47 49	47 10	Growlers.
20	839	do	47 47	47 07	Do.
20	840	do	47 44	47 05	Do.
20	841	do	47 44	46 58	Do.
20	842	do	47 53	46 53	Do.
20	843	do	47 50	46 43	Large growlers.
20	844	do	47 36	46 41	Do.
20	845	do	47 49	46 35	Large growler.
20	846	do	47 54	46 33	Do.
20	847	do	47 59	46 32	Large berg.
20	848	do	47 54	46 30	Small berg.
21	849	Doric	47 55	49 50	Do.
21	850	do	47 58	49 43	Long, low berg.
21	851	do	47 59	49 41	Large berg and medium low berg.
21	852	do	48 00	49 32	Large berg and 2 growlers.
21	853	Coldilana	42 45	51 15	Large berg.
21	854	Doric	48 08 to 48 24	49 03 to 48 28	Large and medium bergs, many growlers on both sides of track.
21	855	do	48 24	48 28	Many bergs to northeastward.
21	856	Montcalm	48 10	46 45	Small berg, several growlers.
21	857	do	47 58	46 45	Large berg.
21	858	do	47 54	47 00	Do.
21	859	do	47 48	47 14	Do.
21	860	do	47 59	47 20	Small berg.
21	861	do	48 08	47 23	2 small bergs.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 21	862	Montcalm	48 02	47 25	Small berg.
21	863	do	48 02	47 26	Do.
21	864	do	47 50	47 27	Large berg.
21	865	do	47 56	47 27	Medium berg.
21	866	do	48 00	47 33	Large growler.
21	867	do	47 55	47 34	Large berg.
21	868	do	48 01	47 37	Do.
21	869	do	48 02	47 40	Berg and growlers.
21	870	do	47 48	47 42	Large low berg.
21	871	do	47 59	47 42	Small berg.
21	872	do	48 06	47 48	Berg.
21	873	do	48 01	47 48	Growler.
21	874	do	47 58 to 47 38	47 48 to 48 50	20 large bergs north and south of line.
21	875	Thuban	47 23 to 47 05	45 22 to 46 17	5 bergs and several growlers.
21	876	St. Amos Fafalios	45 04	45 46	2 bergs.
22	877	Scythia	47 33	49 49	Berg.
22	878	do	48 08	48 38	Numerous bergs and growlers each side of track.
22	879	do	48 06	48 45	Large berg.
22	880	do	48 05	48 45	2 long, low bergs.
21	881	Frederick VIII	46 50	40 31	Large berg.
22	882	Beaverford	47 29	48 23	Berg.
22	883	do	47 40	47 38	Growler.
22	884	Scythia	48 16	48 14	Berg.
22	885	Cape Race Station	48 10 to 47 38	46 45 to 48 50	36 bergs and many growlers both sides of track.
22	886	do	47 36 to 48 35	50 26 to 48 06	17 bergs and many growlers both sides of track.
22	887	do	47 27	43 51	Berg.
22	888	do	47 08	44 41	3 growlers.
22	889	do	47 11	45 00	Berg.
22	890	do	47 09	45 11	Large berg and growlers.
22	891	do	47 05	45 30	2 bergs and 2 growlers.
22	892	do	47 04	45 44	Berg.
22	893	do	46 55	45 53	Do.
22	894	do	46 55	46 00	2 bergs.
23	895	Caledonia	48 34	48 02	Growler.
23	896	do	48 25	48 14	Berg and 5 growlers.
23	897	Koeln	49 00	48 16	Growler.
23	898	do	48 57	48 18	Do.
23	899	Cape Race Station	48 20 to 47 45	48 43 to 50 10	Numerous bergs and growlers on track.
23	900	Hada County	48 06	47 55	Growlers.
23	901	do	48 04	48 00	Small berg.
23	902	do	47 54 to 47 40	48 40 to 49 35	8 bergs and many growlers.
23	903	Koeln	48 07	48 50	Field ice with uncountable growlers and large and small bergs.
23	904	Regina	48 43	48 19	Growlers.
23	905	do	48 36	48 33	Large berg also field ice and growlers on both side of track extending towards south-southwest.
23	906	Caledonia	48 23	48 29	Large berg.
23	907	do	48 21 to 48 18	48 23 to 49 03	Field ice extending north and south to horizon with growlers, small bergs, and two large bergs.
23	908	do	48 14	49 17	Large berg.
23	909	do	48 14	49 13	Very large berg.
23	910	do	48 09	49 14	Small berg.
23	911	do	48 08	49 18	Large berg.
23	912	Koeln	47 58	49 13	Do.
23	913	Heronspool	45 46	47 26	Do.
23	914	do	45 46	47 22	Large berg and growlers.
23	915	do	45 59	47 11	Very large berg.
23	916	Caledonia	48 20	49 40	Large berg.
23	917	do	48 00	49 40	Do.
23	918	do	47 57	49 42	Very large berg.
23	919	do	47 54	49 59	Large berg.
23	920	Cape Race Station	48 40	49 59	Small berg.
23	921	do	48 37	50 10	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 23	922	Cape Race Station	48 36	50 13	Small berg.
23	923	do	48 27	50 20	Do.
23	924	do	48 28	50 23	Do.
23	925	do	48 23	50 40	Do.
23	926	do	48 33 to 48 32	48 42 to 48 48	Field of broken hummocky ice.
23	927	do	48 32 to 47 57	48 48 to 50 06	Scattered bergs and growlers north and south of track.
23	928	do	48 02	49 14	Very large berg.
23	929	do	48 13 to 47 10	47 24 to 49 00	Many bergs and growlers both sides of track.
24	930	Ascania	47 59	46 40	Small berg.
24	931	Athenia	48 37	48 12	3 growlers and several pieces of ice.
24	932	do	48 32	48 28	Growler.
24	933	Heronspool	46 12 to 46 34	46 08 to 45 13	13 bergs.
24	934	Empress of Australia	47 45 to 48 00	47 20 to 46 30	7 bergs and some pieces.
23	935	Cape Race Station	48 20 to 47 45	48 43 to 50 10	Numerous bergs and growlers on "F" track.
23	936	do	48 21	48 23	Large berg.
23	937	do	48 02	49 14	Do.
23	938	do	48 13 to 47 10	47 24 to 49 00	Many bergs and growlers both sides of track.
24	939	do	45 04	48 38	Large berg.
24	940	do	47 58	50 06	Berg.
24	941	Ice patrol	42 53	51 13	Growler.
24	942	Heronspool	46 41	44 23	2 bergs.
24	943	Kentucky	48 02	50 36	Berg.
23	944	do	47 21	51 40	3 bergs.
24	945	do	48 16	50 10	Berg.
24	946	do	48 20 to 48 44	50 03 to 49 28	Field ice with growlers and 1 berg.
24	947	Ascania	47 57 to 47 35	46 51 to 48 59	35 scattered bergs and growlers north and south of track.
24	948	Selvistan	44 20	47 14	Large berg and 4 growlers.
24	949	Athenia	48 37	48 12	3 growlers, numerous pieces.
24	950	do	48 32	48 28	1 growler and pieces.
24	951	do	48 22	48 48	Berg.
24	952	do	48 18	48 57	Berg and several growlers.
24	953	do	48 16	49 07	Berg.
24	954	do	48 12	49 07	Do.
24	955	do	48 18	49 19	Do.
24	956	do	48 07	49 24	4 bergs.
24	957	do	47 55	49 49	Berg.
24	958	do	47 25	51 33	Do.
24	959	Cape Race Station	47 38 to 48 00	48 14 to 46 30	13 bergs, 4 growlers.
25	960	Vallemare	45 27 to 45 54	47 18 to 48 07	9 bergs and many growlers.
25	961	Edouard Jeramec	45 08	46 14	Large berg.
25	962	do	45 11	46 58	Do.
25	963	do	45 11	46 59	Do.
25	964	do	45 05	47 09	Small berg.
25	965	do	44 59	47 16	Very large berg and growler.
25	966	Cape Race Station	47 30	43 42	Berg.
25	967	do	47 14	44 49	Do.
25	968	do	47 26	44 52	Do.
25	969	do	47 07	44 35	Do.
25	970	do	47 07	45 17	Do.
25	971	do	46 47	46 53	17 large bergs, 26 large growlers, and numerous pieces along track and north and south to horizon.
25	972	do	46 46 to 46 50	47 00 to 47 05	5 large bergs.
25	973	do	46 42	47 20	2 large bergs.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 25	974	Cape Race Station	46 56	47 10	2 large bergs.
26	975	Odensholm	47 30	51 38	3 bergs.
26	976	Cape Race Station	48 10	49 20	2 large bergs.
26	977	do	48 30	49 50	Do.
27	978	Homeric	40 28	50 01	Buoy about 10 feet high painted red with superstructure black, square cage on top.
28	979	Vlieland	48 25	45 50	Berg and growlers.
27	980	Cape Race Station	48 35 to 48 10	49 48 to 50 30	Several large bergs and numerous growlers extending north and south as far as could be seen.
28	981	Antonia	47 16	51 18	Small berg.
28	982	do	47 55	49 58	Large berg.
28	983	do	48 07	49 34	Ice island.
28	984	do	48 07	49 15	Small berg.
28	985	do	48 09	49 14	Large berg.
28	986	do	48 01	48 52	Large berg and growler.
28	987	do	48 16	48 22	Small berg.
28	988	Metagama	48 13	48 50	Large berg.
28	989	do	48 11	48 50	Very large berg.
28	990	do	48 15	48 42	Berg.
28	991	do	48 14	48 39	Do.
28	992	Cape Race Station	48 07	48 52	Small berg.
28	993	do	48 16	48 22	Do.
28	994	Beaverhill	47 38	48 17	Large berg.
28	995	do	47 41	48 17	Do.
28	996	Regnhildholm	43 30	51 30	Small berg.
28	997	Ausonia	48 09	45 49	Berg.
28	998	Montclare	48 22	46 07	Small berg.
28	999	do	48 28	46 20	Large berg.
28	1000	do	48 36	46 23	Growler.
28	1001	do	48 32	46 35	Berg.
28	1002	do	48 27	46 36	2 bergs and small pieces.
28	1003	do	48 33	45 53	Berg.
28	1004	do	48 40	45 55	Growler.
28	1005	do	48 25	46 47	Small berg.
28	1006	do	48 25	46 48	Large and small berg.
28	1007	Beaverhill	47 43 to 47 58	47 30 to 46 30	Numerous bergs and growlers to north and south.
28	1008	do	48 02	45 59	Berg.
28	1009	do	48 05	45 47	Growler.
28	1010	Cape Race Station	48 56	44 46	Spar floating vertically apparently attached to submerged wreckage.
28	1011	Montclare	48 07	48 02	Berg and numerous small pieces.
28	1012	do	48 02	48 17	Berg.
28	1013	do	47 58	48 17	Do.
28	1014	do	47 57	48 31	Do.
28	1015	do	47 53	48 30	2 bergs.
29	1016	Saguache	46 20 to 46 14	44 50 to 44 41	1 large and 2 small bergs and several growlers.
29	1017	Tiger	49 06 to 48 28	49 40 to 50 45	4 large, 10 small growlers, 1 large, 2 small bergs.
28	1018	Cape Race Station	49 00	47 09	Berg.
28	1019	do	48 48	47 25	Do.
28	1020	do	48 49	47 39	Do.
28	1021	do	48 39	47 57	Do.
28	1022	do	48 33	48 28	Do.
28	1023	do	47 57	49 48	Do.
29	1024	California	48 13	49 17	Large berg.
29	1025	do	47 57	48 53	Large berg and several growlers.
29	1026	Nova Scotia	48 20 to 48 52	50 50 to 49 24	100 bergs and unnumerable growlers.
29	1027	Dalcairn	45 50	45 43	Large berg and growler.
29	1028	California	48 13 to 48 21	49 17 to 47 53	9 large, 16 medium, and 9 small bergs, also many growlers north and south of track.
29	1029	do	48 21 to 48 35	47 53 to 47 15	5 bergs north and south of track.
29	1030	Cape Race Station	47 15	44 30	1 large and 1 small berg.
29	1031	do	47 22	45 10	2 small bergs.
29	1032	do	47 00	45 55	2 large bergs, several growlers.
29	1033	do	46 55	46 30	2 large and 1 small bergs.
30	1034	Laurentic	48 26	49 00	Small berg.
30	1035	do	48 18	48 59	Growler.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 30	1036	California	48 11	47 29	3 bergs.
30	1037	do	48 37	47 31	Berg.
30	1038	do	48 46	47 08	2 bergs.
30	1039	do	48 43	46 45	Very large berg.
30	1040	do	48 58	46 31	Berg and many growlers.
30	1041	Andania	48 20	48 57	Growler, same as 1035.
30	1042	Cameronia	48 21 to 48 02	48 49 to 49 09	21 bergs and a number of growlers.
30	1043	Andania	48 35	48 59	Growler.
30	1044	do	48 22	49 16	Do.
30	1045	do	48 19	49 16	Do.
30	1046	do	48 20	49 17	Large berg.
30	1047	do	48 21	49 20	Growlers.
30	1048	do	48 22	49 21	Do.
30	1049	do	48 19	49 20	Berg.
30	1050	do	48 20	49 36	Large berg.
30	1051	do	48 17	49 35	Do.
30	1052	do	48 18	49 43	Do.
30	1053	do	48 12	49 39	Do.
30	1054	do	48 14	49 43	Do.
30	1055	do	48 06	48 36	Do.
30	1056	do	48 17	49 44	Do.
30	1057	do	48 15	49 46	Do.
30	1058	do	48 09	49 45	Do.
30	1059	do	48 14	49 56	Do.
30	1060	Laurentic	48 26 to 48 09	49 00 to 49 33	7 bergs and numerous growlers.
30	1061	do	48 05	49 07	Large berg.
30	1062	do	47 31	51 20	Do.
30	1063	do	47 13	51 44	Do.
30	1064	Arabic	48 30 to 48 20	46 04 to 46 50	5 bergs and several growlers.
30	1065	Minnedosa	48 31	46 29	2 bergs and several growlers.
30	1066	do	48 24	46 50	Small berg.
30	1067	Andania	47 30	51 19	Large berg.
30	1068	do	47 27	51 25	Berg.
30	1069	Cape Race Station	46 28 to 46 13	47 05 to 47 53	10 large, 3 small bergs.
30	1070	Andania	47 16	51 37	Berg.
30	1071	Arabic	48 06 to 47 48	47 46 to 48 48	10 bergs and 2 growlers.
30	1072	Hardenberg	45 05 to 45 03	49 13 to 48 25	5 bergs.
30	1073	Sonda	47 00	46 34	Small berg.
31	1074	Minnedosa	48 09	47 44	Growler.
31	1075	do	48 04	47 56	Small berg and piece.
31	1076	do	48 00	48 08	Growler.
31	1077	do	48 00	48 19	4 growlers.
31	1078	do	47 58	48 27	Growler.
31	1079	do	47 54	48 27	2 small bergs.
31	1080	do	47 55	48 31	Growler and 2 pieces.
31	1081	do	47 52 to 47 49	48 42 to 48 52	2 large and 3 medium bergs and 1 growler.
31	1082	do	47 41	49 20	Berg.
31	1083	Arabic	47 46	48 50	Large low berg.
31	1084	do	47 43	49 00	Berg.
31	1085	do	47 45	49 04	Berg and growler.
31	1086	do	47 40	49 16	Growler.
31	1087	Villaperosa	45 02 to 45 34	47 47 to 46 50	13 large bergs.
31	1088	do	45 34 to 45 40	46 50 to 46 35	3 small bergs.
31	1089	Minnedosa	47 04	51 48	Berg.
31	1090	Cape Race Station	48 31	46 29	2 bergs, 4 growlers, and several pieces.
31	1091	do	48 24	46 50	Small berg.
31	1092	Ice patrol	43 04	48 57	Large berg.
31	1093	do	43 20	48 55	Do.
31	1094	do	43 17	49 03	Do.
31	1095	do	42 53	49 07	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
May 31	1096	Ice patrol	43 05	49 29	Large low berg.
31	1097	Trevaljan	46 03 to 46 17	47 50 to 46 25	19 bergs and several growlers.
31	1098	do	46 12	46 47	Berg and many growlers.
31	1099	do	46 12	46 23	2 bergs.
31	1100	do	46 18	45 08	Berg.
31	1101	America	40 34	55 47	Large tree covered with marine growth.
31	1102	Carmia	48 25	49 30	Berg.
31	1103	do	47 47	50 55	Do.
June 1	1104	America	40 55	50 37	Tall white cage lattice top buoy sur mounted by black square top; lettered A, B, E, L, on side; lower part of buoy covered with marine growth.
1	1105	Fluorspar	41 22	48 23	Log about 20 feet long and 2 feet diameter.
1	1106	Beaverbrae	48 17	46 30	Large berg and several growlers.
1	1107	Ice patrol	42 55	49 26	Large berg, same as 1096.
1	1108	do	42 52	49 11	Large berg, same as 1092.
1	1109	do	42 48	49 17	Large berg, same as 1095.
1	1110	Montcalm	47 12	49 20	Low-lying berg.
1	1111	do	47 14	49 15	Small-piece ice.
1	1112	do	47 18	49 00	Growler.
1	1113	do	47 20	48 52	Berg.
1	1114	do	47 21	48 42	Growler.
1	1115	do	47 22	48 40	Small-piece ice.
1	1116	do	47 23	48 28	Berg.
1	1117	do	47 22 to 47 40	48 39 to 47 16	4 bergs, 2 growlers, and numerous pieces.
1	1118	do	47 26	48 30	Extremely low-lying berg and low-lying ice.
1	1119	Ice patrol	43 06	49 08	Large berg, same as 1094.
1	1120	Beaverbrae	47 46 to 47 38	48 16 to 48 46	9 bergs and numerous pieces, and soft pack.
1	1121	Ice patrol	42 40	49 25	Large berg.
1	1122	American Shipper	40 43	56 48	Spar projecting 5 feet apparently attached to submerged wreckage.
1	1123	Cape Race Station	47 15 to 46 54	51 15 to 51 40	2 large and 2 small bergs and several growlers.
2	1124	Beaverbrae	47 30	48 57	Low flat berg and small pieces.
2	1125	do	47 28	49 00	3 growlers.
2	1126	do	47 25	49 17	Berg.
2	1127	do	47 28	49 20	Do.
2	1128	Esonia	47 43	51 05	Small growlers.
2	1129	do	47 46	50 59	Do.
2	1130	Valfiorota	43 46	48 10	Large berg.
2	1131	do	43 42	48 12	Berg.
2	1132	do	43 41	48 17	Berg, 2 small bergs, and several pieces.
2	1133	Korsholm	47 55 to 47 45	50 20 to 50 50	4 bergs and several growlers.
2	1134	Concordia	46 45	52 13	Small berg.
2	1135	do	46 47	52 07	Do.
2	1136	do	46 52	52 03	Do.
2	1137	do	46 55	51 35	Do.
2	1138	Korsholm	47 14	51 45	Berg.
2	1139	Beaverbrae	47 01 to 47 06	50 10 to 49 52	5 bergs.
2	1140	Cape Race Station	46 45	52 15	Berg, same as 1134.
2	1141	do	47 01 to 47 06	50 10 to 49 52	5 bergs, same as 1139.
3	1142	do	46 43	52 27	Berg.
3	1143	do	46 41	52 33	Growler.
3	1144	do	46 44	52 38	Berg.
3	1145	Bird City	49 34	48 08	Large berg.
3	1146	Athenia	47 24	51 00	Growler.
3	1147	Concordia	47 20	51 17	Berg.
3	1148	do	47 25	50 55	Small berg.
3	1149	do	47 42	50 02	Large berg.
3	1150	do	47 39	50 15	Berg.
3	1151	Ascania	47 20	50 00	Large berg.
3	1152	do	47 16	49 50	Berg and growlers.
3	1153	do	47 27	49 50	Large berg.
3	1154	Ranja	40 37	56 05	Spar floating upright apparently attached to submerged wreckage.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by —	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 3	1155	Pennsylvania	40 15	47 30	Spar 10 feet long 3 feet diameter dangerous to navigation.
3	1156	Teucer	40 28	43 37	Red iron cylinder about 40 feet long and 6 feet high.
3	1157	Bird City	48 15	50 15	1 large and 1 small berg.
4	1158	Athenia	47 24	51 00	Growler, same as 1146.
4	1159	do	47 33	50 41	2 bergs.
4	1160	do	47 41	50 29	Growler.
4	1161	do	47 36	50 29	Berg.
4	1162	do	47 37	50 14	Do.
4	1163	do	47 42	50 14	2 growlers.
4	1164	do	47 44	50 08	1 berg.
4	1165	do	47 43	50 05	Berg.
4	1166	do	47 47	49 53	3 bergs.
4	1167	do	47 52	49 48	Berg.
4	1168	Parklaan	42 54	51 10	Large berg.
4	1169	Bird City	47 50	51 06	2 large bergs, 1 growler.
4	1170	Ascania	47 40	48 37	Large berg.
4	1171	do	47 38	48 12	24 bergs and growlers scattered north and south of track.
4	1172	Etna	44 43	47 31	Berg and growler.
4	1173	do	44 40	47 53	Do.
4	1174	do	44 30	48 44	Berg and growler.
3	1175	Blair Gourie	42 47	49 00	Berg.
3	1176	Cape Race Station	46 08	48 00	Do.
3	1177	do	46 09	47 55	Large low-lying berg.
4	1178	do	47 40	50 18	Berg and growlers.
4	1179	do	47 38	50 24	Do.
4	1180	do	47 32	50 32	Do.
4	1181	do	47 25	50 30	Do.
4	1182	Caledonia	46 42	51 49	Small berg and growler.
4	1183	do	47 04	51 33	Berg and numerous small pieces.
4	1184	Ice patrol	42 50	49 04	Large berg.
4	1185	do	42 43	49 00	Do.
4	1186	do	42 33	49 48	Large berg and growlers.
4	1187	United States	42 26	49 45	Large berg, same as 1186.
4	1188	do	42 28	50 02	Large berg.
4	1189	Caledonia	47 14	51 20	Do.
4	1190	do	47 18	50 57	Growler.
4	1191	do	47 35	50 43	2 bergs.
4	1192	do	47 28	50 40	Very large berg.
4	1193	do	47 37	50 29	Do.
4	1194	do	47 45	50 20	2 large bergs.
4	1195	do	47 40	50 08	Berg and growlers.
4	1196	Naples Maru	43 05	49 10	3 large bergs.
5	1197	Regina	47 17	50 44	Several bergs.
5	1198	Koeln	47 48	50 48	Several small bergs.
5	1199	Caledonia	47 47	49 50	Large berg.
5	1200	do	47 44	49 42	Do.
5	1201	Koeln	47 44	50 41	Several bergs.
5	1202	Naples Maru	43 10	52 08	Numerous growlers.
5	1203	do	43 07	52 17	Large berg and growlers.
5	1204	Cape Race Station	47 46	49 42	Two large bergs.
5	1205	do	47 17 to 47 44	50 44 to 49 40	A number of bergs on each side of track.
5	1206	do	48 16	49 31	Do.
5	1207	do	47 54	50 17	Do.
5	1208	do	47 50	50 25	Do.
5	1209	do	47 49	50 27	Do.
5	1210	do	47 47	50 32	Do.
5	1211	do	47 44	50 39	Do.
5	1212	do	47 37	51 50	Do.
5	1213	do	47 39	51 01	Do.
5	1214	do	47 23	51 09	Do.
5	1215	do	47 18	51 36	Do.
5	1216	do	47 04	51 58	Do.
5	1217	do	47 34	45 44	Growlers.
5	1218	do	47 27	45 48	Large berg.
5	1219	do	47 18	46 35	Do.
5	1220	Koeln	48 32	49 09	2 small bergs.
5	1221	Ice patrol	42 29	50 19	Berg and growlers, same as 1188.
5	1222	do	42 36	50 07	Berg.
5	1223	do	42 42	50 23	Do.
5	1224	do	42 26	49 53	Large berg and growlers, same as 1186.
5	1225	Regina	48 19	48 03	Large berg.
5	1226	do	48 40	47 42	Small berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 5	1227	Doric	48 24 to 48 02	48 45 to 49 40	Several growlers.
5	1228	do	48 14	49 10	Berg.
5	1229	do	48 05	49 32	Low-lying berg.
6	1230	Melita	47 49	49 43	Berg.
6	1231	do	47 46	49 51	Growlers.
6	1232	do	47 34	50 06	Berg.
6	1233	do	47 29	50 12	Do.
6	1234	do	47 40	50 20	Do.
6	1235	Empress of Australia	47 30	49 25	18 bergs, 5 growlers, numerous pieces north and south of track.
6	1236	Montrose	47 09	50 42	Growler.
6	1237	do	46 55	51 32	Do.
6	1238	do	46 51	51 49	2 bergs.
6	1239	do	46 53	52 18	Berg.
6	1240	do	46 44	52 27	Do.
6	1241	Melita	48 07	49 04	Do.
6	1242	do	48 07	49 00	Growlers.
6	1243	Montrose	47 28 to 47 11	49 07 to 50 37	7 bergs, 1 growler on or near track.
6	1244	Doric	47 25	51 07	Very large low berg.
6	1245	Polonia	45 57	43 25	Berg.
6	1246	do	44 55	46 57	Do.
6	1247	Koranton	42 59	51 16	Do.
6	1248	do	43 00	51 00	Hogshead painted black with white band carrying mast surmounted with lantern.
6	1249	Letitia	49 08	47 10	Berg.
6	1250	Empress of Australia	47 07	50 38	7 bergs, 4 growlers, and numerous pieces, one low-lying dangerous berg.
6	1251	Cairnross	48 00	50 22	Berg.
6	1252	do	48 02	50 33	Do.
6	1253	do	47 51	50 51	Berg and growlers.
6	1254	Cape Race Station	47 49 to 47 19	50 55 to 51 50	16 bergs and several growlers on both sides of track.
6	1255	do	48 26 to 47 25	48 44 to 51 07	14 bergs and many growlers on both sides of track.
6	1256	do	46 39	52 48	Large berg.
6	1257	Melita	47 32	50 26	Berg.
6	1258	do	47 29	50 24	Do.
6	1259	do	47 16	51 02	Do.
6	1260	Alaunia	47 39	49 14	Growlers.
6	1261	do	47 42	49 26	Berg.
6	1262	do	47 47	49 34	Bergs and growlers.
6	1263	do	47 29	49 24	Do.
6	1264	do	47 35	49 40	Do.
6	1265	do	47 29	49 39	Do.
6	1266	do	47 32	49 45	Do.
6	1267	Polonia	44 53	47 35	Berg.
6	1268	do	44 48	47 46	3 growlers.
6	1269	Mincio	42 58	52 30	Large berg.
6	1270	Alaunia	47 02 to 47 29	50 56 to 49 55	20 bergs and many growlers north and south of track.
6	1271	Einarjarl	40 05	44 16	Cylindrical iron tank 18 feet long 3½ feet diameter apparently long time in water, no visible marks, no color.
6	1272	Ice patrol	42 26	49 43	Berg and growlers, same as 1186.
6	1273	Bergensfjord	46 04	44 00	Berg.
6	1274	Letitia	48 24	48 46	Large berg.
6	1275	do	48 14	48 59	Do.
6	1276	Melita	46 57	51 46	Berg.
6	1277	do	46 59	52 08	Do.
6	1278	do	46 48	52 08	Do.
6	1279	do	46 44	52 15	Do.
6	1280	do	47 00	52 32	Do.
6	1281	Letitia	48 14 to 47 56	48 59 to 50 30	12 bergs with growlers and small pieces; westernmost berg 250 feet high.
6	1282	President Wilson	40 29	48 17	Large, round smooth spar 25 feet long 1 foot diameter.
6	1283	St. Amos Fafalios	42 42	51 15	Berg.
7	1284	Letitia	47 40 to 47 30	50 40 to 50 45	9 bergs, several growlers, and several pieces.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 7	1285	Scythia	48 35	46 52	Small berg.
7	1286	Eupatoria	42 11	43 26	Piece of wreck 25 meters long, 1 to 2 meters high.
7	1287	St. Amos Fafalios	41 38	48 56	Very large berg.
7	1288	Beaverbrae	47 03	51 05	3 growlers.
6	1289	Cape Race Station	46 35 to 48 00	52 15 to 48 40	40 bergs and many growlers north and south of track.
7	1290	Oxelosund	44 54	47 02	Berg.
7	1291	do	44 45	47 40	3 bergs.
7	1292	Megantic	47 12	51 06	Low-lying berg.
7	1293	do	47 04	51 11	Large berg.
7	1294	Bergensfjord	42 24	49 40	Large berg same as 1186.
7	1295	Megantic	46 58	51 34	1 large berg, 1 low berg, and 4 growlers.
7	1296	Scythia	47 33	47 31	Growlers.
7	1297	do	47 24	51 16	Small bergs.
7	1298	do	47 21	50 22	Do.
7	1299	do	47 26	50 32	Large berg.
7	1300	do	47 37 to 47 24	49 43 to 50 16	Several small pieces.
7	1301	Oxelosund	44 35	48 47	Several bergs.
7	1302	Bergensfjord	42 29	50 27	Berg.
7	1303	Pipiriki	46 27	40 55	Small berg.
7	1304	Cynthia	46 56	50 39	Small flat berg.
7	1305	do	47 02	51 14	Large berg.
7	1306	do	46 49	51 30	Small berg.
7	1307	do	46 37	51 58	Flat berg.
7	1308	do	46 40	52 22	Large berg.
8	1309	Scythia	46 40	52 10	Small berg.
8	1310	Hatteras	46 03	40 55	Berg 200 feet long, 50 feet high, same as 1298.
7	1311	Cape Race Station	48 57	50 05	Berg.
8	1312	Lord Kelvin	45 42	48 15	2 bergs.
8	1313	do	45 52	48 09	Berg.
9	1314	Montclare	46 54	51 36	Small flat berg.
8	1315	Cape Race Station	46 40	52 36	Berg drifting southwest.
9	1316	do	47 28	50 12	Berg.
9	1317	do	47 36	51 59	4 bergs.
9	1318	do	48 03	51 00	4 bergs and 1 large berg.
9	1319	do	47 54	50 33	Large berg.
9	1320	do	48 00	50 35	Do.
9	1321	do	48 08	50 44	Do.
9	1322	Montclare	47 09	50 38	Berg.
9	1323	do	47 18	50 11	Do.
9	1324	do	47 22	50 02	Growler.
9	1325	do	47 25	50 03	Berg.
9	1326	do	47 17	49 59	Do.
9	1327	do	47 16	49 56	Do.
9	1328	do	47 18	49 53	Do.
9	1329	do	46 54 to 47 37	51 33 to 48 53	28 bergs and numerous growlers north and south of track.
9	1330	Tiger	47 10 to 48 04	51 48 to 50 36	50 bergs and numerous growlers along track.
9	1331	Tyrifjord	42 52	48 41	8 bergs.
9	1332	do	42 46	48 52	Berg.
9	1333	do	42 30	49 43	Large berg, same as 1186.
9	1334	Cape Race Station	46 35	45 29	Large berg and growler.
9	1335	do	46 12	45 43	Large berg.
9	1336	do	46 18	46 03	Do.
9	1337	do	46 16	46 11	Do.
9	1338	do	48 18	50 23	Berg.
9	1339	do	48 24	50 30	Large berg.
9	1340	do	48 24 to 48 22	50 20 to 49 46	Growlers.
9	1341	do	48 28	49 50	Large berg.
9	1342	do	48 40	49 00	Do.
9	1343	do	48 22	49 01	4 small bergs and 2 small growlers.
9	1344	Montclare	48 08	47 14	Large berg.
10	1345	Ice patrol	42 32	49 48	Berg and growlers, same as 1186.
10	1346	Highcliffe	45 45	47 28	Large berg.
10	1347	do	45 39	45 25	Growlers and several pieces.
10	1348	Ice patrol	42 43	50 05	Berg.
9	1349	Cape Race Station	46 39	52 46	Large flat low berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 10	1350	Cape Race Station	46 37 to 48 16	52 33 to 48 39	8 bergs.
10	1351	do	48 24	49 00	Small berg.
10	1352	do	48 17	49 13	Do.
10	1353	do	47 47	50 12	Berg.
10	1354	do	47 45	50 26	Four bergs.
10	1355	do	47 42	50 32	Berg and 2 growlers.
10	1356	do	47 39	50 38	Berg and several growlers.
10	1357	do	47 18	51 25	2 bergs.
10	1358	do	47 03	47 51	3 small bergs and 5 growlers.
10	1359	Ice patrol	43 02	50 22	2 bergs.
10	1360	do	43 04	50 00	Berg.
11	1361	Nieu Amsterdam	48 15	46 12	Growler.
11	1362	do	48 03	46 45	Do.
11	1363	do	47 47	47 10	Do.
11	1364	Kungsholm	42 19	49 40	Small berg.
11	1365	Nieu Amsterdam	47 24	48 51	Do.
11	1366	do	47 20	49 11	Growler.
11	1367	do	47 07	49 46	Berg.
11	1368	Minnedosa	47 37	51 02	Do.
11	1369	Andania	46 37	52 33	Large berg.
11	1370	do	46 49	52 15	Growler.
11	1371	do	46 49	52 11	3 growlers.
11	1372	do	46 57	52 04	Berg.
11	1373	do	47 14	51 03	Do.
11	1374	do	47 33	50 33	3 bergs.
11	1375	do	47 30	50 09	Berg.
11	1376	do	47 35	50 10	2 bergs.
11	1377	do	47 40	49 50	2 bergs and growlers.
11	1378	do	47 57	49 34	Berg.
11	1379	do	48 00	49 10	Growler.
11	1380	do	48 18	48 30	2 growlers.
11	1381	do	48 13	48 28	Do.
11	1382	do	48 33	48 25	Large berg.
11	1383	Laurentic	46 38	52 29	Large flat berg.
11	1384	do	46 54	51 26	Small berg.
11	1385	Ice patrol	42 27	49 52	Berg, same as 1186.
11	1386	do	42 42	50 03	Large berg.
11	1387	do	42 37	50 22	Berg, same as 1343.
11	1388	do	43 05 to 42 50	50 40 to 49 45	7 bergs.
11	1389	do	42 39	49 53	Several growlers.
11	1390	Minnedosa	47 43 to 47 52	50 58 to 50 41	6 bergs and 4 growlers.
11	1391	do	48 01	50 41	11 large bergs.
11	1392	do	47 57	50 35	Growler.
11	1393	do	47 51	50 18	Berg.
11	1394	do	47 55	50 17	Do.
11	1395	do	47 58	50 20	Growler.
11	1396	do	48 02	50 21	Large berg.
11	1397	do	48 16	50 15	Do.
11	1398	do	48 06	50 15	Do
11	1399	do	48 11	49 53	Do.
11	1400	Laurentic	46 38	52 29	Do.
11	1401	do	46 54	51 26	Small berg.
11	1402	do	48 19	48 27	Growlers.
11	1403	do	48 14	48 17	Growler and small berg.
11	1404	Cape Race Station	46 49	52 25	Growlers.
11	1405	Nieu Amsterdam	46 54	51 12	Growler.
11	1406	do	46 39	52 22	Large flat berg.
11	1407	C. F. Liljevalch	47 40	52 31	Berg.
11	1408	do	47 53	52 32	Do.
11	1409	do	47 51	52 31	Growler.
11	1410	Ice patrol	42 48	49 24	Large berg.
11	1411	do	42 42	49 40	Growler.
11	1412	do	42 48	48 51	Berg.
11	1413	C. F. Liljevalch	48 10	52 35	Small berg.
11	1414	do	48 01	52 47	2 bergs.
11	1415	do	48 24	52 40	Small berg.
11	1416	do	48 20	52 35	Large berg.
11	1417	do	48 10	52 50	Several bergs and growlers along shore.
11	1418	Dalblair	39 18	50 29	Heavy spar floating vertically, projecting 6 feet.
11	1419	West Kyska	42 11	43 26	Floating oil drum on end, partly submerged.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 12	1420	Villedys	46 45	47 10	Large and 3 small bergs.
12	1421	do	46 50	47 20	Large berg.
12	1422	do	46 44	47 20	Do.
12	1423	Transylvania	48 00	49 49	Growler.
12	1424	do	47 54	50 01	Several growlers.
12	1425	Gripsholm	45 43	42 20	Partly submerged wreckage.
12	1426	Transylvania	47 33	50 45	Berg.
12	1427	do	47 14	51 59	3 small bergs.
12	1428	Montroyal	48 07	47 32	Growler.
12	1429	do	47 55	48 04	Berg.
12	1430	Cape Race Station	47 58 to 48 03	50 53 to 50 44	11 bergs.
12	1431	do	47 57 to 48 02	50 35 to 50 21	3 large bergs and 2 growlers.
12	1432	do	48 27	48 58	Small berg.
12	1433	do	47 45 to 48 10	52 45 to 51 01	40 bergs.
12	1434	Mount Royal	47 43	48 41	Berg.
12	1435	do	47 35	49 17	Large berg and 2 growlers.
12	1436	Transylvania	46 59	52 00	Small berg and growler.
12	1437	do	46 59	52 14	Do.
12	1438	do	46 45	52 40	Large berg and 7 growlers.
12	1439	Mount Royal	47 28	49 33	Growler.
12	1440	do	47 31	49 34	Large berg.
12	1441	do	47 22	50 16	Berg and several growlers.
12	1442	Montroyal	47 27	48 38	Berg.
12	1443	do	47 31	49 41	2 bergs.
13	1444	Cameronia	48 05	49 45	Several pieces of ice.
13	1445	Crefeld	49 03 to 48 33	50 48 to 51 16	Great number of large and small bergs; many bergs still ahead.
13	1446	Zonnewyk	42 52	51 32	Small berg.
13	1447	do	43 01	51 56	Berg.
13	1448	do	43 06	51 56	Large berg.
13	1449	do	43 15	52 12	2 bergs.
13	1450	Gripsholm	42 31	49 33	Berg.
12	1451	Cape Race Station	48 40	45 30	Long, low dangerous berg 4 feet high.
13	1452	Urania	47 43	48 12	Low berg.
13	1453	do	47 50	48 12	Growler.
13	1454	do	47 48	48 08	Do.
13	1455	Pennland	48 32	45 28	Low-lying berg.
13	1456	Ice patrol	42 57	49 16	Berg and growlers.
13	1457	do	42 54	49 16	Small berg.
13	1458	Crefeld	47 38	51 48	3 large bergs.
13	1459	do	48 30 to 47 38	51 16 to 51 48	Many bergs.
13	1460	Ice patrol	42 55	49 40	Large berg and growlers.
13	1461	do	42 53	49 50	Do.
13	1462	do	42 58	49 41	Berg.
13	1463	Aurania	47 52	48 42	Berg and growler.
13	1464	do	47 44	48 58	Growler.
13	1465	do	47 43	49 00	Small growler.
13	1466	do	47 38	49 19	Large berg.
13	1467	Metagama	48 26	48 17	Low berg.
13	1468	Pennland	48 08	47 17	Growler and several pieces.
13	1469	Montroyal	47 07	51 04	Large berg.
13	1470	Beaverbrae	47 14	49 12	Berg.
13	1471	do	47 18	48 54	Do.
13	1472	do	47 22	48 42	Do.
13	1473	do	47 24	48 42	Do.
13	1474	do	47 27	48 42	Do.
13	1475	do	47 26	48 32	Do.
13	1476	do	47 20	48 30	Do.
13	1477	do	47 21	48 29	Do.
13	1478	Metagama	48 06	49 04	Large berg.
13	1479	do	48 02	49 11	Do.
13	1480	do	47 55	49 35	Small berg.
13	1481	Empress of Australia	46 46	52 27	Large low berg.
13	1482	Frode	47 38	44 22	Several heavy growlers.
13	1483	Deerlodge	40 53	47 10	White cage top buoy.
13	1484	Cape Race Station	47 18	48 54	Berg.
13	1485	do	48 36	49 43	Do.
13	1486	do	48 10	50 18	Large berg.
13	1487	do	48 05	50 30	Several bergs in vicinity.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north °	′	Position: Longitude west °	′	Nature of ice or obstruction
June 13	1488	Cape Race Station	47	53	50	45	Small berg.
13	1489	do	47	30	49	39	Berg.
13	1490	do	47	29	49	44	Do.
13	1491	do	48	45	50	55	Do.
13	1492	do	48	49	50	31	Do.
13	1493	do	48	30	50	21	Do.
13	1494	do	48	39	50	38	Do.
13	1495	Metagama	47	56	49	40	Do.
13	1496	do	47	53	49	42	Do.
13	1497	do	47	44	50	28	Do.
13	1498	do	47	38	50	47	Large low-lying berg.
13	1499	do	47	56	49	40	Berg.
13	1500	Aurania	47	30	49	39	Do.
13	1501	do	47	29	49	44	Do.
13	1502	Antonia	48	45	50	58	Do.
13	1503	do	48	22	51	36	Do.
13	1504	do	48	20	51	45	Do.
13	1505	do	48	13	51	51	Do.
13	1506	do	48	04	51	48	Do.
13	1507	do	48	01	51	58	Do.
13	1508	do	48	38	51	41	Do.
13	1509	do	48	24	51	45	Do.
13	1510	do	48	16	51	40	Do.
13	1511	do	48	10	51	59	Do.
13	1512	do	48	03	51	48	Do.
13	1513	do	48	40	51	21	Do.
13	1514	do	48	29	51	42	Do.
13	1515	do	48	20	51	45	Do.
13	1516	do	48	17	51	58	Do.
13	1517	do	48	09	51	56	Do.
13	1518	do	48	02	51	48	Do.
13	1519	do	47	56	52	11	Do.
13	1520	do	47	54	52	18	Do.
13	1521	Pennland	48	08	47	17	Growler and small berg.
13	1522	do	47	55	48	13	Small berg.
13	1523	do	47	42	48	40	Small flat berg.
13	1524	do	47	36	48	31	Berg.
13	1525	do	47	33	48	43	Do.
14	1526	Metagama	46	56	51	54	Large berg.
14	1527	do	46	55	51	56	Do.
14	1528	do	46	55	51	57	Do.
14	1529	do	46	51	52	13	Large long berg.
13	1530	Cape Race Station	46 46 to 48 00		48 50 to 52 27		35 bergs and growlers.
14	1531	do	48	38	48	00	Berg.
14	1532	do	48	00	48	12	Do.
14	1533	do	47	54	48	52	Do.
14	1534	do	48	00	49	16	Do.
14	1535	do	47	47	49	31	Do.
14	1536	do	48	26	48	17	Do.
14	1537	do	48	06	49	04	Do.
14	1538	do	48	02	49	11	Do.
14	1539	do	47	55	49	35	Do.
14	1540	do	47	56	49	40	Do.
14	1541	do	47	56	49	42	Do.
14	1542	do	47	53	49	42	Do.
14	1543	do	47	44	50	28	Do.
14	1544	do	47	38	50	47	Do.
14	1545	Frode	46	16	47	50	Large and 2 small bergs.
14	1546	Empress of Australia	47	33	48	36	Berg.
14	1547	do	47	55	46	55	Do.
14	1548	Stagpool	45	00	48	35	2 large and 2 small bergs.
14	1549	Cape Race Station	47	20	49	37	Berg.
14	1550	do	47	47	47	32	Do.
14	1551	do	46	52	51	07	Do.
14	1552	Beaverford	47	58	46	56	Small berg, same as 1547.
14	1553	do	47	49	47	42	Small berg.
14	1554	do	47	36	48	35	Berg.
14	1555	do	47	31	48	53	Small berg.
14	1556	do	47	27	49	10	Do.
14	1557	do	47	25	49	08	Do.
14	1558	do	47	25	49	37	Berg.
14	1559	do	47	15	49	52	Large berg and 1 growler.
14	1560	do	47	11	49	56	Large berg.
14	1561	Toruguero	40	09	51	34	Spar 40 feet long covered with marine growth.
14	1562	do	40	09	51	08	Spar 50 feet long 2 feet diameter covered with marine growth.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 14	1563	Pennland	47 02	52 07	Small berg.
14	1564	do	46 50	52 27	Large berg.
14	1565	Nevisian	37 28	67 26	Schooner Cutty Sark abandoned on fire rudder gone, salt cargo, leaking badly.
14	1566	Mansepool	42 48	50 05	Berg and growler.
14	1567	Cape Race Station	47 27 to 47 50	49 25 to 48 20	18 bergs and numerous growlers.
14	1568	do	47 25 to 47 00	49 25 to 51 13	6 bergs.
14	1569	do	48 10	47 12	Growlers.
14	1570	do	48 07	47 25	Small berg.
14	1571	do	48 00	48 0[illegible]	Berg.
14	1572	do	47 54	48 53	Large berg and growlers.
14	1573	do	47 51	49 04	Berg.
14	1574	do	47 39	48 58	Do.
14	1575	do	47 40	49 06	Do.
14	1576	do	43 45	51 20	Do.
15	1577	Hesperos	43 17	48 10	Do.
15	1578	Melmore Head	48 09	48 39	Large growler.
15	1579	do	47 56 to 47 37	48 50 to 48 47	4 large and 1 small berg and 1 growler.
15	1580	do	47 55	49 09	2 large bergs, 2 large growlers.
15	1581	Toruguero	41 22	45 02	Large rusty iron barrel, shape resembling buoy.
15	1582	City of Fairbury	45 05	47 16	Berg.
15	1583	do	44 55	47 44	Large berg.
15	1584	do	44 47	48 25	Several small bergs and growlers.
15	1585	do	44 41	48 36	Small berg.
15	1586	Valleluce	43 55	48 14	2 large bergs.
15	1587	Ice patrol	42 17	49 23	Berg.
15	1588	Hesperos	43 06	49 04	Do.
15	1589	do	43 06	49 15	Large berg and several growlers.
15	1590	Manchester Hero	48 10	49 03	Berg.
15	1591	Montrose	47 14 to 47 30	49 38 to 48 22	12 bergs and numerous growlers.
15	1592	Tortuguero	41 40	44 16	Large rusty iron barrel resembling a buoy.
15	1593	Manchester Hero	47 50	49 50	2 large bergs and several growlers.
15	1594	Valleluce	43 50 to 44 00	48 12 to 48 35	8 large bergs.
15	1595	Melmore Head	47 34	49 57	2 bergs and 1 growler.
15	1596	Amersham	45 29	49 20	Small berg.
15	1597	do	45 27	47 22	Large berg.
15	1598	do	45 20	45 17	Growler.
15	1599	Ovre	47 46	41 17	Berg.
15	1600	Melmore Head	47 18	50 55	Growler.
15	1601	do	47 11	50 51	Large berg.
15	1602	City of Canberra	48 00	47 18	Berg 100 feet high 600 feet long.
16	1603	Montrose	47 45	48 08	Very large berg.
16	1604	do	47 44	48 05	Large berg.
16	1605	do	47 56	47 19	Berg.
16	1606	do	47 49	47 02	Growler.
16	1607	City of Canberra	47 42	48 27	Large berg.
16	1608	Cape Race Station	48 06	49 09	Do.
16	1609	do	48 12	49 52	Do.
16	1610	do	48 11	50 20	Berg.
16	1611	Megantic	47 14	49 02	Small growler.
16	1612	do	47 18	48 41	Small growler and several pieces.
14	1613	Cape Race Station	46 58	51 10	Large berg.
14	1614	do	47 10	50 20	Do.
14	1615	do	47 15	49 40	2 bergs.
14	1616	do	47 27	49 40	Very large berg and several growlers.
14	1617	do	46 34	52 39	Several growlers.
17	1618	do	48 02	51 56	Large berg.
17	1619	do	48 18	51 29	Do.
17	1620	Melita	47 00	51 20	Berg.
17	1621	do	47 18	50 43	Large berg.
17	1622	Nova Scotia	47 52 to 48 02	51 35 to 51 00	6 bergs and 1 growler.
18	1623	Ice patrol	42 55	49 40	Growler.
18	1624	do	42 46	51 35	2 large bergs.
18	1625	do	42 46	52 19	Small berg.
18	1626	do	42 38	52 02	Berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north		Position: Longitude west		Nature of ice or obstruction
			°	′	°	′	
June 18	1627	Dutchess of Bedford	47	16	49	38	Berg.
18	1628	do	47	20	48	55	Do.
17	1629	Cape Race Station	47	17	52	12	Berg and 2 growlers.
17	1630	do	47	14	50	44	Berg.
18	1631	do	48	00	51	12	2 bergs.
18	1632	Iserholm	42	10	48	12	Large berg.
18	1633	Dutchess of Bedford	47	20	48	34	Berg.
18	1634	do	47	29	48	25	Berg and 2 growlers.
18	1635	do	47	32	48	12	Berg.
18	1636	Izarco	57	10	44	28	Red conical buoy carrying number 2.
18	1637	Calgaric	47	14	50	44	Large berg.
19	1638	Ice patrol	42	37	50	56	Berg.
18	1639	Cape Race Station	47	31	49	45	Do.
18	1640	do	47	27	48	34	2 bergs.
18	1641	do	47	43	50	44	Berg.
18	1642	do	47	38	48	20	Do.
18	1643	do	47	40	48	09	Do.
18	1644	do	47	10	52	03	Large berg.
18	1645	do	47	46	50	37	Berg.
18	1646	do	47	36	50	53	Do.
18	1647	do	47	24	51	45	Do.
18	1648	do	48	15	52	10	Growlers.
18	1649	do	47	25	49	35	Berg and growlers.
18	1650	do	47	43	49	45	Large berg.
18	1651	do	47	13	49	54	Do.
18	1652	Concordia	43	16	51	10	Berg.
19	1653	Letitia	48	14	48	11	Large berg.
19	1654	Ice patrol	42	50	51	30	2 bergs.
19	1655	do	42	53	52	13	Berg.
19	1656	do	43	00	52	40	Berg and growler.
18	1657	Cape Race Station	47	28	51	25	2 bergs.
18	1658	do	47	38	48	22	Berg.
19	1659	Collamer	42	13	48	23	Do.
19	1660	Levenbridge	45	25	49	27	Growler.
19	1661	Ice patrol	42	23	48	33	Berg, same as 1659.
19	1662	Cape Race Station	47	18	51	52	Berg.
19	1663	do	47	24	51	55	Do.
19	1664	do	47	20	51	32	Do.
19	1665	do	46	34	52	35	Do.
19	1666	do	47	00	49	29	Do.
19	1667	do	47	32	49	25	Do.
19	1668	do	47	38	49	06	Do.
19	1669	do	47	41	48	55	Do.
19	1670	do	47	34	48	55	Do.
19	1671	do	47	44	48	45	Do.
19	1672	do	47	54	48	52	Do.
19	1673	do	47	40	48	40	Do.
19	1674	do	47	58	48	38	Do.
19	1675	do	47	49	48	34	Do.
19	1676	do	47	44	48	38	Do.
19	1677	do	47	38	48	47	Do.
19	1678	do	47	49	48	55	Do.
19	1679	do	47	45	49	01	2 bergs.
19	1680	do	47	43	49	03	Berg.
19	1681	do	47	40	49	27	Do.
19	1682	do	47	35	49	29	Do.
19	1683	do	47	12	50	02	Do.
19	1684	do	47	00	51	00	Growlers.
19	1685	do	46	33	52	29	Do.
19	1686	do	48	14	47	41	Do.
19	1687	do	47 52 to 47 49		48 49 to 49 08		Many bergs and growlers.
19	1688	do	47	44	49	14	3 bergs.
19	1689	do	47	42	49	27	Berg.
19	1690	do	47	39	49	42	Do.
19	1691	do	47	31	52	46	Do.
19	1692	do	47	02	52	46	Do.
19	1693	do	47	14	52	44	Do.
19	1694	do	47	26	52	39	Do.
19	1695	do	47	24	52	41	Do.
19	1696	do	47	25	52	32	Do.
19	1697	do	47	31	52	35	Do.
19	1698	do	47	02	50	40	Large berg.
19	1699	do	46	32	52	25	Very large flat berg.
19	1700	do	47	55	50	45	Berg.
19	1701	do	48	08	50	29	Do.
19	1702	do	48	25	49	58	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 19	1703	Cape Race Station	47 45	51 05	7 bergs in vicinity.
19	1704	do	47 26	52 37	Several bergs.
19	1705	Ausonia	47 53	47 36	Berg.
20	1706	do	47 42	48 46	Do.
20	1707	do	47 56	47 51	Small berg.
20	1708	Doric	47 10	51 10	Large berg.
20	1709	Cape Race Station	48 10	49 24	Do.
20	1710	do	48 10	49 27	Large growler.
20	1711	do	48 20	49 30	Large berg.
20	1712	do	47 57	50 23	Berg.
20	1713	do	47 51	50 18	Do.
20	1714	do	47 31	50 39	Do.
20	1715	do	47 49	50 44	Do.
20	1716	do	47 44	50 51	Do.
20	1717	do	47 25	51 35	Do.
20	1718	do	46 40	52 40	Do.
20	1719	do	47 23 to 47 58	52 35 to 52 43	14 bergs.
20	1720	do	47 53	49 11	Large berg.
20	1721	do	47 49 to 48 20	52 47 to 50 45	14 bergs, many growlers.
20	1722	Doric	48 31	48 04	Large growler.
18	1723	Cairnross	47 20	51 45	Berg.
18	1724	do	47 28	51 35	2 bergs.
18	1725	do	48 15	50 10	Growlers.
20	1726	Cragpool	45 24	49 23	Small berg and growler.
20	1727	do	45 19	48 58	Berg and growler.
20	1728	Caledonia	47 35	49 22	Large berg and several growlers extending 5 miles north.
20	1729	do	47 13	50 35	Large berg.
20	1730	do	46 34	52 21	Large flat top berg.
20	1731	do	46 41	52 47	2 large bergs.
20	1732	do	46 34	52 43	Small berg.
20	1733	Montcalm	47 48 to 47 28	48 25 to 49 20	14 bergs and many growlers.
20	1734	Bothwell	47 48	48 05	Berg.
20	1735	do	47 59	47 31	Do.
20	1736	Montcalm	47 28 to 47 12	49 20 to 51 00	5 bergs.
20	1737	Cape Race Station	47 56 to 47 17	50 23 to 51 52	14 bergs north and south of track.
20	1738	do	47 37	50 42	Very large berg.
20	1739	do	47 53	47 25	Large berg.
20	1740	do	47 56	47 51	Small berg.
20	1741	do	47 42	48 46	Berg.
20	1742	do	47 30	49 28	Large berg.
20	1743	do	47 15	50 38	Small berg.
20	1744	do	46 30	52 20	Large berg.
20	1745	do	46 34	52 33	Small berg.
21	1746	Valfiorita	43 08	52 47	Large berg.
21	1747	do	42 55	51 45	1 small and 2 large bergs to north, 1 berg to south.
21	1748	Lake Gorin	43 14	48 36	Berg.
21	1749	do	43 09	48 42	Do.
21	1750	do	43 03	49 06	Berg and several growlers.
21	1751	Cape Race Station	46 32	52 48	Large berg.
21	1752	Carinthia	41 13	49 59	Large red conical buoy unlit.
21	1753	Ice patrol	42 42	48 06	Berg, same as 1659.
20	1754	Athenia	48 12	48 51	Growler.
20	1755	do	48 05	49 04	Berg.
20	1756	do	48 15	49 10	Do.
20	1757	do	47 45	49 10	Do.
20	1758	do	47 59	49 26	Do.
20	1759	do	48 07	49 38	Do.
20	1760	do	47 34	50 34	Do.
21	1761	do	46 53	52 42	Do.
21	1762	do	46 45	52 42	Do.
21	1763	do	46 43	52 43	Do.
21	1764	Brighton	46 00 to 46 00	47 44 to 48 00	3 low bergs.
21	1765	New York	41 22	49 57	Red conical buoy marked "2AFP."
21	1766	Lake Gorin	43 08	50 27	Berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 21	1767	Lake Gorin	43 02	50 31	2 bergs.
21	1768	do	43 08	50 42	Berg 60 feet high.
21	1769	Ice patrol	42 42	49 00	Berg.
21	1770	do	42 45	49 11	Large tabular berg.
21	1771	Valfiorita	42 41	49 56	Large and 2 small bergs.
21	1772	do	42 49	49 44	Berg.
21	1773	Lake Gorin	43 16	51 12	Do.
21	1774	do	43 21	51 20	Do.
21	1775	Valnegra	44 33	48 55	2 large bergs and several growlers.
21	1776	Schenectady	41 30	50 25	Red nun buoy marked "2AFP."
21	1777	Lake Gorin	43 04	51 25	Large berg.
21	1778	do	43 17	51 36	3 large bergs, same as 1747.
21	1779	do	43 05	51 48	Large berg, same as 1747.
21	1780	Valfiorita	42 33	49 08	Small berg, same as 1779.
21	1781	Montroyal	46 37	52 41	Large berg and several pieces.
21	1782	do	46 39	52 38	Large berg.
21	1783	do	46 45	52 39	Small berg.
21	1784	do	46 35	52 19	Large berg.
21	1785	do	47 06	51 45	Berg.
22	1786	do	47 29	50 13	Berg and pieces.
22	1787	Lituania	45 22	48 31	Berg.
22	1788	do	45 16	47 55	Do.
22	1789	Ice patrol	42 42	49 18	Berg, same as 1780.
22	1790	do	42 40	49 54	Small berg, same as 1782.
22	1791	do	42 35	50 02	Growler, same as 1781.
22	1792	do	42 35	50 10	Berg, same as 1781.
22	1793	do	42 38	49 08	Berg, same as 1779.
22	1794	Montroyal	48 01	49 24	Large berg and pieces.
22	1795	do	47 57	49 03	Do.
22	1796	do	47 50	48 58	Large berg.
22	1797	do	47 57	48 32	Do.
23	1798	Cold Harbor	42 20	49 23	Large berg, small berg 4 miles to eastward.
23	1799	Coelleda	43 15	49 20	Large growler.
23	1800	Villedys	45 26	47 56	Big berg.
22	1801	Wright	46 48	44 01	Berg.
22	1802	do	46 55	44 07	Small berg.
22	1803	Cape Race Station	48 16	51 30	Large berg 150 feet high, with 1 fairly large berg, 2 small bergs, and numerous growlers in vicinity.
22	1804	do	48 40	50 29	Large flat berg 60 feet high.
22	1805	do	48 00 to 47 30	47 50 to 50 00	Numerous bergs.
22	1806	do	46 35	52 24	Large berg and numerous growlers.
22	1807	do	46 41	52 42	Large berg.
23	1808	Ice patrol	42 37	50 12	Berg.
23	1809	do	42 46	50 39	Do.
23	1810	do	42 51	50 38	Large berg.
23	1811	do	43 06	50 21	Do.
23	1812	do	43 05	50 28	Berg.
23	1813	do	43 03	50 25	Growlers.
23	1814	do	43 11	50 36	Large berg.
23	1815	Cape Race Station	46 32	52 45	Do.
23	1816	Quaker City	43 31	51 39	Small berg.
23	1817	Cold Harbor	42 25	50 20	Berg with small berg 3 miles north, same as 1818.
23	1818	Ice patrol	43 24	51 09	Large berg.
23	1819	do	43 25	51 18	Large high berg.
23	1820	do	43 25	51 22	Small berg.
23	1821	do	43 29	51 31	Berg.
23	1822	do	43 29	51 42	Large flat-topped berg.
23	1823	Cold Harbor	42 37	50 51	Berg.
23	1824	do	43 05	50 35	Do.
23	1825	Coelleda	43 13	51 14	Large low growler.
23	1826	Quaker City	44 10	48 48	Berg.
23	1827	Waukegan	42 20	49 20	Berg, same as 1808.
23	1828	do	42 24	49 05	Do.
23	1829	Ice patrol	42 59	51 46	Large berg.
23	1830	do	42 53	51 57	Do.
23	1831	do	43 03	52 10	Large low berg.
23	1832	do	42 44	52 09	Berg.
23	1833	Cold Harbor	42 27	51 42	3 bergs to northwest 10 to 15 miles, same as 1839–41.
23	1834	Ice patrol	42 53	51 36	Berg.
23	1835	Cold Harbor	42 33	52 11	Small berg.
23	1836	Ice patrol	42 55	51 24	Berg.
23	1837	McKeesport	42 48	48 00	Large berg.
23	1838	Coelleda	43 19	51 38	Berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north		Position: Longitude west		Nature of ice or obstruction
			°	′	°	′	
June 23	1839	Coelleda	43	21	51	44	Berg.
23	1840	do	43	18	51	47	Growler.
23	1841	do	43	24	51	54	Berg.
23	1842	do	43	24	51	50	Do.
23	1843	do	43	06	51	57	Do.
23	1844	do	43	06	52	00	Do.
23	1845	do	43	15	52	02	Growler and small pieces.
23	1846	do	43	05	52	05	Berg.
23	1847	do	43	08	52	24	Small berg.
23	1848	do	43	07	52	40	Do.
23	1849	Cape Race Station	47	00	47	38	8 bergs within radius of 5 miles.
23	1850	do	47	05	48	14	Berg.
23	1851	Leviathan	41	21	50	20	Buoy marked "2AFP."
24	1852	Bird City	42	38	48	38	Berg.
24	1853	Aurania	46	56	51	38	Do.
24	1854	Beaverford	47	12	50	32	Do.
24	1855	Bird City	42	00	50	00	Large berg.
24	1856	do	42	20	49	18	Large berg and small berg.
24	1857	Cape Race Station	47	20	49	37	Berg.
24	1858	California	48	18	49	09	Do.
24	1859	do	47	44	50	02	Do.
24	1860	do	47	37	50	07	Do.
24	1861	do	46	36	50	25	Do.
24	1862	do	47	34	50	27	Do.
24	1863	do	47	44	50	37	Do.
24	1864	do	47	24	50	45	Do.
24	1865	do	47	21	50	51	Do.
24	1866	do	47	37	50	52	Do.
24	1867	do	47	30	51	03	Do.
24	1868	do	47	37	51	06	Do.
24	1869	do	47	37	51	08	Do.
24	1870	do	47	27	50	41	Growler.
24	1871	do	47	36	50	25	Many growlers.
24	1872	do	47	21	51	30	Berg.
24	1873	do	47	22	51	31	Do.
24	1874	do	47	16	51	25	Do.
24	1875	do	47	03	51	53	Berg and growlers.
24	1876	Ice patrol	43	02	52	18	Berg.
24	1877	do	42	48	52	13	Do.
24	1878	do	42	55	52	03	Do.
24	1879	do	43	04	50	52	Do.
24	1880	do	43	00	50	33	Do.
24	1881	Ausonia	47	07	51	15	Do.
24	1882	do	47	17	50	56	Very large berg.
24	1883	do	47	13	50	34	Small berg.
24	1884	do	47	08	50	21	Berg.
24	1885	do	47	06	50	20	Growler.
24	1886	do	47	30	50	00	Berg.
24	1887	Bird City	42	51	48	25	Large berg.
24	1888	Svendal	43	30	49	16	7 large bergs.
24	1889	Beaverford	47	20	49	37	Small berg.
24	1890	do	47	25	49	03	3 small growlers.
24	1891	do	47 26 to 47 35		48 56 to 48 15		13 large scattered bergs.
24	1892	Ice patrol	42	24	50	00	Large growler.
24	1893	do	42	18	49	50	Small berg.
24	1894	California	46	55	52	05	Do.
24	1895	Aurania	47	22	49	38	Berg.
24	1896	do	47	23	49	35	Growler.
24	1897	Beaverford	47 45 to 47 38		47 35 to 47 58		4 scattered bergs.
24	1898	Cape Corso	43	03	52	55	Large berg.
24	1899	do	43	00	53	03	Berg.
24	1900	do	42	57	53	00	Do.
24	1901	do	42	55	52	35	Do.
24	1902	Svendal	43	30	49	16	Large berg, same as 1898.
24	1903	Cape Race Station	47 07 to 47 26		50 41 to 51 38		7 bergs and some growlers.
24	1904	do	46	44	51	10	2 small bergs.
24	1905	do	46	49	52	14	Growler.
24	1906	do	47	00	51	39	Berg.
24	1907	do	47	10	51	22	Do.
24	1908	do	47	21	50	49	Do.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 24	1909	Cape Race Station	47 33	50 26	2 large bergs.
25	1910	Veendam	47 44	48 25	Berg.
25	1911	Ausonia	47 38	48 37	Do.
25	1912	do	47 35	48 27	Do.
25	1913	Maria Mediaca	45 21	48 10	7 bergs.
25	1914	Cape Corso	42 05	49 48	Large berg.
25	1915	Montclare	47 53	48 42	Large berg and many bergy bits.
25	1916	Veendam	46 55	51 32	Berg.
25	1917	do	46 57	51 39	Do.
25	1918	do	46 33	52 11	Do.
25	1919	Transylvania	46 13	52 45	Do.
25	1920	do	46 22	52 32	Do.
25	1921	do	46 34	52 27	Do.
25	1922	Bellhaven	46 25	47 20	Large berg.
25	1923	Metagama	46 56	51 38	Do.
25	1924	do	46 58	51 32	Do.
25	1925	Cape Race Station	46 32	52 53	Large flat berg.
25	1926	do	48 04 to 47 15	49 50 to 51 28	8 bergs and some growlers on both sides of track.
25	1927	Transylvania	46 32	52 16	Large berg.
25	1928	do	46 53	51 43	Berg and growlers.
25	1929	do	46 55	51 46	Do.
25	1930	Montclare	47 29	50 05	Berg
25	1931	do	47 25	50 21	Do.
25	1932	do	47 22	50 33	Several small pieces.
25	1933	Metagama	47 37	50 00	Large berg.
25	1934	Transylvania	47 22	50 30	Numerous growlers.
26	1935	Carlsholm	47 19	51 34	1 large berg and 1 small berg.
26	1936	do	47 54	50 37	2 bergs.
26	1937	Cape Race Station	46 43	52 48	Berg.
26	1938	do	46 35	52 11	Very large berg.
26	1939	Minnedosa	47 25	50 21	Large berg.
26	1940	do	47 25	50 40	Do.
26	1941	do	47 27	50 49	Do.
26	1942	do	47 16	50 53	Berg.
26	1943	do	47 21	51 06	Large berg.
26	1944	do	47 07	51 32	Small berg.
26	1945	Cape Race Station	48 03	50 34	Large berg.
26	1946	do	47 54	50 44	2 bergs.
26	1947	do	47 38	50 32	Berg.
26	1948	do	47 42	50 42	2 bergs.
26	1949	do	46 46	52 03	Large berg.
26	1950	do	47 50	51 44	Berg.
26	1951	do	47 04	51 35	Do.
26	1952	do	47 00	51 23	Do.
26	1953	do	47 13	50 45	Large berg.
27	1954	Malaren	44 43	44 18	Berg.
27	1955	Cape Race Station	46 43	52 49	Do.
28	1956	Laurentic	47 47	49 52	Do.
27	1957	Empress of Australia	47 13	50 40	Do.
27	1958	do	46 52	51 39	Growler.
27	1959	do	46 51	51 43	Berg.
27	1960	do	46 49	51 50	Do.
27	1961	do	46 34	52 52	Growler.
27	1962	do	46 33	52 56	Berg.
27	1963	Munchen	41 30	50 25	Red conical buoy marked "2AFP."
28	1964	Laurentic	47 52	50 09	Small berg.
28	1965	do	47 30	50 41	Do.
28	1966	do	47 32	50 47	Do.
28	1967	do	47 31	50 52	Medium berg.
28	1968	do	47 17	50 44	Large berg.
28	1969	do	47 28	51 04	1 large berg, 1 small berg.
28	1970	do	47 19	51 06	Small berg.
28	1971	do	47 13	51 03	Large berg.
28	1972	Arabic	48 02	46 50	Small berg.
28	1973	do	47 44	49 20	Large berg.
28	1974	Svithiod	42 27	49 06	Small berg.
27	1975	Cape Race Station	46 30	53 00	Berg aground.
28	1976	Arabic	47 32	49 45	Large berg.
28	1977	Cape Race Station	46 43	52 49	2 bergs drifting south.
28	1978	Arabic	47 34	49 47	Growler.
28	1979	do	47 25	50 08	Berg.
28	1980	do	47 31	50 24	Do.
28	1981	do	47 33	50 26	Do.
28	1982	do	47 31	50 30	Small berg.
28	1983	do	47 31	50 40	Berg.
28	1984	Alf	46 05	52 47	Large berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north	Position: Longitude west	Nature of ice or obstruction
			° ′	° ′	
June 28	1985	Arabic	47 47	51 08	Berg.
28	1986	do	47 10	51 38	Berg and growler.
28	1987	do	46 53	51 46	Berg.
28	1988	do	46 55	51 52	Do.
28	1989	do	46 38	52 30	Large berg.
29	1990	W. D. Anderson	42 32	48 36	Small berg.
29	1991	Santa Aurora	42 18	50 21	Do.
29	1992	Ice patrol	42 26	50 12	Berg.
29	1993	Cape Race Station	46 44 to 46 34	52 44 to 52 53	5 bergs.
29	1994	Nortonian	45 44	48 28	Large berg.
29	1995	Ellen	46 16	47 06	Scattered small bergs.
29	1996	do	46 18	47 29	Berg 660 feet long 170 feet high.
29	1997	Nortonian	46 12	47 02	Bergs and growlers, same as 1995.
29	1998	do	46 10	46 56	Large berg.
29	1999	Cape Race Station	46 49	51 30	Berg.
29	2000	Nortonian	45 47	48 08	2 large growlers.
29	2001	do	45 56	47 55	Large berg and several growlers.
29	2002	do	45 57	47 50	Small berg.
29	2003	do	46 12	47 24	Large berg, same as 1996.
29	2004	Cape Race Station	46 42	51 42	Berg.
29	2005	do	46 34	52 07	Do.
29	2006	Montcalm	46 31	52 50	Large berg.
29	2007	do	46 49	52 50	2 large bergs.
29	2008	do	46 32	52 14	Large berg.
29	2009	do	46 44	51 44	Berg.
29	2010	do	46 48	51 28	Large berg.
29	2011	Edderheim	42 08	52 28	Berg and growlers.
30	2012	Montcalm	47 26	48 54	Berg.
30	2013	Tigura	44 20	48 30	Do.
30	2014	Ville Dys	44 20	49 30	Mast of a sailing vessel.
30	2015	Montcalm	48 12	45 30	Berg.
30	2016	Winnebago	45 30	47 12	Do.
30	2017	do	45 30	47 12	Do.
30	2018	Cape Race Station	46 38	52 51	Do.
30	2019	do	47 03	51 40	Do.
30	2020	do	47 04	51 39	Do.
30	2021	do	47 13	51 14	Do.
30	2022	do	47 30	50 53	Do.
30	2023	do	47 21	50 39	Do.
30	2024	do	47 26	50 32	Do.
30	2025	do	47 31	50 27	Do.
30	2026	do	47 50	50 08	Do.
30	2027	do	47 54	49 52	Do.
30	2028	do	47 43	49 47	Do.
July 1	2029	Lancastria	40 26	58 55	Buoy about 12 feet high, with frame structure and light.
1	2030	Cape Race Station	47 52	51 42	2 bergs.
1	2031	do	48 00	51 46	Do.
1	2032	Maroc	43 50	51 40	Berg.
1	2033	do	43 50	51 47	Do.
2	2034	Cape Race Station	46 35	52 44	Do.
2	2035	do	46 36	52 43	Growler.
2	2036	Calgaric	47 23	51 47	Berg.
2	2037	do	47 23	51 43	Large growler and several small ones.
3	2038	Cape Race Station	47 45	51 20	Large berg.
3	2039	Reliance	41 03	46 20	Wreckage of wooden ship not visible above surface.
3	2040	Ice patrol	43 03	53 07	Berg and growlers.
4	2041	Port Darwin	43 09	49 22	2 bergs and 1 growler.
3	2042	Cape Race Station	46 25	52 49	Large berg.
3	2043	do	46 22	52 42	Berg.
3	2044	do	46 39	52 51	Do.
3	2045	do	46 42	52 43	Do.
4	2046	Port Darwin	43 08	48 49	Berg 15 feet high 150 feet long and several growlers.
4	2047	do	43 04	48 49	Berg.
4	2048	Cape Race Station	47 54	50 55	Large berg and 6 growlers.
4	2049	do	47 45	50 00	Berg.
4	2050	do	47 38	50 15	Growler.
4	2051	do	47 35	50 20	Berg and growlers.
4	2052	do	47 33	50 24	Do.
4	2053	do	46 30 to 46 43	52 51 to 52 49	4 bergs.
4	2054	Ice patrol	42 26	50 00	Large berg.
4	2055	do	42 31	50 00	Small berg.

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north °	′	Position: Longitude west °	′	Nature of ice or obstruction
July 4	2056	Letitia	48	12	49	40	Berg.
4	2057	do	47	48	50	03	Berg, same as 2049.
4	2058	Ice patrol	42	04	49	34	Berg.
4	2059	Malmen	41	51	49	33	Small berg, same as 2058.
5	2060	Ice patrol	42	05	49	33	Do.
4	2061	Cape Race Station	47	28	51	42	Berg.
4	2062	do	47	38	51	23	Do.
4	2063	do	47	50	51	08	Do.
4	2064	do	47	52	50	34	Do.
4	2065	do	47	58	50	34	Several small pieces.
4	2066	do	48	13	50	12	Large berg.
4	2067	do	48	30	49	57	Do.
4	2068	do	46	23	52	10	Do.
4	2069	do	46	41	52	20	2 large bergs.
4	2070	do	46	42	52	32	Large berg several growlers.
4	2071	do	48	19	49	45	Small berg.
4	2072	do	48	25	50	14	Large berg.
4	2073	do	48 to 47	26 to 33	50 to 52	02 to 32	17 large bergs and numerous growlers north and south of track.
5	2074	San Ugon	40	13	49	37	Buoy marked "FID US Survey" with white superstructure and white flag height above water about 15 feet.
5	2075	Lehigh	43	07	48	53	Large berg.
5	2076	do	43	00	48	59	Small berg.
5	2077	Cape Race Station	47	48	51	10	Do.
5	2078	do	48	04	50	24	Large berg.
5	2079	do	48	12	50	08	Do.
5	2080	do	46	29	52	57	Do.
6	2081	Ice patrol	42	24	49	51	Berg.
6	2082	Lehigh	42	42	53	33	Small berg in 67° water.
8	2083	Cameronia	48	06	48	13	Large berg.
8	2084	do	47	57	49	10	Do.
8	2085	do	47	40	50	00	Do.
7	2086	Cape Race Station	48	45	50	20	Do.
7	2087	do	48	25	50	54	Do.
7	2088	do	48	18	51	27	Berg.
7	2089	do	48	14	51	31	Do.
8	2090	do	46	30	52	45	2 growlers.
9	2091	Villarparosa	45	09	49	08	Large berg.
9	2092	Vittero Veneto	42	57	52	30	Do.
9	2093	Ice patrol	43	12	49	15	Berg.
9	2094	do	43	11	49	25	Do.
9	2095	Saguache	42	06	49	43	2 large bergs and 1 growler.
10	2096	Gripsholm	48	30	50	04	2 bergs and 1 growler.
10	2097	do	48	11	51	10	Berg.
10	2098	do	48	02	51	06	Do.
10	2099	Ice patrol	42	57	49	38	Small berg, same as 2093.
10	2100	do	43	03	49	42	Berg, same as 2094.
10	2101	do	42	35	49	52	Small berg.
10	2102	Koranna	42	15	49	30	Berg.
10	2103	Hofuku Maru	46	19	53	01	Large berg 200 feet high.
10	2104	Cape Race Station	46	18	52	47	Large berg.
10	2105	Koranna	42	32	49	54	Large berg, same as 2101.
10	2106	Gripsholm	47	01	52	30	Berg 135 feet high.
10	2107	Vittorio Veneto	41	55	49	30	2 large bergs.
10	2108	do	41	50	49	02	Berg.
10	2109	do	41	48	49	01	Berg and growler.
10	2110	Brazil	46	42	52	08	2 growlers.
10	2111	Ice patrol	41	55	49	25	2 bergs, same as 2107.
10	2112	Koranna	42	37	50	20	Berg.
10	2113	Dordrecht	41	44	49	04	2 large bergs, same as 2108–09.
10	2114	Ice patrol	41	44	49	00	2 bergs, same as 2113.
10	2115	Consul Olson	45	03	49	02	Berg.
11	2116	Ragnhildsholm	44	15	49	11	Do.
11	2117	Pennland	48	39	45	14	Large berg.
11	2118	Transylvania	46	47	52	12	Low-lying berg.
11	2119	Pennland	48	04	47	17	Large berg.
11	2120	Stuttgart	41	21	48	43	2 large bergs and several growlers.
10	2121	Cape Race Station	48	53	50	17	Berg.
10	2122	do	48	34	50	11	Do.
10	2123	do	47	45	51	09	Do.
10	2124	do	47	46	51	24	Do.
10	2125	do	47	38	51	40	Do.
11	2126	Manchester Hero	41	30	48	40	2 bergs, same as 2107.
11	2127	Hofuku Maru	46	00	47	17	Large berg.
11	2128	do	45	55	47	16	Do.
11	2129	do	45	52	47	16	Do

Table of ice and other obstructions, 1929—Continued

Date	No.	Reported by—	Position: Latitude north °	′	Position: Longitude west °	′	Nature of ice or obstruction
July 11	2130	Hofuku Maru	45	50	47	12	Berg.
11	2131	Capricorne	44	55	54	10	2 bergs.
11	2132	United States	42	00	50	10	Small berg, several growlers.
11	2133	Kearney	42	31	50	04	Small berg and 2 growlers.
11	2134	Ice patrol	41	39	48	38	Large berg same as 2113.
11	2135	do	41	36	48	32	Do.
11	2136	Piako	41	23	48	36	Large berg with 2 peaks, same as 2113.
11	2137	Cape Race Station	46	17	52	00	Large berg 80 feet high.
12	2138	Rochambeau	41	44	49	50	Large berg.
12	2139	Ice patrol	41	30	48	15	Large berg, small berg, and several growlers, same as 2113.
12	2140	Bergensfjord	48	16	49	49	Berg.
12	2141	do	47	46	50	42	Do.
12	2142	do	47	43	50	56	Do.
12	2143	do	47	44	50	48	Do.
12	2144	do	47	35	51	48	Do.
12	2145	do	47	27	52	05	Do.
12	2146	Invergoil	49	55	45	17	Wooden skeleton 15 feet high marked "FID US Survey" with 2 flags.
13	2147	Lackawanna	41	57	49	43	Small berg.
13	2148	Artigas	45	58	47	08	2 bergs.
13	2149	do	45	26	48	55	Berg and 2 growlers.
13	2150	Ice patrol	42	13	48	35	Berg, same as 2113.
13	2151	do	41	41	48	30	Small berg.
13	2152	do	41	45	48	32	2 growlers.
13	2153	Sergeant Gouarme	43	30	49	10	Large berg.
14	2154	Lake Benbow	41	36	48	11	Large berg and several growlers.
13	2155	Cape Race Station	42	52	50	00	Berg.
13	2156	do	45	32	48	56	4 bergs and growlers.
13	2157	do	45	15	54	55	Berg.
13	2158	do	48	20	49	42	Do.
13	2159	do	48	36	50	09	Do.
13	2160	do	46	33	53	05	Do.
14	2161	Tuscania	40	15	46	03	White buoy marked "FID US Survey" with tripod superstructure black cage and blue and white flags.
14	2162	Ice patrol	41	33	48	05	Berg.
14	2163	do	41	44	48	44	Growler.
14	2164	Lake Benbow	41	24	49	38	3 large bergs.
14	2165	Hagno	43	33	48	09	Small berg.
14	2166	Scythia	46	33	52	56	Large berg.
14	2167	do	46	57	52	08	Berg.
15	2168	do	47	47	49	13	Do.
15	2169	do	47	58	48	59	Large growler.
15	2170	do	48	12	49	00	Large berg.
14	2171	Saco	41	28	49	28	2 bergs, same as 2164.
15	2172	Ice patrol	41	34	48	58	Large berg and growlers, same as 2164.
15	2173	do	41	34	48	53	Berg, same as 2164.
15	2174	Cape Race Station	47	51	51	00	Berg.
15	2175	Westphalia	41	44	49	34	Growler.
15	2176	Schenectady	42	13	50	34	Large berg, 3 growlers.
15	2177	Cape Race Station	47	24	52	24	Large berg.
15	2178	do	46	57	52	20	Do.
15	2179	do	48	39	50	20	Do.
15	2180	do	48	33	50	31	Do.
15	2181	do	48	29	50	52	Small berg.
15	2182	do	48	14	50	48	Large berg.
15	2183	do	46	33	53	00	Berg aground.
15	2184	Scythia	48	07	48	32	Berg.
15	2185	do	48	12	48	16	Large berg.
16	2186	Ice patrol	41	43	48	50	Berg, same as 2164.
16	2187	do	41	46	48	40	Do.
16	2188	Ellin	43	51	49	15	Berg.
17	2189	Koenig	42	07	50	11	Large berg and 4 growlers.
17	2190	Alexandre Andre	41	39	48	24	Large berg, same as 2164.
17	2191	do	41	31	48	38	Do.
17	2192	Ice patrol	41	45	48	40	Berg, same as 2164.
17	2193	do	41	43	48	27	Small berg, same as 2164.
17	2194	do	42	08	49	42	Large berg.
17	2195	West Arrow	46	10	46	00	Growler.
17	2196	Cape Race Station	46	28	53	05	Berg drifting south.
17	2197	Hallaren	48	27	50	01	Berg.
17	2198	Drachenfels	43	35	49	14	Large berg 40 to 45 feet high.
17	2199	Henri Jaspar	42	24	49	09	Growler.
16	2200	Doric	51	20	57	15	Large berg.
16	2201	do	51	23	57	03	Berg.
16	2202	do	51	26	56	54	Do.
16	2203	do	51	46	55	49	Large berg.

Table of ice and other obstructions, 1929—Continued

Date		No.	Reported by—	Position				Nature of ice or obstruction
				Latitude north		Longitude west		
				°	′	°	′	
July	16	2204	Doric	51	43	55	44	Berg.
	16	2205	do	51	50	55	39	Small berg.
	16	2206	do	51	52	55	32	Berg.
	16	2207	do	51	51	55	25	Large berg.
	16	2208	do	51	52	55	17	Do.
	16	2209	do	52	00	55	30	4 large bergs.
	16	2210	do	52	05	54	49	2 large bergs.
	16	2211	do	51	58	54	33	1 large berg.
	18	2212	do	52	57	50	54	Do.
	18	2213	do	52	46	50	54	2 growlers.
	18	2214	Caledonia	48	17	48	30	Berg.
	18	2215	do	48	06	49	04	Do.
	18	2216	do	48	19	49	17	Large berg.
	18	2217	Ice patrol	42	28	50	05	Berg.
	18	2218	*Griesheim*	48	50	48	38	Growler.
	17	2219	Cape Race Station	47	00	52	51	Large berg.
	17	2220	do	47	11	52	50	2 bergs.
	17	2221	do	47	11	52	40	2 small bergs and growlers.
	17	2222	do	47	18	52	45	Berg.
	18	2223	do	46	26	52	56	Large berg.
	18	2224	Ice patrol	42	03	49	31	Large berg, same as 2194.
	18	2225	Hellig Olaf	41	49	48	16	Berg, same as 2192.
	18	2226	Clara	39	58	53	08	Black buoy with a structure 15 feet high.
	11	2227	Cape Race Station	47	00	30	34	Wreckage of schooner hull 40 feet long 20 feet wide.
	19	2228	Phyrcania	39	46	53	30	Red buoy.
	19	2229	Ice patrol	42	06	49	28	Large berg, same as 2194.
	19	2230	do	41	57	48	22	Small berg, same as 2192.
	19	2231	Cape Race Station	47	15	47	20	Large berg.
	19	2232	do	48	23	51	01	Large berg and 2 growlers.
	19	2233	Tiger	46	30	52	50	Berg.
	20	2234	Ice patrol	42	10	48	23	Growler.
	20	2235	Byron	41	09	48	42	Small berg.
	20	2236	Gripsholm	46	23	52	41	Berg.
	20	2237	Baron Dalmeny	41	49	49	53	Large berg.
	21	2238	Vimeira	42	40	49	44	Do.
	21	2239	Transylvania	46	25	52	42	Berg, same as 2236.
	21	2240	Cambridge	46	21	52	43	Do.
	21	2241	Mercer	41	45	49	43	Berg 75 feet high with growlers extending 2 miles to south.
	21	2242	Seattle Spirit	48	23	45	52	Large berg.
	21	2243	Dakarian	41	42	49	42	Large berg and several growlers.
	21	2244	Seattle Spirit	48	02	46	41	Large berg and growlers.
	22	2245	Szeldedyk	41	55	49	32	Large berg.
	22	2246	do	41	44	49	35	Do.
	22	2247	Paul Albert	43	20	50	40	Berg.
	22	2248	Ice patrol	42	00	49	32	Large berg, same as 2245.
	22	2249	do	42	34	49	47	Berg.
	22	2250	Scandia	45	45	45	14	Large berg.
	22	2251	do	45	44	45	47	Small berg.
	23	2252	Olna	42	36	49	48	Large berg, same as 2249.
	23	2253	Ice patrol	41	49	49	18	Small berg.
	23	2254	do	42	10	49	28	Berg.
	23	2255	Scandia	42	57	49	20	Berg and growler.
	23	2256	Jenny	41	51	49	19	Large berg.
	23	2257	do	41	56	49	18	Do.
	23	2258	United States	42	10	49	30	Do.
	23	2259	do	41	55	49	20	Small berg.
	23	2260	Scandia	42	31	49	46	Berg.
	23	2261	Cape Race Station	48	18	50	38	2 large bergs.
	24	2262	Olna	42	43	49	37	Berg.
	24	2263	Aquitania	41	47	49	15	Growler, same as 2253.
	24	2264	Ice patrol	41	54	49	16	Do.
	24	2265	do	42	11	49	29	Berg, same as 2254.
	24	2266	Cape Race Station	48	40	49	45	Large berg.
	25	2267	Dresden	41	34	54	40	Big mast with yard.
	25	2268	Ice patrol	42	14	49	30	Berg, same as 2254.
	25	2269	Arabic	48	06	47	06	Large berg.
	26	2270	Albertic	48	28	48	47	Very large berg.
	26	2271	Ice patrol	42	20	49	45	Growler, same as 2254.
	27	2272	City of Hankow	44	58	48	34	Large berg.
	27	2273	Cape Race Station	48	02	46	47	Very large berg 100 feet high.
	28	2274	do	47	10	46	40	Large berg.
	28	2275	Westphalia	40	31	54	13	Open fishing boat marked "Nr. 2."
	29	2276	Cape Race Station	49	04	49	45	Berg.
	29	2277	do	48	46	50	42	Large berg.
Aug.	1	2278	Frederic VIII	48	28	49	40	Berg.
	3	2279	Cape Race Station	47	52	52	39	Do.

WEATHER

Throughout the 1929 ice-patrol season the vessels actually on patrol remained within 120 nautical miles of 42° 30′ N., 49° 30′ W. That position, therefore, can be taken for all practical purposes as the place where the observations, which are described below, month by month, were made. But too much stress should not be placed on this position, for the weather experienced by the ice-patrol vessels depends to a very great extent on their location in the ice-patrol area. The northern part of the area cruised in is often cold and foggy because of Labrador Current water, while, at the same time, the near-by southern part of the ice-patrol area is warm and sunny because of Gulf Stream influence. In comparing figures like average air temperatures and fog percentages of any one month with those of the corresponding month in previous years, or of other months of the same year, the fact should not be lost sight of that warmer and clearer conditions recorded may be due not so much to actually different conditions in the region as a whole as to whether or not the patrol vessels remained in the colder or warmer parts of the ice area during the greater part of the time under consideration.

The weather diagrams for each month of the active patrol season show graphically the wind directions and forces averaged for each 12 hours, the barometric curve, and the time and duration of fog and low visibility. In addition, the maximum, minimum, and average air temperatures, as well as percentages of the time that bad and poor visibility prevailed, have been given for each patrol month. As these figures were obtained in exactly the same manner as the corresponding ones for last year, the remarks made regarding them on page 50 of the 1928 Ice Patrol Bulletin apply with equal force to this season's values.

APRIL

Maximum air temperature, 57° F.
Minimum air temperature, 30° F.
Average air temperature, 40° F.
Visibility was less than 4 miles 35 per cent of the time.
Visibility was less than 2 miles 26 per cent of the time.

The first ship to go out on the 1929 ice patrol left Boston, Mass., for the eastward on April 1 during the early stages of one of the four deep barometric depressions of the month. Winds of gale force were experienced on the second day out, but, fortunately for progress and fuel consumption, they came from a following direction. The temperature and fog figures given above are those from noon of the 3d to the end of the month. The values for the first two and a half days of April were disregarded because the patrol vessel did not get out into the real ice-patrol area conditions of weather until after that time.

The monthly weather diagram plainly shows that fog was almost entirely absent until the morning of the 18th. From then on to the last of the month there was so much fog and bad visibility, however, that the figures for the whole month are slightly above what has here been called normal for the time and region. There were two prolonged periods of fog, the first with a low barometer on the 18th, 19th, and 20th, and the second with comparatively high barometer on the 27th, 28th, 29th, and 30th. The latter period of thick weather was terminated on the 30th by a shift of wind to the westward which followed upon the passage, far to the north through the Strait of Belle Isle, of the center of a large cyclonic storm.

Throughout nine half-day periods the wind force averaged Beaufort 7 or greater. This shows more boisterous conditions than obtained during April, 1928, for then only five such periods were recorded. During two of the cyclonic disturbances very heavy swells were noted with waves at least 30 feet high. This height was estimated by noting when the ship was on an even keel in the trough between swells the height above the water line at which the line of sight ran off tangent to the tops of the seas.

When over the cold water, even during the periods of good visibility, morning and evening star sights could very seldom be obtained because of a typical stratus cloud formation, resembling a high fog, that was very frequently noted at certain hours. It was dark and heavy early in the morning, but gradually thinned out during the course of the forenoon. Around 10 a. m. a pale sun could be seen through the thinner parts, and at this time the first observations of the day could be taken, usually without the use of any shade glasses in the sextants. From about 11 a. m. to 3 p. m. sun sights could usually be taken at will, but as the afternoon progressed the rolling, fairly low, cloud layer would form again, blot out the blue sky, and gradually thicken until the sun's disk could be seen no more. This sort of cloudiness did not hamper the search for ice greatly, for the visibility usually remained excellent just over the sea, the lower limits of the fog or cloud keeping at a uniform moderate level at all times. The delay in fixing position was the most serious thing involved, preventing as it did prompt and accurate determination of ship's position, berg drifts, currents, and exact limits of areas fully searched.

MAY

Maximum air temperature, 56° F.

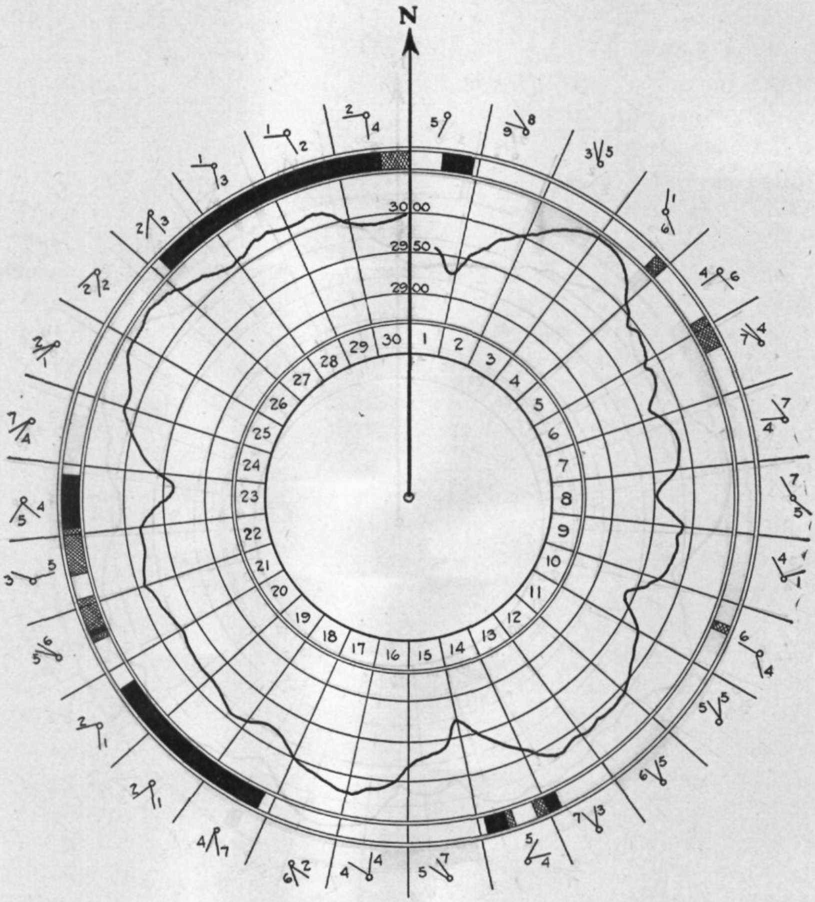
Minimum air temperature, 34° F.

Average air temperature, 42.9° F.

Visibility was less than 4 miles 34 per cent of the time.

Visibility was less than 2 miles 27 per cent of the time.

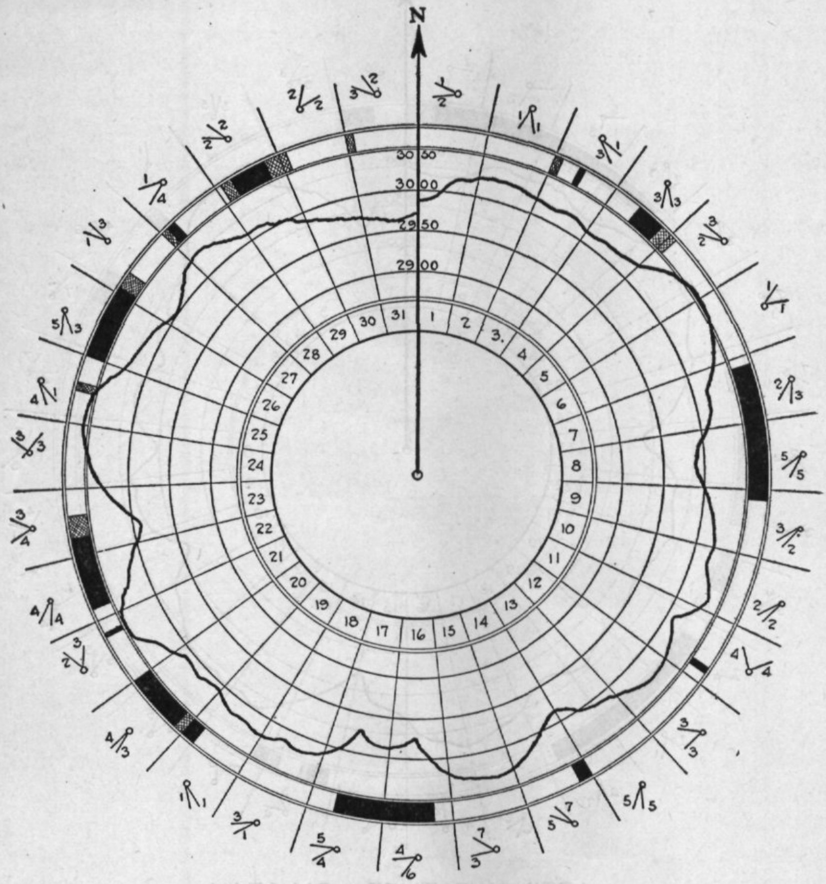
May, 1928, had about twice as much fog and bad visibility, as usual, but in 1929 the figures for the month were back to normal again.



APRIL WEATHER DIAGRAM
1929

VIS. 7, 8, & 9 = WHITE
VIS. 5 & 6 = CROSS HATCHED.
VIS. 0, 1, 2, 3 & 4 = BLACK

FIGURE 2.—Inner figures show day of the month; the next band out contains the record of the atmospheric pressure; the next outer one indicates the degree of visibility (black areas for visibility of less than two sea miles and cross-hatched areas for visibilities of between two and four miles); the outer margin shows the average direction and force of wind per 12-hour periods, midnight to noon and noon to midnight. Wind directions are toward the small circle in each case. Arrow indicates true north



MAY WEATHER DIAGRAM
1929

VIS. 7, 8, & 9 = WHITE
VIS. 5 & 6 = CROSS HATCHED
VIS. 0, 1, 2, 3 & 4 = BLACK

FIGURE 3.—For explanation of symbols, see Figure 2

The month was quite a pleasant one, taken as a whole. Air temperatures were quite low due to the unusual coldness of the ice-bearing waters, but there was much bright sunshine, and the air and sea temperatures slowly rose as the month advanced.

A few large cyclones passed northeastward across Newfoundland and Labrador, but the patrol vessels escaped all but the southern edges of these, and so had only two 12-hour periods of gales and no barometric pressure lower than 29.62, which figure was reached on the last day of the month. One feature noted on the weather maps made on board from synoptic data was a succession of large high-pressure areas that moved southeastward across the United States Atlantic Coast States and out to sea to join the Azorean High. Barometric pressures in the ice-patrol area became very high at times, exceeding 30.50 on five different days, which were invariably fine and sunny, though on two of these five days there was a slight haze that made bergs appear yellowish in the distance and disappear from sight when from 8 to 10 miles distant. Phenomenal visibility prevailed on the 2d, however, when the barometer was at 30.22 and light variable airs were blowing. At this time a berg about 50 feet high was seen from a height of eye of 30 feet when it was 38 sea miles distant.

The short period of fog experienced on the 11th with a high and rising barometer and north-northwest breezes was most unexpected. It occurred just before sunset over cold water near the junction of the Labrador Current and the Gulf Stream. The line of demarcation between the two waters was very ragged, for a little earlier in the day the patrol had cruised though alternate areas of cold and warm water each about 2 miles wide. The fog can best be explained by assuming that the surface air had just passed over a warm band of water and become moist and warm. A cold band of water happened to be to leeward of the warm band and, the critical conditions being just right, the moisture in the north-northwest breeze was condensed as fog as soon as the lowest layers of the warmed moistened air were chilled by contact with the small cold area in the sea. This unusual local fog occurred again on the 21st under almost identical conditions, except that in the second case the barometer was even higher, about 30.50 throughout the time. With northerly breezes fog is sometimes formed over the warm water, but its presence over cold water was very hard to explain.

Many other interesting meteorological phenomena were observed. For instance, the weather diagram shows that fog was finally caused on the 19th after southeasterly airs had been blowing for some time. As a general thing it takes a considerable time for southerly breezes to bring on a period of fog, and the further advanced the season is and the warmer the surface water is the harder it seems to be for the thick weather to get started.

When fog is formed over the cold water it is often very thin vertically with a clear blue sky showing overhead, as was the case on the 22d. Very often the rays of sunlight that reach the deck through the fog around midday have considerable warmth left in them, but not enough to remove the fog from the cold water as long as the wind continues to blow from warmer water toward colder. When conditions are rather finely balanced there is sometimes a tapering clear lane over the sea for a quarter of a mile or more directly to leeward of the drifting patrol ship, caused by the warmth escaping from the stack and hull.

The weather cleared slowly on the 23d after a shift of wind to the northwest. By evening the atmosphere was remarkably clear to the westward and sunset was followed by a very distinct green flash at the spot on the horizon where the sun had just disappeared. The next day, with its high barometer and gentle breezes, was about the brightest, clearest, and finest day of the whole season.

JUNE

Maximum air temperature, 70° F.

Minimum air temperature, 38° F.

Average air temperature, 51.2° F.

Visibility was less than 4 miles 42 per cent of the time.

Visibility was less than 2 miles 34 per cent of the time.

June, as is quite normal, had a higher percentage of hours with fog than either of the two preceding months. There was a marked change to general summer weather conditions. The procession of "Lows" along the American coast and up the St. Lawrence Valley slowed down, and a great high-pressure area in the ocean east of the United States and southern Canada stood opposed to a fairly constant condition of low pressure over North America. This distribution of pressures always gives the Grand Banks region a large proportion of gentle but steady southerly breezes, which are over the colder water areas, accompanied by foggy weather. An even greater number of times than during May there was low-lying fog with clear or partly cloudy sky plainly visible overhead. The bright sunshine on some of the days made fogbows and allied phenomena of common occurrence.

When cruising along the temperature wall many areas of fog patches were encountered. The search courses at such times frequently changed the surface water temperatures 11° F. in 11 minutes, say, from 48° F. to 59° F., and the air temperatures fluctuated almost as much and as rapidly. It would be raw and foggy over the cold water and damp and muggy over the warmer mixed water close by. During the first half of the month cold water pushed 150 miles to the southeastward to 40° N., 46° 40′ W., in a band about 20 miles wide. This stream was very difficult to search for ice because winds from

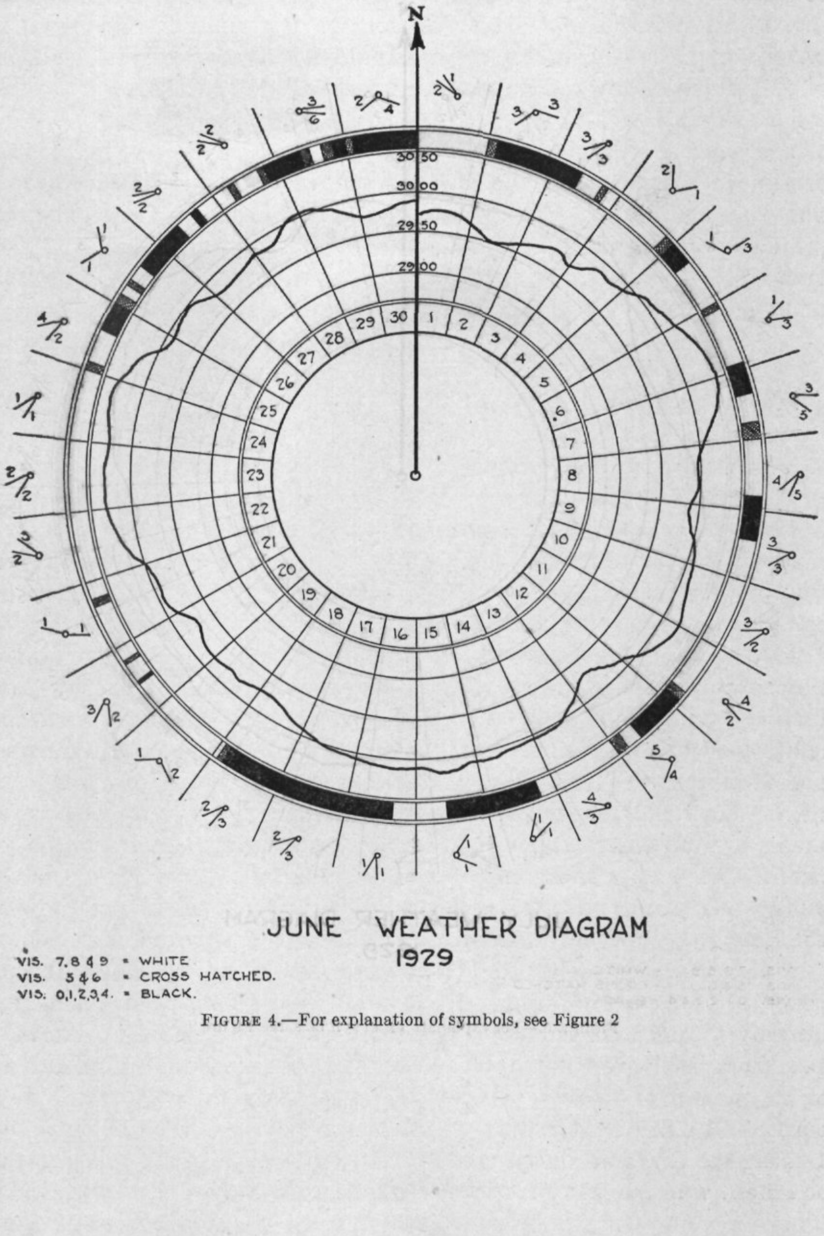
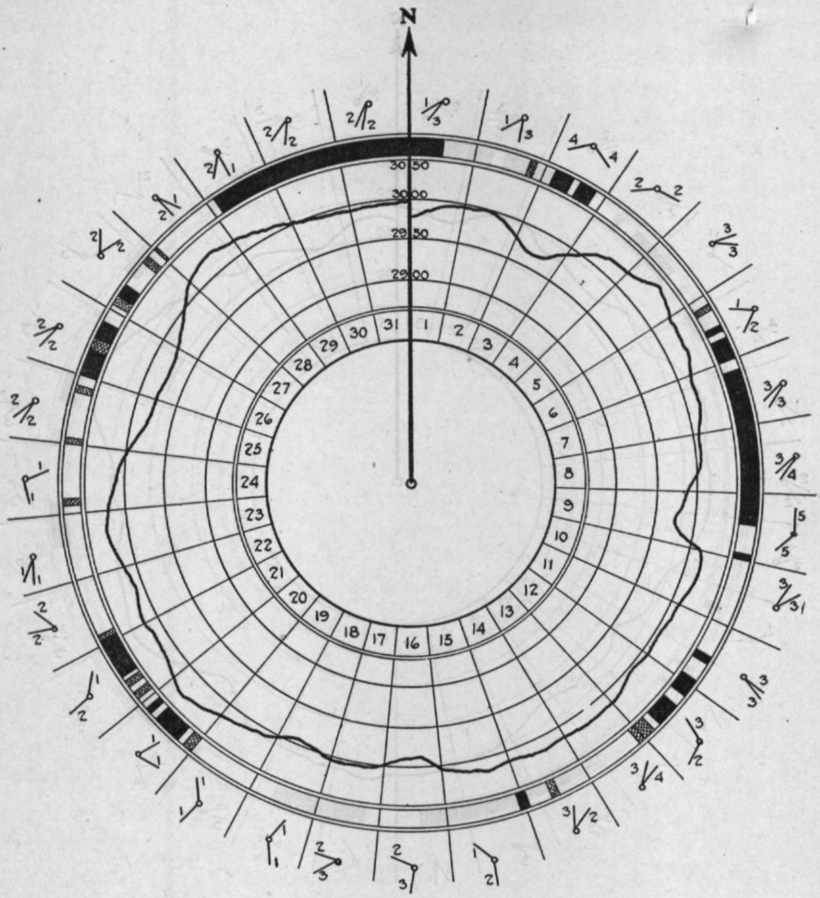


FIGURE 4.—For explanation of symbols, see Figure 2



JULY WEATHER DIAGRAM
1929.

VIS. 7, 8, & 9 = WHITE
VIS. 5 & 6 = CROSS HATCHED.
VIS. 0, 1, 2, 3, 4 4 = BLACK.

FIGURE 5.—For explanati on of sym bols, see Fi gure 2

any direction except northwest came from warmer water areas and usually gave fog.

The lowest barometric pressure for the month, 29.50, was reached on the 2d, but this depression was unaccompanied by gales, there being only a few hours of fresh breezes while the wind was hauling through south to southwest. The whole month saw no full 12-hour periods of gales, but there was a near approach to one on the 29th, when the wind averaged force 6 between noon and midnight.

During a period of good visibility on the 4th, which was a drizzly, overcast day, a berg was sighted about 10 miles off. While it was being approached the cloud blanket shut down closer and closer to the sea. When the berg was finally reached it was seen that its upper parts were completely hidden in a fog. It was then noted that the patrol ship's topmast and crow's nest were also in fog, though visibility still remained good at sea level. In a short time the fog shut down completely. The wind was light from the north-northeast and the air temperature was 42° F. This case is mentioned because it is quite the opposite condition to that much more often experienced where the upper layers of the air remain clear and only the lower layers are foggy.

On the 9th the ship was in warm mixed water near the long southeast push of cold water mentioned above. It had been foggy, and after the wind hauled to the north of west it remained so, instead of quickly clearing as usual. In order that the good visibility which, it was thought, must exist near by might not be lost for searching purposes, the patrol stood to windward and in a short time entered cold water, over which there was no fog whatever. Over the region of warmer water to the southeastward the pall of fog could be seen hanging throughout the remainder of the day.

There was noticeably bad refraction on four days. On one a 40-foot berg was sighted 26 miles away, and a few hours later the sun went down not like a round ball of fire but greatly flattened, like a vertical section through a watch being lowered face uppermost into the sea. On another day double horizon lines were noted for some hours until continuing southerly breezes finally brought on fog and rain.

During several foggy days which were spent along the temperature wall, copious showers were experienced. Some of these were regular tropical downpours. From ship reports received, it is believed that at the same time bright weather was prevailing over the Gulf Stream drift, and the usual Grand Banks fog with clear sky overhead was prevailing farther north well inside the area of cold water. At other times, when cruising near the temperature wall, squalls from varying directions were experienced, all of which indicates that at times along the line of junction of Labrador Current and Gulf Stream there is an unstable area, where uprushes of air, indrafts, and such activities take place.

JULY

Maximum air temperature, 73° F.
Minimum air temperature, 43° F.
Average air temperature, 59.8° F.
Visibility was less than 4 miles 38 per cent of the time.
Visibility was less than 2 miles 32 per cent of the time.

Previous to the 1929 season the ice patrol has always been discontinued by the middle of July, but the 1929 ice conditions necessitated its continuance until August 3. The July meteorological information given here and on the July weather diagram is, therefore, for the first time that for the full month. The patrol was discontinued so early in August that no separate discussion or weather diagram has been prepared for the time after July 31.

July was marked by very weak barometric gradients with accompanying fine moderate weather. The weather maps showed a tendency for a low-pressure area to remain over the central portions of North America and for high pressures to prevail over great areas of the North Atlantic Ocean and over the United States Middle Atlantic States. There was a marked increase in sea and air temperatures in the ice-patrol area because of continued solar warming, and a falling off in fog percentages as compared with the previous month. The last three days of the month were days of dense fog because of persistent southerly breezes and airs, and this fogginess was continued, over the colder waters along the eastern edge of the Grand Banks at least, without a break until after the patrol was discontinued on August 3. This shows that an advanced summer season, while it lessens the hours of fog over the warm and the warmed mixed waters, has but little beneficial effect over the southern reaches of the Labrador Current proper. It was often possible to pick clear-weather areas and to remain in them by working toward cold-water areas during northerly breezes and running toward warmer water when southerly breezes began to cause fog.

GENERAL REMARKS

Because much interest is shown by shipping in the patrol vessel's weather, the conditions prevailing were always incorporated in the routine ice broadcasts. Placing the data in these messages not only assured as wide a dissemination of it as possible but saved time and effort for all concerned through the cutting off of many inquiries regarding weather conditions that experience has shown would otherwise have come in from single vessels.

Twice daily a coded weather report was dispatched to the United States Weather Bureau, Washington, D. C., and at the end of each cruise the regular Weather Bureau forms were filled in for the patrol period and mailed upon arrival in port. The coded dispatches to Washington always included, when available, the weather at one or more ship stations well separated from the patrol. These composite messages were transmitted direct to Washington at scheduled times which were sufficiently early to insure that the data would be available for use in making up the Weather Bureau's ocean forecasts. The same weather information sent to Washington was transmitted via Canadian coastal radio stations to the Canadian meterological officials at Ottawa, Ontario, for their use. This was a new departure, beginning with the 1929 patrol season.

An average of 60 water-temperature reports were received each day from vessels within the ice-patrol area, which may be defined as the area bounded by latitudes 39° and 48° N. and longitudes 43° and 56° W. Shipping was frequently reminded of the need of the patrol for reports by broadcasts worded about as follows: "All vessels while within the ice-patrol area are requested to transmit to the ice-patrol vessel, call NIDK, the following every four hours: Ship's name, G. M. C. T., latitude, longitude, course, speed, temperature of water, weather conditions, and any ice or other obstructions sighted." In response many of the ships included in their water-temperature reports all the necessary meterological elements, for the most part, no doubt, very carefully and regularly observed. When a number of the best-cooperating ships were well scattered along the tracks there was a wealth of material to choose from, and most of the remaining time there were at least a few vessel reports to consider when making up the Weather Bureau dispatches. Only the latest, most reliable, and best situated reports were marked for coding and transmission to shore.

On the patrol vessels, especially during foggy periods, the weather obtaining at the positions of reporting vessels would be frequently plotted on suitable ocean charts. The limits of fog sheets, rain areas, good weather, gales, and other conditions could then be seen with considerable accuracy and ease. Detailed weather information obtained from reports so plotted was several times furnished the United States Weather Bureau officials on request during the anxious times just prior to projected trans-Atlantic airplane flights.

Following the customs of previous years, two weather maps were made up each day from data contained in the general synoptic broadcasts transmitted by NAA, at Arlington, Va. Supplemented by the weather reports received from shipping, these maps were used for forecasting the local weather. They proved most useful for use in connection with planning the patrol's cruising as well as interesting. With their aid it was always possible to know what weather conditions were prevailing in a large area to the westward. These conditions, it

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is very soon clear to observers on the patrol ships, control to a great extent the immediate future course of weather in the ice-patrol area.

DEPTH SURVEY CARRIED OUT BY THE SONIC METHOD

Throughout the 1929 ice-patrol season both the *Tampa* and *Modoc* were equipped with commercial instruments for determining the depth of the water by sonic means. It was usually possible to use these instruments successfully so long as the ships remained inside the 1,400-fathom curve. On smooth days when the sets were working especially well they could be used in water up to about 2,000 fathoms deep. Whenever echoes could be obtained from the sea bottom frequent soundings were taken and recorded.

One hundred and ninety-one values that were obtained when the vessels' positions were well fixed by sights have been corrected for certain errors due to actual conditions of salinity, temperature, and pressure in the water column and forwarded to the United States Hydrographic Office and to the United States Coast and Geodetic Survey for use on charts of the North Atlantic Ocean. Altogether many times 191 values were recorded, but the great majority of soundings, though useful for immediate navigational purposes, were taken when the exact geographical position was in some doubt due to such things as abnormal refraction, cloudiness, darkness, and fog. The depths obtained when the position was uncertain were without exception discarded so far as giving them consideration for hydrographic use was concerned. The area where the patrol vessels cruised in 1929 has been rather well sounded out, and for this reason nothing but the best work of the season was considered worth keeping.

Two navigators worked out the different positions of the ships independently for check purposes, so the locations listed with the sounding values saved are based on double work and are believed to be as nearly correct as such values can be on board a ship on ice-patrol duty in the Grand Banks region. Of course some of the positions are closer to being right than others. The radius of error probably varies from next to nothing at all up to a maximum of about 10,000 yards.

ICE OBSERVATION

The varying ice conditions that existed during the first nine months of 1929 in the North Atlantic south of the forty-eighth parallel are discussed here. The monthly ice charts (figs. 6–11 inclusive) show plainly where the ice at different times was located with respect to the coast lines, principal steamship tracks, and other features of the Grand Banks region. They furnish a far better means than written remarks for comparing the change of ice conditions from month to month and those of certain months of one year with corresponding months of another. United States Hydrographic Office Miscellaneous Chart 2,511 was used as the base map for plotting all ice data.

Iceberg totals and ice conditions are based during the actual active patrol season on first-hand information, supplemented by that received by radio from ship and coast stations. Reports of ice published weekly in the United States Hydrographic Bulletin and those received from Canadian Government authorities are depended upon during the inactive season when there is no patrol ship in the vicinity of the Grand Banks.

The large number of ships on the various tracks that cooperate by reporting regularly makes much care necessary to keep duplications from unduly swelling the berg totals. Suppose, for instance, that 10 ships all pass along the same general line and each one reports four bergs to the patrol from about the same locations on the same day. Only one of these reports of ice can be considered for broadcast and statistical purposes, for it is obvious that all the ships have seen and reported the same ice.

Probable drift tracks of ice are rather well known from experience, and the general principles of these drifts are explained in conjunction with the charts on pages 68 and 69 of the Ice Patrol's Bulletin for 1927. In addition, particular detailed drifts and variations from the general rules can often be forecast after a study of the cruise isotherm and ice charts that are always kept up to date on the patrol vessels. Bergs reported from one position on one day, therefore, are frequently assumed to be identical with bergs reported from two or three and sometimes even five or six days earlier from different locations, and are eliminated from the statistical totals. But no reported berg is omitted from the broadcasts unless it is pretty definitely known to be identical with some other reported berg. It is certainly wiser to broadcast the presence of slightly more ice than exists rather than to eliminate from the reports mention of any ice that may still remain.

In accordance with the practice of all previous years, it was considered that the start of a new month cleared off the statistical slate, all bergs reported anew on or after the first of a month being considered once more for determination of monthly totals, whether or not they had already been reported.

Nine months instead of twelve are discussed here because complete ice information for the last three months of the year is not at hand as this section is being written. The 1930 Ice Observation and Ice Patrol Service pamphlet will contain the discussion for October, November, and December, 1929. As these three months share with January the distinction of being the very lightest ice months of the year, their omission from this publication is really of no moment.

Frequent reference is made throughout this and other sections to the "ice-patrol area." This never refers exclusively to the rather limited area south and east of the Tail of the Banks that can be physically covered by the efforts of the ice-patrol vessels themselves. It always includes all that area between the thirty-ninth and forty-eighth parallels and the forty-third and fifty-sixth meridians, which is constantly being crossed and recrossed by reporting vessels. In general, during clear weather all parts within these limits that are at all near the several steamship tracks are well covered either by the patrol or for it. During good weather conditions the situation may be said to be well in hand, and, therefore, advice can be given about ice conditions with confidence to vessels that may be crossing the ocean hundreds of miles to the north or the south of the actual limits of vision of the ice patrol. During the long periods of fog, however, when the eyes of reporting vessels as well as those of the patrol are blindfolded, the exact status of affairs with respect to the location of the ice is not so well known, and then extra precautions are regularly advised both in the broadcasts and in the special ice-information messages. The patrol's experience is that bergs can be detected only when they can be seen. It is only rarely that bergs are sighted or reported during thick weather or darkness, though undoubtedly the the brightest lookout is kept for them during just those times.

The ice-patrol area as defined above does not by any means set a bound to the patrol's interest, information, or service. Reports of ice and obstructions that come in from far to the eastward of the forty-third meridian and from far to the northward of the forty-eighth and even forty-ninth parallels are gladly received and when on hand are invariably included in the broadcasts. Far to the westward, also, the changing field-ice conditions in the approach to the Gulf of St. Lawrence are followed and reported as closely as the radio advices received make possible.

Water-temperature reports from the area surrounding the so-called ice-patrol area are also frequently received. They are always care-

PLATE X.—Medical officer of the *Tampa* on board a French fishing vessel off the eastern edge of the Grand Banks. There are between 20 and 30 men on each of these sailing vessels, and usually at least 1 member of the crew is in need of medical treatment. Complaints range from injuries and sores to abscessed teeth and tuberculosis

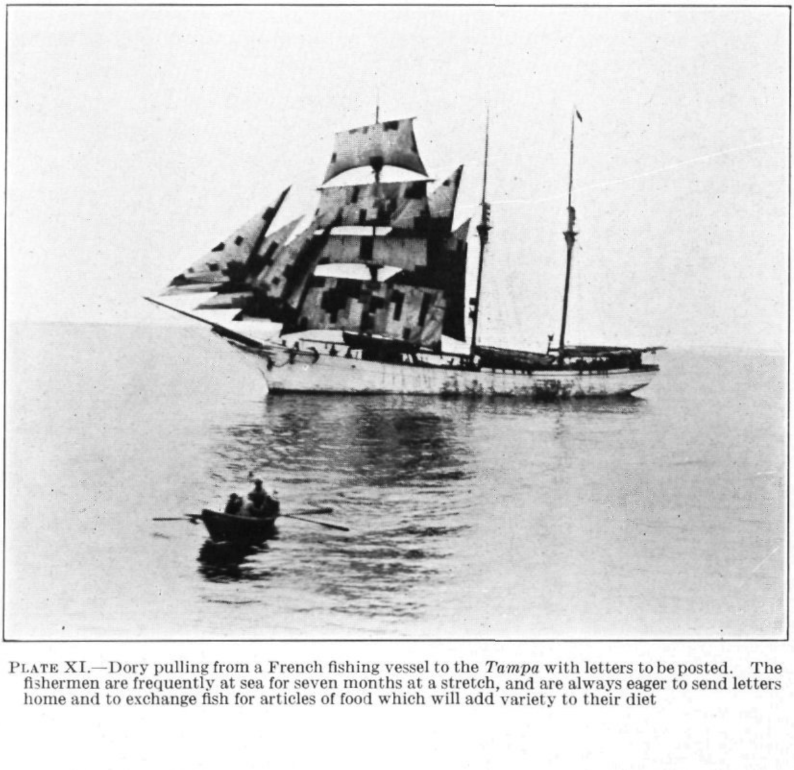

PLATE XI.—Dory pulling from a French fishing vessel to the *Tampa* with letters to be posted. The fishermen are frequently at sea for seven months at a stretch, and are always eager to send letters home and to exchange fish for articles of food which will add variety to their diet

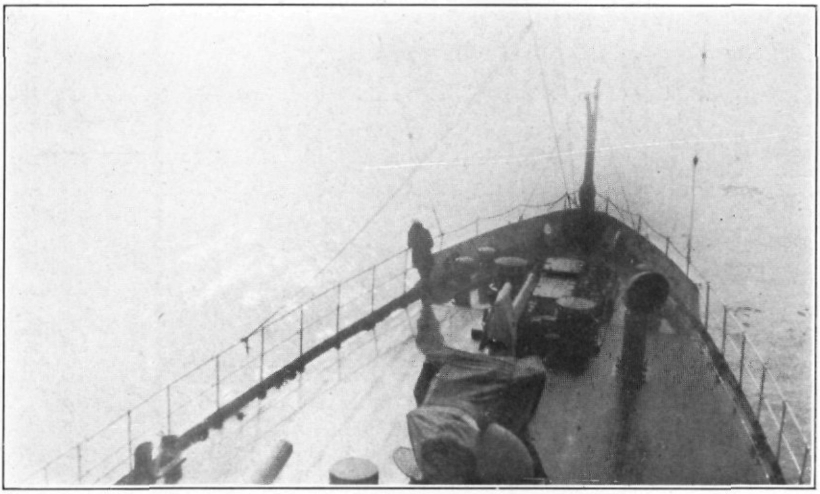

PLATE XII.—For approximately one-third of the time the ice patrol cutters are blindfolded by dense fog like this. The fog is usually brought on by long continuing light southerly breezes. Often it is so thin vertically that the sun is able to shine down dimly to the water, as here

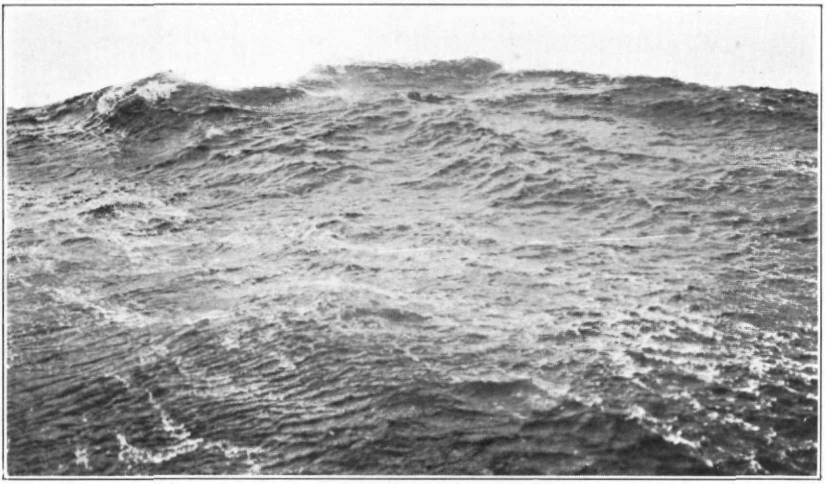

PLATE XIII.—There are a number of storms each season. These, as well as the fog, interfere with the scouting and scientific programs. This wave was photographed from the stern of an ice patrol cutter while not far from the tail of the Grand Banks fully plotted and studied to see what bearing they may have upon ice, current, and weather conditions now obtaining or that may soon obtain within the area that is most intimately under the cognizance of the patrol.

JANUARY

There were no reports of ice from the region of the Grand Banks. Some field ice, however, was carried seaward from the Gulf of St. Lawrence by the Cape Breton Current and was reported during the latter part of the month from 60 miles southeast of Cape Breton.

FEBRUARY

Considerable field ice from the Gulf of St. Lawrence was reported from areas about midway between Sable Island and Cape Breton. Further east the first field ice of the season began to drift south into the international ice-patrol area proper, where it was reported frequently from the region just north of the Grand Banks. By the end of the month the southernmost limits of this latter ice had pushed south of the forty-seventh parallel along the line between Cape Race and the northeastern shoulder of the Grand Banks, and on the 28th there was a report of field ice and growlers extending south in the main branch of the Labrador Current along the eastern edge of the Grand Banks to 46° 25′ N., 47° 40′ W. So far as is known during this month no bergs drifted south of the forty-eighth parallel in company with the field ice from the north. The ice map for February, 1929, is almost identical with that for February, 1928.

MARCH

The ice map for this month also bears a remarkable resemblance to that for the corresponding period of the preceding year. The ice of March, 1929, being apparently somewhat heavier and of greater extent, however, gave the first hint that an unusually heavy ice season was about to develop. Vessels passing north of Sable Island reported large patches of loose field ice from the Gulf of St. Lawrence to be extending to about 120 miles southeast of Cape Breton. Some of these patches over the northeastern limits of Banquerau Bank were described as heavy.

Ten degrees to the eastward, along the eastern edge of the Grand Banks, the first bergs of the season began to be reported wherever the trans-Atlantic traffic sighted the southward moving field ice. Indeed, throughout most of the area northwest of the line from Cape Race to Flemish Cap and on both sides of the line from Flemish Cap to 44° 30′ N., 49° 00′ W., field ice and bergs were frequently reported together.

APRIL

No reports were received of the Gulf of St. Lawrence field ice but in the Labrador Current along the eastern edge of the Grand Banks there appeared a far greater amount of all kinds of ice than usual for the season. In the first place a great amount of field ice seriously obstructed navigation within the area partially bounded by lines running from Cape Race to 44° 20′ N., 48° 30′ W., thence to 47° 30′ N., 46° 30′ W., and thence northwestward past the forty-ninth parallel, and so out of the field of observation. Everywhere this field ice was more or less thickly studded with bergs.

Toward the end of the month ship reports indicated that the limits of the field ice had retreated rapidly to north of the forty-seventh parallel. After the flat ice was melted by sun, wave, and warmer water the large bergs, being much more resistant, remained to continue their southward drift toward the Gulf Stream waters. The great majority of the April bergs were situated between the 50-fathom curve of the eastern edge of the Grand Banks and a line located 60 miles to the eastward of it. The most southerly bergs of the month were located along the direct southerly extension of this ice stream, where they almost reached to the forty-second degree of north latitude in longitude 49° 30′ W.

There was also a very distinct curving of ice and cold water to the westward around the Tail of the Banks. If this outlet had not existed it is very probable that the southward push of icy waters would have been greater and would have sufficed to carry bergs across the westbound B tracks to the south and southeast of the Tail.

About the middle of the month reports showed that scattered bergs were rapidly advancing southeastward into and across the area of warm surface water to the east and west of 42° 50′ N., 44° 30′ W. One of these bergs actually crossed the westbound B track from Fastnet, in longitude 43° 50′ W. This push of bergs was quite alarming, and was one of the factors that made the patrol recommend a shift of tracks south to the extra southern or "A" lanes on April 19, though, as matters turned out, after that date there were very few further reports of threatening bergs in the eastern part of the ice-patrol area. The warm waters rapidly melted the southeasternmost of the invading bergs and their ranks were not filled by new levies from the continuous procession moving south along the eastern edge. During April, 1928, there was a southeasterly push of bergs very similar to the one of 1929. The feature this year, however, in common with all ice conditions about the Grand Banks from April on, was far heavier and more serious. This year the patrol ships were prevented by the ice just below the Tail from investigating the southeastern sector themselves; therefore a careful study of the subsurface conditions in the latter area could not be carried out. The bergs, as shown by numerous reports, were apparently drifting southeast across warm water at right angles to the surface isotherms and to the usually conceived direction of the Gulf Stream drift. The 120-mile berg-free separation of the southeasternmost bergs from the ice just below the Tail precludes, when combined with a study of the successive reported positions of the ice, the belief that the former group was made up of bergs that had earlier drifted south past the Tail and got into a northeast-flowing current.

MAY

Early in the month the two latest reports for the year were received of the Gulf of St. Lawrence field ice, both from the northern end of St. Pierre Bank. In the Grand Banks region farther to the eastward great changes took place in the ice situation. Throughout the month the surface waters north of the forty-second parallel remained on the average considerably colder than in 1928. Nevertheless, the effects of the advancing sun caused field ice that drifted south of Newfoundland to melt with considerable rapidity and the southern limits of the pack ice to retreat apace. Before the end of the month field ice was reported for the last time in 1929 from anywhere in the ice-patrol area.

Bergs were present in almost unheard-of numbers northeast of the Grand Banks, especially in the area extending 150 miles northeast from the line between 48° 15′ N., 51° 10′ W., and 45° 50′ N., 47° 10′ W. The patrol vessels, as usual, watched the southernmost ice and in the cases of a few critical bergs were able to determine their drift tracks. These are located in the general vicinity of the Tail and are shown by dotted lines on the ice chart.

During May there was an unexpected falling off in bergs south of the forty-third parallel and a lull in the menace to the United States, Europe tracks. Almost all bergs that reached the latitude of the Tail curved closely around it and passed to the westward. Instead of continuing northwestward along the southwest edge of the Banks, some of this ice, as it had done during April, turned offshore and pushed southward along the fifty-first meridian from the forty-third parallel. However, the southernmost ice of the month, which was along this line, failed to reach even the westbound "B" track to Boston by over 30 miles.

The ice chart for May shows an apparent lack of bergs along the eastern edge of the Banks between 44° 00′ N. and 45° 30′ N. This is probably due to the fact that the area concerned was crossed so little by reporting steamers that many bergs undoubtedly escaped observation there. The shifting north of the Canadian tracks as soon as the ice conditions permit in the spring leaves a wide comparatively unsearched gap between the usual seat of operations of the ice patrol in the latitude of the Tail and the next set of traffic lanes to the north.

JUNE

The severity of June, 1929, from an ice standpoint, can best be seen when one compares the month's ice map with that for June, 1928. (See United States Coast Guard Bulletin No. 17, fig. 10.) Though the chart for the latter month shows a total number of bergs south of the forty-eighth parallel somewhat in excess of normal, and one berg with an extreme southerly drift, the total number of bergs in the ice-patrol area during June, 1929, was several times as great and the situation was considerably more dangerous.

The surface waters north of the Banks, along the eastern edge, and to the westward of the Tail continued to be abnormally cold. A feature of the month was the recurrence of a great number of bergs south of the Tail. These bergs extended from 43° 10′ N., 53° 00′ W., to 42° 40′ N., 48° 00′ W., and along a 190-nautical-mile front the foremost of them pushed farther south than did any bergs during May.

North of this group, except along the tracks of the few cooperating vessels that crossed the eastern edge, there is a relative scarcity of bergs plotted, but, as stated above in the discussion for May, the lack of bergs plotted in certain areas can often be credited to lack of reporting vessels rather than to actual lack of bergs. In June the Canada-Europe traffic was on the Cape Race tracks, still farther north than it had been during the preceding month. Had the waters along the eastern edge been well covered by the patrol ships or by reporting vessels, doubtless a considerable number of bergs that remained unreported would have been found.

From along the Cape Race, or F tracks, great numbers of bergs were reported. Even there, however, they noticeably thinned out in numbers as the month progressed. During June shore stations located along the Newfoundland coast between Cape Race and St. Johns began to sight bergs for the first time in 1929. This was the result of the bergs in the northern part of the ice-patrol area being located on the average much farther westward in the ocean than earlier in the year. The disappearance of the field ice with the advance of the season is regularly followed by a westward movement of the average of the drift tracks of bergs north of the forty-seventh parallel. A continuation of such a tendency finally results in a failure of supply of bergs to the narrow cold stream that runs south along the eastern edge. It is just as though the supply of grain to the hopper of a mill were cut off by the slow deflection of the grain chute that keeps it filled. Even though the bergs should keep coming down in undiminished numbers across the forty-eighth parallel (which they never do), the farther west they come down in the ocean the less is their chance of getting south past the islands and rocks of the Labrador and Newfoundland shores and past the shoals and slack waters that exist along the northern edges of the Grand Banks.

JULY

Though still abnormally heavy from an ice standpoint, July, 1929, when compared with the preceding month, shows a great decrease of bergs along the Cape Race tracks. The ice extended a little farther to the westward around Cape Race than in June, but it did not drift through the gulley off this point beyond longitude 53° 10′ W. Many ships went east and west past Cape Race, and if any bergs had been located farther to the westward they would certainly have been reported.

The few bergs reported from unusual positions near 45° 00′ N., 54° 30′ W., and 43° 00′ N., 53° 00′ W., were doubtless straggling remnants of the ice that had made its way so freely to the westward around the Tail during the previous month. The westward tendency in the southern part of the ice-patrol area was definitely stopped early in July by the pushing northeast to the Tail of an undulation in the northern limits of the Gulf Stream. This invasion of warm surface water almost entirely obliterated the extension of cold current that had previously passed westward around the Tail. At the same time it caused the southern branch of the Labrador Current to increase in power and extension until it was carrying bergs southeast almost to 41° N. 48° W. The United States-Europe ships had been recalled from the extra southern A tracks, and such an unlooked-for final push of ice and cold water caused the patrol deep concern. From the 11th to the 24th it sent a number of large bergs drifting eastward right along the path of the liners on the westbound B tracks.

During the last few days of the month the southernmost bergs melted under the eyes of the patrol. Their final disintegration was quite rapid because of midsummer air and water temperatures and apparent mixture of the surrounding northern waters with the Gulf Stream drift. As the southern limit of the ice gradually retreated northward the patrol followed it along from berg to berg, for the push of the cold waters had weakened and no new ice was coming down to take the place of that melting below the Tail. The exact status of affairs a little to the northward along the eastern edge could not be determined during the closing days of the month because persistent fog remained over the narrow stream of pure Labrador Current water that according to surface temperatures, still extended to just south of the forty-third parallel.

AUGUST

The long, heavy ice season finally ended during this month. August saw but one report of ice from the ice-patrol area proper, that of a berg on the 3d near the Newfoundland coast just north of St. John's.

There were reports of five bergs early in the month from north of the Banks, but none of these were ever reported from south of the forty-eighth parallel. Constant fog prevailed over the narrow cold stream of cold water along the eastern edge of the Banks until after the ice-patrol service for 1929 was discontinued on the 3d, so it is just possible that an unreported berg or two may have disintegrated there unseen.

SEPTEMBER

A berg was reported on the 19th from 44° 05′ N., 44° 30′ W.

GENERAL REMARKS AND SUMMARY

The above monthly discussions and the charts following this section show in general how ice was distributed southeast of Newfoundland throughout the 1929 ice season. A narrative account of the ice seen from the patrol vessels, together with remarks on circumstances attending its disintegration in some instances, can be found, respectively, in the sections devoted to the cruise reports and oceanography.

The following tabular summary shows how the 1929 monthly berg totals compare with those of the average year, the latter being based on a study of iceberg reports from south of the forty-eighth parallel for the period 1900–1926:

Month	Bergs south of 48° N. in 1929	Bergs south of 43° N. in 1929	Bergs south of 48° N. normally	Bergs south of 43° N. normally
January	0	0	3	0
February	0	0	10	1
March	45	0	36	4
April	332	32	83	9
May	460	9	130	18
June	376	72	68	13
July	107	21	25	3
August	1	0	13	2
September	1	0	9	1
Total	1,322	134	377	51

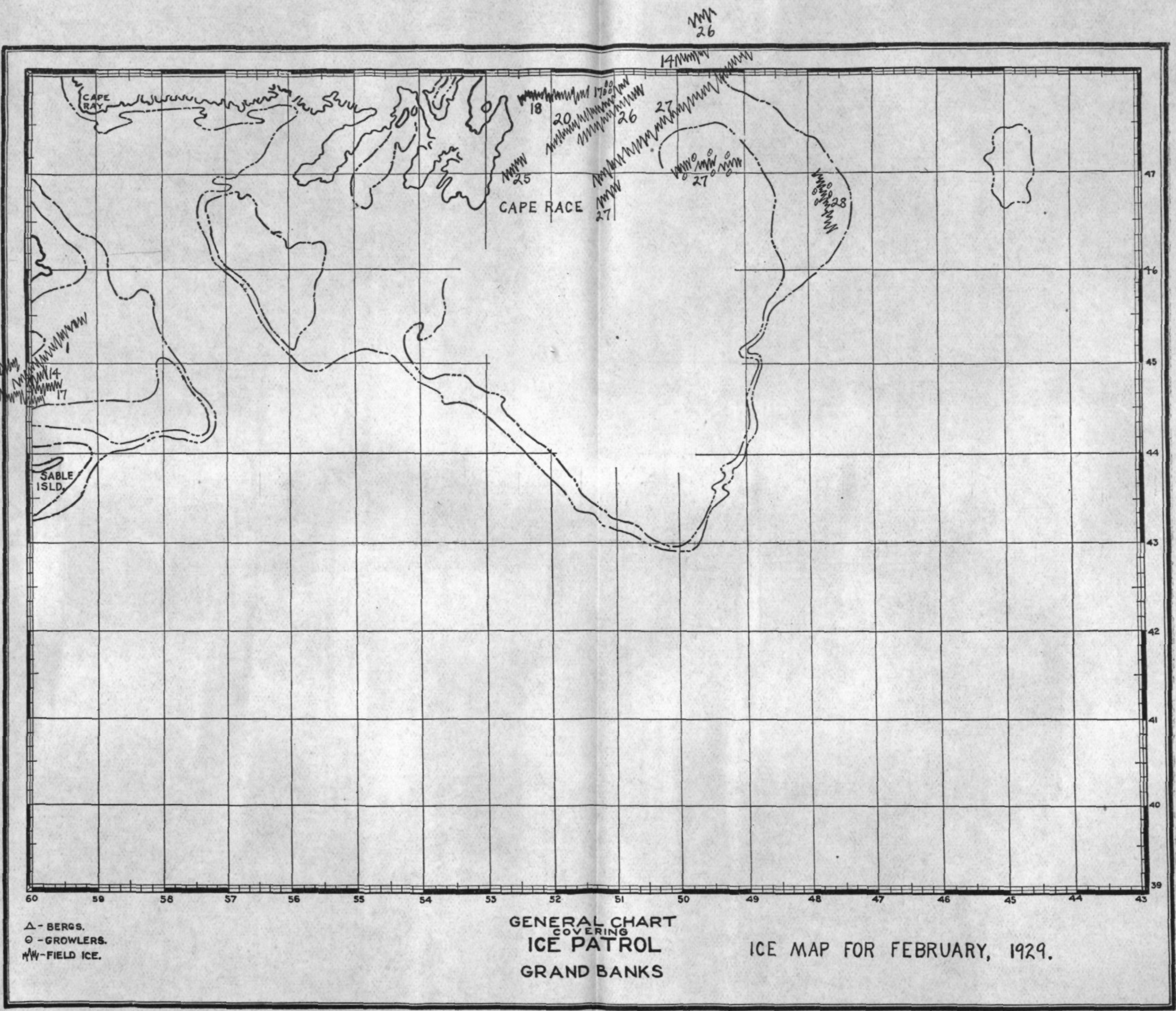

FIGURE 6.—February ice map. No known icebergs were south of the 48th parallel during the month

100277—30. (Face p. 82.) No. 1

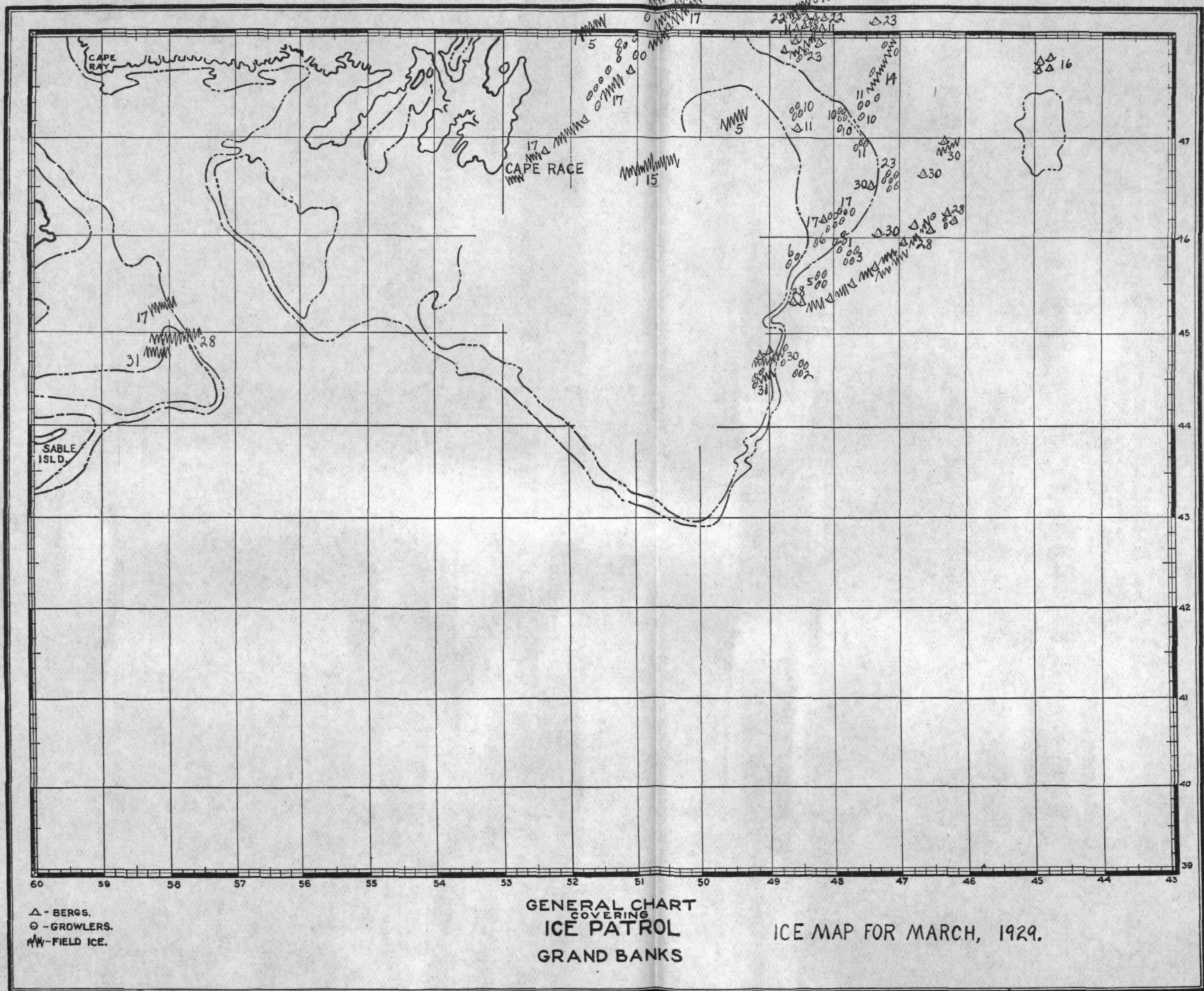

FIGURE 7.—March ice map. Forty-five known icebergs were south of the 48th parallel during the month

100277—30. (Face p. 82.) No. 2

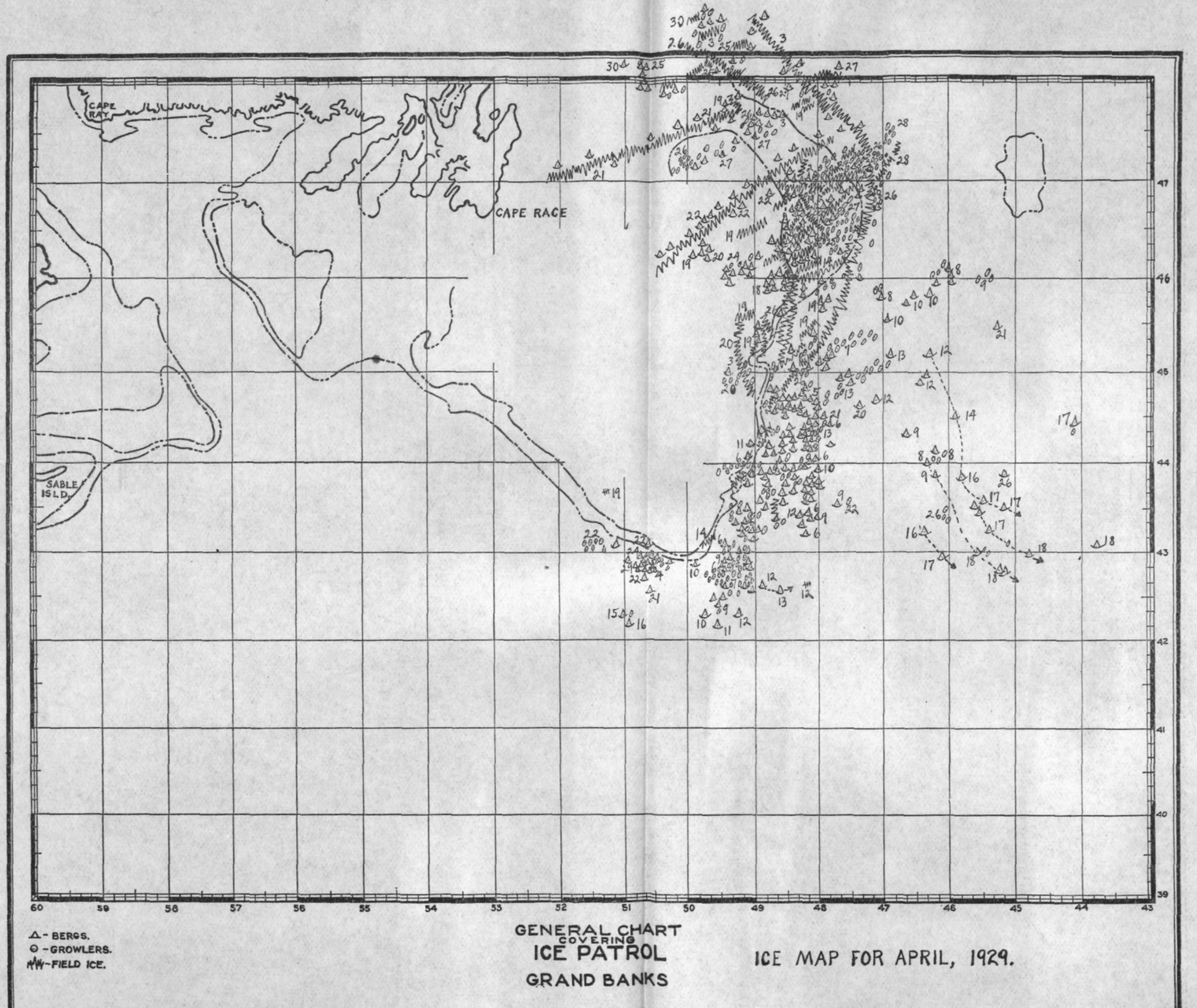

FIGURE 8.—April ice map. Three hundred and thirty-two known icebergs were south of the 48th parallel during the month

100277—30. (Face p. 82.) No. 3

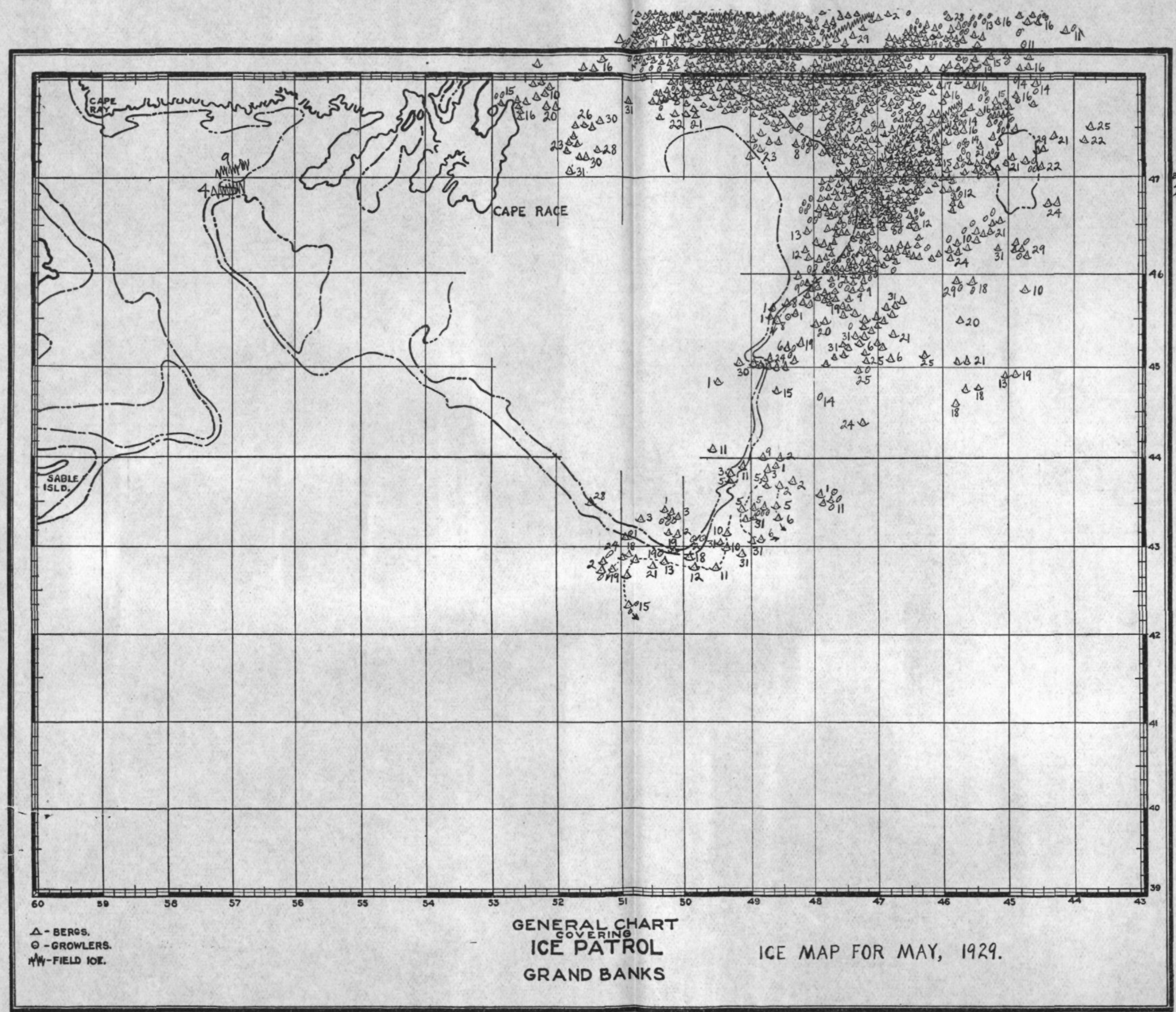

FIGURE 9.—May ice map. Four hundred and sixty known icebergs were south of the 48th parallel during the month

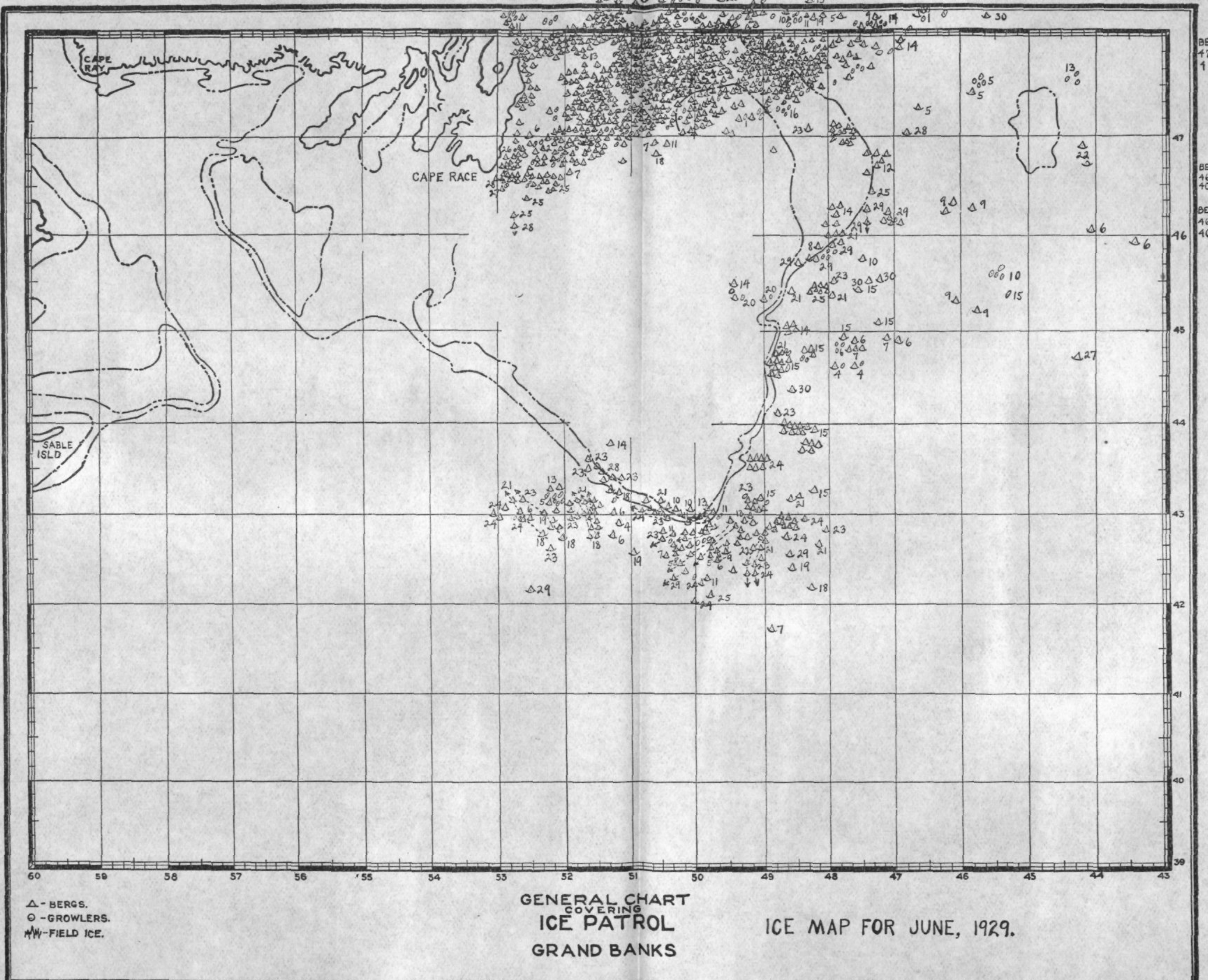

FIGURE 10.—June ice map. Three hundred and seventy-six known icebergs were south of the 48th parallel during the month

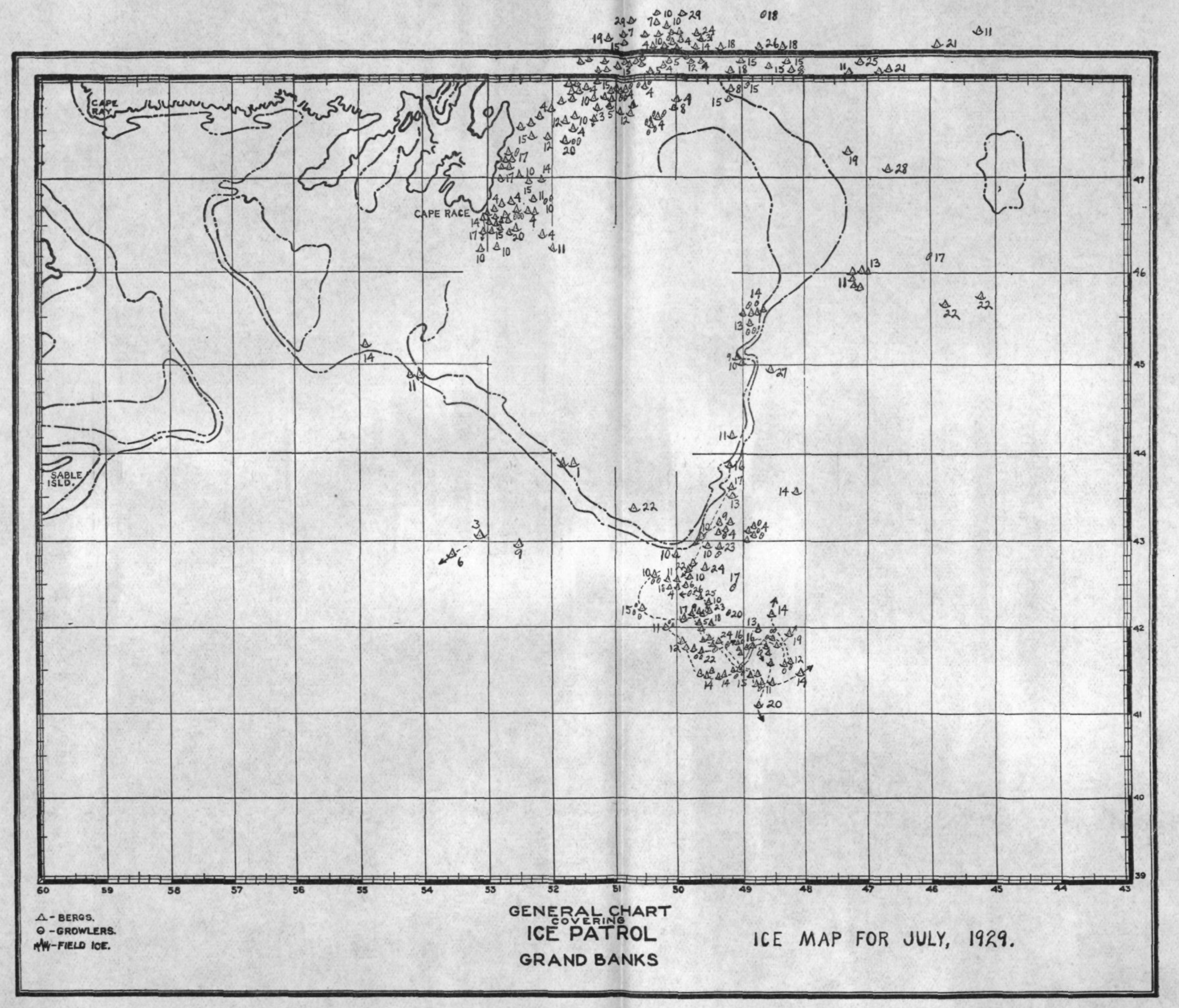

FIGURE 11.—July ice map. About 100 known icebergs were south of the 48th parallel during the month

100277—30. (Face p. 82.) No. 6

SOME OF THE ICE PATROL'S PROBLEMS, AND HOW IT ATTACKS THEM

The primary duty of the ice patrol is locating and broadcasting the position of all ice near the steamship tracks which cross the North Atlantic south of Newfoundland. The patrol service is maintained to assure, if possible, that vessels using these tracks will not run unwarned into ice-infested waters.

The patrol's responsibility is certainly not the safe passage of persons, vessels, and freight across the ice-patrol regions. That is, indeed, the final aim of the ice patrol's work, but the safety of each individual ship is something not under the control of the ice-patrol officials. Safety from dangers incident to collision with ice is dependent upon the judgment of the individual shipmasters in estimating the situation ahead of them. The patrol's broadcasts give these men a certain amount of late information, which is undoubtedly useful as a guide for shaping their course and speed policies past the Grand Banks.

One patrol vessel is out on duty at all times during the heavy ice season. The fuel capacity and other limitations of the vessels that have been used to date are such that they can cruise at about 10 knots during daylight hours of good visibility during their 15-day duty periods in the ice regions, and ordinarily no more. Greater work than that they can not do because of the need for fuel to carry the ships to and from the ice area, to evaporate sea water for domestic and boiler purposes, to supply demands for steam during long stand-by periods of fog, darkness, and storm, to retain position in currents, and for emergency reserves.

Bad visibility and bad weather together are so prevalent that on the average the patrol can count on no more than 150 hours of efficient searching weather per 15-day period of patrol duty. During these 150 hours the patrol ship averaging 10 knots can run 1,500 sea miles and can sight bergs at an average distance of not over 15 miles on either hand. In other words, the patrol vessel herself can examine not over 45,000 square sea miles of water area per average patrol cruise, even when every available hour of good visibility is utilized to the full for search purposes.

Some ground is lost because of doubly searched areas that unavoidably exist about the corners of the search patterns. Other reasons, such as necessary overlapping of searches made on different days due to indeterminate differential surface drifts of neighboring sea areas, and large ship drifts during periods of darkness and low visibility, cause additional losses. As a matter of fact, a good figure to take for the maximum actual area that can be well covered for ice by one patrol ship per 15-day patrol cruise is 30,000 square sea miles.

The area about the Grand Banks that most frequently contains bergs and to which it is desirable to confine most of the patrol's activity lies between longitudes 43° and 54° W. and latitudes 40° 30′ and 48° N. Deducting the area of the Avalon Peninsula of Newfoundland and that of a warm iceless portion in the southeastern corner of this region, it will be found that the total area south of the forty-eighth parallel which is most likely to contain ice contains about 168,000 square geographical miles. Some of the areas over the Grand Banks themselves are not frequented by trans-atlantic traffic. There is, besides, very little sustained current in the shoal water. Therefore, the total area which must be most closely watched can be reduced to about 150,000 square geographical miles.

North of this great southern ice area and extending eastward for several degrees of longitude from the North American coasts, the waters are particularly liable to be congested with ice. It is normal for unnavigable field ice to exist over broad areas immediately north of the forty-eighth parallel during several winter and spring months. The same waters are liable to be more or less thickly strewn with bergs throughout the whole year. Though ice conditions vary in different localities for various reasons, it is true, generally speaking, that the farther north of the forty-eighth parallel one goes along the North American coast the worse will be the ice conditions met. This holds true all the way up into the Arctic regions that are choked all year round with impenetrable field ice.

The serious ice conditions likely to be met at any time to the north of the Grand Banks and the forty-eighth parallel are doubtless well realized by the masters of all vessels crossing in the higher latitudes, so for all practical purposes this area can be considered as beyond the ice patrol's particular sphere of action, though not at all beyond its sphere of experience, interest, or knowledge. Ice information received in the form of reports from the northern sections is always placed in the broadcasts and retained for about five days before being dropped. Any vessel requesting special information from the patrol ship regarding ice in the area north of the forty-eighth parallel will usually be able to get valuable information.

There have been occasional reports of bergs to the west, south, and east of the usual ice area between 43° W. to 54° W. and 40° 30′ N. to 48° N. Ice in such locations, however, may be considered as due to extraordinary berg or current conditions. The ice-patrol ships themselves can not attempt to locate ice in waters where it is only phenomenally present any more than they can keep track of all the ice in the tremendous ice regions of the north. As a matter of fact, if the patrol limits its cruising activities to the important ice area of 150,000 square sea miles about the Grand Banks, it is confronted with a very sizable problem, for it has been shown that in a full 15-day cruise period the patrol's own searching can be made to cover but about one-fifth of such an area.

The result is that the patrol is compelled to concentrate on the most critical parts of the 150,000 square sea mile ice area south of the forty-eighth parallel. It relies upon reports from passing ships for its knowledge of ice in many parts of this area, as well as in the surrounding northern and southern regions, that on the one hand always, and on the other only exceptionally, contain ice.

It may be of interest to state here what takes place on the patrol vessel when ice or water temperature reports are received. Copies of all these incoming messages are promptly taken to the chart room and delivered to the ice-observation force. They first scrutinize the reports for errors. The tracks and approximate positions of all regularly reporting steamers while in the ice-patrol area are kept plotted on special charts. If a new report is from an obviously improbable location, some distance from where the reporting ship should have been at the time of origin of the message, the value is thrown out if an ordinary temperature report. If it is an ice report, or a water temperature value from an area that few vessels have been through recently, an inquiry for verification of the questionable location or other particular is promptly sent out.

At this point it should be noted that the size of bergs seen at sea at a distance of 2 or more miles is very deceptive. There is usually nothing of known size near them with which they can be compared. The patrol itself has frequently seen bergs that appeared to all on the bridge to be very large pinnacled ice masses when they were near the horizon, but which, when closely approached, proved to be rather insignificant, rising less than 30 feet above the sea and being less than 100 feet in diameter. So it is that bergs in the frequently bright smooth waters of the southern ice sectors, though reported as "large" and "very large," are often found when reached to be in fact quite small. They were probably sighted on the horizon line when nearly abeam of the reporting vessel, which had never closely approached and examined them because of the loss of valuable time that this would have involved.

The unusually large refraction values often found near the junction of the warm and cold waters makes the identification of bergs difficult and adds to the uncertainty when determining berg sizes from a distance. Sometimes bergs not over 30 feet high can be seen for 20 to 30 sea miles from a height of eye of 20 feet. Once during the 1929 ice season on a day when refraction was making objects loom up higher than usual the white ice-patrol vessel was reported to herself as a berg by a steamer that was observed to be passing by at a distance of approximately 10 miles.

However, if after a careful inspection no flaw in an incoming iceberg or temperature report is apparent, it must be accepted as correct and plotted on the cruise chart. The plotted bergs always have the date of the report written near by so that their successive positions from day to day can be followed. The water temperature values are plotted in different colored inks, the colors being changed every few days to enable the special portion of the cruise period during which they were received to be readily seen.

The water-temperature values and the ice, but especially the latter, are never looked upon as something fixed and unmoving. They are constantly regarded as though in motion, and from the moment they are plotted they are looked at with a continually questioning attitude. Where will they be and how much will they be changed in one, two, or more days? If the patrol is to be of high value to shipping this attitude is necessary. Bergs often have to be found several days after they have been reported, as at the end of a period of fog, or after the patrol has been released by the complete melting of a particularly dangerous berg that was being watched. Constant estimates must be made of berg positions at the expiration of different time intervals. The patrol has time to search out only the most probable locations of reported bergs. In most cases, due to the normal prevalence of strong currents, it can afford to go directly toward the spot where a berg was last sighted or reported only when the information is extremely recent, say, less than one day old.

The task of keeping track of the southern ice limits would be fairly simple if good visibility were as prevalent over the Labrador Current as it is over the Gulf Stream 180 miles south of the Tail of the Banks. As it is, the patrol has to keep up a constant matching of its wits against fog-shrouded currents. Its errors and successes are strongly brought home as its searches during daylight periods of good visibility are successful or fruitless. There is a constant stimulus to find new ways of predicting berg movements and to perfect the old, not so much for the information of shipping, but for the guidance of the ice searches of the patrol vessels themselves.

As the bergs are little affected by the wind, their movements are mostly controlled by ocean currents. Therefore, any method of predicting ice movements entails finding out the drift of water at the time. The present state of knowledge regarding ocean physics about the Grand Banks makes it appear that hydrodynamic surveys are the best means for determining the oceanic circulation there. The ice patrol has studied and worked with dynamic oceanographic methods for some years. It has been found that the making of satisfactory surveys of this sort entails steaming over large areas frequently, for the precise surface and subsurface information that must be obtained can only be gathered by the patrol vessels themselves. With only one ice patrol vessel out on duty at one time this interferes greatly with the normal conduct of the practical part of the service.

The second-best method of determining currents and berg drifts about the Grand Banks is the interpreting of surface isotherm curves in the light of past experience. The cooperation from shipping that has been worked up enables the patrol vessel to plot the surface isotherms over a large area. The requirements of the hydrodynamic method and the dependence which can be placed on the surface isotherms are both discussed in the next chapter.

Conditions under which the patrol vessels work vary from month to month and from year to year. Weather conditions and information about ice coming in by radio often make it wise for the patrol to alter its course of action several times during even a single day. No hard-and-fast rules can ever be laid down, but existing circumstances, as viewed in the light of the patrol's past experience, must always determine the cruising and other activities of the patrol vessels on each cruise. As a general principle, however, it can be said that the patrol must leave for other vessels to find and report all ice east of the forty-seventh meridian and north of the forty-fourth parallel. To narrow down and simplify the problem still further, it can be stated that the patrol vessels should almost exclusively confine their own activities to the area of an equilateral triangle with sides about 175 sea miles long and corners near 41° 30′ N., 47° 00′ W., 41° 30′ N., 51° 00′ W., and 44° 48′ N., 48° 00′ W.

The above triangle contains about 13,200 square sea miles, and so is of the order of size that theoretically can be searched for ice two times during each patrol cruise. The areas along the western and southern edges of this triangle are most critical and should never be left unguarded for more than a very few days at a time, even during light ice periods. The reason for this is because the general drift of ice is southward down the western part of the triangle, then eastward along the westbound B steamship tracks near the southern part of it, and, finally, northward and northeastward away from the southern tracks and across the eastern side of the triangle.

A berg entering the circulation at the northern apex of the critical triangle, if it is not melted, shunted off by local currents, or held up by some means such as grounding or coming into an eddy, can easily be discharged into a very dangerous position right along the westbound B tracks within a period of from 10 to 15 days. Fog and strong currents and the necessity for standing by the most dangerous bergs, whether they are inside or outside of the critical triangle, make the actual proper patroling of even the critical western and southern parts of its 13,200 square sea miles a continual problem.

During heavy ice periods about the only times when the area inside of this triangle should be left are when bergs that must be followed drift west or south of its southern portion. Of course during very light-ice times, which occur near the ends of some seasons, it sometimes happens that there is no ice in the critical triangle. Then occasional runs to the north can be made in order to locate the southernmost ice limits. Generally speaking, however, throughout the active ice-patrol season, if a high degree of safety from danger of collision with ice is to be maintained during times of low visibility along the B tracks, the western and southern portions of the critical triangle must be constantly and repeatedly searched. The ice found there must be most carefully watched and followed until it either melts or recurves and drifts so far to the north that it no longer menaces the B tracks.

During most of the ice-patrol season the B tracks just south of the critical triangle are in constant use. That means the route of westbound traffic to the United States lies right along the southern edge of the critical triangle. These westbound ships are of great assistance in reporting water temperatures and in notifying the patrol of chance bergs that may be crossing the southern part of the triangle for points farther south, with some drift of cold water. The eastbound B tracks are 60 geographical miles south of the westbound ones, and so are considerably safer than the latter, on the general proposition that the farther south of the Tail of the Banks one is in the ocean, in the long run, the fewer bergs will be encountered. The eastbound traffic is doubly protected from liability of meeting unreported ice by the active operations of the westbound ships in cooperating with the patrol.

Nevertheless, the 60 miles separating the eastbound and westbound traffic streams of the B tracks can be traversed by a berg during certain times of accelerated circulation in a period of about 30 hours. Therefore, especially toward the ends of periods of fog of two or more days' duration, even along the eastbound B tracks, vessels while between 52° W. and 45° W. are subject to a real, though very slight, chance of unexpectedly meeting an unreported iceberg. Because of the much greater danger along the westbound B tracks, however, the ice patrol must at all times exert its utmost efforts to locate all bergs that are approaching the latter lanes from the north.

Freighters, tankers, and other vessels not carrying passengers are not included in any track agreement and are not expected to adhere to any definite lane. A large number of the bolder vessels of the nonpassenger class cross the ocean about where they see fit. The reports from such sources are the main dependence of the patrol for its knowledge of by far the largest part of the great area lying between the United States and the Canadian tracks. This area is large when the patrol season starts, but it becomes very much larger as the advance of the spring melts back the field ice and permits the Canadian tracks to be shifted farther and farther north. It goes without saying that the value to the patrol of temperature and ice reports from vessels crossing between the usual tracks is inestimable. A large gain would be effected by the ice-patrol service if all such vessels would report their positions and water temperatures regularly instead of remaining silent unless they see ice, as it appears a number of them still do.

Those passenger vessels which cut to the north of the tracks that are in effect (and the patrol noted, in 1929, 100 different cases where vessels carrying passengers were 20 miles or more north of their prescribed lanes), if they do not take rigid extra precautions, decrease their chances of coming through the ice regions safely. Their masters should bear in mind the fact that the ice-patrol broadcasts do not necessarily list all the icebergs in any area, but only the icebergs of which the patrol and the reporting vessels have knowledge. The positions of ice in the broadcasts are always subject to a certain amount of observational error in the first place, and they become less and less reliable as time goes on, due to the impossibility of accurately forecasting berg drifts. Hope to make absolute determinations of future berg drifts can be expected neither from construction of dynamic current maps nor isotherm and ice charts. The best that can ever be hoped for is some reasonable approximation of the most probable courses and rates of movement that given bergs will take.

South of the Tail of the Banks reported positions of bergs, even if correct within a mile to begin with, are normally subject to a 24-sea-mile radius of error with every day that passes from the time of the last report of them. Occasionally swift currents cause the radius of error to reach 48 sea miles daily, and very exceptionally to approach 72 sea miles per day. The dates given with the positions of the southernmost bergs enable the recipients of the broadcasts to determine within 24 hours the time the different bergs were last reported or sighted. This permits their making a very rough approximation of probable berg locations when knowledge of the usual drifts of ice is at hand.

Some passenger liners, both eastbound and westbound, maintain notoriously high rates of speed, such as 20 knots, more or less, according to ability, even during periods of fog and darkness. The ice patrol has noted that a few of them actually maintain such speeds during bad visibility conditions when they are 100 miles and more north of their proper tracks. Such action is extremely foolhardy and is bound to result sooner or later in disaster.

100277—30——7

Vessels maintaining high speeds southeast of the Grand Banks, as well as in more northern parts of the ice-patrol area, are at times dependent for safety on their chances of having an ice-free track ahead of them. It is entirely idle to think that microthermographs, subsurface echo or listening devices, or any other instruments that have as yet been developed by science, can protect ships from collision with ice if they are traveling at from 10 to 24 knots during dense fog, pitch darkness, and the like. If any device for detecting the presence ahead of bergs or heavy field ice were practical the fine steamers on the Canadian tracks would adopt it and proceed at reasonable speeds during bad conditions of visibility instead of stopping or groping along at about 3 knots, as many of them do at such times, while between the longitudes where icebergs are situated.

The danger of collision with ice is a real and not a fancied one at many times and places south of the Cape Race tracks and even south of the Tail. The *Titanic* is far from being the only vessel to have struck a berg. To mention two recent cases, the reader is reminded of the *Montrose*, which in 1928 and the *Vimeita*, which in 1929, struck bergs head on off the eastern edge of the Grand Banks. Neither vessel was lost, but heavy damage was sustained in both cases. No one should deceive himself in this matter. To depend blindly on the broadcasts of the ice patrol is not enough. The only way to be sure of not hitting ice in regions where bergs are liable to exist is to keep a bright lookout and to travel at speeds low enough to insure ability to stop or turn aside before striking a berg just visible ahead under the prevailing atmospheric conditions.

The Western North Atlantic can be likened to a great dance hall and the bergs to dancers. The southern part of the room is warm and unoccupied. The cold northern part of it is where the orchestra of the wind holds sway. There the floor is crowded by jostling dancers through whom one must pick one's way with great care. The central part of the room is occupied at times by a few of the hardiest and swiftest performers. Their maneuvers are watched, but the floor is vast and the light is so bad that fully half the time they can not be seen. Sending vessels past the Tail at high speeds during low visibility is like rolling thin glass balls across the central part of such a dance floor and hoping that they will not strike the flying feet of the dancers that occasionally execute intricate figures in the middle of the hall.

For postulated berg sizes and frequencies the mathematical chances of collision with ice under the worst conditions of high speed and low visibility can easily be calculated. Let us suppose that bergs 300 feet in diameter are ahead of a fast liner and that there is only one such berg along each 60 mile front at right angles to the course line. It very frequently happens that the southernmost bergs have not been sighted for 24 hours because of fog. A berg may move north, though the flow of the main body of the Labrador Current more often makes it move south. If it goes south very rapidly under the above conditions of berg distribution the chances are good that the next berg to the north will take its place in the 60 mile section immediately ahead of the ship. In 24 hours the position of each berg south of the Tail may be assumed to be indeterminate by about 30 sea miles. What is the chance that ice will be hit?

The breadth of the liner can be neglected, for her maneuvering powers may be such that she can avoid a berg sighted ahead by half the amount of her beam, though if not properly made use of these same maneuvering powers are capable of causing a long raking collision when otherwise the vessel would have just passed clear. The chance that a berg will be hit works out at 1 chance in 1,200, the ratio between the 300-foot diameter of the bergs and the 60-mile front at right angles to the course line along which each berg was assumed to lie.

Such chances are not desperate ones, and they would doubtless be welcomed by trans-Atlantic fliers; but the aspect becomes different when it is considered that there are exceedingly many steamship crossings past the Tail during fog and darkness each season and that when bergs are far south they are likely to be spaced much closer than one to every 60 sea miles at right angles to the track.

Frequent long periods of fog make it impossible to guarantee that occasionally unannounced bergs will not get upon the B tracks. Whether or not there will be disastrous collisions with ice in the North Atlantic depends largely on the speed at which vessels run during thick weather and darkness while they are east, south, and southwest of the Tail. Ships crossing north of the Tail are, as has already been said, liable to meet more and more icebergs in proportion as they cross the Labrador Current in higher and higher latitudes; but their masters realize this and generally run very slowly during low visibility, thereby minimizing the chances of serious damage in the cases where they find collision with ice is unavoidable.

The above all serves to place some of the problems of the patrol before the reader and shows the inherent danger that lies in neglecting the scouting program for any purpose at all, even that of attempting to make current maps by the hydrodynamic method. So long as there is only one vessel out on patrol at a time, oceanographic stations can be taken here and there without any appreciable interference with the practical program, and this should certainly be done to keep up the annual continuity of the records of salinity and temperature offshore about the Grand Banks. Much useful information and much training in physical oceanography that may be valuable in the future, is given by the occasional scattered stations; but such station arrangement only gives fragmentary dynamic information, and most assuredly does not permit the making of current maps of a sort that can be used as the basis for confident prediction of berg drifts.

The Convention for the Safety of Life at Sea that was held in London in 1929 took up the matter of the ice patrol and recommended that a maximum of three instead of two ships be made available for the work. It is hoped that in the future it will be possible to employ a third vessel whose complement will include a professional oceanographer. The ice-scouting and information-broadcasting vessels could then be relieved of the burden of the larger part, at least, of the scientific oceanographic work.

The addition of a vessel primarily for the scientific program would mean a great step forward and would be justified even if the dynamic current maps which it could make should finally prove to be of small practical value. In addition to the large funds of knowledge that such a ship should be able to obtain for pure science in such fields as oceanic circulation and submarine bottom configuration, her presence about the Grand Banks under the direction of the commander, International Ice Patrol, would at critical times be of great practical value. She could send in surface temperature and weather conditions reports to the scouting ship from areas from which no ships were reporting and could be called upon when necessity arose to search key areas or to trail and observe the final disintegration of especially dangerous bergs.

The main patrol vessels, on the other hand, when relieved of the oceanographic station work could better take on board the necessary additional personnel and gear to permit a start to be made in the matter of ice scouting by aircraft from the patrol vessels. The cautious and well-thought-out use of aircraft to assist during periods of fine weather in searching out the region in and near the critical triangular area just north of the B tracks would seem to be one of the most promising of the fields of development that are open to the ice patrol at the present time.

OCEANOGRAPHY

1. **Scientific work during the 1929 patrol season.**
2. **Prediction of iceberg drifts.**
   - **A. Surface isotherms as basis for prediction.**
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3. **Estimate of total annual amount of glacial ice south of forty-eighth parallel and its total chilling effect on the water.**
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1. SCIENTIFIC WORK DURING THE 1929 PATROL SEASON

Following immediately after this chapter the reader will find figures showing a number of current diagrams and oceanographic sections constructed from data obtained at some of the 69 oceanographic stations occupied during the season. That portion of the year's stations too isolated either in time or place to be utilized for the construction of current diagrams or sections are of scientific interest as records of 1929 surface and subsurface temperatures and salinities in the vicinity of the Tail of the Grand Banks. Therefore, all station data are given in full at the end of this pamphlet.

Station procedure in general and the normal levels to be sampled were the same in 1929 as since 1925. The main advantage in adhering to the same levels year after year is that the values found are then strictly and easily comparable over long periods of time. Uncorrected Richter and Wiese reversing thermometers without attached auxiliary thermometers were used in Greene-Bigelow water bottles at all stations. The variable-speed electric hoists used at the stations were equipped with spooling devices that laid up the $\frac{5}{32}$-inch steel wire on the drums satisfactorily. The hoists gave good service without any interruptions and there was no loss of gear.

One of the ice patrol's two electrical salinity determining cabinets having worn out, the use of a titrating outfit for the *Modoc* was obtained through the courtesy of Harvard University. This method of determining salinities, new for the ice patrol, was purposely set up and tried out during rough weather early in the season. It was found perfectly workable when due precautions were taken to handle the delicate glass instruments with care and to protect them by the use of suitable racks and string ties.

The electrical salinity measuring method as used on the ice-patrol vessels is about twice as fast as the titration method and is much easier and simpler; hence it should be used when a very large number of water samples are to be handled. The comparative cheapness, light weight, and availability of the titrating outfits, however, make them preferable to the electric-salinity cabinets, unless over 1,000 samples of water are to be analyzed per ship per season. The former are from twenty-five to fifty times cheaper and lighter than the electrical outfits. For worth-while results both methods require well-trained and conscientious operators. Under comparable conditions the accuracies obtainable by the two methods are probably about equal.

The large number of bergs south of the forty-eighth parallel during the 1929 ice season claimed the patrol's almost undivided attention. If the ice had been less, either in extent or amount, more oceanographic work would have been done. In a general way, and as in previous years, the currents that the dynamic oceanographic computations showed theoretically should exist, actually did exist in fact, as shown by occasional iceberg and patrol-ship drifts.

2. POSSIBILITY OF PREDICTING ICEBERG DRIFTS

A. SURFACE ISOTHERMS AS BASIS FOR PREDICTION

Berg-drift predictions are highly necessary for the information and guidance of the patrol itself, even though the conclusions should not be accurate enough to send out in the broadcasts. Therefore, any method simpler than the dynamic one that the patrol ships could employ without interfering too much with their primary scouting and trailing duties is much to be desired. Having explained at some length in the preceding chapter the features of some of the problems confronting the ice patrol, the matter of predicting berg drifts can now be taken up with clearer understanding.

The only other method besides dynamic mapping that has been suggested for picturing the varying circulation in the ice-patrol area has been that based on a study of surface isotherm charts. The surface isotherms have always been assumed to give a broad general idea of the prevailing water and ice movements in and about the Labrador Current throughout the season. The main reason why the patrol vessel carefully plots both her own surface-temperature observations and those coming in from other ships is because the ice in general is expected to be found and to remain where the water is coldest.

The cruise isotherm charts have been considered valuable enough to reproduce each year in the ice patrol's bulletins, but they have not been given important consideration when attempting to forecast movements of bergs that have not been sighted or reported for some time. The reason for this lack of confidence lies in the numerous discrepancies that have been noted when bergs did not move parallel to the isotherms or even close to the direction which the surface isotherms seemed to indicate they should take.

It is obvious that if it were possible to deduce from a study of the surface temperatures alone the circulation existing at the time, and that is likely to continue to exist for some time to come, the making of estimations of future berg drifts would be rather simple. Experience shows that with the cooperation of passing vessels isotherm charts can be constructed every 15 days which show in excellent detail the picture of surface temperatures over almost the whole of the region between the thirty-ninth and forty-ninth parallels and the forty-third and fifth-sixth meridians. This embraces all of the usual ice regions south of Newfoundland and a goodly area of their surrounding waters as well. It covers an area between ten and twenty times as large as that which two ships of the character of the present ice-patrol vessels could keep properly mapped dynamically in the eddying waters about the Grand Banks, even if they devoted alternating at-sea periods entirely to oceanography.

The making of the isotherm charts from the ship's log and from the received radiograms is a routine process that requires but one or two hours of work per day from two men. It does not consume any of the ship's scouting time or interfere with any other of her ice-patrol duties, and so is entirely within the capabilities of the present ice patrol. On the other hand, the full projection of dynamic current maps is not, as will be shown in the next section.

The vital question is whether the best surface isotherm charts procurable can be interpreted in any way to be relied upon to properly picture the circulation of the layers of water which control the movements of the bergs. Hardly less important is another query: If the true circulation at the instant is mirrored properly, how much can the surface isotherms be depended upon to tell the story of what currents will prevail from two to seven days later?

The first thing that must be done when approaching the problem is to determine what paths icebergs have taken in the past. The main courses that they are likely to follow in the southern part of the Labrador Current are very clearly shown in Figure 30 on page 69 of Coast Guard Bulletin 16. This chart, which sums up the berg-drift information gathered by the ice patrol up to and through the 1927 season, is one of the fundamental sources of practical ice-drift information. It is constantly referred to when bergs are reported or sighted because it gives some information of the direction in which the ice may drift while not under surveillance. This chart and its companion chart, Figure 29 on the page facing it, when compared with the composite picture obtained from a study of all the isotherm charts explain why it has been assumed that the bergs tend to remain in the colder waters and to follow in general the usual paths taken by the varying pushes of the same.

Even when the case is narrowed down from full seasons and cruise periods to that of individual drifts it is still found that a good agreement is actually observable between many berg, wreckage, and ship drifts, on the one hand, and the particular distribution of current that the surface isotherms at the time suggest, on the other. This raises grounds for hope that an intelligent interpretation of the isotherm curves alone can be used to forecast future berg drifts, at least in some regions and cases.

Let us examine the isotherm and ice charts of the 1928 and 1929 ice-patrol seasons and see how much the isotherm charts in their present state of development can be depended upon to indicate berg drifts. The charts should be considered with the usual drifts of bergs about the Grand Banks in mind and with a knowledge of the general subsurface conditions of the region that the oceanographic station work to date has furnished. To depend upon the different isotherm charts alone would be to invite confusion and misinterpretation.

Some of the rapid berg drifts indicated by dotted lines south of the forty-third parallel on the ice charts for the months of May and June, 1928, show a general agreement with the isotherm chart for the period during which they occurred, May 21 to June 5, 1928. Comparison of three drifts shown on Figures 9 and 10 with the isotherms on Figure 28 in Coast Guard Bulletin No. 17 suffices to show this. The berg drifts during the period of the seventh and eighth patrol cruises of 1929, from July 3 to August 2, again illustrate the good correlation between the surface isotherms and the regional oceanic circulation in the area of special danger to shipping south and southeast of the Tail. To facilitate comparison the drift tracks of all of the 1929 bergs whose drifts the patrol was able to determine have been placed on the respective isotherm charts appearing in this Coast Guard Bulletin.

From the comparatively pure Gulf Stream waters just to the south of the limits of bergs many temperature reports are received by the patrol. These waters are found to be often characterized by deep embayment of the isotherms, similar to those that occur in the colder mixed waters just offshore of the Tail. Coming in with the temperature reports from the waters of tropical character there are frequent reports of spars, buoys, and other floating objects. Attention is called to the particular drift of a buoy shown on the isotherm chart for the period June 18–July 2, 1929. This buoy's drift was plotted from a series of reports each so complete and specific as to positively identify it. There were no strong breezes or gales to interfere with the local currents. It can be seen that its successive positions indicate that the local drift among the isotherm embayments in the warm water was at the time to the northwestward, very much at variance with the ordinary conception of the flow of the Gulf Stream drift but in direct agreement with the direction of drift which would have been predicted from an inspection of the local surface isotherms on the chart.

But watching the drift of bergs and other passively floating bodies is not the only available means of ascertaining local currents. The moderate wind conditions that usually prevail in the ice-patrol area during the last half of the patrol season enable that portion of the patrol ship's own drift which is due to current alone to be rather accurately determined during times of good visibility.

The value of current determinations of this sort varies with the accuracy with which the vessel's observations of the heavenly bodies are made. Methods of position fixing by means of soundings and radio bearings, though at all times useful for check purposes, and necessarily relied upon during foggy and overcast weather, are not exact enough to be of much use for accurately determining ocean currents off the Tail of the Grand Banks. On the other hand, the positions obtainable through celo-navigational methods during favorable periods are at times dependable within a radius of not over 3 miles, and so quite valuable for this purpose.

Position fixing is of prime importance to the ice patrol for a number of reasons and great attention is paid to it. The most modern methods of handling the observational and chart work are followed. Positions are checked by independent work of at least two experienced navigators.

Spending most of its time searching relatively small areas near the temperature wall between the Gulf Stream and the Labrador Current, drifting at night, and keeping track of its position as it does, it is believed that the ice patrol is at many times particularly capable of observing the rates and directions of the local currents. Many of these currents are so restricted in size and vary so much in direction over the course of one or two hundred miles that they are frequently averaged out and lost during the long runs made daily by ships bound east and west across the ocean at speeds exceeding 8 or 10 knots.

In three cases when the ship's location was well determined strong currents were observed during the 1929 ice-patrol season, as follows: On April 25 and 26, a sustained 2.6-knot current setting east and northeast along the forty-second parallel between 49° W. and 51° W. On June 7, a current setting southeast over 2 knots near 41° 38′ N., 48° 56′ W. On June 24 and 25, a 2-knot easterly current near 42° N., 50° W. In every case the existence of these strong currents is fully indicated by the position of the curves on the isotherm charts. When a well-developed cold wall exists between the Gulf Stream and Labrador Current a rapid flow parallel to the isotherms seems to be characteristic.

One of the striking features shown by the surface isotherms southeast of the Banks is that of the tremendous embayments in the boundary between the cold and warm currents. That the warm and cold tongues are especially well developed in the middle part of the ice season is shown by the isotherm chart for the period May 21–June 5, 1928 (fig. 28 in Coast Guard Bulletin 17), and the one for the period June 3–18, 1929 (fig. 29 in this pamphlet).

Very often where an extra cold tongue from the Labrador Current extends southward on the surface an extra warm tongue will protrude north close to it and just to the westward, it would seem almost as a compensation. This sharp contrast of waters at times appears to accelerate the local oceanic circulation along the adjacent intensified temperature walls. The 5-day drift of 160 miles across the forty-fifth parallel of the southeasternmost berg of April, 1928, is not in close agreement with the surface isotherm indications in the area, but it is quite characteristic, and may be typical of the local area and the particular contemporary distribution of surface temperature. The writer believes it to be referrable to the close approximation of tongues of 42° and 54° surface water near 44° 20′ N., 45° 50′ W., which are plotted on the isotherm chart for the period April 6–21, 1928 (fig. 25, Coast Guard Bulletin 17).

Examples of berg drifts much at variance with the surface isotherm indications are easily found. Off Cape Race, along the eastern edge of the Grand Banks and close to and west of the Tail, such apparently anomalous berg drifts are frequent. Possible explanation of this condition can be found in the persistent streaming along of the layers of cold water controlling the bergs. It appears as though the cold water is at times forced under warmer and lighter surface layers, and in these cases the surface isotherms should not be taken as guides for berg drifts. To be able to detect these cases experience in the ice-patrol region or close study of the old ice-patrol records is necessary.

Before any definite statement can be made it will be necessary to determine more fully under what conditions and how regularly surface isotherm curves can be assumed to mirror the underlying circulation. Present indications are that this is the case and that valuable information can be obtained from them in the cases where and when a cold wall is strongly developed. By a cold wall is meant a region in which the surface isotherms are noticeably packed. It is a narrow belt across which the surface temperature gradient is much greater than it is farther on in either direction along the line drawn at right angles to the different isotherm curves.

The dynamic investigations have shown that the density wall, which usually controls the circulation, normally lies a variable distance inshore of the cold wall in the Grand Banks area. When depending on the surface temperatures alone the exact location of the density wall is, of course, unknown. Nevertheless, in cases where a cold wall is strongly developed, it appears that the following rule holds good. An observer stationed along the junction line between markedly warmer and colder water, will, if he faces directly toward the cold water and puts the warm water at his back, have the local ocean current in his immediate vicinity, both behind and before him, flowing from his left-hand side toward his right-hand side.

This is not advanced as any general rule for the Northern Hemisphere or even as an infallible one for use in the whole of the 150,000 square sea mile most probable ice area about the Grand Banks. At some times and in some places the varying relations between different water masses are affected by earth rotation, winds, shoals, and other factors too much for that. There are complications caused by shifting of surface and subsurface layers from their original positions, and masking effects due in place to late season surface warming over true cold water. Nevertheless, the rule is a good working one for the ice patrol when it is used with due regard for the special dynamic and other circulation conditions that are liable to be encountered.

When the horizontal surface temperature gradient is small, and in the localities liable to subsurface pushes of cold water the case is not clear. Nevertheless, the surface isotherm charts are already of such great value to the patrol for the estimation of berg drifts that every effort should be made to improve their character, regardless of whether or not the dynamic oceanographic maps are continued.

It is certain that the isothermal method is susceptible of greatly increased development, mainly through increasing the number of incoming water-temperature reports. Such an increase in number would be very desirable even if the values were not useful for constructing surface isotherm charts. These reports serve to keep a close check on the positions and courses of the different passing vessels, inform the patrol what areas are being searched for ice, and tell what weather conditions are prevailing in different localities.

An average of 60 water temperature reports per day were received during the 1929 ice season. If this could be increased to 100 reports per day the value of the isotherms for estimating currents and berg drifts would be more than doubled. The value of the isotherm charts would be greatly increased by a few more reports per day if these could be obtained from vessels crossing the ocean between the United States and the Canadian tracks. Requests for water temperatures from this area are often inserted in the broadcasts in order to obtain more values from the little-frequented parts of it. An increase in the total number of temperature reports and a little better distribution of them would permit the making of a valuable isotherm chart weekly instead of every 15 days and would also permit a slight reduction in the temperature interval between some of the isothermal lines.

Any final general statement at this time of the value of the isothermal method of determining ocean currents in the Grand Banks region would be premature, however. The whole matter of correlating berg drifts and surface isotherms is now under critical study. The drifts of bergs during the 1930 ice season will be closely watched for instances of their adherence or nonadherence to the isothermal indications. They should furnish considerable additional data upon which to judge the merits of the case.

B. DYNAMIC CURRENT MAPS AS BASIS FOR PREDICTION

Another method, distinct from the examination of surface isotherm curves by experienced observers, has been suggested for prediction of iceberg movements. It involves the construction of dynamic current maps, and is undoubtedly accurate when certain conditions are fulfilled. To make good current maps of this kind, however, a more detailed dynamic mapping of the area is necessary than the ice patrol can usually undertake. Therefore, under the present conditions it is impossible to get the maximum obtainable amount of benefit from this method.

How an exact knowlege of the temperatures and salinities prevailing at the different levels throughtout an area permits the construction of a current map showing the local oceanic circulation has been fully explained in the Coast Guard bulletins describing the ice patrols of 1926, 1927, and 1928. Coast Guard Bulletin 14, December, 1925, gives detailed information telling how such maps can be made and interpreted. Some idea of the effort which the ice patrol must put forth to do satisfactory dynamic oceanographic work will be obtained from the discussion which follows.

Because of rapid mixture of warm Gulf Stream and cold Labrador Current water, the ocean currents off the Tail and the eastern slope of the Grand Banks are in a particularly active state of turmoil and fluctuation. Therefore, to be sufficiently comparable, dynamically, to give satisfactory current maps, the different oceanographic stations within an area about 100 geographical miles square must be occupied during a period of not over 10 days. The results would be more reliable and lasting if the stations were taken within a period of seven days. To confine the station work to an area smaller than 100 sea miles square, or to an equivalent rectangle of less than 10,000 square geographical miles, would be to limit so seriously the scope over which the berg-drift predictions could be made as to make the current map of very small practical value.

The time during which the taking of a series of stations can be safely spread out will vary much with the rate of change of location of the different water masses in the area under observation. The

7 to 10 day periods mentioned above represent the estimated time lapse which the writer considers permissible for a set of observations taken under the usual conditions that prevail in the various 10,000 square geographical mile areas located over the deep water just east and southeast of the Grand Banks.

A case of shift of position of water masses due to time lapse can be seen when stations 1078 and 1091 are compared. These were occupied within 10 miles of each other, but the interval of 21 days between them prevents a reasonable dynamic comparison of the two water columns. In the period between the taking of the first and second of these stations a lighter water column appears to have pushed inshore toward the eastern edge of the Banks. The warming of the surface layer can be attributed to seasonal effects, but this cause can not explain the large temperature rise of the 125 and 50 meter levels. The salinities at all levels above 750 meters are much alike at the two stations. The considerable difference in temperature values at some levels can best be explained by postulating an inshore invasion of warm water.

Fifty stations, taken within the stipulated 7 to 10 day period, are about the minimum number that can give a current map of a 10,000 square sea-mile area of sufficient accuracy to be of much real practical value to the ice patrol. From the experience of the past four years it is known that 50 stations, arranged in five rows 20 miles apart, with 10 stations in each row spaced at intervals averaging 10 miles, would suffice to give a dynamic current map showing in some detail the complicated local currents of a 100 sea-mile square area.

When completed, the dynamic current maps are interpreted much like weather maps, but the stations must be placed much closer together than the Weather Bureau's observing stations if the complicated detail of the water circulation is to be caught. They must be spaced much closer about the Grand Banks region than similar oceanographic stations taken for like purposes in parts of the ocean where erratic currents due to mixture of radically different water masses are absent.

The hydrographic station values need not be regathered so frequently as meteorological observations at weather stations. It is well that this is so because it is much more tedious and difficult to get the required dynamic data properly at an oceanographic station than it is to observe the meteorological elements at an ordinary Weather Bureau station. The great mobility of the atmosphere requires the weather map to be remade from the synoptic data every 12 hours and in the sea off the Grand Banks where the currents are especially complicated and interlocking, the stations must be taken, as stated previously, within a 7 to 10 day period and comparatively close together to get the full story of the sea-water interactions. Because the current speed and the mobility of the ocean swirls are of the order of twenty to forty times less than that of those in the atmosphere, the current maps when once made are probably good for about one week, though it is doubtful if the detailed current map of the hypothetical 10,000 square sea-mile area made during the course of 7 to 10 days, can be depended on very closely after three or four days from its completion, due to the length of time required to develop it.

Taking the most favorable arrangement of courses possible, to make a good useful current map of the 100 sea-mile square area with 50 stations as outlined above, it is necessary to steam about 600 sea-miles. At 8 knots, a high average speed for a scientific ship to maintain under the conditions prevailing about the Grand Banks, this would take 75 hours. Add 50 hours to this for the time required for work at the 50 stations, and a period of 125 hours, or just over five and one-sixth days, of intensive undivided work by a ship in midocean is seen to be necessary to gather the data required for the making of a dynamic current map of what is really a very small portion of the usual ice area south of the forty-eighth parallel.

During a large part of the station taking period good visibility should prevail, for it is very necessary to insure accurate geographical location of at least a number of the stations to keep the whole map from being hazy and indefinite. In places near the edge of the Banks radio bearings and sonic soundings serve to locate position rather accurately at times, but in most places many and good celo-navigational observations are absolutely essential to satisfactory position fixing. Observations can only be obtained during weather excellent for ice searching.

If the very exacting oceanographic work inseparable from the construction of detailed dynamic current maps is seriously prosecuted, the primary object of the patrol, the location by scouting and radio information of ice for the protection of shipping, must be neglected to an appreciable extent. Each time, before commencing upon the cruising necessary to the construction of a current map, the commanding officer of the patrol ship must weigh the possible advantages to be obtained from a dynamic current map against all features inimical to the practical program that such construction will entail. A current map made at the expense of a vessel's disastrous collision with ice which might have been averted, but for the oceanographic work, would involve a cost entirely too high to pay. A single patrol ship can either make current maps or stay with the ice. It can not do both at the same time with any degree of justice to either.

Apart from their practical value to the ice patrol, dynamic current maps have a permanent scientific value which is not interfered with by delay in plotting them. A number of current maps in the Grand

Banks region have already been made, however, and it would seem to be established that they can be made, and that they can be made again whenever necessity arises. A close study of maps already on hand would now seem to be in order, rather than a multiplication of maps of very transient value to the patrol.

During very light ice years, and at times when all the bergs are 200 miles or so to the north of the steamship tracks being used between Europe and the United States, an ice patrol with one vessel only out on duty might be justified in devoting itself to the tasks of dynamic oceanography to the extent of attempting to make detailed current maps of 10,000 square sea mile areas. Even during such times, however, such a procedure is open to question. When the Europe-United States tracks are not endangered by ice it would seem to be but logical to devote attention to actual patrolling along the southernmost routes between Canada and Europe. The ice patrol, besides being international in name, is entirely so in fact, receiving its support from international contributions, and therefore bound to protect impartially to the limit of its ability all the ice-endangered tracks across the North Atlantic.

Putting aside this possible exception during light ice years and periods, it would certainly seem that the ice-patrol service as now conducted, that is with two ships alternately out on duty, should most emphatically not devote its activities to oceanography to the extent required for the construction of good dynamic current maps. Depending upon poor current maps is worse than not having any at all. The real solution of the dynamic mapping problem lies in the employment for the ice-patrol duty of an additional vessel, charged primarily with the scientific work.

3. ESTIMATE OF TOTAL ANNUAL AMOUNT OF GLACIAL ICE SOUTH OF FORTY-EIGHTH PARALLEL, AND ITS TOTAL CHILLING EFFECT ON THE WATER

It has been argued by a certain school of scientific thought, influenced by the oceanographer, O. Petterson, that the bergs about the Grand Banks in melting furnish the energy which keeps the southern reaches of the Labrador Current moving along as they do. On the other hand, others, and especially F. Nansen, contend that melting icebergs have little effect in producing great ocean currents.

Attempts to estimate the total amount of glacial ice that comes south of the forty-eighth parallel in any one year and to consider its possible chilling effect on the water masses there may throw some light on this problem. If it is a fact that a negligible amount of cold water is produced by the melting of the bergs that get south of the forty-eighth parallel in the Labrador Current, it will be reasonable to suppose that their melting will be unable to have much effect on the horizontal ocean currents that exist to the east and south of the Grand Banks plateau.

In 1929, the heaviest ice year that the international ice patrol has experienced to date, approximately 1,300 bergs drifted south of the forty-eighth parallel in the Western North Atlantic. When it crosses the forty-eighth parallel the cubical contents of the average berg, above water, is not greater than that of a block of ice 100 feet high, 400 feet long, and 100 feet wide. That means that the average berg has, above water, not more than 4,000,000 cubic feet of glacier ice. Lieut. Commander Edward H. Smith, a former ice-observation officer of the patrol, estimates the average above-water volume of bergs about the Grand Banks to be one-third of this amount. However, a certain amount of glacial ice in the form of growlers crosses the forty-eighth parallel each year. To allow for this ice, and to insure that the total quantity of fresh-water ice will not be underestimated, a rather larger average size has been allowed for the bergs than would otherwise be the case.

It is quite likely that a fair estimate of the correct annual total amount of above-water glacial ice that enters the region about the Grand Banks will be obtained by multiplying the total number of bergs given by the ice patrol as south of the forty-eighth parallel each year by 4,000,000 cubic feet. This figure is advanced as a maximum one, the real amount being probably somewhat smaller, due mainly to duplication of berg reports.

The total amount of ice to come south of the forty-eighth parallel is, of course, the sum of that which is above and below the sea surface. The underwater body of a berg being quite irregular and largely hidden, its total volume is extremely hard to determine by actual observation or measurement. In the past it has undoubtedly been overestimated. The fresh-water glacial ice of the North Atlantic iceberg is, according to experiments made by the physicist, H. T. Barnes, about 10 per cent lighter than the solid ice which is formed on the surfaces of lakes and streams in winter. The reason for its lightness is found in the much larger proportion of air in the form of tiny bubbles that it contains. All the pictures of ice in this bulletin show how white and clouded with innumerable tiny air bubbles the glacial ice of icebergs really is. According to Barnes' estimate its specific gravity averages close to 0.830 as compared with about 0.916 for clear ice and 1.000 for pure water at the point of maximum density.

Since nearly all of the bergs to the south of latitude 48° N. float in sea water of density varying between 1.02 and 1.03, they must float on the average about one-fifth out of water instead of one-eighth. Until recently the latter figure has commonly been accepted as approximately correct, but if Barnes is right, it is entirely too small.

The actual range of density of glacial ice in the Grand Banks region should be checked by more observations.

The size of the average berg has been taken great enough to insure that no large underestimation can be introduced into the final figures by the slight uncertainty that still exists relative to the average specific gravity of the ice. Therefore, multiplying the average berg's 4 million cubic feet of above water ice by five, we find that on entering the waters about the Grand Banks it contains not over 20 million cubic feet of ice in all, or, in other words, has a total mass slightly in excess of 500,000 short tons.

The total amount of berg ice, both above and below water, south of the forty-eighth parallel in 1929, may, therefore, be estimated as thirteen hundred times 20 million or 26 billion cubic feet, which is roughly about 676 million short tons. Such an amount of ice would require well over 100 trillion British thermal units to reduce it to water at 32° F. This is a formidable amount of heat, for each British thermal unit is equal to 252 gram calories.

It is with this draft of heat that icebergs melting south of the forty-eighth parallel directly affect the temperature of the waters in which they are distributed. As soon as the area in which the 26 billion cubic feet of ice melts is estimated, the possible effects on water layers in the area can be computed.

The isotherm and ice maps show that the cold waters that would be directly affected by this melting ice extend over about 20,000 square sea miles south of the Tail, 30,000 square sea miles along the eastern edge of the Banks, and 24,000 square sea miles between the forty-seventh and forty-eighth parallels. (See figure 1.) This is a total area of 74,000 square sea miles or 2,644 billion square feet.

Hereafter this area will be referred to as the "melting area." The section of it to the south of the Tail, and the southern half of the section of it along the eastern edge of the Banks, include the whole of the 13,200 square sea-mile critical triangle of the patrol described in the chapter on procedure and remarks. They include the waters that surround the critical triangle as well. The northern parts of the "melting area" include all waters through which the bergs pass to reach the critical triangle.

It was also stated in the discssion of the practical problems of the patrol that berg ice is normally found each year inside a 150,000 square sea-mile area south of the forty-eighth parallel. The "melting area" is the very heart of this usual ice area, and inside of it fully 90 per cent of the ice that comes south of the forty-eighth parallel can be expected to melt. To draw comparisons so that the size of the "melting area" can be more readily visualized, its 74,000 square sea-mile extent is a little larger than the six States that comprise

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New England, and a little smaller than the combined area of England and Scotland.

Without attempting to discuss the vertical circulation that takes place within the radius of a mile or so from a berg melting under the varying weather and water conditions that it encounters during its life span in the Grand Banks region, it is certain that the bergs do chill sea water there in melting. It makes no difference in a discussion of their total chilling effect whether they affect surface or subsurface layers. From whatever stratum the heat is chiefly drawn, the total amount consumed will be the same.

Let us assume that the bergs directly affect a layer of water averaging over the 74,000 square sea-mile "melting area" 50 feet thick. This is a minimum thickness to expect them to affect and a convenient one for calculations. It gives 133,200 billion cubic feet of water in the "melting area" to be affected by the disintegration of the total of 26 billion cubic feet of glacial ice. Simplifying the problem, it is found that for each 5,123 cubic feet of water there is 1 cubic foot of ice.

The latter is very close to 32° F. in temperature when it crosses the forty-eighth parallel. Neglecting the lightness of the glacial ice, and the salinity of the sea water, and generously allowing that 80 cubic feet of the latter can be chilled 1° F. by the melting of 1 cubic foot of the ice, it follows that the melting of the total amount of glacial ice present throughout the whole ice season in the region under discussion would only counteract the normal seasonal warming of a 50-foot layer of water in the melting area south of the forty-eighth parallel by 0.0156° F., an insignificant amount.

It should be borne in mind that the 1929 ice year, on which the 26 billion cubic-foot berg ice total used above is based, was an ice year about three times as heavy as the normal one. It is safe to say that during the normal year, when less than 400 bergs come south of the forty-eighth parallel, supplying the heat requirements of the glacial ice disintegrating in the "melting area" does not chill any 50-foot stratum of water in the cold current there by more than 0.01° F.

It has been assumed in arriving at the above estimate that no chilling effect from the bergs is lost directly to the air. This loss exists, but it is doubtless extremely small. It has been further assumed that no locally ice-chilled water is lost from the "melting area" to the westward past Cape Race, to the westward to form bottom water over the Grand Banks, or to the southeastward past Flemish Cap. Analysis of berg drifts shows that, during the ice season at least, there is but little push of cold water to the westward past Cape Race or onto the Banks. Some losses in these directions occur, however, and even more ice and cold water are lost to the southeastward past Flemish Cap. The sum total of losses in all three directions probably amounts to well over 5 per cent of the effect of the melting bergs. The larger this percentage loss is, the less will be the chilling effect on the local waters of the bergs that melt in the "melting area."

The 0.01° F. figure is a maximum for still another reason not previously brought out. During a 100-day ice-patrol season, the cold current is entirely renewed at least once throughout the "melting area" if the average southerly drift of the current is only 4 sea miles per day. But the southerly drift of the ice bearing waters averages much more rapid than this. Therefore, the chilling effect of the season's bergs should not be figured upon the simple extent of the 74,000 square sea miles. It should be spread out over a water volume covering a surface more than twice as large, over the total area of cold water that passes through the "melting area" during the ice season.

These conditions need not be emphasized because the approximate figure of 0.01° F. which was arrived at is already sufficiently small to indicate the relative unimportance of the bergs as chilling agents in the southern reaches of the Labrador Current. Even if very large miscalculations have crept in, and the total amount of berg ice to get south of the forty-eighth parallel should by any chance be twice as large as has been estimated, still its effects will be so small as to make them extremely unimportant.

An oceanic effect diametrically opposite to the chilling influence of melting bergs is to be found in the vernal warming at and near the surface about the Grand Banks. The next paragraphs will discuss that part of the tremendous seasonal warming which the ice patrol is able to observe, and will compare its magnitude with the 0.01° F. chilling value just deduced.

The normal ice-patrol season can be taken as 100 days long, from March 25 to July 3. A slight amount of exterpolation is necessary to arrive at the March 25 and July 3 surface temperature values in years when the active patrol season begins late or ends unusually early. On the whole such allowances are easy to make and the ice-patrol period can be used as a convenient measuring stick.

Since the normal ice-patrol season extends from just past the vernal equinox to well past the time of the sun's most northerly declination, the sun has a high position in the heavens at noon, and the surface waters warm up rapidly over the whole Grand Banks regions throughout the time. Although there are large local variations, and also annual variations of less amount but larger significance, comparison of the patrol's surface isotherm charts show that the rates and amounts of warming in the same areas in different years agree closely.

At the beginning of the season, just before April 1, the temperature of the Grand Banks surface water is about 33° F. At the close of the season, a little after July 1, it is about 55° F., a rise of 22° F. Over the varying extent of cold Arctic stream water south of the Tail, the temperature is about 33° F. at the start of the season and 50° F. at its close, a rise of 17° F. Along the eastern edge of the Banks the true cold water rises from about 32° F. to about 47° F., a rise of 15° F. Between the forty-seventh and forty-eighth parallels the Labrador Current surface water during the same time warms from about 32° F. to about 44° F., a rise of 12° F. South of the Banks along the fortieth parallel in the Gulf Stream the rise during a 100-day ice-patrol season amounts to 10° F., from about 60° to 70° F.

The varying rates of warming in different areas about the Grand Banks are in the main easily accounted for. The Grand Banks water, for instance, is shoal and it is somewhat less subject to fog blankets than the Labrador Current. Moreover it is relatively stationary in so far as the effects of true ocean currents, as distinct from tidal ones, are concerned. It is, therefore, favorably situated to show a high degree of vernal surface warming.

On the other hand, the surface water of the southern parts of the Labrador Current is constantly being replenished by cold water from the north. It is underlaid by extremely cold water and overlaid by much fog throughout the season. The effects of solar warming show up slowly and it is easy to see why it only warms up 14⅝° F. on the average during the time in which the Grand Banks surface waters are warming up 22° F.

The Gulf Stream's small surface warming despite much clear weather can be attributed principally to the fact that its waters are already warm. It is flowing with a large northerly component into cooler regions of decreased sun strength where radiation and other losses can with less and less facility be counterbalanced.

The area of mixed surface water between the Gulf Stream and the Labrador Current changes position and size rapidly, varying so much from month to month and year to year that it is hard to say just what its exact increase in temperature is. A fair figure would be one somewhere between that of the pure Labrador Current and Gulf Stream surface water, say 13° F.

Coming back to the 74,000 square sea mile "melting area" it can be seen that, though principally over the Labrador Current, it slightly overlaps the Banks, and extensively overlaps the mixed water offshore. Fourteen degrees Fahrenheit can be taken as a good figure for the total rise of its surface water temperatures during the 100-day ice-patrol season. The warmed waters tend, of course, to remain near the surface of the sea, hence the warming effect decreases rapidly with depth throughout the Grand Banks region.

Let us assume that the rise of temperature at the 50-foot level in the "melting area" during the ice-patrol season is 10° F., as compared with 14° F. at the surface during the same time. The stations which the ice patrol has taken in the area usually sample the surface, the 25-

meter, and lower levels, and tell nothing directly about the temperature of the 50-foot level. Nevertheless, a study of temperature curves made from the station figures shows that 10° F. is a conservative estimate to make for the average increase in temperature at the 50-foot level between March 25 and July 3.

Let us neglect the tremendous sum total warming that takes place in decreasing increments in the 50-foot layers of water below the 50-foot layer that has its upper boundary at the surface of the sea. We can for the purpose of this discussion simply assume that the total effect of solar warming from March 25 to July 4 is not less than enough to warm all the water from the surface down to the 50-foot level in the "melting area" an average amount of 12° F.

Now a rise of 12° F. in 100 days means that the average rise is 0.12° F. per day. It has been shown that 0.01° F. is a very generous amount to allow for the chilling effect of a full season's bergs south of the forty-eighth parallel on a 50-foot layer of the "melting area." One one-hundredths degree Fahrenheit is only one-twelfth as much as the average daily rise of 0.12° F. In other words the total chilling effect of bergs in the "melting area" is not sufficient to nullify more than two hours of the average vernal warming effect that is active throughout the ice-patrol season.

This seems hard to believe at first when one looks at the ice charts of the ice patrol. It must be kept in mind that the bergs marked on these charts must be large enough to be plainly seen. As drawn they are far too big in proportion to their proper scale size. The real amount of glacial ice south of the forty-eighth parallel each year is comparatively small when considered in relation to water volumes of 50-foot layers of the "melting area."

One way to get a conception of the relative smallness of the 26 billion cubic feet of glacial ice that came south of 48° N. during the heavy 1929 ice season is to assume it to be spread out evenly over the surface of the "melting area," of 74,000 square miles, or 2,664 billion square feet. The whole season's bergs spread out at once would make a uniform layer of glacial ice only about 0.01 foot, or one-eighth inch thick.

A skim of ice only one-eighth inch thick would not be expected to last long or to interfere much with vernal warming of a fresh-water lake. It should be expected to last far less time and to interfere with warming no more over the "melting area." On second thought the comparatively negligible effect of the bergs south of the forty-eighth parallel on the water masses there is seen to be quite plausible.

It is recognized that none of the variables that have been considered in arriving at the conclusions reached in this section are accurately known. Therefore, the results can be only approximate and can only serve to give an idea of the orders of magnitude involved. In cases of doubt large values have been taken to arrive at the chilling effects of the bergs, and extremely small values to arrive at the total effect of vernal warming. For this reason the estimate that the melting of bergs south of the forty-eighth parallel offsets the solar warming effect in the "melting area" by but two hours is likely to be much too large. The true time figure is probably less than one hour. But even if gross errors have crept in and the two hours should be 100 per cent too small instead of too large, the negligible effects of the melting bergs in the southern parts of the Labrador Current would still be apparent.

If the bergs melting south of the forty-eighth parallel do not make and keep the southern reaches of the Labrador Current cold and active, then what does? The answer to this question leads very far afield and can not be more than hinted at here.

Barnes [1] sees the source of the cold water layers in the Gulf of St. Lawrence and southeast of Newfoundland in the melting of icebergs. Lieut. Commander Edward H. Smith, United States Coast Guard, has stated in the course of conversation with the writer that, because of their large size and immense numbers, the melting of bergs north of the forty-eighth parallel has a much more powerful effect than that of bergs melting in the "melting area." The sum total of the berg effects, in his opinion, amounts to almost nothing, however. It is many times exceeded by that of melting northern field ice. He further stated that the combined effects of both bergs and field ice were entirely inadequate to account for the enormous volume of cold water that is discharged annually past Labrador by the Labrador Current. He contends that its true source must be looked for in direct winter chilling of the sea in northern regions by the air.

He bases his opinion on a critical study of all the important oceanographic and explorational work that has been undertaken in the North Atlantic and polar basins, as well as on the results of his own work while with the ice patrol and the Marion Expedition. The latter scientific expedition into the waters between Greenland and Labrador, it will be remembered, was sponsored by the United States Coast Guard for the benefit of the scientific program of the ice patrol in 1928. The results of its work have not yet been fully published, but will be issued from time to time as special numbers in the series of Coast Guard bulletins. Lieutenant Commander Smith has just finished his discussion of ice and currents, and these sections, embodying his views, a few of which are briefly outlined above, should appear at an early date.

It is believed that the calculations of chilling and warming effects made in this section will help in a small way to support the Nansen idea of oceanic circulation as interpreted by Lieut. Commander Edward H. Smith.

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[1] P. 75, Transactions Royal Society of Canada, 1914, Sec. III, third series, vol. 8.

4. OBSERVATIONS ON ICEBERG DISINTEGRATION SOUTH OF THE FORTY-FOURTH PARALLEL

One might assume that the ice patrol as now conducted has more frequent and better opportunities actually to observe the disintegration of icebergs and field ice than is the fact. There are some opportunities for first-hand observation, of course, but these are often not so good as might be wished. For instance, during the writer's four years' experience with the ice patrol he has never seen a single square foot of the field ice that is so abundant during the early season in the northern parts of the Grand Banks region. The reason for this is that the patrol must almost always remain close by the southernmost ice limits. About these limits the field ice is not usually found, and even the bergs themselves are rather few and far between.

Frequently after a day of searching a berg reported earlier by a passing vessel is found late in the afternoon after the completion of a predetermined search pattern. It is usually given a berth of from one-half to one-fourth mile, though sometimes it is passed closer, depending upon weather and other conditions. The ship will then be stopped 1 or 2 miles to leeward of the berg, where it is "secured" for the night—that is, steam is turned off the propelling machinery and the larger generators and auxiliaries, to save fuel for future searches for ice.

When daylight returns next morning the berg is usually only a small white mass on the horizon. It may even be 8 or 10 miles to windward, on account of the relatively greater effect of breezes on the ship and surface water than on the deep-lying berg. It may be approached again before the new day's search is started, but in many cases it is only relocated from a distance by a series of bearings taken with the aid of the gyrocompass repeaters on the wings of the bridge. Such bearings can locate the geographical position of the berg as well as steaming up to it, and they can be taken while the ship is running along on a set of courses planned to make the new day's search for ice most effective.

Possibly the patrol will return to the old berg for the night, and if this is done, a comparison can be made with the way the ice looked 24 hours earlier. But new bergs that require watching may be found in more threatening positions than the old one, and if this is the case, the former may never be seen again.

Each season a few of the most southern bergs are watched during a period of days. Then the usual procedure is to drift well clear of the ice and to run up toward it once or twice a day, in the evening, or both morning and evening, depending on the rate at which the patrol ship is drifted or blown away.

During about one-third of the ice-patrol season fog makes all continued observations of ice impossible. Bergs under surveillance when a long period of fog shuts down are invariably lost. After a protracted foggy spell the patrol does its most intensive cruising, trying to relocate the new positions of the dangerous bergs.

Each year a certain amount of time is lost in futile searching for bergs reported from extra southerly locations. These bergs frequently can not be found because of the strong currents and rapid ice disintegration, which obtain in the warm surface waters along the northern edge of the Gulf Stream.

Besides the rather limited opportunities for close first-hand observation, the varying shapes of the bergs themselves, and the varying conditions of wave motion and water temperature about them, all go to make the subject of berg disintegration a complicated and conjectural one. The determination of the life of a berg that is sighted south of the Tail of the Banks is certainly not obtainable through the application of any hard and fast rules.

Obviously 130,000 tons of ice in the form of growlers and small pieces will melt much faster than the same amount of ice in the form of a single solid berg. Not only will the smaller pieces have a greater total area exposed to water action, but they will be entirely in the upper layers of water that are warmer and more affected by wave motion than the layers that are 50 feet and more below the surface. The pieces of ice that calve from a berg nearly always stream off to leeward, under the influence of winds, waves, and surface currents. They rapidly melt and disappear and the life of the parent berg is undoubtedly materially shortened by continued prolific calving. Some of the bergs, because of their peculiar shape and particular internal structure, or the unusual conditions of water and weather that they experience, calve more than others.

The fresh ice exposed when a piece falls from a berg south of the forty-fourth parallel is dry and frosty at first. The spot, even though far above the reach of sea and spray, soon becomes wet, however, and so it generally remains. After long exposure the upper parts of bergs sometimes become rough and granular and apparently dry, while between the granules they may be wet in fact.

Barnes [2] states that bergs calve most near sunrise and that they dry up and freeze on account of radiation from their surfaces at night. This may be true of bergs north of the Grand Banks, but that it is true of bergs melting in the warmer southern portions of the "melting area" south of the forty-fourth parallel should not be assumed without more direct evidence. On the contrary, the late afternoons, nights, and early mornings are foggy or cloudy more than 50 per cent of the time during the ice season in the southern parts of the "melting area." Such conditions are not conducive to effective nocturnal chilling of berg surfaces by radiation and keep as well the early rays

[2] H. T. Barnes, "Thermit and Icebergs." Journal of the Franklin Institute, May, 1927.

of the sun from striking the ice. During 1929 one berg southeast of the Tail approached on a cloudy night was seen when the beams of a searchlight were played on it to be pouring off water from all visible surfaces, just as so usually happens during the day.

Notwithstanding the need for further observation and study, the observations which the ice patrol has been able to make to date permit some conclusions to be drawn about the life of bergs south of the forty-fourth parallel. Two late instances will be given.

A berg of not less than 500,000 short tons mass was seen by the patrol for the first time on July 17, 1929, about 55 miles south-southeast of the Tail. It was in water close to 60° F. at the surface at this time and remained in such water throughout the remainder of its life. It disappeared entirely late on July 26, nine days after it had been first sighted. The berg was a rather solid one and this disintegration was considered quite rapid. A berg of about the same size in 1928 lasted south of the Tail from May 21 to June 4, a period of 14 days. The time was earlier in the season and the water was considerably colder during most of this time. In fact, it was in surface water colder than 38° F. from May 21 to May 25. Both of the above bergs were larger than the average berg that gets below the forty-fourth parallel, being of the approximate size of the generously large berg taken in section 3 of this chapter as the average size which crosses the forty-eighth parallel.

The experience of the ice patrol all goes to show that in the 50° to 60° surface water south and east of the Grand Banks the average berg can be counted on under all ordinary circumstances to be entirely melted in from 7 to 10 days. Only extremely large and resistant bergs are able to survive longer in water warmer than 50° F.

It was computed in the section of this chapter dealing with glacial ice totals that the abnormally heavy 1929 ice season provided only enough ice south of the forty-eighth parallel to cover the "melting area" of 74,000 square sea miles with a film of ice one-eighth inch thick. The only reason why the glacial ice reaches so much lower latitudes and persists south of the forty-eighth parallel each season two to three months longer than the field ice does is because of its concentration in the large masses known as icebergs. If it were not so concentrated it would vanish overnight and never reach the 50° and 60° water east and south of the Banks.

The field ice so prevalent during the first third of the ice patrol season in the northern half of the "melting area" and in the regions to the north of that, has an enormous preservative influence on the bergs. If there were no field ice off the Labrador and Newfoundland coasts in the winter and spring there would be far less of a berg problem along the trans-Atlantic tracks than there now is. The field ice has been credited with acting as a fender which keeps the bergs during certain months from grounding along the North American coast north of Cape Race, and so eliminating themselves from southern waters. Whether this be true or not, it is an undeniable fact that the field ice tends to keep the surface water about it ice cold. A berg surrounded by field ice in the Labrador Current until it is south of the forty-fifth parallel is conserved much as a cargo of meat is conserved in a refrigerating vessel that is steaming through the Tropics.

But the field ice prolongs the life of the bergs in another way than through its great cooling effect. In addition it effectually prevents the development of wave motion, and in this way protects most efficiently the vulnerable waterlines of bergs from the washing and melting attacks of moving surface water.

Calving most frequently takes place by the dropping down of ice masses that overhang an undercut water line, and so is closely related to surface water attacks. Calving upwards from the smoothly rounded underwater portions of a berg is exceptional in the ice patrol regions. Sometimes a projecting spur that is mostly submerged is broken off by stresses arising from the rise and fall of the swell. These stresses are very large at times, and so are the blows of the sea against a berg's sides. Bergs are usually very dead in the water and take the full force of the seas like rocks. They do not normally roll or ride over the seas like well-designed ships do when drifting.

Calving generally involves but a very small portion of the mass of a berg at any one time. Of course bergs sometimes break up into two nearly equal parts, but in fully 90 per cent of the cases the amount of ice involved in a calving is so small in comparison with the mass of the berg that equilibrium is only slightly affected. This is the case, even when the meaning of calving is restricted to production of ice volumes of more than 1 ton. The breaking off of small pieces is very frequent under some conditions, and this production of small amounts of ice in the form of chips and tiny blocks is not considered real calving, such as is contemplated here.

It is reasonable to suppose that the chances of calving and rolling will be much greater in warm water than in cold, but it must be remembered that the conditions will vary much with each individual berg. To venture an opinion for the benefit of those who in the future may be called upon to work upon bergs for any purpose, it is estimated that the average berg south of the forty-fourth parallel can be expected to have natural calvings involving the falling off of over 1 ton of ice about three times a day, and to experience changes of position involving the turning about an axis more than 60° in less than one minute of time about twice a week. The above is only a rough estimate, based on comparatively few observations. Some bergs will not calve for days at a time and will never turn over until they have been reduced to the size of a ship's boat. Other bergs will both calve and roll about much more than the average.

The varying water temperatures in which a berg may be floating have a great effect on its speed of disintegration, but it is doubtful if the percentage of the total wastage due to calving, compared with that due to direct melting from the berg, varies much under any conditions met south of the forty-fourth or even the forty-eighth parallel. The effects of calving are more noticeable in some cases than others, however. For instance several bergs seen near the Tail in 1929 had water lines showing that the upper parts of the berg were rising higher and higher out of the water. They were very few in number, and they may be explained by excessive calving, or by floating in very cold sub surface water during periods of warm bright weather that were especially destructive to large portions of their above-water bodies.

Nevertheless, despite low temperatures of surface water at all places during the early season, and in many places until close to the end of the ice period, and despite permanent low temperatures at the lower levels reached by bergs in the "melting area," the constant effect of the sea water moving about in intimate contact with the water line and the great underwater surfaces of bergs must be the most important factor working toward their destruction. Subaerial melting from the bergs is a minor factor, but still it adds its quota to the melting process of berg disintegration, as distinct from the loss of mass through calving. Over the whole ice-patrol area the sum total calving effect is probably much less than the total surface melting effect in getting rid of the bergs.

From a small boat that pulled about a berg which pitched heavily while calving on July 15, many air bubbles were seen to be rising through the smooth water and breaking at the surface within a dozen feet or so of the vertical ice walls of one side. Some of these bubbles appeared to be nearly 1 inch in diameter and these made a considerable disturbance at the surface like the large bubbles of marsh gas that rise through shallow waters under certain conditions. Each of the larger bubbles of gas in the case of the berg were undoubtedly made up from the combined contents of many of the formerly imprisoned tiny air bubbles of the glacier ice. The separate air bubbles in the bergs are generally less than one-thirty-second of an inch in diameter, much smaller in size than the head of an ordinary common pin. The particular berg of this instance was floating in surface water of temperature 57° F. The continuous coming up of air around it is good evidence of the rapid underwater wastage which occurs whenever the water is that warm.

When movement of the slight swell exposed portions of ice below the average water line of the above berg it was seen that the underwater surfaces were not smooth, but dimpled. This condition was undoubtedly due to differential melting about the individual glacier grains. This dimpled effect is almost always noticeable when the water lines of bergs are closely inspected. Perhaps the underwater bodies of bergs while melting about the Grand Banks, though smoothed and rounded in general outline, may all be composed when the detail is considered of these roughened surfaces. They can be compared to nothing so well as to magnified "goose-flesh" with the intervals between the individual projections or the individual hollows of the order of about half an inch.

To mention a few more examples of berg disintegration observed during the 1929 season it can be stated that on the afternoon of July 24 the ice patrol was standing by a berg in 61° water 55 miles south-southeast of the Tail. The berg was seen to calve heavily. In a few minutes a boat put out from the patrol ship with a swimming party and a number of the growlers in the vicinity of the berg were boarded.

This could be easily be done, either from the boat or the water, without much discomfort, for the chilling effects of the ice on the surface water could be noted on ordinary ship's hold water thermometers only when within a few yards from some of the berg's ice walls, and when the boat was in the midst of a group of growlers spaced on the average 50 feet or less apart. In a few such places temperatures 58° F., but 3° lower than the general sea surface of the neighborhood, were recorded.

About the berg that pitched when calving on July 15 slightly greater local depression of surface temperature was noted. This berg, as already stated, was surrounded by sea water of 57° F. temperature at the surface. In one direction only from this berg was any chilling noted, but a depression of over 1° F. extended on this side to about one-fourth mile from the ice. Close to the berg the sea was 54° to 52° F. at the surface on this chilled side, and here, inside an ice-bottomed, well-washed bay cut into the berg behind an outlying ice pinnacle the temperature was 50° F. Among some near-by growlers a minimum surface temperature of only 48° F. was found. On the other hand, unchilled 57° F. surface water was found close to the vertical walls of the berg on the side opposite to the chilled water and growlers. The weather was calm, warm, and clear, and there was only a slight swell.

5. POSSIBILITY OF BREAKING UP ICEBERGS ARTIFICIALLY

It has often been stated that noise or small blows can break up bergs. The firing of 6-pounder blanks and the sounding of the steam whistle and siren within 100 yards of unstable looking bergs has always failed to bring down any pieces of ice at all during the dozen or more instances in which the writer has seen it persistently tried. Even

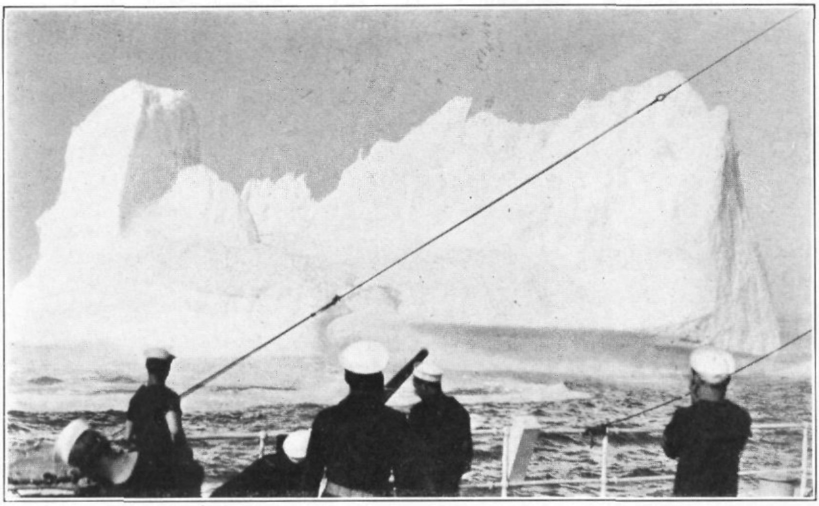


PLATE XIV.—Firing explosive 6-pounder shells into the high thin wall forming one side of a dry-dock type of berg. In this instance a number of tons of cracked ice were brought down into the sea. July 11, 1929, latitude 41° 34′ N., longitude 49° 00′ W.

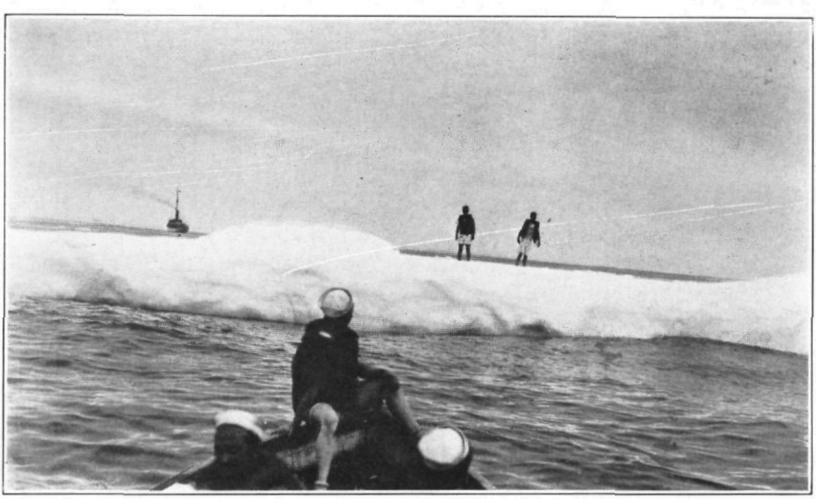


PLATE XV.—Two officers from the *Modoc* on a large growler that an hour earlier formed a projecting ledge just below the water line of a near-by berg. This ice was entirely melted within 24 hours, 61-degree water, July 24, 1929, latitude 42° 10′ N., longitude 49° 30′ W.

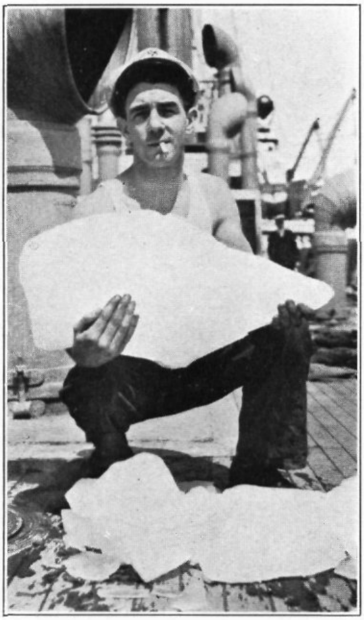


PLATE XVI.—Fragments of iceberg hoisted aboard. This ice is hard and homogeneous. Its opacity is due solely to great numbers of tiny spherical air bubbles

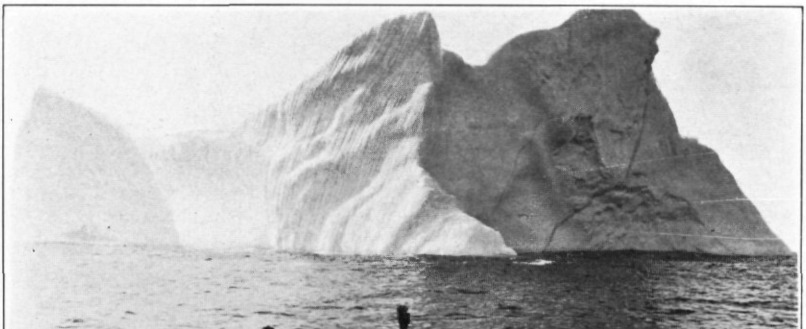


PLATE XVII.—Swimming close to an iceberg in 58° surface water. This ice is not in the Gulf Stream, but is in a great pool of Labrador current water that has been highly warmed at the surface by continued vernal warming. At 100 feet below the surface the temperature was less than 40° F. The striping on the sunlit berg wall directly behind the swimmers may be due to differential melting between annual layers accumulated on the ice cap of Greenland. Taken from ship's boat July 18, 1929, latitude 42° 28′ N., longitude 50° 05′ W.

overhanging and towering ice walls and cracked pinnacles seem unaffected by such noises. Six-pounder shells will bring down from a few pounds to a few tons of ice. They are most likely to produce damage if fired into weak portions of vertical or overhanging walls. Sometimes a lucky shot placed in a crack near a pinnacle or a corner about ready to fall will serve to produce a sizeable growler.

That a berg about the Grand Banks can be noticeably shattered or affected by any such thing as the making of noises near it, or by weak blows like those from an axe should be considered as conceivable, but verging upon the extreme height of improbability. The above statement is made in spite of the following experience with a seemingly fragile berg.

One day in August, 1928, the United States Guard Cutter *Marion* was run alongside a small grounded berg off the Labrador coast for the purpose of obtaining ice. While the berg was being attacked with an axe it calved and pieces of large size thundered into the sea, pushing the vessel well clear. The action of this berg was alarming and impressive to those witnessing it, but it should not be taken as showing the great liability of bergs to disintegrate because of small blows. As a matter of fact the ice that calved off amounted to very little when compared to the total mass of the berg. The parts that fell off were located along an almost vertical, slightly undercut wall. The ice was probably just about to come down of its own accord from the internally strained, grounded berg. It did so when the ship was gently bumped against it by the slight swell, and when the men on deck struck at the ice surface opposite them with an axe.

Because of the rapidity with which bergs break up themselves, and because of the known physical properties of ice, it has been suggested that the southernmost bergs be removed from the paths of navigation by boarding and mining them. Some experiments along these lines have been carried out in past years by the ice patrol, but without much success. There are on the average 51 bergs south of the forty-third parallel each year, and to attempt to mine any large proportion of them, even if feasible, would consume much valuable time that might be devoted to ice scouting.

It has already been shown that bergs in the warm waters south and east of the Grand Banks have a life span of only 7 to 10 days. The rapidity with which they break up from natural causes throws no little element of risk into mining operations on them. The conditions are brought out somewhat in the preceding section on ice disintegration, but to evaluate further the risks the next few paragraphs have been written for the benefit of future ice patrol officers who may be called upon to experiment again with the mining of bergs.

Some bergs are very delicately balanced. Two turned over during 1929 while being passed by the ice patrol vessel. It is hard to see why a great piece of ice riding on the swell of the open ocean should turn over when struck by the almost imperceptible waves of a vessel passing 100 yards or more away at a speed of 10 knots, but that is what seemed to take place. Many bergs, even among the number of those that project like rounded cones and hills from the sea, are so finely balanced that they require but little to make them roll over. One small rounded berg that was boarded in 1927 from a small boat off the eastern edge of the Banks turned over half an hour after the boarding party had departed. One smoothly rounded 1929 berg that was watched for about a week southeast of the Tail was seen to roll over at least once a day without any noticeable calving or breaking up.

Assuming, however, that the situation appears to be favorable, and that it is decided to attempt to mine a berg, the first problem is to get upon it. Bergs too steep to be boarded without the aid of ropes can doubtless in some cases be solved by shooting lines over them, hauling stronger lines over their summits, and fastening floating weights such as log fenders to the end of the line opposite to the boarding party. Spiked shoes are needed to keep from slipping, and axes for cutting footholds in the hard ice are essential if any steep slopes are to be ascended. The officer in charge of the boarding party must bear in mind that, to the ordinary small boat risks attendant on landing upon and getting picked up from a large uninhabited object in the open sea must be added the danger of immersion in cold water.

The actual cold water and boarding risks approach the vanishing point about bergs in smooth water over 50° F. at the surface. But whether a berg will calve or turn over while being approached or worked upon is hard to predict. The observations of the patrol show that calving south of the forty-fourth parallel is not generally confined to any particular time of the day but is liable to occur at any time. Turning over of a berg usually occupies a number of seconds, but it is liable to occur without warning, or only after the sudden warning of a heavy crackling and calving. Probably in most cases where a berg turns rapidly through 60° or more the boats attending the working party will have the duty of pulling their charges out of the water.

Even if all parts of the berg that have towering pinnacles are avoided, there is danger that a subsequent rolling movement will cause ice to slide down upon persons on a berg. A movement in the other direction would elevate the working party and put them in danger of dropping down over cliffs to ice shelves or down into the sea upon or among closely spaced growlers.

The most stable bergs on the whole are the tabular ones. A squad of infantry could be placed upon the tops of the largest of these bergs and drilled at both close and extended order with comparative safety. In 1929 the tabular bergs south of the forty-fourth parallel were about as numerous as the thin-walled dry-dock type or the rounded water-worn type. The undulating top surface of the tabular bergs often appears to be but a very slightly modified form of the surface of the original glacier from which the ice was set free. From a short distance it appears to be composed of rough grains about the size of marbles and it is often muddied and soiled by the abundant bird life. Many of the tabular bergs have walls that are kept vertical throughout almost all of their life history in the Grand Banks area by calving off of overhanging pieces as the waves eat into the berg about the water line

On May 31 a tabular berg approximately 115 feet high and 400 feet square was seen near the Tail, and on July 15 another large berg, seen around noon 90 miles south-southeast of the Tail, was of a form bordering upon this type. At about 2 p. m. attention was called to the latter berg by a cry from the bridge. It was calving heavily and pitching as it did so. Whenever its sheer end walls became overhanging ones they gave way, and then the suddenly lightened end of the berg would lurch upwards. This caused the process to be repeated from the other end. The berg calved three or four times in this manner during the space of about a minute. It was not over 2 miles away and could be clearly seen at the time by those on the bridge and about the decks. Soon it became quiescent very close to its former position of trim.

6. LOCAL CONVECTIONAL CIRCULATION ABOUT ICEBERGS

Barnes [3] states that melting bergs draw in the surface waters toward them and that they have warmer surface water immediately about them than is the case farther away. It is quite possible that bergs do draw in, chill, and sink certain amounts of surface water under some conditions of melting. This might easily be concluded in view of the rather small surface temperature effects described in the section of this chapter on ice disintegration.

Nevertheless it is difficult to see from theoretical consideration how bergs can do much along the line of sinking chilled water in the "melting area" south of the forty-eighth parallel. During the ice-patrol season the surface water of the region is in general much warmer and somewhat fresher than the layers 25 and 50 meters down. Such conditions indicate a marked stability of the water column, and are directly opposed to the production of vertical convection currents.

In the early season many of the bergs keep in water that is below 32° F. at all levels about them until they are well south of the Tail. Of course, in the case of such conditions they can not cause much local circulation through chilling and sinking water that they draw in

[3] Annual Report of the Smithsonian Institution for 1912, p .737.

toward themselves because of the physical impossibility of anything chilling the already frigid water by more than 1° or 2°.

Throughout the year, just below the upper 25 or 50 meters of water throughout almost all the 74,000 square sea mile "melting area," the next layers of water remain, in general, very cold. At many stations 38° and 37° F. water is found just below the 25-meter level, even though the time may be June or July, and 50° to 55° F. water may be encountered at the surface.

Let us consider the conditions that prevailed in the upper portions of the water column at station 1085. That station was taken at 42° 01′ N., 49° 29′ W., about 3 miles east of a large berg, on July 18, 1929. The conditions there are listed below and are a bit more extreme than the average, but still they are rather typical of the melting conditions that surround nearly all the bergs that melt south of the forty-fourth parallel during the last half of the ice-patrol season.

Levels	Temperatures	Salinities
	°F.	*Per mille*
Surface	57.2	32.89
25 meters	39.7	33.31
50 meters	35.4	33.91
125 meters	37.0	34.42

It is evident from an inspection of the above figures that the berg because of the increasing salinity with depth, would be forced to chill the surface waters very much more than 21.8° F. in order to sink them down to the 50-meter level. The inevitable freshening of the waters while they are being chilled by the glacial ice would make it still harder for them to be sunk.

Let us neglect the great differences of salinities and the freshening effects and assume that the berg will chill the surface waters in immediate contact with it 20° F. and sink them to some depth located between the surface and 50 meters where they will find their new hydrostatic level. It is easy to calculate the approximate amount of water that can be chilled 20° F. by an individual berg of 130,000 short tons mass. Lieut. Commander Edward H. Smith estimates this to be the size of the average berg about the Grand Banks, so it can safely be taken as the average size of bergs in the southern half of this area south of the forty-fourth parallel.

If each pound of the ice can chill 80 pounds of water 1° F., a 260-million pound berg can chill approximately 1,040 million pounds of water 20° F. At 62½ pounds per cubic foot, the amount of water chilled 20° F. would be 16,640,000 cubic feet. Suppose the berg lasts out a full life-expectancy for surface water over 50° F. and continues to melt for 10 days. It will then sink daily, on the average, 1,664,000 cubic feet of water chilled 20° F.

Assuming that the sinking action attracts in toward the berg the surrounding surface waters down to the 10-foot level, what will be the rate of inflow of these surface layers? At the circumference of a circle of 1,000-foot radius from the center of the waterline plane of the berg the area of a 10-foot vertical section of the surface layers of water will be 62,832 square feet. A horizontal inflow of but 27 feet per day, which is only about 0.0002 knot, will more than suffice to supply 1,664,000 cubic feet of water daily through an opening of this size. By proportion it can be assumed that the inflow will amount to about 270 feet per day, or 0.002 knot, at a point close to the ice walls, but 100 feet from the center of the waterline plane of the berg.

The above figures are believed to give a very fair theoretical value for the order of magnitude of surface inflow that is possible about a berg melting in the Grand Banks region. The inflow is undoubtedly so small in value that differential drift of surface and subsurface layers, wind and wave effects, and other confusing elements, are easily capable of distorting and entirely masking most of the noticeable effects of such an inflow, if and when it exists. Even should the above approximations be in error by a factor of 10, still the inflow toward the most rapidly melting bergs would be extremely small.

It is now plain why growlers calved while breezes of any appreciable strength are blowing generally float away rapidly to leeward from a berg. Even those produced during periods of light airs and calms almost invariably move away, though on the average at much lower rates of speed. The maximum flow that the sinking of chilled water can cause apparently produces an inflow of surface water so small that it is nearly always masked by the other forces operating. If the inflow were at all large it would often be able to hold calved growlers and small pieces in positions alongside the parent berg.

Final conclusions regarding the local circulation, both vertical and horizontal, about bergs south of latitude 44° or 48° N. should not be drawn from theoretical considerations, however. Neither should they be formed from the results of a study of tank experiments or of the few actual observations about bergs that have been made to date. It is hoped that when opportunity offers the ice patrol will take numerous special oceanographic stations and make studies with variously colored stains placed in the water close to bergs during all sorts of weather and water conditions. What is now needed is a larger body of exact observational data upon which to base sound opinions.

Microthermographs have been suggested as instruments for warning ships of the proximity of ice during times of low visibility, but whether they will ever be of much practical value is still an open question and subject to grave doubt. The scientific observer of the international ice patrol should never be satisfied until after the detailed circulation about bergs under all conditions has been thoroughly investigated and is well understood.

7. MISCELLANEOUS

Detailed sounding and bottom sampling work about the Grand Banks region would be very useful, practically as well as scientifically. For the past five centuries the fishermen of France have been frequenting this area, yet even to-day the French scientists admit that they know almost nothing about the composition or detailed bottom configuration of the top or slopes of the Grand Banks plateau. Steam trawlers are annually increasing in numbers there. These vessels can not proceed haphazardly with their fishing like the old fashioned sailing vessels. Their costs prohibit hit or miss methods. They must know promptly where the greatest numbers of fish are located and where the bottom characteristics are not destructive to their expensive gear. Well coordinated scientific investigations are called for by the fisheries problems alone.

In 1927 one of the French Government ships attending the fishing fleet reported that three new shoals were situated less than 30 miles to the westward of the main track of bergs along the 1,000-fathom curve of the eastern slope of the Grand Banks. These shoals, though small, were said to have only 8 to 11 fathoms of water over them. Do they presage the birth of another low sandy island like that graveyard of the Atlantic, Sable Island, or will the water over them eventually be deepened by the waves of the open sea? Only continued soundings in their vicinity can tell.

On November 18, 1929, there occurred an earthquake centered in the sea south of Newfoundland. The shock was severe enough to be distinctly felt in the New England States, over 800 miles to the westward. Twelve cables crossing the area of greatest disturbance were broken in 23 places and the Burin Peninsula of Southern Newfoundland was visited by an earthquake wave. This wave was so large that much property and a number of lives were destroyed. Some geologists believe that the section of the ocean floor where the cable breaks occurred foundered during this earthquake. The ice-patrol ships will have a good opportunity to sound out the supposedly sunken area south-southeast of Cabot Strait with sonic depth finders, for they must cross it every time they proceed between the ice regions and their Nova Scotian base of supplies. If any great increase in depth over the form values exists, it should be detected when the new soundings are compared with the old ones that are already on the charts.

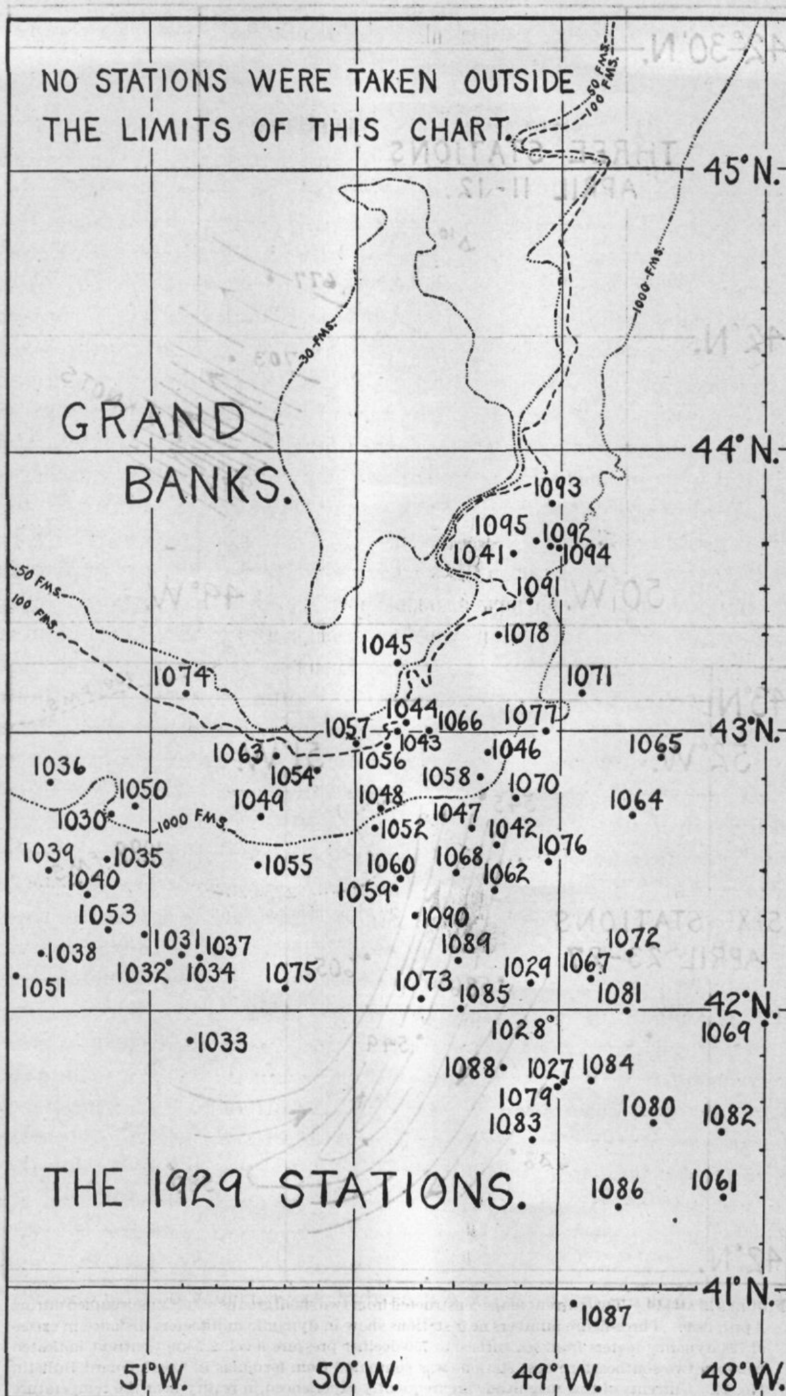
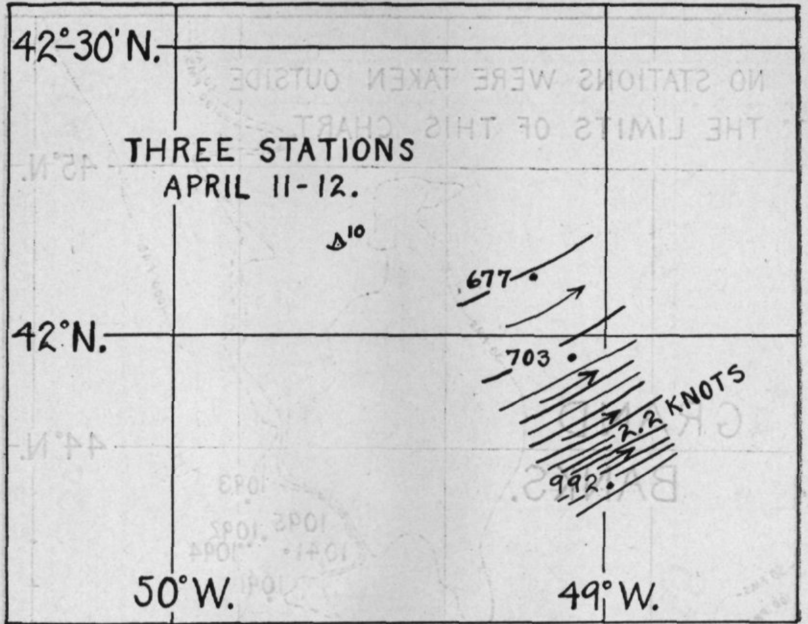
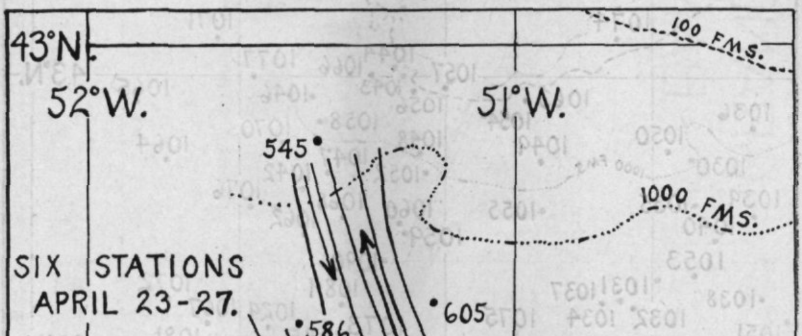


FIGURE 12.—Distribution of oceanographic stations





Figures 13 and 14.—Two current maps constructed from two small groups of stations occupied during April, 1929. Three-figure numbers near stations show in dynamic millimeters distance in excess of 728 dynamic meters from sea surface to 750-decibar pressure level; 2.2-knot current indicated between two southeasternmost stations was computed from formulas in Coast Guard Bulletin No. 14. Currents of this magnitude are frequently experienced in reality near the temperature wall between Gulf Stream and Labrador Current waters

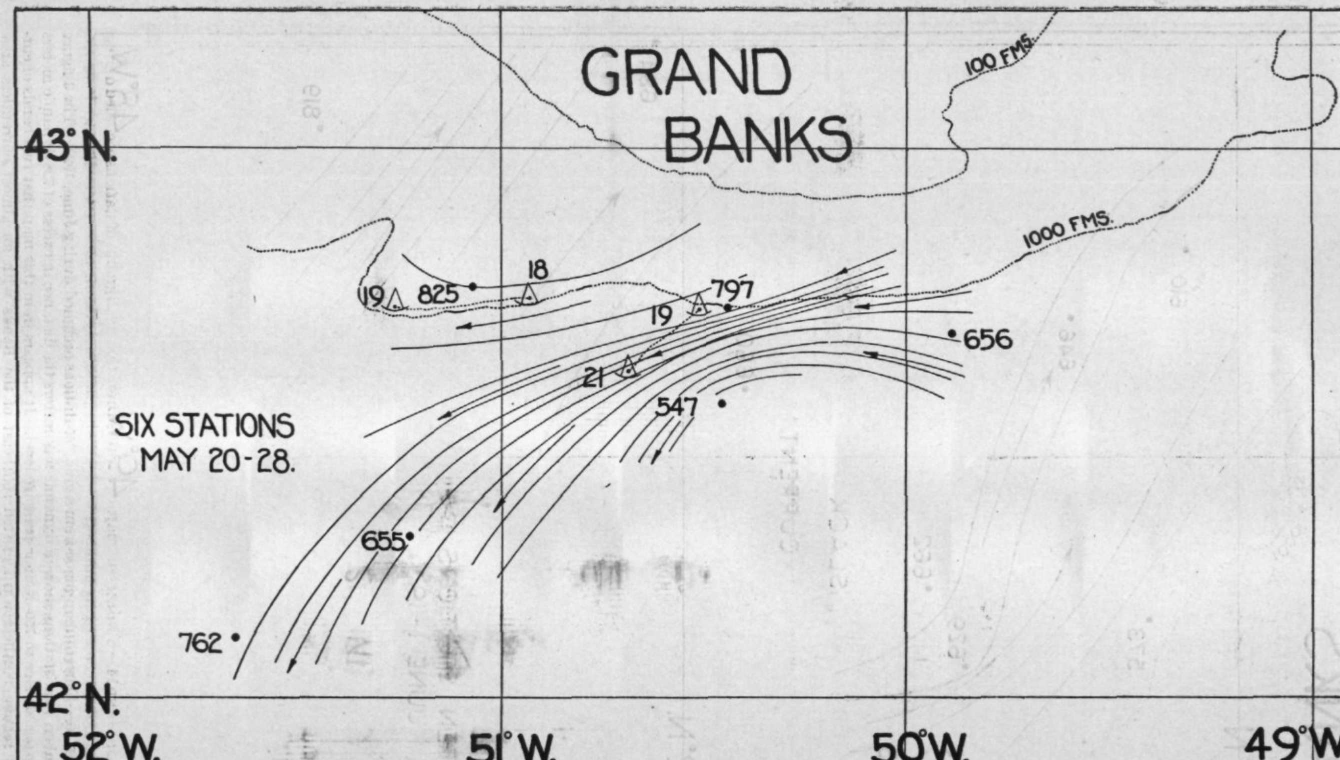


FIGURE 15.—Current map made from a group of stations occupied during May, 1929. Three-figure numbers near stations show in dynamic millimeters distance in excess of 728 dynamic meters from sea surface to 750-decibar pressure level. Great packing of contour lines between the two stations SSW. of the Tail probably due in part to the 8-day interval between their dates of occupation. At no time during May was a current of unusual strength observed in this locality

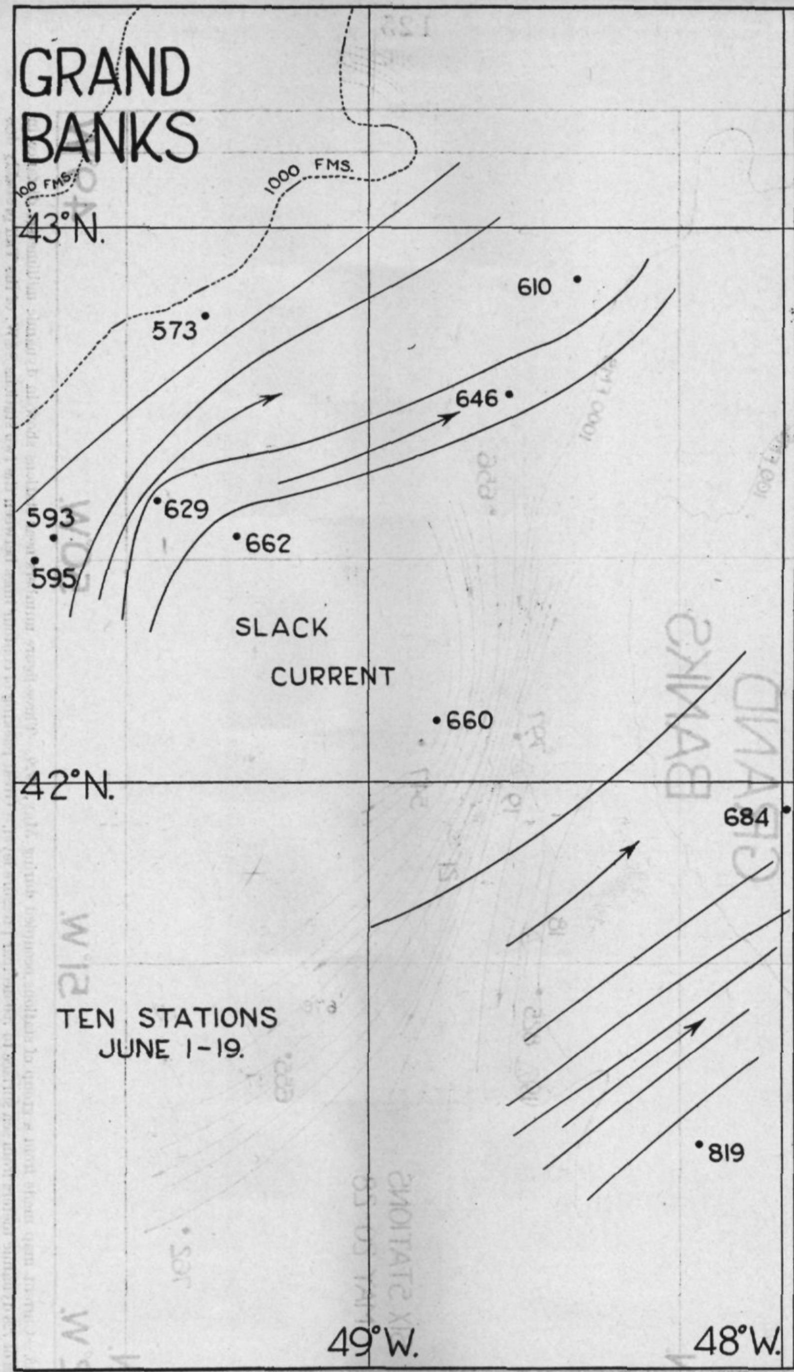


FIGURE 16.—Current map made from a group of stations occupied during June, 1929. The 3-figure *numbers near stations show in dynamic millimeters the distance in excess of 728 dynamic meters* from sea surface to 750-decibar pressure level. It appears from this map that two bands of current setting northeastward existed southeast of the Banks with an almost currentless area between them. Such slack waters do exist in fact off the Banks at times and bergs getting into them may remain almost stationary for several days

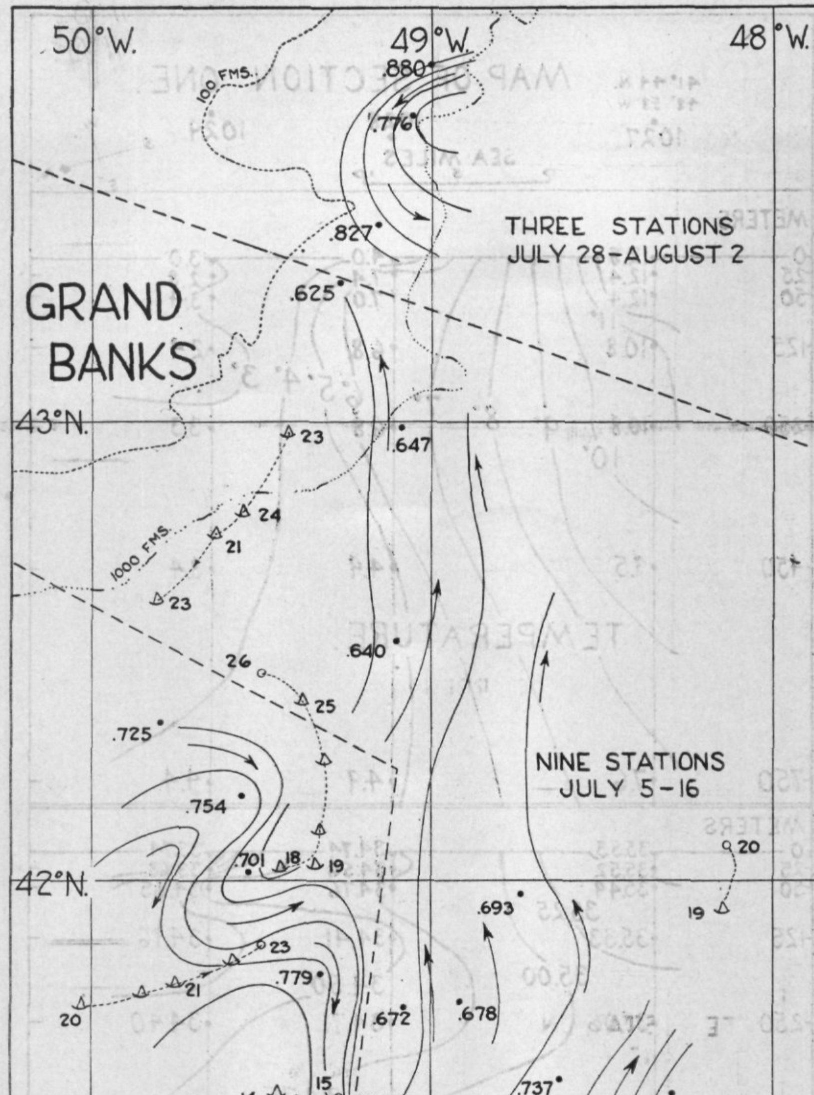


FIGURE 17.—Current map constructed from small groups of late season stations. Dashed lines show areas that are to be considered separately because of time-lapse factor. Three-figure numbers near stations show in dynamic millimeters distance in excess of 728 dynamic meters from sea surface to 750-decibar pressure level. A few known berg drifts are plotted to show relation between actual and dynamically determined currents

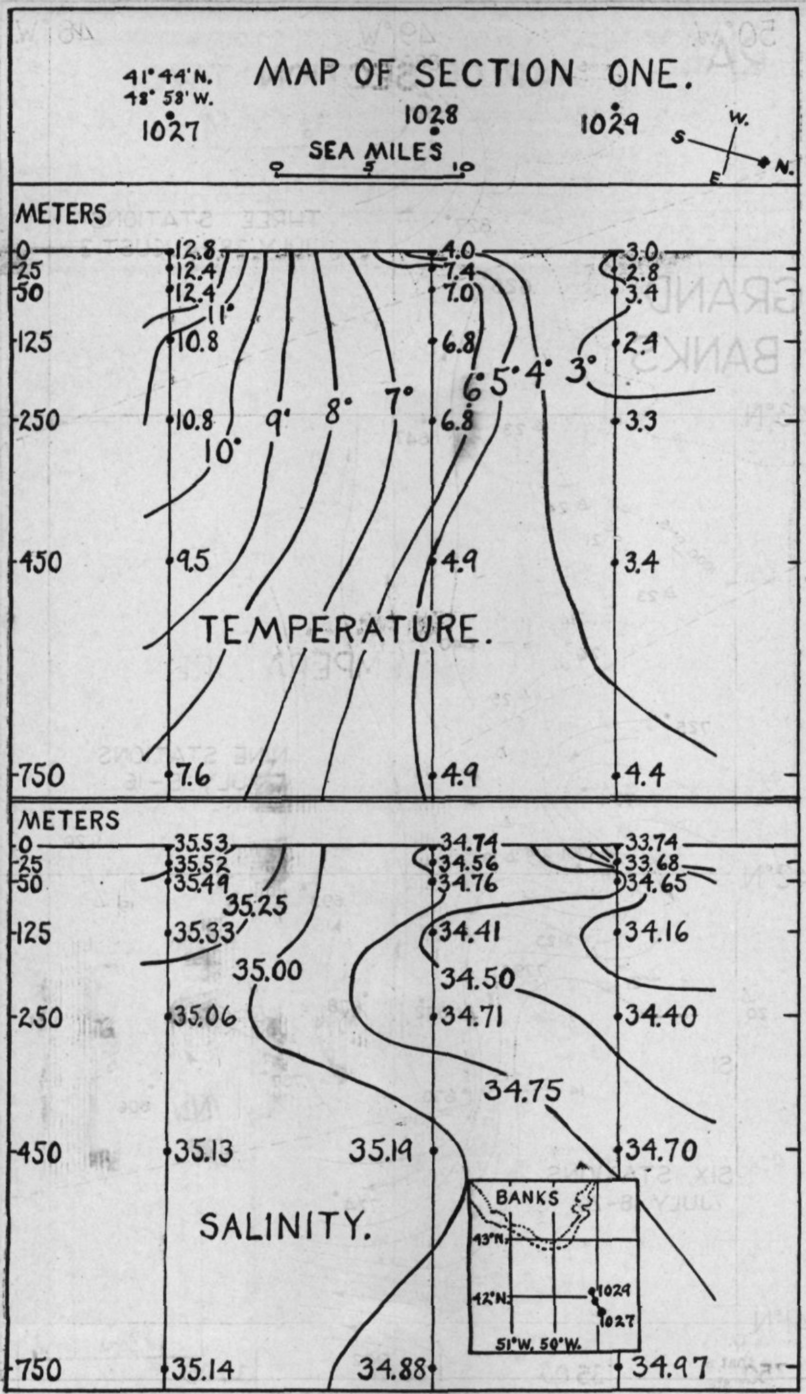


FIGURE 18.—Oceanographic section one was drawn from data obtained at stations taken April 11–12, 1929. The vertical scale is exaggerated about sixty times. Note very steep slope of isotherms and isohalines, characteristic of temperature wall

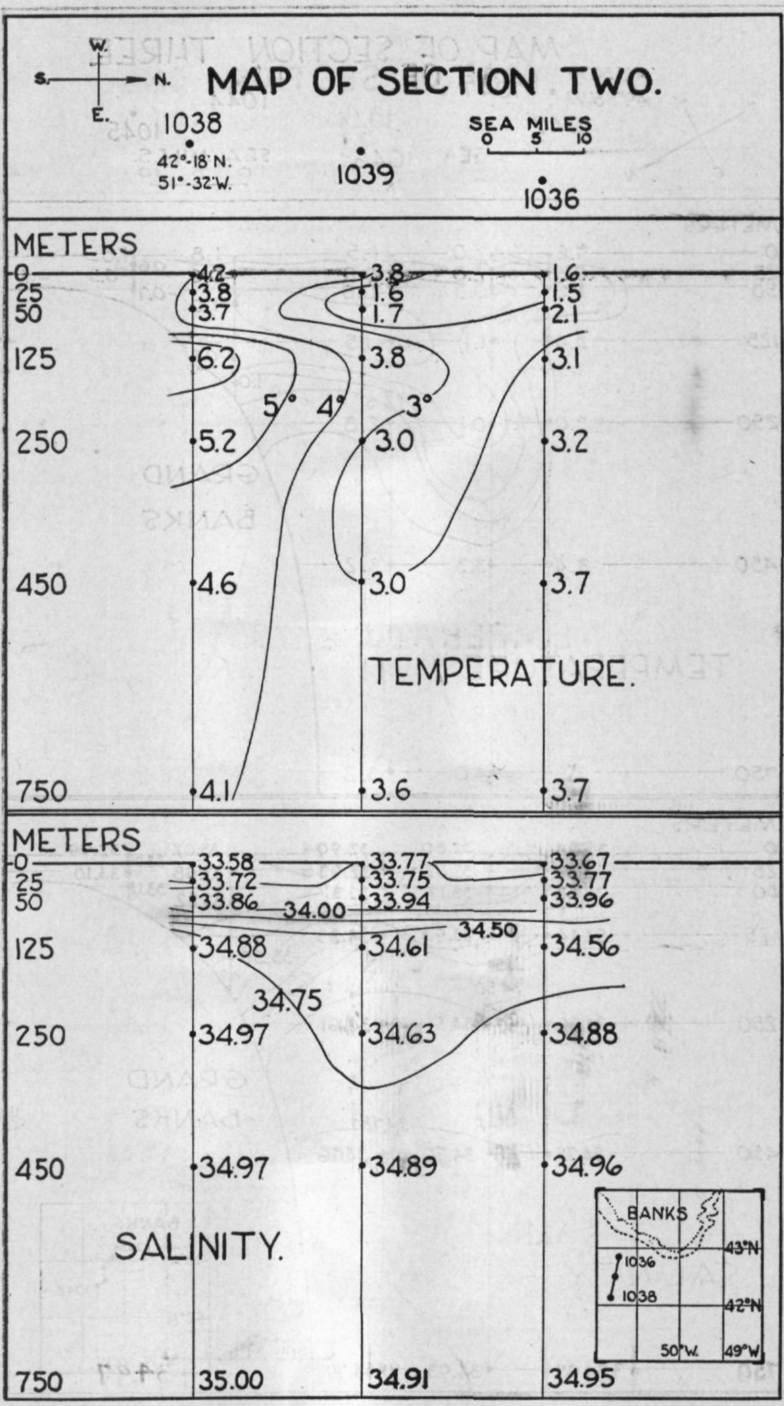


FIGURE 19.—Oceanographic section two was drawn from data obtained at stations taken April 23-26, 1929. The vertical scale is exaggerated about one hundred and twenty times. The salinity increases markedly with depth. This is characteristic of the cold and mixed waters about the Tail, where the Labrador Current overrides warmer Atlantic water of higher salinity

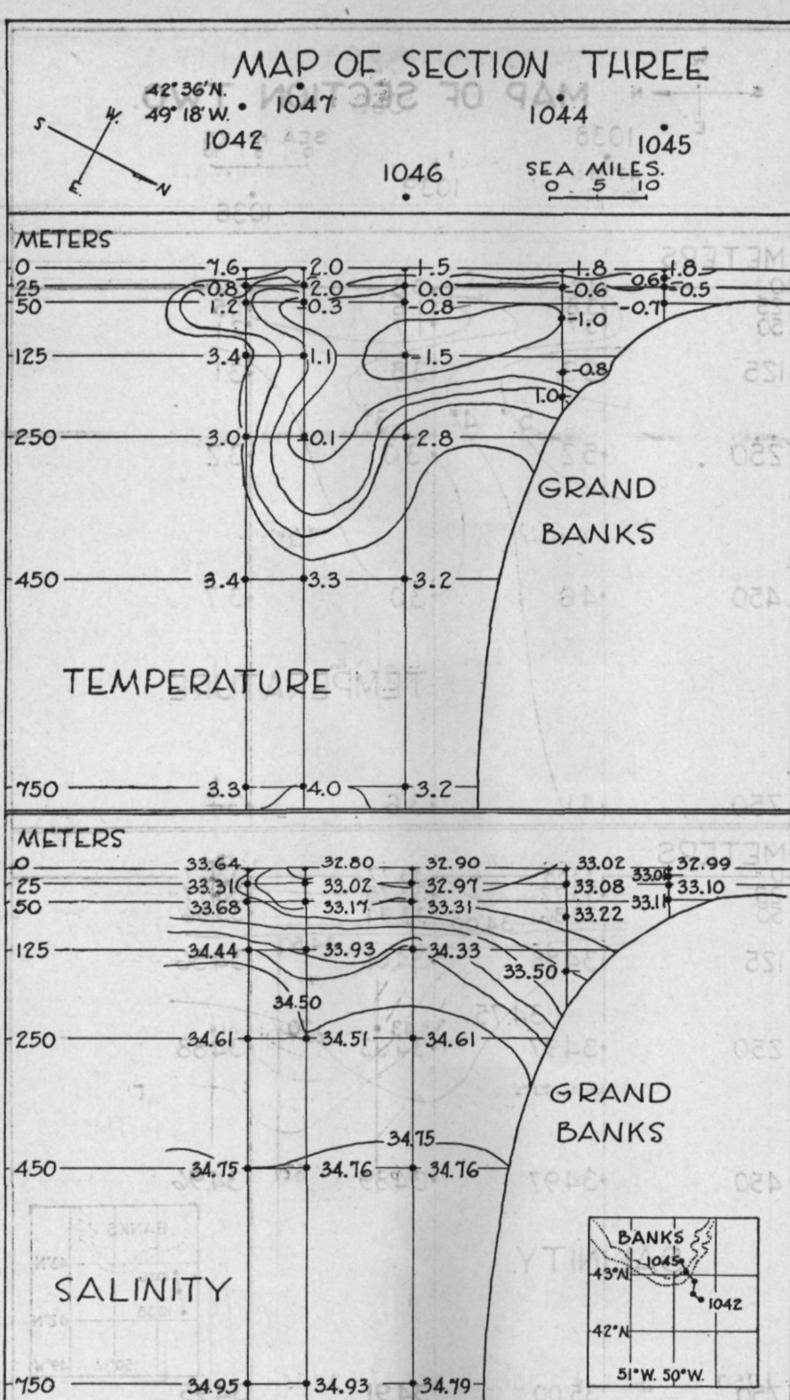


FIGURE 20.—Oceanographic section three was drawn from data obtained at stations taken May 6-11, 1929. The vertical scale is exaggerated about one hundred and twenty times. The salinity increases rapidly with depth. A cold-water layer between warmer surface and bottom waters can be seen. This is characteristic of the Labrador Current after the sun warms up the surface layers in the spring

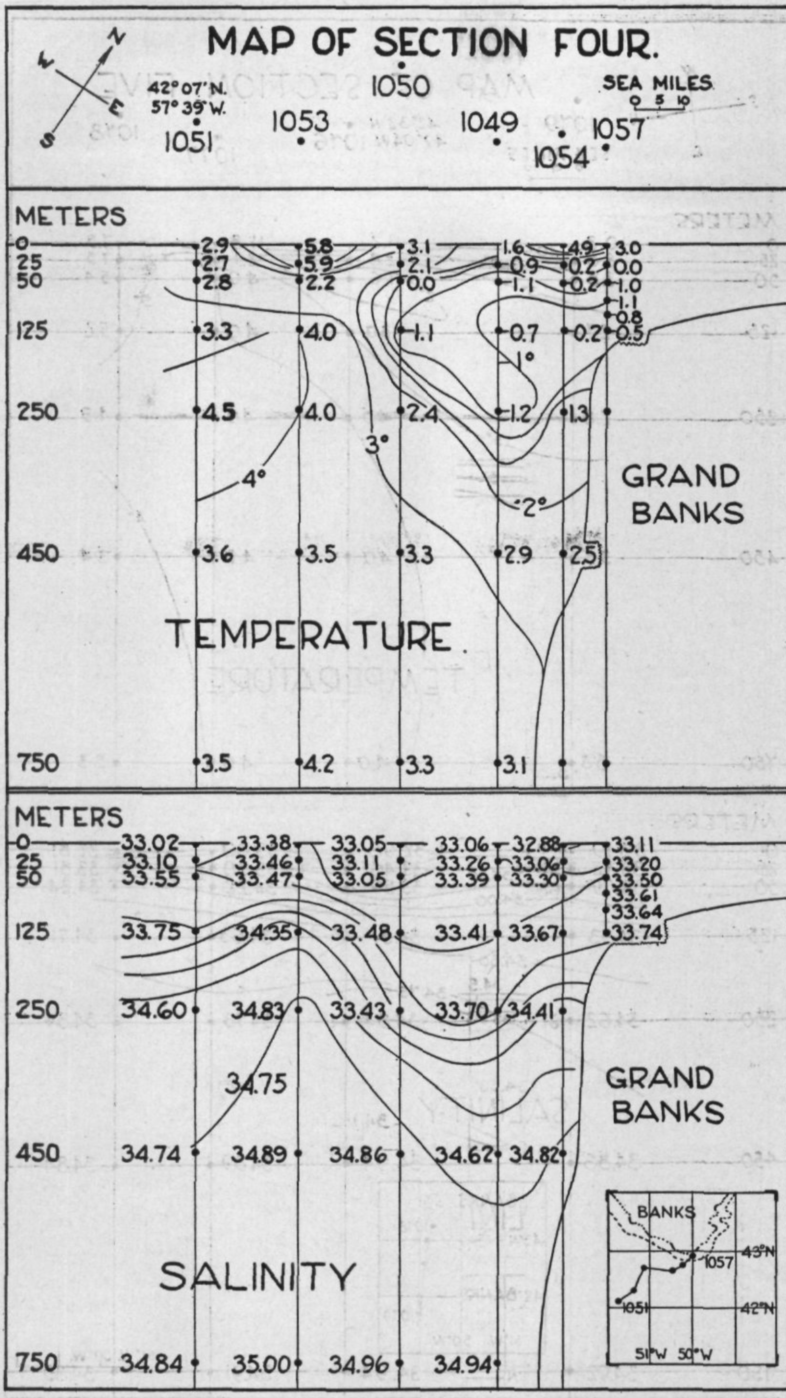


FIGURE 21.—Oceanographic section four was drawn from data obtained at stations taken May 20–31, 1929. Vertical scale exaggerated about two hundred and forty times. Temperature and salinity distribution similar to that of section three

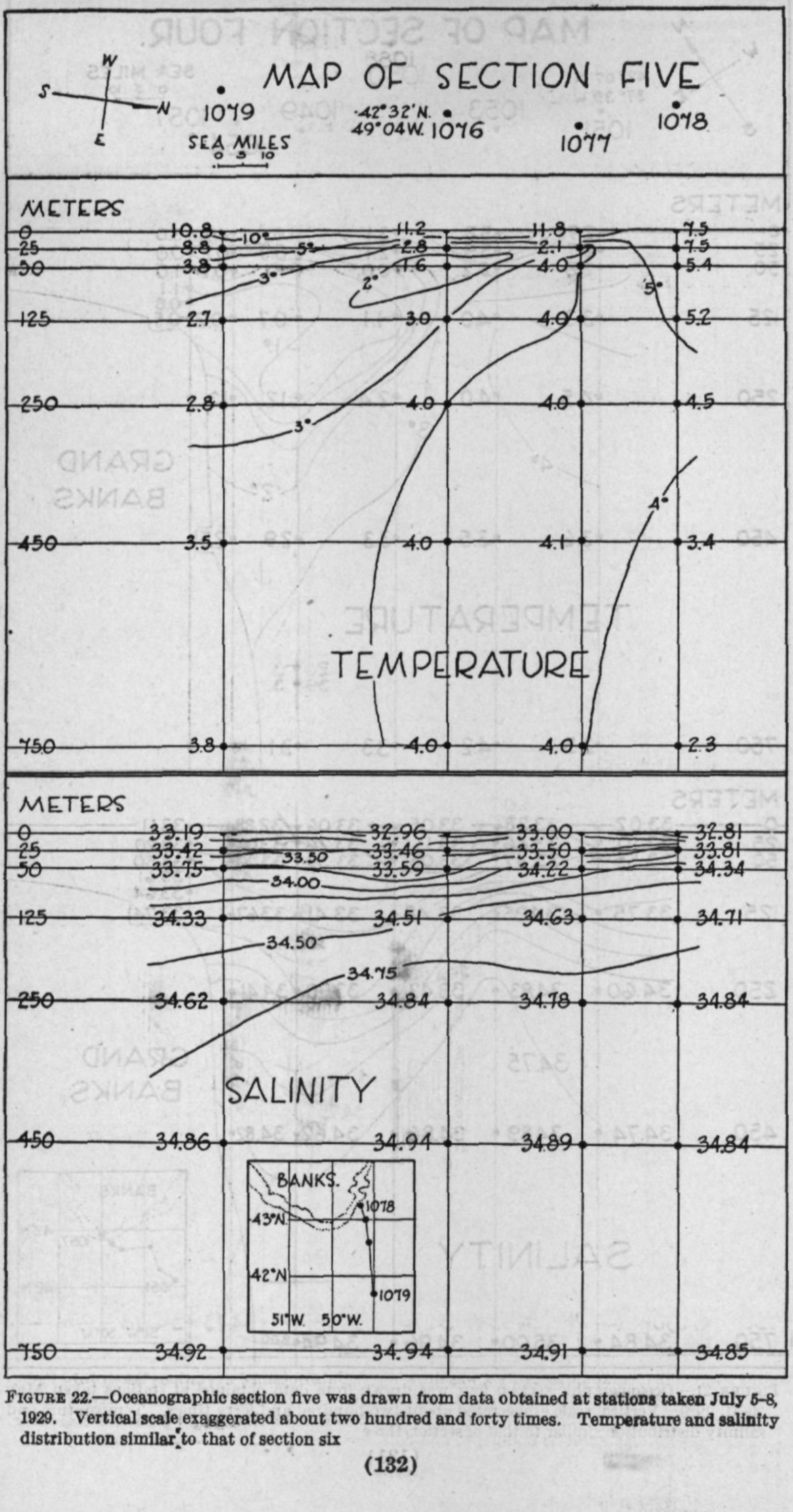


FIGURE 22.—Oceanographic section five was drawn from data obtained at stations taken July 5–8, 1929. Vertical scale exaggerated about two hundred and forty times. Temperature and salinity distribution similar to that of section six

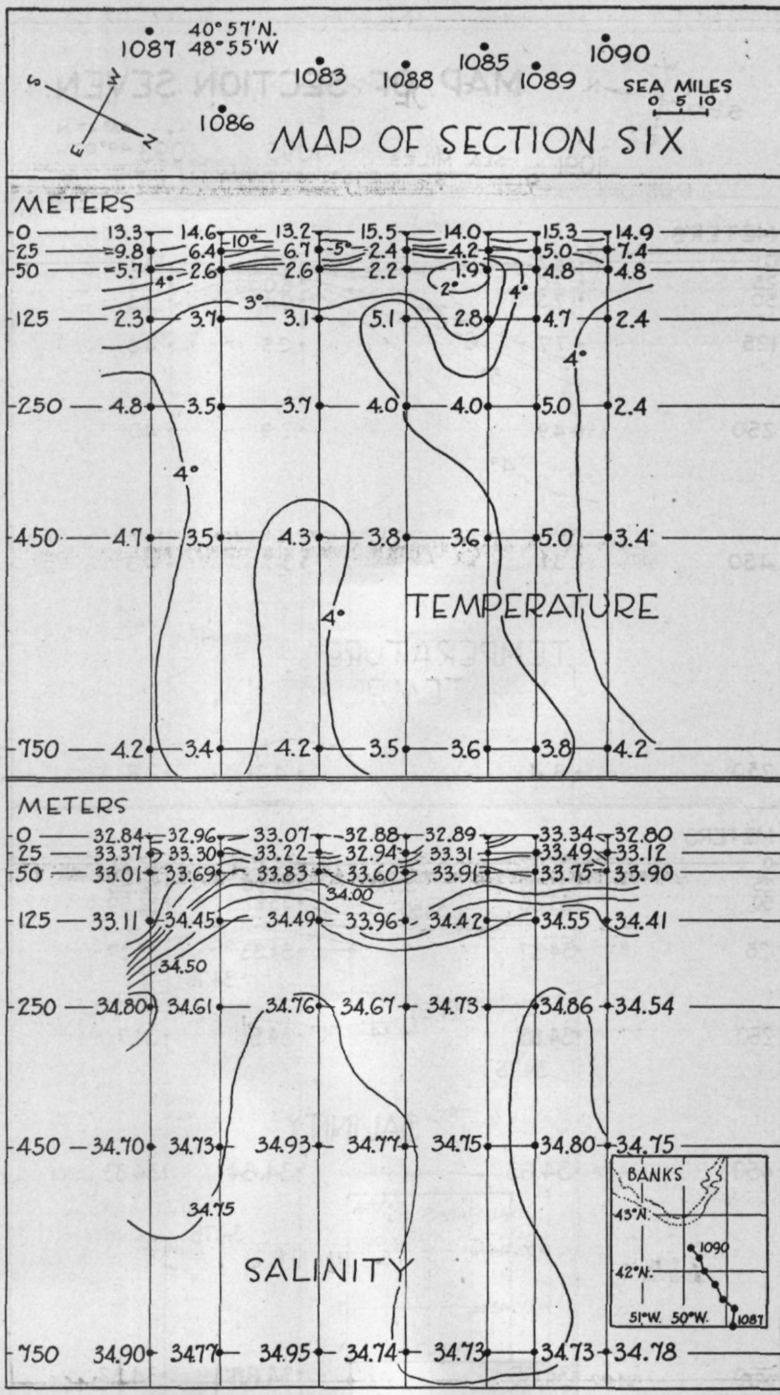


FIGURE 23.—Oceanographic section six was drawn from data obtained at stations taken July 15–26, 1929. Vertical scale exaggerated about two hundred and forty times. Surface layers much warmed. Salinity increases rapidly from surface to 200-meter level due to push of Labrador Current over North Atlantic mid-depth and bottom waters

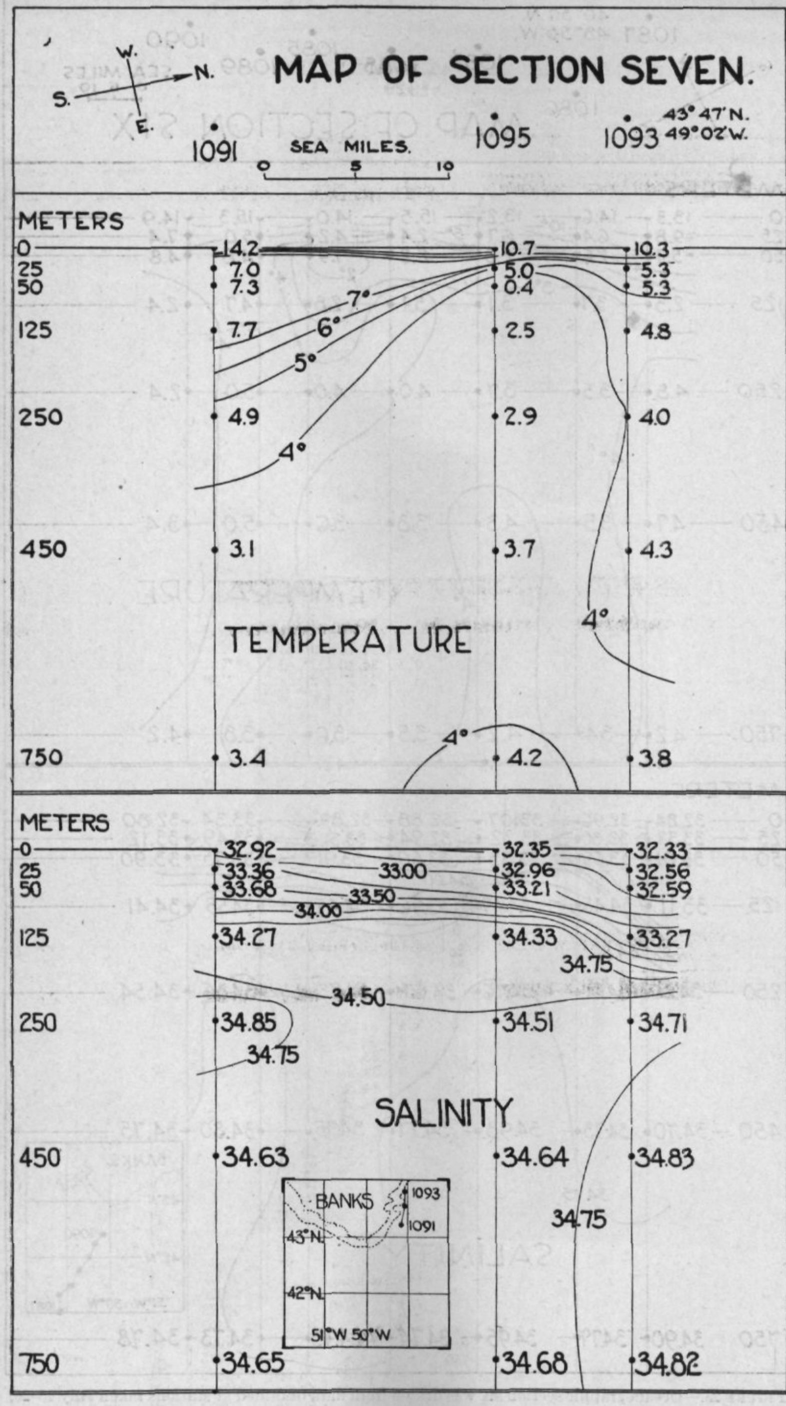


FIGURE 24.—Oceanographic section seven was drawn from data obtained at stations taken July 28 to August 2, 1929. Vertical scale exaggerated about sixty times. Temperature and salinity distribution similar to that of section six.

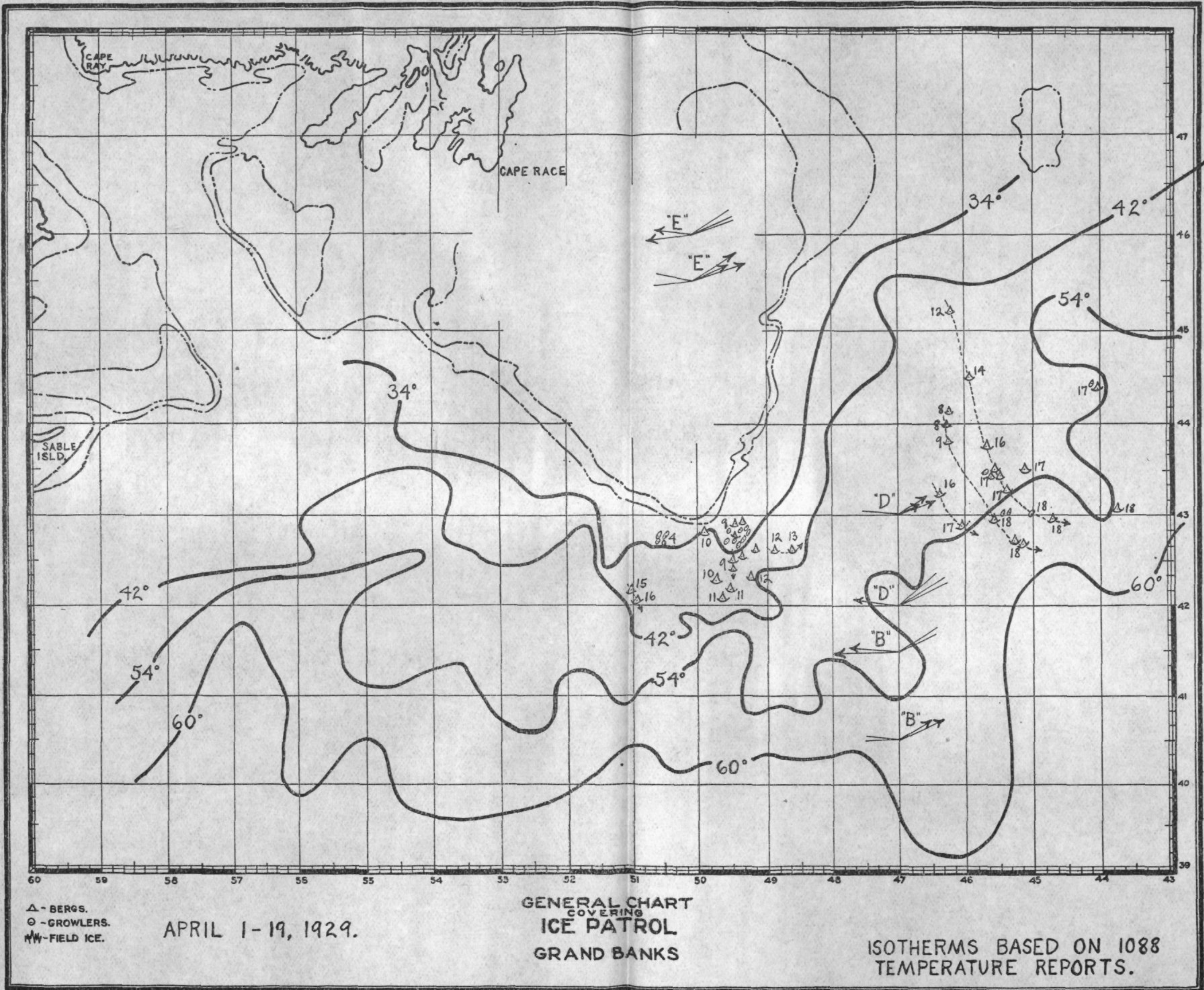


FIGURE 25.—Surface temperatures April 1-19, 1929. Portions of steamship tracks in use and southernmost ice are shown. Dotted lines connecting berg positions indicate probable drift tracks

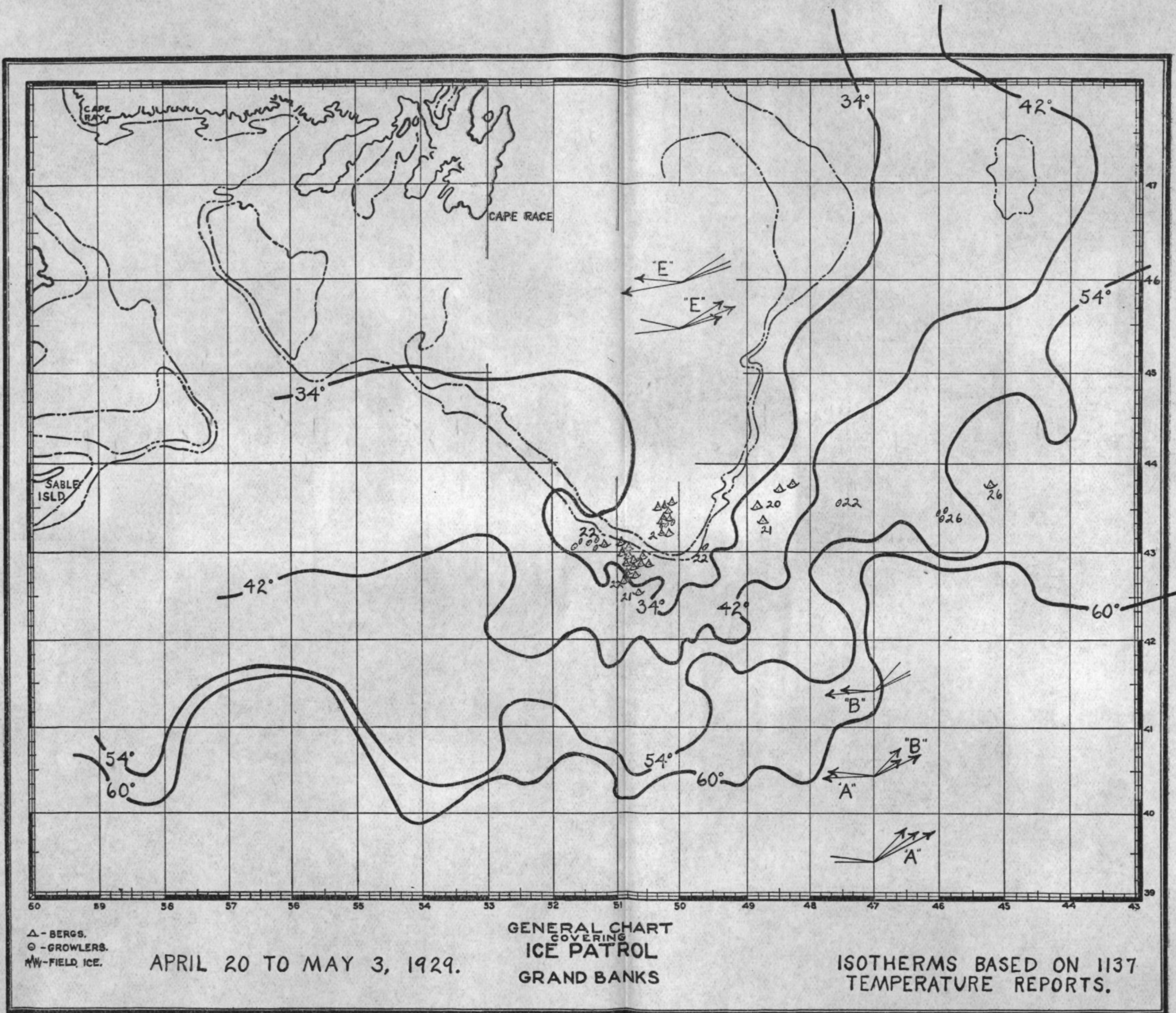


FIGURE 26.—Surface temperatures April 20 to May 3, 1929. See remarks under Figure 25

100277—30. (Face p. 134.) No. 2

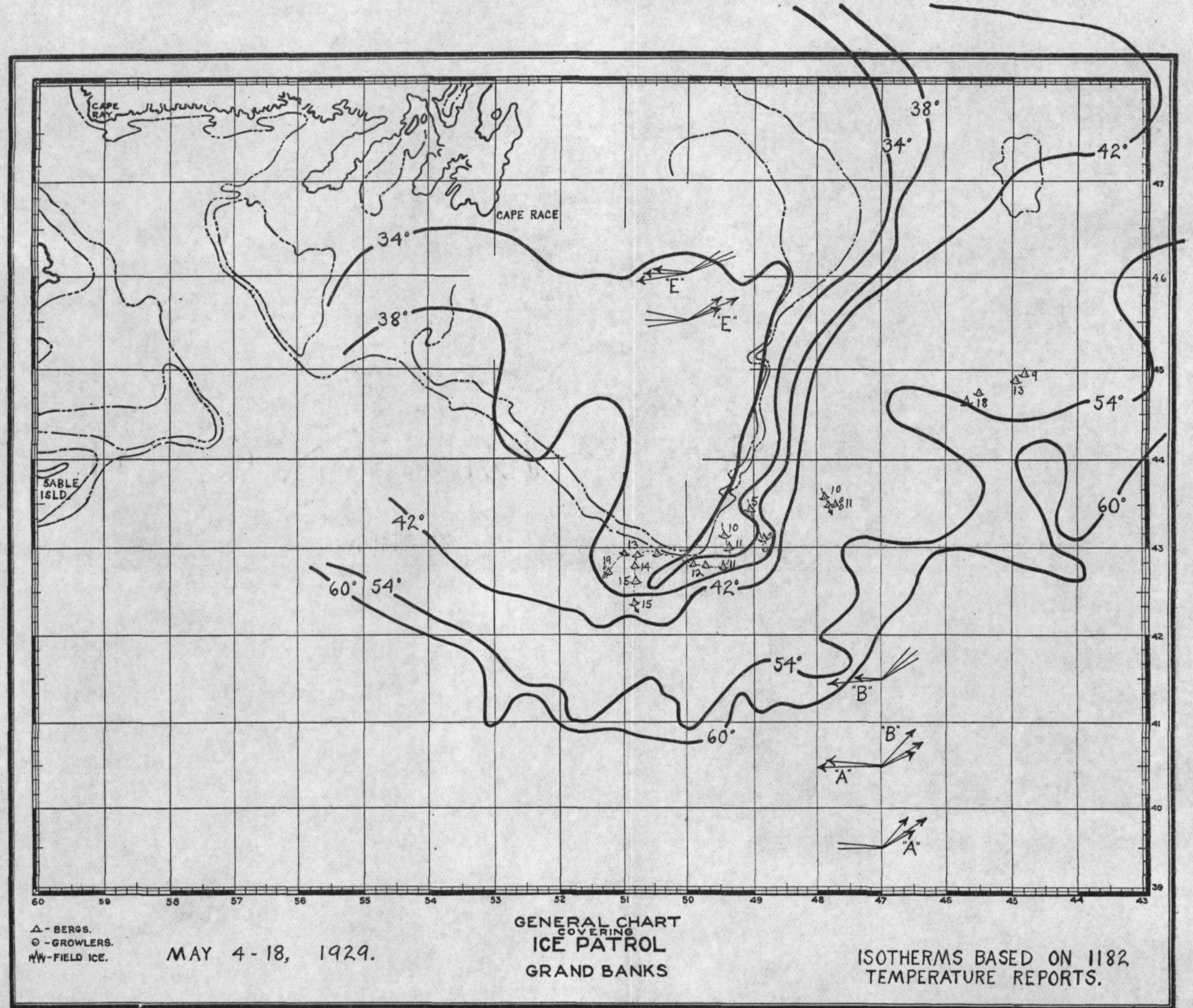


FIGURE 27.—Surface temperatures May 4-18, 1929. See remarks under Figure 25

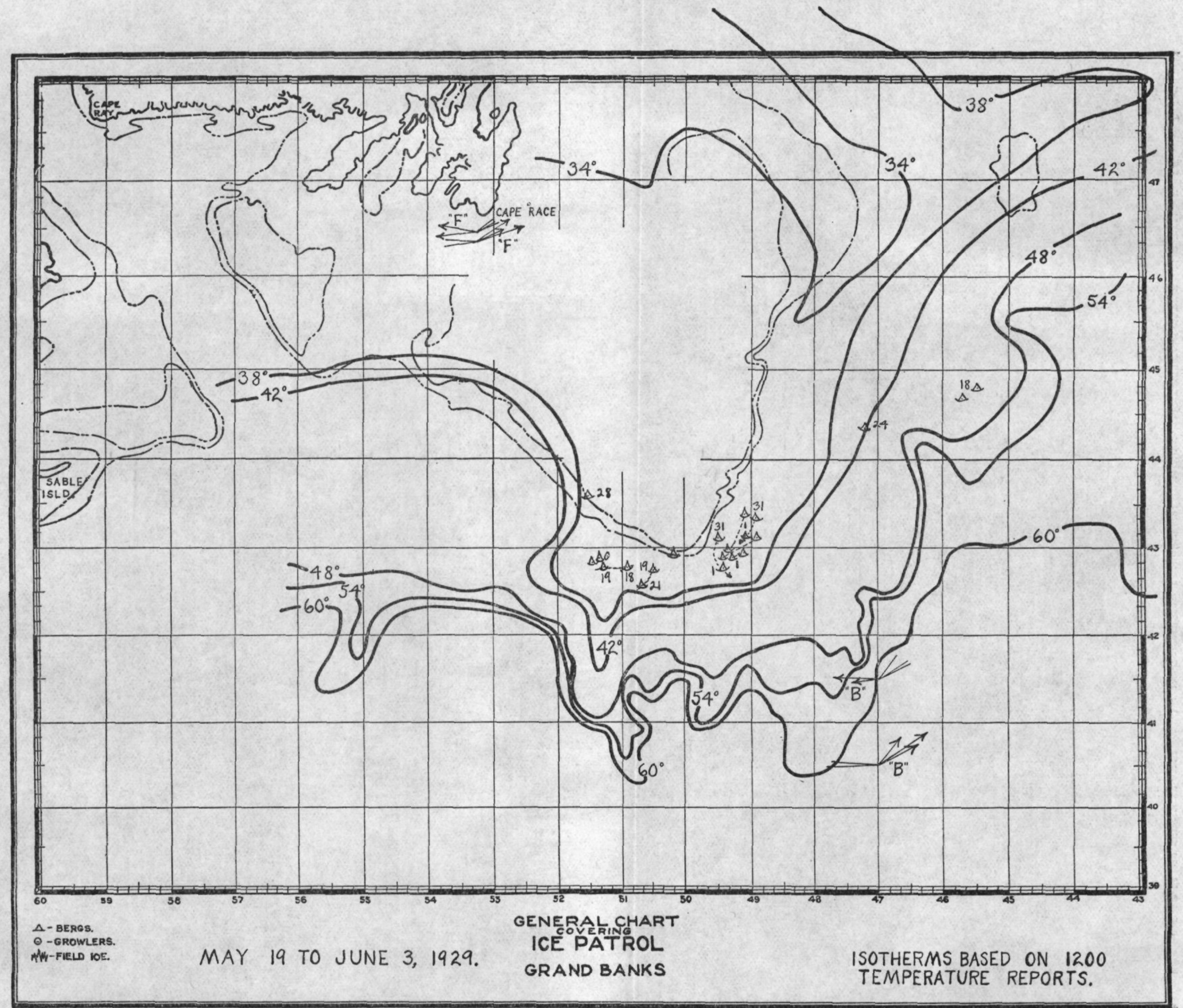


FIGURE 28.—Surface temperatures May 19 to June 3, 1929. See remarks under Figure 25

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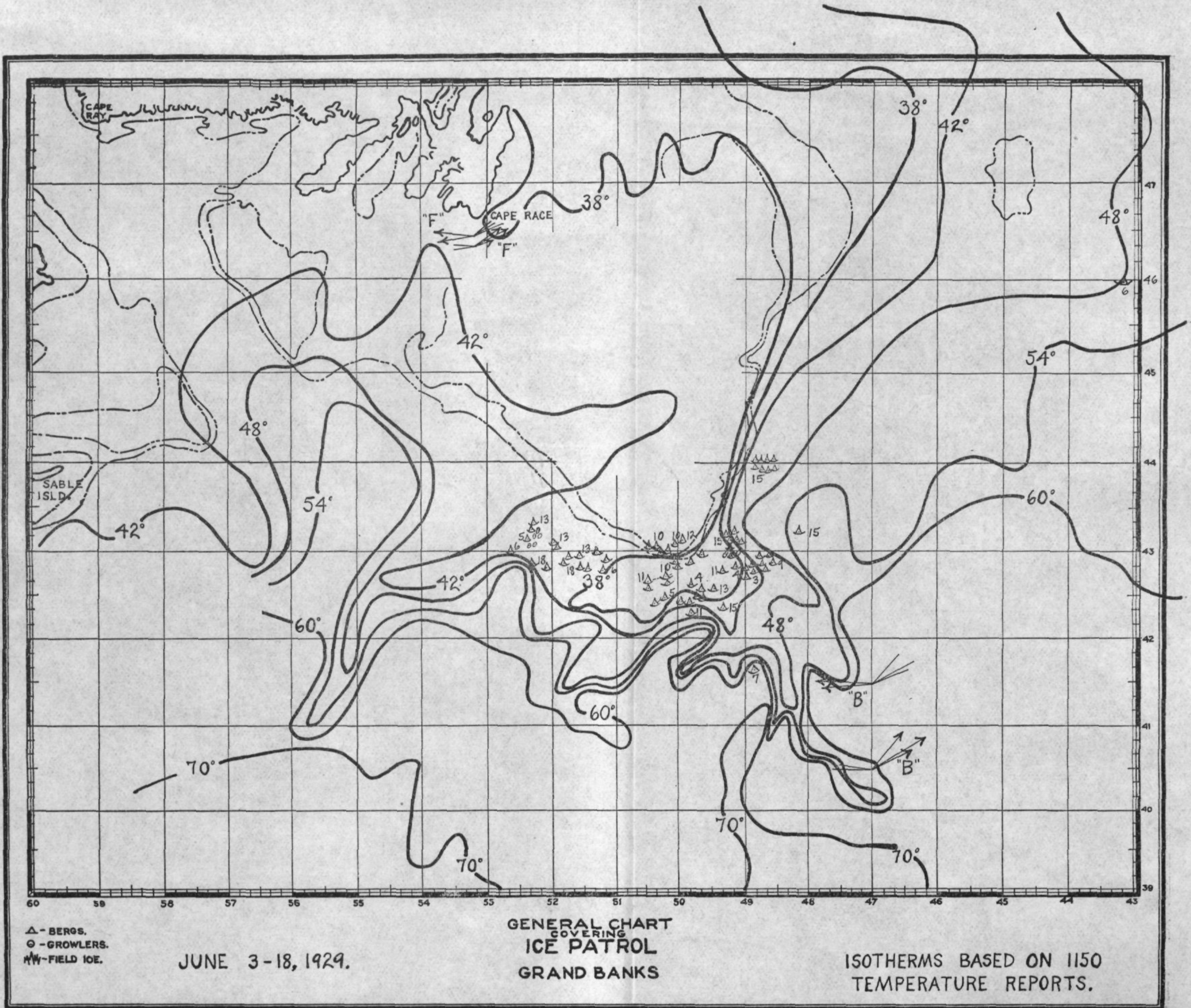

FIGURE 29.—Surface temperatures June 3-18, 1929. See remarks under Figure 25

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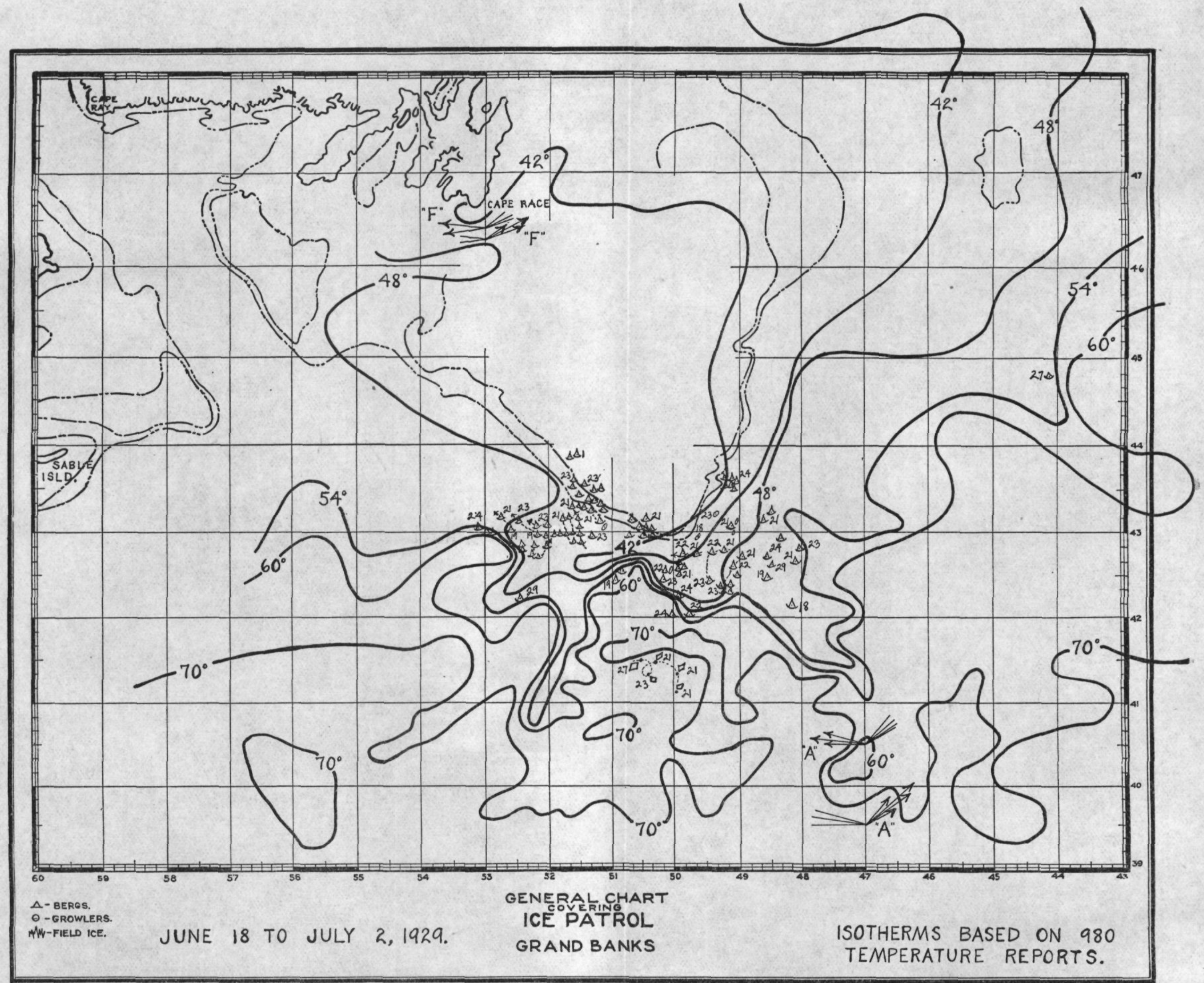

FIGURE 30.—Surface temperatures June 18 to July 2, 1929. See remarks under Figure 25

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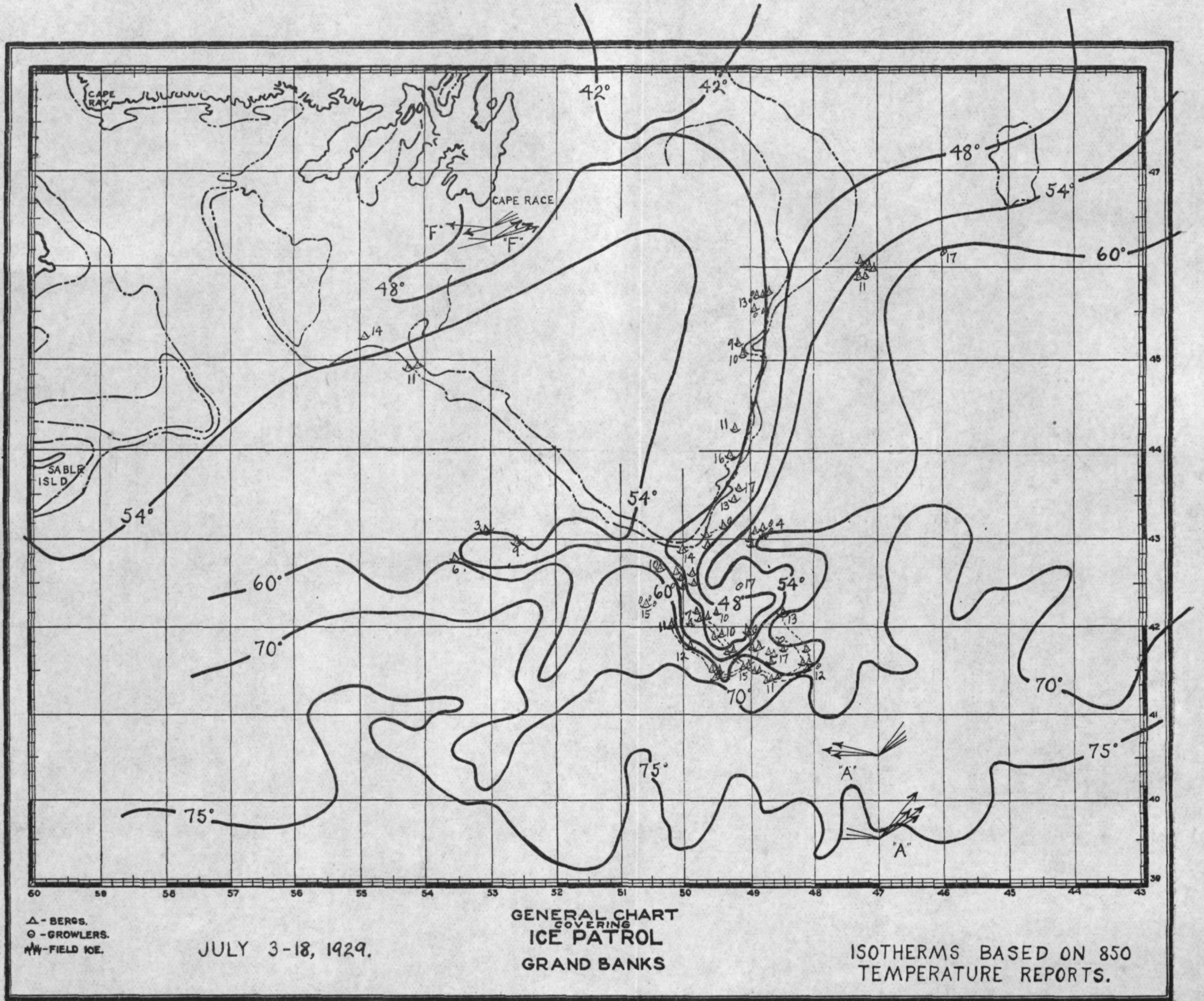

FIGURE 31.—Surface temperatures July 3-18, 1929. See remarks under Figure 25

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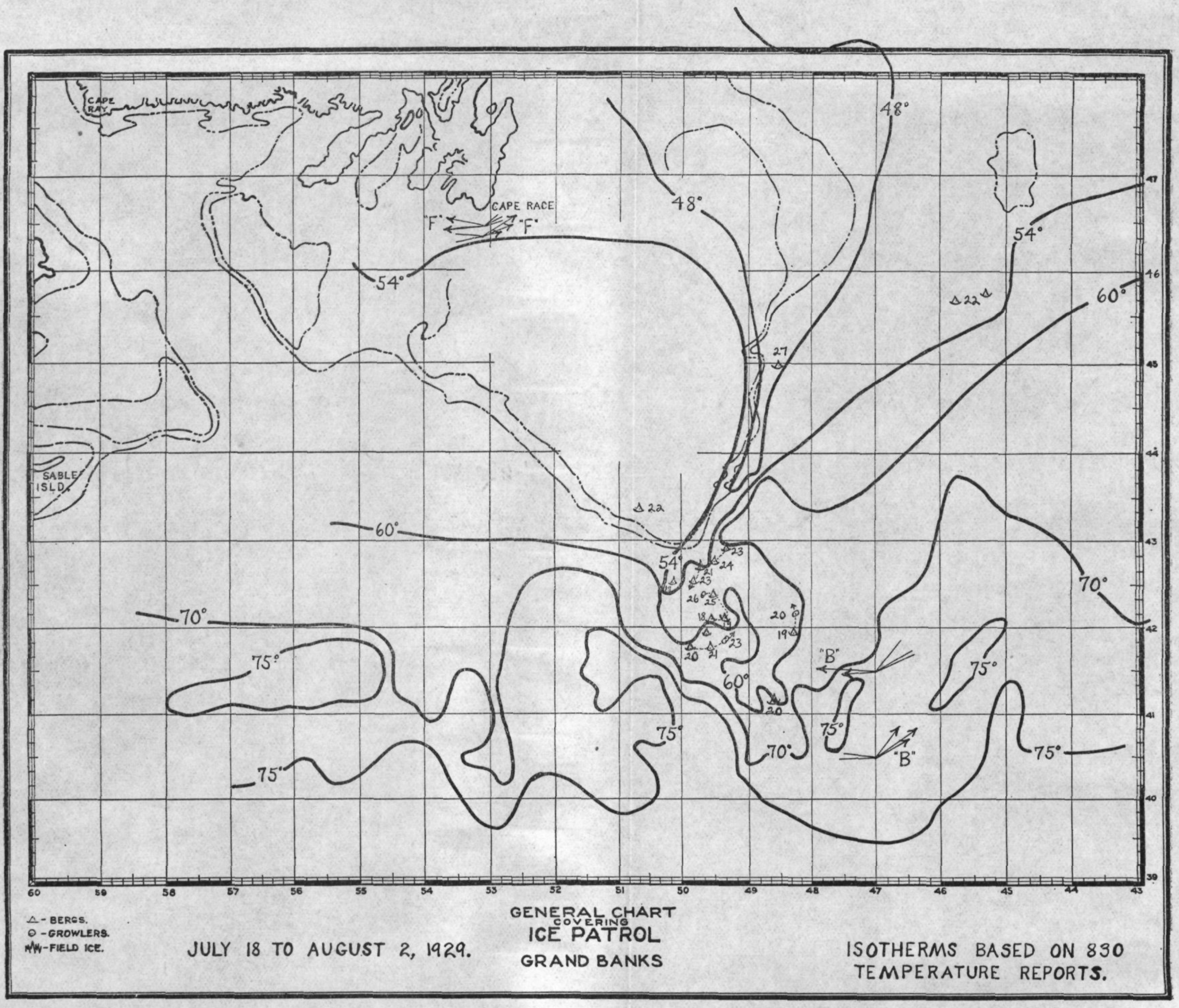

FIGURE 32.—Surface temperatures July 18 to August 2, 1929. See remarks under Figure 25

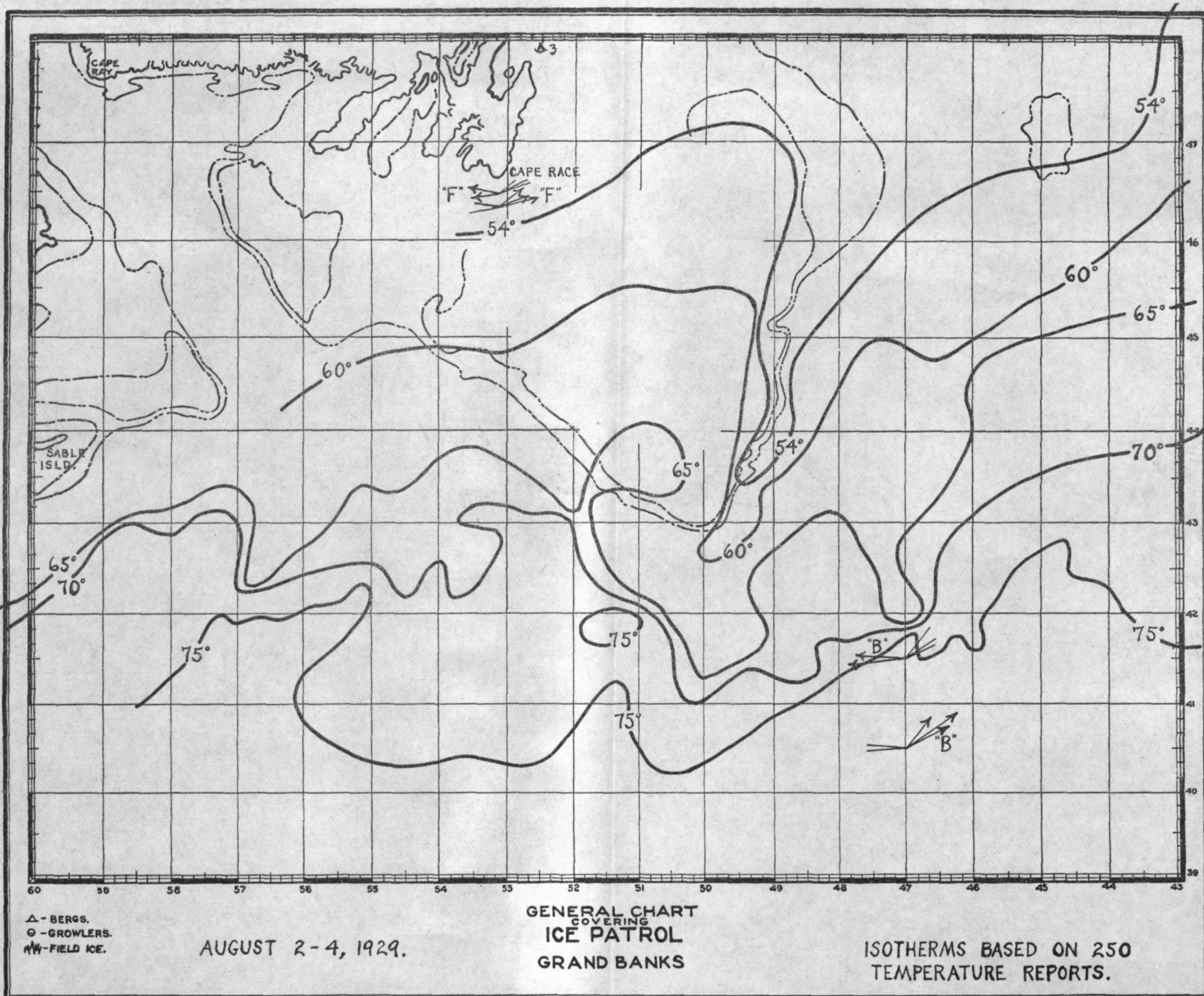

FIGURE 33.—Surface temperatures August 2-4, 1929. Only one iceberg reported during this period south of 48th parallel

100277—30. (Face p. 134.) No. 9

OCEANOGRAPHIC STATION DATA AND DYNAMIC CALCULATIONS
1929

δ_t at head of column 9 represents the value, density.
V at head of column 10 represents the value, specific volume in situ.
$V-V_1$ at head of column 11 represents the value, anomaly of specific volume in situ.
E at head of column 12 represents the value, height in dynamic meters.
$E-E_1$ at head of column 13 represents the value, anomaly of dynamic height.

Station	Date	Latitude N.	Longitude W.	a Depth of water	a_1 Depth	a=meters Temperature	Salinity	δ_t	a_1=pressure in decibars V	$V-V_1$	E	$E-E_1$
		° ′	° ′			° C.	0/00					
1027	Apr. 11	41 44	48 58	3,109	0	12.8	35.53	26.86	0.97384	120	0	0
					25	12.4	35.52	26.93	.97366	113	24.34375	.02910
					50	12.4	35.49	26.91	.97357	115	48.68413	.05763
					125	10.8	35.33	27.08	.97310	102	121.68425	.13913
					250	10.8	35.06	26.88	.97275	123	243.29988	.27989
					450	9.5	35.13	27.16	.97164	102	437.73888	.50539
					750	7.6	35.14	27.46	.97005	76	728.99238	.77289
1028	...do.....	41 58	49 03	3,229	0	4.0	34.74	27.60	.97314	50	0	0
					25	7.4	34.56	27.04	.97356	103	24.33375	.01910
					50	7.0	34.76	27.25	.97325	83	48.66888	.04238
					125	6.8	34.41	27.01	.97316	108	121.65925	.11413
					250	6.8	34.71	27.24	.97240	88	243.25675	.23676
					450	4.9	35.19	27.87	.97092	30	437.58875	.35526
					750	4.9	34.88	27.63	.96984	55	728.70275	.48326
1029	Apr. 12	42 06	49 09	3,200	0	3.0	33.74	26.90	.97380	116	0	0
					25	2.8	33.68	26.87	.97372	119	24.34400	.02935
					50	3.4	34.65	27.59	.97292	50	48.67700	.05050
					125	2.4	34.16	27.28	.97290	82	121.64525	.10013
					250	3.3	34.40	27.40	.97222	70	243.21525	.19575
					450	3.4	34.70	27.63	.97112	50	437.54925	.31576
					750	4.4	34.97	27.74	.96973	44	728.67675	.45726
1030	Apr. 14	42 43	51 10	1,463	0	−.6	33.32	26.80	.97390	126	0	0
					25	[1] −.8	33.33	26.81	.97378	125	24.34613	.03148
					50	−1.0	33.17	26.69	.97377	135	48.69050	.06400
					125	−1.1	33.59	27.03	.97312	104	121.69887	.15375
					250	−1.1	33.28	26.78	.97279	127	243.31824	.29825
					450	0	34.54	27.76	.97097	35	437.69424	.46075
					750	3.5	34.79	27.70	.96975	46	728.80224	.58275
1031	Apr. 15	42 16	51 01	2,926	0	1.8	33.83	27.07	.97365	101	0	0
					25	1.8	33.86	27.10	.97351	98	24.33950	.02485
					50	2.2	34.22	27.35	.97315	73	48.67275	.04625
					125	3.6	34.62	27.54	.97265	57	121.64025	.09513
					250	−.6	34.12	27.44	.97216	64	243.19087	.17088
					450	0	34.11	27.41	.97130	68	437.53687	.30338
					750	4.2	34.80	27.63	.96982	53	728.70487	.48538
1032	...do.....	42 10	50 55	2,926	0	3.4	33.78	26.90	.97380	116	0	0
					25	2.5	33.81	27.00	.97360	107	24.34250	.02785
					50	2.5	33.78	26.97	.97351	109	48.68137	.05487
					125	2.0	33.82	27.05	.97311	103	121.68962	.14450
					250	2.0	33.83	27.05	.97255	103	243.28337	.26338
					450	3.2	33.81	26.94	.97177	115	437.71537	.48188
					750	3.4	34.65	27.59	.96985	56	728.95837	.73888
1033	Apr. 16	41 53	50 47	3,749	0	3.8	33.84	26.91	.97379	115	0	0
					25	3.8	33.82	26.89	.97370	117	24.34350	.02885
					50	3.6	33.87	26.95	.97352	110	48.68375	.05725
					125	4.6	34.38	27.25	.97292	84	121.67525	.13013
					250	4.4	34.75	27.56	.97208	56	243.23775	.21776
					450	4.2	34.83	27.65	.97111	49	437.55475	.32126
					750	3.8	34.91	27.76	.96970	41	728.67625	.45676
1034	...do.....	42 11	50 50	2,971	0	2.6	33.79	26.98	.97373	109	0	0
					25	2.3	33.81	27.02	.97358	105	24.34138	.02673
					50	2.2	34.21	27.34	.97316	74	48.67563	.04913
					125	3.4	34.53	27.49	.97270	62	121.64538	.10026
					250	4.4	34.90	27.63	.97201	49	243.18975	.17955
					450	4.8	34.82	27.58	.97119	57	437.50975	.27626
					750	4.5	34.90	27.68	.96978	49	728.65675	.43726
1035	Apr. 23	42 33	51 12	2,341	0	4.2	33.94	26.95	.97375	111	0	0
					25	2.9	34.00	27.12	.97349	96	24.34050	.02585
					50	2.9	[1] 34.23	27.30	.97320	78	48.67413	.04763
					125	3.1	34.44	27.45	.97273	65	121.64651	.10139
					250	4.0	34.76	27.62	.97202	50	243.19339	.17340
					450	4.0	34.98	27.78	.97099	37	437.49439	.26090
					750	3.5	34.81	27.70	.96975	46	728.60539	.38590
1036	...do.....	42 50	51 28	1,646	0	1.6	33.67	26.95	.97375	111	0	0
					25	1.5	33.77	27.04	.97356	103	24.34137	.02672
					50	2.1	33.96	27.16	.97333	91	48.67750	.05100
					125	3.1	34.56	27.55	.97264	56	121.65138	.10626
					250	3.2	34.88	27.80	.97184	32	243.17638	.15639
					450	3.7	34.96	27.81	.97096	34	437.45638	.22289
					750	3.4	34.95	27.82	.96963	34	728.54488	.32539

[1] Interpolated.

Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	a Depth of water	a₁ Depth	Temperature	Salinity	δ_t	V	V−V₁	E	E−E₁
						a=meters			*a₁*=pressure in decibars			
		° ′	° ′			° *C.*	*0/00*					
1037	Apr. 26	42 11	50 45	3,109	0	3.2	33.70	26.85	0.97385	121	0	0
					25	2.8	34.17	27.26	.97336	83	24.34012	.02547
					50	2.2	34.25	27.37	.97313	71	48.67124	.04474
					125	3.0	34.45	27.47	.97272	64	121.64062	.09550
					250	5.2	35.01	27.68	.97198	46	243.18437	.16438
					450	4.1	34.97	27.77	.97100	38	437.48237	.24888
					750	3.9	34.99	27.81	.96965	36	728.57987	.36038
1038	...do.....	42 13	51 32	3,475	0	4.2	33.58	26.60	.97409	145	0	0
					25	3.8	33.72	26.86	.97373	120	24.34775	.03310
					50	3.7	33.86	26.98	.97350	108	48.68812	.06162
					125	6.2	34.88	27.45	.97275	67	121.67250	.12738
					250	5.2	34.97	27.68	.97198	46	243.21812	.19813
					450	4.6	34.97	27.73	.97105	43	437.52112	.28763
					750	4.1	35.00	27.80	.96966	37	728.62762	.40813
1039	...do.....	42 31	51 31	2,880	0	3.8	33.77	26.85	.97385	121	0	0
					25	1.6	33.75	27.02	.97358	105	24.34287	.02822
					50	1.7	33.94	27.17	.97332	90	48.67912	.05262
					125	3.8	34.61	27.52	.97267	59	121.65374	.10862
					250	3.0	34.63	27.61	.97203	51	243.19749	.17750
					450	3.0	34.89	27.82	.97094	32	437.49449	.26100
					750	3.6	34.91	27.78	.96967	38	728.58599	.36650
1040	Apr. 27	42 25	51 19	2,743	0	1.0	33.56	26.91	.97379	115	0	0
					25	.2	33.94	27.26	.97336	83	24.33937	.02472
					50	.4	34.05	27.34	.97316	74	48.67087	.04437
					125	1.8	34.43	27.55	.97264	56	121.63837	.09325
					250	2.8	34.78	27.75	.97189	37	243.17149	.15150
					450	3.2	34.87	27.79	.97097	35	437.45749	.22400
					750	3.2	34.88	27.80	.96964	35	728.54899	.32950
1041	May 5	43 38	49 14	136	0	2.0	32.97	26.37	.97430	166	0	0
					10	.9	32.90	26.38	.97424	164	9.74270	.01650
					25	−.1	32.99	26.51	.97406	153	24.35495	.04030
					50	−1.0	33.04	26.58	.97387	145	48.70407	.07757
					75	−1.1	33.22	26.73	.97362	131	73.04769	.11215
					100	−1.1	33.28	26.78	.97347	128	97.38631	.14456
					125	−.8	33.46	26.92	.97322	114	121.71993	.17481
1042	May 6	42 36	49 18	2,560	0	7.6	33.64	26.29	.97438	174	0	0
					25	−.8	33.31	26.80	.97379	126	24.35225	.03760
					50	1.2	33.68	26.99	.97349	107	48.69325	.06675
					125	3.4	34.44	27.42	.97276	68	121.67762	.13250
					250	3.0	34.61	27.60	.97203	51	243.22699	.20700
					450	3.4	34.75	27.67	.97109	47	437.53899	.30550
					750	3.3	34.95	27.84	.96960	31	728.64249	.42300
1043	May 8	43 00	49 48	248	0	2.5	33.03	26.37	.97431	167	0	0
					25	−.2	33.09	26.59	.97399	146	24.35375	.03910
					50	−1.0	33.18	26.70	.97376	134	48.70062	.07412
					75	−1.0	33.30	26.79	.97357	126	72.04224	.10670
					125	−1.0	33.48	26.94	.97320	112	121.71149	.16637
					200	.2	33.79	27.14	.97267	93	194.68161	.24312
					225	1.2	34.08	27.32	.97239	76	218.99486	--------
1044	...do.....	43 03	49 45	184	0	1.8	33.02	26.42	.97426	162	0	0
					25	−.6	33.08	26.60	.97398	145	24.35300	.03835
					75	−1.0	33.22	26.73	.97362	131	73.04300	.10746
					150	−.8	33.50	26.95	.97308	111	146.71050	--------
					175	1.0	33.58	26.92	.97299	113	171.03637	--------
1045	May 9	43 14	49 50	70	0	1.8	32.99	26.39	.97429	165	0	0
					15	.6	33.01	26.49	.97412	155	14.61307	.02393
					25	−.5	33.10	26.61	.97397	144	24.35352	.03887
					50	−.7	33.11	26.63	.97383	141	48.70102	.07452
1046	May 10	42 56	49 21	1,600	0	1.5	32.90	26.35	.97432	168	0	0
					25	.0	32.97	26.49	.97408	155	24.35500	.04035
					50	−.8	33.31	26.79	.97368	126	48.70200	.07550
					125	−1.5	34.33	27.64	.97253	45	121.68487	.13975
					250	2.8	34.61	27.62	.97201	49	243.21862	.19863
					450	3.2	34.76	27.70	.97106	44	437.52562	.29213
					750	3.2	34.79	27.72	.96962	43	728.64262	.42313
1047	May 11	42 40	49 25	1,920	0	2.0	32.80	26.24	.97443	179	0	0
					25	2.0	33.02	26.40	.97417	164	24.35750	.04285
					50	−.3	33.17	26.67	.97379	137	48.70700	.08050
					125	1.1	33.93	27.20	.97296	88	121.71012	.16500
					250	−.1	34.51	27.74	.97188	36	243.26262	.24263
					450	3.3	34.76	27.69	.97107	45	437.55762	.32413
					750	4.0	34.93	27.75	.96971	42	728.67462	.45513

Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	*a* Depth of water	a_1 Depth	*a*=meters Temperature	Salinity	δ_t	a_1=pressure in decibars V	$V-V_1$	E	$E-E_1$
		° ′	° ′			° *C.*	*0/00*					
1048	May 12	42 44	49 53	1,460	0	2.5	32.81	26.20	0.97447	183	0	0
					25	1.0	32.89	26.37	.97420	167	24.35837	.04372
					50	−.8	33.30	26.78	.97369	127	48.70699	.08049
					125	2.2	34.18	27.32	.97286	78	121.70261	.15749
					250	2.2	34.55	27.61	.97202	50	243.25761	.23762
					450	2.1	34.74	27.78	.97098	36	437.55761	.32412
					750	3.2	34.87	27.79	.96965	36	728.65211	.43262
1049	May 20	42 43	50 27	1,645	0	1.6	33.06	26.46	.97422	158	0	0
					25	−.9	33.26	26.76	.97383	130	24.35062	.03597
					50	−1.1	33.39	26.88	.97359	117	48.69337	.06687
					125	−.7	33.41	26.88	.97326	118	121.70024	.15512
					250	1.2	33.70	27.01	.97259	107	243.31586	.29587
					450	2.9	34.62	27.62	.97113	51	437.68786	.45437
					750	3.1	34.94	27.85	.96960	31	728.79736	.56387
1050	May 21	42 45	51 04	1,645	0	3.1	33.05	26.34	.97433	169	0	0
					25	2.1	33.11	26.47	.97410	157	24.35537	.04072
					50	.0	33.05	26.56	.97390	148	48.70537	.07887
					125	−1.1	33.48	26.95	.97319	111	121.72124	.17612
					250	2.4	33.43	26.71	.97287	135	243.34999	.33000
					450	3.3	34.86	27.77	.97099	37	437.73599	.50250
					750	3.3	34.96	27.85	.96960	31	728.82449	.60500
1051	May 23	42 07	51 39	3,509	0	2.9	33.02	26.34	.97433	169	0	0
					25	2.7	33.10	26.42	.97415	162	24.35600	.04135
					50	2.8	33.55	26.77	.97370	128	48.70412	.07762
					125	3.3	[1]33.75	26.88	.97327	119	121.71549	.17037
					250	4.5	34.60	27.44	.97219	67	243.30674	.28675
					450	3.6	34.74	27.64	.97112	50	437.63774	.40425
					750	3.5	34.84	27.73	.96971	42	728.76224	.44275
1052	May 24	42 40	49 53	2,110	0	1.0	32.96	26.42	.97426	162	0	0
					25	.0	33.04	26.54	.97403	150	24.35362	.03897
					50	1.9	33.83	27.06	.97343	101	48.69687	.07037
					125	1.9	[1]34.00	27.20	.97297	89	121.68687	.14175
					250	1.9	34.45	27.56	.97207	55	243.25187	.23188
					450	3.0	34.81	27.76	.97100	38	437.55887	.32538
					750	3.2	34.87	27.79	.96965	36	728.65637	.43688
1053	May 25	42 18	51 13	2,744	0	5.8	33.38	26.32	.97435	171	0	0
					25	5.9	33.46	26.37	.97420	167	24.35687	.04222
					50	2.2	33.47	26.75	.97371	129	48.70574	.07924
					125	4.0	34.35	27.29	.97289	81	121.70324	.15812
					250	4.0	34.83	27.67	.97198	46	243.25761	.23762
					450	3.5	34.89	27.77	.97099	37	437.55461	.32112
					750	4.2	35.00	27.78	.96968	39	728.65511	.43562
1054	May 27	42 52	50 13	510	0	4.9	32.88	26.03	.97463	199	0	0
					25	.2	33.06	26.55	.97402	149	24.35812	.04347
					50	−.2	33.30	26.76	.97371	129	48.70474	.07824
					125	−.2	33.67	27.07	.97309	101	121.70974	.16462
					250	1.3	34.41	27.57	.97206	54	243.28161	.26162
					450	2.5	34.82	27.81	.97095	44	437.58261	.34912
1055	May 28	42 32	50 27	2,010	0	3.0	32.88	26.22	.97445	181	0	0
					25	3.0	33.40	26.63	.97395	142	24.35500	.04035
					50	1.2	34.09	27.32	.97318	76	48.69412	.06762
					125	2.9	34.64	27.64	.97255	47	121.65899	.11387
					250	2.9	34.74	27.71	.97193	41	243.18899	.16900
					450	3.2	34.95	27.86	.97091	29	437.47299	.23959
					750	3.2	34.97	27.87	.96958	29	728.54649	.32700
1056	May 29	42 57	49 50	183	0	4.6	33.16	26.28	.97439	175	0	0
					25	2.2	33.20	26.53	.97404	151	24.35537	.04072
					50	1.0	33.25	26.66	.97380	138	48.70337	.07687
					75	−.2	33.35	26.81	.97355	124	73.04524	.10970
					100	−.8	33.37	26.85	.97340	121	97.38211	.14036
					125	−.3	33.56	26.98	.97317	109	121.71423	.16911
1057	May 31	42 56	50 00	140	0	3.0	33.11	26.39	.97429	165	0	0
					25	.0	33.20	26.68	.97390	137	24.35237	.03772
					50	−1.0	33.50	26.96	.97352	110	48.69512	.06862
					75	−1.1	33.61	27.05	.97332	101	73.03062	.09508
					100	−.8	33.64	27.06	.97320	101	97.36212	.12037
					125	−.5	33.74	27.13	.97303	95	121.68999	.14487
1058	June 1	42 51	49 23	1,462	0	3.2	32.93	26.20	.97447	183	0	0
					25	1.6	33.45	26.77	.97382	129	24.35362	.03897
					50	1.1	34.06	27.31	.97319	77	48.69124	.06474
					125	2.7	34.58	27.60	.97259	51	121.65799	.11287
					250	3.0	34.75	27.71	.97193	41	243.19049	.17050
					450	3.1	34.85	27.78	.97098	36	437.48149	.24800
					750	3.2	34.90	27.81	.96963	34	728.57299	.35350

[1] Interpolated.

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Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	a Depth of water	a_1 Depth	a = meters: Temperature	a = meters: Salinity	a = meters: δ_t	a_1 = pressure in decibars: V	a_1 = pressure in decibars: V-V_1	a_1 = pressure in decibars: E	a_1 = pressure in decibars: E-E_1
		° ′	° ′			° C.	0/00					
1059	June 4	42 26	49 48	2,927	0	3.1	32.81	26.16	0.97451	187	0	0
					25	.2	33.15	26.62	.97396	143	24.35587	.04122
					50	.0	33 70	27.08	.97341	99	48.69799	.07149
					125	3.1	34.58	27.56	.97263	55	121.67449	.12937
					250	3.1	34.75	27.70	.97194	42	243.21011	.19012
					450	3.4	34.87	27.77	.97099	37	437.50311	.28962
					750	3.1	34.90	27.82	.96962	33	728.59461	.37512
1060	June 7	42 27	49 46	2,744	0	4.0	32.85	26.10	.97456	192	0	0
					25	1.1	33.31	26.70	.97388	135	24.35550	.04085
					50	1.0	33.78	27.09	.97340	98	48.69650	.07000
					125	2.1	34.48	27.56	.97263	55	121.67262	.12750
					250	3.0	34.74	27.70	.97194	42	243.20824	.18825
					450	3.2	34.86	27.78	.97098	36	437.50024	.26675
					750	3.2	34.88	27.80	.96964	35	728.59324	.37375
1061	June 8	41 20	48 12	3,382	0	9.1	33.19	25.70	.97494	230	0	0
					25	7.5	33.22	25.97	.97458	205	24.36900	.05435
					50	5.2	33.27	26.31	.97413	171	48.72787	.10137
					125	4.9	33.77	26.74	.97340	132	121.76024	.21512
					250	3.0	34.45	27.47	.97216	64	243.35773	.33774
					450	4.9	34 89	27.62	.97115	53	437.68873	.45524
					750	4.0	34.92	27.74	.96972	43	728.81924	.59975
1062	June 9	42 27	49 19	2,744	0	4.9	32.78	25.95	.97471	207	0	0
					25	1.8	33.04	26.44	.97413	160	24.36050	.04585
					50	1.1	33.85	27.14	.97335	93	48.70400	.07750
					125	2.1	34.40	27.50	.97269	61	121.68050	.13538
					250	3.0	34.62	27.61	.97202	50	243.22487	.20488
					450	4.1	34.91	27.72	.97105	43	437.53187	.29838
					750	4.9	34.92	27.65	.96982	53	728.66237	.44288
1063	June 10	42 55	50 23	346	0	2.2	33.08	26.44	.97424	160	0	0
					25	.1	33.13	26.61	.97397	144	24.35262	.03797
					50	.0	33.28	26.74	.97372	130	48.69874	.07224
					125	.2	33.81	27.16	.97300	92	121.70074	.15562
					250	1.4	34.24	27.43	.97219	67	243.27511	.25512
1064	June 11	42 42	48 40	2,927	0	6.0	32.93	25.94	.97471	207	0	0
					25	5.2	33.21	26.26	.97430	177	24.36262	.04797
					50	1.8	33.73	26.99	.97349	107	48.70999	.08349
					125	3.0	34.45	27.47	.97272	64	121.69286	.14774
					250	2.9	34.66	27.65	.97198	46	243.23661	.21662
					450	4.0	34.92	27.75	.97102	40	437.53661	.30312
					750	[2] 4.3	34.97	27.75	.96971	42	728.64611	.42662
1065	June 12	42 55	48 30	2,812	0	7.2	33.22	26.01	.97465	201	0	0
					25	5.2	33.52	26.50	.97407	154	24.35900	.04435
					50	1.4	34.49	27.63	.97288	46	48.69587	.06937
					125	4.1	34.68	27.54	.97265	57	121.65324	.10812
					250	4.2	34.88	27.74	.97191	39	243.18824	.16825
					450	4.0	34.88	27.71	.97106	44	437.48524	.25175
					750	4.6	34.89	27.71	.96977	48	728.60974	.39025
					1000	4.5	34.88	27.66	.96873	54	970.92224	.51775
					1500	4.1	34.86	27.69	.96657	------	1454.74724	--------
					1700	3.0	34.86	27.80	.96559	------	1647.96324	--------
1066	June 13	43 00	49 40	822	0	2.8	32.80	26.17	.97450	186	0	0
					25	.2	32.92	26.44	.97413	160	24.35787	.04322
					50	−1.0	33.34	26.83	.97364	122	48.70499	.07849
					125	.0	33.69	27.07	.97309	101	121.70736	.16224
					250	2.0	34.42	27.53	.97210	58	243.28173	.26174
					450	3.2	34.81	27.74	.97102	40	437.59373	.36024
					700	3.2	34.85	27.78	.96989	60	680.20748	.45799
1067	June 15	42 07	48 50	3,209	0	7.0	33.04	25.91	.97474	210	0	0
					25	3.9	33.29	26.46	.97411	158	24.36062	.04597
					50	1.0	33.76	27.07	.97342	100	48.70474	.07824
					125	2.4	34.42	27.49	.97270	62	121.68424	.13912
					250	3.2	34.73	27.68	.97196	44	243.22549	.20550
					450	4.1	[1] 34.86	27.68	.97109	47	437.53049	.29700
					750	4.0	34.85	27.69	.96977	48	728.65949	.44000
1068	June 16	42 30	49 30	2,559	0	5.8	33.18	26.16	.97451	187	0	0
					25	2.6	33.71	26.99	.97361	108	24.35150	.03685
					50	3.9	34.29	27.25	.97324	82	48.68712	.06062
					125	3.8	34.56	27.48	.97271	63	121.66024	.11512
					250	4.1	34.82	27.65	.97199	47	243.20399	.18400
					450	3.5	34.84	27.73	.97103	41	437.50599	.27250
					750	4.6	34.92	27.68	.96979	50	728.62899	.40950

[1] Interpolated. [2] Exterpolated.

Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	*a* Depth of water	a_1 Depth	*a*=meters: Temperature	*a*=meters: Salinity	*a*=meters: δ_t	a_1=pressure in decibars: V	a_1=pressure in decibars: V−V_1	a_1=pressure in decibars: E	a_1=pressure in decibars: E−E_1
		° ′	° ′			° *C.*	*0/00*					
1069	June 19	41 57	48 00	3,749	0	11.4	33.15	25.29	0.97533	269	0	0
					25	5.9	33.42	26.33	.97423	170	24.36950	.05485
					50	3.7	33.76	26.85	.97362	120	48.71762	.09112
					125	4.2	34.48	27.37	.97281	73	121.70874	.16362
					250	4.7	34.85	27.61	.97204	96	243.26186	.24187
					450	4.2	34.91	27.71	.97106	44	437.57186	.33837
					750	4.0	34.95	27.77	.96969	40	728.68436	.46487
1070	June 21	42 45	49 11	2,378	0	6.2	33.28	26.19	.97488	184	0	0
					25	3.3	33.56	26.73	.97385	132	24.35412	.03947
					50	2.9	34.03	27.18	.97333	91	48.69387	.06737
					125	2.8	34.54	27.56	.97263	55	121.66737	.12225
					250	2.8	34.81	27.78	.97186	34	243.19799	.17800
					450	3.6	34.87	27.75	.97102	40	437.48599	.25250
					750	3.6	34.91	27.79	.96966	37	728.58799	.36850
1071	June 25	43 07	48 53	*2,269*	*0*	*9.0*	*33.35*	25.85	.97480	*216*	*0*	*0*
					25	5.0	33.41	26.44	.97413	160	24.36162	.04697
					50	2.4	33.90	27.08	.97341	99	48.70587	.07937
					125	3.2	34.55	27.53	.97266	58	121.68349	.13837
					250	4.2	34.83	27.65	.97200	48	243.22474	.20475
					450	3.8	34.88	27.73	.97104	42	437.52784	.29435
					750	3.6	34.88	27.75	.96970	41	728.63974	.42025
1072	June 26	42 13	48 40	3,199	0	17.4	34.81	25.30	.97532	268	0	0
					25	13.9	34.82	26.09	.97446	193	24.37225	.05760
					50	13.2	34.96	26.34	.97411	169	48.72937	.10287
					125	11.8	35.21	26.81	.97335	127	121.75912	.21400
					250	7.8	35.39	27.63	.97203	51	243.34537	.32538
					450	7.6	35.42	27.69	.97112	50	437.66037	.42688
					750	4.2	35.43	28.12	.96936	7	728.73237	.51288
1073	June 28	42 03	49 40	3,247	0	6.1	32.63	25.68	.97496	232	0	0
					25	2.5	32.92	26.29	.97427	174	24.36537	.05072
					50	.2	33.29	26.74	.97372	130	48.71524	.08874
					125	2.0	33.98	27.18	.97299	91	121.71686	.17174
					250	2.6	34.52	27.56	.97207	55	243.28311	.26312
					450	3.0	34.72	27.69	.97107	45	437.59711	.36362
					750	3.2	34.82	27.75	.96969	40	728.71111	.49162
1074	June 30	43 08	50 50	101	0	10.8	32.96	25.25	.97437	173	0	0
					25	3.0	33.03	26.34	.97422	169	24.35737	.04272
					50	−.3	33.23	26.71	.97375	133	48.70699	.08049
					75	2.0	33.88	27.10	.97328	97	73.04486	.10932
					100	3.4	34.20	27.23	.97305	86	97.37372	.13217
1075	July 1	42 05	50 20	3,290	0	19.8	34.73	24.66	.97594	330	0	0
					25	18.4	35.00	25.20	.97532	279	24.39075	.07610
					50	15.2	35.41	26.27	.97418	176	48.75950	.13300
					125	13.0	35.44	26.75	.97342	134	121.79450	.24938
					250	11.8	35.48	27.02	.97263	111	243.42262	.40263
					450	7.2	35.60	27.89	.97092	30	437.77762	.54413
					750	3.4	35.66	28.39	.97909	−20	728.77912	.55963
1076	July 5	42 32	49 04	2,779	0	11.2	32.96	25.18	.97544	280	0	0
					25	2.8	33.46	26.70	.97388	135	24.36650	.05185
					50	1.6	33.59	26.89	.97358	116	48.70975	.08325
					125	3.0	34.51	27.51	.97268	60	121.69450	.14938
					250	4.0	34.84	27.68	.97197	45	243.23512	.21513
					450	4.0	34.94	27.76	.97101	39	437.53312	.29963
					750	4.0	34.94	27.76	.96970	41	728.63962	.42013
1077	July 6	43 00	49 05	2,560	0	11.8	33.00	25.10	.97551	287	0	0
					25	2.1	33.50	26.78	.97381	128	24.36650	.05185
					50	4.0	34.22	27.19	.97330	88	48.70537	.07887
					125	4.0	34.63	27.51	.97268	60	121.67962	.13450
					250	4.0	34.78	27.63	.97201	49	243.22274	.20275
					450	4.1	34.89	27.71	.97106	44	437.52974	.39625
					750	4.0	34.91	27.74	.96972	43	728.64674	.42735
1078	July 7	*43 20*	*49 17*	*915*	*0*	*7.5*	*32.81*	*25.64*	*.97500*	*236*	*0*	*0*
					25	7.5	33.81	26.44	.97413	160	24.36412	.04947
					50	5.4	34.34	27.13	.97336	94	48.70774	.08124
					125	5.2	34.71	27.45	.97273	65	121.68611	.14099
					250	4.5	34.84	27.63	.97201	49	243.23236	.21237
					450	3.4	34.84	27.74	.97102	40	437.53536	.30187
					750	2.3	34.85	27.85	.96958	29	728.62536	.40587
1079	July 8	41 44	49 00	3,290	0	10.8	33.19	25.45	.97518	254	0	0
					25	8.8	33.42	25.93	.97461	208	24.37237	.05772
					50	3.8	33.75	26.84	.97363	121	48.72537	.09887
					125	2.7	34.33	27.40	.97278	70	121.71574	.17062
					250	2.8	34.62	27.62	.97201	49	243.26511	.24512
					450	3.5	34.86	27.75	.97101	39	437.56711	.33362
					750	3.8	34.92	27.77	.96969	40	728.67211	.45262

Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	*a* Depth of water	a_1 Depth	*a*=meters Temperature	Salinity	δ_t	a_1=pressure in decibars V	$V-V_1$	E	$E-E_1$
		° ′	° ′			° C.	0/00					
1080	July 9	41 36	48 32	3,430	0	11.4	32.82	25.03	0.97558	294	0	0
					25	8.9	33.20	25.74	.97479	226	24.37962	.06497
					50	4.2	33.44	26.56	.97390	148	48.73824	.11174
					125	2.7	34.16	27.26	.97292	84	121.74399	.19887
					250	4.4	34.71	27.54	.97210	58	243.30774	.28775
					450	3.9	34.87	27.72	.97105	43	437.62274	.38925
					750	[2]3.9	34.91	27.75	.96971	42	728.73674	.51725
1081	July 13	42 00	48 40	3,239	0	11.9	32.92	25.02	.97559	295	0	0
					25	6.0	33.24	26.19	.97437	184	24.37450	.05985
					50	4.2	33.74	26.79	.97368	126	48.72512	.09862
					125	2.1	34.36	27.47	.97272	64	121.71512	.17000
					250	3.2	34.65	27.61	.97202	50	243.26137	.24138
					450	4.0	34.85	27.69	.97108	46	437.57137	.33788
					750	4.0	34.92	27.73	.96973	44	728.69287	.47338
1082	July 14	41 34	48 11	3,381	0	17.7	34.26	24.80	.97580	316	0	0
					25	17.3	34.57	25.40	.97512	259	24.38650	.07185
					50	14.8	34.65	25.70	.97472	230	48.75950	.13300
					125	[1]3.6	34.64	27.56	.97263	55	121.78512	.24000
					250	3.8	34.64	27.54	.97210	58	243.33074	.31075
					450	4.4	34.71	27.54	.97122	60	437.66274	.42925
					750	4.4	34.95	27.73	.96974	45	728.80624	.58675
1083	July 15	41 32	49 07	3,327	0	13.2	33.07	24.88	.97572	308	0	0
					25	6.7	33.22	26.08	.97447	194	24.37737	.06272
					50	2.6	33.83	27.00	.97348	106	48.72674	.10024
					125	3.1	34.49	27.49	.97270	62	121.70849	.16337
					250	3.7	34.76	27.65	.97199	47	243.25161	.23162
					450	4.3	34.93	27.72	.97105	43	437.55561	.32212
					750	4.2	34.95	27.75	.96971	42	728.66961	.45012
1084	July 16	41 45	48 50	3,107	0	13.4	33.06	24.81	.97579	315	0	0
					25	6.8	33.38	26.20	.97436	183	24.37687	.06222
					50	3.4	33.94	27.02	.97346	104	48.72462	.09812
					125	2.9	34.46	27.48	.97271	63	121.70599	.16087
					250	3.5	34.70	27.62	.97202	50	243.25162	.23163
					450	3.7	34.83	27.70	.97107	45	437.56062	.32713
					750	3.7	34.89	27.75	.96971	42	728.67762	.45813
1085	July 18	42 01	49 29	3,290	0	14.0	32.89	24.59	.97600	336	0	0
					25	4.2	33.31	26.45	.97412	159	24.37650	.06185
					50	1.9	33.91	27.13	.97336	94	48.72000	.09350
					125	2.8	34.42	27.46	.97273	65	121.69837	.15325
					250	4.0	34.73	27.59	.97205	53	243.24712	.22713
					450	3.6	34.75	27.65	.97115	53	437.56312	.32963
					750	3.6	34.73	27.63	.96981	52	728.70112	.48163
1086	July 20	41 18	48 43	3,343	0	14.6	32.96	24.51	.97608	344	0	0
					25	6.4	33.30	26.19	.97437	184	24.38062	.06597
					50	2.6	33.69	26.90	.97357	115	48.72987	.10337
					125	3.7	34.45	27.41	.97277	69	121.71762	.17250
					250	3.5	34.61	27.55	.97209	57	243.27137	.25138
					450	3.5	34.73	27.64	.97112	50	437.59267	.35918
					750	3.4	34.77	27.69	.96976	47	728.72437	.50488
1087	July 21	40 57	48 55	3,290	0	13.3	32.84	24.68	.97592	328	0	0
					25	9.8	33.37	25.73	.97480	227	24.38400	.06935
					50	5.7	33.01	26.05	.97438	196	48.74875	.12225
					125	2.3	33.11	26.46	.97367	159	121.80062	.25550
					250	4.8	34.80	27.56	.97209	57	243.41062	.39063
					450	4.7	34.70	27.49	.97128	66	437.74762	.51413
					750	4.2	34.90	27.71	.96975	46	728.90212	.68263
1088	July 23	41 48	49 15	3,290	0	15.5	32.88	24.66	.97594	330	0	0
					25	2.4	32.94	26.32	.97424	171	24.37725	.06260
					50	2.2	33.60	26.85	.97362	120	48.72550	.09900
					125	5.1	33.96	26.85	.97330	122	121.73500	.18988
					250	4.0	34.67	27.54	.97210	58	243.32250	.30251
					450	3.8	34.77	27.65	.97111	49	437.64350	.41001
					750	3.5	34.74	27.65	.96979	50	728.77850	.55901
1089	July 24	42 11	49 29	3,109	0	15.3	33.34	24.63	.97596	332	0	0
					25	5.0	33.49	26.51	.97406	153	24.37525	.06060
					50	4.8	33.75	26.73	.97373	131	48.72262	.09612
					125	4.7	34.55	27.38	.97280	72	121.71749	.17237
					250	5.0	34.86	27.59	.97206	54	243.27124	.25125
					450	5.0	34.80	27.56	.97121	59	437.59824	.36475
					750	3.8	34.73	27.62	.96983	54	728.75424	.53475
1090	July 26	42 20	49 45	3,019	0	14.9	32.80	24.32	.97626	362	0	0
					25	7.4	33.12	25.90	.97464	211	24.38625	.07160
					50	4.8	33.90	26.85	.97362	120	48.73950	.11300
					125	2.4	34.41	27.48	.97271	63	121.72687	.18175
					250	2.4	34.54	27.59	.97204	52	243.27374	.25375
					450	3.4	34.75	27.67	.97109	47	437.58674	.35325
					750	4.2	34.78	27.62	.96983	54	728.72474	.50525

[1] Interpolated. [2] Exterpolated.

Oceanographic station data and dynamic calculations, 1929—Continued

Station	Date	Latitude N.	Longitude W.	*a* Depth of water	a_1 Depth	*a*=meters: Temperature	*a*=meters: Salinity	*a*=meters: δ_t	a_1=pressure in decibars: V	a_1=pressure in decibars: V–V_1	a_1=pressure in decibars: E	a_1=pressure in decibars: E–E_1
		° ′	° ′			° *C.*	*0/00*					
1091	July 28	43 26	49 10	1,096	0	14.2	32.92	24.53	0.97606	342	0	0
					25	7.0	33.36	26.16	.97440	187	24.38075	.06610
					50	7.3	33.68	26.36	.97410	168	48.73700	.10050
					125	7.7	34.27	26.75	.97340	132	121.76825	.22313
					250	4.9	34.85	27.61	.97204	52	243.35825	.33826
					450	[1] 3.1	34.63	27.60	.97115	53	437.67725	.44376
					750	3.4	34.65	27.59	.96985	56	728.82725	.60776
1092	July 29	43 40	49 03	913	0	14.8	33.73	25.05	.97556	292	0	0
					25	11.6	35.03	26.71	.97387	134	24.36787	.05322
					50	11.8	35.22	26.84	.97364	122	48.71174	.08524
					125	10.2	35.17	27.07	.97311	103	121.71486	.16974
					250	8.6	34.77	27.02	.97262	110	243.32298	.30299
					450	4.3	34.84	27.65	.97111	49	437.69598	.46249
1093	July 30	43 47	49 02	1,280	0	10.3	32.33	24.83	.97577	313	0	0
					25	5.3	32.56	25.72	.97481	228	24.38225	.06760
					50	5.3	32.59	25.75	.97466	224	48.75062	.12412
					125	4.8	33.27	26.36	.97377	169	121.81674	.27162
					250	4.0	34.71	27.58	.97206	54	243.43111	.41112
					450	4.3	34.83	27.65	.97111	49	437.74811	.51462
					750	3.8	34.82	27.69	.96977	48	728.88011	.66062
1094	July 31	43 40	49 00	982	0	11.0	32.61	24.94	.97566	302	0	0
					25	3.9	33.79	26.85	.97374	121	24.36750	.05285
					50	4.6	34.50	27.34	.97316	74	48.70375	.07725
					125	4.5	34.55	27.40	.97278	70	121.67650	.13138
					250	4.6	34.82	27.60	.97205	53	243.22837	.20838
1095	Aug. 2	43 41	49 05	783	0	10.7	32.35	24.79	.97581	317	0	0
					25	5.0	32.96	26.09	.97446	193	24.37837	.06372
					50	−.4	33.21	26.70	.97376	134	48.73112	.10462
					125	2.5	34.33	27.42	.97278	70	121.72637	.18125
					250	2.9	34.51	27.52	.97211	59	243.28199	.26200
					450	3.7	34.64	27.55	.97121	59	437.61399	.38050
					750	4.2	34.68	27.58	.96987	58	728.77599	.55650

[1] Interpolated.

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