

COMPILATION OF HISTORICAL ACCOUNTS OF ICEBERG GROUNDINGS ON THE
EASTERN CANADA CONTINENTAL SHELF

PREPARED FOR
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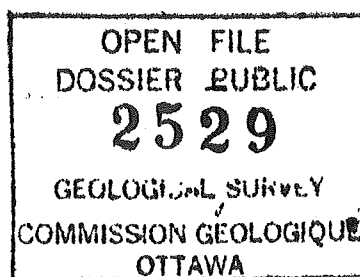


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1. INTRODUCTION

This report presents a listing of icebergs which were observed by the International Ice Patrol (IIP) to have grounded on the Grand Banks of Newfoundland from 1913 to 1948 inclusively, except for the years 1917 and 1918 when IIP Bulletins were not issued. IIP reports beyond 1948 do not include information about groundings because iceberg surveillance by aircraft superseded the use of surface vessels. The groundings reported by vessels are unfortunately sporadic and limited in areal coverage and do not permit estimating rates of scouring, except for the season in 1923. A minimum scour rate has been calculated for the 1923 ice season for the Tail of the Banks south of 44°N and within the 100 fathom (183m) line. One scour with an inferred scour length of 20 km has been identified in 110m of water and may be useful in estimating scour degradation when a scour survey is conducted. As regards wind and current influences on the drift of icebergs, the data are limited to the extent that it is not possible to reach conclusions about wind and current influences during grounding events. The listing of the 42 identified grounding events is considered as an addendum to the listings of grounded icebergs extracted from oil company iceberg drift data (Banke, 1989a and b).

2. IIP SURVEILLANCE FOR ICEBERG

Surveillance for icebergs started in 1913 as a result of the tragic sinking of the TITANIC in 1912. IIP used surface vessels to scout for icebergs. The majority of iceberg surveys by IIP vessels were concentrated in the vicinity of the Tail of the Banks owing to the proximity to major shipping lanes. When icebergs were situated further north, surveys were conducted north of the Tail of the Banks. Excellent reports were issued by IIP, detailing the icebergs observed on each cruise from 1913 to 1948 inclusively; however no bulletins were issued for the war years 1917 and 1918. By 1948 the use of aircraft surveillance was firmly established and resulted in a drastic reduction of ship-based iceberg reports. Consequently, the historical iceberg groundings presented herein cover the period of IIP reporting from 1913 to 1948 inclusively.

3. SUMMARY OF HISTORICAL GROUNDINGS

The results of the search for historical groundings on the Grand Banks are presented in Fig. 1. A total of 41 icebergs were observed to have experienced 42 groundings. One iceberg was noted to have grounded in two locations and a scour is inferred for the berg drift between the two noted positions. The noted groundings are summarized in Table 1 and detailed in Tables 2 to 16. In Table 1, missing years between 1913 and 1948 indicate that groundings were not observed by IIP, except for 1917 and 1918 when no iceberg patrols were conducted.

TABLE 1

SUMMARY LISTING OF GROUNDED ICEBERGS REPORTED BY IIP

YEAR	NUMBER OF GROUNDED BERGS	BERG POPULATION
1913	1	550
1914	1	731
1915	2	468
1921	3	746
1922	4	523
1923	11	236
1926	1	345
1927	1	389
1929	1	1351
1931	1	13
1932	7	514
1934	3	576
1935	2	875
1937	2	470
1948	1	510

Note: The berg population is that of the number of icebergs south of 48°N as tabulated by the International Ice Patrol and presented in Fig 2.

Number of Icebergs South of 48°N (1912-87)

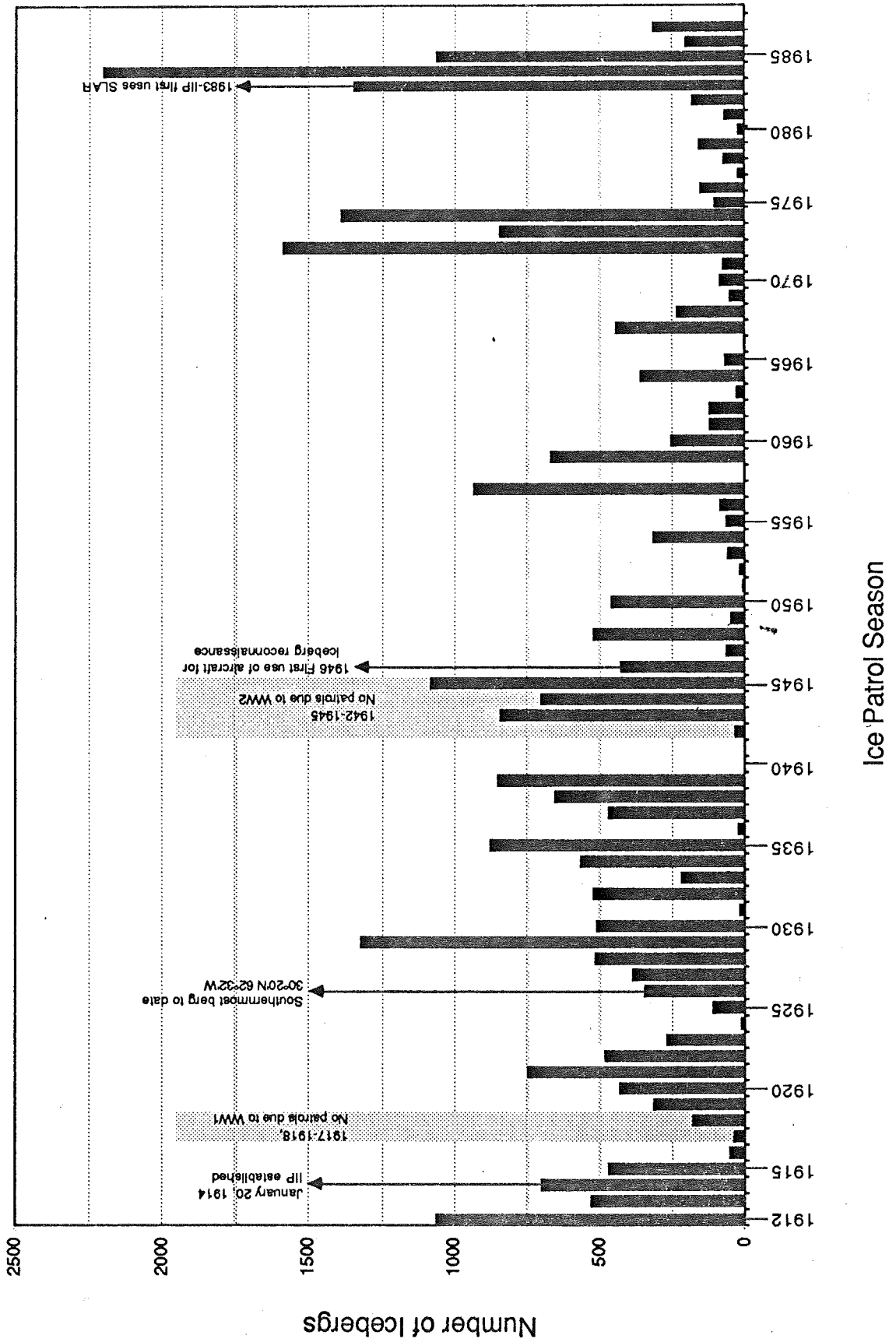


FIGURE 2 Number of icebergs south of 48°N compiled by the International Ice Patrol

4 EXPLANATION OF TABLES 2 TO 16.

In Tables 2 to 16, the following information is listed:

- * the page number in the IIP Bulletin describing each grounded iceberg.
- * the latitude at each grounding location.
- * the longitude at each grounding location.
- * the berg size if known. The length, width and height are presented as available.
- * the water depth at each grounded position as given by IIP or from charts.
- * the date of observation of grounding and where possible the grounding duration.
- * the source of information.
- * a dash indicates a lack of data.

Note that for the years not listed in the tables, grounding events were not detected in the relevant IIP bulletins.

5. LISTING OF GROUNDED ICEBERGS.

TABLE 2

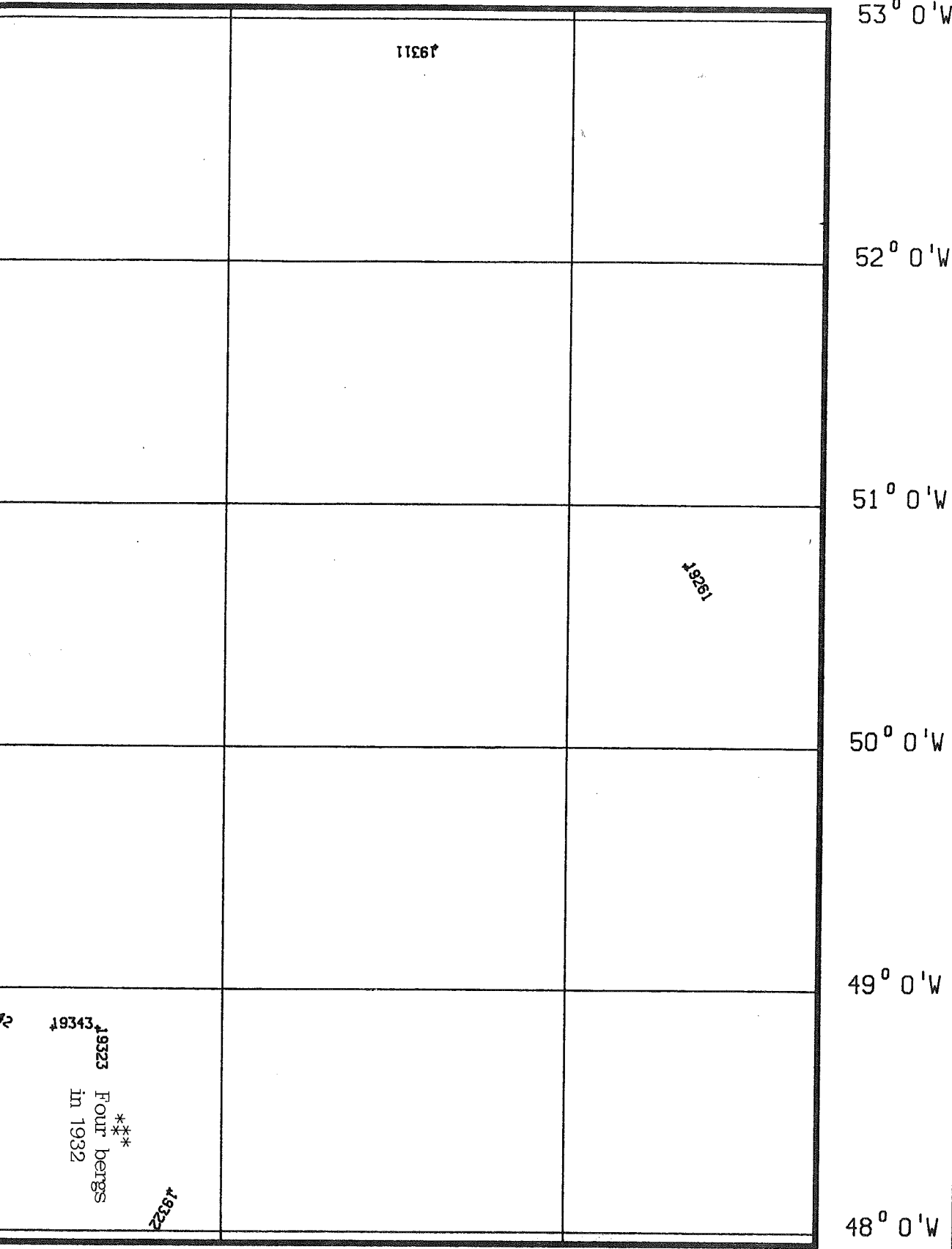
LISTING OF GROUNDED ICEBERGS IN 1913

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
16	44°-56'	49°-16'	73	LATE APRIL, EARLY MAY

NOTE: There is no information on berg size.

SOURCE: IIP Bulletin No. 1

HISTORIC ICEBERG GROUNDINGS IIP 1913-1948
 : 1 750 000 AT 47.0 MERCATOR



53° 0' W
 52° 0' W
 51° 0' W
 50° 0' W
 49° 0' W
 48° 0' W

47° 0' N
 46° 0' N

1913
JSP
Report

dragged until 4 a. m. the 26th, when anchors were found to be away. Hove them up and stood to southwest, fog lifting temporarily at 8 a. m. The barkentine *Aralia*, to which the rescued fishermen belonged, was sighted a couple of miles distant. The men were returned to the *Aralia*. The fog set in soon afterwards, so vessel anchored at noon.

10. Fog lifted with a shift of wind to the northward during the night; observations were taken, and at 5.30 a. m. vessel continued search for bergs. The waters between latitudes 42-40 and 43-25 and longitudes 48-40 and 50-00 were patrolled. The steamship *Columbia* at same time stood 72° from 42-26, 50-01, at noon. At 8 p. m. she reported no ice. On May 28 the *France*, on a parallel course, but 50 miles south, sent in same report.

11. On the 27th, between the two latitudes 43-55 and 43-10, in longitude 49-10, the water temperature fell from 50 to 36°.

On the 28th, in 43-28, 48-30, heading east, temperature rose from 38 to 50°. On this day the *Miami* searched the waters between latitudes 43-20 and 44-00, and longitudes 48-20 and 49-50; no ice in sight. Vessel anchored for the night. The 29th came in drizzling and later changed to dense fog; wind fresh from south-southeast; vessel dragging to north-northwest.

12. A radio message from the *Seneca* was received at 5.40 p. m. when about 300 miles west by south. I informed the senior officer that our position at the time could not be determined, as it had been foggy since anchoring and the *Miami* had dragged miles to the northward. By arrangement the *Miami* got under way at 4.30 the next morning and steamed to the westward, in the hope of intercepting the *Seneca* as she steamed to the eastward along the 44th parallel. She was sighted dead ahead at 4.45 p. m. Both vessels lay to at 5.15 p. m. while track chart and copies of radiograms were delivered to the senior officer, after which both vessels proceeded on their respective ways.

Respectfully,

A. S. GAMBLE,
Commanding.U. S. REVENUE CUTTER "SENECA,"
Halifax, Nova Scotia, June 19, 1913.

Subject Report of third cruise on ice patrol

STR: 1. The *Seneca* left Halifax on May 28, 1913, in a fog and reached Grand Bank May 31, having had high shifting southerly winds and rain most of the way. On the 31st it cleared and I directed the *Miami* to meet us on parallel 44, which she did. After receiving charts and reports I relieved the *Miami* and she proceeded to Halifax. Fog closing in again, I anchored on the 30 fathom bank. On June 1 the wind came out heavy from the southwest and I got under way for fear of parting the chain.

2. On June 2 the weather cleared and moderated and I stood out to the south and east to look for bergs. Capt. Gamble reported the last berg he saw was in 43-30 N., 48-30 W., and from his sketch of it I recognized the berg I have previously called No. 2. It was north of where I last saw it. That was May 22. I worked down to the position mentioned, and from there I cruised between the Grand Bank and the north branch of the Gulf Stream, working to the northward. I found the current to be north 40 east, about a mile an hour. Continuing the search to the northward, nothing was seen until May 4, when we sighted the berg previously reported aground in 44-56 N., 49-16 W. It had apparently turned over twice and bore no resemblance to the berg we saw there before. It was rapidly breaking up. Sea water 42° at surface, 40 at condenser intake. The day was very clear and we picked up the berg at 18 miles. Fog closing down later, I ran to the westward and anchored. On the 5th we ran back to the berg during a drizzling rain and could then see it plainly 2 miles and indistinctly half a mile farther. Water temperature is 5° higher than a month ago. Current north 26 east, three-fourths mile an hour.

TABLE 3

LISTING OF GROUNDED ICEBERGS IN 1914

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
23	43°-00'	50°-00'	75	MAY 17

NOTE: The berg was noted as large.

SOURCE: IIP Bulletin No. 3

barometer then climbed steadily to 30.45 and remained steady there for a week, with southerly winds, mild weather, and much fog over cold water, but hazy over the Gulf Stream. The third week the barometer slowly fell to normal, with variable winds and a continuance of the fogs.

The Gulf Stream is very weak, running only about a quarter of a mile an hour where it was running over a mile an hour in February and March. Its temperature is 3° lower than in February along the northern edge. The Labrador is still strong and has evidently been very strong, pushing the Gulf 90 miles south and nearly as far east at the point where the northeast turn is usually made—in the vicinity of latitude 43° N., longitude 49° W. This is not a case of the Labrador overriding the Gulf, but pushing it bodily away. Samples of water taken down to 500 fathoms show a practically uniform ocean bed at 400 fathoms with temperature 38° to 39° F. In the Gulf Stream there is a gradual fall from surface to this temperature, and in the Labrador there is a gradual rise from about 32° to 39°. At the point of meeting of the two currents we got a zigzag of temperatures, indicating a gradual mixing. The temperature of the Labrador Stream near the tail of the Bank is now about 34°, 2° up from last month.

On several occasions, particularly with easterly winds, we have had marked mirage effects. In approaching the cold water, May 10, while still in the Gulf, we saw the horizon over the cold stream in a double mirage, the first being 4 minutes and 30 seconds above true horizon and the second a minute still higher. There is usually a cold gray sky above the mirage, giving it the effect of a barrier of ice. I had a lengthy message by radio from Captain Irvine, of the *Laconia*, describing a similar phenomenon and stating that it was difficult to convince the passengers that it was not ice.

Bird life has changed again. The gulls have gone landward to nest; the murre and dovekeys are to the north around field ice and will soon be nesting; the jaegers are appearing in number; terns are fairly numerous, and Wilson petrel not uncommon, particularly in warm water. The shearwaters and fulmars remain mostly around cold water, especially around the cod banks, now that the French fishing fleet is there. We saw three varieties of jaeger—the pomarine, parasitic, and long-tail, the last being most numerous.

MAY 15 TO MAY 31—SECOND CRUISE, "MIAMI."

The *Miami* left Halifax at 4.45 p. m. May 12, 1914, and proceeded to the patrol grounds. Arrangements were made by radio to meet the *Seneca*, but owing to a dense fog and prospects of its continuance, all ice information was turned over to me by wireless by Captain Johnston, and at 8 p. m. May 15, in latitude 42° 56' N., longitude 52° 32' W., the *Seneca* was relieved and directed to proceed to Halifax.

The *Miami* arrived on the tail of the Banks the next morning, our approximate position being determined by a series of soundings. At 6.45 a. m. of the 17th, the fog having lifted, we sighted a large berg, which proved to be grounded in 41 fathoms of water on the edge of the Banks in about latitude 43° N., longitude 50° W. We recognized it as the same berg from which we had obtained echoes with the submarine oscillator on April 25 in latitude 45° N. It was rapidly break-

TABLE 4

LISTING OF ICEBERGS GROUNDED IN 1915

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	BERG SIZE	DATE
22	43°-00'	50°-09'	69	MEDIUM	APR. 6
22	44°-55'	49°-18'	123	NO DATA	APR. 9

SOURCE: IIP Bulletin No. 5

REPORTS OF VESSELS ON ICE OBSERVATION AND ICE PATROL.

ICE OBSERVATIONS.

During the months of February and March the *Seneca* encountered stormy and thick weather in the vicinity of the Grand Banks and found very little ice. Comparatively few vessels gave any ice information, and on the whole the ice-observation duty was not productive of any important results. Radio communication was poor and the commanding officer of the *Seneca* was able to transmit only a few ice reports during this period.

ICE PATROL REPORTS.

APRIL 1 TO APRIL 14—FIRST CRUISE OF THE "SENECA," CAPT. F. A. LEVIS.

The *Seneca* left Halifax on April 1 for the Grand Banks of Newfoundland to begin the continuous ice patrol and to do such work as oceanography as might be carried on therewith.

Our course took the *Seneca* to the south of Sable Island and we made two stations for oceanography on Sable Island Bank. On the 4th we experienced a hard blow from the SE., shifting to the SW., with very heavy confused sea, which compelled us to lie to for 24 hours. At 8 a. m. 5th instant we were in lat. 42° 14' N., long. 50° 43' W., from which position we steamed north (true) through thick fog to the tail of the bank, where we lay to for the night.

On the 6th instant we sighted a medium-sized iceberg and found it to be aground in 38 fathoms of water in lat. 43° N., long. 50° 09' W. We circled around it, keeping it about 200 yards on port beam, and we found that our continuous record of temperature of injection water showed 32° F. throughout the circle and that there was no change in temperature of water in approaching or departing from it. Leaving this berg at 10.30 a. m., we ran SE. (true) until we raised the temperature of surface water to 36° F. at 2 p. m. in lat. 42° 40' N., long. 49° 40' W. Several steamers to the southward of our position having reported clear weather and no ice visible, I was satisfied that there was no ice south of the grounded berg.

On the 7th, 8th, and 9th we searched to northward in the Labrador current, running parallels across from the bank to warmer water, until we reached lat. 44° 55' N. On this parallel, on the 9th, we found a berg with three growlers in long. 49° 18' W. and another berg in warm water in long. 47° 03' W. From this berg we steered SW. (true) and, as we had had three days of fine, clear weather, I

reaches a position south of the forty-fourth parallel the wind determines its course entirely until it makes the Gulf Stream, when it is either carried to the N. E. or to the E., depending upon how far it penetrates the stream.

The set of the iceberg which the *Seneca* watched from June 16 to 29 (shown by sketch appended to my June report) is an example of a berg being driven to the westward by the combined action of wind and current. On June 25 the wind changed to the westward, and this berg having reached warmer water, lat. 42 18 N., long. 52 23 W., turned and began to drift to the ESE.

To the southwest of the Grand Bank narrow bands of warm and cold water were observed, and the northern edge of the Gulf Stream was farther north than it was directly south of the tail of the bank.

In February there was field ice at the eastern edge of the Grand Bank, but the *Seneca* had to answer a call for assistance from S. S. *Mongolian* and was consequently unable to ascertain its extent. We found that the *Mongolian* was leaking badly and needed a convoy to Halifax, and during the run of nearly 600 miles, at the request of the master, I kept the *Seneca* close on her quarter. We had much fog during this run and a rough, confused sea. The *Mongolian's* speed varied greatly on account of using steam for her pumps, and it required constant vigilance to hold our position. Radio messages kept me informed as to the leak, and under her own steam she safely reached Halifax, where she was docked and several new plates put in. Her damage was caused by hitting a rock off St. Johns, Newfoundland, after which the master made temporary repairs and put to sea, but the repair job did not hold tight.

The March cruise to the ice region was very stormy and thick, with sleet and snow squalls. A steamer, which refused to give her name, reported an iceberg in lat. 40° 25' N., long. 47° 00' W. The *Seneca*, however, located no iceberg south of parallel 43 and there was no field ice in the vicinity of the tail of the Grand Bank. There was a large berg reported in lat. 43° 24' N., long. 49° 32' W.

On April 4 we had a strong gale from the SE., shifting to SW., during which a heavy cross sea boarded the *Seneca* and tore the motor launch from its lashings, throwing it against the engine room skylight and ventilator, crushing in the latter. During April we encountered more fog than during any other month of the ice-patrol season, and after the blow on the 4th instant light southerly winds prevailed. On April 6 we found an iceberg aground in 38 fathoms of water on the tail of the bank in lat. 43° N., long. 50° 09' W., and on the 9th another one aground in 67 fathoms in lat. 44° 55' N., long. 49° 18' W. We ran parallels to the eastward of the bank, but found only one berg to the eastward; that was in lat. 44° 55' N., long. 47° 03' W., in warm water and drifting to the northward and eastward. During April no ice was seen or reported to the *Seneca* south of parallel 43.

During May the *Seneca* received several reports of wreckage in the Gulf Stream, south of the tail of the Grand Bank, resulting from the storm of April 4 on the American coast, and we searched nearly a week for obstructions along the steamer tracks, finally picking up the derelict schooner *William Thomas Moore*, dismasted, seas breaking over her amidships, and deck cargo of lumber gone. This derelict was in the eastbound steamer lane and was a very dangerous obstruction. We towed it to Halifax, making, I believe, the longest

TABLE 5

LISTING OF ICEBERGS GROUNDED IN 1921

HP PAGE	LAT. (°N)	LONG. (°W)	LENGTH(m)	HEIGHT(m)	DEPTH(m)	DATE
20	43°-12'	49°-47'	122	18	59	APR. 24
39	43°-26'	50°-34'	305	18	55	JAN. 17
39	43°-17'	50°-54'	-	66	110	JAN. 17

SOURCE: HP Bulletin No. 9

Banks, where it had been reported to us by Cape Race on the 25th. This condition was the subject of our first report to the Hydrographic Office. These fields were too heavy for safe navigation by a vessel of this type; the heavier pans projected 6 feet above water and much more below. In working through the thinner streaks where not packed, the engine was stopped at intervals to avoid breaking screw and only steerageway was maintained until reaching open water. There was probably heavier ice farther ahead, as growlers were reported in this vicinity, $46^{\circ} 13' N.$, extending from $52^{\circ} 06' W.$ to $53^{\circ} 20' W.$, by Cape Race on March 4.

One berg was reported by Cape Race on February 25, in $44^{\circ} 25' N.$, $50^{\circ} 54' W.$, and two in $45^{\circ} 56' N.$, $50^{\circ} 57' W.$ The *Seneca* passed through the first position on the 27th, but no ice was sighted. Several steamers have crossed the Banks this month in that locality and have reported no ice. The reported locality of the others, 30 miles to the southward of the Virgin Rocks, was reached the evening of March 6, and the vessel anchored to resume search the next day. A strong southerly gale blew that night, making up a heavy sea; vessel labored heavily and dragged. Weighed anchor at 2 a. m., March 7, and made steerageway to the southward. With daylight fog set in, which, with the position of the bergs and of the ship uncertain and with rocks in the vicinity, made further search for this time impracticable. With the preponderance of southeasterly winds since our arrival on the Banks, the bergs must have been driven to the NW. and are probably the growlers reported March 4 by Cape Race, lat. $46^{\circ} 13' N.$, between longs. $52^{\circ} 06' W.$ and $53^{\circ} 20' W.$

Two bergs were reported February 25 in $48^{\circ} 19' N.$, $49^{\circ} 47' W.$, and $48^{\circ} 10' N.$, $50^{\circ} 07' W.$ On March 5 they were reported in the same positions; they were most likely in the dead water between the Labrador and the West Greenland currents and should not engage our attention until much later, if at all.

The vessel cruised from daylight to dark, except in foggy weather, which kept her at anchor March 2 and March 5. Several nights were spent underway, proceeding from one locality searched during the day to another where search was intended the next day. At such times speed was kept down to 2 or 3 knots. The prevailing high southerly winds have kept all the ice well to the northward of the steamer tracks, but have made the cruising of the *Seneca* unsatisfactory, as on but few days was visibility such that we had a sea horizon.

The best results toward ice scouting were contributed by the steamships, who in answer to our broadcast requests for data as to ice and water temperatures, positions and courses, supplied information that enables me to state that there is no ice on the Banks or east of them south of the 46th parallel.

The steamships assisting were: *Lorentz Hansen*, February 26; *Corsican*, *Comanche*, and *Vedic*, February 27; *Canadia* and *Savoie*, February 28; *Andrea Luckenbach*, March 2; *Afoundria* and *East Side*, March 3; *Graciana*, *Rotterdam*, *Afoundria*, and *Shropshire*, March 4; *Montcalm* and *Rotterdam*, March 5; *Manchuria*, *Montcalm*, *Ampetco*, *Manning*, *Neshobee*, and *United States*, March 6; *Helig Olav*, *Saint Anthony*, *Fanghead*, *Metagama*, *Vendelia*, and *Youngstown*, March 7. Special thanks for several reports are due

a. m. that vessel departed for base and the *Yamacraw* took up the patrol.

As the distance to the ice was greater than could be made before dark, proceeded to an anchorage on the 30-fathom bank, with the intention of proceeding from that vantage point to the southern limit of bergs reported in the vicinity of the Great Bank, at the first favorable opportunity, for the purpose of observation and report upon bergs previously seen this month by the patrol.

Ice information was received from the steamship *Boling Brode*, which reported two bergs in lat. $45^{\circ} 20'$ N., long. $49^{\circ} 20'$ W., and lat. $43^{\circ} 25'$ N., long. $49^{\circ} 22'$ W. This information was embodied in the radio message forwarded to the Hydrographic Office at 4 a. m. on the 22d.

En route to lat. $43^{\circ} 50'$ N., long. $50^{\circ} 07'$ W., which had been selected as a desirable anchorage, the French fishing schooner *Thorange* was met. She was boarded by a boat from the *Yamacraw* and medical assistance proffered, but none was needed. The boat was hoisted, and we proceeded to an anchorage, where we arrived at 5 p. m.

Intercepted a radio message from Headquarters to the *Seneca*, suggesting that operations be confined nearer to the steamer lanes, on account of ice reported to the southward. At 4 p. m., on April 23, weighed anchor and stood for the position of the bergs reported by the steamship *Boling Brode* the previous day.

At 9 a. m., passed a small growler to the south and west; also what was apparently a berg. As the latter was approached, it gave the appearance of being three separate small bergs clustered together, one resembling a buffalo, another a thatched-roof hut tilted at an angle, and the other a large millstone with a smaller one on top. Stopped within 400 feet of it, in lat. $43^{\circ} 12'$ N., long. $49^{\circ} 47'$ W., and found the berg to be approximately 60 feet high and 400 feet long. Soundings showed 32 fathoms. A close view showed that the berg was in its third stage, with large cracks, evidently recently made, extending from its base to the water. It had previously cracked asunder and was in three sections, each of which was grounded on the Bank, with the sea breaking in the space inclosed by the sections. But few birds were noted and these mostly gulls. No other animal or bird life was observed.

A radiogram was received from the *Seneca*, quoting the previously referred-to radio from Headquarters, and suggesting operating closer to the steamer lanes and advising coaling at St. John, should fuel supply become short at end of patrol. Acknowledged it and stood to the southward to verify position of reported bergs, and then to proceed toward the steamer lanes to the 50th meridian, to fulfill one of the missions of the patrol. En route, a radio was received from the steamship *Rose Castle*, asking if ice was near the Louisburg (Cape Breton) track. A reply was sent in the negative, with reference to bergs, but informing him that he would meet field ice.

At 11.45 a. m., a berg was reported by the lookout, two points on the port bow. A small growler was passed in lat. $43^{\circ} 09'$ N., long. $49^{\circ} 12'$ W., and the berg itself was found in lat. $43^{\circ} 09'$ N., long. $49^{\circ} 10'$ W., it having been 20 miles distant when sighted. Arriving abeam of it, the mass was found to be 160 feet high, 750 feet long, and 575

point it had drifted since the 14th from lat. $43^{\circ} 20' N.$, long. $48^{\circ} 26' W.$; drift 0.7 knot, set 200° true. Bergs that for the last month have been drifting west of the Tail of the Bank were found on the 17th to be setting to the NW. and disintegrating rapidly; the one reported by the steamship *Reber* in lat. $42^{\circ} 27' N.$, long. $51^{\circ} 27' W.$, being among the others. On June 29, 1915, a berg drifted to lat. $41^{\circ} 57' N.$, long. $50^{\circ} 30' W.$, and there disintegrated a few miles above the northernmost track to Boston. I will instruct the *Yamacraw* to watch the southernmost berg reported on the 17th in lat. $42^{\circ} 30' N.$, long. $48^{\circ} 50' W.$, and when assured that its further travel will not bring it toward the lanes, to so inform me at Halifax, when I shall recommend the discontinuance of the patrol, and the moving of the northernmost lanes to $41^{\circ} 30' N.$ on the 47th meridian.

During our June cruise sailing directions and ice warnings were given the following vessels on dates as stated: *Coateth Hall* and *Shick Shinnny*, the 3d; *Cameronian*, *Gdansk*, and U. S. S. *Breckenridge*, the 4th; *Mount Vernon Bridge* and *Edgemont*, the 5th; *La Fayette* and *San Guiseppe*, the 6th; *Rockaway Park*, the 7th; *Merry Mount* and *Cohasset*, the 8th; *City of Alton* and U. S. S. *Connecticut*, the 9th; *Munidies*, *Cryme Queen*, and *Ethel Radcliff*, the 10th; *Delaware*, *Drottning*, *Old North State*, and *Continental Bridge*, the 12th; *Eastern Temple*, *Maiden Creek*, *Saronia*, and *Oregonian*, the 13th; *Orinoco*, the 14th; *Victorian*, the 16th. On the 15th the Portuguese fishing schooners *Argus* and *Chaira*, of Lisbon, sent two men on board, who were given medical treatment, furnished the ship's position, and their mail forwarded to port. On the 7th, 8th, and 9th, broadcasted steamship *Merry Mount*'s report of a mine in lat. $39^{\circ} 25' N.$, long. $46^{\circ} 49' W.$ On the 13th, broadcasted warning of a 40-foot log reported by the steamship *Peekskill* in lat. $40^{\circ} 58' N.$, long. $48^{\circ} 04' W.$ On the 15th, broadcasted report of the derelict wooden hulk reported by the steamship *West Cohas* in lat. $43^{\circ} 01' N.$, long. $41^{\circ} 21' W.$; 300 vessels supplied 750 sea-water temperature reports.

At 3.30 p. m., June 16, stopped at station 166 (see chart "A"), lat. $43^{\circ} 50' N.$, long. $50^{\circ} 20' W.$, and made usual tests. Here the temperature of the surface water had risen to 52° , it having been 44° in May and 42° in April. This rise is probably due to the advance of the season. The crew caught 200 pounds of cod and haddock at this station, and the fish scrap attracted a flock of Wilson petrel and half a dozen greater shearwater. Weather cleared at sunset, barometer steady, and wind veered to SW. Underway at daylight on the 17th and stood for bergs farthest to the south, which were reported on the 15th, in lat. $42^{\circ} 27' N.$, long. $51^{\circ} 55' W.$ Between 8 a. m. and 11 a. m., passed six bergs in line on a bearing of WSW, true, extending from lat. $43^{\circ} 26' N.$, long. $50^{\circ} 34' W.$, to lat. $43^{\circ} 17' N.$, long. $50^{\circ} 54' W.$ Surface temperature 48° . The southernmost berg was 1,000 feet in length and 60 in height, with hummocky outline, and was grounded in 30 fathoms. The westernmost berg was 216 feet in height and was grounded in 60 fathoms. These are the six bergs near which the *Seneca* lay June 9 in lat. $42^{\circ} 37' N.$, long. $50^{\circ} 06' W.$, and they drifted to the north and west 45 miles in a week's time. It is my opinion that they first drifted W. and then NE., as the larger ones were grounded on the side of the Bank sloping to the SW.

ing in the hope of finding what we had named the "key berg." At 2 p. m., the sea-water temperature dropped from 56° to 44° and the vessel had left the mixed water and entered the Labrador Current. At 2 p. m., three bergs were sighted bearing NW. (true); stood for them. From their distance and position they evidently were bergs sighted by the *Seneca*, grounded on the Bank. At 3 p. m., two bergs having been sighted in a position where the two bergs reported to this vessel on the 21st were expected to have been found, changed course to N. (true). At 5.50 p. m., stood for them and slowed engine close to the nearer of the two (they being separated by a distance of 2 miles). It was in its last stages, two large horns protruding vertically from the base, the latter being a hollow basin with a medium-sized peak on one side, while vapor from the melting ice was clinging to the berg like steam; everything showed that it could last but a short time. It was about 100 feet long and as much in breadth. The position, by observation, was found to be lat. 43° 11' N., long. 49° 19' W. A few herring gulls, kittiwakes, and skua were noted in the vicinity. At 6.20 p. m., stopped engine about three-quarters of a mile from the berg and drifted with it during the night. A search of the entire area for the berg reported to the *Seneca* the last night of her patrol had given no results except to determine the fact that it was not in that area and had not crossed the mixed waters between the Labrador Current and the Gulf Stream, and that if it were anywhere it had gone NW. There will always remain the thought that the reporting vessel's position was incorrect, or that the berg, when reported, was miles away. Informed the *Seneca* by radio that the berg reported to her on the evening of the 17th was not in the area searched, also that numerous bergs had been reported in the Gulf Stream near the lanes to the North of Scotland, and that with these exceptions the steamer lanes were not threatened by any bergs.

At 9.15 a. m., June 22, got underway for the berg which could be made out astern, and which appeared low and flat in the fast dispelling fog. Came up abreast of it at 9.40 a. m. and at once took observations, which showed that during the night the drift had been 230° (true) 10 miles, consequently the berg and its companions, which had retained their relative positions of the night before, as determined by bearings, was drifting toward the Tail of the Bank and would soon ground there. At 6.55 p. m., received a radiogram from the *Seneca*, directing the *Yamacraw* to proceed to the present position of the bergs reported on the 20th instant as near the North of Scotland steamer lanes, to observe set and drift of Gulf Stream and obtain water temperatures there. Bright moonlight, clear weather, and a gradually rising barometer continued to the end of the day. No ice was seen en route after leaving the Great Bank.

The 23d of June was spent in cruising to the position of the bergs reported on the 20th by the steamship *Strathcarn* as being near the north of Scotland steamer lanes. At 2 p. m. the sea-water temperature dropped from 46° to 42°; at 9 a. m. it had risen to 51°, while several steamers passing near the Tail of the Bank reported the bergs visited by the *Yamacraw* on the 21st and 22d. At 10 a. m. the sea water registered 55°, at 3 p. m. it was 57°, at 3.15 p. m. it was 55°. and at 3.30 p. m. it jumped up to 62° and the *Yamacraw* had entered the Gulf Stream. From that hour the rise in water temperature was

TABLE 6

LISTING OF GROUNDED ICEBERGS IN 1922

IIP PAGE	LAT. (°N)	LONG. (°W)	HEIGHT(m)	DEPTH(m)	DATE
36	43°-21'	50°-45'	-	75	JUNE 14
36	43°-15'	50°-14'	-	66	JUNE 14
36	43°-09'	50°-00'	-	64	JUNE 14
38	43°-07'	50°-55'*	38	110	JUNE 15

* The position given above is different by 1° in longitude from the longitude given on IIP page 36. The reason is that at the position given by IIP, the water depth is far in excess of the 200m generally accepted grounding depth. Therefore the above position is accepted.

SOURCE: IIP Bulletin No. 10

dense fog; 9.25 a. m., continued to delineate the limits of the Gulf Stream; 8 p. m. position, lat. $42^{\circ} 38' N.$, long. $47^{\circ} 21' W.$ Sent special ice warning to the steamship *Satanta*.

June 14. Moderate to fresh SW. to moderate to light N. wind; fog and rain first part, mostly clear latter part. Rough sea first part, smooth sea with southerly swell latter part. The day began with the *Tampa* standing for central station "C." (See chart "A.") Dense fog prevailed in the ice area. At 9.10 a. m., passed several small pieces of ice. Established communication with the *Modoc* and arranged for the *Tampa* to occupy the oceanographic stations toward Halifax, while the *Modoc* would take the more northern ones, including station "C" (see chart "A"), on account of existing fog. At 11 a. m. the wind shifted to N. and blew a moderate breeze, clearing away the fog and enabling us to resume search for bergs. At 12.35 p. m. sighted a medium-sized grounded berg and at 1 p. m. photographed it, in lat. $43^{\circ} 21' N.$, long. $50^{\circ} 45' W.$ At 1.28 p. m., photographed a second berg, in lat. $43^{\circ} 15' N.$, long. $50^{\circ} 14' W.$, and then stood on course to meet the *Modoc*. A third grounded berg was sighted, bearing 120° , true, 12 miles distant from the second berg. At 3 p. m. passed a number of growlers, and at 4.15 p. m. passed another growler. Sent special ice reports to steamships *Ampetco*, *Woodmansie*, and *Kristiancafferal*. At 9.30 p. m. met the *Modoc*, in lat. $42^{\circ} 55' N.$, long. $52^{\circ} 35' W.$, when the oceanographic and scientific observers were transferred to that vessel, which relieved the *Tampa* of ice-patrol duty.

Ice reports were received as follows: May 30, steamship *Caserta*, bergs in lat. $43^{\circ} 22' N.$, long. $49^{\circ} 16' W.$; steamship *Canopic*, bergs from lat. $46^{\circ} 35' N.$, long. $52^{\circ} 56' W.$, to lat. $47^{\circ} 10' N.$, long. $51^{\circ} 10' W.$; steamship *Canadian Challenger*, three large bergs in lat. $46^{\circ} 56' N.$, long. $51^{\circ} 27' W.$, and a small berg in lat. $46^{\circ} 41' N.$, long. $52^{\circ} 31' W.$; steamship *Columbia*, three bergs from lat. $43^{\circ} 15' N.$, long. $49^{\circ} 07' W.$, to lat. $43^{\circ} 21' N.$, long. $48^{\circ} 40' W.$; steamship *Gen. Consul Pallisen*, numerous bergs and growlers between lat. $48^{\circ} 06' N.$, long. $49^{\circ} 56' W.$, and lat. $47^{\circ} 12' N.$, long. $51^{\circ} 31' W.$ May 31, steamship *Albania*, numerous bergs and growlers between lat. $47^{\circ} 41' N.$, long. $49^{\circ} 07' W.$, and lat. $50^{\circ} 43' N.$, long. $50^{\circ} 32' W.$; steamship *Hastings County*, two large bergs in lat. $45^{\circ} 16' N.$, long. $45^{\circ} 57' W.$, and lat. $45^{\circ} 14' N.$, long. $46^{\circ} 00' W.$ June 1, steamship *Hastings County*, two bergs in lat. $43^{\circ} 36' N.$, long. $49^{\circ} 08' W.$; steamship *W. H. Tilford*, one big and several small bergs in lat. $45^{\circ} 00' N.$, long. $46^{\circ} 00' W.$ June 3, steamship *Knockfern*, passed several large bergs and growlers, from 3 to 5 miles apart, between lat. $48^{\circ} 41' N.$, long. $51^{\circ} 21' W.$, to Cape St. Francis. June 4, steamship *Bramell Point*, numerous bergs and growlers from off Cape St. Francis to lat. $48^{\circ} 38' N.$, long. $49^{\circ} 48' W.$, three bergs in lat. $48^{\circ} 30' N.$, long. $50^{\circ} 19' W.$, and growlers in lat. $48^{\circ} 38' N.$, long. $49^{\circ} 58' W.$ June 5, steamship *Esther Eliza*, 13 large bergs 20 miles east of St. Johns. June 6, steamship *Canadian Cruiser*, a berg in lat. $47^{\circ} 21' N.$, long. $51^{\circ} 12' W.$, a large berg in lat. $47^{\circ} 30' N.$, long. $50^{\circ} 00' W.$, three bergs and several growlers between meridians $48^{\circ} 30' W.$ and $47^{\circ} 50' W.$ along blue track 6. June 10, steamship *Cairnvalona*, many bergs between lat. $48^{\circ} 12' N.$, long. $49^{\circ} 03' W.$, and Cape Race. June 11, steamship *Cairnvalona*, large berg in lat. $46^{\circ} 26' N.$, long. $54^{\circ} 00' W.$ June 13, Cape Bona Vista reported no ice.

moderate E. wind and rain. At 8.15 a. m. we headed back for the berg passed early in the morning. When within about one-half mile of it, the loftier pinnacle broke off and fell with a great splash. (See Plate 3.) At 2.10 p. m. we passed a small, saddleback berg and growlers, in lat. $42^{\circ} 44'$ N., long. $51^{\circ} 19'$ W. At 3.55 p. m. a small berg and growlers were sighted in lat. $42^{\circ} 52'$ N., long. $51^{\circ} 06'$ W., and at 4.10 p. m. we passed, in lat. $42^{\circ} 54'$ N., long. $51^{\circ} 05'$ W., a large, flat-topped berg, marked with blue veins and earth-colored streaks. At 5.50 p. m. we arrived alongside of a large, single-peak berg, which was grounded in 55 fathoms on the Tail of the Bank, in lat. $43^{\circ} 07'$ N., long. $51^{\circ} 55'$ W. (See Chart "O".) This was the largest berg we have sighted this season, being about 125 feet high and marked with several earth-colored streaks. We drifted near by for the night. Upon approaching this berg, numbers of fulmars and shearwaters were noted in its vicinity, but they all disappeared within an hour of our arrival.

June 16. Gentle to moderate S. winds, with thick fog, prevailed all day. We drifted in the fog until 11.35 a. m., when, the weather showing no signs of clearing, we proceeded to oceanographic station 239, in lat. $43^{\circ} 50'$ N., long. $50^{\circ} 25'$ W., where water temperatures were taken and specimens of plankton collected. At 7.05 p. m. anchored for the night.

The steamship *Marinlea* was furnished special ice information. A radio message was received from the steamship *Western Plains*, reporting that an engineer officer on that vessel had been ill since the 14th inst., with high temperature, slight pain in left groin, general feeling of nausea, and other symptoms, and asking advice from our medical officer. This was given promptly.

June 17. Light to gentle SW. wind; generally foggy. At 6.10 a. m. we got under way and stood for oceanographic station 240, in lat. $43^{\circ} 10'$ N., long. $51^{\circ} 15'$ W., where sea-water temperatures were taken and plankton collected. Received a radio message from the steamship *Eastern Tempest*, stating that a seaman had dislocated his shoulder and that they were unable to get it back in place. Our medical officer gave the necessary advice. At 7.50 p. m., fog shutting in thick, we stopped and drifted for the night.

June 18. Gentle SW. winds to light SW. airs; foggy first half, clear latter half. Occupied oceanographic station 241, in lat. $42^{\circ} 30'$ N., long. $51^{\circ} 45'$ W.; station 242, in lat. $42^{\circ} 05'$ N., long. $52^{\circ} 14'$ W., and station 243, in lat. $41^{\circ} 41'$ N., long. $52^{\circ} 35'$ W. At 12.30 p. m., lat. $42^{\circ} 14'$ N., long. $52^{\circ} 06'$ W., we passed into the warm water of the Gulf Stream and had fine, clear, semitropical weather for the remainder of the day. Porpoises, Portuguese men-of-war, gulf seaweed, and a few petrels and shearwaters were sighted.

Special ice information was sent to the steamships *Clearton* and *Orkild*.

June 19. Light airs to gentle winds, backing from S. to ENE., with dense fog over the colder waters and misty to hazy over the Gulf Stream. We devoted the day to an attempt to delineate the northern limits of the Gulf Stream between longs. $51^{\circ} 38'$ W. and $50^{\circ} 30'$ W., and found it to be approximately lat. $41^{\circ} 50'$ N. The steamship *Duca de Abruzzi* reported by radio that she passed a large ice field in lat. $40^{\circ} 34'$ N., long. $49^{\circ} 25'$ W. This information was no doubt incorrect, as the sea water in the reported locality had a temperature

TABLE 7

LISTING OF GROUNDED ICEBERGS IN 1923.

IIP PAGE	LAT. (°N)	LONG. (°W)	LENGTH(m)	WIDTH(m)	HEIGHT(m)	DEPTH(m)	DATE
7	42°-55'	50°-21'	-	-	-	119	MAR. 20
16	42°-56'	50°-17'	-	-	-	106	APR. 12
17	43°-00'	50°-17'	92	92	27	82	APR. 14
24	42°-55'	50°-32'	-	-	49	165	APR. 20
26	43°-06'	50°-50'	46	31	23	106	MAY 1
31	43°-38'	51°-51'	-	-	-	101	MAY 3
32	43°-12'	51°-03'	46	31	23	110	MAY 4
33	43°-55'	49°-03'	LARGE TABLE TOP BERG			119*	MAY 10
34	43°-10'	49°-34'	LARGE BERG			201	MAY 11
35	43°-48'	51°52'	LONG, LOW FLAT TOP BERG			91	MAY 15
39	43°-58'	49°-20'	-	-	-	42	MAY 17
47	43°-37'	51°-01'	-	-	-	69	JUNE 4

NOTE: The iceberg grounded on May 1 is the same berg seen on May 4. The berg dragged its keel a distance of 20 km to the north-west between May 1 and 4.

* The 119m depth is the 65 fathom depth given by IIP. According to hydrographic charts, the depth at the location is 290m, which suggests that the given position is in error.

SOURCE: IIP Bulletin No. 11

inclusive. Warnings were broadcast at 6 a. m. and at 6 p. m., 75th meridian time, from the night of the 11th to the night of the 19th, inclusive. As the vessel never anchored, no current observations were made and what drift was observed could be accounted for by wind surface set. The prevailing winds were strong SW. to NW., with choppy sea. The following steamers gave us ice reports: *Weyingham*, *Lord Dufferin*, *Canadian Mariner*, *Gallymere*, *Cottage City*, and *Pinemoor*. Sixty-eight vessels contributed 321 surface-water temperature reports, according to which the edge of the Gulf Stream swept in an easy curve through lat. 42° 00' N., long. 55° 00' W., lat. 41° 30' N., long. 50° 00' W., lat. 42° 30' N., long. 46° 00' W.

The *Tampa* was intercepted in lat. 42° 50' N., long. 50° 45' W. at 5 p. m., March 19, when the patrol was taken over by that vessel.

COAST GUARD CUTTER "TAMPA," LIEUT. COMMANDER W. J. WHEELER, ICE PATROL, FIRST CRUISE, MARCH 15 TO APRIL 3, 1923.

The *Tampa* left Boston Navy Yard at 1 p. m., March 15, to relieve the *Seneca* on international ice patrol duty. Light airs to gentle breezes were experienced until the early morning of March 16, when the southerly breeze gradually increased to moderate and fresh gale, S. to SW., with falling barometer, which continued from 10 a. m. the 16th until 1 a. m. the 17th. This was followed by a rising barometer, the wind shifting to NW. and falling to gentle and light variable breezes, which continued until the night of the 19th. The southerly gale made up a very heavy sea on the night of the 16th and 17th. Flying fish were observed in the forenoon of the 19th, in lat. 42° 50', indicating that the Gulf Stream was unusually far north. At 12.20 p. m., March 19, a berg, apparently of medium size, was sighted in lat. 43° 00', long. 51° 48'. At 3.30 p. m. the same day a second medium-sized berg was sighted, in lat. 42° 58', long. 50° 52'. The *Tampa* met the *Seneca* at 4.40 p. m., March 19, in lat. 42° 49', long. 50° 39', and relieved her of the ice patrol duty, the *Seneca* leaving for New York. At 6.05 p. m. the *Tampa* stood 65°, true, for a third berg, sighted some 8 miles distant, and at 6.50 p. m. stopped and drifted for the night in the vicinity of the berg. As per arrangement, the routine reports were sent out by the *Seneca* this day.

March 20 began with the vessel drifting. At 5.30 under way to locate the last berg sighted on the previous day. At 7.05 a. m. sighted the berg, distant 6 miles. Stood around berg, photographed it, and ascertained that it was grounded on the Tail of the Bank in lat. 42° 55', long. 50° 21'. Many shearwater, dovekies, and a few sea parrots were in the vicinity of this berg. The following weather

and good visibility. Oceanographic stations 257, 258, 259, 260, and 261 were occupied. At 0.50 G. M. T., in lat. $42^{\circ} 56'$, long. $51^{\circ} 06'$, a long, low berg was passed and photographed. This berg was reported by the steamship *Canadian Mariner*, on the 8th, as being three-fourths of a mile long. It was variously estimated this day as being from 500 to 800 feet long and 50 feet high. It was sighted by the patrol on the 12th, in lat. $42^{\circ} 52'$, long. $50^{\circ} 46'$, and had drifted 288° true, at the rate of 0.5 knot per hour. At 9.35 G. M. T. passed another berg, about 300 feet by 300 feet by 90 feet high, grounded on the Tail of the Bank, in lat. $43^{\circ} 00'$, long. $50^{\circ} 17'$. A third large berg was sighted, in lat. $42^{\circ} 50'$, long. $50^{\circ} 00'$. Both the latter bergs had been sighted by the Patrol on the 12th. Fulmars were thick around the bergs and one whale and numerous murrens were noted. A robin lighted on the ship. Special ice information was furnished the steamships *Manchester Hero* and *Bremen*.

April 15: Moderate gale to strong winds from NNW.; cloudy, with good visibility. Occupied station No. 262, and at daybreak arrived at lat. $41^{\circ} 46'$, long. $50^{\circ} 14'$, where the *Titanic* sank, after colliding with an iceberg, on April 15, 1912. The engines were stopped and at sunrise colors were half-masted. At 10 a. m., 75th meridian time, by request all stations within range observed radio silence for five minutes and the patrol carried out memorial exercises for those who perished on this spot 11 years ago, including a general muster, a memorial address by Lieutenant Smith, prayer by Surgeon Lave, three volleys, and taps. The following message was received from the Agent of Marine, Halifax: "Halifax desires to be associated with you in your memorial service over *Titanic* grave to-day." Upon conclusion of these exercises, the vessel proceeded to occupy oceanographic stations 263 and 264. Special ice information was furnished the steamship *Maryland* and information and warning was furnished the passenger steamship *Montrosa*, bound east, whose course was carrying her dangerously close during the night to the three bergs last located by the patrol on the 14th.

April 16: Fresh NNW. winds, falling and backing to WSW., with very good visibility. In the early morning a brilliant meteor was seen to the northward. At 2.35 G. M. T. passed a large berg, in lat. $42^{\circ} 40'$, long. $50^{\circ} 44'$. This berg was conical in shape, about 110 feet high, with a small peak attached to the main berg below the surface and a long underwater ledge. It was located by the patrol on the 11th, 12th, and 14th, and had drifted, since last observed, 255° true, at the rate of 1.5 knots per hour. A second berg was passed at 4 G. M. T., in lat. $42^{\circ} 48'$, long. $50^{\circ} 55'$. This was the long, low berg sighted on the 14th, since which time it had drifted 12 miles, 138° , true. Occupied oceanographic stations 265

W. Otherwise her course was clear, but she was advised to keep a careful lookout for the above ice. The master thanked the patrol for its timely warning.

Steamship *Cassandra*: This passenger steamer, bound for Halifax, inquired as to what information the patrol had regarding ice around Sable Island. She was assured that there was little likelihood of her encountering field ice south of Sable Island, but that ice could be expected extending 4 or 5 miles out from the Nova Scotian shore.

Steamship *Hammac*: The case of this vessel was similar to that of the *Wekika*. Being in lat. $41^{\circ} 25'$ N., long. $43^{\circ} 00'$ W., she was endangered by the same berg as the *Wekika*. A warning was therefore sent her, advising when and where to be on the lookout for a berg and growlers.

Steamship *Columbia*: This steamer, at 7 a. m., April 5, was found to be heading west, at a speed of 7 knots, in lat. $43^{\circ} 58'$ N., long. $47^{\circ} 20'$ W. The following warning was immediately sent: "Your course is liable to take you amongst bergs and field ice. If you will send us your present position and course, the patrol will furnish you with all ice information." The position furnished was lat. $43^{\circ} 28'$ N., long. $48^{\circ} 15'$ W., and at 12.30 a. m., April 6, the regular broadcast ice warning was specially issued to her, with particular attention called to "Dangerous berg $43^{\circ} 00'$ N., $50^{\circ} 15'$ W. Bergs may be met as far west as 52d meridian." At 3.24 a. m., April 6, a message was received from her, stating that she had met field ice, as predicted in our broadcast, at lat. $43^{\circ} 17'$ N., long. $48^{\circ} 38'$ W., and had immediately changed course south.

Dania: This motor ship was sighted in lat. $43^{\circ} 01'$ N., long. $47^{\circ} 10'$ W., by the patrol while scouting for bergs on April 5. She had failed to signal her approach to the ice regions, but upon being seen reported her name. She was warned that she was liable to encounter bergs and fog on her course and advised to go south until after crossing the 42d parallel, before heading west. Nothing further was heard from her.

Steamship *Elizabeth Marie*: This small French trawler, bound to St. Pierre, applied to the patrol for routing advice. She was directed to proceed to the westward until past the 52d meridian, then to haul up for St. Pierre. Probabilities of encountering heavy ice were predicted.

Steamship *Canada*: At 4.10 a. m., April 10, it was noted that this passenger liner was in lat. $43^{\circ} 14'$ N., long. $52^{\circ} 43'$ W., course 94° true, speed 14 knots, dense fog. The patrol immediately sent her the following ice warning: "Your course will carry you near bergs, one grounded on the Tail in $43^{\circ} 00'$ N., $50^{\circ} 19'$ W., and another, April 8, in $42^{\circ} 42'$ N., $50^{\circ} 28'$ W. Advise getting south of 42d parallel." The following reply was received: "Thanks for ice warning. Am

April 12 began with the vessel drifting. Weather mild and pleasant, with gentle NE. to SE. wind; clear, with excellent visibility and smooth sea. Ice could be picked up at an unusual distance. Searched from the 48th to 52d meridians to the north and south of the 43d parallel. At 23.15 G. M. T. (11th) a large berg was sighted in lat. $42^{\circ} 40'$, long. $49^{\circ} 55'$. Another large berg was sighted at 5.20 G. M. T., in lat. $42^{\circ} 56'$, long. $50^{\circ} 17'$, and a third one at 7.30 G. M. T., in lat. $42^{\circ} 52'$, long. $50^{\circ} 46'$. The second berg was grounded on the Tail of the Bank and had been reported several times. The third berg was estimated to be 300 feet long by 75 feet high and was reported on the 8th by the steamship *Canadian Mariner*, in lat. $42^{\circ} 42'$, long. $50^{\circ} 28'$. Occupied station No. 253, on the southwestern radial of oceanographic stations, in lat. $42^{\circ} 30'$, long. $51^{\circ} 46'$, after which we stood down along the radial for station No. 254. The following message was received from Halifax: "Disregard our message of yesterday and in future please send daily ice report addressed Agent of Marine, Halifax." In accordance with this message, daily reports to Halifax were resumed this date. Special ice information was sent to the steamship *West Caddou*. Many murre, fulmars, and dovekies, and one whale were observed during the day.

April 13: Moderate to light SW. and W. winds, with dense fog over the colder water. During the midwatch of this day lightning flashes were seen to the southward. A bird resembling a jaeger and a species of grebe were observed, also jellyfish and several dead fish about 3 inches long. The following oceanographic stations were occupied, Station No. 254, station No. 255, and station No. 256. After completing the work at the last-named station, the vessel drifted for the night. It is deemed worthy of note here that the bergs observed and reported on the western edge of the Gulf Stream, between the 43d and 45th parallels, during the preceding patrol of the *Tampa*, are drifting to the eastward and slowly melting in the warm water, one having been reported on the 6th as far east as long. $39^{\circ} 42'$ in lat. $43^{\circ} 05'$, and the area of their original observation has been left clear of ice, whereas all newly discovered bergs have been in the Labrador Current, drifting slowly in the cold water that sets to the southward along the eastern edge and then westerly around the Tail of the Bank. This seems to indicate that the influences at work earlier in the season, which set the bergs off to the eastward into the Gulf Stream before they had reached the latitude of the Tail of the Bank, no longer prevail. Special ice information was furnished the steamships *Cabotia* and *Hastings County*.

April 14 began with the vessel drifting. During the midwatch the wind shifted suddenly to NW., accompanied by hail and heavy snow, with thunder and lightning to the southward, and continued from fresh to strong NW. and N. during the day, with cloudy weather

This illustrates the great uncertainty of the current in this region of the "Graveyard of the North Atlantic." Upon assuming the duties of the ice patrol, the following estimate was made of the present ice situation: The southernmost ice consists of a large pinnacle berg, 163 feet high, which was last seen on the afternoon of April 16 in lat. $42^{\circ} 46'$, long. $50^{\circ} 41'$. This berg had been tracked for several days and was found to be drifting 250° , true, at the rate of 1 knot per hour, which would indicate that the Labrador Current is of unusual strength. Another berg, over 1,000 feet long and about 50 feet high, was in lat. $42^{\circ} 48'$, long. $50^{\circ} 55'$, on April 16. It had been observed for several days and was in a counter eddy current, SW. of the Tail of the Bank. A large berg was grounded on the Tail of the Bank and there were several bergs to the northward, which will probably arrive around the Tail of the Bank in a few days. To the northeastward there were a few bergs drifting to the northeastward along the edge of the Gulf Stream. After a careful review of the ice situation, it was decided to proceed to an advantageous point to commence search at daylight of April 18 for the 163-foot pinnacle berg, so the *Tampa* steamed to the eastward and the *Modoc* proceeded toward Halifax. The steamship *Armach* reported having passed a berg on April 18 in lat. $41^{\circ} 13'$, long. $46^{\circ} 16'$.

April 18: At 1.15 a. m. we had reached a point to commence search for the pinnacle berg, but were compelled to stop and drift, on account of dense fog, until 6.10 a. m., when the fog cleared and search was commenced to the eastward. The weather was none too favorable, as the wind increased to a moderate gale from SSE. at nightfall and then abated to a fresh SW. breeze at the end of the day. Rain fell at intervals, and a thick fog shut in at 3.30 p. m., at which time the search was discontinued for the day and the vessel permitted to drift. Gave ice warning to the steamship *Ariano*. At 11.35 p. m. received the following broadcast from the steamship *Orduna*: "Barquentine *Olutha* abandoned and in sinking condition and set on fire in latitude 44 N., longitude 47 W., may possibly be a danger to navigation. Crew now on board steamship *Orduna*." Signed Warner, steamship *Orduna*.

April 19: Drifted in dense fog throughout the day. In the forenoon the fresh SW. breeze increased to a moderate SSW. gale. In the afternoon the wind fell to a moderate S. breeze, but increased to a moderate S. gale at the end of the day. Heavy southerly swell; overcast, foggy, and rainy. Gave ice information to the steamship *West Scyovia*.

April 20: The day began with a strong S. wind, which in the forenoon moderated and hauled to W. and then NW. In the afternoon gentle to moderate W. to SW. winds prevailed. Overcast to mostly cloudy, with fog first part. At 4.30 a. m., fog partially clearing, stood

S. to fix position. At 7.30 a. m., determined position of ship and found that the current had set us N. 1.5 miles per hour since 3.30 p. m. of the 18th. Resumed search to the southward and eastward for the berg last sighted by the *Modoc* on the 16th inst., and at 2.35 p. m. raised a pinnacle berg bearing 65° , true, 11.5 miles distant. Stood for the berg and at 3.50 p. m. took photographs of it, in lat. $42^{\circ} 55'$, long. $50^{\circ} 32'$. The berg was identified as the one last sighted by the *Modoc* in lat. $42^{\circ} 40'$, long. $50^{\circ} 51'$, on April 16. It was grounded in 70 fathoms of water and its pinnacle peak was some 160 feet high. A few kittiwakes and shearwater were in the vicinity. Continued scouting to the northward and eastward until dark, in search of the long, low-lying berg sighted by the *Modoc* on April 16, and at 6.55 p. m. anchored for the night, in 30 fathoms of water. Ice warnings were given to the steamships *Cairnvalona*, *Gemma*, and *Brant County*. Routing instructions were given to the steamship *Hickman*.

April 21: Moderate to fresh winds from S. to W. Thick fog during most of day, temporarily clearing during the morning; rain at intervals. Heavy southerly swell. At 1.15 a. m., the fog clearing temporarily, stood N. for an anchorage on the Grand Banks, and at 9 a. m. anchored on the Tail of the Bank, in lat. $43^{\circ} 05'$, long. $50^{\circ} 09'$.

April 22: Moderate to light winds, WNW, to SW. Moderate SW. swell. Dense fog. Remained at anchor the entire day. Sent special ice information to steamships *Canadian Navigator*, *Bourdonnais*, and *Montcalm*, and sent special ice information and routing instructions to steamship *Capitaine Faure*.

April 23: Fresh to moderate winds, SW. to SSW.; moderate swell. Dense fog. Remained at anchor throughout the day. Ice information and routing instructions were given to the following steamships: *Bolingbroke*, *Mexico*, *Fredeniberg*, *Marburg*, and *Cymric Queen*, the last named being bound for Louisburg, Cape Breton Island. Received from the steamship *Rosalind* detailed ice information regarding ice fields over the Newfoundland Banks. The following wreck report was received from the steamship *Mabriton*: "Three-masted schooner *Gay Gordon*, of St. Johns, sinking and may be a danger to navigation in latitude $41^{\circ} 55'$, longitude $41^{\circ} 46'$, on 21st instant. Crew taken off."

April 24: Moderate to gentle winds, SW. to S.; moderate southerly swell. Remained at anchor on the Tail of the Bank throughout the day on account of dense fog. Routine reports from other vessels indicated that the fog was widespread. Special ice information was given to the U. S. S. *Sapelo*.

April 25: Light to fresh southerly wind; moderate southerly swell; dense fog, with light rain at intervals. Remained at anchor because of dense fog. Occupied oceanographic station 269 at anchorage, lat. $43^{\circ} 09'$; long. $50^{\circ} 05'$, taking sea-water temperatures and water samples at four depths from surface to bottom. Reports from other

from French trawler *La Provence*, fast in the ice and out of fuel in lat. $45^{\circ} 24'$, long. $59^{\circ} 02'$, Paris meridian, stating that French cruiser *Regulus* had been unable to reach her. Communicated with the *Regulus* and confirmed the report. Sent message to the *Modoc*, via Cape Race, and so advised the *La Provence*; also advised that vessel that the patrol vessel could leave the station only to save life and that *Modoc* was scheduled to leave Halifax on the 30th.

April 30: Light airs to light breezes; partly cloudy, fine weather. At the beginning of the day we were standing on course 233° , true, to reach a position south of the Tail of the Bank for daylight scouting, and also searching for ice en route. At 7.30 p. m. stopped and occupied oceanographic station 283, and at 10 p. m. occupied station 284. At 11.15 p. m. sighted an iceberg in the moonlight, bearing 320° , true, 5 miles distant. At 12 midnight, alongside of berg, which proved to be of medium size, in lat. $42^{\circ} 45'$, long. $50^{\circ} 30'$. This appeared to be the berg reported by the steamship *Persier* on the 29th inst. in practically the same position. Later, it was decided that this was also the berg reported by the *Manchester Importer* on April 29, 16 G. M. T., as in lat. $42^{\circ} 30'$, long. $50^{\circ} 13'$, which position was evidently in error. Flocks of shearwater and petrel were seen this day.

In the early evening communicated with the *Modoc* and was advised that she would relieve the *Tampa* on ice patrol to permit us to go to the assistance of the *La Provence* en route to Halifax. We were also advised that a trawler was proceeding to the assistance of the *La Provence*, which information was communicated to the *La Provence* and the *Regulus*.

May 1: Light to moderate winds, ESE. to E.; mostly clear, fine weather. Occupied oceanographic stations 286 and 285. At 2.30 a. m. sighted a berg in the moonlight, 4 miles distant; steamed to it and made a sketch. Found this berg to be the one grounded in lat. $43^{\circ} 00'$, long. $50^{\circ} 25'$, which was visited by the *Tampa* on April 20. It was now reduced to about one-fourth the size that it was on that date, and was reported by the steamship *Verdulia* on April 29 and the steamship *Persier* on April 30. At 4 a. m. stood west, true, from station 286, and resumed scouting for bergs. At 4.30 a. m., sighted a large berg, 11 miles distant, and upon arriving alongside photographed it and found it grounded in lat. $43^{\circ} 06'$, long. $50^{\circ} 50'$. It was some 75 feet in height, with a base 100 by 150 feet, and vertical walls, which were hollow on one side. Small growlers were calving off this berg and drifting to leeward. It was reported by the steamship *Persier* on April 30, but was not sighted by the *Verdulia* on the 29th ultimo, although that vessel reported passing growlers in the fog in its vicinity and must have passed very near to it, with the consequent risk of colliding with it. At 6 a. m. resumed scouting for bergs, and at 9 a. m. sighted growlers not previously reported, in

Ice reports were broadcast twice daily and a daily report was sent to Halifax and to Hydrographic Office, New York. A daily weather report was sent to the Weather Bureau, Washington.

Ice information was received from 37 vessels and special ice reports were sent to 29 vessels. Six obstruction reports were received.

An aggregate of 1,228 water temperature reports was received during this cruise.

COAST GUARD CUTTER "MODOC," COMMANDER B. M. CHISWELL,
ICE PATROL, SECOND CRUISE, MAY 2-17, 1923.

The *Modoc* sailed from Halifax at 1.15 p. m., April 30, to relieve the *Tampa*. The weather was stormy at the time, the wind varying from fresh S. wind to moderate SW. gale, with thick, driving rain. From the time of departure until contact with the *Tampa*, either heavy, driving rain or dense fog prevailed. Without the aid of the radio compass it would have been difficult, if not impossible, to have located that vessel. At 5.20 p. m., May 2, the *Tampa* was relieved of the ice patrol duty, in lat. $42^{\circ} 56'$, long. $55^{\circ} 22'$, and directed to proceed to Halifax, the oceanographic observer being transferred from the *Tampa* to the *Modoc*, after which the *Modoc* occupied oceanographic station 291, at the point where the relief was effected. At 7.40 p. m. steamed to the eastward. The dense fog cleared at 11 p. m.

May 3: Moderate SSE. to SE. wind, with moderate southerly swell. At 3.30 a. m. dense fog set in and lasted until 8 a. m., when the fog cleared and cloudy weather, with very good visibility, prevailed during the remainder of the day. Oceanographic stations 292, 293, 294, and 295 were occupied. At 9.20 G. M. T. a large, low, irregularly shaped, hummocky berg was located, grounded in 54 fathoms, on the west side of the Tail of the Bank, in lat. $43^{\circ} 38'$, long. $51^{\circ} 51'$. During the greater part of the day the vessel was in the Labrador Current to the westward of the Grand Banks and experienced a noticeable set to the northward and westward. At 10.50 p. m. the *Modoc* was anchored, to hold her position during the night.

Special ice information was given to the steamships *Strassa*, *Montrose*, *Cabotia*, *Domira*, *Pennsylvania*, and *Catinat*, several of which were bound to St. Lawrence River ports. They were advised that the river was not yet open to navigation. Scattering fulmars and dovekies were noted and many were observed flying about the berg sighted.

May 4: Moderate to fresh SE. to ESE. winds, with falling barometer, and partly clear to overcast weather, with light rain and moderate sea, prevailed during the day. The visibility was good to fair. At

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5 a. m., under way, and later occupied oceanographic stations 296 and 297.

At 5.30 G. M. T. a large pinnacle berg was passed in lat. $43^{\circ} 12'$, long. $51^{\circ} 03'$. This berg was located by the *Tampa*, May 1, in lat. $43^{\circ} 06'$, long. $50^{\circ} 50'$, and had drifted NW 11 miles, dragging along the bottom of the SW. slope of the Bank during the interval. At 7 G. M. T. a small berg was observed, grounded in lat. $43^{\circ} 04'$, long. $50^{\circ} 55'$. The present tendency of the berg drift seems to be from the north along the east side of the Bank to between the 42d and 43d parallels, then to the westward until the 50th meridian is passed, after which the set is rather sharply to the north and the bergs ground on the Bank between the 50th and 52d meridians, which shows that the Labrador Current is flowing strongly around the Tail of the Bank and up toward Cabot Straits.

Special ice information was furnished the steamships *Thyra*, *Catinat*, *Drottningholm*, and *Canadian Mariner*, and the *Drottningholm* was also warned. Bird life was plentiful and fulmars, jaegers, murrees, and dovekies were seen.

At 8.35 p. m. anchored on the Banks for the night.

May 5: Gentle to moderate SE. wind, with falling barometer; moderate southerly sea and swell, and dense fog prevailed throughout the day. The *Modoc* remained at anchor, in lat. $43^{\circ} 11'$, long. $50^{\circ} 14'$. A few whales and blackfish played about the ship and a number of fulmars were seen during the day.

Special ice information and routing advice was furnished the steamships *Appalachee*, *Loyal Deronian*, *Comanche*, and *Pennsylvania*.

May 6: Fresh to gentle SE. wind, hauling to S. at the end of the day; dense fog, lifting in the late afternoon and closing again at dark. The vessel remained at anchor. At 5.30 p. m. a berg was sighted, bearing 168° , true. Fulmars, jaegers, and a few jellyfish were observed, and a sea cucumber was brought up from the bottom on a fishhook.

Special ice information was furnished the steamships *Wallsum*, *United States*, *Valacia*, *Manchester Shipper*, *Ballygally Head*, and *Empress of Scotland*. Upon request routing advice was given the *Wallsum*, *Manchester Shipper*, and *Valacia*. The steamship *Sahale* was warned.

May 7: Light W. winds during the day, backing to SSE. by night; foggy. At 8.50 a. m. weighed anchor and steamed slowly, through the fog along the Cape Race radial of oceanographic stations, later occupying station 298. A few fulmars and dovekies were seen during the day.

Special ice information was furnished the steamships *Alfred Nobel*, *Cassandra*, *Fort McHenry*, and *Ansonia*. The widespread prevalence

of fog over the Grand Banks makes effective scouting for icebergs almost impossible.

May 8: Gentle wind, hauling from SSE. around to NW. during the day; thick fog until 8 p. m. At 7.10 a. m. weighed anchor and stood to the northward at reduced speed along the Cape Race radial of oceanographic stations, the thick fog making scouting for ice impracticable. The following stations were occupied: Stations 299, 300, and 301. Fulmars, dovebies, murre, and one stormy petrel were seen. A faint display of the aurora borealis was observed from 8 p. m. until 11 p. m.

Special ice information was furnished the steamships *Thunder*, *Cassandra*, *Cedric*, and *Tuscania*. As many steamships are now asking for ice conditions and routing instructions for the St. Lawrence River, the patrol endeavors to keep posted on these matters from all available sources and furnishes them with the latest information obtainable.

May 9: Gentle wind from WNW. to NW., falling to light NE. wind at the end of the day; fog throughout the day. Barometer rising slowly. Oceanographic stations 303, 304, and 305 were occupied. In the gully south of Cape Race a marked set of current to the westward was experienced. After completing observations at station 305, course was set for the eastern edge of the Banks, lat. $45^{\circ} 30'$, to investigate ice conditions in the Labrador Current and along that parallel and to the southward. Many murre and dovebies were sighted.

Special ice information was given to the steamships *Bothwell*, *Recca*, *Ste. Jehanne*, *Andania*, *Montcalm*, *Canada*, *Ballygally Head*, and *Rathland Head*. The *Montcalm* and *Canada* were warned that their respective courses were carrying them into danger.

May 10: Moderate to fresh variable winds, between NE. and NW.; overcast and cloudy; fair to good visibility. The fog lifted shortly after daybreak and was followed by light, drizzling rain. During the day scouted to the southward along the eastern edge of the Grand Banks, and at 5.15 p. m. passed a large, table-topped berg, with many blue diagonal veins, grounded in 65 fathoms, in lat. $43^{\circ} 55'$, long. $49^{\circ} 03'$. Fulmars, murre, jaegers, dovebies, and petrel were plentiful, and a large school of whales was seen near the berg. At 6 p. m. dense fog closed in and continued until the end of the day. At 6.55 p. m. anchored in lat. $44^{\circ} 00'$, long. $49^{\circ} 17'$. From 8.25 p. m. until 11 p. m. a steamer, apparently a trawler, identity unknown, cruised about in the vicinity of our anchorage.

Special ice information was furnished the steamships *Orduna*, *Waimate*, and *Metagama*. The *Metagama* was warned that her course was taking her near the berg we had sighted in the afternoon. The following interesting and instructive report, dated May 10, was re-

ceived from the steamship *Empress of Scotland*: "5 a. m., off Cape Ray at edge of ice field. Excepting for loose fringe of heavy pack ice, no break visible from masthead. Positions of vessels located in ice field yesterday remained unchanged. Ships which entered the field p. m. yesterday only penetrated beyond the fringe and remain there. Regarding best route to approach this position, would advice passing Miquelon 6 miles, Rose Blanche and Port Basque at 2 miles. Area of several miles open water off these points between 58 10 W. and 59 10 W. Have cruised around this area and find the field solid to the southward. Gillies, Commander." The steamship *Cassandra*, on May 10, reported as follows: "Entered open ice St. Pierre bearing 318°, 18 miles. Now passing through heavy open ice, Platte Point, Miquelon, 68°, 14 miles."

May 11: Gentle to light northerly winds. When the vessel left her anchorage, at 5.20 a. m., the weather was clear, but within a half hour we ran into a path of dense fog, and later into clear, pleasant weather, for a short spell, which was followed by almost constant light fog, with poor visibility, until in the late afternoon, when, the wind having backed to WNW., the fog settled very low. During the day we scouted along the east side of the Grand Banks, between lats. 41° 00', and 43° 09', and at 9 p. m. anchored in lat. 43° 09', long. 49° 50'. A large berg of most irregular shape, consisting of three ice masses resting on one common base and connected above water by what appeared to be comparatively soft snow ice, through which the sea had carved several picturesque arches, was passed at 7.15 p. m., in lat. 43° 10', long. 49° 34'. Two medium-sized growlers were seen to the southward of this berg, and the usual bird life was observed; also a few "hell-divers," a species of grebe, and several hair seal.

Special ice information was given the steamship *Bothwell*. It was noticed from water temperature reports received from the steamships *Celtic* and *Orduna* that their respective courses would carry them very close to the line of drift of a berg reported by the *Alki* on the 9th instant in lat. 40° 42', long., 48° 55'. As they had clear weather, with excellent visibility, they were requested to keep a sharp lookout for bergs. The following dispatch was received from the *Celtic*: "No sign of berg reported 40° 42', 48° 55', on 9th."

May 12: The day began with a gentle SE. wind and falling barometer, the wind hauling through W. to N. and reaching fresh gale force by night. A heavy cold rain and moderate to rough sea prevailed during most of the day. At 5.10 a. m. weighed anchor and searched an area off the southeastern edge of the Grand Banks, the visibility ranging from good to poor. The berg sighted the previous evening was visited in the early morning, when it was found that it had not noticeably changed its location. At 10.25 p. m. anchored on the Banks, in lat. 43° 15', long. 50° 39'.

Ice information was sent to the steamship *Belvidere* and to a steamship whose radio call letters were "FZB." An ice warning was sent to the steamship *War Nazan*. The usual bird life was in evidence during the day, and a number of murre, fulmars, and stormy petrel were seen.

May 13: At the beginning of the day wind was strong to fresh from NW., and later hauled to NNE., and moderated until at night light airs and calms prevailed. Beginning with overcast and rainy, the weather finally settled into thick, low fog, which cleared away toward midnight. The vessel remained at anchor throughout the day, on account of unfavorable conditions for scouting. Special ice information was furnished the steamships *Sinasta* and *Olympic*.

May 14: The day began with light southerly airs and winds, hauling to NW. and N.; weather clear, with good visibility, but shutting in dense fog at 8 a. m. and continuing thick throughout the day. At 5.05 a. m. weighed anchor and began search for ice south of the Grand Banks. At 12.50 p. m., while steaming slowly in the thick fog, some drift ice was sighted, which, upon being followed up, led to the location of a large berg, at 1.30 p. m., in lat. $42^{\circ} 52'$, long. $50^{\circ} 42'$. Fulmars, jaegers, "hell-divers," murre, petrel, and tern were observed in the vicinity of the berg, and a small flock of fulmars was perched on it.

Ice information was furnished the steamships *Majestic*, *Carriigan Head*, *Bolingbroke*, and *Sinasta*. The steamship *Bolingbroke* reported that she was from Montreal and that she had come "via Gut of Canso and Northumberland," and the steamship *Montrose* reported that she had "from 20 miles east of Rosier skirted field ice in clear water to 14 miles north of Bird Rock; then heavy pack ice to Cape Ray; then clear water passing 10 miles off Platte Point, having kept well north of track to clear ice field."

May 15: Gentle to fresh NW. to NE. winds, falling to light airs at the close of the day; foggy, clearing by daylight. At 4.45 a. m. weighed anchor and cruised along the southwestern edge of the Grand Banks. At 7.15 a. m. and 10.55 a. m., in lat. $43^{\circ} 07'$, long. $51^{\circ} 04'$, and lat. $43^{\circ} 21'$, long. $51^{\circ} 40'$, respectively, sea-water temperatures were taken at various depths, to determine the prevalence of the Labrador Current. The temperatures indicated that the Current was nonexistent. Several small fishing schooners were seen during the day. At 3 p. m. we passed a long, low, flat-topped berg, grounded in 56 fathoms in lat. $43^{\circ} 48'$, long. $51^{\circ} 52'$. Fulmars, jaegers, and tern were plentiful and a large flock of tern was resting on the berg. This berg was first reported by the steamship *Canadian Mariner*, on April 8, in lat. $42^{\circ} 42'$, long. $50^{\circ} 28'$, and it was located by the *Moloc*, on April 16, in lat. $42^{\circ} 48'$, long. $50^{\circ} 55'$, and was last seen by an ice-patrol vessel on May 3, 5 miles south of its present

the steamship *Loyal Devonian* was found to be standing toward bergs in foggy weather, with night approaching. The patrol advised her to change course to 180° to avoid ice and get into warm water and clear weather. The master acknowledged this message as follows: "Now steering S. 10 W. true to avoid dangers advised by you. Have you any warnings for my present course? Dense fog prevails." She was carefully watched and alterations of course were advised until she reached a region of safety.

May 6 the steamship *Pennsylvanian*, after being furnished with the latest advice for passage to Montreal, asked the patrol as follows: "Will it be advisable to call for an anchorage at St. Pierre if I can't get past, owing to ice? Are pilots obtainable there?" We replied: "Pilots obtainable St. Pierre. Send service message 'FIT' and he will give you local information." On this day the steamships *Swanice* and *Sahale* were observed, by means of their water temperature reports, to be standing into danger, with night approaching. The *Swanice* was warned as follows: "Advise you steer 90° until after you cross 47° W." The following message was sent to the *Sahale*: "Advise you steer due south until you cross 42° N; then 270° until you cross 52° W." Both messages were acknowledged with thanks. This is an illustration of the constant alert watch that has to be maintained, especially in fog and darkness, as then the passage of the ice regions becomes more dangerous.

On the occasion of an erroneous report of a berg near the westbound steamer track, inquiries were received from several ships, including the *Orduna*, *Olympic*, *Cedric*, *Tuscania*, and *United States*, asking us to "Please confirm," "Verify immediately," etc. These big ships were worried about the possibility of a berg being in the locality reported. The patrol was prepared and at once reassured them, advising them that their courses were clear. Such replies as "Thanks. Knew you would be cognizant," etc., indicated a confidence and dependency that is quite gratifying.

May 11 we were anchored 11 miles west of a large berg grounded on the east slope of the Banks. It was calm, with dense fog, and the night was dark. The lights of the passenger steamship *Metagama* could be seen as she passed near us, bound to the eastward. Our broadcast time was an hour away. By quick work we were able to advise her of the danger in her path, with the following message: "Large berg grounded 11 miles east of us. See your lights. Advise cautious lookout to-night."

May 14 the Japanese steamship *Ryufuku Maru*, evidently a stranger in this region, was heard calling Cape Race, asking for ice information for vessels bound for Montreal. The patrol gave her its special St. Lawrence information, kept on file and corrected to date. The

lat. $42^{\circ} 15'$ at the present time and the drift tendency is around the Tail of the Bank and thence to the northward and westward. An unusual number of bergs are grounded. A

A line of oceanographic stations from the central station to Cape Race was occupied. Ice warnings were broadcast twice daily on 600-meter and once daily on 2,300-meter wave lengths. A daily ice report was sent to the Hydrographic Office, Washington, and after the 9th two daily weather reports were sent to the Observer, Washington.

We were furnished with 1,017 water temperature reports by 185 vessels, 33 vessels reported ice, and 66 vessels were given special ice information, several of them being warned. Montreal-bound steamers regularly asked for and received routing advice.

**COAST GUARD CUTTER "TAMPA," LIEUT. COMMANDER W. J. WHEELER,
ICE PATROL, THIRD CRUISE, MAY 17 TO JUNE 1, 1923.**

The *Tampa* sailed from Halifax at 1 p. m., May 15, and relieved the *Modoc* on ice patrol at 3.10 p. m., May 17, in lat. $43^{\circ} 08'$, long. $53^{\circ} 05'$, the oceanographic observer being transferred to the *Tampa*. Fine weather with slight southerly airs and breezes was experienced. On the morning of the 17th a drifting bell buoy was destroyed by gunfire.

The following summary of the ice situation was made by the oceanographic observer: There are to-day only five bergs south of the 44th parallel. Their positions are as follows: One berg is grounded on the east slope of the Grand Banks in lat. $43^{\circ} 58'$, long. $49^{\circ} 20'$; another berg was last seen May 14, west of the Tail, in lat. $42^{\circ} 57'$, long. $50^{\circ} 50'$; two bergs lie well to the northwestward on the southwest slope of the Grand Banks in lat. $43^{\circ} 45'$, long. $51^{\circ} 50'$, are disintegrating rapidly, and will entirely melt in this locality: the only other berg in the area was observed by the *Modoc* this morning, in lat. $42^{\circ} 28'$, long. $51^{\circ} 35'$, and may be expected to assume what has been found to be the normal drift of bergs south of the Tail of the Bank. In the early season the Arctic Current was found to be drifting the bergs abnormally to the eastward between the 44th and 46th parallels. About the middle of April this movement ceased and the Labrador Current was found running around the Tail of the Bank and drifting the ice to the northwestward onto the southwest slope of the Grand Banks. Within the last week it has been found that this northwesterly current extension has ceased and we now may expect a southwesterly current past the Tail of the Bank. Since the berg in lat. $42^{\circ} 28'$, long. $51^{\circ} 35'$, is the southernmost berg and the situation is so clearly defined, it would seem advisable to relocate this berg and lie near by, observing its drift southward and eastward.

June 3: Light airs and breezes from NW. to WSW. Clear weather and excellent visibility. The berg showed the results of the pounding it had received during the gale, the rough seas, at temperatures between 40° and 50° F., having materially reduced its bulk. It appeared to be not more than half as large as on the evening of the 1st. At 9.50 a. m. proceeded to the westward to occupy oceanographic stations along the WSW. radial. Our noon sight, worked back by dead reckoning, placed the berg in lat. $43^{\circ} 05'$, long. $53^{\circ} 03'$, with a drift of 85° , true, 25 miles since it was located by the *Tampa* on the morning of the 1st. The following oceanographic stations were occupied: Stations 315, 316, and 317. Fulmars and petrel were seen and a brown thrush flew on board. Plentiful gulf weed and phosphorescence at night indicated Gulf Stream influences. Special ice information was furnished the steamships *Olympic* and *Waukegan*. The steamship *Winifredion* transmitted the following report: "19.30 G. M. T. 41-34 N., 55-06 W., steering 277, 12 knots, water 54, air 59, wind north 3, partly cloudy, visibility good; experienced 2 knot easterly current from noon 2d to noon 3d."

June 4: Light airs and breezes from NW., backing to SE.; weather clear. At 8.30 a. m., in lat. $43^{\circ} 37'$, long. $51^{\circ} 01'$, passed a grounded berg with a growler about 5 miles N. This berg, which consisted of three rather large ice hummocks attached to a common underwater base, was identified as one sighted by the *Modoc* on May 11 in lat. $43^{\circ} 09'$, long. $49^{\circ} 40'$. Oceanographic stations 318, 319, 320, 321, 322, 323, and 324 were occupied. Traces of Arctic water were found on the WSW. radial, indicating considerable mixing. On the SW. radial temperatures showed Arctic water extending for 35 miles from the SW. slope of the Bank. As long as this is present in such strong character we may expect bergs south of the Tail. Jaegers, fulmars, dovekies, Leach petrel, blackfish, jellyfish, and Portuguese men-of-war were seen this day. A mirage gave the illusion of a large sea plane rising from the water and another that of a steamer upside down above the horizon. Special ice information was furnished the steamships *Wikika* and *Loki*.

June 5: Light S. winds to fresh SW. breezes. Overcast and cloudy, with good to fair visibility, followed by dense fog after 11.25 a. m. In the morning we searched between the 50th and 52d meridians to lat. $42^{\circ} 40'$. At 11.25 a. m., dense fog shutting in and continuing for the remainder of the day, a course was laid for station 225, where the vessel anchored at 8.40 p. m. lat. $43^{\circ} 20'$, long. $50^{\circ} 22'$. Special ice information was given the steamship *Hickman*.

June 6: Fresh SW. moderating to light W. breezes prevailed, with fog in the early morning, followed by heavy haze, with occasional light rainfall; visibility fair to poor. At 6 a. m. under way and began search for the bergs reported by the *Manchester Importer* on the 4th.

TABLE 8

LISTING OF GROUNDED ICEBERGS IN 1926.

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
58	47°-20'	50°-45'	79	APR. 22 to MAY 12

SOURCE: IIP Bulletin No. 15

position on the forty-fourth parallel, it might be added, was the farthest south recorded for any berg during April. Looking northward on the map for April, we note that four bergs were reported the 14th on the western edge of Flemish Cap. Two bergs were just inside the 100-fathom curve to the westward on the Grand Bank and seven bergs were scattered on an east and west line between the Bank and the Cap. A berg was reported on the 16th close in to the Bank slope, and of all the glacial ice recorded to date this berg was regarded from its position as being most liable to drift southward and menace the southern routes. This fear proved groundless as nothing more was heard of its career. A berg was reported offshore on the 10th, and again on the 14th, in each instance located without much doubt in the northern edge of the Gulf Stream drift. A second report from this locality of a small berg probably referred to the one previously mentioned on the 10th; its new position would accord with the oceanographic circulation and indicated a rate of drift of 0.7 knot per hour. Three bergs between the forty-fifth and forty-sixth parallels about 50 miles eastward of the slope were reported on the 21st and it is believed that they were the same as two previously recorded on the 16th, which would account for a drift almost due south at the rate of 0.4 knot per hour.

Clear weather set in the 22d on the northern routes and for a period of the next three or four days a considerable number of bergs were reported which greatly augmented the list for April. For example the most populous distribution existed on the 100-fathom curve in latitude 47° where one ship sighted 26 bergs and an extensive ice field. These bergs with the addition of a few scattered ones were continually being reported by passing vessels the 23d to 26th instant. On the 28th and 29th three or four bergs of this aforementioned original group were reported south to the extreme limit for the month, excepting three small bergs on the 8th, on the east edge of the Bank in latitude $44^{\circ} 45'$. One berg only was reported in on the shelf, but its position was well to the northward in latitude $47^{\circ} 20'$ longitude $50^{\circ} 45'$. It is worth remarking that records show only about one-eighth or one-ninth of the total number of bergs south of Newfoundland ever succeed in drifting south of the Tail of the Grand Bank.

We ought not to fail to mention the behavior and distribution of the field ice for April. It was present during the entire month on the northeastern slope of the Banks north of the forty-sixth parallel, but due to the fact that there were few ships passing through this zone the presence of the fields were not recorded often. Whenever a ship crossed this vicinity, however, we were quite certain to receive an ice report. The patrol recorded what proved to be the southernmost invasion of the Arctic sea ice for the current year, the field

and the same as reported in a dispatch of the 22d instant and as previously discussed. It remained grounded in this spot; depth of water 43 fathoms, for the next four or five days.

The clearing of the fog on the 13th and 14th instant was due to the northward spread of the summer time North Atlantic high pressure area, which accordingly caused a shift of the wind from the prevailing southerly direction to the northwest quadrant. Not only was this clear weather a great boon to the patrol, enabling it to accurately fix the position of the southerly bergs, but also it permitted steamships to the northward which were crossing the continental slope, east and west bound from Canadian ports, to sight numerous bergs in those regions. There was a total of approximately 102 reports concerning the position of bergs north of the forty-fifth parallel submitted by passing steamers to the patrol vessel in order that we might collect and rebroadcast such information to other ships. In fact, during this period of nine days there were received about two-thirds of the reports for the entire month, all of which concerned the location of bergs distributed from the forty-fifth parallel northward to the forty-eighth parallel. The area containing the most abundant amount of ice was between the forty-sixth and forty-eighth parallels on the eastern side of the Bank. Nearly all the aforementioned ships were using track E, and the distribution of bergs as shown from the map indicated this populous belt extended northeast and southwest from just inshore of Flemish Cap southwestward in over the Bank to an extremely western position of longitude $50^{\circ} 20'$.

The duration of clear weather was comparatively short, for on the 15th instant about noon the fog shut in again with earnestness. This illustrates the general behavior of weather conditions during the spring of the year and with which the patrol is obliged to contend. Prevailing atmospheric circulation supplies a more or less constant indraft of warm moisture-laden winds which blow from the southerly quarter and the Gulf Stream. These winds, reaching the relatively cold water which surrounds the Banks, are cooled and their moisture is precipitated mostly in the form of fog interspersed with rain. Occasional interruptions come in the form of high-pressure atmosphere phenomena which usually bring clear weather for a short time only, so that the patrol has come to expect on the average a period of four to seven days of thick weather followed by two or three days of clear visibility and then a resumption of fog. Before the fog rolled in on the 15th the patrol vessel had time to identify one of the southerly bergs as observed the day previously which was then drifting 1.5 knots per hour southwestward past the Tail. Here then was a potential menace which was probably drifting to the westward, and from the current map probably on to the southwest slope;

TABLE 9

LISTING OF GROUNDED ICEBERGS IN 1927.

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
55	43°-31'	49°-28'	91	APR. 2

NOTE: Berg dimensions are not available.

SOURCE: IIP Bulletin No. 16

to the southward, more or less parallel with the general trend of the Bank. It was noticed that the ice consisted of small bergs, which plainly showed the effects of last summer's disintegration in high latitudes; and, also, this is a characteristic form for the early season. An interesting incident was the case of a large berg which remained grounded about 7 miles southwest of Cape Race, in plain sight of the station, from the 6th day throughout the remainder of the month. It is estimated that there was a total of 26 bergs in the North Atlantic, south of Newfoundland, for the month. A normal March records 36 bergs south of the forty-eighth parallel and 4 south of the Tail, but this year none of the ice succeeded in drifting as far south as the Tail.

APRIL

The small berg which we had been standing by the last few days of March grounded on the 2nd instant in latitude $43^{\circ} 31'$, longitude $49^{\circ} 28'$, at a point where the contour of the Grand Bank projects abruptly out to the eastward. The drift covering March 29 to April 2 is shown on Figure 22. The neighboring berg, which on March 29 had been 10 miles farther offshore, drifted south faster in the current and was by this time no longer in sight, nor did we see it again in spite of a search covering the day of April 3. Its drift must have been offshore to the eastward as well as to the southward, where undoubtedly it was caught in the warm counter current. A small growler was reported on the afternoon of the 2d instant about 50 miles due south of the Tail. This was the southernmost position that ice had attained thus far this year, and we believe it to have been the same growler as one sighted by the patrol on March 30, 30 miles north of the Tail.

The patrol found a small berg and growler on the 4th about 35 miles almost due east of the Tail. We remained drifting near this ice the remainder of that day. It was moving southward at the rate of 1 to 1.5 knots per hour. A strong wind blew from the north during the night, and although we had been able to keep in sight of the growler, at daylight, the 5th, the berg was nowhere to be seen. Search was carried on for the entire day without success and we were forced to conclude that the berg had been set southeast, or east, into the warm offshore current. Since no ice was reported later to the southward, this behavior was somewhat substantiated.

Two small bergs were sighted April 7, the smaller in on the Bank and the larger about 10 miles east on the 100-fathom contour and about 25 miles north of the Tail. Fog shut in for the next two days, and when the patrol was next able to search, the larger of the two bergs was found southeast of the Tail, drifting in the heart of the current to the westward. We followed it as it swung to the northwest and later to the north, at about 0.9 knot per hour. Finally,

on the 13th, it entered water of practically no current in on the shoal of the Tail of the Bank itself. We remained near this berg until the morning of the 15th. It had calved several growlers, melted somewhat, and naturally was slowly becoming smaller. The water

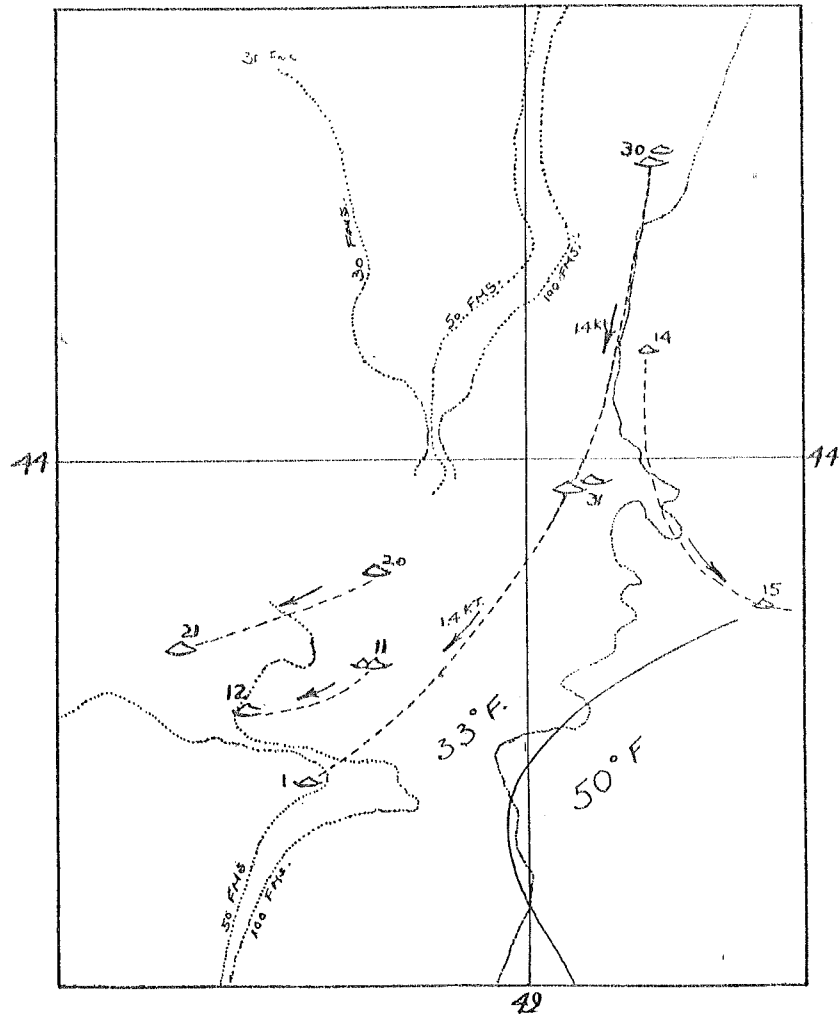


FIG. 22.—The drift of 3 bergs into the shallow water on the eastern side of the Grand Bank during April. Warm water from offshore pressing against the slope at this point is believed responsible for the deviation in the normal path of the ice

was relatively cool, 35° where it floated, and therefore not especially favorable for fast disintegration.

From the 10th to the 15th bergs were reported in positions scattered all along the slope from the Tail northward to the twenty-seventh parallel. A relatively great number of bergs, beginning with the 20th, were reported on the northern part of the Bank, as steamers began using tracks E bound for the Gulf of St. Lawrence.

parallel. On the 6th and 7th days of May the *Tampa* sighted approximately 100 bergs, most of which were found in an area bounded by parallels $47^{\circ} 50''$ and $47^{\circ} 30''$ and meridians $50^{\circ} 30''$ and 51° , an area of about 36,000 square miles situated about 150 miles northeast of Cape Race. This great quantity of ice apparently was drifting southward eventually to ground on the northern part of the Bank; many of the bergs it was expected would succeed in drifting toward Cape Race while a much less number would probably follow the 50 and 100 fathom contours down the east side of the Bank. The fact that over 100 icebergs were in these regions on the northern slope of the Bank was considered an event of especial importance, particularly in view of the fact that the Cape Race tracks, leading directly through this area, would become effective May 15 and thus endanger those steamers bound to and from St. Lawrence ports. May 7 to 11 was spent near the southernmost known berg on the east side of the Bank near the forty-sixth parallel in 40 fathoms of water. The berg apparently was aground, or else there was no current at that place, because it did not change its position materially for four days. The patrol during this time broadcasted warnings every six hours regarding the unusual quantity of ice then present on the northern part of the Bank.

May 11 to 16, the fog settled over the cold, ice-infested waters on the northern part of the Bank, cutting off all opportunity to observe the behavior and drift of the bergs. It was with surprise that we received a report of a growler on May 15, in latitude $41^{\circ} 57'$, longitude $49^{\circ} 53'$, but the steamer which made the report added her inability to secure "sights" for the past two days and this naturally made the position very uncertain. In view of subsequent events, the presence of ice in this locality, approximately 60 miles south of the Tail, is deemed very unlikely. The patrol ship during the foggy spell, 11th to 16th, employed its time almost exclusively in making a survey of the circulation along the eastern slope of the Grand Bank and southward around the Tail (see p. 80).

May 21 was the first clear day for a fortnight and so we searched northward along the east side of the bank, and as guided by the boundary between the two currents, which now it had been possible to delineate on the current map just compiled. A considerable amount of ice was reported on the 21st instant. For example, the steamship *Calgarie* sighted about 38 bergs on the Cape Race tracks between longitude $49^{\circ} 40'$ and $50^{\circ} 30'$. These were thought to be part of the same large group last seen by the ice patrol on May 6.

May 23 to 27 were days of clear visibility and accordingly the patrol ship searched northward from the forty-fifth parallel all the way to the twenty-seventh parallel. A total of six bergs were sighted, which comprised the southernmost group on the eastern side of the Bank. The farthest south berg on the 23d instant was

TABLE 10

LISTING OF GROUNDED ICEBERGS IN 1929.

IIP PAGE	LAT. (°N)	LONG. (°W)	LENGTH(m)	WIDTH(m)	HEIGHT(m)	DEPTH(m)	DATE
14	43°-05'	49°-29'	122	122	35	732*	JUNE 10

* The water depth of 732m (400 fathom) is much greater than expected for grounded bergs, but this berg is included because of its 6 days in the above position. It is possible that the given position is in error or that the berg drifted around and just happened to be in the same position twice.

SOURCE: IIP Bulletin No. 18

for ice in the cold water southwest of the Tail. A growler in $42^{\circ} 53' N.$, $51^{\circ} 13' W.$, 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 $42^{\circ} 55' N.$ and $43^{\circ} 20' N.$ One of these was a solid, massive, block of ice 115 feet high and about 400 feet square. Another large berg was seen in $43^{\circ} 05' N.$, $49^{\circ} 29' W.$ 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 $42^{\circ} 33' N.$, $50^{\circ} 20' W.$

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 $46^{\circ} 50' N.$, $40^{\circ} 31' W.$ 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 $42^{\circ} 33' N.$, $49^{\circ} 48' W.$ 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 $41^{\circ} 38' N.$, $48^{\circ} 56' W.$ 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 *Tyriffjord* from near $42^{\circ} 40' N.$, $49^{\circ} 10' W.$ 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 $42^{\circ} 40' N.$ 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 $43^{\circ} 10' N.$ At 4.30 p. m. the patrol stopped in haze and rain near a berg in $42^{\circ} 48' N.$, $48^{\circ} 51' W.$ 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 $42^{\circ} 17' N.$, $49^{\circ} 23' W.$

TABLE 11

LISTING OF GROUNDED ICEBERGS in 1931.

IIP PAGE	LAT. (°N)	LONG. (°W)	LENGTH(m)	HEIGHT(m)	DEPTH(m)	DATE
5	46°-36'	52°-53'	91	18	44	APR. 21

SOURCE: IIP Bulletin No. 21

On April 12 fog set in accompanied by a fresh to strong southwest wind. During the period of fog we remained to the southward of the pack ice. This fog, however, was of but short duration, as the weather cleared by midnight.

On the 14th of April we scouted westward from latitude $48^{\circ} 45' N.$, longitude $51^{\circ} 57' W.$ to Cape Bonavista, then southward to latitude $45^{\circ} 12' N.$ and then 30 miles offshore. Two growlers were sighted 10 miles east of Cape Bonavista.

Memorial services were held at noon on the 14th day of April in latitude $48^{\circ} 25' N.$, longitude $52^{\circ} 08' W.$ in memory of the nineteenth anniversary of the *Titanic* disaster.

At 5.30 p. m. the following was received from steamship *Drottningholm*: "Passed large berg latitude $47^{\circ} 02' N.$, longitude $52^{\circ} 39' W.$ " We proceeded immediately to the reported position of the berg.

At 8.15 a. m., April 15, we sighted the reported berg and some ice pieces in latitude $46^{\circ} 55' N.$, longitude $52^{\circ} 45' W.$ The berg had three pinnacles, the tallest being estimated at 120 feet high. It was about 300 feet long on the water line. This being the only ice sighted or reported south of latitude $48^{\circ} N.$, the *General Greene* hove to in the vicinity. Probably the *General Greene* had passed this berg without sighting it because of darkness during the night that she was proceeding northward from St. John's.

We drifted with this berg from the 15th to the 22d of April. At noon on the 21st it grounded in 24 fathoms of water in latitude $46^{\circ} 36' N.$, longitude $52^{\circ} 53' W.$, within sight of Cape Race. The drift of the iceberg is plotted in Figure 13 and is described later in the section on ice observation.

At 9.15 p. m. on the 20th of April, the Canadian steamship *Philip T. Dodge* bound for London, standing in close, was warned off by means of playing our searchlight on the berg. The master of the vessel thanked us for the service rendered. At 11.45 p. m. the same day the Norwegian steamship *Terra Nova* was sighted standing in from the eastward with masthead and range lights in line and heading directly between two pinnacles of the berg. Upon again playing the searchlight on the berg, this steamer hauled off almost at a right angle to her original course. She then came up slowly and spoke to us, inquiring about ice conditions on the south coast of Newfoundland, being bound for Placentia.

The berg calved several times between the time of grounding and sunset. After having informed Cape Race radio station of our intention, we stood in for St. John's, Newfoundland, at 9.15 a. m., April 22, for fuel, water, and provisions. At 4.20 p. m., April 22, we docked at St. John's.

During this patrol ice information was broadcast to shipping twice daily, at 8 a. m. and 8 p. m. plus three zone time. The surface

(1939) year

TABLE 12

LISTING OF GROUNDED ICEBERGS IN 1932.

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
5	44°-11'	49°-26'	48	APR. 5
7	45°-51'	48°-10'	128	APR. 21
7	45°-38'	48°-50'	81	APR. 24 to 26

NOTE: On page 7, four bergs are noted as being grounded just inside the 50 fathom (92m) curve between 45°-39'N and 46°-01'N. The total groundings therefore are 7.

SOURCE: IIP Bulletin No. 22

45° 00' N. The following day the eastern slope of the Banks was scouted. On April 3 small bergs, growlers, and field ice were located in latitude 45° 00' N., longitude 48° 00' W. The *General Greene* scouted to the eastward from this ice to longitude 46° 10' W. As the regular ice patrol vessel arrived in the area on this date, the rest of the cruise of the *General Greene* was spent taking oceanographic stations. The *General Greene* returned to St. John's on April 8, 1932.

FIRST CRUISE, "TAMPA," APRIL 1 TO APRIL 18, 1932

The *Tampa* sailed from Boston at 9 a. m. April 1 to inaugurate the 1932 international ice patrol. Just outside Boston Harbor the radio compass was compensated and the ship swung to determine the deviation of the magnetic compasses. Then the *Tampa* was headed for the turning point of the B track to begin her scouting for ice. On the evening of the 2d the regular ice broadcasts were started and all ships crossing the ice regions were asked to report to the ice-patrol vessel all ice sighted, their position, course, speed, and sea-water temperature every four hours.

Fog and low visibility were encountered on April 4 and 5. On April 5 the steamship *Thuhaug* was jammed tight in the ice 200 miles, 85° from Cape Race. In reply to her message asking for advice she was told that a change in wind and weather would probably form a lead to open water soon and when free to head south. The *Thuhaug* remained icebound until the morning of April 7. On the 6th scouting to the north and east was begun just south of the Grand Banks. On this date the southernmost ice was a berg in 44° 01' N., 49° 26' W., evidently grounded in 26 fathoms of water. This was the only known ice south of latitude 45° 20' N.

Dense fog prohibited the search for ice on April 7 and 8. On April 9 fog lifted at 9 a. m. and a large growler was sighted about 5 miles south-southeast from where we were drifting in 44° 30' N., 49° 46' W. From the growler the *Tampa* was headed eastward for deep water, for several hours passing through foggy patches. At 3 in the afternoon stopped and drifted in dense fog which lasted until the morning of April 11. During the 11th the *Tampa* ran through alternate clear and foggy patches.

April 12, with visibility of 10 miles, the ice-patrol vessel searched to north and east from 44° 08' N., 48° 50' W., to 45° 20' N., 48° 00' W. No ice was sighted in this area. On April 13 a search was made to the southward along the eastern slope of the Grand Banks. The 14th and 15th, the *Tampa* drifted in a dense fog.

April 16 was spent in proceeding at slow speed in dense fog toward a rendezvous with *Pontchartrain*. A southerly gale sprang up meanwhile, which forced the *Tampa* to steam farther to the westward than originally intended. Contact was finally made in 42° 15' N., 54°

36' W., and the ice-observation party duly transferred to the relieving vessel, and the *Tampa* proceeded to Halifax for fuel and supplies.

By April 8 the limits of the ice area were well defined by reports from cooperating ships to be north of latitude 45° 20' N. and west of longitude 46° 00' W. The most ice-congested area was between latitudes 45° 20' N. and 46° 30' N., and longitudes 48° 00' and 49° 00' W., where numerous bergs, growlers, and field ice had been reported. The bergs reported were small, with many growlers near them, indicating that they probably were old bergs that did not complete their journey south last year. Continued south and southeast winds kept this ice from drifting south as fast as normally would be expected.

On April 13 the southernmost ice was a berg in 45° 00' N., 48° 45' W. Continued fog and low visibility had greatly hindered the scouting operations of the ice-patrol vessel, but with the cooperation of several vessels that passed through the ice regions the limits of the ice were kept well defined at all times. By April 13 bergs were reported well within 50-fathom curve and were numerous along the Canadian track E now in use as far west as the turning point. Two bergs were in the center of the Banks near 45° 30' N., 51° 40' W. After this date a warning to proceed with caution when north of latitude 44° 30' N. and between longitudes 46° 00' and 51° 00' W. was included in the broadcasts. On April 14 and 15 no searching could be done on account of fog and no reports of ice were received by radio.

The weather generally was mild, with south and southeast breezes prevailing. The visibility was remarkably poor throughout the entire cruise. The percentage of time with visibility of less than 2 miles was 56.5.

A total of 56 ice reports were received during the patrol from 13 different ships. Besides the regular broadcasts ice information was furnished seven vessels. Sea-water temperatures were received from 121 different vessels, furnishing a total of 628 reports. A detailed picture of ice conditions and surface isotherms is shown on Figure 1.

SECOND CRUISE, "PONTCHARTRAIN," APRIL 18 TO MAY 3, 1932

The ship being in all respects ready for sea, proceeded at 2.05 p. m. April 14 for the Grand Banks. The weather held fair, wind general and variable until the morning of April 16, when a southeast gale was encountered. At 8.10 a. m. slowed to 10 knots. At 12 noon hove to at 70 revolutions. Remained hove to for 24 hours. Sea continued rough. Made first contact with the *Tampa* at 10.45 p. m. April 17. The sea was too rough for effecting transfer. Hove to on several courses until noon next day. At 12.20 p. m. April 18, the *Tampa's* boat came alongside. Lieut. R. M. Hoyle and Chief

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Quartermaster Joel S. Wingate, ice observers, came on board. The *Tampa* proceeded to port, the *Pontchartrain* having relieved her. Proceeded on course 82° at 92 revolutions for the tail of the Grand Banks to begin a search for ice.

On April 19, the *Pontchartrain* searched, with good visibility, to the northward along the eastern slope of the Banks, between the 100 and 1,000 fathom curve to latitude $44^{\circ} 47' N.$ During the night, while drifting, a slight set to the northward was experienced instead of a strong set to the south-southwest, as would normally be expected. On April 20, the scouting for ice was continued to the northward. Four bergs were sighted grounded just inside the 50-fathom curve between latitudes $45^{\circ} 39' N.$ and $46^{\circ} 01' N.$ A low, flat berg, very hard to see, and a very much weather-beaten berg were sighted a few miles from the grounded bergs. At 4 p. m. thick fog enveloped the ship, which put a stop to the scouting for the rest of the day.

On the morning of April 21, two bergs sighted the day before were visited and their set and drift determined. The low, flat berg was drifting 327° true at 0.5 of a mile per hour, while the other was drifting 317° true at one-third of a mile per hour. The average wind was southeast with force four.

The *Pontchartrain* located a large berg grounded in latitude $45^{\circ} 51' N.$, longitude $48^{\circ} 10' W.$, the same morning. Scouting for ice was continued to the southeastward to the 1,000-fathom curve and thence southwestward until dark. On the 22d the ice-patrol vessel searched for ice in the outer fringe of cold water east of the Banks as far south as $43^{\circ} 45' N.$ The *Pontchartrain* searched along the edge of the Banks on the 23d to the northward. April 24 was spent drifting in a fog. When the weather cleared in the afternoon a berg was located aground in $45^{\circ} 38' N.$, $48^{\circ} 50' W.$

The *Pontchartrain* steamed at reduced speed into a moderate southerly gale during the morning of April 25. As the gale moderated the visibility decreased to 2 miles, so little scouting could be done.

On the afternoon of April 26, the berg sighted April 24 was again visited. It was found to be still aground and its position unchanged. Its size was noticeably reduced by the action of the seas in the last two days. The *Pontchartrain* then headed for the position of a berg reported the same day, in latitude $45^{\circ} 35' N.$, longitude $47^{\circ} 30' W.$ This position was reached just at sunset, and the berg could not be located on account of darkness.

Dense fog prevented all scouting operations on April 27 and 28. For the same reason few ice reports were received on the 27th and none on the 28th. When the fog cleared on the morning of April 29 a small berg was sighted in latitude $45^{\circ} 30' N.$, longitude $48^{\circ} 07' W.$ The positions of the four grounded bergs sighted by the ice patrol on the 20th were sighted. Three of these bergs had disappeared. Also

TABLE 13

LISTING OF GROUNDED ICEBERGS IN 1934.

IP	PAGE	LAT. (°N)	LONG.(°W)	LENGTH(m)	WIDTH(m)	HEIGHT(m)	DEPTH(m)	DATE
2		44°-23'	49°-10'	69	31	14	62	APR. 24
2		45°-16'	48°-55'	-	-	-	77	APR. 24
2		45°-30'	48°-50'	-	-	-	101	APR. 24

SOURCE: IIP Bulletin No. 24

visibility improved on the Grand Banks along track E and ice reports were received from two vessels in that area reporting 13 separate bergs.

On April 24 the fog lifted at 6 a. m. and it was generally clear over the entire ice-patrol area. The *Mendota* searched from latitude $43^{\circ}00'$ N., to the northward in the cold current between the 100- and 1,000-fathom curve just east of the Grand Banks. At 12:50 p. m. we located a berg aground in 34 fathoms of water in latitude $44^{\circ}23'$ N., longitude $49^{\circ}10'$ W. This berg was about 45 feet high, 225 feet long, and 100 feet wide. It was entirely water washed and several old water lines were visible, giving evidence that it was an old berg that did not complete its southward journey last year. From this berg the ice-patrol vessel continued its search to the northward just east of the 50-fathom curve as far north as $45^{\circ}30'$ N. Ice was located in the following positions: Two bergs $45^{\circ}12'$ N., $48^{\circ}55'$ W.; berg $45^{\circ}16'$ N., $48^{\circ}55'$ W.; berg $45^{\circ}30'$ N., $48^{\circ}50'$ W. These bergs were also aground and gave evidence of being last year's bergs. Then the *Mendota* ran east for 12 miles and stopped and drifted on account of darkness. During the 25th and 26th fog prevented all scouting.

On the 27th the ice-patrol vessel scouted with good visibility to the northward from latitude $45^{\circ}00'$ N., to latitude $45^{\circ}50'$ N., in longitude $46^{\circ}40'$ W., and then westward to the 50-fathom curve. A berg was located in $45^{\circ}45'$ N., $48^{\circ}31'$ W., in 61 fathoms of water. This was a large solid berg about 300 feet long, 200 feet wide, and 100 feet high at the highest peak. From this berg the *Mendota* searched to the south-southeastward until dark. At daylight the following morning we contacted the *General Greene* and received a current chart of the critical ice area which the oceanographer on the *General Greene* had just completed. Then we scouted to the southward east of the Grand Banks on courses parallel to and 24 miles east of those we steered on our northward search on the 24th. Good visibility prevailed until 3:20 p. m., when dense fog set in.

During the night of the 28th the *Mendota* ran to the westward toward the relieving point. The *Pontchartrain* was met at 8 a. m. April 29, in latitude $42^{\circ}30'$ N., longitude $52^{\circ}45'$ W. Lt. R. M. Hoyle and ice observation party were transferred to the *Pontchartrain*, and the *Mendota* was relieved as ice-patrol vessel. Then we proceeded to Halifax, Nova Scotia.

The limits of the ice during the period of this cruise were unusually far on the Grand Banks in shoal water. In fact bergs were numerous on the Grand Banks from the eastern edge as far south as latitude $44^{\circ}00'$ N., and westward to longitude $53^{\circ}00'$ W. The southernmost ice was a berg reported on the 13th in $43^{\circ}57'$ N., $48^{\circ}47'$ W. This berg could not be located on the 24th when the fog cleared, affording the ice-patrol vessel the first opportunity to scout the area since arriving in the ice regions on the 16th. This berg and the berg sighted by

the *Mendota* on the 27th were the only two bergs east of the 50-fathom curve, known to be south of 46°00' N.

After arriving in the vicinity of the Grand Banks the weather was generally mild and foggy. During the first part of the cruise light east winds predominated. Then the winds were southerly for the rest of the cruise with exception of the 24th and 27th. North winds on the 24th and westerly winds on the 27th brought relief from the fog on those 2 days. The percentage of time with fog after arriving in the ice-patrol area was 76.0.

The following is a summary of the ice and water temperature reports received during the cruise:

Number of bergs reported south of 48°00' N.....	161
Number of bergs reported south of 43°00' N.....	0
Number of ice reports received.....	269
Number of water temperature reports received.....	1,046
Number of vessels furnishing ice reports.....	42
Number of vessels furnishing water temperature reports.....	146
Number of vessels furnished special ice information.....	9

Figure 3 shows track of patrol vessel, ice conditions, and surface isotherms for this cruise.

SECOND CRUISE, "PONTCHARTRAIN", APRIL 29-MAY 13, 1934

The *Pontchartrain* sailed from Boston at 8:28 a. m., 26 April, 1934, to relieve the *Mendota* on International Ice Patrol. The *Mendota* was met in 42°30' N., 52°45' W., at 8 a. m., April 29, 1934. The ice observation party reported aboard, and the *Pontchartrain* relieved the *Mendota* as ice-patrol vessel. We then headed for a position 15 miles south of the tail of the Grand Banks to begin a search for ice. On the following day with excellent visibility we searched to the northward in the Labrador current just east of the Grand Banks between the 100- and 1,000-fathom curves as far north as latitude 45°00' N. A berg was located in 44°18' N., 48°50' W., in 775 fathoms of water. This berg was about 200 feet long, 100 feet wide, and 45 feet high. An old water line gave evidence that it had recently turned over 90°, making its former top a side. From this berg we headed for a berg aground in 33 fathoms of water in latitude 44°24' N., longitude 49°08' W. This proved to be the same berg sighted near this position on April 24 by the *Mendota*. Its position or appearance had not appreciably changed since it was last sighted. Before dark bergs were sighted in latitude 44°37' N., longitude 48°53' W., and 44°44' N., 48°51' W. At 7:55 p. m. the ice-patrol vessel stopped and drifted for the night.

On May 1 we scouted to the southward to latitude 43°30' N., on parallel courses 25 miles to the east of those steered on the previous day. No ice was sighted in this area. Then the bergs sighted the

day before were located and their set and drift determined. The grounded berg had not moved. The southernmost berg had drifted 18.5 miles, 174° true. The other two bergs had drifted 155° true, 15 and 9 miles, respectively. The following day we scouted from $44^\circ 30'$ N., $49^\circ 20'$ W., on course 38° true at 15 knots, with visibility about 6 miles. At 9 a. m. we located a small berg in $45^\circ 12'$ N., $49^\circ 49'$ W., in 300 fathoms of water; sea water temperature, 34° . Another berg was found in $45^\circ 24'$ N., $48^\circ 36'$ W., at 9:50 a. m. Then we steered 119° true for 15 miles and changed course to the south-southwest to locate the bergs we sighted the previous day. We found a berg in $44^\circ 49'$ N., $48^\circ 29'$ W., in 36° F. water. This is probably the northernmost berg of the group sighted on May 1. Its drift had curved to the northeast. The southernmost berg of the group was found in $44^\circ 03'$ N., $48^\circ 30'$ W. Since the day before it had drifted 10 miles to the eastward into 42° water. The search was continued to the southward to latitude $43^\circ 35'$ and then to the west for 10 miles and then north to latitude $44^\circ 00'$ N. We then headed for shoal water and anchored for the night.

On May 3 we located the berg aground in latitude $41^\circ 24'$ N., longitude $49^\circ 10'$ W., early in the morning. Then the ice-patrol vessel headed for the southernmost berg found the previous day. It was found 4 miles to the north of its previous position in 48° water. Then we scouted to the south-southwest in latitude $43^\circ 20'$ N., and then ran 20 miles west. At 12:48 p. m. the course was changed to 18° . Late in the afternoon bergs were located in the following positions: $44^\circ 44'$ N., $48^\circ 33'$ W; $44^\circ 17'$ N., $48^\circ 30'$ W; $44^\circ 16'$ N., $48^\circ 41'$ W. Since no ice was found farther to the south, the two bergs farthest to the east must evidently be the same bergs sighted on the 1st and 2d to the south of these positions. The winds must have driven them from the southerly current into the northeast current. From the last berg the *Pontchartrain* ran southwest for 28 miles until dark. Fog and low visibility prevented all scouting for ice on the 4th, 5th, 6th, and 7th. On the 8th, with visibility about 6 miles, we ran from latitude $44^\circ 30'$ N., down the eastern edge of the Grand Banks, and then westward around the tail of the Grand Banks to longitude $50^\circ 30'$. No ice was found in this area.

On May 9, with excellent visibility, we scouted to the northward, just east of the area searched the previous day. In latitude $43^\circ 55'$ N., we ran east for 25 miles, then north for 25 miles, and west until dark. May 10 a berg was found in $44^\circ 24'$ N., $48^\circ 57'$ W., in 100 fathoms of water with sea-water temperature 35° F. Then we searched to the eastward 25 miles north of our track of the day before. In longitude $47^\circ 30'$ we ran 25 miles north and then westward until dark. We found a small berg in 54° water in $45^\circ 02'$ N., $47^\circ 35'$ W. This berg

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winds from the south and southwest brought a 4-day period of fog. North winds on May 9 dissipated the fog. At the close of the cruise south winds were causing a general fog over the ice-patrol area. The percentage of time with visibility less than 2 miles was 35.7; less than 4 miles, 39.3.

The following is a summary of the ice- and water-temperature reports received during the cruise:

Estimated number of bergs reported south of 48° N.....	170
Estimated number of bergs reported south of 45° N.....	11
Number of vessels furnishing ice reports.....	76
Number of vessels furnishing water-temperature reports.....	193
Number of vessels furnished special ice information.....	6
Number of ice reports received.....	441
Number of water-temperature reports received.....	897

Figure 4 shows ice conditions and surface isotherms for this cruise.

THIRD CRUISE, "MENDOTA", MAY 13 TO 26, 1934

The *Mendota* sailed from Halifax at 5 a. m. May 11. The *Pontchartrain* was met in latitude 42-30 N., longitude 52-45 W. Lt. R. M. Hoyle and ice-observation party reported aboard and the *Mendota* relieved the *Pontchartrain* as ice-patrol vessel at 6:10 a. m. May 13. The *Mendota* then proceeded to a point 15 miles south of the tail of the Grand Banks. From this point we scouted to the northeastward for 25 miles, when fog set in.

No scouting for ice could be done on the following day on account of fog. On May 15 the fog cleared in the afternoon and the ice-patrol vessel searched the area between the 100- and 1,000-fathom curves from the tail of the Grand Banks in the cold water. The berg sighted on May 11 by the *Pontchartrain* in 44°01' N., 49°01' W., was found in 75 fathoms with water temperature 35° F. in 43°58' N., 49°07' W. Its appearance had not changed appreciably. Another berg was found in 44°42' N., 48°47' W. This berg was approximately 700 feet long, 400 feet wide, and 70 feet high and was a solid block of ice with a flat top. A small pyramid-shaped berg was found in 44°47' N., 48°35' W. At 3 p. m. fog shut in and no further scouting could be done.

At noon the following day the fog lifted. From 45°00' N., 47°30' W., the *Mendota* ran west for 30 miles and then changed course to 199° to locate the bergs sighted the previous day. The northernmost berg of the group was found in 44°25' N., 48°22' W., at 4 p. m. This berg had drifted 24 miles, 155° true in 25 hours. The second berg of the three was found in 44°14' N., 48°41' W., at 6 p. m. This berg had drifted 28 miles, 172° true in 29 hours. The southernmost berg was found in 43°45' N., 49°05' W., at 8 p. m. Its drift was 13 miles, 172° true, in 34 hours. During the night the *Mendota* lay to near this berg. At 10:20 p. m. we gave ice

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information by visual signal to the Norwegian steamer *Aun*. By 5 a. m. the next morning (May 18) the berg had drifted 7.5 miles 215° true from its 8 p. m. position. From May 11 to May 16 this berg had drifted only 5 miles. Evidently during part of this time it was aground.

From this berg the *Mendota* scouted to the northeastward and located the two bergs sighted the previous day. One of these bergs was located in $44^{\circ}11' N.$, $48^{\circ}38' W.$, at 7:48 a. m. It had drifted 5 miles, 149° true, in 14 hours. The winds were north to northeast, force 1 to 2. The third berg of the group was found at noon in $44^{\circ}45' N.$, $48^{\circ}03' W.$ In 20 hours its drift was 17 miles, 55° true. From this berg the *Mendota* headed for a group of three bergs reported on May 17 just north of latitude $45^{\circ} N.$ At 2:40 p. m. a dangerous growler was located in $45^{\circ}02' N.$, $48^{\circ}44' W.$ A berg was found at 3 p. m. in $45^{\circ}01' N.$, $48^{\circ}50' W.$, 250 fathoms, water temperature 36° . This was a small drydock-type berg and was disintegrating fast. Another berg which we did not run close to was 7 miles distant in $45^{\circ}05' N.$, $48^{\circ}58' W.$ At this time the visibility decreased to about 3 miles on account of rain and fog. Then the *Mendota* ran 190° true. A large drydock-type berg was found in $44^{\circ}55' N.$, $48^{\circ}51' W.$

It was foggy until 4 p. m. on the 19th. After the fog cleared the *Mendota* searched for the southernmost berg until dark. At daylight the following day the *Mendota* ran up the eastern edge of the Grand Banks to latitude $44^{\circ}00' N.$, then east for 25 miles, and then changed course to 199° true. The southernmost berg was found in $43^{\circ}31' N.$, $48^{\circ}45' W.$, sea-water temperature $47^{\circ} F.$ at 1 p. m. The ice-patrol vessel drifted near this berg during the 21st and 22d. At noon on the 21st the berg had drifted 9 miles northeast. During the night of the 21st fresh east winds arose shifting to northeast and north during the morning of the 22d. From noon 21st to noon 22d the berg drifted 39 miles, 238° true. From then until 6 a. m. May 23 it drifted 16 miles, 214° true. The berg during this time had become very much smaller both from melting and the frequent calving of growlers. On the morning of May 23 the ice-patrol vessel stood up the eastern edge of the Grand Banks as far as latitude $44^{\circ}00' N.$, to search for a berg that had been reported the previous day in $43^{\circ}28' N.$, $49^{\circ}22' W.$ As this berg was not located it might have been the same berg that the *Mendota* was watching. At noon thick fog set in and no more scouting could be done. We then ran to the southward to be near the southernmost ice when the fog cleared.

At 12:45 a. m., May 25, the *General Greene* sighted a berg in $42^{\circ}38' N.$, $50^{\circ}15' W.$ The *Mendota* located this berg in $42^{\circ}30' N.$, $50^{\circ}14' W.$, at 9:30 a. m. the same day. This berg proved to be the same one

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TABLE 14

LISTING OF GROUNDED ICEBERGS IN 1935.

IIP PAGE	LAT. (°N)	LONG. (°W)	LENGTH(m)	WIDTH(m)	HEIGHT(m)	DEPTH(m)	DATE
29	43°-58'	49°-05'	122	92	31	110	APR. 14-15
29	43°-41'	49°-29'	-	-	-	82*	APR. 16-17

** IIP states the grounding depth as 28 fathom (51m), but the chart shows 45 fathom (82m) at this location.

SOURCE: IIP Bulletin No. 25

growlers and much heavy pack ice. At sunset the *Mendota* stopped and drifted for the night.

At daybreak, April 11, the *Mendota* commenced scouting from latitude $45^{\circ}05'$ N., longitude $47^{\circ}20'$ W., to the westward, to determine whether any ice lay in the area between the ice field and the 100-fathom curve. At 1107 a large iceberg was sighted in latitude $45^{\circ}05'$ N., longitude $48^{\circ}30'$ W. This berg was long and quite low with a single ridge along one side about 60 feet high. The rest of the berg was only about 20 feet above the water, and the whole was 400 feet long, 200 feet wide. At 1310, a large iceberg was sighted in latitude $45^{\circ}32'$ N., longitude $48^{\circ}17'$ W. This berg was not approached, as, upon advice of the medical officer of this ship, it was decided to proceed with all possible speed to St. John's, Newfoundland, to hospitalize a man suffering from acute appendicitis. The *Mendota* anchored in St. John's Harbor at 0755, April 12, 1935, hospitalized the sick man in St. John's General Hospital and returned to sea at 0955. This necessary emergency trip did not in any way interfere with the conduct of the patrol. The 0700 broadcast was transmitted before entering the harbor, and the schedule with Washington, being on a high-frequency band, did not violate harbor regulations, was successfully dispatched while at anchor, and the 1000 broadcast was transmitted on time after the *Mendota* had cleared the harbor. The Ice Patrol call, N. I. D. K., was answered by the *General Greene* during the 2 hours the *Mendota* was in St. Johns. While en route to the eastern edge of the Grand Banks from St. John's, an iceberg was sighted in latitude $47^{\circ}00'$ N., longitude $51^{\circ}54'$ W.

The *Mendota* arrived in the cold current east of the banks early April 13, and at 0600 sighted a berg in latitude $43^{\circ}53'$ N., longitude $49^{\circ}07'$ W. The water temperature was 29° F. This berg was unmistakably the berg found in latitude $45^{\circ}05'$ N., longitude $46^{\circ}30'$ W., on April 11. The drift of this berg had averaged over 30 miles a day south-southeastward since last sighted. Such a drift is exceptional, though it has been often noted in past seasons. The *Mendota* continued her southward search just east of the 100-fathom curve, and during the day scouted out an area 35 miles wide between latitudes $42^{\circ}40'$ N. and $43^{\circ}45'$ N. No further ice was sighted so the *Mendota* returned to the berg sighted that morning and drifted with it during the night. This was the southernmost known ice. The next day the *Mendota* ran northeastward between the 100 and 1,000 fathom curves to see what other ice was moving southward in the cold current. At 1006, April 14, a large iceberg was sighted in latitude $43^{\circ}58'$ N., longitude $49^{\circ}05'$ W. This berg was easily identified as the berg sighted on April 10, in latitude $46^{\circ}04'$ N., longitude

47°36' W., and again on April 11, in latitude 45°32' N., longitude 47°17' W. The identifying points were: (a) its size, (b) the distribution of the peaks and depressions, and (c) the most conservative point, three strongly marked old-water lines cut high on one side just below the loftiest peak. This berg had, with one exception, changed not at all in appearance. Its length when first seen was estimated at 500 feet. Apparently it had had one major calving, or had sloughed off considerable ice from one end for its length was only slightly over 400 feet at this time. The latter hypothesis seemed the better as the sea in all directions around the berg was strewn with small pieces of berg ice. This berg had an even more remarkable drift than the other one sighted on April 13. From the 10th to 11th of April the berg drifted 42 miles, and from the 11th to the 14th, when sighted, it averaged over 30 miles per day. This berg was found in 62 fathoms of water and was undoubtedly aground. Open field ice, probably the remnants of the large ice field sighted on April 10, was strewn in all directions from this berg. Although this ice offered little hindrance to navigation in daylight hours, it would prove a hazard at night, for many large pieces were present, demanding low speed and caution during periods of darkness or low visibility. A boat was lowered here to obtain samples of berg ice and pictures. The *Mendota* proceeded to scout to the eastward to determine the width of the cold current and to see if ice had drifted southward to the east of the previous day's search. At 1230 a large growler was sighted in latitude 43°54' N., longitude 48°59' W. The cold current was found to be unexpectedly wide at this point, water as low as 37° F. extending out to longitude 48°17' W. No further ice being sighted, the *Mendota* returned to the southernmost berg and drifted in the vicinity throughout the night. Since this berg was located on April 13 it had drifted only 10 miles along the 100-fathom curve to the southwest, and was now in latitude 43°44' N., longitude 49°31' W.

The next day, April 15, the *Mendota* kept track of the two southernmost bergs. The large berg proved to be aground as it moved not at all since first sighted on April 14. The more southern of the two bergs drifted slowly southwest, just outside the 100-fathom curve, and on April 16, apparently grounded in 28 fathoms of water in latitude 43°41' N., longitude 49°29' W. On April 15, a small berg was sighted in latitude 43°37' N., longitude 49°32' W. The morning of April 16 found the whole ice-patrol area covered with fog, making scouting impossible, so the *Mendota* ran southward at slow speed during the morning. The fog lifted in the afternoon, and the *Mendota* scouted northeast, 12 miles outside the 100-fathom

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curve, and returned to the southernmost ice and drifted for the night. The morning of April 17, dense fog covered the whole ice area so the *Mendota* drifted in the vicinity of the berg aground in latitude 43°41' N., longitude 49°29' W., throughout the day and night. The next 2 days, April 18 and 19, dense fog persisted and no scouting could be done.

On April 20, at about 0930, the fog cleared sufficiently for scouting. This day the *Mendota* searched on a line to the southwestward, 10 miles outside the 100-fathom curve from latitude 44°30' N., to latitude 42°30' N., and sighted nine small bergs and one growler. All these bergs were in advanced stages of disintegration and would hardly be a menace for more than a week. At 1939, the *Mendota* slowed to one-third speed and maintained position in latitude 42°46' N., longitude 49°48' W., throughout the night. The next day, with only fair visibility, the horizon being very hazy, the *Mendota* scouted northeastward 20 miles outside the previous day's search. Only one berg was sighted. This was an average size berg, in latitude 43°47' N., longitude 48°44' W. At 1621, the *General Greene* was contacted in latitude 44°10' N., longitude 48°26' W., and the commanding officer, Boatswain A. L. Cunningham and Senior Oceanographer Floyd M. Soule, reported aboard for a conference. Mr. Soule delivered a current map of the critical area. At 1815, the *General Greene* departed for St. John's, Newfoundland. The visibility was too poor to warrant further scouting that day so the *Mendota* ran at slow speeds or drifted throughout the night.

At daylight, April 22, the *Mendota* scouted to the southwestward just outside the 1,000-fathom curve and sighted three growlers in latitude 42°58' N., longitude 48°53' W. At 0720 the *Mendota* headed west for the relieving point. The *Pontchartrain* was contacted at 2210, April 22, in latitude 43°10' N., longitude 52°50' W. A boat was lowered and Lt. G. Van A. Graves, ice-observation officer, and the observer's party were transferred to the *Pontchartrain*. At 2253, April 22, the *Mendota* was relieved by the *Pontchartrain* as ice patrol vessel, and set course for Halifax, Nova Scotia, arriving there at 0534, April 24, 1935. (See fig. 12.)

The following is a summary of ice and water-temperature reports received during the cruise:

Number of bergs reported south of 48° N.....	148
Number of bergs reported south of 44° N.....	10
Number of ice reports received.....	89
Number of water-temperature reports received.....	1144
Number of vessels furnishing ice reports.....	35
Number of vessels furnishing water-temperature reports.....	75
Number of vessels furnished special ice information.....	11

TABLE 15

LISTING OF GROUNDED ICEBERGS IN 1937.

IIP PAGE	LAT. (°N)	LONG. (°W)	DEPTH (m)	DATE
30	44°-25'	49°-05'	60	Apr. 7 to 11
35	45°-13'	48°-52'	92	MAY 7

NOTE: There is no information on berg size except that the first berg was large.

SOURCE: IIP Bulletin No. 27

was known to contain large masses of heavy field ice and many bergs was now found to be almost entirely free of ice with exception of three small bergs and five growlers in scattered positions sighted on April 4. This ice had apparently been blown off the coast and down from the north by the prevailing northerly winds. With the completion of this search on the evening of April 4 the *Champlain* headed to the south-westward toward the relieving point.

The *Mendota* was met in latitude 43°31' N., longitude 56°15' W. A boat was lowered and Lt. G. Van A. Graves, ice observation officer, and the observer's party were transferred to the *Mendota* and at 1700 April 5, 1937, the *Mendota* relieved the *Champlain* as ice observation vessel. The *Champlain* set course for Halifax, Nova Scotia, arriving there, without incident, at 1545, April 6, 1937.

The following is a summary of ice and water temperature reports received during the patrol:

Number of vessels furnishing ice reports.....	8
Number of vessels furnishing water temperature reports.....	110
Number of ice reports received.....	17
Number of water temperature reports received.....	867
Number of vessels furnished special information.....	10

FIFTH CRUISE, "MENDOTA," APRIL 5 TO 20, 1937

The *Mendota* sailed from Halifax, Nova Scotia, at 0600, April 4, 1937, to relieve the *Champlain* as ice observation vessel. The voyage to the relieving point was accomplished without incident. Fresh to strong north and northeast winds with the accompanying rough sea, prevailed. The *Champlain* was met at 1530 and Lt. G. Van A. Graves, ice observation officer, and the observer's party reported aboard and the *Mendota* relieved the *Champlain* as ice observation vessel at 1700, April 5, 1937, in latitude 43°39' N., longitude 56°23' W. The *Mendota* set course to the eastward crossing the Banks and arriving on the eastern edge at daylight, April 7. That day and the next 2 days, April 8 and 9, the *Mendota* scouted out the cold current between latitude 44° N., and 45° N. On April 7 three bergs and two growlers were sighted in this area. One berg was large and had grounded in 33 fathoms of water in latitude 44°25' N., longitude 49°05' W. On April 8, the grounded berg was relocated and had not moved, but poor visibility prevented a thorough search for the other ice. However, two growlers were found that day and on April 9, all the ice seen on the 7th was relocated showing a southward drift of about 16 miles per day. The *General Greene* was sighted this day and while she was on station in latitude 44°20' N., longitude 48°48' W., one seaman from the *Champlain* was transferred to the *General Greene* to fill a vacancy in her crew. April 10 was foggy and no scouting could be done.

On the morning of April 11, the grounded berg was ascertained to be in the same position and at noon the *Mendota* steamed to the north-eastward to contact the *General Greene*, which was met at 1415, and a current map of the critical area was delivered by heaving line over the stern of the *Mendota*. The *General Greene* proceeded to St. John's, Newfoundland. Three average sized bergs were found this day in the following positions: latitude $44^{\circ}46'$ N., longitude $48^{\circ}43'$ W., latitude $44^{\circ}42'$ N., longitude $48^{\circ}51'$ W., and latitude $44^{\circ}37'$ N., longitude $48^{\circ}43'$ W. These bergs were in the south bound current as shown by the current chart and moved rapidly southward accordingly. Following the southward drift of this ice occupied the remainder of the patrol. During the day of April 12, the area between latitudes 43° N., and 44° N., in the cold current was searched in an effort to locate the two small bergs and two growlers last sighted just north of latitude 44° N., on April 9. This ice was not found nor was any other ice sighted in this area. Northeast winds and poor visibility prevailed all of April 13, but efforts were made to find the berg which had been grounded in latitude $44^{\circ}25'$ N., longitude $49^{\circ}05'$ W. It was not found.

The search on April 14 was planned so as to pick up the three bergs sighted on April 11, and if possible, to relocate the grounded berg last seen April 11. The three bergs were found in the following positions: latitude $43^{\circ}50'$ N., longitude 49° W., latitude $44^{\circ}12'$ N., longitude $48^{\circ}49'$ W., and latitude $44^{\circ}06'$ N., longitude $48^{\circ}28'$ W. Over the period of 3 days, two of these bergs averaged 16 miles a day and one averaged 13 miles a day. The observed velocities and directions of drift of these bergs are in excellent agreement with the calculated stream lines shown on the current chart. The grounded berg was not found. The *Mendota* drifted with the easternmost of these bergs the night of the 14, and the next day, April 15, all three were relocated. The easternmost of these three had drifted into the warm northerly current and moved only 7 miles in a northeast direction. The other two showed continued southerly drift in accordance with the current chart but the observed velocity of movement, about 20 miles per day, was in excess of what should be expected from the density of the isobaths. The search courses on the 15 were planned so as to cover the 50-fathom curve from latitude $44^{\circ}30'$ N., to latitude $43^{\circ}12'$ N., in a final effort to locate the large berg last seen aground on April 11 in latitude $44^{\circ}25'$ N., longitude $49^{\circ}05'$ W. The search was unsuccessful so at sunset the *Mendota* returned to the southernmost ice, then in latitude $43^{\circ}29'$ N., longitude $48^{\circ}53'$ W. to drift for the night. Due to rapid southward drift of these bergs carrying them south of latitude 44° N., into west bound tracks C and D, it was recommended to the Commander, International Ice Patrol Force on April 14 that ice patrol be inaugurated for the season of 1937. Acting on this recommendation the Commander, International Ice Patrol Force or-

dered the commencement of ice patrol at 2400 G. C. T., April 15, 1937, and Headquarters and the United States Hydrographic Office were so advised.

To review the story of the berg repeatedly mentioned in the paragraph above, as aground in latitude $44^{\circ}25'$ N., longitude $49^{\circ}05'$ W., this berg was first reported April 7, and was identified and located by the patrol ship that same day. It was visited each day thereafter up to and including the morning of April 11, at which time it was apparently still hard aground in the same position in 33 fathoms of water. Advantage of good weather was taken on April 12 to scout out the area between latitude 44° N., and latitude 43° N., as mentioned above. No ice was sighted. Although the visibility was poor April 13, it was attempted to find the grounded berg. Its position and the immediate vicinity were searched but because of the low visibility the search was inconclusive. It not having been found, however, and it being in the strength of the Labrador Current while aground, its whereabouts became a serious concern of the patrol. Its possible movements may be summarized as follows: Assuming that the berg rolled or was moved sufficiently to dislodge itself immediately after the *Mendota* left it at noon, April 11, the current would have carried it almost due south clear of the shoal. But 10 miles south of its starting position the current bends strongly towards the shoal and this tendency, combined with the strong northeast winds of the 13th, would have surely carried the berg back onto the shoal again. Admitting the possibility that it might have remained clear of the shoal it would have drifted southward along the Banks with the current. In either case, the scouting on April 12 would have found it so that its immediate dislodgement seems unlikely. As the position was run over in clear weather on April 15, and the berg's departure definitely established, the 12, 13, or 14 are the days it must have moved if it was dislodged as a whole to drift with the current. The scouting of April 14 and 15 exhausted the possibilities of its moving southward close in along the Banks as it most naturally would, or of moving due south or south southeast, its only other possible directions, and definitely established its disappearance from the critical area. However, it cannot be thus summarily dismissed, for, when last seen on April 11, it was the largest berg south of latitude 45° N. and the possibility of its melting is beyond consideration. The only hypothesis which would explain the failure to find the berg in its normal drift tracks is that being hard aground and unable to float freely, it had internal stresses set up in it by sloughing off pieces, which it did from time to time, changing the distribution of weight and mass sufficiently to cause it to break up into two or three pieces small enough to drift over the 30-fathom curve where they will join the Grand Banks oscillatory rotary circulation and melt in the constantly warming Bank water.

and east to latitude 45°20' N., in cold current and ran a line southward 20 miles outside the search of May 4, southward to latitude 43°45' N. Only one growler was sighted in this area. On May 7, the berg which was supposedly aground in latitude 45°13' N., longitude 48°52' W., was relocated in latitude 44°30' N., longitude 48°47' W., having drifted 43 miles in 37 hours or about 28 miles per day. That night the *Champlain* headed westward toward relieving point intending to investigate several bergs reported on May 1, 2, 4, and 5, in vicinity latitude 44°30' N., longitude 54°30' W., enroute. (See fig. 30.)

The following cases of medical assistance were handled during this patrol. On April 22, the steam trawler *Imperialist* of St. John's, Newfoundland, requested advice concerning a man aboard with badly infected gum or jaw following an extraction. Advice was promptly given and the patient was reported 2 days later as greatly improved and resting nicely. On April 28, the S. S. *Svaneholm* bound east reported a passenger, woman 65 years old, suffering from suppuration in upper jaw and possible blood poisoning to the brain and requested whether the patrol vessel could take patient or if some passenger vessel bound west in vicinity could take patient aboard. The S. S. *Svaneholm* was given the position, course, and speed of the S. S. *Scanmail*, bound New York, in her vicinity and told to communicate with that vessel and inform the *Champlain* of result. The S. S. *Scanmail* was willing to take patient and the transfer was successfully effected at 0130, April 29, or 7 hours and 30 minutes after the first message.

The *Mendota* was met in latitude 44°39' N., longitude 55°18' W. Lt. G. Van A. Graves, ice observer, and the observer's party were transferred to the *Mendota* and at 1345, May 9, the *Mendota* relieved the *Champlain* as ice patrol vessel. The *Champlain* set course for Halifax, Nova Scotia, arriving there at 0745, May 11, 1937.

The following is a summary of ice and temperature reports during the cruise:

Number of water temperature reports received.....	1,926
Number of ice reports received.....	175
Number of vessels furnishing ice reports.....	71
Number of vessels furnishing water temperature reports	102
Number of vessels furnished special information.....	19

SEVENTH CRUISE "MENDOTA," MAY 9 TO 24, 1937

The *Mendota* sailed from Halifax, Nova Scotia, at 0557, May 7, 1937, and after clearing the sea buoy set course for the relieving position. Strong east northeast winds were experienced the first day and then light and variable winds with fog and rain until the *Champlain* was met in latitude 44°39' N., longitude 55°26' W. The commanding officer departed for a conference with Commander, Inter-

TABLE 16

LISTING OF GROUNDED ICEBERGS IN 1948.

IIP PAGE	LAT. (°N)	LONG. (°W)	LENGTH (m)	HEIGHT (m)	DEPTH (m)	DATE
10	43°-19'	50°-10'	137	37	64	MAY 13

SOURCE: IIP Bulletin No. 34

Current moving south along the eastern slope of the Grand Banks continued their southward movement until on the 23d several bergs and growlers were reported as far south as 43° N., 49° W.

Anticipating the advent of unfavorable conditions for aerial reconnaissance during the early part of May, the *USCGC Mendota* departed from Argentia, Newfoundland at 2031 G.c.t., 26 April on an ice observation cruise in the vicinity of the Tail of the Banks, the bergs in that area representing the greatest potential menace to vessels traveling track B. By the end of the month 2 bergs had rounded the Tail of the Banks, one being located at 43°04' N., 50°19' W., the other at 42°57' N., 50°38' W. As the month ended, bergs, upon arriving in the area between the Grand Banks and Flemish Cap, still tended to separate, the greater proportion proceeding southward along the slope of the Grand Banks but with a smaller proportion still persisting in moving to the southeast to a position just to the south of Flemish Cap. Here their progress to the southeast ceased. No current chart for this period and area was available but it appeared likely that the northeasterly flowing Atlantic Current was blocking their further progress to the southeast. For that reason, bergs taking the southeastern branch at the fork represented little or no menace to track B, the critical area being near the Tail of the Banks.

It is estimated that 210 bergs drifted south of 48° N., during April. The distribution of bergs and field ice during the month of April is shown graphically in figure 4.

MAY

During the last few days in April and the first few days in May, the ice observation vessel scouted out the areas south and west of the Tail of the Banks. Of the two bergs that had been sighted on the 29th of April just to the west of the Tail of the Banks by an ice patrol plane, only one was relocated at 43°03' N., 50°20' W. Conditions for aerial reconnaissance in this area were unfavorable during the first part of May until the 12th when the eastern slope of the Grand Banks between the 43d and 47th parallels was scouted out by ice patrol aircraft. The 12th was merely the best of a series of bad days, however, and complete coverage was not possible. As a result the berg previously sighted at the Tail of the Banks was not relocated nor were any bergs sighted to the east of the slope.

On the 13th of the month the ice observation vessel sighted a berg at 43°19' N., 50°10' W. This was undoubtedly the same one sighted previously at 43°03' N., 50°20' W. An examination of the current chart for the period 6 to 10 May, contained elsewhere in this bulletin, will show the presence of a small clockwise eddy centered just north of the Tail of the Banks. After rounding the Tail of the Banks late in April, this particular berg was evidently carried to the northward in the above mentioned clockwise eddy, subsequently grounding in 35 fathoms of water in the position where it was sighted by the ice observation vessel on the 13th. It is difficult to explain how a berg with its dimensions

(120 feet high and 450 feet in length) could have drifted into such shoal water. Originally the underwater body of the berg must have resembled a huge shelf surrounding a central mass of ice which projected above the water.

By the third week in the month the over-all picture on the Grand Banks was altered somewhat. There were now a number of bergs in position to drift southward in the western branch of the Labrador Current along the Avalon Peninsula of Newfoundland. One having already made the journey was reported off Cape Race on the 15th. At the same time bergs were reported as far east as the 45th meridian between the 45th and 47th parallels and as far east as the 44th meridian between the 47th and 48th parallels.

In the meantime the over-all berg picture coupled with adverse conditions for aerial scouting in the Grand Banks area as a whole necessitated the inauguration of a continuous surface vessel patrol. Therefore at 1130 G.t.c. on 14 May a continuous surface vessel patrol was inaugurated. On the 18th of the month the ice patrol vessel located a berg at 44°30' N., 45°38' W. When located it was drifting to the southeast. By the 20th of the month the berg had deteriorated considerably and was apparently drifting in a small counterclockwise eddy. Although only 40 miles to the northwest of westbound track B it had definitely ceased to be a potential threat. By the end of the month, only a few bergs had successfully negotiated the trip southward from the 48th parallel along the slope of the Grand Banks and a similarly small number into the area south of Flemish Cap. One had managed to round the Tail of the Banks. A few were still reported along the Avalon Peninsula from Cape Race to Baccalieu Island. None threatened vessels traveling on the scheduled United States-European track B.

As the month began, the field ice limits in the St. Lawrence area ran from 5 miles off Cape North to 46°50' N., 59°30' W., and thence to 46°25' N., 58°40' W. On the 10th of the month the Canadian Department of Transport reported scattered strings and patches of field ice as far east as the 59th meridian between 45°50' N., and 47°00' N., with a 10-mile wide shore lead along the east coast of Cape Breton Island. By the 16th of the month only remnants of heavy field ice remained off the east coast of Cape Breton Island between 45°50' N., and 47°00' N. The end of the month saw the St. Lawrence area definitely clear of all field ice.

To the north a belt of field ice 40 miles wide was reported on the 18th along the coast of Labrador and Newfoundland running northward from the parallel of 50°20' N., and blocking the Strait of Belle Isle. The Strait of Belle Isle was apparently clear westward of the 56th meridian.

During the month of May it is estimated that 185 bergs drifted into the area south of 48° N. Their distribution is shown graphically in figure 5.

JUNE

A marked reduction in the number of bergs entering the area south of

6. ESTIMATE OF SCOURING RATE FOR THE 1923 ICE-SEASON

As presented in Table 7, a total of 12 groundings involving 11 icebergs were noted by IIP in 1923 in the area of the Tail of the Banks below 44°N and inside the 100 fathom (183m) line. The total area surveyed was determined by noting all the vessel positions reported in 1923 for all IIP cruises in the area. The area searched was about 17000 square kilometers and the inferred scour rate is taken to be $12/17000 = 0.071$ scours/ 100 square kilometers-year. One grounding on May 1 and 4 is inferred to indicate a definite scour track between 43°-06'N by 50°-50'W and 43°-12'N by 51° 03'W in a water depth of 110m. The scour track length is about 20 km and the scour should be easy to find. The point in mentioning this inferred scour is that a historical scour of known age may be of interest with respect to ongoing studies of scour degradation.

As for the grounding events reported by IIP for other ice-seasons (summarized in Table 1 and presented in Fig. 1), it is not possible to compute realistic estimates of scouring by icebergs, owing to the apparent sparsity of reported groundings. For example, in 1939 a total of 850 bergs were reported to have drifted south of 48°N which was about twice the yearly average; yet no groundings were reported in 1939. It is a virtual certainty that groundings occurred but none were noted by IIP vessels. The same can be said for the 1938 ice-season; as shown in Fig. 3, there were plenty of bergs as early as April, but no groundings were reported. Therefore it seems that reliable estimates of scour rates cannot be computed from IIP reports. However it is considered that the inferred scour rate for the 1923 ice-season for the Tail of the Banks below 44°N is probably realistic as a minimum scour rate.

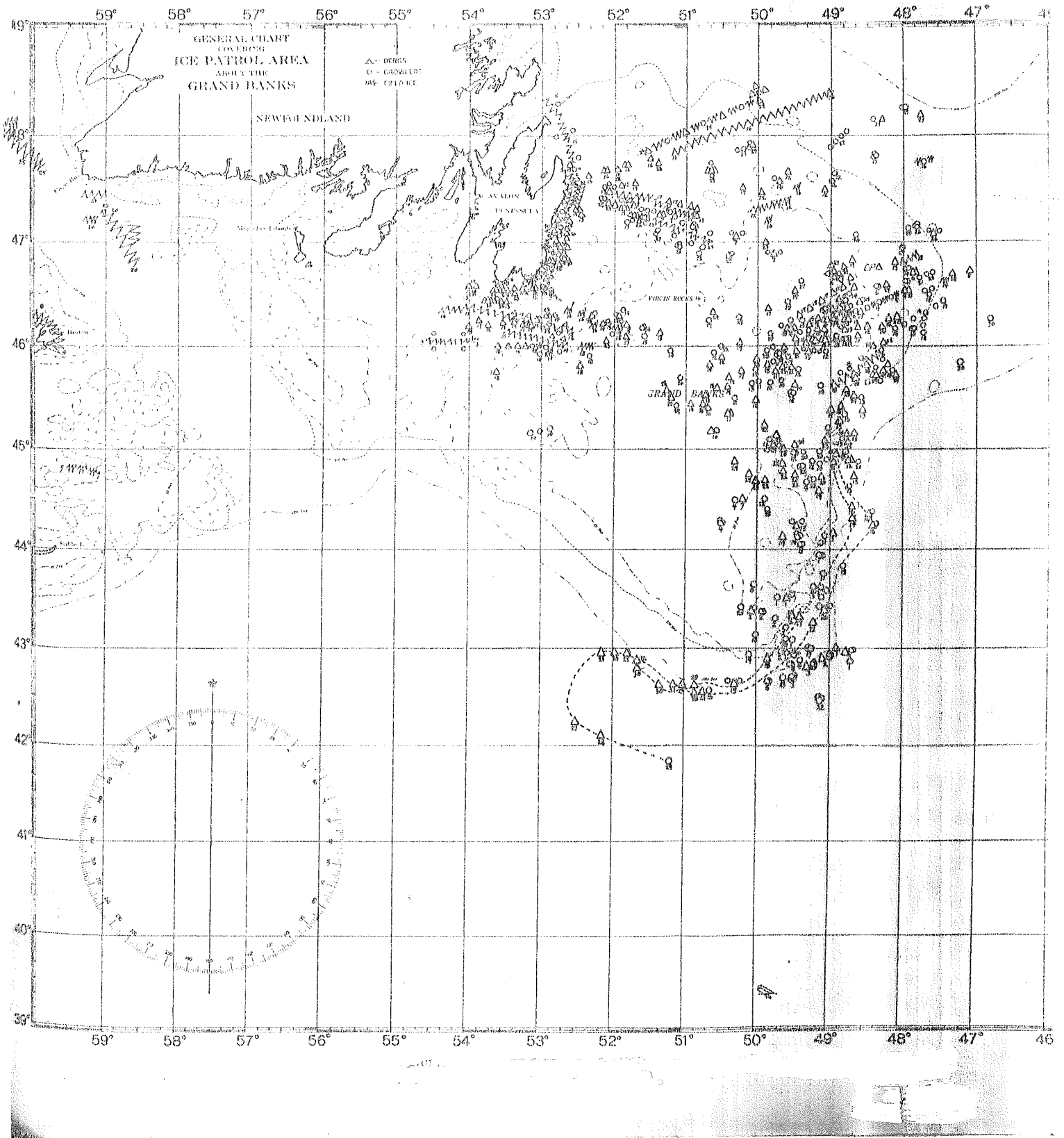


FIGURE 3 Icebergs in April, 1938.

7 WINDS, CURRENTS AND WATER TEMPERATURES.

The icebergs listed in Table 1 as having grounded, were observed by IIP after grounding took place. Therefore the dates of groundings are not known and the winds, currents and sea temperatures at each grounding site are not known. On a large scale, IIP attributed the groundings observed on the south-west slope of the Tail of the Banks during April, 1923 to the Labrador current. This current skirted along the eastern edge of the Grand Banks as far south as the Tail of the Banks, then flowed around the Tail of the Banks and then in a north-west direction towards Cabot Strait. Some of the bergs that rounded the Tail of the Banks drifted into shallow water on the south-west facing slope and ran aground. The drift into shallow water was probably caused by combined current and wind effects, and the north-west flowing current is evidenced by the inferred scour track shown in Fig. 1.

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