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The Iceberg Sightings Database: Its Purpose and Some Initial Analysis

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SUMMARY

This report details the Iceberg Sightings Database, created by Brian T. Hill of the Institute for Ocean Technology (IOT) in St. John's, Newfoundland. The database is a detailed historical log of all iceberg sightings recorded since the 1890's for the North Atlantic waters surrounding the island of Newfoundland. The purpose of the database is to provide an accurate and comprehensive log of ice movements surrounding the island. From this log it is possible to gain insight relating to the frequency patterns and quantity of the icebergs witnessed throughout the past century.

This report focuses on providing the background information on icebergs needed to fully appreciate their fatalistic potential. This information includes iceberg origin, various iceberg classifications, and the destructive ability of icebergs. Information is also given on the specifics surrounding the foundation of the International Ice Patrol (IIP), what the IIP has accomplished, and how iceberg tracking technology has progressed in the past century. From this information it is easy to recognize the necessity for foundations such as the IIP, and databases such as the Iceberg Sightings Database (ISD).

The other major section of this report deals with the structure and classification of the Excel files that formulate the initial stages of the ISD. The preliminary analysis of the derived statistics associated with these files is also included.

Finally, a conclusion summarizing what has already been done and commenting on what has yet to be accomplished is included at the end of this report.

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LIST OF SYMBOLS AND ABBREVIATIONS

&	And
~	Approximately
°	Degrees
‘	Minutes
#	Number
“	Seconds
ft	Feet
HB	Hydrographic Bulletin
HH	Halifax Herald
IIP	International Ice Patrol
IOT	Institute for Ocean Technology
ISD	Iceberg Sightings Database
kg	Kilogram
KML	Google Earth File
Ltd.	Limited
m	Meters
MO	Marine Observer
MS DOS	Microsoft Disk Operating System
N	North
NRC	National Research Council
NYMR	New York Maritime Register
P.E.R.D	Program for Energy Research and Development
S	South
SAR	Synthetic Aperture Radar
SICDB	Ship Iceberg Colision Database
SOLAS	Safety of Life at Sea
S.S.	Steamship
U.S.	United States of America
VMAP	Versamap Computer Mapping Program
W	West
WNW	West Northwest
XLS	Excel File

1.0 INTRODUCTION

Here in Newfoundland, icebergs are a common occurrence; a spectacle so familiar that they are often taken for granted. Tourists come from all over the world to witness these spectacular and awe inspiring pieces of nature. But, despite they're cold beauty, icebergs, like any other large ocean obstruction, must be viewed and navigated around with extreme caution.

Fig. 1 A large iceberg floating in the North Atlantic

Modern day ice patrol is a detailed and expansive process using all sorts of new and improved technology to accurately locate, identify and predict the location and size of icebergs. Before all of these technological advancements however, iceberg tracking wasn't such an easy or accurate process. The information that was obtained came from visual sightings by individuals traveling aboard various ships who then took the time to record the date, location, quantity, and sometimes size of the iceberg(s). To add even more confusion to this rudimentary system, before the sinking of the titanic in 1912, there was no set foundation to which ships could report their iceberg sightings.

The International Ice Patrol (IIP) was started by the United States Coast Guard in 1914, and grew from this time up to the late 1920's when it finally seems to have dominated the iceberg sightings records which are currently being filed away in an iceberg sightings database.

This database is a comprehensive record of all the iceberg data available from the 1890's onward. This extremely large quantity of data is currently being entered into an Excel file and will eventually be transformed into a convenient database format. The analysis of this data will hopefully lead to informative conclusions regarding ice flow in the Western North Atlantic.

2.0 BACKGROUND INFORMATION

2.1 Iceberg Origin

Thousands of icebergs are calved from Arctic glaciers every year. Ninety percent of those that plague Newfoundland's Grand Banks are pieces of the west Greenland glaciers. These bergs travel at sea for around two years, covering approximately 1,800 nautical miles in the process. The Labrador Current, which extends down the eastern coast of Newfoundland, is responsible for carrying these bergs south, towards their eventual demise in the slightly warmer waters surrounding the island.

Fig. 2 A calving glacier in Northwest Greenland

It is estimated that 30 – 40 thousand icebergs break away from Greenland glaciers each year. Most are not carried very far by ocean currents and stay in cold, northerly places such as Baffin Bay. A lot more are lost from being trapped in shore ice, or from being grounded along the Labrador coast during their trip south. Only around 10% of the original bergs actually make it as far south as Newfoundland. Out of this 10%, even fewer reach waters south of 48 degrees latitude. The main reason for this being that a lot of bergs get pushed into the Strait of Belle Isle [Fig. 3]. In the Strait, they either run aground and melt or continue on to the western side of the island, down towards Cape Breton, Nova Scotia (melting progressively along the way). Other bergs become grounded on the eastern seaboard of Newfoundland where they remain fixed, eventually breaking apart into insignificant pieces and melting. More still have simply melted away in the water by the time they reach the 48th parallel, and therefore cannot be counted.

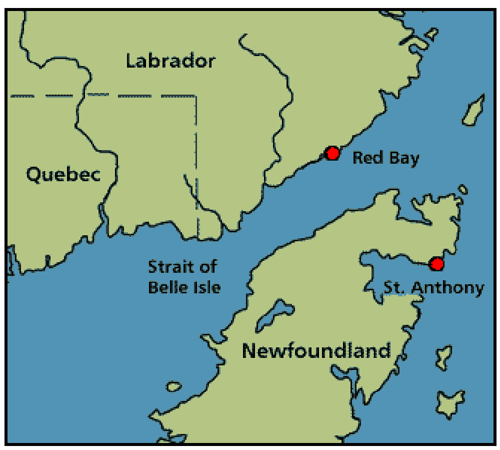


Fig. 3 Strait of Belle Isle

Despite the significantly reduced iceberg quantity around the shores of Newfoundland, they still pose a huge threat to any ocean going vessel. Unlike other ocean obstructions, the most dangerous part of the iceberg is not what we witness above the water. As is commonly known, 90% of an iceberg's mass resides beneath the ocean's surface. This fact, along with others to be discussed later in this report, are major reasons for icebergs being named one of the North Atlantic's most menacing obstructions for ships.

2.2 Iceberg Descriptions and Classifications

The International Ice Patrol has adopted a set of standard guidelines surrounding the naming and size classification of icebergs.

Table 1 Iceberg classification chart

Iceberg Size	Height above waterline (meters)	Length (meters)	Weight (Megatons)
Growler	Less than 1 m	Less than 5 m	0.001
Bergy Bit	1 m to less than 5 m	5 m to less than 15 m	0.01
Small Berg	5 m to 15 m	15 m to 60 m	0.1
Medium Berg	16 m to 45 m	61 m to 120 m	2.0
Large Berg	46 m to 75 m	121 m to 200 m	10.0
Very Large Berg	Greater than 75 m	Greater than 200 m	Greater than 10.0

While most of icebergs observed during any particular season fall into these general size classifications, a few still manage to exceed any normal expectations. These abnormally sized bergs, generally in excess of 500 m long, are recorded as “ice islands.” The number of ice islands charted varies from year to year. [Fig. 17] However, the largest iceberg (ice island) ever recorded in the Northern Hemisphere was found in 1882, near Baffin Island. It was approximately 13 kilometres long, six kilometres wide, and 20 metres above sea level with a mass of about nine billion tonnes.

Fig. 4 An ice island with multiple melt pools

The naming of icebergs is a little different. There are two basic forms of icebergs: tabular and non-tabular. Tabular icebergs have steep, vertical sides and flat tops. Their length-to-height ratio is generally greater than 5:1.

Fig. 5 A tabular iceberg

Non-tabular icebergs, which do not resemble a huge plateau, are sub-divided further into more specific classification categories. These categories are:

Iceberg Shape	**General Description**
Dome 	An iceberg with a rounded top
Pinnacle 	An iceberg which has one or more spires (tall peaks)
Wedge 	An iceberg resembling a giant wedge (a steep vertical edge on one side, with the other side sloping gradually to the water's surface)

Dry-Dock		An iceberg which has eroded away in the center forming two pinnacle-like icbergs that are attached underneath the suface (a water channel is found in the center)
Blocky		An iceberg with steep vertical sides and a relatively flat top. They have a smaller length-to-hegith ratio than a tabular iceberg. (They look more like a block)

2.3 The Dangers Associated with Icebergs

Icebergs are major ocean obstructions in the North Atlantic. Since the density of pure ice approximately 920 kg/m^3 and the density of sea water is approximately 1025 kg/m^3, typically only one-tenth of the volume of an iceberg is above the waterline. This makes it very difficult to estimate the true destructive potential of any iceberg, as its underwater section is nearly impossible to classify.

Icebergs also have an audacious tendency to roll over quickly with very little, if any warning. Pieces of ice may fall from a berg, or they may calve (split into two or more pieces). All of these occurrences could potentially create waves capable of swamping a deck, or cause swells large enough to endanger the stability of a ship.

It is generally assumed that the larger the iceberg, the more damage it is capable of causing. While this is technically true since the large icebergs are significantly heavier and stronger, due to visibility issues, the smaller bergs are actually the ones which generally cause the most damage to ships. The main reason behind this increased risk is the high potential for smaller icebergs to “slip under the radar”. Modern day radar and satellite systems use the reflecting potential of an iceberg’s surface to identify and track their movement through the ocean. Smaller bergs provide smaller targets and are therefore less easily seen and followed. Modern tracking however is still much more effective and efficient than relying solely on the gift of human sight as was common in the early 20th century. Smaller bergs were hard for helmsmen to see until the ships were practically on top of them. This left little or no time to slow down and/or react in a practical fashion.

For example, the iceberg which sunk the Titanic early in the morning on April 15th, 1912 is speculated to have been around 50 to 100 feet (15.24 to 30.48 m) high and 200 to 400 feet (60.96 to 121.92 m) long. [Fig. 6] By modern day standards this would be classified as a medium sized berg. This berg tore a hole straight through the Titanic's supposedly "unsinkable" double hull, sinking the ocean liner within three hours of contact. Consequently an estimated 1503 individuals lost their lives in the cold, unyielding waters of the North Atlantic. The ship is estimated to have sunk to a depth of 12,600 ft at the location 41° 43' 42" N, 49° 56' 49" W, southeast of the island of Newfoundland.

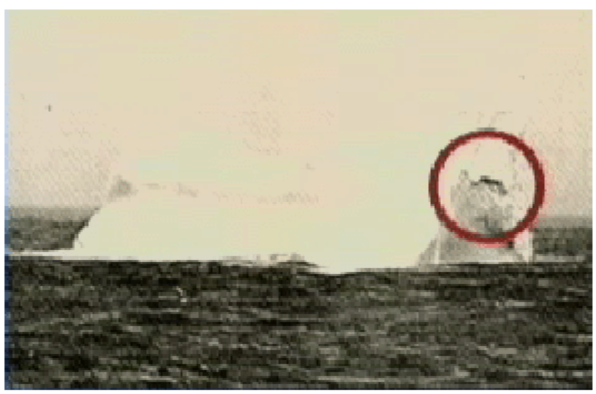


Fig. 6 Recently discovered picture of the iceberg believed to have sunk the titanic.

2.4 Establishment of the International Ice Patrol (IIP)

Icebergs had always been known to be a nuissance and a slight menace to ships. However, it was only after the sinking of the Titanic that their true catastrophic potential was realized. It became the consensus of many countries that something had to be done to address the issue.

For the remainder of 1912, the United States Navy stepped in to patrol the Grand Banks area for the presence of any more potentially dangerous bergs. When the Navy couldn't spare any ships in 1913, the Revenue Cutter Service (forerunner of the coast guard) took over the task.

On November 12th of 1913, the first International Conference on the Safety of Life at Sea (SOLAS) was held in London, England. The idea of ice patrol for the northerly regions was discussed at great length. A few months later, on January 30th of 1914 a convention was signed. The main objective of this conference was, as the name SOLAS indicates, to protect human life while at sea. To initiate and fullfill this protection promise, it was decided that an "ice patrol service, consisting of vessels, which should patrol the ice regions during the season of iceberg danger and attempt to keep the trans-Atlantic lanes clear of derelicts during the remainder of the year" would be put in place. It was agreed that the United States Government would take up responsibility of this task while receiving funding from the various countries interested in the patrol. A formula specifically designed to estimate each country's individual benefit was derived, and each country was to make a financial contribution accordingly.

For the remainder of the decade of 1910, and continuing into the 1920's, the International Ice Patrol (IIP), as it was named, continued to grow in both experience and the number of sightings which it reported. [Table 2] The second SOLAS international conference was held in London on April 16th of 1929. A total of 18 countries were present and the final act was signed by all on May 31st, 1929. This conference addressed many of the same issues as its predecessor in 1914, with only a couple of new and/or revised sections annexed into the documentation.

Since the 1929 conference, up to modern day, three more SOLAS conferences have been held. These conferences, in 1948, 1960 and 1974 updated and improved upon rules and regulations regarding previously introduced topics but offered no real change to the fundamental concepts of the IIP organization.

Currently, 17 countries provide funding for the IIP. These countries are:

- Canada
- United States of America
- United Kingdom
- Belgium
- Denmark
- Finland
- France
- Germany
- Greece
- Italy
- Japan
- Netherlands
- Norway
- Panama
- Poland
- Spain
- Sweden

The funding proportion provided by each individual nation is now based on the percentage of total cargo tonnage travelling through the patrol area which they control during ice season. In other words, the more you ship, the more you pay!

2.5 Accomplishments of the SOLAS Conferences

Since the sinking of the Titanic in 1912, major improvements have been made to the safety regulations onboard ships travelling the North Atlantic through iceberg alley (the section of the Labrador Current which runs approximately 250 miles east and southeast off Newfoundland's Grand Banks). On top of creating a constant ice patrol in the North Atlantic (IIP), a few of the changes that were induced by SOLAS are:

- ✓ Regulations regarding the speed at which a ship may travel through icy waters were put in place. At night all ships are recquired to slow down to a moderate pace or alter their course away from the known danger ahead.
- ✓ A comprehensive public address system must now be present onboard all vessels. Therefore, if an emergency does occurr, all passengers and crew can be informed of the situation quickly and in an effective manner.
- ✓ All crew members now have to be properly trained to use the saftey equipment onboard the vessel. Also, they must have easy access to comprehensive instruction manuals.
- ✓ There must be enough life vessels (some of which may be substituted for liferafts) to support all persons onboard the ship.
- ✓ Lifeboats must now be partially or completely covered to avoid prolonged open exposure to the cold North Atlantic waters. Partially enclosed lifeboats must have a collapsible roof to fully enlcose the vessel once everyone is inside.
- ✓ A certain number of cold water immersion suits must now be kept on all passenger and cargo vessels.
- ✓ Evacuation chutes must meet a quality standard for both saftey and speed of use.
- ✓ It is now a requirement that an 'abandon ship' and fire drill routine be conducted weekly on all passenger ships.

2.6 Progression of Iceberg Tracking Technology

For decades the main source of ice data came from visual sightings made by helmsmen or other individuals onboard a ship. Although these sightings were numerous in quantity, they were often disorganized, low in accuracy, and repetitive.

Many variables, such as the weather, affected the reliability of a visual iceberg sighting. Extensive cloud cover (which significantly diminishes the daylight), fog, snow, rain, sleet, etc. all affected the accuracy of an iceberg count, or the determination of an iceberg's approximate size. Ocean swells (often due to high winds) were also effective in masking both berg quantity and quality. Determining an accurate iceberg count during the night was also a major challenge. Since the reflection of moonlight on icebergs wasn't the most reliable mode of identification, only bergs in the immediate vicinity of a ship were visible. Therefore, nights that were plagued by immense cloud cover were even less likely to yield an accurate iceberg count.

Also, visual sightings were only as good as the eyes designated to identify the potential dangers. Therefore, weak or damaged telescopes had a negative impact on iceberg sighting accuracy. The potential for human error after many hours completing such a monotonous, repetitive task could have also caused accuracy problems. Therefore, the chances of missing or recounting an iceberg were high with visual recording, especially in the vicinity of dense ice.

Coupled with the problems associated with actually sighting ice, the recording and transmission of acquired visual information was also problematic. These problems would have been especially evident in the beginning of the 20th century as only the rudimentary Marconi signal transmission was available as the outside communication device onboard a ship. It was common for information to be delayed or lost in the transmission process. Often ships had a transmission limit. For example, the Titanic had a signal that only reached around 500 nautical miles. Therefore, long distance transmission of ice information was essentially non-existent.

The 1930's brought the introduction of aerial surveillance of the oceans as another method of iceberg tracking. Planes made it easier to identify and trace ocean currents and therefore track the icebergs that they carried with them.

Fig. 7 U.S. Coast Guard plane similar to those used for ice patrol purposes

In 1945, radar had made its initial appearance as a potential tracking device for large ocean obstructions, including icebergs. By 1955, oceanographic monitoring outposts using radar technology were established. These outposts were used for the purpose of monitoring and gathering information of the changing ocean front in the general vicinity of wherever they were located. Another giant step for oceanographic monitoring technology occurred in 1964 when the first computer was installed on a ship to be used for this purpose.

The decade of 1970 brought the introduction of the satellite into ocean surveillance. It became standard for icebreakers to be equipped with systems for automatically transmitting photographs via satellites. However, at this point in time, these transmissions were still fairly limited by weather conditions.

Technological potential and reliability has increased steadliy since the 1970's. Currently the Canadian Government is employing a system using Synthetic Aperture Radar (SAR) and multipolarization modes to track iceberg location and progress. SAR transmits microwave energy to the ocean's surface where they can reflect off any large obstruction and give an exact location. This system can also accurately measure changes in surface height of the ocean.

Despite the high accuracy of modern day satellite and radar systems, they are still incapable of tracking every iceberg floating in the North Atlantic. These electronic systems may malfunction at any time, often without warning. They may produce blurry images as a result of storm interruption or extreme ocean glare. Therefore, it can be argued that satellite and radar systems shouldn't completely replace visual sightings from ships and planes. Instead, they should be viewed and used as a valuable complimentary tool. Together the old and new tracking methods make finding icebergs and following their southbound progress more accurate, more effective, and more reliable than one or the other by themselves.

3.0 THE ICEBERG SIGHTINGS DATABASE

3.1 Contents of the Excel File

The Iceberg Sightings Database is in-depth electronic record of all the recoded iceberg sightings from the late 1800's up to modern day. It is currenty an extensive array of Excel spreadsheets (.xls files). Each spreadsheet consists of thousands of lines of information for each year which has been recorded thus far. Each spreadsheet also consists of an arrangement of titled fields which are designed to aid with appropriately sorting the entered data into categories and classifications if needed. These columns are:

- Source (In the case of this database, the source is always IOT)
- Flag
- IIP #
- Iceberg # (Same as the IIP #)
- Resight
- Sighting Source
- Vessel Name
- Sighting Method
- Latitude
- Longitude
- Ice Season
- Year (Same as the Ice Season)
- Month
- Date

- Time
- Size
- #Bergs
- #Growlers
- #Bergy Bits
- Small
- Medium
- Large
- Very Large
- Ice Island
- Unidentified
- Shape
- Length
- Length Flag
- Height
- Height Flag
- Width
- Width Flag
- Draft
- Draft Flag
- Mass
- Mass Flag
- Drill Site
- Comments

	data source	Flag	IIP #	Iceberg #	resight	sighting source	Vessel Name	sighting method	latitude	longitude
2	IOT	1	1	1	N	Ship	Unknown	Visual	46.50	48.00
3	IOT	1	2	2	N	Ship	Unknown	Visual	48.10	52.06
4	IOT	1	3	3	N	Ship	Unknown	Visual	47.35	46.20
5	IOT	1	4	4	N	Ship	Bergensfjord (SS)	Visual	47.00	44.30
6	IOT	1	5	5	N	Ship	Unknown	Visual	43.50	47.23
7	IOT	1	6	6	N	Ship	Unknown	Visual	43.35	47.27
8	IOT	1	7	7	N	Ship	Unknown	Visual	46.07	45.09
9	IOT	1	8	8	N	Ship	Unknown	Visual	43.45	48.35
10	IOT	1	9	9	N	Ship	Hollandia (SS)	Visual	37.50	47.23
11	IOT	1	10.1	10.1	N	Ship	Unknown	Visual	43.58	47.11
12	IOT	1	10.2	10.2	N	Ship	Unknown	Visual	43.58	47.11
13	IOT	1	11	11	N	Ship	Unknown	Visual	46.35	53.04
14	IOT	1	12	12	N	Ship	Hollandia (SS)	Visual	43.35	35.57

Fig. 8 The first ten columns of the database file for 1921.

Each new sighting at a particular location is designated its own ‘iceberg #’ (which is the same as the IIP #) as to effectively identify resights. If more than one type of iceberg was seen at a particular location or if the sighting extended over a specified distance, decimal places are added accordingly. The first decimal place of the iceberg # is assigned to designate multiple iceberg sightings in one location. For example, “4 large bergs and 2 growlers seen at 42°09’N, 47°45’W” might be given iceberg #’s of 42.1 and 42.2 respectively.

The second decimal place of the iceberg # is assigned to designate a sighting given over a certain distance range. For example, if the entry reads “30 small bergs were seen from 47°28’N, 50°10’ W to Belle Isle, then the iceberg #’s would be 376.01 and 376.02 respectively. If one entry reported both multiple sightings and a specified distance range, then both decimal places are simply utilized at the same time. For example, the iceberg #’s would be 43.11, 43.12, 43.21, and 43.22.

A flag value of either 1 or 0 is also designated to each line of every entry. The flag number was entered as 0 if it is the second location of a “from here to here” entry. A flag number of 1 is given for all other entries.

The resight column simply requires the entry of a ‘Y’ if there are repeat entries for bergs in that loaction, and ‘N’ if there are not.

The sighting source, ship name, and method of sighting each also have their own separate column. For earlier decades, all sightings would have been visual as satellite and radar tracking was not yet available.

In the column for size, a title of either berg, growler, bergy bit, small, medium, large, very large or ice island is given to the particular berg or bergs being described. Which category an iceberg is placed in depends on if the entry in question specifically titles the iceberg, or gives its dimensions. If no information has been given besides its location, then it is placed in the general ‘berg’ category.

Under the columns titled ‘berg’, ‘growler’, ‘bergy bit’, etc, the quantity of icebergs are recorded accordingly.

In the column designated for comments, the original source of the data is stated. Any other new and relevant information not classified within the other columns can also be entered in this section.

F	AL	AM
n flag	Comments	
	HB 2017 May 2	
	HB 2017 May 2: growler ~45' long	
	HB 2017 May 2: berg ~60' high & 180' long	
	HB 2017 May 2: berg from 80 to 100' high & 250' long	
	HB 2017 May 2 [probably resight of #203]	
	HB 2017 May 2: drifting WNW near berg & growlers	
	HB 2017 May 2: drifting WNW near berg & growlers	
	HB 2018 May 9	

Fig. 9 Excerpt from the Comments Coulmn in the Excel Database File for 1928

The information recorded in IOT’s Iceberg Sightings Database is also submitted to the Program for Energy Research and Development (P.E.R.D). This government funded program is administered by NRC and maintained by BMT Fleet Technology Limited. IOT has already contributed over 90,000 records from the era prior to 1960.

3.2 Using the Information Stored in the Excel Files

When all the information from all the available sources has been properly stored in the database, the information is converted into various formats convenient for further analysis. For example, the identifications and locations of each iceberg are converted into a .KML file which can be uploaded and viewed in Google Earth. A little green balloon appears in each of the locations where icebergs would have been. Therefore, it is very easy to recognize those sightings which have accidently been given land coordinates. An accurate approximation of the correct location for these icebergs can then be made in Google Earth. The new coordiantes are then transcribed back into the file, and a note made in the 'Comments' column as to what they were changed from and why.

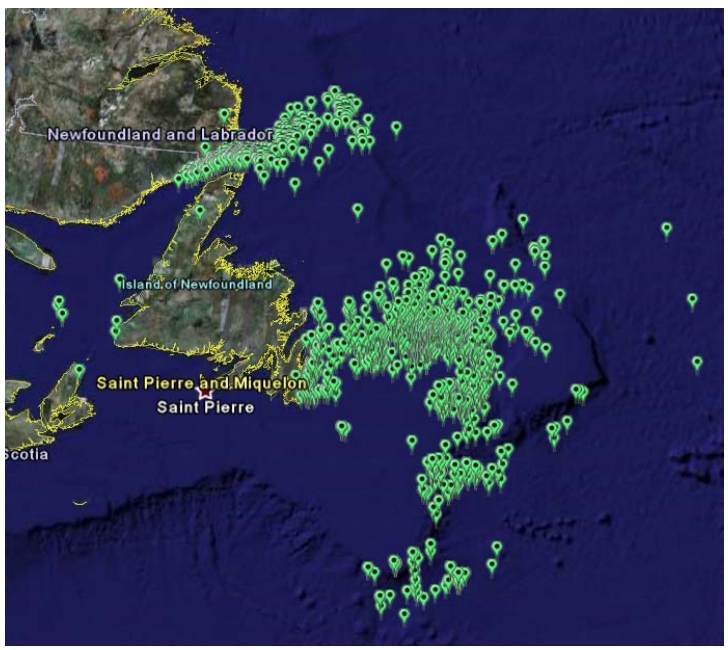


Fig. 10 Google Earth image depicting the iceberg dispersion of 1925

Another useful tool for plotting maps showing yearly iceberg trackings is the MS DOS program called VMAP. In this program, .prn files created from the original Excel database files are converted into visual representations of the iceberg sightings. A template map (in this case Newfoundland and its immediate surroundings) is called up and each iceberg is represented on the map by a marker such as the red triangles seen below. [Fig.11] Once these files are created they can be saved for future analysis purposes.

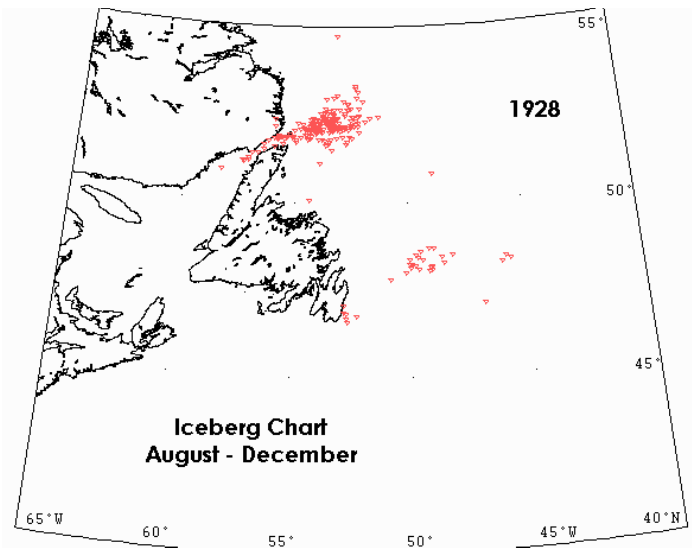


Fig. 11 The image created by VMAP for all of the iceberg sightings during 1928

4.0 DATABASING THE 1920's

4.1 Information Sources

The iceberg sightings made during the decade of 1920 were analyzed and recorded in detail. Multiple sources were used to obtain this data. These sources were:

- International Ice Patrol (IIP)
- Hydrographic Bulletin (HB)
- New York Martime Register (NYMR)
- Ship Iceberg Collision Database (SICDB)
- Halifax Herald (HH)
- Marine Observer (MO)

As the decade of the 1920's progressed, the trend for iceberg sighting sources gradually reversed. In the beginning of the decade (Ex: 1920), the majority of the sightings came from the HB, and a small percentage came from the IIP. By the end of the decade (Ex: 1929) the percentages had roughly reversed, giving the IIP most of the sightings. The proportion of sightings that came from the other four sources remained minimal and relatively stable throughout the 10-year span.

Table 2 Percentage of total sightings from each source per year

Year	% HB	% IIP	% Other
1920	92	7	1
1921	92	5	3
1922	91	7	2
1923	87	11	2
1924	78	19	3
1925	49	51	0
1926	57	43	0
1927	30	70	0
1928	38	62	0
1929	11	89	0

When the total number of sightings from each source was tabulated, the following percentages presented themselves:

Table 3 Percentage of total sightings from each source for the full decade from 1920 to 1929

Source	Percents
HB	59%
IIP	40%
Other	1%

As is evident from the complete decade analysis, the HB supplied the majority of the iceberg sighting information during the 1920's. However, as is also evident, the percentage of sightings from the IIP escalated dramatically in the late 1920's. This information provides evidence for the statement that by the beginning of the 1930's the IIP had successfully taken control of the North Atlantic ice sightings.

4.2 Importance of the Hydrographic Bulletin (HB)

It may seem that by the 1930's papers such as the Hydrographic Bulletin had become obsolete. However the HB kept record of a lot of interesting and valuable information regarding a variety of ocean related obstructions and points of interest. This is the main reason behind the continuation of publication of the HB up until 1954 when printing ceased. Some of the other information recorded by the HB was:

- Dangerous Ocean Debris (In the North Atlantic, the South Oceans and the Great Lakes)
- Seismic Activity (including tide rips)
- Astral Activity
- Volcanic Activity
- Bottle Drifts
- Occurrence of Waterspouts
- Occurrence of Sea Waves
- Whale Sightings

4.3 Comparing Our Statistics to Those Provided by the IIP

As a source of comparison reference, an Excel file, prepared by individuals associated with the IIP was obtained. This file was analyzed and plotted in a similar fashion as the information from the database, focusing particularly on sightings south of 48° from the months of August through December during the decade of 1920-1929.

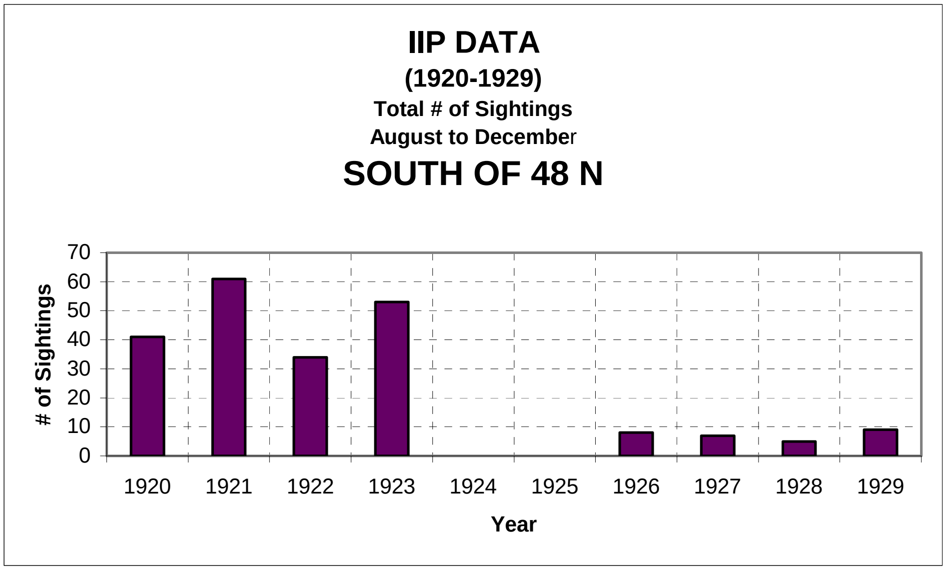


Fig. 12 Graph of the data obtained from the IIP

VS.

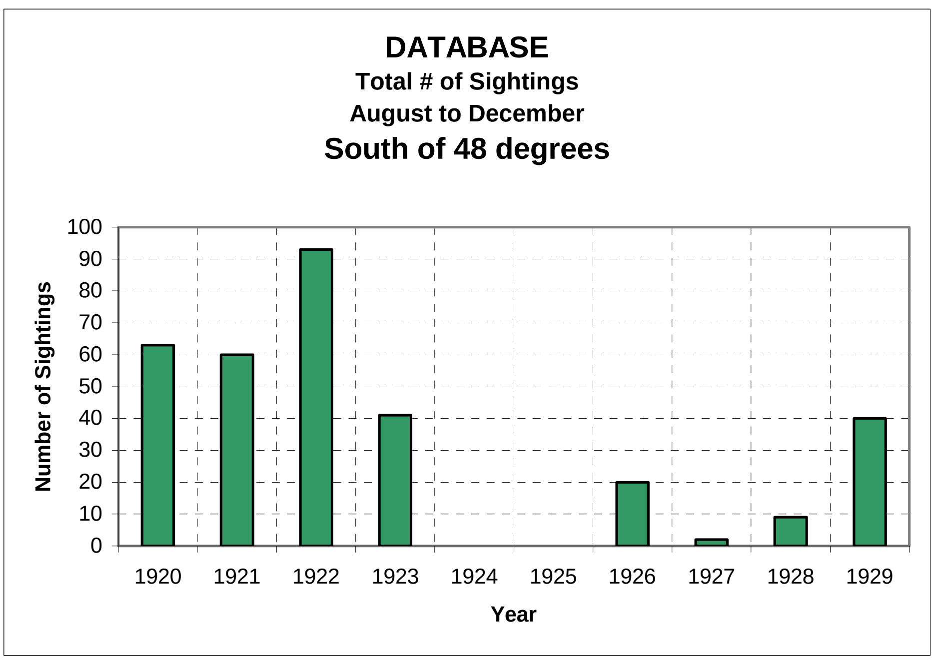


Fig. 13 Graph of the data collected in the Iceberg Sightings Database

The trend found from August to December for both the IIP data [Fig.4.1], and the database information [Fig.4.2] is very similar. The significant number of sightings observed during the first four years of the decade was followed by a two-year absence of iceberg recording. The sightings re-occurred during the last four years of the decade, however their quantity was significantly reduced.
The information contained in the database graph [Fig.4.2] is a collection of sightings from all the possible sources that were available for the decade. When the graph of only the IIP sightings was plotted:

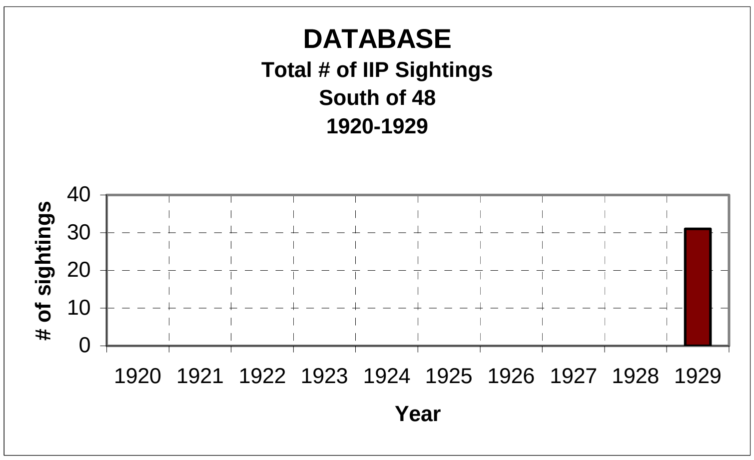


Fig. 14 Graph of solely the IIP data collected in the Iceberg Sightings Database

Based on this graph, it is logical to conclude that the information received from IIP has also been assembled from a variety of sources. The IIP wasn't a significant supplier of iceberg sightings until 1929 and therefore must have used sightings from other sources as information references for the prior era.

4.4 Implications of the Analyzed Data

As stated before, the data obtained throughout the decade of the 1920's is very divided. The latter half of the ten-year span shows a significantly reduced iceberg count below the 48th parallel. This observation can lead to much speculation surrounding a climate shift that may have occurred around 1924.

Given that the average iceberg calving rate from the Greenland glaciers remained relatively steady throughout the decade, a high iceberg count below the 48th parallel generally indicates low mean yearly temperatures. Consequently, a low iceberg count below 48° north generally indicates higher yearly mean temperatures.

It has been deduced by many that a gradual increase in average yearly temperatures began during the 1920's. The reason could be that a significant "increase in human-created greenhouse gases in the atmosphere" occurred around this time. The information obtained through analysis of the data contained in the Iceberg Sightings Database supports this warming theory. More specifically, the Iceberg Sightings Database may even be able to indicate a more specific time period as to when these trends first began, along with its yearly changes throughout the proceeding decades.

5.0 CONCLUSION

Since the sinking of the Titanic in 1912, iceberg tracking has steadily become more accurate and reliable. The foundation of the International Ice Patrol along with the impressive technological advancement of the past century has made this possible. Historic journals and/or bulletins that existed prior to the IIP, such as the Hydrographic Bulletin, have also aided in this growth process. These documents provided a rich cushion of information for the IIP to rely on for periods both prior and including those that they recorded.

Recording the details pertaining to the icebergs sighted each year has proven to be a very important and informative practice. Despite still being in its primitive stages, the Iceberg Sightings Database has already yielded valuable information regarding historic ice flow and potential climate shifts. With the continuation of the current Excel files and the creation of a more interactive database format, even more elucidative information may be obtained. Also, the plans for a web page dedicated to the Iceberg Sightings Database are in the process of being created. With the introduction of this easy-to-use web page, the considerable information obtained in the database will be readily available for public use.

6.0 REFERENCES

1) International Ice Patrol Documentation:

"Table of Ice and Other Obstructions-1920"
"Table of Ice and Other Obstructions-1921"
"Table of Ice and Other Obstructions-1922"
"Table of Ice and Other Obstructions-1923"
"Table of Ice and Other Obstructions-1924"
"Table of Ice and Other Obstructions-1925"
"Table of Ice and Other Obstructions-1926"
"Table of Ice and Other Obstructions-1927"
"Table of Ice and Other Obstructions-1928"
"Table of Ice and Other Obstructions-1929"

2) Hydrographic Bulletin Documentation:

Photographs taken of all issues of the Hydrographic Bulletin from the years between 1889 and 1947 were used as reference. The photographs for the years between 1920 and 1929 were of particular interest for this report.

3) Websites:

http://www.uscg.mil/LANTAREA/IIP/home.html

http://www.wikipedia.org/

~ http://en.wikipedia.org/wiki/Iceberg

~ http://en.wikipedia.org/wiki/International_Ice_Patrol

~ http://en.wikipedia.org/wiki/RMS_Titanic

http://www.canadiangeographic.ca/magazine/ma06/indepth/nathistory.asp

http://www.radio.cz/en/article/31001

http://www.exn.ca/titanic/icebergs.cfm

http://www.titanic-titanic.com/titanic_wreck_location.shtml

http://www.uscg.mil/LANTAREA/IIP/pdf/IMO_TITANIC.pdf

http://www.mss-int.com/solas.html

http://archive.greenpeace.org/climate/arctic99/reports/seaice3.html

7.0 ACKNOWLEDGEMENTS

I would like to acknowledge Mr. Brian T. Hill of the Institute for Ocean Technology (NRC-CNRC) for his extensive contribution to this report. Without his superior knowledge pertaining to the subject of ice distribution and trends in the Western North Atlantic, and without his vast amounts of acquired historical data, this report would not have been possible.

Another acknowledgment is extended to Mr. Wayne Pearson, also of the Institute for Ocean Technology (NRC-CNRC), for his creation of the conversion program necessary for transcribing the Excel (.xls) database files into Google Earth (.KML) files.

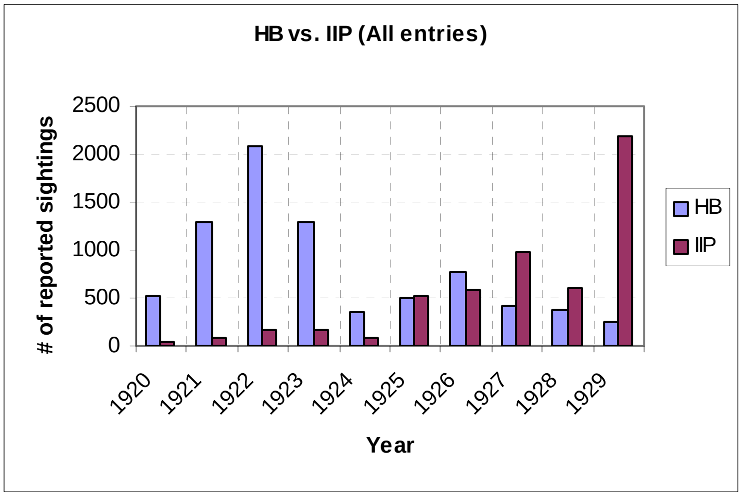


Fig. 15 Graph comparing the number of iceberg sightings from the HB and the IIP for all locations during the decade of 1920

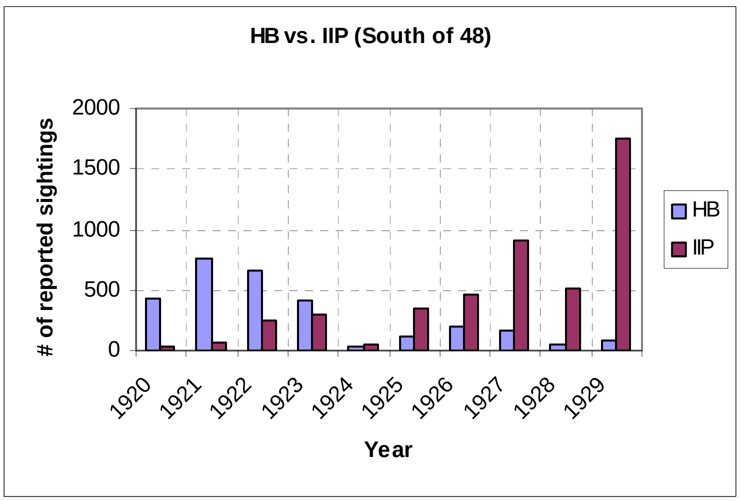


Fig. 16 Graph comparing the number of iceberg sightings from the HB and the IIP for locations South of 48° during the decade of 1920

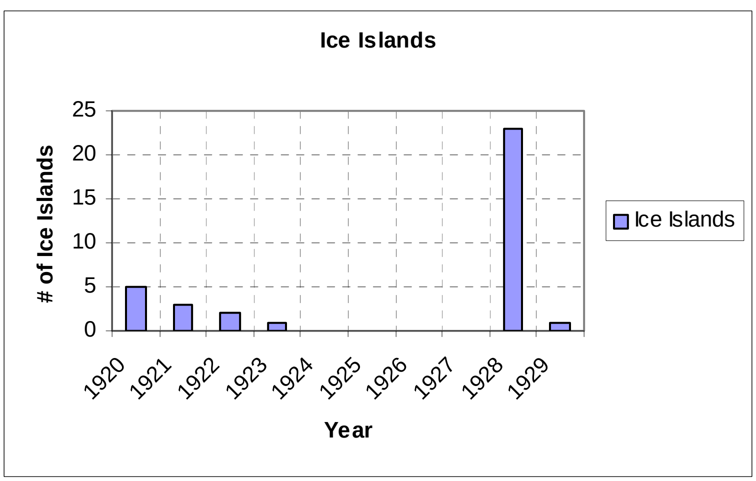


Fig. 17 Graph of the ice islands seen during the decade of 1920

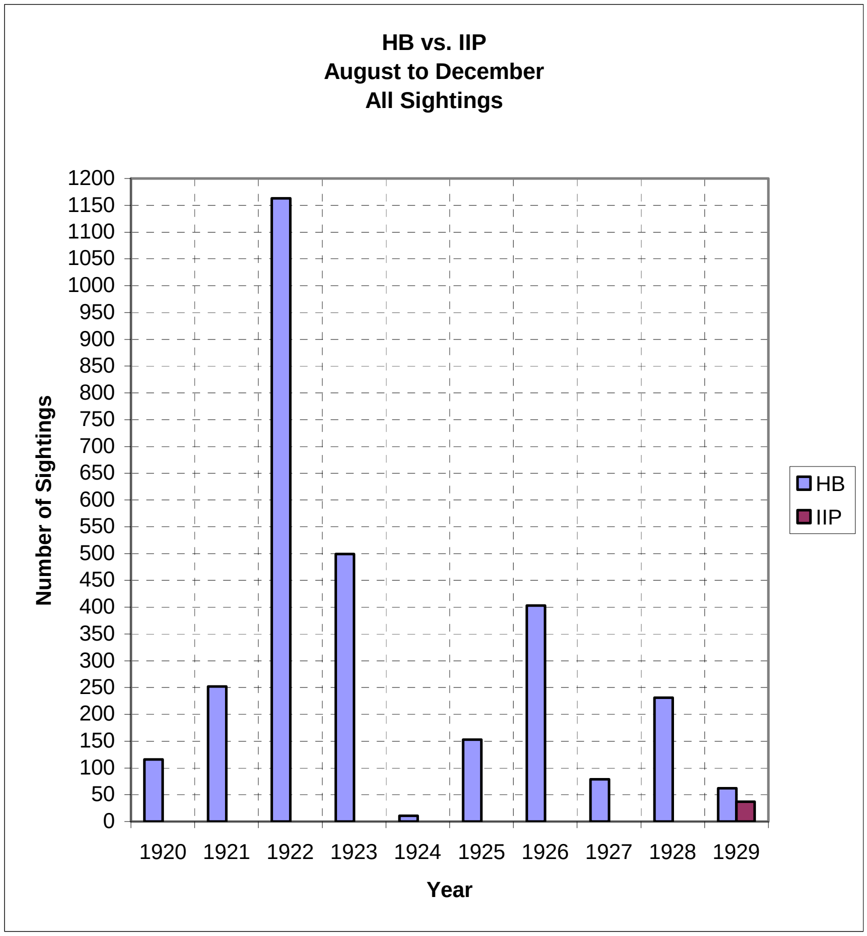


Fig. 18 Graph comparing the number of iceberg sightings from the HB and the IIP for all locations from August to December during the decade of 1920

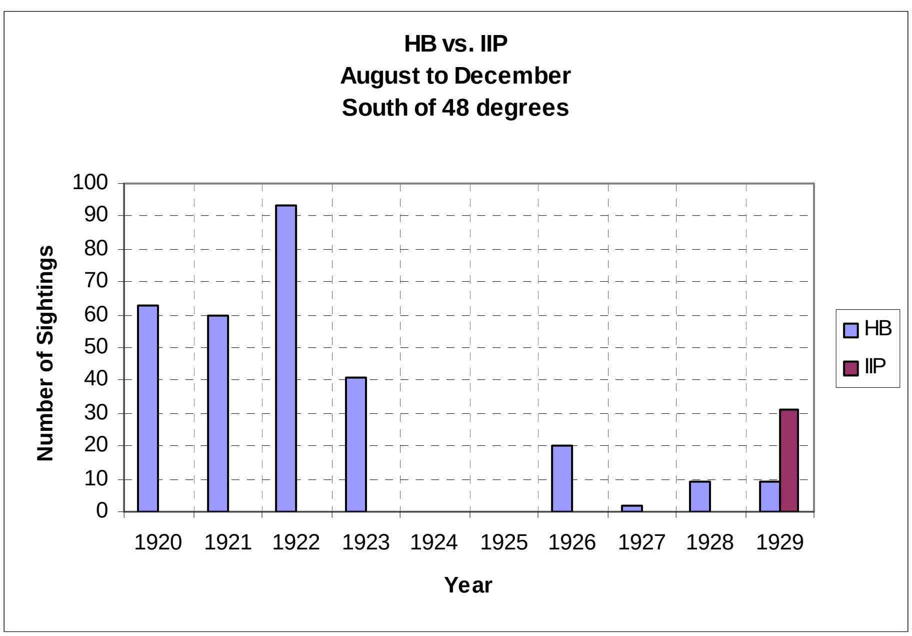


Fig. 19 Graph comparing the number of iceberg sightings from the HB and the IIP for locations south of 48° from August to December during the decade of 1920

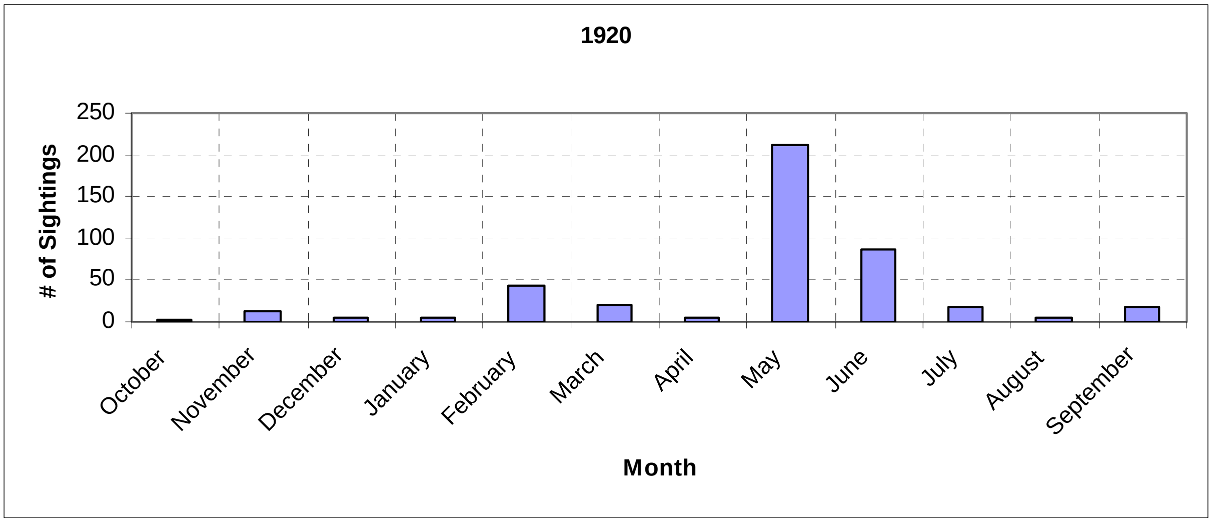


Fig. 20 Graph of the total monthly sightings for 1920

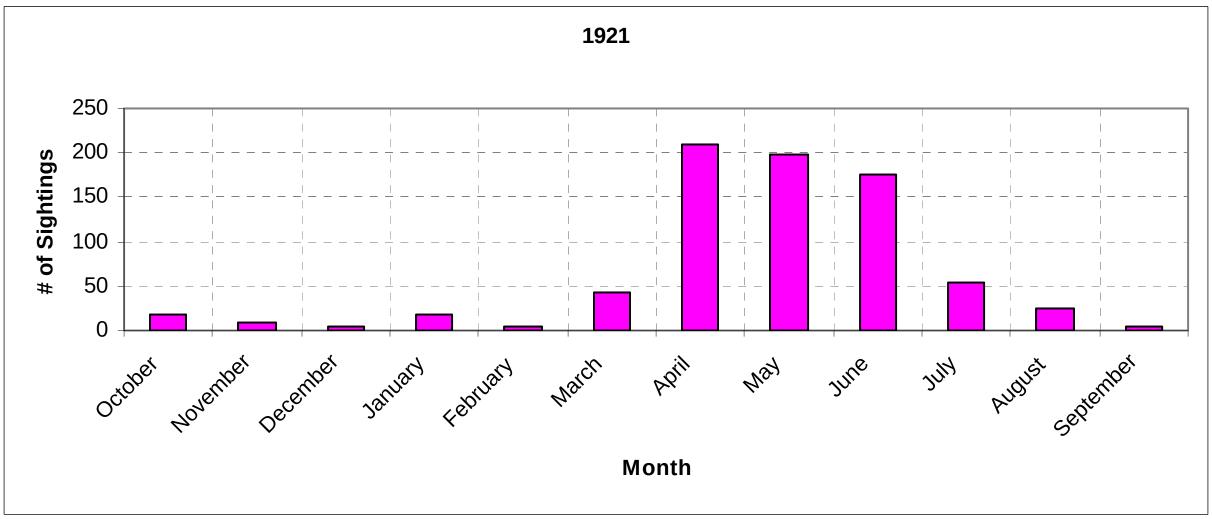


Fig. 21 Graph of the total monthly sightings for 1921

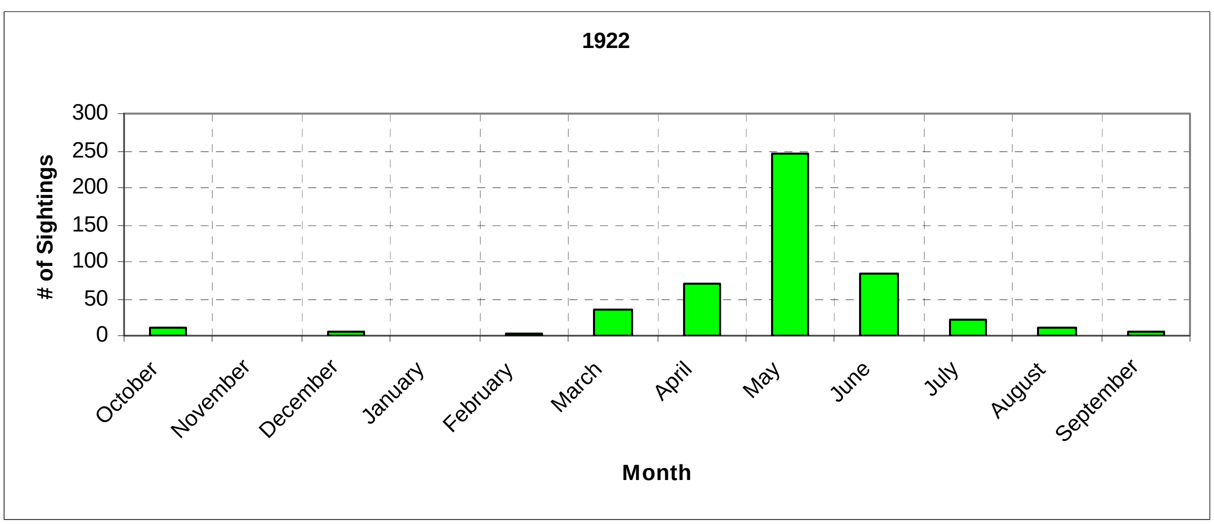


Fig. 22 Graph of the total monthly sightings for 1922

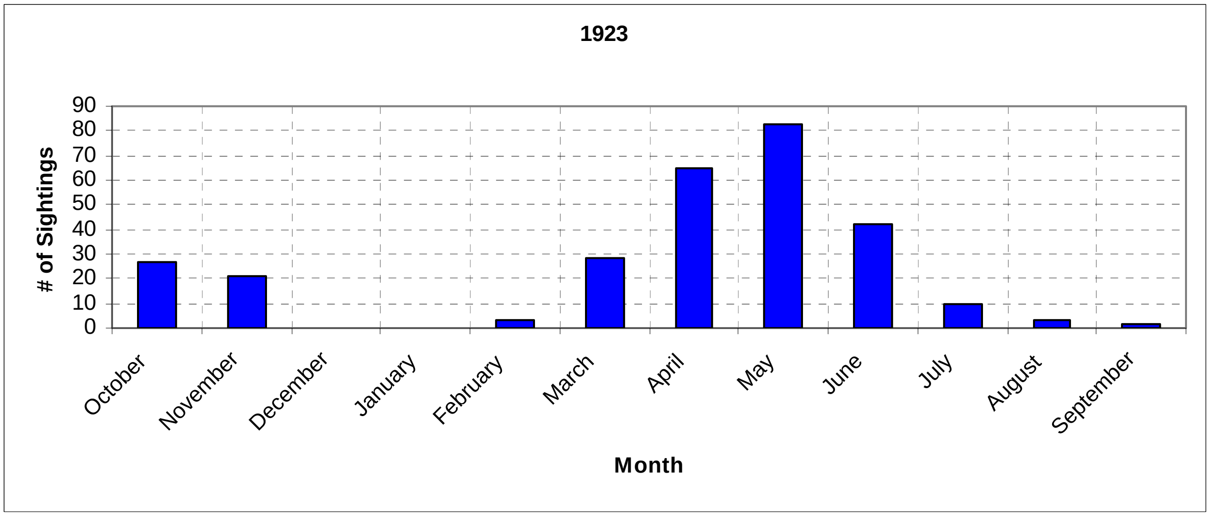


Fig. 23 Graph of the total monthly sightings for 1923

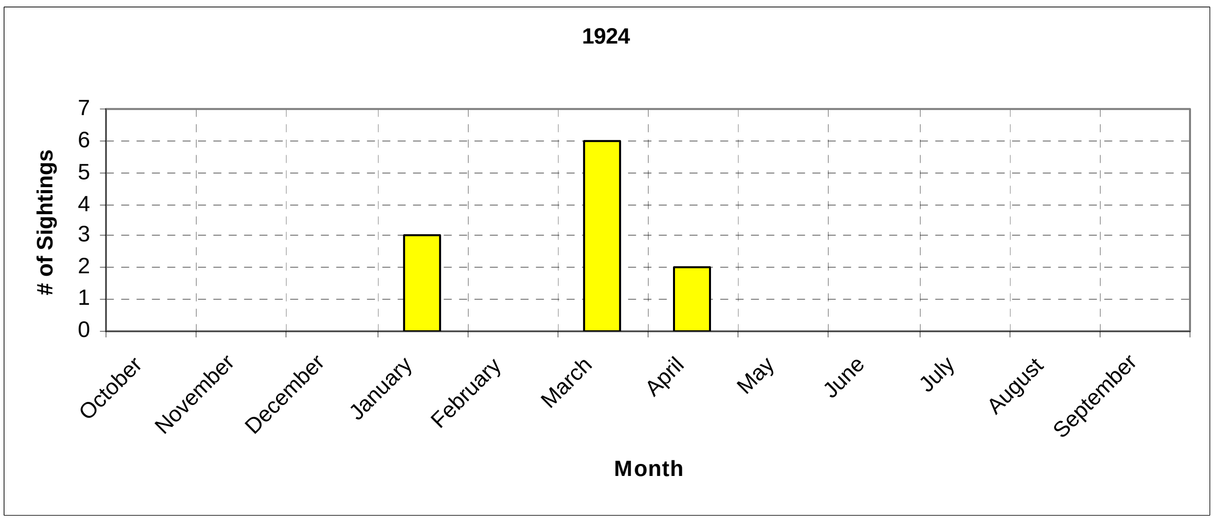


Fig. 24 Graph of the total monthly sightings for 1924

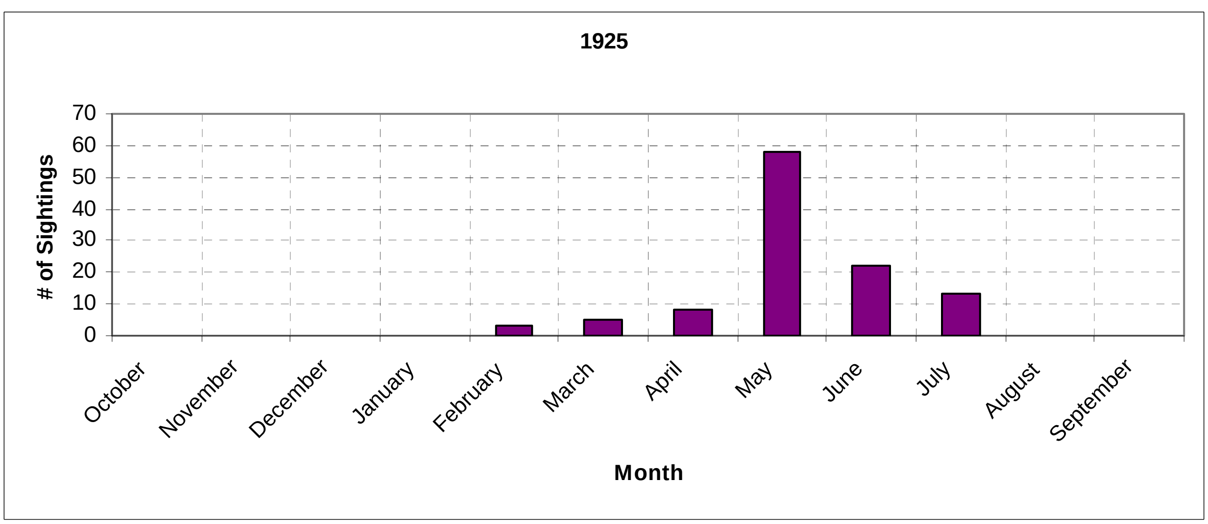


Fig. 25 Graph of the total monthly sightings for 1925

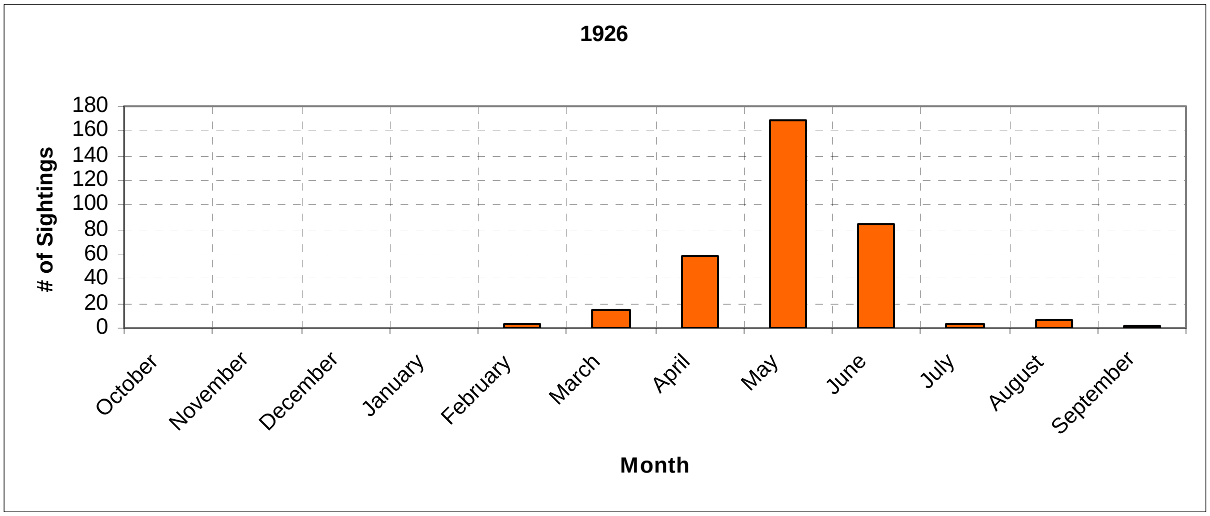


Fig. 26 Graph of the total monthly sightings for 1926

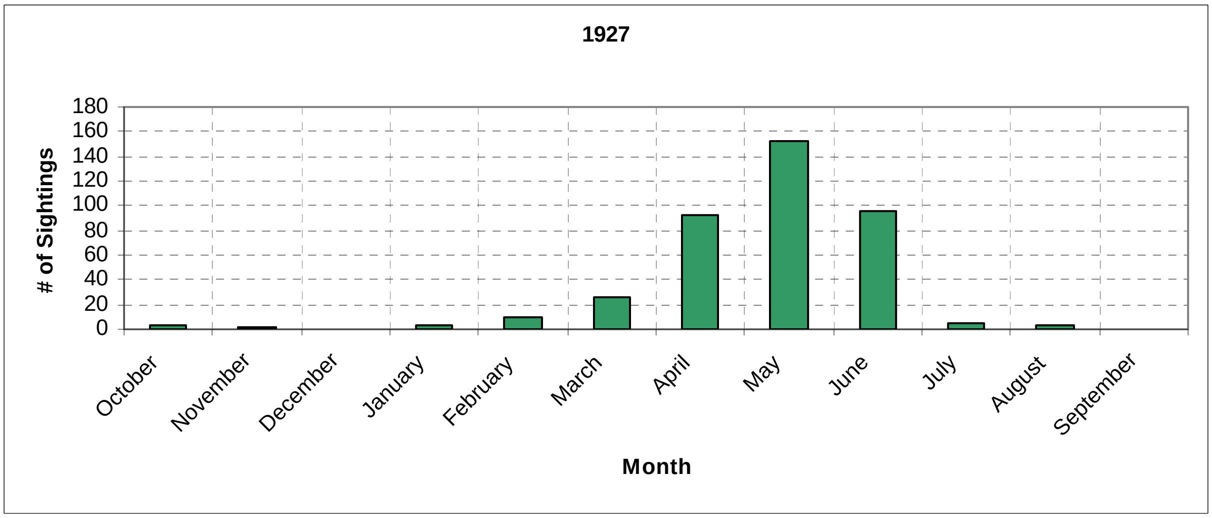


Fig. 27 Graph of the total monthly sightings for 1927

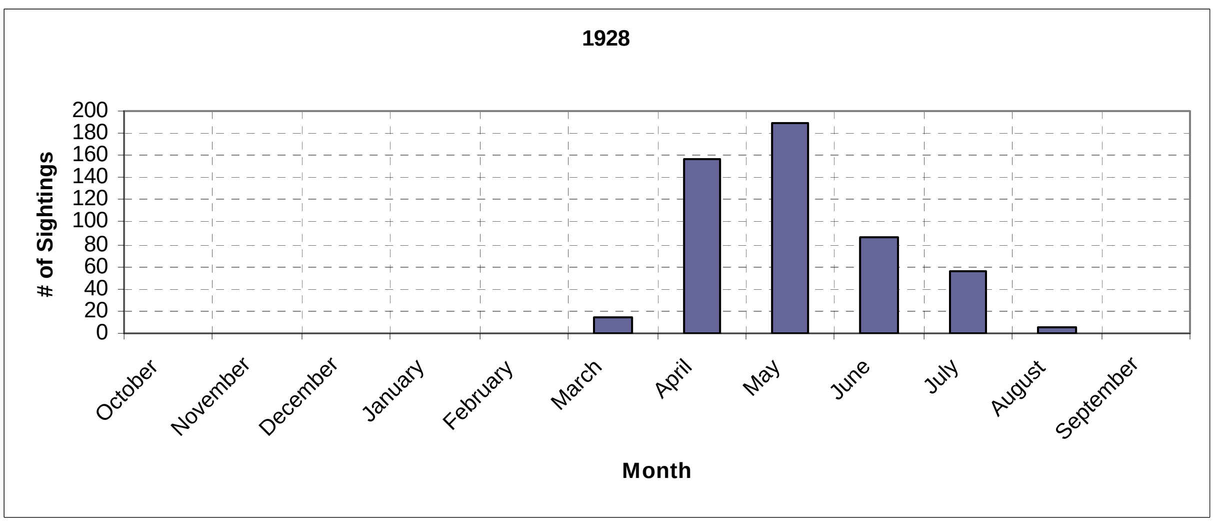


Fig. 28 Graph of the total monthly sightings for 1928

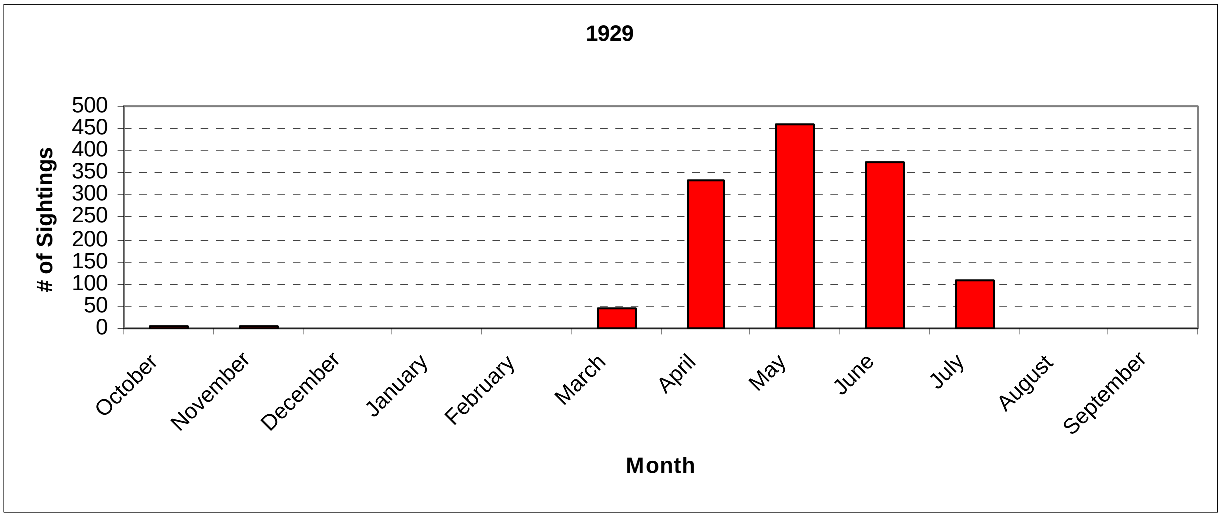
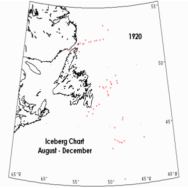
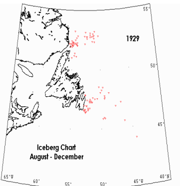


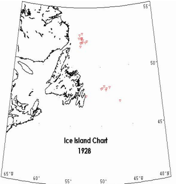
Fig. 29 Graph of the total monthly sightings for 1929



1920
Iceberg Chart
August - December
65°W
60°
55°
50°
45°W
40°N
45°
50°
55°



1929
Iceberg Chart
August - December
55°
50°
45°
65°W
60°
55°
50°
45°W
40°N



55°
50°
45°
Ice Island Chart
1928
65°W
60°
55°
50°
45°W
40°N

Hydrographic Bulletin

ISSUED WEEKLY

No. 1611 WASHINGTON, D. C., JULY 21 1920

Published by the Hydrographic Office under the authority of the SECRETARY OF THE NAVY.

The object of the HYDROGRAPHIC OFFICE is to place within reach of mariners, AT NO EXPENSE TO THEM, such useful information as can not be collected profitably by any private individual, but which the Government can readily gather, without additional cost, through agencies already established.

Owing to the small scale to which the PILOT CHARTS are necessarily limited, much nautical information received by this office is omitted from those publications. The HYDROGRAPHIC BULLETIN will supply such omissions by giving an account of obstructions and dangers along the coasts, the principal ocean routes, and on the Great Lakes, and by publishing other matter relating to navigation and of interest to seamen.

It is compiled from reports by cooperating observers and from other sources.

The maritime community is invited to send any information of value for this publication, or for the PILOT CHARTS, to the HYDROGRAPHIC OFFICE at Washington, or to one of the Branch Offices at—

BOSTON	14th Floor, Customhouse.
NEW YORK	Rooms 301, 302, Maritime Exchange, 78–80 Broad Street.
PHILADELPHIA	Main Floor, The Bourse Building.
BALTIMORE	Room 123, Customhouse.
NORFOLK	Room 2, Customhouse.
SAVANNAH	Second Floor, Customhouse.
NEW ORLEANS	Room 215, Customhouse.
GALVESTON	Room 301, Customhouse.
SAN FRANCISCO	Merchants' Exchange.
PORTLAND, OREG	Room 407, Customhouse.
SEATTLE	Room 408, Lowman Building.
SAULT SAINTE MARIE	Room 10, Federal Building.
DULUTH	Room 1000, Torrey Building.
CLEVELAND	Rooms 406–408, Federal Building.
CHICAGO	Room 531, Post Office Building.
BUFFALO	Room 340, Post Office Building.

These offices are supplied with information and publications pertaining to navigation, and masters and officers of vessels are cordially invited to visit them and consult freely the officers in charge, during the office hours, 9 a. m. to 4.30 p. m.

All Branch Hydrographic Offices are supplied with a daily memorandum containing a synopsis of all important information received by the Hydrographic Office at Washington up to 4 p. m. of the day of issue.

NOTE.—By authority of the Governor of the Panama Canal some of the duties of Branch Hydrographic Offices are performed by the Captain of the Port at Cristobal and the Captain of the Port at Balboa. Reference charts and sailing directions may be consulted at these offices and shipmasters may receive the Pilot Charts, Notice to Mariners, and Hydrographic Bulletin in return for marine and meteorological data reports. Observers' blanks and comparisons of navigational instruments may be obtained at the same time.

REPRINTS OF HYDROGRAPHIC INFORMATION.

From time to time the Hydrographic Office reprints in pamphlet form information that has appeared in the PILOT CHARTS and BULLETINS.

The titles of those most in demand are:

No. 2.—North Atlantic Ice Movements.
No. 3.—Use of Oil to Calm the Sea.
No. 8.—Questions and Answers.
No. 9.—The Origin and Mission of the Hydrographic Office.
No. 10.—The Use and Interpretation of Charts and Sailing Directions.
No. 11.—Production of Navigational Charts.
No. 13.—Cyclonic Storms.
No. 14.—Questions and Answers No. 2.
No. 21.—Questions and Answers No. 3.
No. 24.—North Atlantic Ice Patrols. (Appeared October 24, 1913.)
No. 25.—Questions and Answers No. 4.

Masters and officers can obtain them on application to a Branch Hydrographic Office.

U. S. RADIO COMPASS STATIONS.

Masters of vessels are invited to make use of the U. S. naval radio compass (direction finding) stations to fix positions during thick weather.

The following U. S. naval shore radio compass stations are now in operation for the purpose of furnishing bearings in the Western Atlantic. For the present there will be no charge for bearings furnished.

Radio Compass Station.	Radio call.	Position.	
Bar Harbor, Me	NBD	Lat. 44° 18′ 36″ N.	Lon. 68° 11′ 27″ W.
Gloucester, Mass	NAD	Lat. 42° 35′ 19″ N.	Lon. 70° 41′ 08″ W.
Deer Island, Mass	NAD	Lat. 42° 21′ 15″ N.	Lon. 70° 57′ 30″ W.
Fourth Cliff, Mass	NAD	Lat. 42° 09′ 40″ N.	Lon. 70° 42′ 22″ W.
Cape Cod, Mass	NAE	Lat. 42° 02′ 58″ N.	Lon. 70° 04′ 32″ W.
Surfside, Nantucket, Mass	NBS	Lat. 41° 14′ 42″ N.	Lon. 70° 05′ 56″ W.
Price's Neck, R. I	NAF	Lat. 41° 27′ 06″ N.	Lon. 71° 20′ 15″ W.
Watch Hill, R. I			

tions are not over 2 degrees of arc in error, but do not meet at a fixed point, the geometrical center of the triangle formed by the bearings can generally be taken as the approximate position of the vessel.

The primary object of these stations is to assist in the navigation of vessels during atmosphere of low visibility.

In order that the operation of shore radio compass stations may be checked up, it is requested that a brief report be forwarded to the Director, Naval Communications, Navy Department, Washington, D. C., containing the following particulars:

1. Name of ship.
2. Name of radio compass station.
3. Date and G. M. T. at which radio bearing was taken.
4. Bearing given by radio compass station.
5. Estimated position of ship at above time and dates by methods other than radio.
6. The probable degree of accuracy of the estimated position.
7. Weather conditions at above time.
8. Remarks, if any.
9. Signature of master or responsible navigating officer.

ACCURACY OF RADIO BEARINGS.

The following information was furnished by the Director of the U. S. Naval Communication Service under date of Oct. 10, 1919:

"The reliance that can be placed in bearings furnished by shore radio compass stations will be governed by the following conditions:

"(a) When two sets of bearings are received which do not agree, a third set should immediately be requested.

"(b) In thick weather bearings should be requested at least every half hour.

"(c) Bearings that pass over intervening land or that are tangent to the shore line are not as reliable as those that have a clear sweep over the sea.

"(d) Navigators receiving a set of bearings should immediately investigate the approximate fix indicated and determine whether or not they are being furnished with bearings from the stations that should be most reliable.

"(e) When the position of the ship as indicated by the radio bearing differs materially from the position by dead reckoning, a second set of radio bearings should be requested in order to check the first radio position."

NOTE.—While the Navy Department states that at the present time radio compass bearings have reached a high degree of accuracy, it must be understood that the Government incurs no liability for any consequences resulting from any inaccuracy in the taking or transmission of radio compass bearings. These bearings are provided free of charge, as aids to navigation, to be used at the discretion of the master of the vessel.

TIME SIGNALS BY RADIO.

According to information received under date of Oct. 31, 1919, from the Director of Naval Communications, time signals are being transmitted by the United States naval radio stations as follows:

Station.	Call letters.	Wave length (meters).	When sent.
Washington	NAA	2,500	Daily at 11.55 a. m. to noon, and 9.55 to 10 p. m., standard time, 75th meridian.
Annapolis	NSS	*17,000	Daily at 11.55 a. m. to noon, and 9.55 to 10 p. m., standard time, 75th meridian.
Key West	NAR	1,500	[illegible]

AN INVITATION TO VISIT THE HYDROGRAPHIC OFFICE.

The U. S. Hydrographic Office has always greatly appreciated the freedom with which the officers of the merchant marines of all nations have made use of the facilities afforded in United States ports by the U. S. Branch Hydrographic Offices. The Hydrographer desires, however, to inform all such officers that they will always receive an equal welcome at the Hydrographic Office itself, in the Navy Department, Washington, D. C., and that it would give him much pleasure at all times to receive at that office any of them who may be able to come to Washington, whether the purpose of their visit be professional or merely social, and to render to them while in Washington any service that may lie within his power or within that of the Office.

L. H. CHANDLER,
Rear Admiral, U. S. Navy,
Hydrographer.

NORTH ATLANTIC OCEAN.

OFF THE AMERICAN COAST.

The following obstruction was reported:

JULY 15.—Lat. 40° 33′, lon. 73° 04′, an unlighted obstruction buoy.

JULY 12.—Lat. 40° 26′, lon. 67° 33′, a heavy spar.

JULY 18.—Lat. 40° 12′ 30″, lon. 74° 38′ 30″, a broken spar about 18 inches in diameter with a large sliver showing about 2 feet out of water, apparently attached to submerged wreckage.

JULY 17.—Lat. 39° 20′, lon. 69° 15′, a drifting mine.

JULY 12.—About 8 miles off Atlantic City, N. J., the steamer *Lake Frampton* was sunk in collision with another steamer.

JULY 16.—Lat. 38° 29′, lon. 65° 05′, a spar about 2 feet in diameter projecting about 8 feet out of water, apparently attached to submerged wreckage.

JULY 11.—Lat. 38° 26′, lon. 64° 58′, a capsized wooden hull about 250 feet long painted red with spars attached.

JULY 12.—Lat. 38° 10′, lon. 74° 15′, about 100 filled oil barrels scattered over a radius of 10 miles.

JULY 13.—Lat. 37° 39′, lon. 71° 13′, a spar about 16 feet long and 1 foot in diameter.

JULY 11.—Lat. 37° 34′, lon. 74° 37′, a pile with a large spike in the top standing upright and projecting about 2 feet out of water.

JULY 15.—Lat. 32° 38′, lon. 78° 54′, a drifting buoy showing a white flashing light every 2 seconds.

JULY 18.—About 5 miles NNE. from Carysfort Reef Light, a spar about 50 feet long.

ALONG THE OVER-SEA ROUTES.

The following obstructions were reported:

JULY 13.—Lat. 35°, lon. 62° 26′, a large tree.

JUNE 26.—Lat. 36° 58′, lon. 60° 59′, a conical buoy painted red or yellow, marked 1 in white, showing about 5 feet out of water.

JUNE 14.—Lat. 40° 32′, lon. 60° 25′, a white spar buoy.

JUNE 25.—Lat. 34°, lon. 60° 16′, two pieces of a spar or mast about 40 feet long.

JULY 12.—Lat. 41° 29′ 30″, lon. 53° 32′, what appeared to be a drifting mine with an eye bolt in the center of the top; painted white on top and copper-colored underneath.

JULY 11.—Lat. 40° 50′, lon. 49° 10′, a gray painted lifeboat bottom up.

at 11.55 a. m. to noon, standard time, 120th meridian, west.
Daily at 11.55 a. m. to noon, standard time, 120th meridian, west.
Daily except Sundays and holidays at 10.55 a. m. to 11 a. m., standard time, 90th meridian.
Daily at 180th meridian mean noon.

† Spark.

ATIONS AT SEA.

United States Weather Bureau, l Service of the United States," weather and water temperature possible. The commercial value s the several uses to which the story of this young but valuable h the opinion of Lieut. Matthew vy, one of the great pioneers in look to the sea for the rule" in

to associate itself actively with more voluntary observers. The been drawn to the sea for service ard's fleet have found ready for of the several oceans, the storm-ly forecasts by radio. They must n guesswork or theory, for they eady stream of weather observa-eather Bureau. The fuller that its composing elements are, the afarer will be the results. Self-e not yet aroused, should prompt ser touch with this branch of his brief daily attention required of a hat is can be learned by inquiring st seaport station, where the above-

HART AGENTS.

Office charts are again available for 851, and 4853.

JUNE 30.—Lat. 49° 40′, lon. 7° 40′, a drifting mine.

ICE REPORTS.

Ice has been reported as follows:

MAY 24.—Lat. 45° 05′, lon. 49° 50′, iceberg; lat. 45° 15′, lon. 49° 13′, icebergs; lat. 42° 09′, lon. 48° 41′, icebergs; and lat. 49° 29′, lon. 49° 10′, icebergs.

MAY 25.—Lat. 44° 13′, lon. 44° 51′, two icebergs.

MAY 25.—Lat. 47° 16′, lon. 47° 57′, two icebergs.

MAY 26.—Lat. 44° 39′, lon. 48° 01′, to lat. 44° 15′, lon. 49° 10′, three icebergs.

MAY 26.—Lat. 45° 15′, lon. 54° 20′, two icebergs.

MAY 28.—Lat. 47° 36′, lon. 51°, two icebergs.

MAY 31.—Lat. 47° 17′, lon. 52° 20′, icebergs; lat. 46° 20′, lon. 53°, icebergs; and lat. 49° 33′, lon. 47° 54′, icebergs.

JUNE 2.—Lat. 47° 15′, lon. 48° 50′, icebergs.

JUNE 2.—Lat. 41° 58′, lon. 48° 33′, an iceberg; lat. 42° 05′, lon. 48° 42′, a large iceberg; lat. 42° 03′, lon. 48° 35′, an iceberg and three growlers; and lat. 42° 40′, lon. 47° 06′, a large iceberg.

JUNE 5.—Lat. 40°, lon. 47° 42′, icebergs.

JULY 4.—Lat. 43° 25′, lon. 46°, icebergs.

JULY 7.—Lat. 48° 47′, lon. 45° 25′, an iceberg about 100 feet high.

JULY 7.—Lat. 48° 27′, lon. 47° 20′, an iceberg about 100 feet high and 300 feet long.

JULY 7.—Lat. 46° 55′, lon. 46° 52′, two large icebergs close together; also several growlers.

JULY 7.—Lat. 48° 25′, lon. 47° 20′, icebergs; lat. 46° 46′, lon. 47° 02′, icebergs; and lat. 48° 48′, lon. 48° 23′, two icebergs.

JULY 8.—A large number of icebergs and growlers reported north and south of the tracks from lon. 48° to Cape Race and vicinity between lat. 47° 30′ and lat. 48° 30′.

NORTH PACIFIC OCEAN.

ICE REPORTS.

Ice has been reported as follows:

MAY 15.—Lat. 57° 40′ N., lon. 158° W., saw a small field of scattered ice extending from Ugashik toward the northwest for about 25 miles. The rest of Bristol Bay was apparently clear of ice.

Lon. 70° 57′ 30″ W.
Lon. 70° 42′ 22″ W.
Lon. 70° 04′ 32″ W.
Lon. 70° 05′ 56″ W.
Lon. 71° 20′ 15″ W.
Lon. 71° 51′ 29″ W.
Lon. 71° 57′ 27″ W.
Lon. 73° 12′ 32″ W.
Lon. 73° 52′ 40″ W.
Lon. 74° 01′ 06″ W.
Lon. 74° 03′ 10″ W.
Lon. 74° 53′ 10″ W.
Lon. 75° 05′ 27″ W.
Lon. 75° 03′ 21″ W.
Lon. 75° 42′ 37″ W.
Lon. 75° 50′ 51″ W.
Lon. 75° 31′ 42″ W.
Lon. 76° 32′ 15″ W.
Lon. 79° 11′ 06″ W.
Lon. 79° 53′ 17″ W.

rily out of com-
R. I.: Rockaway

tions have the
wire telegraph
the radio call
a request for
answers with
control.
l be used until

.... Radio

called in the
to be followed
ing!" When
ship's radio

minute, with

t the compass
eply "QTE,"
spelled out in
om which the
test will be

e bearings by
nd repeat, in
es all stations

p watch and
s wave length
all communi-

earing is fur-
s the operator
ich side of his
ft to the com-

rate within 2
compass sta-
meet at a fixed
y the bearings
the vessel.
navigation of

not suppose that all these rest upon guesswork or theory, for they are based in large part upon the steady stream of weather observations that flows daily into the Weather Bureau. The fuller that stream is and the more accurate its composing elements are, the better and more helpful to the seafarer will be the results. Self-interest alone, if other motives are not yet aroused, should prompt every seagoing officer to get in closer touch with this branch of his profession and give it at least the brief daily attention required of a cooperating observer. Just what that is can be learned by inquiring of the Weather Bureau or its nearest seaport station, where the above-named pamphlet can also be had.

AN INVITATION TO VISIT THE HYDROGRAPHIC OFFICE.

The U. S. Hydrographic Office has always greatly appreciated the freedom with which the officers of the merchant marines of all nations have made use of the facilities afforded in the United States ports by the U. S. Branch Hydrographic Offices. The Hydrographers desires, however, to inform all such officers that they will always receive an equal welcome at the Hydrographic Office itself, in the Navy Department, Washington, D. C., and that it would give him much pleasure at all times to receive at that office any of them who may be able to come to Washington, whether the purpose of their visit be professional or merely social, and to render to them while in Washington any service that may lie within his power or within that of the Office.

L. H. Chandler,
Rear Admiral, U. S. Navy,
Hydrographer.

BOTTLE PAPER DRIFTS.

A bottle paper set adrift by Dr. Willis G. Tucker, passenger on the British steamer *City of Rome*, on July 9, 1896, in lat. 49° 49′ N., lon. 36° 11′ W., was recovered at Balivanitch on the west coast of Benbecula Island, Hebrides Islands, on Mar. 1, 1897.

DRY DOCK AT LEVIS, QUEBEC.

There are several graving or dry docks owned and operated by the Canadian Government. The dock at Levis, Quebec, is 1,150 feet long, divided into two parts 550 and 600 feet, respectively, and is 120 feet in width. It has a depth at high water of 40 feet. [From information furnished by the U. S. consul, Kingston, Canada, May 31, 1920.]

CANADIAN GOVERNMENT-CONTROLLED CANALS.

There are at present six canal systems under the control of the Canadian Government in connection with navigable lakes and rivers. They consist of the canals between Port Arthur or Fort William and Montreal; from Montreal to Ottawa; from Montreal to the American boundary near Lake Champlain; from Ottawa to Kingston and Perth; the Trenton Canal from Lake Ontario to Lake Huron; St. Peter's Canal from the Atlantic Ocean to Bras D'Or Lakes, Cape Breton. The total length of the waterways comprised within these systems is about 1,594 statute miles. [From information furnished by the U. S. consul, Kingston, Canada, May 31, 1920.]

NORTH ATLANTIC OCEAN.

PORT FACILITIES.

Port Lobos, Mexico.—Situated in approximately lat. 21° 20′ N., lon. 97° 25′ W. Approach the coast south of Lobos Island to 7 or 8 fathoms. When about 2 miles off numerous landmarks, such as smokestacks, a chimney, water tower, and radio mast can be seen, the

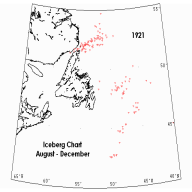
July 6.—Lat.
on beam ends.
July 5.—Lat.
sel painted red,
June 21.—Lat
2 feet in diamete
July 7.—Lat.
painted white w
with barnacles.
July 12.—Lat
lat. 40° 07′, wha
feet wide, compo
July 7.—Lat.
over "L" in blac
Note.—This b
28° 11′.
July 10.—Lat
July 4.—Lat.
July 3.—Lat.
of a derelict ves
of water.

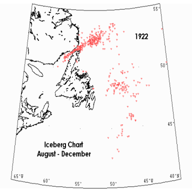
The following c
June 20.—La
tank-type steam
in the bunkers;

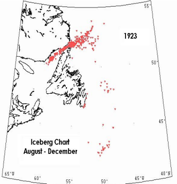
The following c
July 15.—Lat
long and 5 feet i
July 6.—Lat.
and 2½ feet in d
barnacles.
July 6.—Lat.
long and 3 feet i
with marine gro
June 26.—Lat
and 3 feet in dia

Grand Marais
made July 2–8,
approach to the
feet outside the en
the least depth b
water by keeping
through the lake
when they should
between the piers
to the Branch H
Engineer Office, J

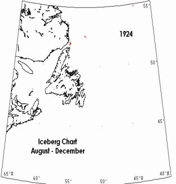
New signal lette
of the United Sta


1921
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W

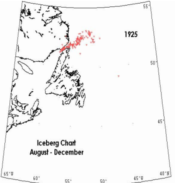

1922
Iceberg Chart
August - December
65°W
60°
55°
50°
45°W
40°N
55°
50°
45°

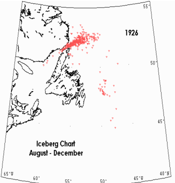


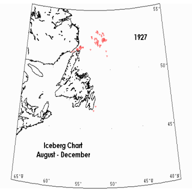
1923
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W



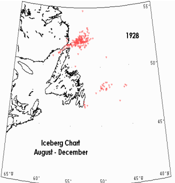
1924
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W


1925
Iceberg Chart
August - December
65° W
60°
55°
50°
45° W
40° N
55°
50°
45°


1926
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W



1927
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W



1928
Iceberg Chart
August - December
55°
50°
45°
40°N
65°W
60°
55°
50°
45°W