The International Ice Patrol:
Or, How Icebergs (and Iceberg Hunters) Shaped the Modern World

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Introduction

On May 1, 1925, eight men on the US Coast Guard cutter the *Tampa* climbed into a lifeboat, rowed 500 yards through waves in the treacherous North Atlantic Ocean, boarded a large iceberg drifting silently in the Labrador Current, and planted a floating mine at the edge of the ice. The International Ice Patrol, a US Coast Guard division with 14 participating nations that was set up after the *Titanic* sank in 1912, was conducting iceberg demolition experiments over the Grand Banks of Newfoundland, near the world's busiest shipping lanes and some of earth's richest fishing grounds. The small group from the *Tampa* maneuvered their lifeboat away from the iceberg as they ran a hundred yards of wire from the mine on the berg's ledge to their precarious position bobbing in the waves. And then, as officers and crewmen from the *Tampa's* deck watched and took photographs, they detonated the mine. A spectacular geyser of ice, water, and smoke shot into the air and sent out small waves toward the boats as bits of ice peppered the area. The men in the lifeboat rowed back to the *Tampa*, climbed aboard, and moved on. A few hours later, they approached another berg and converted it into a "shooting gallery." The crew pounded the iceberg with thirty rounds of three-inch artillery shells.[2] Despite sounding farfetched, dangerous, and even ridiculous, the Ice Patrol had noble intentions with these iceberg explosions: they hoped to hasten the demise of bergs before they floated directly into the

[1] Special thanks to Alexa Kanbergs for invaluable research assistance.
[2] Leo Shubow, *Iceberg Dead Ahead!* (Boston: Bruce Humphries, Inc., 1959).

steamship lanes and created a menace for international shipping and transportation. They were trying to ensure that another *Titanic* catastrophe never again occurred.

The main problem with bombing bergs is that it just didn't work. Not even close. And it was dangerous. But it took the Coast Guard's Ice Patrol nearly a half century to figure that out definitively. The typical outcome of iceberg warfare was what Coast Guard yeoman Leo Shubow witnessed with these two assaults in 1925. The impact of the mine planted by the *Tampa*, he concluded, was "unnoticeable." And "after all this hubbub and shooting" at the second iceberg, Shubow asked: "What happened to the berg? Only a few chunks had been shaved off the ends, but the berg proper seemed to remain impregnable and adamant. Nature itself would have to be more cooperative in undoing these icy mountains through rain, fog, surging waves, and the approaching warm Gulf Stream."[3] In fact, Shubow was more insightful and forward-looking than he might have imagined. Almost forty years later, the International Ice Patrol finally abandoned a half century of experimenting with iceberg obliteration. They surrendered to the ice. After 1960, the Ice Patrol focused solely on identifying and tracking icebergs floating down Iceberg Alley from western Greenland toward the transatlantic shipping lanes over the Grand Banks. The Coast Guard has done this iceberg monitoring since 1913, and it broadcasts what it calls the Limits of All Known Ice twice every day, or more if conditions warrant. But since 1960, the Ice Patrol has not tried to blow up bergs anymore. It just finds the ice, reports the location of every iceberg, and recommends the safest tracks for shipping in the North Atlantic.

Through this century of monitoring bergs, and despite the futility of bombing them, the Ice Patrol has managed to make the North Atlantic—one of the busiest areas in the world's oceans—safe. The Ice Patrol has an impeccable record: there has been no loss of ship or life for anyone heeding their warnings in 100 years. The patrol's oceanographers, observers, and crews have produced a rich though largely untapped source of oceanographic, meteorological, and cryospheric data. In the process, they

[3] Ibid., 157.

helped transform icebergs into an avoidable nuisance rather than a looming catastrophe. They have saved the shipping industry countless resources, goods, money, and, most importantly, human lives. These savings and the untold work of the Ice Patrol have influenced transportation, consumer prices, economic activity, world trade, international diplomacy, oceanographic research, iceberg science, climatology, and fishing and food supplies—not to mention perceptions of and interactions with oceans and ice.

On the one hand, the history of the Ice Patrol represents the great hubris of the twentieth century: lobbing heavy artillery, bombs, mines, TNT, carbon-black, and other heat-producing weapons at floating ice in an attempt to sweep and clean the ocean's surface and to stop the effects of iceberg manufacturing from the Greenland ice sheet. Such hubris represents a common trajectory of the twentieth century, when engineers and technocrats sought to master, control, and manipulate non-human nature—from trees and plants to canyons and watersheds, from the air and the soil to insects and pathogens.[4] The Ice Patrol studied and monitored the ice, they observed icebergs, stalked them, and told everyone in the vicinity where they were. This kind of surveillance, scholars have argued, empowers states, yields power, and influences narratives of nature.[5]

Yet, on the other hand, the Ice Patrol followed a different, more humble approach to the hostile environment they encountered. Just as the US military was concocting plans to melt the Arctic, build a

[4] For just a few examples, see Paul R. Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington: Island Press, 2002); Nancy Langston, *Forest Dreams, Forest Nightmares: The Paradox of Old Growth in the Inland West* (Seattle: University of Washington Press, 1995); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Oxford University Press, 1992); J.R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: W.W. Norton & Company, 2000); Jessica B. Teisch, *Engineering Nature: Water, Development, and the Global Spread of American Environmental Expertise* (Chapel Hill: University of North Carolina Press, 2011); Maurits Ertsen, *Locales of Happiness: Colonial Irrigation in the Netherlands East Indies and its Remains, 1830-1980* (Leeghwaterstraat, Netherlands: VSSD, 2010); Paul S. Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal," *Isis* 98 (2007): 724-54.

[5] James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, Conn.: Yale University Press, 1998); Denis Wood, *The Power of Maps* (New York: Guilford Press, 1992); Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York: Oxford University Press, 1988); Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*; Wood, *The Power of Maps*.

nuclear-powered city under the Greenland ice sheet, and steer hurricanes through weather modification and cloud seeding programs, the Coast Guard decided the best way to deal with icebergs was to leave them alone and let them float into the warm Gulf Stream where they melted on their own.[6] Part of this surrendering to ice has to do with the Ice Patrol's limited budgets and resources. Part of it probably had to do with the location of the Ice Patrol in the Coast Guard, not the Navy or Army, which had astronomically more resources to direct toward earth and ocean sciences and large-scale engineering.[7] And part of it has to do with the power of icebergs. There was, of course, a discursive and scientific "control" over the ice and ocean through the Ice Patrol's almost hourly mapping of icebergs and ocean currents. But the technological quest to use military power and brute force engineering vanished in 1960. The story of the Ice Patrol, then, is a different history. As much as we need to avoid environmental determinism in our scholarship, we also need to study cases like this in which non-human nature—in this case cold, hard water—shapes history, when scientists, economists, engineers, and multinational companies learn to live with menacing environments, not just plow them into the ground or bury them in the ocean. Ice might be one of the most resilience environmental forces people have encountered in human history.

There is thus an argument here about how environmental forces shape the evolution of science and technology, or how place, geography, and non-human nature influence these trajectories. In this way, this study of the Ice Patrol helps merge environmental history with the history of science and technology. Environmental historians have obviously shown how non-human nature shapes history. Without reverting into environmental determinism, they have effectively illustrated the role of environmental forces in past societies, and how most stories of the past have an environmental angle.[8]

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[6] Jacob Darwin Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (New York: Oxford University Press, 2013).
[7] Ronald E. Doel, "Constituting the Postwar Earth Sciences," *Social Studies of Science* 33, no. 5 (2003): 635-66.
[8] Mark Fiege, *The Republic of Nature: An Environmental History of the United States* (Seattle: University of Washington Press, 2012).

Historians of science and technology have demonstrated how scientific knowledge and technical expertise are produced in particular places and at particular times—what scholars have referred to as the geography of science or the place of science.[9] Linking these fields suggests that the environmental forces encountered in particular places and at particular times thus influences the trajectory of science and technology.[10] This is what happened with the International Ice Patrol. The scientific knowledge produced, the management practices that emerged, the attempted (and abandoned) engineering efforts, and the narratives of ice were all influenced by the particular type of ice found in that specific part of the ocean. In other words, engineers and scientists failed to effectively bomb bergs and eliminate the menace to shipping because of the ways in which the the ocean, weather, and ice affected their experiments and daily activities in the North Atlantic. I thus argue that part of the reason the relationship with icebergs has been more modest and less aggressive than the brute force engineering and arming of mother nature described elsewhere was because the Ice Patrol crews spent months every year bobbing around out in the ocean swells, boarding dangerous bergs, and feeling their way through a week-long bout of fog as they chased seemingly invisible ice.[11] They were not just sketching plans from Washington D.C. offices.

[9] D. A. Finnegan, "The work of ice: glacial theory and scientific culture in early Victorian Edinburgh," *British Journal for the History of Science* 37, no. 132 (2004): 29-52; Diarmid A. Finnegan, "The spatial turn: geographical approaches in the history of science," *Journal of the History of Biology* 41 (2008): 369-88; David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago, Ill.: University of Chicago Press, 2003); S. Naylor, "Introduction: historical geographies of science - places, contexts, cartographies," *British Journal for the History of Science* 38, no. 136 (2005): 1-12; Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (New York: Palgrave MacMillan, 2007).

[10] Antonio Barrera-Osorio, *Experiencing Nature: The Spanish American Empire and the Early Scientific Revolution* (Austin: University of Texas Press, 2006); Robert E. Kohler, *Landscapes and Labscapes: exploring the lab-field border in biology* (Chicago: University of Chicago Press, 2002); Martin Reuss, "Seeing Like an Engineer: Water Projects and the Mediation of the Incommensurable," *Technology and Culture* 49, no. 3 (2008): 531-46; Neil Safier, *Measuring the New World: Enlightenment Science and South America* (Chicago, Ill.: University of Chicago Press, 2008); Sutter, "Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change during the Construction of the Panama Canal."

[11] Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism*; Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World*.

The International Ice Patrol is largely unstudied and virtually absent from any larger histories, even histories of the Coast Guard. Coast Guard scholarship has tended to focus on the agency's role in national security and emergency responses to natural disasters.[12] The limited research on the Coast Guard's historical role in environmental issues seems contradictory, showing in some cases how its presence helps enforce environmental laws, such as whale protection, while in other cases lamenting its increasing involvement in the War on Terror, which leaves little time for environmental monitoring.[13] What is clear is that the Ice Patrol has only barely been analyzed, much less even than the Coast Guard, and especially in environmental history and history of science scholarship. And yet the Ice Patrol has a fascinating and important history with the Atlantic Ocean, Greenland glaciers, sea ice, and icebergs—though the oceans and cryosphere (the world's ice) have not necessarily received much attention from non-scientist scholars. Icebergs, however, have played a significant role in modern history, not just because a berg sunk the *Titanic*, which caused a catastrophe that altered history and continues to evoke horrors of the past and cautionary tales for the future, particularly related to technological hubris and the arrogance of humans over the environment. More generally, icebergs have affected everything from war and national security to the global economy, perceptions of nature, energy generation, recreation, scientific advances, and the place of technology in modern societies. Icebergs are thus an underappreciated and understudied part of the past, not to mention the future as concerns about global sea level rise, climate change, offshore oil exploration, Polar tourism, and water use put icebergs in the

[12] On the USCG and national security, see V. Crea, "The U.S. coast guard: A flexible force for national security," *Naval War College Review* 60, no. 1 (2007): 15-23; S. Vapnderplas, "Coast Guard Focus - Arm the Coast Guard for the War on Terror," *Proceedings of the United States Naval Institute* 130, no. 8 (2004); Robert Warren, "The Coast Guard's Critical Role as an Armed Service" (U.S. Army War College, 2012).. On disaster responses, see D.L. Canney, *In Katrina's wake: The U.S. Coast Guard and the Gulf Coast hurricanes of 2005* (Gainesville: University Press of Florida, 2010); Darrell Hillier, "Sub-Arctic Ordeal: United States Coast Guard to the Rescue " *Canadian Aviation Historical Society Journal* 50, no. 1 (2012): 26-40; William Thiesen, "LCDR Edward "Iceberg" Smith, '13 and the 1932 Arctic Expedition of the German Airship Graf Zeppelin," (2010), http://www.uscg.mil/history/articles/SmithIcebergZeppelin.pdf.

[13] R. Canty, "The Coast Guard and environmental protection: Recent changes and potential impacts," *Naval War College Review* 52, no. 4 (1999): 77-89; L. Mah, "Sailing by looking in the rearview mirror: EPA's unreasonable deferral of ballast-water regulation to a now ineffective Coast Guard," *Ecology Law Quarterly* 31, no. 3 (2004): 665-87.

news almost daily. Understanding the International Ice Patrol, the agency that has been chasing icebergs since the *Titanic* sank, illuminates an important and largely untold history of the last century.

Iceberg Alley

Wherever glaciers meet water, giant chunks of ice can fall off and float away. These spectacular events are what tourists on Alaskan cruises hope to see, at least from a distance since the waves can cause tsunami-like inundations. Greenland glaciers routinely (and often dramatically) shed ice into the fjords that carry the new bergs out to the North Atlantic and into what's called Iceberg Alley. Iceberg production thus depends on dynamics of the entire Greenland ice sheet and its floating termini at the ocean. Sea ice does not come from glaciers; rather, it is ice that forms on the surface of the ocean. Sea ice west of Greenland can trap or release icebergs, holding the bergs hostage for weeks, months, or even years depending on the year, the season, and the location. From there, the Labrador Current acts like a conveyer belt, carrying the bergs farther south to the Grand Banks off Newfoundland—directly in the Europe-North America shipping lanes and right into one of the world's great fishing grounds. The vast majority of North Atlantic icebergs arriving at the Grand Banks come from about 100 glaciers in west Greenland that reach the sea and discharge 10,000-15,000 icebergs annually. The remaining 15 percent of North Atlantic icebergs come from eastern Greenland and Ellesmere Island.[14]

Once in the open water of Iceberg Alley, bergs are influenced by a variety of forces, from ocean currents and wind to rain, waves, and even the moon. Ship captains and scientists have been trying to understand these various forces for centuries in order to predict iceberg behavior. Wind and ocean currents affect the flow, and water depth influences iceberg speed and routes. Wave action and rain

[14] John Stengel, "Icebergs," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 17-20.

can both wear away at the integrity of icebergs. Coastal geography also affected icebergs because it creates eddies and changes currents, while also providing shoals and shallow water where icebergs run aground and get stuck. Because iceberg drift depends in part on ocean currents and tide levels, some recent studies have even attributed the iceberg that sank the *Titanic* to the moon, which was particular close to earth in the winter of 1911-1912. In fact, in January 1912, the moon passed the closest to earth that it had in 1,400 years, and this occurred just one day after the earth was at its closest to the sun. The result, according to physicists at Texas State University – San Marcos, was extraordinary high tides. The exceptionally high water may have freed bergs that otherwise would have remained grounded along the coast of Labrador and Newfoundland. And these icebergs, they speculate, could have traveled farther south than usual, right into the path of the *Titanic*.[15] Clearly, a host of variables can influence the path of icebergs from fjords in western Greenland to the transatlantic shipping lanes at the tail of the Grand Banks.

The most important factor in the life (and death) of an iceberg is water temperature. Cold waters in the Labrador Current might be around 30 degree F. or colder; saltwater freezes around 28 degrees F. But the water flowing north into the Grand Banks with the Gulf Stream can be 20-30 degrees warmer. It is this collision of warm water from the Caribbean and Gulf of Mexico with the cold Arctic water in the Labrador Current that creates intense condensation, making the Grand Banks one of the foggiest places in the world—right in the place where icebergs are finding their way into the shipping lanes and fishing grounds. But it is also the warm Gulf Stream water that has the most decisive impact on icebergs: it melts them quickly, usually within a few days or weeks. When Shubow assessed the failed iceberg demolition experiments and said the Ice Patrol would have to leave Nature to take care of the bergs, he was referring to the Gulf Stream, the ultimate weapon against the ice.

[15] Jayme Blaschke, "The Iceberg's Accomplice: Did the Moon Sink the Titanic?" Texas State University-San Marcos News Service (5 March 2012): http://www.txstate.edu/news/news_releases/news_archive/2012/March-2012/Titanic030512.html (accessed 8 Jan. 2014).

Not all of these icebergs reach the tail of the Grand Banks, where the main shipping tracks are. Many are grounded along the Labrador coast, for example. Most melt before they ever reach what the Ice Patrol sees as the critical point: 48 degrees North latitude, below which passes heavy shipping traffic. Over time, the numbers of bergs interfering with transatlantic shipping has varied. A typical year sees about 500 icebergs floating south of 48 degrees North and into the shipping lanes. But in 2011, for example, only three icebergs floated south of 48 degrees, making it one of the lightest iceberg years in a century. In 2009, however, 1,204 icebergs passed into the shipping lanes.

The danger of icebergs is that they are not very visible, especially the smaller bergs called growlers that only lurk a few feet above the ocean's surface but can nonetheless weigh tens of thousands of tons and sink a giant ship. Because icebergs are less dense than water, seven-eighths of the ice is actually underwater—just like the ice cube in your gin and tonic. The "tip of the iceberg" is an expression born in truth because what you see from a boat is literally just a small portion. Sea ice, on the other hand, is distinct from icebergs because it is formed on the surface of the ocean, not in land-based glaciers. The other problem with icebergs is that radar has only in recent decades been able to consistently detect them, and even in these cases it is often necessary to ground-truth or visually confirm the actual existence of icebergs (and not confuse them with boats or floating debris or even waves). The same difficulty exists for satellites. Cloud cover diminishes visibility from space, while satellite readings cannot reliably distinguish icebergs from boats. Given the large number of fishing vessels in the Grand Banks, the confusion between boats and bergs makes satellite imagery unreliable for ships traveling the area. This is why the Ice Patrol's main function for the last century has focused on iceberg detection and monitoring, and it has done it almost entirely with human eyes looking out from a Coast Guard cutter or, after World War II, looking down from a low-flying airplane covering a 33,000 square mile area of dense traffic around the Grand Banks.[16]

[16] Madelyn Klein Anderson, *Iceberg Alley* (New York: Julian Messner, 1976). 40.

The Limits of All Known Ice

When the *Titanic* went down over the Grand Banks near Newfoundland in April 1912, it may have been one of the most deadly shipping disasters, but it certainly was not the first. Hundreds of ships have collided with bergs in the Grand Banks region at the tail of Iceberg Alley over the last 300 years, making the trip across the North Atlantic dangerous during iceberg season (March-July), unless captains added hundreds of miles to their trip by dipping south below the iceberg minefield southwest of Greenland. Brian Hill of Canada's National Research Council and the Institute for Ocean Technology has compiled extensive details about historical ship collisions with icebergs in the North Atlantic. These accidents, he explains, date back to 570 A.D., when St. Brendan's voyage out of Ireland reported an encounter with a "column of pure crystal." Others such as Norse settlers and Basque fishers likely met bergs over subsequent centuries. Hill's records begin systematic counting of ship-iceberg collisions with an accident in 1686, when the North West Fur Company's unfortunately named ship *Happy Return* collided with an iceberg and sank in Hudson's Straight. There are many other accounts of sinking ships and perishing passengers as a result of iceberg collisions in the North Atlantic through the subsequent centuries. Chilling examples litter the record of transatlantic shipping well before the fateful *Titanic* went down, such as the Irish immigrants on the *William Brown* that went down with 33 of its 64 passengers and 17 crew members after hitting a berg in 1841. In the 1850s, as steamship travel became more common, captains tried to increase their speed—sometimes with deadly results.[17] Overall, Hill's database chronicles over 670 ship-iceberg collisions in the Northern Hemisphere since 1686, with the vast majority prior to the creation of the International Ice Patrol and with most occurring in the North

[17] Brian Hill, "Ship Collisions with Icebergs," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 75-78.

Atlantic in the Grand Banks vicinity.[18] Clearly, by the early twentieth century there was an international need for an ice patrol to protect transatlantic shipping and fishing vessels at the tail of Iceberg Alley.

But in early 1912, the likelihood of using the Revenue Cutter Service (named the US Coast Guard since 1915) to search for ice looked unlikely at best. President Taft's Commission on Economy and Efficiency recommended that "after a careful study of the work now being performed by the Revenue Cutter Service (RCS), the commission is convinced that the service has not a single duty or function that cannot be performed by some other existing service, and be performed by the latter at much smaller expense."[19] Despite vigorous and compelling protests from the RCS, Taft ultimately clung to the recommendation and on April 4, 1912 sent the approved report on to Congress for consideration. Eight days later the *Titanic* collided with an iceberg, killing more than 1,500 people and altering the course of history.

It was the sheer scale of the *Titanic* disaster that finally led governments to do something about icebergs. A month after the catastrophe, the US Hydrographic Office recommended to the US government that the navy should patrol the region for icebergs. The navy responded immediately and in May 1912 sent the U.S.S. *Birmingham* and *Chester* to alternate on ice patrol duty for the remainder of the iceberg season.[20] The Revenue Cutter Service took over the iceberg monitoring in 1913, and in January 1914, following the International Conference for the Safety of Life at Sea (SOLAS), fourteen nations agreed to establish the International Ice Patrol.[21] It was run by the United States with participating nations agreeing to contribute based on the proportion of shipping, by tons, annually passing through the North Atlantic shipping lanes. The Ice Patrol is paid for by the participating nations

[18] See www.icedata.ca.
[19] Quoted in Michael Hicks, "The U.S. Coast Guard International Ice Patrol," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 6-9.
[20] Robert De C. Ward, "A Cruise with the International Ice Patrol," *Monthly Weather Review* 52, no. 2 (1924): 71-78.
[21] Committee on Safety of Navigation, "Report and Minutes of Proceedings," International Conference on Safety of Life at Sea," London, 8 Dec. 1913.

based on their proportion of shipping, by tons, in the North Atlantic shipping lanes. The *New York Times* reported in 1930 that Great Britain paid 30 percent of the cost, with the United States, France, and Germany paying 15 percent each. Other countries paid smaller portions. The US portion, however, was going to increase to 20 percent later that year.[22] Today there are 17 countries involved with the International Ice Patrol: Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Panama, Poland, Spain, Sweden, United Kingdom, and the United States.[23]

Ever since it was created in 1913, the Ice Patrol has sought to broadcast what it calls the Limits of All Known Ice twice per day during iceberg season, which runs roughly from March to July, depending on the year's iceberg activity. When a menacing berg is directly in the shipping lanes, it has sometimes issued radio warnings every two hours. Determining the Limits of All Known Ice has involved a century of iceberg observations, monitoring, research, and analysis. The Ice Patrol has always relied on information from other passenger, transportation, or fishing vessels traveling in the area, requesting that each passing ship report on iceberg sightings, water temperature, and weather conditions every four hours. From the outset, the Ice Patrol sought to hunt down and track any iceberg drifting south of 48 degrees North latitude in the vicinity of the Grand Banks. The North Atlantic might seem remote and desolate to someone unfamiliar with the area. But it has actually been a busy place for transatlantic traffic and fishing. A century ago, for example, on April 12, 1913, the Ice Patrol was patrolling near the Grand Banks and came upon a French fishing fleet consisting of about 300 vessels and approximately 10,500 men.[24] The Ice Patrol stayed with a few drifting bergs in this area for more than a week, repeatedly warning the French fishermen about the location of these icebergs. Up until World War II, the Coast Guard patrolled the region by sending a Coast Guard cutter or two to Newfoundland. After

[22] "Ice Near Ship Lanes Starts Up the Patrol: Attacking a Menacing Iceberg in the Ship Lanes," *New York Times*, 23 Feb. 1930, 139.
[23] Hicks, "The U.S. Coast Guard International Ice Patrol."; United States Coast Guard USCG, "2011 Season," *Report of the International Ice Patrol in the North Atlantic* 97 (2012).
[24] Revenue Cutter Service, *Reports of Vessels on Ice Patrol in the North Atlantic Ocean: April, May, June 1913. RCS Bulletin No. 1* (Washington, D.C.: US Government Printing Office, 1913). 7.

the war they used airplanes, except in years when icebergs were abundant and they sent ships to the region, too. In 1972 and 1973, for example, more than a thousand icebergs drifted into the shipping tracks.[25]

One key way the Ice Patrol predicted iceberg threats was by studying and mapping the "cold wall" between the Labrador Current and the Gulf Stream. Once in the early 1920s, the *Tampa* straddled this line, which is sometimes a rather precise and literal wall of water. The crewmen measured 34 degree water at the bow and 56 degrees at the stern.[26] Leo Shubow, the Ice Patrol assistant sent out to sea in 1925, explains how he learned about this wall of water. The Coast Guard first sent him to Harvard for six weeks to learn about oceanography and icebergs from the Louis Agassiz Museum curator, Henry Bigelow, who had also trained famed Ice Patrol oceanographer Edward Smith. As Shubow learned, the mission of the Ice Patrol was like "the role of a naval detective to track down these marauders of the seas," the icebergs.[27] One of the main goals of the Ice Patrol, noted Bigelow, was to chart the wall between ice cold water flowing south in the Labrador Current, which preserves icebergs, and the 50-60 degree water flowing north along the Gulf Stream from the Gulf of Mexico and Caribbean. This could be mapped daily because all ships in the North Atlantic and shipping lanes had to report their location and the water temperature. A patrolman like Shubow could then map all these ship data to determine the line between the Labrador Current and the Gulf Stream, the warm water that sent icebergs to an early death or, as Bigelow put it, "their deserved watery grave."[28]

All this compilation and analysis of data meant that within ten years of operation, the Ice Patrol had compiled the world's most extensive oceanographic and meteorological data for the busy but always feared North Atlantic shipping lanes. Surprisingly, none of this data has been analyzed or

[25] Anderson, *Iceberg Alley*: 38.
[26] Steuart M. Emery, "Iceberg Patrol Is Ready for its Vigil," *New York Times*, 14 March 1926, 3.
[27] Shubow, *Iceberg Dead Ahead!*: 63.
[28] Ibid., 64.

reconstructed in recent years, despite the wave of interest in global climate change and historical climatology.

Identifying the Limits of All Known Ice has helped keep the North Atlantic safe, and many have both recognized and appreciated the important work of the patrol. In 1926, for example, a French ship captain explained that "The value of the patrol is beyond appreciation. Their devotion, their endurance and intelligence probably save many lives, and their observations will make it possible hereafter to adopt safer tracks. They warned me long in advance of the presence of several icebergs directly on the international road of the sea. Thanks to the clearness of the weather I was able to see and avoid them, keeping on my way; but if it had been foggy, or if I had had to pass them at night, I should have had no hesitation in altering my course then and there so as to avoid any chance of collision. The presence of the patrol vessels is a blessing to the navigation of all countries."[29] In 1930 the *New York Times* echoed such praise, reporting that "Tramp steamers, lacking radio, sometimes have clashed with the bergs, but no liner has been endangered, and no life has been lost since the ice patrol took up its vigil."[30]

Shipping lanes in the North Atlantic were established by an international treaty in 1898, the North Atlantic Track Agreement. The goal was to establish eastbound and westbound lanes or tracks, which helped reduce congestion and avoid collisions, while also serving to have all the ships in the same lanes to offer assistance to each other.[31] The 1898 agreement was not an official law, but rather an agreement. During the iceberg season, agents of the shipping lines in New York and London would represent the various companies. When they received new information about the Ice Patrol's recommendation, usually through the US Hydrographic Office, to move the tracks south to escape threatening icebergs or north again once the hazard cleared, then these agents would consult with each

[29] Quoted in Emery, "Iceberg Patrol Is Ready for its Vigil."
[30] "Ice Near Ship Lanes Starts Up the Patrol: Attacking a Menacing Iceberg in the Ship Lanes."
[31] Anderson, *Iceberg Alley*: 32.

other and notify shipping lines of the subsequent changes.[32] A good example of the responsiveness of ships comes from 1939, when the Ice Patrol reported icebergs particularly far south clogging the westbound steamer tracks. Following the Ice Patrol's recommendation, which was broadcast by the navy's Hydrographic Office, they agreed to shift the transatlantic lane 45 miles south into a special emergency track, the farthest south the lane had been since the Ice Patrol was formed. Shipping had already moved into an initial emergency lane on May 5, 1939, and this second shift south demonstrated the abundance of encroaching icebergs, largely because the wall of water between the Labrador Current and the Gulf Stream remained farther south than usual, allowing icebergs to live longer as they drifted south in the cold Arctic current.[33]

Today the Ice Patrol uses a variety of strategies to determine the Limits of All Known Ice. For the 2012 season, for example, the 370 icebergs passing below the 48th parallel were reported by a combination of Ice Patrol flights, commercially contracted reconnaissance flights, satellites, commercial ships, and other sources such as lighthouse operators or passenger ships. Once detected, the iceberg location and characteristics such as size and shape are fed into the IceBerg Analysis and Prediction System (BAPS), a computer model that projects iceberg drift and deterioration.[34] In the past, to gain more information about iceberg behavior and drift, the Ice Patrol tried painting the bergs, dropping dye on them, shooting dye at them with bow and arrow, and attaching beacons to them to track them. None of these strategies worked: the icebergs tumble and roll too often; they capsize and wash off these markings. They have also been using computer programs to help predict iceberg drift for the last several decades. But nothing seems to work well. As Lieutenant Junior Grade Thomas J. Neill, an ice

[32] "Ice Near Ship Lanes Starts Up the Patrol: Attacking a Menacing Iceberg in the Ship Lanes."
[33] "Iceberg Warning Sends Ships to South to Dodge Worst Drift since Titanic Days," *New York Times*, 1 June 1939, 31.
[34] US Coast Guard, "2012 Season," *Report on the International Ice Patrol in the North Atlantic*, Bulletin No. 98 (2012): 6-7.

observer, said throwing up his hands in the 1970s, "There's only one sure way of telling where a berg is, and that's by eyeballing it!"[35]

There are supreme successes stemming from this eyeballing of bergs. On the Grand Banks specifically, prior to 1914 there were 350 ship-iceberg collisions and 3,100 deaths. But since the Ice Patrol was established, only 100 collisions and 13 deaths have occurred. Most of those collisions were fishing vessels, not ships crossing the Atlantic (four cases).[36] Accidents of course continue to occur when captains fail to observe Ice Patrol warnings or when ships try to save time and money by traveling above 48° North. But there has been no loss of life or ship-iceberg collisions when captains complied with Ice Patrol recommended safe zones outside the Limits of All Known Ice—a remarkable accomplishment given the heavy traffic around the Grand Banks and the continuous glacier manufacturing in Greenland with express service to the shipping lanes via the Labrador Current.

There is also the economic success of the Ice Patrol's activities. The Coast Guard estimated in 2005 that a container ship delayed by one day could cost upwards of $100,000. This takes into account the effects on railroads, trucking companies, distributors, mills, worker wages, retailers, and other factors. If the Ice Patrol did not exist, ships would have to slow down to search for and avoid icebergs, thereby imposing significant additional costs to shipping—and thus to consumers. Another alternative would be to shift the shipping lanes farther south, below the typical area for icebergs at the tail of the Grand Banks. This, too, could have severe financial impacts, especially if it was not necessary to shift the tracks south, which adds additional miles to the transatlantic route. The Ice Patrol has a huge financial impact on shipping, production, and consumption. And yet its annual budget runs only around $3

[35] Anderson, *Iceberg Alley*: 48.
[36] Hill, "Ship Collisions with Icebergs."

million. The Coast Guard estimates that it costs about $0.10 per ton of goods crossing the ocean to fund the International Ice Patrol, with its impeccable record over the last 101 years.[37]

Bombing Bergs

While the Ice Patrol today focuses only on iceberg monitoring and issuing its daily reports about the location of all known bergs below the 48th parallel, it originally had a much more aggressive mission that involved some wild strategies to eliminate iceberg hazards. For the first 50 years, hubris drove the Ice Patrol to try to obliterate bergs. An 1890 US Hydrographic Office report captures some of the (mis)conceptions about icebergs that drove these early efforts to destroy floating ice in the North Atlantic. As Ensign Rodman explained in this report, "All ice is brittle, especially that in bergs, and it is wonderful how little it takes to accomplish their destruction. The blow of an ax will at times split them, and the report of a gun, by concussion, will accomplish the same end."[38] Rodman could not have been more misinformed, more wrong it turned out. Ice might be one of the toughest, most stubborn, most recalcitrant substances the military every encountered. But it took until 1960 for the Ice Patrol to surrender to it. Up until that point, the Ice Patrol routinely experimented with many different ways to eliminate icebergs, including gunfire, mines, torpedoes, depth charges, aerial bombing, thermite, and covering icebergs with black dust to warm them and accelerate their melting.[39] But none of these worked.

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[37] R. Dennis Sirois, "Assistant Commandant's Perspective," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 4.

[38] Quoted in Donald L. Murphy and Duyane Alexander, "Seek and Destroy? The History of Iceberg Demolition Experiement," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 50-54.

[39] The Ice Patrol maintains photographs of iceberg destruction experiments at http://www.navcen.uscg.gov/?pageName=photoGallery&photoGalleryId=4.

The Ice Patrol routinely bombed bergs in its early years. In its first annual report for the season of 1913, the Ice Patrol indicated that it shot a large, disintegrating berg with its six-pound canon. After a few days of careful monitoring, they noted that the iceberg tilted markedly in the water, probably because of its significant melting that altered its equilibrium. But after shooting the berg, they noticed that it "had no other effect than to shake down a barrelful of snowlike dust."[40] They reached a rather different conclusion than Rodman's optimistic outlook about the ease of destroying icebergs. In 1915 the Ice Patrol again shot at a berg with its six-pound gun. In this case they had been watching the medium-sized berg drift south for approximately 100 miles in the second half of June. The berg rolled over many times while they observed it, and each time growlers broke off. Every time it capsized it would also take 20-30 minutes to stabilize and recover its equilibrium. These constant movements are what make icebergs so dangerous to approach. At one point the berg righted itself with a vertical wall facing the Ice Patrol ship, and so the crew launched seven non-exploding six-pound shells at the berg. The ice was so "rotten" at that point that the shells embedded themselves in the berg, clearly visible deep inside even from the patrol ship. But nothing happened; the shots did not seem to accelerate the berg's demise.[41]

During the 1920s, the Ice Patrol tried to destroy icebergs with much heavier firepower. In 1923, the *Tampa* patrol ship detonated TNT wrecking mines on icebergs to blast them into oblivion and shorten their lives. Some bergs near the end of their lives, like the ones the *Tampa* targeted, responded appropriately to the bombs and possibly disintegrated more rapidly than if they had not been targeted. But mostly, icebergs were just too big. On that same excursion, the *Tampa* passed another iceberg that was 65 feet high and 1,690 feet long—it contained 36 million tons of ice. As journalist Robert De C. Ward accompanying the *Tampa* reported, it was impossible to fully destroy such a massive amount of

[40] Service, *Reports of Vessels on Ice Patrol in the North Atlantic Ocean: April, May, June 1913. RCS Bulletin No. 1*: 9.
[41] United States Coast Guard USCG, "Season of 1915," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 5 (1916): 20.

ice. And the problem with trying, of course, was that blowing up a big berg just created a bunch of small bergs, which were all still dangerous because even a tiny iceberg can sink a ship. Nevertheless, Ward was optimistic. He reported a May 1923 attempt by the *Tampa* to blow up a berg drifting dangerously close to the shipping lanes using guncotton wrecking mines. The journalist was excited that these blasts shortened the iceberg's life by two days. But he concluded that "the use of wrecking mines for the purpose of destroying icebergs is not feasible or practical under ordinary circumstances." In this case, the berg had already disintegrated considerably and was very near the end of its existence anyway.[42] The Ice Patrol's annual report for 1923 expressed even more concern about bombing bergs, deciding that "from the difficulty experienced in placing the mine and the negligible results obtained, it was concluded that only in unusual cases of disintegrating bergs threatening the steamship lanes was an attempt to destroy them by the use of mines justified."[43] Conclusions like these, as early as the 1920s, were already demonstrating how Ice Patrol specialists were questioning the effects and risks involved with iceberg demolition. They would not have been so hesitant had they not encountered the ice and seen the dangers of bombing bergs in the open ocean.

Despite a decade of inconclusive and mostly failed attempted to demolish icebergs, the Coast Guard maintained optimism that it could indeed be accomplished. In 1925, Fred Zeusler, the season's Ice Patrol commander and lead Ice Observation Officer, was almost giddy to install a large mine at the ledge of an iceberg. As the *Tampa* approached the berg, his assistant Leo Shubow listened to his hopeful outlook and later recalled that "Mr. Zeusler, who had had much experience in laying mines during World War I, was eager to carry out his own plans for the next bombing and added quite confidently, 'If I don't succeed, I'll quit and eat my hat!'"[44] Three weeks later, "Public Enemy No. 1," as Shubow called it, came into view. This 700-feet-long, 240-feet-high, and 225-feet-wide berg became

[42] Ward, "A Cruise with the International Ice Patrol," 76.
[43] United States Coast Guard USCG, "Season of 1923," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 11 (1924): 41.
[44] Shubow, *Iceberg Dead Ahead!*: 156.

Zeusler's target. Once again a mining party with specialists in gunnery—as well as the ship's doctor who also went on these precarious missions—climbed down into a lifeboat, rowed to the berg, and boarded it with their life jackets, spiked shoes, and pickaxes. They dug five holes in the ice large enough to climb into, and then planted four sixty-five pound charges of TNT and one 130-pound charge. Again they strung out 100 yards of cable from their lifeboat and detonated all five charges. "Huge blasts followed," reported Shubow, "causing a black smudge to spread over the side of the berg amid thunderous echoes."[45] But Zeusler concluded after watching the berg for a while that it would take several days to see if the mining had accomplished anything. In 1925 the Ice Patrol reported that the "greatest amount of destruction done to a berg was by heavy seas," not then by artillery or mines.[46] Shubow concluded about the efforts to destroy icebergs that, in the end, "Nature itself would have to be more cooperative in undoing these icy mountains through rain, fog, surging waves, and the approaching warm Gulf Stream."[47]

Renewed optimism in iceberg destruction came a couple years later, as a result of the experiments by the self-declared "Ice Fighter" Howard T. Barnes, a physics professor at McGill University. Barnes started fighting icebergs in the 1890s and believed ice was an enemy to the human race. He initially studied ice characteristics and the interaction between iceberg ice and air.[48] But later he turned to studies and experiments on the destruction of icebergs, especially using thermite, which is a mixture of aluminum and iron oxide. When ignited, thermite generates an expanding explosion of molten iron that reaches 4,000° F. The idea was that such a blast of molten iron would dissolve icebergs instantly. He had already successfully tested these practices on ice jams and field ice blocking the St. Lawrence River. In the 1920s he applied it to North Atlantic icebergs. In one of his experiments in 1926

[45] Ibid., 163.
[46] United States Coast Guard USCG, "Season of 1925," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 13 (1926): 38.
[47] Shubow, *Iceberg Dead Ahead!*: 157.
[48] For example, Howard T. Barnes, "Icebergs and their Location in Navigation," in *Annual Report of the Board of Regents of the Smithsonian Institution* (Washington, D.C.: US Government Printing Office, 1913).

in Newfoundland, Barnes worked with his son, a chemist, to concoct a plan to blow up an iceberg so people in the town of Twillingate could watch. They set 500 pounds of thermite on a big berg off the shore and fired it at sundown to allow, as Barnes reported, the community "to see the spectacle of the burning and disrupting ice. The whole thing was a most wonderful sight when the mighty charge fired and roared, lighting up the iceberg and surrounding hills like Vesuvius in eruption. Flames and molten thermite and ice were shot upwards 100 feet or more by the explosion which followed."[49] Although it did blow a big hole in the iceberg, two days later it was still tumbling about losing mass and crumbling. Nevertheless, they declared the experiment a success because they accelerated the deterioration of the iceberg by several days.

Despite such limitations and dangers, Barnes's experiments nonetheless inspired decades of hope—a lingering conviction that humankind had the capacity to destroy icebergs and eliminate this menace before the bergs entered the shipping lanes. Some of this hubris was expressed as Barnes was conducting his experiments. "The icebergs will come down this Spring to face resistance such as they have never met before," reported the *New York Times* in 1926. At Gotthaven, where the largest glaciers are found, the Barnes expedition will be stationed waiting to smash the moving peaks into splinters."[50] Ten years later, the Ice Patrol maintained such hope for thermite, divulging in its 1935 annual report that, based on Barnes's tests in Newfoundland, "it was therefore hoped that this method might prove valuable in the destruction of isolated bergs, particularly those drifting well south, immediately in the path of the trans-Atlantic express lanes."[51]

But, as the 1935 annual report of the Ice Patrol recognized, there was one significant downside to thermite detonations: they required boarding icebergs. The 1926 tests were conducted on stable

[49] Howard T. Barnes, "Some Physical Properties of Icebergs and a Method for their Destruction," *Proceedings of the Royal Society of London* 114 (1927): 161-68.
[50] Emery, "Iceberg Patrol Is Ready for its Vigil."
[51] United States Coast Guard USCG, "Season of 1935," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 25 (1937): 5.

bergs, likely grounded in shallow, calm bays off the Newfoundland coast. Climbing onto these icebergs was one thing. Landing on a berg in the open ocean of the Grand Banks, as the iceberg sloshed around in the giant swells and as waves crashed over the lower sections of the iceberg created undue risks for the boarding party trying to scramble out of lifeboats and drill holes for the thermite bombs in the ice. Slipping off the iceberg into the 30-40 degree ocean would have meant hypothermia or death, even with a quick rescue. The crew often joked about their lifejackets, recognizing that in the freezing water of Iceberg Alley would kill them well before they drowned. Boarding bergs was perhaps most dangerous because of the threat of a capsizing iceberg. Rolling and listing become increasingly common as icebergs float south, and once they leave the 30 degree water of Iceberg Alley and move into the 50 degree water of the Gulf Stream, a berg can tumble and capsize several times a day. Recent studies have shown just how much power is unleashed by a capsizing iceberg—as much energy as a magnitude 5 or 6 earthquake.[52] Capsizing ice, scientists worry, can thus cause tsunami-like inundations of coastal areas or nearby ships, endangering life and property. The Ice Patrol worried constantly about capsizing icebergs and generally concluded that the effects of planting mines and thermite bombs on icebergs in the open ocean was not worth the risk to the boarding party.

But the memory of Barnes's experiments and the potential for thermite to melt ice kept fantasies of iceberg eradication alive for decades. Motivation to bring back thermite and bombing experiments also stemmed from the particularly heavy iceberg years of 1957 and 1959, with 500 and 931 bergs, respectively, passing below the 48th parallel in those years.[53] Three decades after Barnes' tests, then, the Ice Patrol indicated optimistically that "The report of Professor Barnes' work showed profound results. Large bergs literally were reduced to fragments by a series of explosions and

[52] Anders Levermann, "When Glacial Giants Roll Over," *Nature* 472 (2011): 43-44.
[53] Werner Bamberger, "International ice Patrol Ends; Coast Guard Spent Busy Season," *New York Times*, 26 July 1959, 67.

reactions."[54] While the principal problem with thermite in the 1920s was the risk of boarding bergs, after World War II, the Ice Patrol used aircraft to patrol for icebergs. And thus, in 1959, they set out to conduct serious, systematic iceberg destruction tests—by dropping different types of bombs from airplanes flying 1,000 feet over icebergs.

Their first experiment of the year was dropping 20 different bomb clusters with high temperature characteristics, including thermite packets, on icebergs. Half of these bombs were 700 pounds each, packed with 57 bomblets; the other ten bombs were 975 pounds each, loaded with 182 TH3 incendiary bomblets that included a thermite mixture called thermate. The Ice Patrol selected a medium-sized berg in an area free from shipping or fishing—a place poetically called Virgin Rocks—for its first target practice. Even after practicing for a day using dummy bombs filled with water, the crew was only able to hit the berg about two-thirds of the time. Many of those bombs bounced off the berg, tumbled over the edge, and exploded there, an issue the Ice Patrol saw as a "serious defect" because "the bomblets slid harmlessly down the steep right side of the berg causing little effect." After rigging a new bomb sight on the plane, the airplane crew was able to hit the berg 11 of 12 times in the next round of bombing. But "the behavior of the thermate bomblets was disappointing in that their small size and apparent delay in detonation resulted in most of them bouncing overboard." All these bombs bouncing off the bergs and tumbling into the ocean offers a sharp image of the challenges the Ice Patrol faced and the futility of bombing bergs. At the end of the 1959 iceberg season, the *New York Times* put it like this: the Ice Patrol has "conceded that the icebergs had been more or less impervious to destructive man-made means. Gunfire, torpedoes and placing of explosive charges have been tried off and on since 1914. The conclusion is that nature, through melting in warm ocean currents and in warm air, possesses the only successful method so far of disposal."[55] And yet, the Ice Patrol concluded the

[54] United States Coast Guard USCG, "Season of 1959," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 45 (1960): 23-24.
[55] Bamberger, "International ice Patrol Ends; Coast Guard Spent Busy Season."

1959 season optimistically, noting that the "results of the 1959 tests assure a path for continued experiments in the future."[56]

They were back the next season for another assault on the ice.[57] The Coast Guard dropped ten all-purpose 1,000 pound bombs on icebergs, as well as ten more semi-armor-piercing 1,000 pound bombs. They got the detonations closer to the target, but only 12 of the 20 exploded as hoped by the test architects because three burst under water and three failed to detonate at all. One of the bombs shot ice and water spraying 500 feet into the air with a spectacular explosion. This only caused the berg to tilt slightly. Another berg hit with a bomb "did not materially change in size or attitude."[58] Another, however, was thought to be one-third to one-quarter smaller after the bombing, though it was unclear how much of that shrinking was due to natural forces given that the berg completely melted three weeks later.

A second phase of the 1960 tests included experiments to see once and for all if Barnes's theory of thermite could actually work. The Ice Patrol once again boarded a berg and detonated 40 thermite bombs in total. These charges produced the 4,000° F molten iron that shot out 100 feet in every direction. But they concluded that, even though it worked exactly as Barnes theorized, all it did was generate a few small growlers; otherwise, "there appeared to be little other effect" on the iceberg. For a finale, the team detonated a massive 560-pound thermite bomb on an iceberg in Newfoundland's Bonavista Bay. They witnessed a spectacular explosion hurtling molten iron, chucks of ice, and smoke hundreds of feet into the sky. But the berg "remained virtually unchanged. This concluded the thermite tests." In fact, it concluded them forever—after decades of hope that Barnes had been right and that bergs could be bombed and heated to bits before reaching the shipping lanes fishing grounds near the Grand Banks.

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[56] USCG, "Season of 1959," 28.
[57] Werner Bamberger, "Ocean Ice Patrol Starts this Week," *New York Times*, 7 March 1960, 49.
[58] United States Coast Guard USCG, "Season of 1960," *Bulletin of International Ice Observation and Ice Patrol Service in the North Atlantic Ocean* 46 (1961): 23.

A final test was conducted in 1960 to cover icebergs with carbon black. This was a dark substance they mixed with sand, ground clay, metal filings, and oil. The Ice Patrol tested to see if the carbon black would alter a berg's albedo, absorb the sun's rays, and melt quicker. To avoid boarding bergs, they tried applying the carbon black, once again, by dropping the substance as a bomb from a plane. But as in the real bombing experiments, these carbon black bombs also bounced off the ice and ruptured in mid air. Neither wet or dry mixes worked, so they eventually resorted to spreading it with brooms after climbing aboard a berg and scattering it over an area of 6,500 square feet. Five hours later the berg underwent a major calving event, though the Ice Patrol could not definitively declare that it was caused by the carbon black. They remained optimistic.[59] A journalist reporting on these activities, however, was less enthused. Twelve hours after they covered the berg, he explained, "most of the black coating had been washed away by melting and the treated half of the berg appeared to have raised slightly." In fact, journalist Werner Bamberger reflected negatively on all the 1960 tests by saying that "modern Coast Guard weaponry and science have failed for the second year in a row to solve the problem of the mariner's ancient enemy—the iceberg."[60]

Conclusion

In 2001, a dedicated and experienced Ice Patrol specialist succinctly captured the agency's long history of iceberg destruction efforts: "Since the start of the International Ice Patrol, one question has been asked more than any other. Why not just blow up the iceberg? The short answer is, we tried."[61] And try they did for about a half century. But ultimately they surrendered. They stopped bombing

[59] Ibid., 29.
[60] Werner Bamberger, "Icebergs Defy New Coast Guard Assaults," *New York Times*, 17 July 1960, 154.
[61] Duyane Alexander, "Indestructible Icebergs," *Mariners Weather Log* 45, no. 3 (2001): 4-7: 4.

bergs not only because the ice was too tough for bombs and molten iron, but also because, as International Ice Patrol oceanographer Donald Murphy and marine science technician Duyane Alexander put it, "even if an iceberg could be broken into smaller pieces, the result would be an increase in the number of icebergs. They would be smaller than the parent iceberg and, thus, harder for mariners to detect with their surface radars."[62] The ice won against the Ice Patrol and its weapons from the navy. In 1985, the *New York Times* summed up the decades of failed iceberg demolition efforts and lack of control over the ice, saying: "Despite their use of high technology, the ice patrol has no more control over the bergs than the Viking sailors who centuries ago named them 'mountains of ice.' In recent decades, the Coast Guard has tried to destroy icebergs with aerial bombs, underwater torpedoes, naval shells and land mines. The experiments have largely been abandoned as useless. If the tip of an iceberg is blown off, a new tip will invariably rise because seven-eighths of an iceberg is below water."[63] The ice won, the Coast Guard learned, and they adapted by learning to live with the ice not blast it into oblivion or engineer it out of the shipping lanes.

Ironically, when the Coast Guard surrendered in 1960, ceasing all iceberg bombing experiments, they quit trying to control nature precisely at the point when other half-crazed schemes were just getting underway. The era of brute force engineering was in full swing at this point.[64] Giant dam building projects were going strong, proposals to dam the Bering Strait, and weather modification schemes—such as cloud seeding to steer hurricanes, extinguish tornadoes, and end drought—were ramping up as well.[65] Some of these efforts were even directed at glaciers, such as Camp Century, a nuclear-powered "city under the ice" that the US military started building in 1959 inside the Greenland

[62] Murphy and Alexander, "Seek and Destroy? The History of Iceberg Demolition Experiement," 54.
[63] James Brooke, "Tracking Icebergs from Air Helps Save Ships and Lives," *New York Times*, 12 April 1985, A1.
[64] Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World*.
[65] Ronald E. Doel and Kristine C. Harper, "Prometheus Unleashed: Science as a Diplomatic Weapon in the Lyndon B. Johnson Administration," *Osiris* 21 (2006): 66-85; James Rodger Fleming, *Fixing the Sky: The Checkered History of Weather and Climate Control* (New York: Columbia University Press, 2010); Ted Steinberg, *Acts of God: The Unnatural History of Natural Disaster in America* (New York: Oxford University Press, 2000).

ice sheet to hide it from the Soviet Union. The Defense Department even started planning Project Iceworm around 1960. This project sought to build 1,000 miles of railroad tracks 228 feet below the surface of the Greenland ice sheet, where 600 nuclear missiles would be in constant motion over a 52,000 square mile area but ready to launch from any one of 60 launch sites within 20 minutes.[66]

There was clearly no shortage of grandiose engineering, from ice sheets to the ocean to the atmosphere to waterways. But ice was intractable. Camp Century caved in on itself after just a few years, and the dynamic (previously unrecognized) movement of the ice sheet killed plans for Project Iceworm.[67] Out in the North Atlantic, the Coast Guard yielded to the icebergs, too, which had, interestingly enough, also come from the Greenland ice sheet. In 1959, amidst all the other scheming in the military and among engineers worldwide, the Ice Patrol realized that it would just take too many explosives, too much heat, to eradicate even a medium-sized iceberg. They estimated it would require 1,900 tons of TNT to demolish an iceberg of 70,000 cubic feet. And to melt such a berg would require a heat equivalent to the burning of 2.4 million gallons of gasoline.[68] For economic, human health, and environmental reasons, this amount of TNT and heat was just not practical. Consequently, the Ice Patrol abandoned its berg bombing and other anti-ice campaigns in the 1960s, surrendering to the icebergs manufactured on Greenland's glaciers and brought down to the shipping lanes by the Labrador Current.

Of course the Ice Patrol's studying, classifying, monitoring, tracking, predicting, and broadcasting of iceberg behavior in the North Atlantic over a century has achieved a sort of discursive and knowledge-based "control" over the ice and ocean. The icebergs have been tamed to a degree, and the Ice Patrol facilitated a long term transformation of human-iceberg interactions and perceptions. Frederic Church's 1861 painting "The Icebergs" represents the beautifully haunting view of bergs 150 years ago, before

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[66] Nikolaj Petersen, "The Iceman that Never Came: 'Project Iceworm,' the Search for a NATO Deterrent, and Denmark, 1960-1962," *Scandinavian Journal of History* 33, no. 1 (2008): 75-98; Erik D. Weiss, "Cold War under the Ice: The Army's Bid for a Long-Range Nuclear Role, 1959-1963," *Journal of Cold War Studies* 3, no. 3 (2001): 31-58.
[67] Mark Carey, "Cold War Climate Science and Glaciology," presentation at the "Colonialism and Climate History" Workshop, Georgetown University, Washington, D.C., June 2013.
[68] USCG, "Season of 1959," 23. Stengel, "Icebergs."

the Ice Patrol started. There was also a horrifying fear of bergs that had always been lurking but became particularly prominent after the *Titanic* disaster. Then, for many, a belief emerged that bergs could be eradicated or at least contained. Later, perceptions shifted so that icebergs were seen as a respected threat that could be managed only by living with them, not engineering them out of the way or destroying them. More recently, the bergs have also come to attract tourists and adventurers who even climb them. There is iceberg vodka and water from icebergs, with a recent reality TV show on the Weather Channel called "Iceberg Hunters," about a Newfoundland family that tries to collect iceberg chunks to sell to a water bottling plant. Elsewhere, Greenland icebergs have become central to global warming discussions, including research on sea level, and Arctic ice has become increasingly politicized.[69] The Ice Patrol's history helps illuminate these changing interactions with icebergs over the last century. It exposes the alternative story to so many other environmental histories of environmental manipulation and destruction.

Icebergs elsewhere have continued to affect shipping right up to the present, and in places far beyond the North Atlantic's Grand Banks. In fact, one of the world's worst environmental disasters was caused by icebergs in southern Alaska. The Columbia Glacier that flows into Prince William Sound is one of the fastest flowing glaciers in the world. In 1976, it suddenly started shrinking dramatically and calving significantly more than it had previously. Thirteen years later, the *Exxon Valdez* left the port terminal of the Trans-Alaskan Pipeline with a ship full of oil. It steered out of the shipping lanes to avoid a slew of icebergs and went aground—spilling 11 million gallons of crude into the pristine Prince William Sound, causing one of the world's worst manmade environmental disasters in history as oil coated the sound and killed wildlife. The iceberg threat is not just confined to Alaska, of course. As recently as August 2012 there were reports of dangerous icebergs lurking off the coast of Greenland, threatening oil operations there not only due to a perceived change in iceberg size—such as the one twice the size of

[69] Jason Dittmer et al., "Have You Heard the one About the Disappearing Ice? Recasting Arctic Geopolitics," *Political Geography* 30 (2011): 202-14.

Manhattan that recently floated by—but also because the data used by oil companies to understand iceberg behavior is outdated. By affecting oil tankers, pipelines, and drilling rigs, glaciers and icebergs thus affect global energy flows while directly influencing how much we pay at the pump to fill up our cars or to heat our homes. Understanding the history of the International Ice Patrol thus has far-reaching implications, for the global economy, trade, and transportation; for energy supplies and distribution; for water and natural resources; for the oceanographic, climatic, and glaciological sciences; and for our perceptions and understandings of ice and the oceans—and its importance for people today, in the past, and in the future.

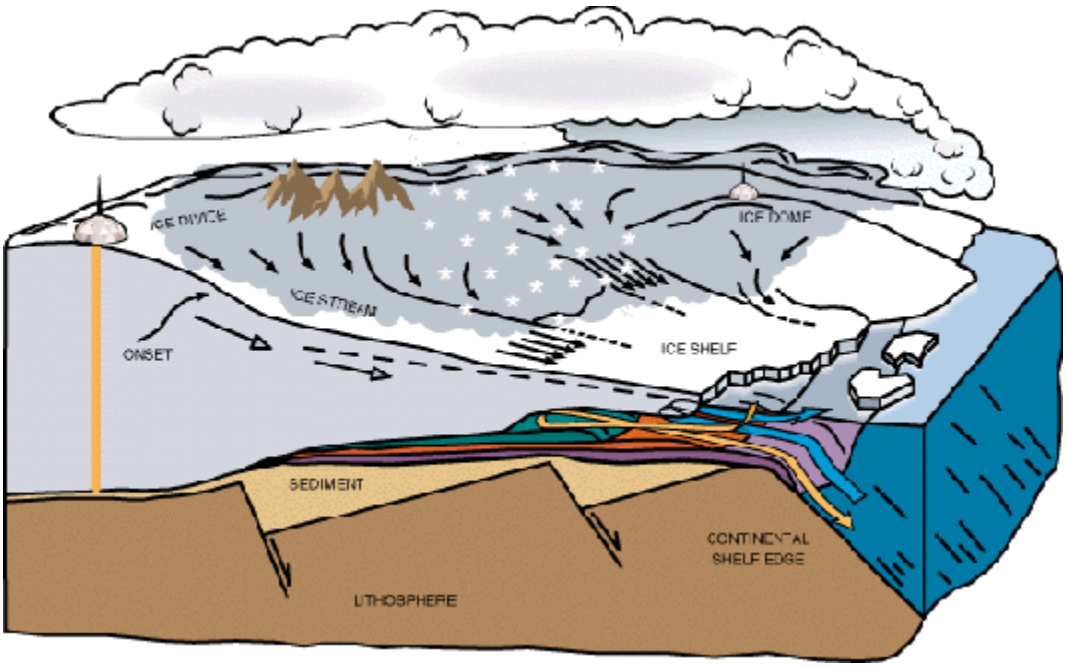
Figures

Size	Height (feet)	Height (meters)	Length (feet)	Length (meters)
Growler	Less than 17	Less than 5	Less than 50	Less than 15
Small Iceberg	17–30	5–15	50–200	15–60
Medium Iceberg	51–150	16–45	201–400	61–122
Large Iceberg	151–240	46–75	401–670	123–213
Very Large Iceberg	Over 240	Over 75	Over 670	Over 213
Shape	**Description**			
Tabular	Steep sides with a flat top. Very solid. Length–height ratio less than 5:1.			
Non-Tabular	This category covers all icebergs that are not tabular-shaped as described above. This includes bergs that are dome-shaped, sloping, blocky, and pinnacles.			

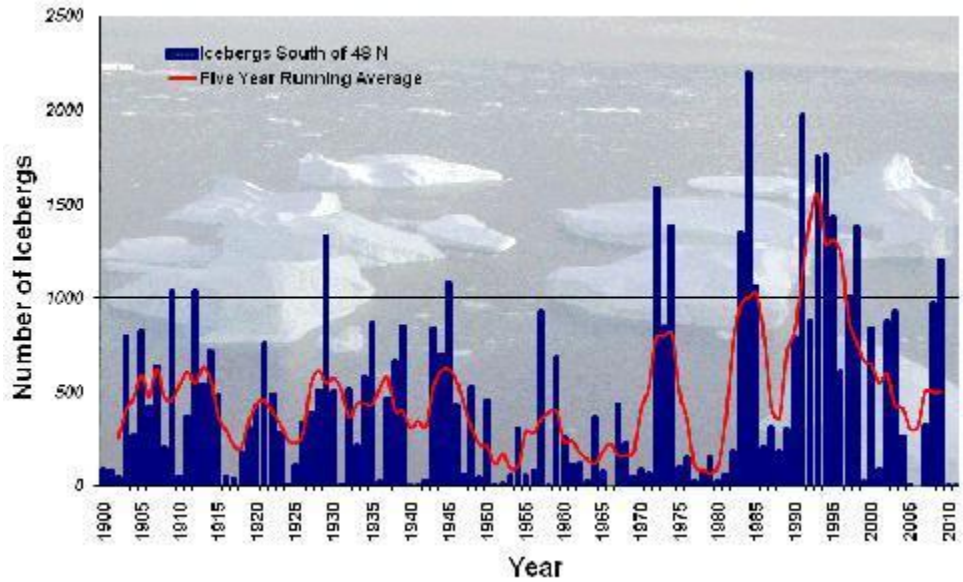
Table 2: Iceberg classification.

Ice Patrol's iceberg classification chart.[70]

[70] Stengel, "Icebergs."

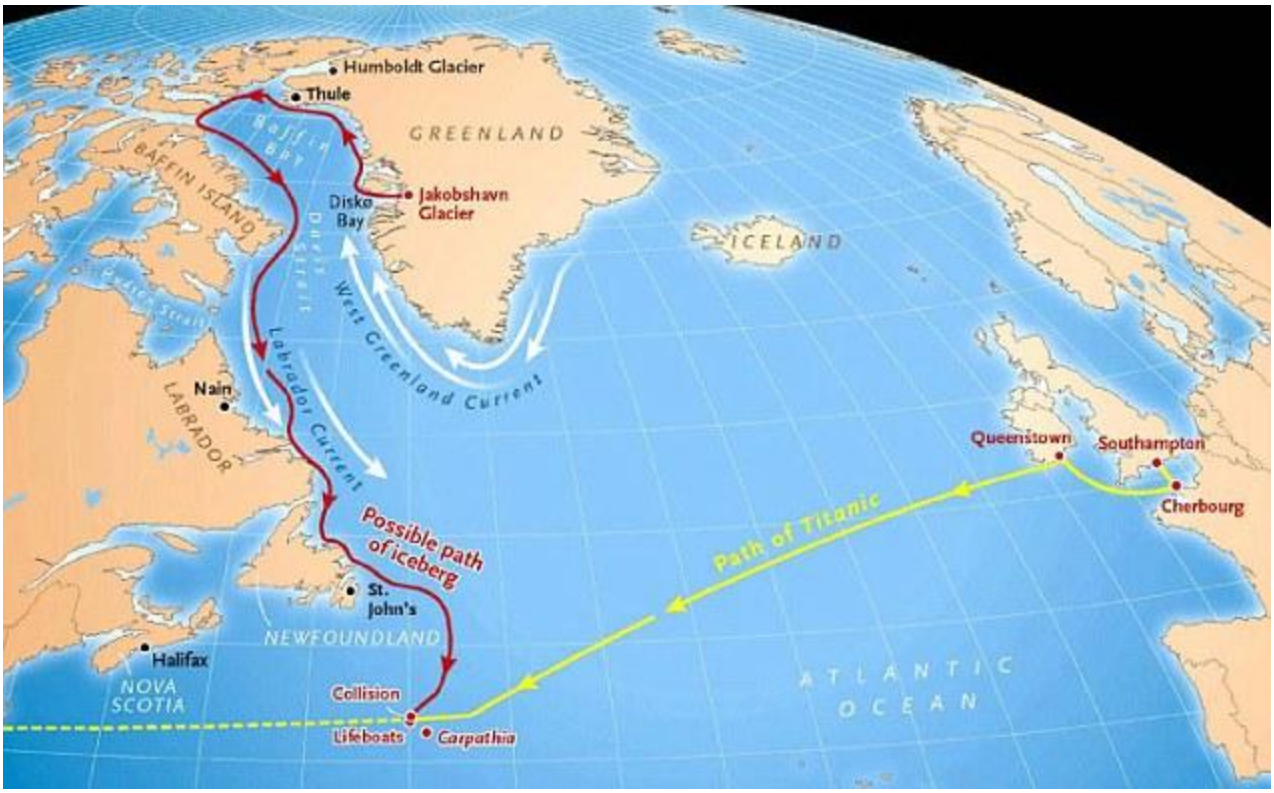


Depiction of Greenland glaciers and iceberg formation, from http://icesat.gsfc.nasa.gov/icesat/science/measurements.php



Iceberg counts from 1900-2011, compiled by International Ice Patrol. Treat carefully due to changing technologies and iceberg estimates versus observations over time.[71]

[71] Donald L. Murphy, "International Ice Patrol's Iceberg Counts, 1900-2011," *U.S. Coast Guard Navigation Center* 2011, http://www.navcen.uscg.gov/?pageName=IIPIcebergCounts (accessed 1 Jan 2014).



Site of the Titanic's sinking with ocean currents and typical iceberg path into North Atlantic shipping lanes from Greenland. map from http://sservi.nasa.gov/articles/did-the-moon-contribute-to-the-sinking-of-the-titanic/

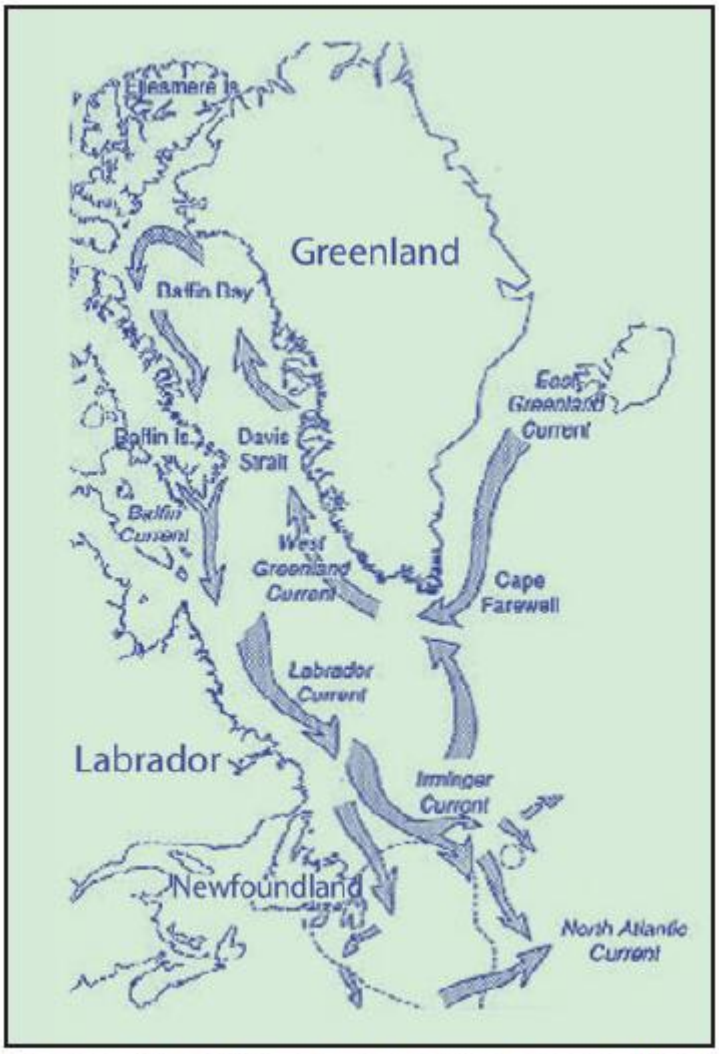


Figure 3: Drift of icebergs from West Greenland glaciers to the Grand Banks of Newfoundland.

Iceberg path from Greenland to the Grand Banks.[72]

[72] U.S. Coast Guard Internationl Ice Patrol Staff, "Oceanography," *The Coast Guard Journal of Safety at Sea Proceedings of the Marine Safety and Security Council* 62, no. 1 (2005): 21-24.