

# *In Manhattan's Wake*

Lieutenant Commander E.B. Stolee's Accounts of  
the Canadian Arctic Voyages of  
*CCGS John A. Macdonald and Louis St. Laurent, 1969/70*



**E.B. Stolee**

Edited and Introduced by  
**P. Whitney Lackenbauer and Adam Lajeunesse**

**Arctic Operational Histories, no.8**

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*Arctic ice along the route intended for MANHATTAN's voyage had not previously been described and identified sufficiently for her purpose. The problems of a tanker in an ice environment were unknowns in 1968 and as the ice and the ship intimately affect each other, Humble Oil's problem was analogous to that of a doctor prescribing medicine for a disease that has neither name nor patients. The world's foremost ice authorities were brought together and a major part of the MANHATTAN effort was devoted to the problem of defining ice.*

- LCdr E.B. Stolee (1970)

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Adam Lajeunesse  
Series Editor

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## List of Acronyms (see also page 87)

ADM	admiral	ICJ	International Court of Justice
ACND	Advisory Committee on Northern Development	KG	kilogram
BLDG	building	KM	kilometres
CAPT	captain	LBS	pounds
CBC	Canadian Broadcasting Corporation	MEGS	magnetos
CCG	Canadian Coast Guard	MHZ	megahertz
CM	centimetre	M.I.T.	Massachusetts Institute of Technology
DCASS	Documents on Canadian Arctic Sovereignty and Security	MK	mark
DND	Department of National Defence	NDHQ	National Defence Headquarters
DOT	Department of Transport	NM	Nautical Miles
ETD	expected time of departure	RT	radio text
G	gravitational force equivalent	RCAF	Royal Canadian Air Force
HP	horsepower	RCN	Royal Canadian Navy
DIAND	Indian Affairs and Northern Development	SHP	shaft horsepower
		SS	steam-ship
		SQ	squared
		USCG	US Coast Guard
		USCGC	US Coast Guard Cutter
		USD	United States Dollar

## INTRODUCTION

*P. Whitney Lackenbauer and Adam Lajeunesse*

In July 1968, the American energy companies Humble Oil and Atlantic Richfield announced the discovery of the largest oil field in North America at Prudhoe Bay on the northern coast of Alaska. Its discovery came just as continental oil production was peaking. The question was how to get the resource to market. In the mid-1960s, geographer Trevor Lloyd had presciently noted that “even if oil in commercial quantities were to be discovered shortly, there might well be considerable delay before it could reach world markets as the method of transportation is still to be determined.”<sup>1</sup> The oil companies’ initial answer was a grand experiment: the voyage of a reinforced ice-breaking supertanker across the Canadian Northwest Passage to test the viability of shipping oil from northern Alaska to refineries on the Eastern Seaboard of the United States. “The chief technique of Arctic navigation in the past had been to avoid ice whenever possible,” journalist William D. Smith explained in his 1970 book *Northwest Passage*. This time it would be different: “Rather than avoid the ice [the ship] would seek it.”<sup>2</sup>

The vessel chosen was the 115,000 deadweight ton super-tanker SS *Manhattan*. Over two months in the summer of 1969, the vessel travelled from New York to Prudhoe Bay and back again, testing everything from ice dynamics to hull pressure and design. “This was no wooden ship of stouthearted men fighting off scurvy, starvation, and death,” historian Ross Coen noted, “yet the *Manhattan* would still achieve the holy grail of polar exploration, a prize that for centuries had eluded the best of mariners – including Franklin, Frobisher, and Hudson.” Nevertheless, on 15 September 1969, “just seven weeks after a human being first set foot on the

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<sup>1</sup> Trevor Lloyd, “New Perspective on the North,” *Foreign Affairs* 42:2 (1964): 306.

<sup>2</sup> William D. Smith, *Northwest Passage* (New York: American Heritage Press, 1970), 18.



moon, the *Manhattan* closed another chapter in the annals of exploration when she became the first commercial vessel to complete a transit of the Northwest Passage.”<sup>1</sup> In April 1970 the ship returned to Canadian Arctic waters, albeit with the more modest objective of conducting winter ice tests in Lancaster Sound without hazarding the full passage. Both voyages were impressive technical successes and, even today, *Manhattan* remains the largest ship to ever travel this fabled route.

While the American tanker made headlines, it owed its achievements to the support provided by the Canadian Coast Guard (CCG), particularly the escort services of the icebreakers CCGS *John A. Macdonald* and *Louis St. Laurent*. These ships kept the tanker moving when it became stuck in heavy ice and facilitated the use of the more ambitious northern route through Viscount Melville Sound and Prince of Wales Strait. When the *Manhattan*'s voyage stimulated unexpected political sensitivity, the operational presence of these two heavy Canadian icebreakers also assumed symbolic significance, providing Canada with a visible demonstration of capacity and control in what otherwise might have been misperceived as an exclusively American venture through Canadian waters.

September 2019 marks the 50<sup>th</sup> anniversary of the *Manhattan*'s voyage. In recognition of this occasion, this volume presents two important reports offering first-hand accounts by Royal Canadian Navy (RCN) Lieutenant Commander Erling Stolee,<sup>2</sup> the Department of National Defence observer assigned to CCGS *John A. Macdonald* (the primary escort to *Manhattan*) in 1969 and CCGS *Louis St. Laurent* (which undertook the escort task in 1970). Together, these reports provide a detailed, day-by-day account of the

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<sup>1</sup> Ross Coen, *Breaking Ice for Arctic Oil* (College, AK: University of Alaska Press, 2012), 5.

<sup>2</sup> Lieutenant-Commander (RCN) Erling Brynjulf Stolee (U-71510) was appointed as a Naval Cadet in the University Naval Training Division of the Royal Canadian Naval Reserve in 1948 and served in HMCS *Nonsuch* – a Royal Canadian Navy Reserve Division located in Edmonton, Alberta. After his transfer to the RCN, he was appointed as a Lieutenant with a promotion to Lieutenant-Commander in 1960. Subsequently, he served in National Defence Headquarters on the Staff of the Chief of Logistics Engineering and Development. <https://www.nauticapedia.ca/database/Query/Biolist3.php?&name=Stolee%2C%20Erling%20Brynjulf&cid=25965&Page=63&input=1>.

voyages and of the CCG's unheralded role in facilitating them, offering glimpses of the dangers and difficulties of operating in the High Arctic. Stolee's reports also provide fascinating insight into life aboard a coast guard icebreaker, including traditions, command structures and culture, as well as issues of logistics, morale, and the unique psychology of sailors operating in the North. Readers today will also find Stolee's broader critique of government policy both interesting and prescient.

## Northern Development

The importance of *Manhattan's* voyage in Canadian Arctic history is well documented. When the *Manhattan* experiment was launched in the late 1960s, both the Canadian and American governments were broadly supportive because they saw in it a means to generate employment and spur development while strengthening national security and improving account balances. For the United States in particular, the prospect of a major new oil supply was welcome. In 1967, the first Arab oil embargo had increased crude prices around the world and threatened to cut off the easy access to oil that fueled the global economy. At the time, prices were kept under control only by tapping spare capacity in the US, but the event raised the spectre of a broader and more coordinated embargo with more serious repercussions,<sup>3</sup> given that the American ability to expand production in the face of an emergency was running out.<sup>4</sup>

The discoveries at Prudhoe Bay in northern Alaska were game-changing for the North American oil market. Initial estimates put the reserve at between five and ten billion barrels of oil, increasing US proven reserves by a third and making it by far the largest oil field on the continent.<sup>5</sup> The oil

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<sup>3</sup> This occurred in 1973 when the second Arab oil embargo raised global crude prices 82% in one year and caused considerable supply disruption in the American market.

<sup>4</sup> US production peaked at roughly 10 million barrels per day in 1979, falling thereafter until the advent of shale oil rejuvenated the industry in the mid-2010s.

<sup>5</sup> Coen, *Breaking Ice for Arctic Oil*, 24. In 2009 Prudhoe Bay's reserves were estimated to be 15.7 billion barrels produced with an additional 35-36 billion in proved reserves remaining (including nearby fields subsequently discovered); NETL, *Alaska North Slope Oil and Gas A Promising Future or an Area in Decline?* Addendum Report DOE/NETL-2009/1385 (April 2009).

companies' immediate concern was how to move the crude to market. From the North Slope of Alaska, oil had to travel roughly 3,200 km by sea to refineries in Washington State; 4,100 to San Francisco; or 8,000 to the East Coast through the Northwest Passage. Pipeline proponents favoured a line stretching nearly 1,300 km from Prudhoe Bay to Valdez in southern Alaska, avoiding ice-covered waters but having to reckon with two major mountain ranges, a series of rivers, and vast tracts of swampy terrain. In 1968 it seemed that tanker transportation would be both easier and cheaper, and the oil companies set upon testing it.<sup>6</sup>

Actually building a tanker fleet capable of regularly and safely transiting the Northwest Passage was a tall order. Canadian and American experience in Arctic shipping was limited to purpose-built icebreakers or seasonally employed cargo ships incapable of handling thick multiyear ice. Despite having operated ships in the region for seven decades, Canada also had a poor understanding of Arctic ice dynamics. Most importantly, there was little information on shipping through the Parry Channel, given that most northern marine activity took place along the easier, but narrower and shallower, southern routes. There was no past precedent of deep draft commercial operations through the Viscount Melville Sound, McClure Strait, or the Beaufort Sea to offer any guidance.<sup>7</sup>

SS *Manhattan* was tasked with acquiring the information needed to build fleets of icebreaking tankers. When constructed in 1961, the ship had been designed for the open seas, but Humble Oil leased the ship and soon converted it into the world's largest icebreaking vessel. Over a mere nine months, *Manhattan* was refitted by a team of 10,000 workers, working over 2.5 million man hours. The ship's bow was replaced with a specially designed icebreaking section, and an ice belt of high tensile steel stretched around its entire length, adding 10,000 tons of Arctic-ready steel to buttress the hull against ice. To assist in the myriad of tests and measurements that the vessel was supposed to undertake, sophisticated sensor and computer equipment was also brought onboard. In the end, the budget for the project

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<sup>6</sup> A.H.G. Storrs and T.C. Pullen, "S.S. Manhattan in Arctic Waters," *Canadian Geographic Journal* 80:5 (1970): 167 and Cohen, *Breaking Ice for Arctic Oil*, 29.

<sup>7</sup> Adam Lajeunesse, *Lock, Stock, and Icebergs: The Evolution of Canada's Arctic Maritime Sovereignty* (Vancouver: University of British Columbia Press, 2016), 139.

reached \$26 million USD (about \$200 million in 2019 dollars).<sup>8</sup> Ready to sail by the end of August 1969, her crew was comprised of 54 men, handpicked from hundreds of Humble employees who had put their names forward. Joining them were 72 others, including scientists, communication specialists, pilots, reporters, and public relations experts.<sup>9</sup>

For the United States, this effort made sense. Both the government and the independent oil companies saw the need to access Alaskan oil as quickly as possible. For Canada, the *Manhattan* project was viewed as an opportunity that could be leveraged to serve Canadian national interests. For Pierre Trudeau's Liberal government, the experiment held out the prospect of realizing broader economic and social objectives in the North. Arctic oil from the Beaufort Sea and Arctic Islands could reduce Canada's own energy imports, provide a new source of federal revenue, and create jobs for Northerners. As the Deputy Minister of Indian Affairs and Northern Development (DIAND) noted in late 1968, "the development of a navigable northern sea route would benefit the Canadian economy and be a spur to northern development."<sup>10</sup> In his report, Stolee shared this view that "Canada stands to gain from a successful venture."<sup>11</sup>

With Canadian interests seemingly served by the *Manhattan* and northern development, the Trudeau government embraced the voyage as a cooperative endeavor – and that cooperation was essential. Only three months after the announcement of the Prudhoe Bay discoveries, Imperial Oil (leading a consortium of oil companies) requested a meeting with the Canadian departments concerned with Arctic development. Here, oil company representatives conveyed their interest in conducting an Arctic tanker experiment and informed the Canadian government that they had already begun the process of procuring the test vessel that would become the renovated *Manhattan*. Requests were naturally made for Canadian

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<sup>8</sup> A.H.G. Storrs to Dr. Claude Isbister, March 5, 1969, Library and Archives Canada (hereafter LAC), RG 12, vol. 5561, file 8100-15-4-2, pt. 1.

<sup>9</sup> Cohen, 63.

<sup>10</sup> 73<sup>rd</sup> meeting of the Committee, 19 December 1968, in P. Whitney Lackenbauer and Dan Heidt, eds., *The Advisory Committee on Northern Development: Context and Meeting Minutes, 1946-66*, Documents on Canadian Arctic Sovereignty and Security vol. 4 (2015), document 73.

<sup>11</sup> This volume, page 39.

icebreaker support and any ice data that the government could provide.<sup>12</sup> From the beginning the American oil companies were keenly interested in official Canadian input and participation in what was, for them, a leap into the great unknown. Stolee notes in his report how “Arctic ice along the route intended for *Manhattan’s* voyage had not previously been described and identified sufficiently for her [*Manhattan’s*] purposes.” Furthermore, “the problems of a tanker in an ice environment were unknown in 1968 and as the ice and the ship intimately affect each other, Humble Oil’s problem was analogous to that of a doctor prescribing medicine for a disease that has neither name nor patients.” The oil companies believed that consultation with Canadian government agencies was essential and engaged with federal officials on a regular basis throughout 1968 and 1969.

The ability of a large tanker to navigate the Northwest Passage was highly uncertain in 1969, and the Canadian government saw the successful development of a northern sea route as aligned with its own interests. It promised ice charts and weather forecasting but ultimately its main contribution to the mission was the provision of Coast Guard heavy icebreakers. In December 1968, the Advisory Committee on Northern Development (ACND), an interdepartmental body tasked with managing policy questions surrounding northern development, agreed to send CCGS *John A. Macdonald* to cooperate with the *Manhattan* on its 1969 voyage. For the *Manhattan’s* return trip in 1970, Canada dispatched its newest ship – “the 15,324-ton CCGS *Louis St. Laurent* – commissioned only the year” before. It was hoped and assumed that by providing such assistance the “overall enterprise could be made to succeed, while also framing the project” as a joint endeavour and thus avoiding the appearance of a unilateral “American operation in Canadian waters.”<sup>13</sup>

### Sovereignty in Question?

While the *Manhattan’s* voyage was conceived as a scientific and commercial endeavor, the tanker took on a political significance before ever

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<sup>12</sup> A.H.G. Storrs to Dr. Claude Isbister, March 5, 1969, LAC, RG 12, vol. 5561, file 8100-15-4-2, pt. 1.

<sup>13</sup> Edgar Dosman, “The Northern Sovereignty Crisis,” in *The Arctic in Question*, ed. Dosman (Toronto: Oxford University Press, 1976), 39-40.

reaching the Arctic. The spectacle of so massive a ship traversing the heretofore largely unnavigable Northwest Passage alarmed the Canadian public. Part of that concern related to the uncertain status of those waters in international law. Since at least the 1950s, Canada and the United States had disagreed over the legal status of the waters of the Northwest Passage.<sup>14</sup> For Canada, the waters in its Arctic Archipelago were historic internal waters over which the country enjoyed complete sovereignty. While no Canadian government had ever enacted that position into legislation, a belief in the country's Arctic sovereignty – over both land and ice – was a fundamental assumption that underlay Canada's northern policy.

This assumption of ownership was clear in Ottawa's cooperation with the United States in northern defence projects during the 1950, and Canadian officials explicitly conveyed this position to their American counterparts on several occasions in the early 1960s. While no American government had ever challenged Canada's maritime sovereignty position, neither had they accepted it explicitly. Joint defence cooperation after the Second World War deliberately side-stepped the matter of maritime sovereignty where possible by focusing on operational requirements, relying on purposefully ambiguous phrasing when it came to permissions and shipping waivers to keep sensitive sovereignty issues off the table and ensure that they did not disrupt shared commitments to continental defence.<sup>15</sup>

While there was never any serious desire in Washington to challenge Canada's sovereignty position, the Americans harboured broader international reasons not to accept it explicitly. In 1969, the American position suggested that the Northwest Passage constituted international waters, with Canadian territorial waters extending only 3 nautical miles (NM) from the coast. Because the US asserted that the passage constituted an international strait, through which the United States (and all foreign-

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<sup>14</sup> See Elizabeth B. Elliot-Meisel, *Arctic Diplomacy: Canada and the United States in the Northwest Passage* (New York: Peter Lang, 1998); P. Whitney Lackenbauer and Peter Kikkert, "Sovereignty and Security: The Department of External Affairs, the United States, and Arctic Sovereignty, 1945-68," *Serving the National Interest: Canada's Department of Foreign Affairs and International Trade, 1909-2009*, Greg Donaghy and Michael Carroll eds. (Calgary: University of Calgary Press, 2011); and Lajeunesse, *Lock, Stock, and Icebergs*.

<sup>15</sup> Lajeunesse, *Lock, Stock, and Icebergs*, 128, 140.

flagged vessels) enjoyed the right of innocent passage, it insisted that Canadian control within those territorial waters was also limited. Although no precise legal criteria existed to determine what constituted an international strait, customary law recognized two main factors: one geographic (meaning that a strait must connect two bodies of high seas) and the other functional (meaning that it must have been a useful passage for international traffic).<sup>16</sup>

While the Northwest Passage clearly met the geographic requirement, the functional one invited differences of legal opinion. In his extensive work on the subject, scholar Donat Pharand explained the difficulties of applying functional criteria to an area like the Northwest Passage that has seen so little commercial activity.<sup>17</sup> The standard for functional use was set in the *Corfu Channel* case, which came before the International Court of Justice (ICJ) in 1949. Here, the ICJ was given shipping statistics for the Corfu Channel from 1 April 1936 to 31 December 1937 – amounting to 2,884 transits by vessels of various states that had put into Corfu while passing through (this excluded transiting ships that did not put into the port).<sup>18</sup> This was fairly light traffic, yet it dwarfed the six foreign vessels that had transited the Northwest Passage by 1969. Furthermore, none of these six constituted what might be considered ‘normal’ international navigation. They were made by the small Norwegian sloop *Gjoa* from 1903-6; the USCG icebreakers *Storis*, *Spar*, and *Bramble* in 1957; and the US submarines *Seadragon* and *Skate* in 1960 and 1962 respectively.<sup>19</sup> For Canada, this clearly differentiated the Northwest Passage from the world’s ‘useful’ straits. In US officials’ eyes, however, the functional element was

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<sup>16</sup> In 1959 conventional law surrounding international straits was defined by the United Nations, Convention on the High Seas, adopted at Geneva, Switzerland on April 29, 1958, Article 16. This convention was, however, ambiguous on the criteria for defining these straits. The relevant precedent from customary law providing that framework was: International Court of Justice, *Fisheries Case*, Judgment of December 18, 1951.

<sup>17</sup> Donat Pharand, “The Arctic Waters and the Northwest Passage: A Final Revisit,” *Ocean Development and International Law* 38:1 (2007): 37-39.

<sup>18</sup> International Court of Justice, *Corfu Channel Case*, Judgment of April 9, 1949: I.C.J. Reports, 1949, *Merits*, 29.

<sup>19</sup> Lajeunesse, *Lock, Stock, and Icebergs*, 155.

secondary to the geographic criteria, leaving the Northwest Passage a strait that *could* be used for international navigation.<sup>20</sup>

Prior to 1969, this legal and political disagreement remained in the background, with both sides effectively agreeing to disagree behind closed doors. In Ottawa the Trudeau government hoped and assumed that *Manhattan's* voyage could be undertaken in a spirit of cooperation and mutual benefit, without reference to awkward questions of sovereignty and jurisdiction. Initially that seemed possible. In the lead up to the mission Canadian officials worked closely with the American oil companies to plan the pilot project – cooperation that led the ACND to assume that Canadian sovereignty was not at stake and that the optics of Canadian control were adequately protected through its participation and presence (including the assistance provided by Captain Thomas C. Pullen, the former commander of HMCS *Labrador*, who served as a Canadian representative on *Manhattan*).<sup>21</sup> Canada provided charts and ice-reporting and *John A. Macdonald* and *Louis St. Laurent* supported the American tanker. Political scientists John Kirton and Don Munton also noted that, because Humble Oil had notified Ottawa of the transit and requested CCG assistance, this implied at least a recognition of Canadian sovereignty.<sup>22</sup> As such, the Trudeau government assumed that Canadian sovereignty was sufficiently protected by this control – all of which provided a clear enough demonstration that the passage was being made possible only through Canadian assistance.<sup>23</sup>

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<sup>20</sup> For an example of the American perspective on the functional criteria see: Richard J. Grunawalt, “United States Policy on International Straits,” *Ocean Development and International Law* 18:456 (1987): 456.

<sup>21</sup> See P. Whitney Lackenbauer and Elizabeth Elliot-Meisel, eds., “*One of the Great Polar Navigators*”: *Captain T.C. Pullen's Personal Records of Arctic Voyages*, Volume 1: *Official Roles* (Calgary and Waterloo: Centre for Military, Strategic and Security Studies/Centre on Foreign Policy and Federalism/Arctic Institute of North America, 2018).

<sup>22</sup> John Kirton and Don Munton, “The Manhattan Voyages and their Aftermath,” *Politics of the Northwest Passage*, Franklyn Griffiths ed. (Kingston: McGill-Queen's University Press, 1987), 71.

<sup>23</sup> Dosman, “Northern Sovereignty Crisis,” 39-40.



## The Manhattan “Crisis”

The assumption that the *Manhattan* voyage could be kept within the confines of a commercial experiment soon foundered on the realities of Canadian nationalism and deep-seated suspicion of American intentions. The unique and dramatic nature of the transit infused it with a degree of notoriety in the Canadian press, sparking public demands for a more direct and forceful approach to upholding national sovereignty. At the heart of this crisis was Washington’s refusal to request formal permission to transit what Canada considered its waters – both for *Manhattan* as well as the US Coast Guard Cutter (USCGC) icebreakers *Northwind*, *Glacier*, and *Staten Island* that joined the CCG in providing support at various points throughout the mission.

In June 1969, in response to growing public concern, the Department of External Affairs offered an “informal suggestion” to the US State Department that it formally request permission to transit – which Canada would happily grant, of course. The Americans turned down this request on the pretext that compliance would have set a damaging precedent at a time when many countries were unilaterally extending their own territorial seas or maritime jurisdiction over strategically and commercially significant straits in other parts of the world.<sup>24</sup> In a 1970 note, the State Department warned that “if Canada had the right to claim and exercise exclusive pollution and resources jurisdiction on the high seas, other countries could assert the right to exercise jurisdiction for other purposes, some reasonable and some not, but all equally invalid according to international law.”<sup>25</sup> Accordingly, the Americans bluntly notified Ottawa that the United States did not recognize Canadian sovereignty over the waters of the Arctic Archipelago or to any waters outside its three-mile territorial sea.<sup>26</sup>

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<sup>24</sup> On the question of the Northwest Passage as precedent setting see: Suzanne Lalonde and Frederic Lasserre, “The Position of the United States on the Northwest Passage: Is the Fear of Creating a Precedent Warranted,” *Ocean Development and International Law* 44:1 (2013).

<sup>25</sup> David Meren and Bora Plumtpre, “Rights of Passage: The Intersecting of Environmentalism, Arctic Sovereignty, and the Law of the Sea, 1968-82,” *Journal of Canadian Studies* 47:1 (Winter 2013): 182.

<sup>26</sup> Dosman, “Northern Sovereignty Crisis,” 40.

The US government's refusal to request permission to transit the Northwest Passage exacerbated the Canadian public's concern over the voyage. Strategist Kenneth Eyre described these sovereignty fears as having "bordered on near hysteria," while legal scholar Maxwell Cohen wrote of a public "panic" and "near paranoia" as the "voyages made Canadians feel that they were on the edge of another American "steal" of Canadian resources and "rights."<sup>27</sup> Trudeau's trusted advisor Ivan Head wrote that there emerged, "with a suddenness wholly uncharacteristic of Canadian public mood swings, a cacophony of anti-American sentiment ... [and] a jingoistic cry for assertive Canadian territorial claims, which ... reach[ed] crescendo pitch at the time of the voyage."<sup>28</sup>

The intensity of this public reaction caught the Canadian government off guard. Ottawa was used to managing questions of sovereignty and American activity in the Arctic through quiet diplomacy, with little fanfare.<sup>29</sup> Canada's observer aboard the tanker, T.C. Pullen, was equally shocked by the nationalistic press reports depicting the voyage as a direct challenge to Canadian sovereignty.<sup>30</sup> Secretary of State for External Affairs Mitchell Sharp expressed a similar concern, telling the *Globe and Mail* that "it is wholly misleading ... to portray the *Manhattan* passage as a test of Canada's sovereignty in the Arctic, the issue simply does not arise."<sup>31</sup> Unconvinced by government statements of this nature, journalists continued to feed public anxieties about American encroachment on Canadian rights.<sup>32</sup>

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<sup>27</sup> Kenneth Eyre, "Forty Years of Military Activity in the Canadian North, 1947-87," *Arctic* 40:4 (December, 1987): 296.

<sup>28</sup> Ivan Head and Pierre Trudeau, *The Canadian Way: Shaping Canada's Foreign Policy, 1968-1984* (Toronto: McClelland and Stewart, 1995), 29-30.

<sup>29</sup> On this see for instance: Lackenbauer and Kikkert, "Sovereignty and Security."

<sup>30</sup> Ken Coates et al., *Arctic Front: Defending Canadian Interests in the Far North* (Toronto: Thomas Allen & Son Ltd., 2008), 93.

<sup>31</sup> Whitney Lackenbauer and Peter Kikkert, "Building on Shifting Sands: The Canadian Armed Forces, Sovereignty and the Arctic, 1968-1972" in *Canadian Arctic Sovereignty and Security: Historical Perspectives* (Calgary: Centre for Military and Strategic Studies, 2011), 288.

<sup>32</sup> Coates et al. *Arctic Front*, 94 and Shelagh Grant, *Polar Imperative* (Toronto: Douglas & McIntyre, 2010), 348-349.

Surprising or not, politicians had to take public concern into account – particularly growing fears that an American refusal to request permission to enter those waters might lead to a dangerous precedent. After all, the *Manhattan* voyage was intended as a trial run, the first of many such transits. As Stolee points out, if the voyage was a success, the oil companies’ plans called for the construction of 26 to 30 massive 1,200-foot long icebreaking Ultra Large Crude Carriers of 250,000 tons, each capable of carrying one million barrels.<sup>33</sup> If *Manhattan* could transit the Northwest Passage without explicit Canadian permission, what control would the country have over the hundreds of tanker voyages to follow in its wake? In December 1969 the *New York Times* quoted an oil company spokesman as saying that the voyage of *Manhattan* “could result in the establishment of a new commercial shipping route through the Arctic region with broad implications for future Arctic development and international trade.”<sup>34</sup> If this came to pass, the northern waters would no longer be the near-exclusive preserve of Canadian icebreakers and joint defence operations; tanker shipping would mean the continuous presence of foreign flagged commercial vessels using the Northwest Passage as a strait “which are used for international navigation” – the simple definition given to international straits by the 1958 United Nations Convention on the Territorial Sea and the Contiguous Zone.<sup>35</sup>

The establishment of an international commercial strait outside of Canadian control was unacceptable to decision makers in Ottawa. They expressed this view to the State Department in April 1970, unequivocally stating that “the Canadian government is aware of U.S.A. interest in ensuring freedom of transit through international straits, but rejects any suggestion that the Northwest Passage is such a strait ... The Northwest

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<sup>33</sup> Minutes of the 73<sup>rd</sup> meeting of the ACND, December 19, 1968, LAC, RG 112, vol. 29803, file 170-80/A6, pt. 7.

<sup>34</sup> “Oil Concerns seek a Northwest Passage to Unlock the Arctic,” *Wall Street Journal*, 17 December 1968.

<sup>35</sup> UN Convention on the Territorial Sea and the Contiguous Zone, done at Geneva on 29 April 1958, entered into force on 10 September 1964 (United Nations, Treaty Series, vol. 516), Article 16.

Passage has not attained the status of an international strait by customary usage nor has it been defined as such by conventional international law.”<sup>36</sup>

### ***Manhattan, Canadian Coast Guard Icebreakers, and the Test Voyages of 1969-70***

Faced with this difficult situation, the ACND and the Interdepartmental Committee on Territorial Waters submitted a joint review of Arctic sovereignty in March 1969, outlining three possible options. First, Canada could assert its Arctic claims by formalizing its sovereignty with domestic legislation. That might have elicited an American challenge and a case before the ICJ, which senior civil servants doubted Canada’s ability to win. A defeat could deal an irrecoverable blow to Canada’s position,<sup>37</sup> and this move more generally would have serious political and economic consequences. The second option was to simply accept the American position and allow unimpeded foreign transit – an option never seriously considered given the national interests involved. The third option was to try and maintain the status quo, assert control with a physical presence, and hope that the issue could be managed rather than resolved.<sup>38</sup> Senior officials rejected the first option as excessively dangerous and the second as political suicide. That left building on the status quo.<sup>39</sup> In its first memorandum to Cabinet, the Task Force on Northern Development (set up that year to provide policy advice) avoided any reference to a political solution and instead recommended that the government respond to the challenge by increasing its northern activity to ensure a continuation of “effective occupation.”<sup>40</sup> Showing the flag was integral to this strategy.

Canadian Coast Guard icebreakers were an essential component of this approach. In 1968, Department of External Affairs legal advisor Leonard Legault explained to the ACND that “if a foreign state opened and made use

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<sup>36</sup> Quoted in Donat Pharand, *The Law of the Sea of the Arctic with Special Reference to Canada* (Ottawa: University of Ottawa Press, 1973), 59.

<sup>37</sup> Minutes of the 73<sup>rd</sup> meeting of the ACND, December 19, 1968, LAC, RG 112, vol. 29803, file 170-80/A6, pt. 7.

<sup>38</sup> Memorandum for Cabinet, March 20, 1969, LAC, RG 12, vol. 5561, file 8100-15-4-2, pt. 1.

<sup>39</sup> Dosman, “Northern Sovereignty Crisis,” 39-40.

<sup>40</sup> Kirton and Munton, “Manhattan Voyages and their Aftermath,” 75.

of the sea route [the Northwest Passage] without reference to or real assistance from the coastal state, a presumption might arise that the area in question was part of the high seas.” Conversely, “under international law, the fact that navigation in a particular area of the sea was possible only because of the aids provided by the coastal state was an important element, among others, in establishing and proving that state’s claim to sovereignty over the area.<sup>41</sup> Put simply, if the United States could demonstrate that its ships were able to transit the Northwest Passage without outside assistance, a precedent for future voyages might be set. If Canada showed that such passage was possible only with Canadian assistance, however, the precedent would reinforce Canadian ownership and control. As such, the tasking of *John A. Macdonald* was as much an expression of Canadian sovereignty and control as it was support to *Manhattan*. As historian Ross Coen points out “the Canadian government did not ask but rather informed Humble Oil that it would be sending its own icebreaker ... to escort the tanker.”<sup>42</sup>

Displacing 9,300 tons, CCGS *John A. Macdonald* was the heaviest icebreaker in the Coast Guard fleet when it was deployed north in the summer of 1969. Launched ten years earlier, it boasted 15,000 ship horsepower and the ability to break 18 feet of ice. It also was “beautifully appointed” compared to its American coast guard counterparts, as Smith described:

There were no gray steel bulkheads but wood panelling in all quarters. The *Macdonald* was immaculate from her completely enclosed bridge to her dinner table and her diesel-electric engine room. She carried a complement of about ninety compared with almost two hundred on the smaller [U.S.] Coast Guard Wind class ships. On Wind class ships the men sleep in very close quarters, and many of the rooms are located

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<sup>41</sup> 73rd meeting of the ACND, 19 December 1968 LAC, RG 112, vol. 29803, file 170-80/A6, pt. 7.

<sup>42</sup> Coen, *Breaking Ice for Arctic Oil*, 8.

over the roaring engines. The “Mac” has only two or three men to a room and singles for the officers.<sup>43</sup>

Even more impressive was CCGS *Louis St. Laurent*, Canada’s newest and most powerful icebreaker. Launched in October 1969, the ship displaced 15,300 tons, could call upon 25,000 horsepower, and could break ice ridges over 42 feet thick. Together, the Canadian ships represented the most powerful icebreaking duo in the Western world and dramatically outclassed their American counterparts.

Until the arrival of the *Polar*-class in late 1970s the USCG fleet was built around seven *Wind*-class vessels dating back to the Second World War. These ships were roughly half the size of *St. Laurent* with no more than 40% its engine strength. The largest American icebreaker then in service was USCGC *Glacier*, essentially an improved *Wind*-class. While still a small vessel at 8,450 tons, it had a more powerful engine with an output of 21,000 horsepower. The American vessels *Staten Island*, *Glacier*, and *Northwind* would accompany the *Manhattan* at various points in her journey, working with the Canadian icebreakers. It was clear, however, that their performance was decidedly inferior, leaving much of the heavy icebreaking to the Canadian ships.

Stolee’s report and journal entries on the summer 1969 voyage onboard CCGS *John A. Macdonald* furnish a rich description of the “high Arctic” marine environment, with particular focus on defining the various forms of ice encountered in Canada’s Arctic Archipelago. “Arctic ice along the route intended for MANHATTAN’S voyage had not previously been described and identified sufficiently for her purpose” he notes. By extension, the problems that a tanker would encounter while operating in an ice environment remained “unknowns” when planners devised their pilot project. Accordingly, “the world’s foremost ice authorities were brought together” to address “the problem of defining ice – one of the core preoccupations associated with the test voyage.”<sup>44</sup>

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<sup>43</sup> Smith, *Northwest Passage*, 146. Smith and other commentators also note that the Canadian ships boasted a bar while the U.S. coast guard ships did not, thus making the Canadian icebreakers a popular destination for their American counterparts.

<sup>44</sup> This volume, page 3.

In his close observations from July-October 1969, Stolee described the wondrous landscapes through which *Macdonald* passed, documented the various ships encountered en route, and carefully assessed the performance of *Manhattan* and its instrumentation. The prose with which he captures the voyage is evocative and precise, offering the reader first-hand insights on what transpired as well as his thoughts on the broader implications for Canada. “This concept of forcing a supertanker, such as MANHATTAN, through the Northwest Passage is imaginative – the route is shorter by several thousand miles than any other Europe-Pacific passages, and Canada stands to gain from a successful venture,” he noted on 11 July 1969. His tone was celebratory, not narrowly defensive or nationalistic. Entering Lancaster Sound on 17 August, he exclaimed: “To be entering these waters at last, where so much of mankind’s finest history has been written, is a humbling and joyful occasion.” He marveled at a glacier, described the wreck of an old whaling ship, and observed a polar bear and cub dining on a narwhal carcass.<sup>45</sup> His journal is filled with similar expressions of intrigue and awe with the Arctic environment.

On 31 August, *Macdonald* met up with *Manhattan* in Frobisher Bay. “Set course north for the Baffin Ice Pack in which MANHATTAN will blood herself,” Stolee recorded in his diary. “She is powerful looking with a wicked, snarling snout.”<sup>46</sup> He documents the CCG’s frequent efforts to free the tanker and its US escorts when they became stuck during ice trials. He



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<sup>45</sup> This volume, page 55.

<sup>46</sup> This volume, page 59.

also describes *Manhattan's* decision to abandon plans to attempt McClure Strait, which would have represented the first westbound passage through Parry Sound. Although the ship "had more than exceeded her planned performance" by 12 September, conditions proved that "she is simply not designed for McClure concentrations, either by horse-power or general hull design."<sup>47</sup> In announcing this decision at a press conference, Haas explained:

Gentlemen, we have decided to turn the ship about and take the southern route through the Prince of Wales Strait. This is the likely route of the year-round vessels. We are in the middle of a large polar floe that is beyond the capabilities of this test vessel. We are not here to make history for its own sake. If we were to continue we would be jeopardizing the mission which after all is to collect data to build bigger and better ships. These ships will have to be able to defeat this kind of ice. They will not be able to avoid it if they are to carry oil all year round. This kind of ice constitutes a real danger to icebreakers. The *Macdonald's* propellers are being hit constantly by the large slabs of polar ice that we have been breaking. We risk losing our icebreaker assistance. We would then be all alone and in real danger.<sup>48</sup>

After arriving at Point Barrow, Alaska, on 21 September, Stolee noted:

We have now completed the western transit of the Northwest Passage, an accomplishment which few have achieved. The circumstances of our journey are so different from those of Parry in 1819-20 and McClure in 1850-54 that one would hardly know the voyages cover the same waters. The odd snow storm and the biting wind from the north which blew a few times hinted at the miseries which the early explorers must have suffered when "wintering" in the north. Parry wintered in Winter Harbour, Melville Island, during the winter of 1819-20, we used Winter Harbour as an airstrip to bring in mail and stores; McClure wintered in Mercy Bay, Banks Island, in the winter of 1851-2. We reached that longitude before turning back towards Prince of Wales in our 1969 attempt. McClure

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<sup>47</sup> This volume, page 68.

<sup>48</sup> Quoted in Smith, *Northwest Passage*, 127.



crossed from Mercy Bay to Winter Harbour during the winter of 1852 to get food and became the first man to complete the Northwest Passage; we crossed these waters twice by ship and complained if the showers didn't work and fresh grape-fruit ran out. Such is life!<sup>49</sup>

*Macdonald* escorted *Manhattan* during its return trip eastward through the Northwest Passage in September and October 1969. Stolee notes repeated efforts to “unstick” the tanker when it became beset in the frozen seas, particularly during the three weeks spent testing various types of ice and collecting data in Viscount Melville Sound. The superior performance of the Canadian icebreakers was valuable to the Canadian government, demonstrating the tanker's inability to transit unassisted (or even with American assistance). On several occasions the heavy tanker needed Canadian assistance, not surprising given Stolee's observation that 1969 was a terrible year for ice. The most dangerous situation occurred in McClure Strait on 11-12 September 1969 where *Manhattan* ground to a halt in a solid block of old ice stretching 3.5nm across. After twelve hours of backing up and ramming without success, Captain Paul Fournier of *Louis St. Laurent* remarked “it's as though she were sailing through a granite quarry.”<sup>50</sup> While *Manhattan* was larger with more powerful engines than either Canadian icebreaker, she was far less maneuverable, had little reverse power, and was a sitting duck once she lost momentum. “She is almost impossible to turn in ice,” Stolee recounted, “and has difficulty in backing up.”<sup>51</sup> Eventually *Manhattan* was freed by the Canadian escorts, a gratifying experience for the crew. In a sentiment that likely applied to both sailors and government officials alike, one junior officer onboard *Macdonald* commented: “it's not that we don't want the mission to succeed. We most certainly do. But the fact is that every one of us has been on his knees praying that [the] big bastard would get stuck just once.”<sup>52</sup>

In addition to helping *Manhattan*, the Canadian icebreakers found themselves assisting their under-powered American escorts. In the thick ice of Viscount Melville Sound, *Macdonald* was twice forced to assist USCGC

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<sup>49</sup> This volume, pages 72-73.

<sup>50</sup> Dosman, “Northern Sovereignty Crisis,” 39.

<sup>51</sup> This volume, page 65.

<sup>52</sup> Quoted in Smith, *Northwest Passage*, 113, and Coen, *Breaking Ice for Arctic Oil*, 125.

*Westwind*. Rather than demonstrating an independent ability to support the tanker, the US icebreakers often forced the convoy to slow and became, at one point, “a hindrance in this ice.”<sup>53</sup> Finally admitting defeat, *Northwind* broke off from the group and headed south to take an easier route through Coronation Gulf while *Manhattan* continued with Canadian support along a more northerly route.

Stolee ended his journal as an observer when the *Manhattan* wrapped up its official trials on 26 October. It completed its round trip on 8 November, stopping into Halifax under the escort of the two Canadian icebreakers. Canadian transport minister Don Jamieson welcomed them back at a reception at Dalhousie University, praising the crews for their contributions to northern knowledge and noting a sense of national pride in their performance. Stan Haas of Humble Oil took the stage at the banquet hall to personally thank the crew of *Macdonald*. “When we encountered the heavier ice in Melville Sound ... we Texans had not yet learned all the lessons,” he proclaimed. “But during the voyage to Prudhoe Bay and Point Barrow, Alaska, the *John A. Macdonald* steamed along at our stern waiting for a call for assistance from us and then answered that call as required with a vigor and enthusiasm typical of the character of the ship and her master.”<sup>54</sup> The voyage had proven that icebreakers were essential enablers to facilitate the transit of large tankers through the passage, and the Canadians took justifiable pride in their role in the test run.

Stolee was adamant that the purpose of polar icebreakers was to aid shipping. “As a test vehicle MANHATTAN answered many questions and was successful in her goal of establishing and validating information from which to design successful northern tankers,” he summarized. The voyage indicated that “‘mass’ is the key to breaking Arctic ice,” but that “economic feasibility is the ultimate consideration for successful exploitation of the Northwest Passage.” This equation also had to factor in global energy markets, as well as the construction and operating costs associated with ice-strengthened tankers, the short shipping season, and the lack of existing infrastructure in the North American Arctic.<sup>55</sup>

While an overall success, the experiment revealed obvious problems with northern shipping. The *Manhattan* spent several days stuck in the ice,

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<sup>53</sup> This volume, page 64.

<sup>54</sup> Coen, *Breaking Ice for Arctic Oil*, 154.

<sup>55</sup> This volume, page 4.

raising fears that the Northwest Passage would not be conducive to tight shipping schedules. “Production facilities and refineries have to know exactly how much oil is arriving and on what date,” Coen explained, and delays would “create surplus product at the other end of the route. Costs would skyrocket.”<sup>56</sup> There were also still significant technological challenges to overcome. Communications in the Arctic were hindered by a lack of infrastructure, atmospheric interference, and the region’s topography – issues that plagued the Royal Canadian Navy (RCN) in its operations throughout the 1970s. In a moment of levity, Stolee points out that *Manhattan’s* integrated position/navigation and impact/sideslip measure system “has proved about as useful as a piglet feeding system on a boar.” In calculating speed the ship had to resort to measuring “by fleet-footed ice scientists who form an endless chain on the starboard side forward, and in succession rush aft past several measured marks on deck yelling ‘Mark’ when abeam.”<sup>57</sup>

Questions of safety remained as well. *Manhattan* had been holed on two separate occasions during its journey. One breach was below the waterline – but not severe enough to penetrate both hulls. The second was in the afterpeak, a small compartment used to store fresh water.<sup>58</sup> While the vessels meant to follow *Manhattan* would have been stronger, the risk of serious damage or sinking would have remained a perpetual concern. Smith observed that “the skippers of the *Manhattan* had learned to respect the ice.”<sup>59</sup>

Stolee also acknowledged the human dimension to successful Arctic operations. “Icebreakers work long months in Arctic isolation deprived of most outside stimuli – even the sight of navigation lights at night is non-existent,” he reported. “Lack of outside stimuli force men to rely on themselves and measure reality from within their own consciousness. Working conditions are exacting and often uncomfortable and weaknesses in character soon become apparent, training schemes are desirable to weed out misfits and orientation is necessary to teach men to cope with problems of Arctic living.” Extracts from his journal describe the motivations of “old timers,” informal social relations on a ship at sea,<sup>60</sup> and the tediousness of

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<sup>56</sup> Coen, *Breaking Ice for Arctic Oil*, 162.

<sup>57</sup> This volume, page 81.

<sup>58</sup> Coen, *Breaking Ice for Arctic Oil*, 158.

<sup>59</sup> Smith, *Northwest Passage*, 134.

<sup>60</sup> On this theme, see also Smith, *Northwest Passage*, 37.

crisscrossing waters to test ice conditions. He observed how months spent in the ice led to frayed nerves and interpersonal tension, with each sailor coming to think that “I am sane but the rest of you bastards are owly.”<sup>61</sup>

Rather than promoting a military-type discipline approach (as one might expect from a Department of National Defence observer), Stolee advocated for “high standards of accommodation, recreational facilities and pay,” self-discipline, and an acceptance of duty – a philosophy that “produces strongly motivated, independent character.”<sup>62</sup> He challenged assumptions that icebreakers had “military purpose” and thus a military role, downplaying international security threats and instead amplifying the more appropriate and practical utility provided by a civilian presence. “An icebreaker has an important role as an expression of sovereignty and, when providing services to world shipping in the Arctic, she becomes a tangible expression of Canada,” he emphasized. “The tangibility of the expression does not lie in military manning of the vessel.”<sup>63</sup>

These opinions reflected a vigorous debate then occurring within federal government circles about the role of the Canadian Forces in strengthening Canada’s legal sovereignty position. Stolee’s journal entry of 29 July 1969 opined:

The defence of the Arctic seem an insurmountable problem, but two questions - what purpose would an enemy have in using the area and what harm would this do to us - gives some indication how to tackle the problem. The most pressing danger may be friendly neighbours moving in to exploit the riches of the empty land and turning it, forever, into a source area for raw material rather than a land in which people settle and live. Defence measures appropriate to a “sovereignty” threat are quite different to those required to counter an “aggressor nation”. No case for special Arctic measures need be made to counter the later threat.<sup>64</sup>

This sober assessment downplayed the value of a military presence to bolster Canadian legal sovereignty, reflective of assessments emanating from the

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<sup>61</sup> This volume, page 41.

<sup>62</sup> This volume, page 35.

<sup>63</sup> This volume, page 36.

<sup>64</sup> This volume, page 47.

Department of External Affairs.<sup>65</sup> Instead, Stolee emphasized the importance of practical measures.

Unlike today, government conversations in 1969/70 seldom linked Inuit to sovereignty, and these permanent Arctic residents and rightsholders factor comparatively little in Stolee's account. Despite having limited interactions with Indigenous peoples as the ship sailed through Inuit Nunangat (the Inuit homeland within Canadian borders), he nevertheless weighed in on Ottawa's poor record when it came to Inuit. "One of the delights of being an Arctic novice lies in anticipation of wondrous things to come," Stolee recorded in his journal on 17 July 1969:

One of these is encountering the Eskimo and the days and evenings pass listening to those who saw and knew these people before government bureaucracy took to "fathering" them. Otherwise reasonable men become abusive in describing the harm this has done. For instance, moving them to areas where it is administratively easy to "care" for them and where indoor toilets, Hershey Bars and soda pop can be provided doesn't make very self reliant people. An Eskimo who is torn from his hunting ground and ancestral lands, given his "civilized" pittance to eat and carefully manipulated loses all dignity and pride. All he really required was a subsidy on what he could produce and then allowed to come to terms with civilization in his own way. "Pacification" of the north consists in spending money so that the white administrators feel they are serving in a community with amenities similar to down "home". The Eskimo has less and less place in the "civilizing" of the north.<sup>66</sup>

This commentary, critical of the federal government's encroachment on Inuit life, revealed an obvious frustration with the "welfare colonialism" that

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<sup>65</sup> P. Whitney Lackenbauer and Peter Kikkert, eds., *The Canadian Forces and Arctic Sovereignty: Debating Roles, Interests, and Requirements, 1968-1974* (Waterloo: Laurier Centre for Military Strategic and Disarmament Studies / WLU Press, 2010).

<sup>66</sup> This volume, page 43.

had already transformed the Arctic.<sup>67</sup> The following year, the visit from an Inuk and his sled dog team drew a cynical view of how far realities deviated from romantic ideals “of yore.”<sup>68</sup> Encounters with Inuit were positive and celebratory. A visit of Inuit school children, whose smiling faces “shine like sun through a rain cloud,” to the ship meant games, tours, movies, and “a gooey snack of ice-cream, cake, soft drinks and candy.”<sup>69</sup>

Of greater concern than the impact of this new shipping route on Inuit was the spectre of pollution in the country’s pristine northern environment. In part, these fears stemmed from the potential environmental degradation which would follow the grounding of an oil-laden tanker – a potential scenario in an area packed with hazardous multi-year ice floes. “Oil pollution is a hazard associated with tanker operations,” Stolee noted:

Some of this results from negligence and malpractice and the cumulative effect is significant. This type can be controlled by legislation, inspection and co-operation of the oil companies concerned in tanker operations. The greater hazards arise from accidental damage to a ship and the total volume of oil discharged in this fashion each year is astonishing. MANHATTAN struck an iceberg on her return journey which holed one tank and ruptured two others. There is no doubt that the opening of the Northwest Passage to tanker trade will introduce oil pollution into the Arctic. The frequency and degree are matters policy i.e. safety standards in construction, masters and mates, provision of ice pilots and aids must all be laid down early in the game.<sup>70</sup>

Disastrous under normal circumstances, Stolee acknowledged that oil spills in the High North would have been especially devastating. Because of the minute rate of hydrocarbon decomposition at frigid temperatures, as

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<sup>67</sup> See, for example, Robert Paine, “The Nursery Game: Colonizers and Colonized in the Canadian Arctic,” *Etudes/Inuit/Studies* (1977); John David Hamilton, *Arctic Revolution: Social Change in the Northwest Territories, 1935-1994* (St. Catherines: Dundurn, 1994); and David Damas, *Arctic Migrants/Arctic Villagers: The Transformation of Inuit Settlement in the Central Arctic* (Montreal: McGill-Queen’s University Press, 2002).

<sup>68</sup> This volume, page 110. See also page 111 on Inuit at a church service.

<sup>69</sup> This volume, page 112.

<sup>70</sup> This volume, page 32.

well as the region's minimal biodiversity and slow plant growth rate, the contamination from such an accident might have been catastrophic to local ecosystems.<sup>71</sup> A string of recent disasters had added urgency to the issue. In 1967 the Liberian tanker *Torrey Canyon* had struck a reef and spilled 868,700 barrels of oil between the Cornish mainland and the Scilly Islands. Two years later a Union Oil platform off Santa Barbara blew out, spilling more than 80,000 barrels of oil onto the California coastline. In a disaster closer to home, the Liberian-flagged *Arrow* ran aground off Nova Scotia in early 1970, spilling all 108,000 barrels of oil stored in her bunkers. These incidents came in quick succession and, in the case of the *Arrow*, in Canadian waters in the midst of the controversy over the *Manhattan*. Concern that such a disaster could occur in the Arctic was hardly a sensational fear, given that icebergs and hard multi-year ice made the region a far more hazardous environment for a supertanker than the waters off Nova Scotia. That *Manhattan* had suffered damage during the transit offered ample proof of this. If the Northwest Passage were to emerge as a year-round shipping route, with 26-30 vessels making nine to ten voyages a year,<sup>72</sup> the odds of a catastrophe would increase exponentially.

Over the winter of 1969 Humble Oil engineers analyzed the wealth of data generated over the preceding months. They decided upon a second voyage to test winter conditions, because any future fleet would need to operate year-round, a second voyage was deemed necessary to test winter conditions. More data was therefore required from the Arctic winter to complement those completed the year before in "primarily sun-battered summer ice. Again *Manhattan* headed north and, again, Stolee participated as an observer. The second voyage began in early April when the Arctic ice was at its thickest and Stolee joined CCGS *Louis St Laurent* in Halifax as it prepared to escort *Manhattan* on its second trip. "The purpose of the second MANHATTAN journey is to pin down power requirements for successful ice tankers," he recorded on 9 April after speaking with Stan Haas, Humble Oil's project manager:

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<sup>71</sup> Department of National Defence (DND), Directorate of Continental Plans, "Law of the Sea – Future Implications for Sovereignty," April 28, 1970, DND, Directorate of History and Heritage (DHH), file 82/125.

<sup>72</sup> Coen, *Breaking Ice for Arctic Oil*, 84 and 162.

Hull formation, bow design, propeller and rudder arrangements, heeling systems, etc., have been established from information derived last year. Power requirements are critical and it is hoped that by steaming MANHATTAN through even thickness, confined ice, as in ECLIPSE SOUND, absolute power values can be acquired and suitable curves plotted for large ships.<sup>73</sup>

By April, the long winter had forged a solid ice pack that held the entire Northwest Passage in its grip, Coen described. “This would provide the ideal conditions for more testing.”<sup>74</sup>

The second *Manhattan* voyage was also a trial for the new Canadian icebreaker *St. Laurent*. When she commenced her escort in early April 1970 the ship was just out of refit, with “all the subsequent difficulties associated with dockyard ‘mateys’, oily rags and wiring diagrams awry.”<sup>75</sup> On 22 April the icebreaker’s flight deck lift broke down, leaving Stolee and Lieutenant Taylor to walk back across the ice from Manhattan, an uncomfortable journey “against an easterly wind, over hummocks and ridges and along the flats like noble explorers of old.”<sup>76</sup> The reports described “teething troubles” including power failures aboard the ship, overly complex control systems, and personnel running them with too little indoctrination and training. Most concerning to Stolee, the *St. Laurent* lacked sufficient range and sustaining capabilities for an Arctic season, and depended upon *Manhattan* for water replenishment. “It is incredible,” Stolee wrote, “that the ship cannot operate for more than a week and a half in ice without a resupply of fuel and water.... Officially she can last a whole ARCTIC summer (the Replenishment Run) because she then steams at one third power and spends most of her time at anchor waiting off-loading.” Public relations efforts aside, he assessed that “no rationalization will make *St. Laurent* an effective ARCTIC icebreaker with her limited range and endurance.”<sup>77</sup> While many of the issues identified in the first year were remedied, issues of limited range

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<sup>73</sup> This volume, page 92.

<sup>74</sup> Coen, *Breaking Ice for Arctic Oil*, 157.

<sup>75</sup> This volume, page 90.

<sup>76</sup> This volume, page 100.

<sup>77</sup> This volume, page 111.



continued to plague the ship until 1988 when it underwent major refit to extend the hull and replace its inefficient propulsion system.<sup>78</sup>

The 1970 voyage did not attempt to transit the entire Northwest Passage, as had been done the year before. Instead, the expedition was confined to the Eastern Arctic channels, where the desired ice conditions could be found. On this journey, Stolee documents how *Manhattan* and *St. Laurent* fought heavy pack ice in Baffin Bay for more than two weeks, making little more than three hundred miles amidst massive ice floes and towering pressure ridges. With the ship in Eclipse Sound on 12 May, he toured the bowels of the vessels just as it made a ten-knot charge into heavy ice. With ice crashing around him the noise and vibrations were harrowing. It was a moving experience that Stolee describes in detail:

Crescendoes of sound rose and fell and weird harmonies amplified each other into death cries of anguished monsters. When the charge halted eerie silence reigned in the vast, cold tomb where seconds previously a host of [Valkyrie] shrieked their [Götterdämmerung]. It is a chill and wretched place.<sup>79</sup>



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<sup>78</sup> Charles D. Maginley, *The Canadian Coast Guard 1962-2002* (St. Catharines: Vanwell, 2002), 53.

<sup>79</sup> This volume, page 109.

The Arctic winter was a poor host for any ship, even one as large as *Manhattan*. With limited astern power, the tanker became stuck repeatedly – a problem compounded by snow on the ice pack that increased the friction on the ship’s hull. Still, the mission continued productively for four weeks of ice testing, led by the U.S. Army Cold Regions Research and Engineering Laboratory near Bylot Island, which measured temperature, compression and tensile strength, and salinity. Concurrently, the ships’ officers recorded the tanker’s velocity and engine performance. In the last week of May *Manhattan* and *Louis St. Laurent* turned south for home, stopping only in Pond Inlet to donate four thousand pounds of food to the hamlet.<sup>80</sup>

Like its Northwest Passage transit the year before, *Manhattan’s* 1970 voyage was considered a resounding success. Canadian politicians looked to see and be seen aboard the ship, anxious to promote northern development and assert Canadian sovereignty. Occasionally these visits intruded on the ships’ operations. Jean Chrétien, Minister of Northern Affairs, visited both *Manhattan* and *Louis St. Laurent* in May 1970, where he seemed to receive a grudging welcome. Stolee describes his arrival with the air of an inconvenienced officer just trying to go about his work. “For chauvinistic reasons, best known to parliamentarians,” the naval observer recounted, “it has been decreed that the ‘royal entourage’ will transfer in our short range helicopters.” The situation left the crew “immobilized for three days, as our choppers are restricted to twenty miles over ice. One wonders why the visit could not have done when the ships were working at POND INLET. It is annoying to be diddled by politicians.”<sup>81</sup>

The second *Manhattan* voyage ended at Chester, Pennsylvania on 13 June 1970 where Humble Chairman Mike Wright extolled its importance. Optimistic industry officials believed that the future of Arctic shipping had arrived. The Northwest Passage could become a viable commercial sea route, it seemed, and Humble Oil soon contracted Newport News Shipbuilding to design the next generation of icebreaking supertankers, each nearly three times *Manhattan’s* size. Evaluations and re-evaluations of the economics of moving Alaskan oil continued to change, however, and by that autumn the

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<sup>80</sup> Coen, *Breaking Ice for Arctic Oil*, 158.

<sup>81</sup> This volume, page 113.

pipeline alternative seemed to enjoy the edge in cost efficiency. Consequently, Humble Oil announced on 21 October 1970 that it was suspending its icebreaker project. Initial estimates, which had given tankers an advantage over the terrestrial route, had not taken into consideration the difficulties presented by northern operations, for which there were no easy answers. The 60 cents/barrel transportation cost by tanker, assumed a few years earlier, had increased to \$1.20 by the end of 1970. That March, Humble estimated costs for its loading and unloading facilities at roughly \$1.1 billion, with much of the expense coming from the massive amount of dredging that would have been required to deepen sea lanes and build a port in the shallow waters of Prudhoe Bay. The projected thirty icebreaking tankers would have cost an additional \$2.2 billion. Against the estimated \$1 billion for a pipeline across Alaska to Valdez, the Northwest Passage appeared uneconomical.<sup>82</sup>

## Concluding Thoughts

The *Manhattan* represented the greatest challenge ever mounted to the domination of the north by ice. To the ice scientists the voyage meant a possible breakthrough in knowledge and money for their esoteric and underfunded field; for the ship's officers and crew, it carried the hope of career opportunities. The naval architects and designers saw the possibility of creating a whole new world of shipping; to Humble it represented potential savings of billions of dollars.

William D. Smith (1970)<sup>83</sup>

While the *Manhattan* voyages have become embedded in narratives emphasizing competing ideas about Arctic sovereignty between the United States and Canada, Stolee's narratives serve as a poignant reminder that, at the time, the prospect of opening the Arctic to development electrified the Canadian imagination as well. "The concept of forcing a supertanker, such

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<sup>82</sup> Coen, *Breaking Ice for Arctic Oil*, 160-63. The US federal government approved plans to build the Trans-Alaska Pipeline in November 1973 and construction was expedited by the Arab oil embargo and the subsequent global fuel shortages that same year.

<sup>83</sup> Smith, *Northwest Passage*, 68.

as MANHATTAN, through the Northwest Passage is imaginative – the route is shorter by several thousand miles than any other Europe-Pacific passages and Canada ... stands to gain from a successful venture,” Stolee noted in his journal.<sup>84</sup> Unwilling to invest the massive capital needed to facilitate large-scale development itself, Ottawa had an abiding interest in this American experiment to explore the prospect of accessing the vast resources of Canada’s Arctic Archipelago. Mitchell Sharp, the Canadian Secretary of State for External Affairs, insisted at the time that “the *Manhattan* project would not have been possible without ... extensive Canadian input, consisting of preparatory studies extending for many years over a vast area of the North.” He emphasized that this was “no time for wide-ranging assertions of sovereignty – rather Canada must concentrate on specific objectives, the most important of which is the opening up of the Canadian Arctic region for development.”<sup>85</sup> Indeed, while *Manhattan* was transiting the Northwest Passage in 1969 and 1970, Ottawa’s immediate requirement was simple: to assist the supertanker and to be seen doing so.

Cheeky Canadian newspaper headlines boasting how “Canadian David Saves Yankee Goliath” celebrated the Coast Guard icebreakers charging through the ice to cut swathes around the supertanker and free her from the Arctic’s icy clutches.<sup>86</sup> Stolee’s journals are filled with such examples. Nevertheless, he suggested that “Canada’s contribution to this venture is open to debate,” pointing to a general asymmetry in the willingness to invest significant resources – both material and intellectual – to address the deep challenges that Arctic ice conditions posed to economic development:

On the one hand icebreakers and ice reconnaissance were provided by the Department of Transport but on the other hand the experts and the impetus came from the States. If the route proves economically feasible, trade will go through and icebreaker assistance will be required on occasion to free

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<sup>84</sup> This volume, page 39.

<sup>85</sup> Quoted in Thomas Tynan, “Canadian-American Relations in the Arctic: The Effect of Environmental Influences Upon Territorial Claims,” *The Review of Politics* 41:3 (1979).

<sup>86</sup> Smith, *Northwest Passage*, 113.

tankers which may get trapped. (This is not an ice convoy concept.) These icebreakers need an ice capability equal to the large tankers and such icebreakers are being designed and built for the US Coast Guard. Canada has not announced an equivalent programme. The problem exists of identifying and defining ice conditions in order to route large tankers through Viscount Melville Sound, the Beaufort Sea and along the northern continental reaches. This problem along with navigational systems required to assist in its solution are being considered seriously in the United States. Canada seems prepared to adopt the resultant recommendations without offering alternatives of her own.<sup>87</sup>

Ironically, while the RCN observer lamented Canada's modest interest and capabilities, American officials and journalists made parallel comments about their own country's comparative lack of capacity and commitment. Congressman Howard Pollack, Alaska's only member in the US House of Representatives at the time, deemed it "unacceptable to our national pride to discover that the U.S. icebreaker [*Northwind*] could not keep up to a commercial tanker and had to let the Canadians do the job alone."<sup>88</sup>

The *Manhattan* voyages also led the Government of Canada to rearrange the traditional order of its maritime priorities. The Arctic was no longer a mere space – it was a *place* of intrinsic value for which Canadians insisted that their government assume responsibility as stewards. Consequently, the political controversy had long-lasting effects. In April 1970, Parliament passed the *Arctic Waters Pollution Prevention Act* – path-breaking environmental legislation which continues to underpin Canada's marine protection regulations in the Arctic a half century later. The voyage also catalyzed an enduring discussion about what steps Canada should take to secure its Arctic sovereignty, leading to nearly two decades of efforts to shape international environmental protection regulations and the law of the sea to meet Canada's regulatory and political objectives in the North.<sup>89</sup> Although

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<sup>87</sup> This volume, page 4.

<sup>88</sup> Quoted in Coen, *Breaking Ice for Arctic Oil*, 129.

<sup>89</sup> On this process see: D.M. McRae, "The Negotiation of Article 234," in *Politics of the Northwest Passage*, Franklyn Griffiths ed. (Montreal and Kingston: McGill-Queen's University Press, 1987), 102-04.

Canada did not declare outright sovereignty over the waters of its Arctic Archipelago until 1985, it generated political impetus to move beyond the status quo and the Department of External Affairs began laying the groundwork for a more explicit declaration of sovereignty.<sup>90</sup>

“Whatever diplomatic hostilities may have existed between Canada and the United States did not extend to the crews of the *Manhattan* and the *John A. Macdonald*, who unfailingly supported one [an]other,” Coen observed. “Theirs was a single expedition, not two that happened to be operating at the same time and in the same geographical space.”<sup>91</sup> Stolee’s narrative offers deep support for this assessment, revealing how essential this cooperation was to the safety and success of the voyage. Smith, a reporter onboard *Manhattan* in 1969, described the stop in Halifax after the eastbound transit of 1969. The stop was made to:

officially... acknowledge our debt to the Canadian government for its assistance on the project; unofficially, to honour our gallant companion, the “Johnny Mac.” She had been our mentor, our rescuer, and our friend. Her crew, our drinking buddies, had helped to give a sense of belonging and pride to the disparate bunch of hired hands on the tanker. The *Manhattan* had much to be proud of, and no small amount of the credit was due to the little red and white Canadian icebreaker.<sup>92</sup>

Smith’s time aboard *Manhattan* mirrors the spirit of Stolee’s report, which captures the sense of camaraderie between the US civilian crew and the Canadian Coast Guard and between the Canadians and Americans that worked side-by-side to make sure the *Manhattan* got through. The spirit of the mission was defined not by competition over sovereignty or jurisdiction, but a common sense of purpose and a driving desire to see this exceptional voyage succeed.

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<sup>90</sup> On this see: Lackenbauer and Kikkert, “Sovereignty and Security.”

<sup>91</sup> Coen, *Breaking Ice for Arctic Oil*, 8.

<sup>92</sup> Smith, *Northwest Passage*, 189.

## **Editors' Note**

Stolee's reports have been reproduced almost verbatim in this volume, with some minor grammatical edits. In several cases, we have converted underlining in the original to italics (for aesthetic reasons) and corrected obvious typographical errors. Otherwise, we have retained the original wording in the reports to preserve their integrity as historical documents produced at a specific time (1969/70) and bearing the biases of the era in which they were written. Accordingly, some of the terms used by the authors are no longer preferred usages for people or places. Today, the name "Eskimos" has been replaced by "Inuit" ("the people" in Inuktut) as the preferred nomenclature. Various locations described in the text have also been renamed, such as Pond Inlet (Mattimatalik), Frobisher Bay (Iqaluit), Godthab (Nuuk), and Sondrestrom (Kangerlussuaq). In other cases, there are Inuktut names for the locations described in these reports that reinforce that the Canadian Arctic is Inuit Nunangat – the Inuit homeland.<sup>93</sup>

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<sup>93</sup> On Inuit land use and occupancy at the time of the *Manhattan* voyages, see: Milton Freeman Research Ltd., *Inuit Land Use and Occupancy Project*, 3 vols. (Ottawa: Department of Indian Affairs and Northern Development, 1976).

REPORT ON THE VOYAGE  
In the  
CANADIAN ARCTIC  
of  
CCGS JOHN A. MACDONALD  
  
SUMMER 1969  
  
(MANHATTAN'S JOURNEY)

by  
LIEUTENANT COMMANDER E. STOLEE

Queen's Printer for Canada  
Ottawa, 1970

Opinions expressed in this report are not necessarily those of the  
Commander of Maritime Command.





ARCTIC GEOPOLITICS – Banks Island, marked with an X, lies centrally between three of the world's main ports.

## **Introduction**

1. In 1968 Humble Oil began studying the feasibility of using the Northwest Passage as a route for marketing north slope Alaska oil. The problems subdivided themselves naturally into ice environment, the ship and terminal facilities from which to load oil. This report contains some observations on ice environment and the ship.

2. Ice breakers have been used for more than a century and the criteria for success are written into naval architecture. New icebreakers are frequently built by extrapolating from the old but, occasionally, projection of this sort is not valid. The tonnage of an economically attractive northern tanker makes extrapolation from known icebreaker data suspect and SS MANHATTAN was used to establish new points on the graphs at the 100,000 DWT range. From these points it is expected that suitable configurations and horsepowers for the 250,000 DWT super-tankers of the future can be arrived at.

3. Arctic ice along the route intended for MANHATTAN'S voyage had not previously been described and identified sufficiently for her purpose. The problems of a tanker in an ice environment were unknowns in 1968 and as the ice and the ship intimately affect each other, Humble Oil's problem was analogous to that of a doctor prescribing medicine for a disease that has neither name nor patients. The world's foremost ice authorities were brought together and a major part of the MANHATTAN effort was devoted to the problem of defining ice.

4. Predicted costs of building deep water terminal facilities on the north shores of Alaska are fantastic and Humble Oil's venture may founder because of this. Possible solutions include joint Canadian-United States development of HERSCHEL ISLAND where deep water is found near land. Problems of ownership and exploitation should not obscure the basic requirements of both countries for deep water northern facilities. These are not required by firms intending to use the northern passage purely for transit between the Pacific and the Atlantic oceans.

5. The ship, SS MANHATTAN, was observed operating in ice during September and October (1969) as she transited the Northwest Passage to

Point Barrow, Alaska, and returned to the eastern seaboard. She also spent three weeks testing various types of ice in Viscount Melville Sound. The months of September and October are “easy” ice months and certainly do not compare with winter conditions. However, 1969 was a heavy ice year in parts of the Arctic and Mr. Stanley Haas, project manager for Humble Oil, is quoted as saying, “The ice data that we have indicates that the ice we are breaking is, surprisingly enough, approaching the strength and quality of winter ice.” As a test vehicle MANHATTAN answered many questions and was successful in her goal of establishing and validating information from which to design successful northern tankers and it seems safe to say that she has proved that “mass” is the key to breaking Arctic ice. However, economic feasibility is the ultimate consideration for successful exploitation of the Northwest Passage and must take into account the building and operating costs of these large vessels, length of the shipping season, turnaround time and terminal facilities.

6. Canada’s contribution to this venture is open to debate. On the one hand icebreakers and ice reconnaissance were provided by the Department of transport but on the other hand the experts and the impetus came from the States. If the route proves economically feasible, trade will go through and icebreaker assistance will be required on occasion to free tankers which may get trapped. (This is not an ice convoy concept.) These icebreakers need an ice capability equal to the large tankers and such icebreakers are being designed and built for the US Coast Guard. Canada has not announced an equivalent programme. The problem exists of identifying and defining ice conditions in order to route large tankers through Viscount Melville Sound, the Beaufort Sea and along the northern continental reaches. This problem along with navigational systems required to assist in its solution are being considered seriously in the United States. Canada seems prepared to adopt the resultant recommendations without offering alternatives of her own.

7. Finally, the Arctic is a fascinating place for a novice and the Department of Transport, through the officers and men of JOHN A MACDONALD proved to be an excellent guide and host during a most rewarding summer. It is hoped that many more “observers” will be privileged to serve with them in the years to come.



Figure 1-1: The Arctic Archipelago – “the jumble of islands soon sorts itself into two groups separated by a wide channel running east called Perry Channel.

## CHAPTER ONE

### **The Environment**

1-1 This report is concerned with the Canadian Arctic, that portion of Canada which lies north of a line drawn from Demarcation Point on the Canada-Alaska border, southeasterly to James Bay and thence eastward to the Labrador Coast. Of particular concern is the “high” Arctic, the northern mainland shores and the islands which form the Arctic Archipelago. It was amongst the channels, bays and inlets of the northern shores and Arctic islands that early expeditions searched for a north west passage and it is through this region that MANHATTAN made her west and east journeys.

### **The Northwest Passage**

1-2 If one looks at a chart of the Canadian Arctic (see Fig 1-1) the jumble of islands soon sorts itself into two groups separated by a wide channel running east and west. The channel is Parry Sound with its four sections; Lancaster Sound, Barrow Strait, Viscount Melville Sound and McClure Straits. The islands to the north are collectively called the Queen Elizabeths, those to the south have no collective name.

1-3 The northwest passage is no specific route through these islands; the name comes from instructions given early explorers. “find a north west passage to Cathay.” The Canadian Arctic Pilot, Volume One, gives four routes which qualify as north west passages. All start at the entrance to Lancaster Sound and all end in the south east corner of the Beaufort Sea; in between they wend their ways through diverse gulfs, channels and straits. Successful voyages have been made through all of them except the direct run west through the full length of Parry Sound -- here the Arctic Pack is still unconquered in McClure Straits.

1-4 The first two routes described in the “Pilot” are the routes followed by Amundsen in 1903-06 and Larsen in 1940-42. Both start in Lancaster Sound and, if proceeding west, turn south at the second and third channels - Prince Regent Inlet and Peel Sound. They follow south to the northern

mainland shores where they turn west again and eventually exit into the Beaufort Sea through Amundsen Gulf, south of Banks Island.

1-5 The third and fourth routes also start in Lancaster Sound and follow west through Parry Sound until the third route (followed by Larsen in 1944) turns left at Prince of Wales Strait, between Victoria and Banks Islands, and exits into the Beaufort Sea through Amundsen Gulf. The fourth route carries on through McClure Straits and rounds Banks Island before heading south to the north continental shores. Once clear of the Canadian Archipelago, all four routes reach for open water between the Arctic Pack and the mainland.

1-6 Only two of the routes, the third and the fourth, are suitable for deep draught navigation. SS MANHATTAN took the third route, via Prince of Wales Strait, on both her west and eastbound transits.

1-7 The key to a north west passage is Parry Sound. A ship approaching from the east makes land on Bylot Island if approaching from a southerly direction or on Devon Island if approaching from the northerly. Both islands are precipitous, rocky masses and mark the entrance to Lancaster sound. The winter ice in Lancaster Sound is mostly first year ice with a few Arctic floes which drift in from Wellington Channel to the West, The Sound clears in early July.

1-8 Lancaster Sound narrows into Barrow Strait where, on Cornwallis Island's south shore is found the settlement of Resolute Bay. This settlement is situated in an unfortunate location as far as harbour facilities are concerned. The bay is shallow, has little protection and seems designed to trap and hold ice long after it has cleared the general area. Of significance in this region are the islands -- the two largest called Griffith and Lowther -- which constrict the Straits and successfully hold back the main assaults of the Arctic Pack. These islands effectively divide Parry Sound into two ice regions -- an eastern region of "easy" ice and a western region of "difficult" polar ice.

1-9 Barrow Straits open west of the isles to form Viscount Melville Sound, two hundred and forty miles long and one hundred miles wide, the largest body of water composing Parry Sound. The westward journey brings increasingly difficult ice conditions; Arctic Pack mixed with immobile multi-year. The ice responds to weather and current and pressures build which grind the fields into ridges and crush unstrengthened hulls like match

boxes under heel. This is also a difficult section to navigate for “dead reckoning” is quickly lost when charting the magnetic pole is close at hand and the low featureless land does not paint well on radar. This is the area where special ice reporting, special routing instructions and icebreaker assistance may be required by the ice-tanker of the future.

1-10 Parry Sound closes again between Hay Point on Melville Island’s south shore and Peel Point on Victoria Island’s north west tip. This is called McClure Straits. Here Arctic ice holds sway and only on occasional years open leads exist along the northern and southern shores. Peel Point, on the southern side, marks the turning point for Prince of Wales Straits -- an escape route to the south west if McClure Straits are barred. Prince of Wales has, like Parry Sound, an island constriction at its central point – [Prince] Regent Island. This holds back the northern Arctic ice but, in consequence, the northern reaches are not ice free until late August.

1-11 The Beaufort Sea presents its own problems which, for our purposes, can be considered the opening and the closing of the northern shore leads as the Arctic Pack, hinging on Point Barrow, responds to the season’s meteorology.

## CHAPTER TWO

### Arctic Ice

2-1 Unless one understands Arctic ice - how it is formed, how it responds to wind and weather, the currents which move it and when and where it melts - the northern seas remain a frozen enigma. It is possible to deal briefly with the subject in a broad-brush sweep from Davis Straits to the Chukchi Sea - from the Labrador Coast to the western shores of Alaska.

2-2 The sweep shows three distinct types of ice, one originating from the land and two from the sea itself. The land borne ice, the icebergs, are masses of compacted snow, blue veined with summer’s frozen melt. These once formed part of the glaciers of Greenland, Baffin Island and the lesser isles. An iceberg is a floating “hunk” of ice varying in size from Greenland’s icy monsters (up to 470 feet in height) to little “bergy” bits the size of summer

cottages. Most are spawned from Greenland's coast where the heavy central ice cap forces the glaciers towards the sea. These Greenland bergs move slowly north towards Baffin Bay where they then proceed to the left and join the Baffin "brood", marching smartly south to become the concern of the International Ice Patrol. A few bergs are spawned in Lancaster Sound and in the Smith Sound areas from "high" Arctic glaciers, but this region is an arid land and not enough snow falls to produce great numbers. Nowhere else in our sweep are ice bergs found.

2-3 Icebergs are important in our story because the road north to Lancaster Sound skirts the west coast of Greenland where the waters open early in the season in the fall. Along this route ships have counted 700 icebergs painting on the radar scopes at one time. Icebergs and "bergy" bits form a collision hazard but are not a physical impedance to movement, as is sea ice.

2-4 Sea ice, like humanity, gets old, tough and crabbed with age. Younger sea ice (two years and under) is tender, more easily cut and broken; but old sea ice (multi-year, polar) is hummocked, pitted, ridged and scarred by pressures from wind and current and on its surface lies the dust and grime of time. This old ice is hard to break, the pressures in its fields are great and ships must turn to flank its larger ridges. Hence our second and third types of ice -- younger sea ice and multiyear polar Ice. Younger sea ice is called second year, first year and new ice.

2-5 Sea ice forms in much the same way as fresh water ice; there are some significant differences. As the sea surface cools in the fall, its waters become progressively denser and sink to be replaced by the "lighter" waters from below. This circulation is important but, because of the vastness of the "heat tank," the Arctic waters never reach a uniform temperature before freezing, as happens in a fresh water lake. What occurs is this; In certain areas where the vertical circulation is restricted, i.e., waters adjacent to ice bergs, floes, land and even in shallow water, an exceptionally cold air temperature will cool the surface water faster than it can be replaced. The fresh water crystallizes out in "needles of ice" called FRASIL ice and trapped amongst the crystals are pockets of saltier sea water. Progressive cooling causes more crystallization and the sea surface takes on the appearance of grease giving the name "GREASE ICE" to this phenomenon. Wind and waves work on the surface "GREASE ICE" and curdle it in small slushy lumps called SLUSH ICE (SLUSH ICE is also seen in heavy snow storms). Repeated



action turns the ice into SHUGA ice with bigger conglomerations of slush. The SHUGA ice eventually solidifies into sheets of new young ice. In these are incorporated large amounts of unfrozen salty water which makes these sheets pliable and weak. These sheets are called NILAS ice.

2-6 The newly formed sheets of NILAS ice collide and ride up over each other in a process called “rafting”, they sometimes break and meet to mend again. However, once formed, their under layer becomes a fertile ground for further ice formation. New ice may thicken from four to six inches a day and continue thus throughout the first year, until a thickness of about eight feet is reached. At this thickness the insulating effect of the ice protects the underlying water from the colder air temperature of the Arctic winter and no more ice is formed. But, always, in the Arctic Seas, pressures break and ridge the ice, the ice splits into leads and closes again until, by spring, the sheets have become vast floes of ridged and hummocked ice -- the polar background to early explorers’ etchings.

2-7 What about the salty packets of unfrozen sea water trapped in this young ice? The salt acts on the surrounding ice, as it does when spread on the city streets, and gradually leaches through to the ocean surface beneath. The pure water left behind refreezes, crystal clean and hard. During this process, which may take more than two seasons to complete, the soft young ice becomes tougher and changes its colour from the greys and greens of youth to gradient shades of blue which culminate in the brilliant emerald blue of multi-year polar ice. In the low temperatures of an Arctic cold spell this ice has compressibility approaching that of steel.

2-8 The general direction of movement of ice in the Arctic Archipelago is south and east. The northern continental shores of Alaska and Canada, the Queen Elizabeth Islands, north Ellesmere Island and Greenland’s northern shores form a boundary against the Arctic Pack -- multi-year polar ice -- which presses hard against these bounds; riding to thicknesses of one hundred and twenty-five feet along the northern shelf. In September and early October, when the younger ice of the previous winter has cleared eastern McClure Straits, Parry Sound and Smith Sound, the Arctic Pack moves in. When the winter freeze sets in, this advance is halted by new formed winter ice. Thus, there is a constant progression of the Arctic Pack from west and north through the channels and leads which collectively form the Arctic islands. This movement of ice through Canada’s Arctic region consists of a sequence of steps locked to the solar year, melting creeps up

from the south slaved to the sun's progression north. When the northern channels free, the Arctic Pack moves in to start the next progression. Winter locks the movement in whatever stage is reached in late October. Every year this Arctic "two-step" occurs and brings fresh surprises.

2-9 The Baffin Pack refers to an accumulation of consolidated ice caught in the centre of an anti-clockwise flow of current which moves up the west coast of Greenland, across Smith Sound and down east Baffin's shores. This Pack clears from Greenland in June and recedes from Baffin's shores by the end of August in general, southerly movement. The October freeze-up immobilizes the Pack each year in newly formed winter ice.

2-10 Ice Islands are a feature of the Arctic Ocean which, over the years, have attracted attention from scientists and military authorities. They have also been employed in a variety of ways. Their origin is believed to be Ward Glacier on Axel Heiberg Island. The present islands in the Beaufort Sea area are believed to be pieces from a large tabular berg which calved in 1961. These pieces, which make up the present population, have been given numbers for identification and their histories are interesting. T3, for example, grounded off Barrow Point for quite some time and then refloated; another large island also grounded on the north slope and broke into numerous bits -- two of these were the "islands" which Humble Oil intended to employ as breakwaters off Prudhoe Bay.

2-11 These two "islands" stood about 20 feet high and grounded in 85-90 feet of water thirty miles north of Prudhoe Bay (see Fig 2-1). In order to keep them fast to the ground it was decided to weight them down against the bottom so that no storm, current or seiche would move them. The "weighting" medium was a top layer of sea water, frozen to form an ice cap ten feet thick. The ice was added at a rate of six inches per day; sea water hoses being rigged from a nearby pumping unit. The right hand island was estimated at 200,000 tons displacement, to this was added 10,000 tons of sea water, Free floating, the extra weight would have sunk the "island" an additional four feet. No increase in draught occurred. In order to insulate the ice from the summer melt, styrofoam gear was shipped from the US; however, the island broke before this could be applied.

2-12 Ice islands have a bibliography produced by devoted scientific admirers. There is, apparently, a correlation between the area of an ice island and its thickness -- those of the largest area are the thinnest. This introduces

a complication as “long wave” pressure changes will crack a large area ice island. It is believed that the large tabular berg which calved from Ward Glacier in 1961 and fathered most existing ice islands, was triggered by “long wave” pressure changes caused by the Soviet Union’s high yield nuclear tests conducted at that time.

2-13 Ice islands can have military significance in the Canadian Arctic as floating platforms from which to suspend under water surveillance systems however, ice islands are identifiable by infra-red film and a nation with a satellite spy system would quickly locate them. Of more interest, possibly, is building ice islands in order to block certain smaller passages in the Queen Elizabeth Islands. These could be built from shore fast ice. The problems is one of weight versus sag and the end product is a lenticular shaped ice ice formation which, presumably, would block a selected passage for years. It could be refurbished each winter by spraying.



Figure 2-1: Two ice islands grounded north of Prudhoe Bay. Attempts were made to fix these to the bottom in order to provide deep water loading facilities for North Slope Alaska oil.

## CHAPTER THREE

### SS *MANHATTAN*

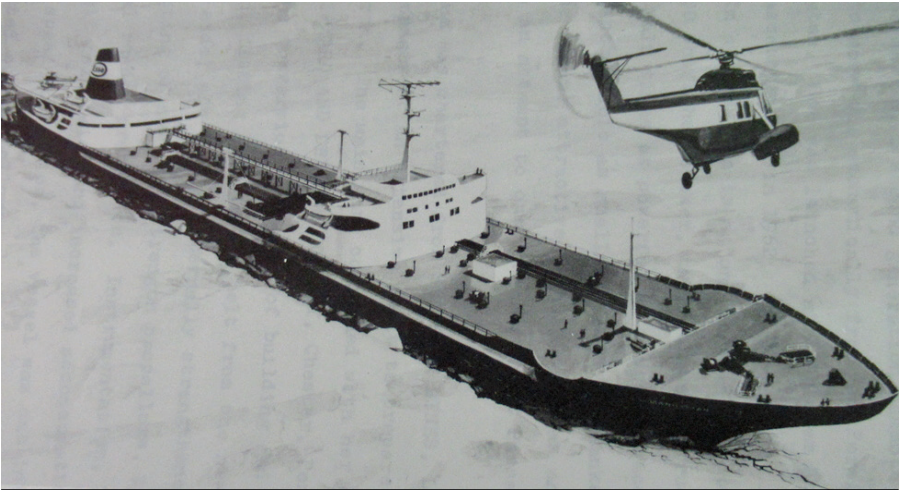


Figure 3-1: An artist's conception of SS *Manhattan* in multi-year polar ice.

#### The Vessel

3-1 MANHATTAN, a second-generation mammoth tanker, was designed to move oil economically from the Persian Gulf to the United States. She was launched at Bethlehem Steel's Shipyard, Quincy, Massachusetts, in 1962.

3-2 In a sense she is a "one vessel breed of super tanker". With 43,000 shaft horsepower, twin screws and rudders, she is one and a half times as powerful as vessels twice her size and twice as manoeuvrable as smaller 70,000 DWT tankers. For these reasons she became attractive to HUMBLE OIL as an Arctic test vehicle in an attempt to open the Northwest Passage as a trade route.

3-3 She was chartered from SEATRAN LINES, LTD. in January, 1969, and underwent an extensive refit to prepare her for the passage north. The main yard concerned with her conversion was the SUN SHIPYARD AND DRYDOCK COMPANY, Chester, Pennsylvania.

3-4 The conversion consisted of building and fitting a new bow section, fitting a heavy ice belt from the new bow section along each side, aft to the internally strengthened stern section and the fitting of new high strength propellers, propeller shafts and external rudder protection. Instrumentation, laboratories, close-circuit television and increased accommodation were also added. To speed conversion, the vessel was cut into four pieces and contracted out as follows:

Bow Section ---- Bath, Maine and Chester Pennsylvania

Forward Section - Newport News Shipbuilding and Drydock Company, VA

Midship Section-Alabama Shipbuilding and Drydock Company, Mobile, Alta.

Stern Section---Remained at Chester for internal strengthening

3-5 Upon completion of conversion MANHATTAN's vital statistics read as follows: (before figures in brackets)

DWT	124,000	(115,000)
LOA	1015'	(945')
Breadth	148'	(132')
Draught	52'	(unk)
SHP	43,000	(43,000)

3-6 MANHATTAN's bow is an MIT Bow M Type Mk 13 with an 18 degree and a 30 degree down angle. The icebreaking capability of this bow is rated 40-60% over conventional ice-breaking bows. The bow has pronounced shoulders which actually create an extreme breadth at the waterline of 152 feet at this point -- if trimmed 52 feet by the bow. The bow is plated with 2 ½ inch steel and is built to withstand pressures of 3500 lbs per square inch.

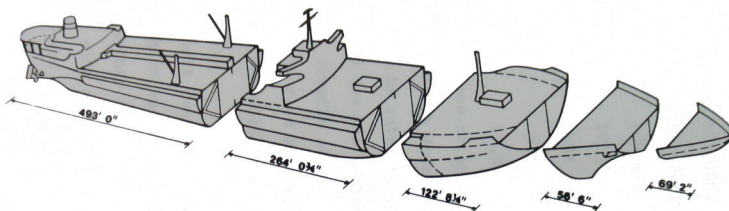


Figure 3-2: To speed conversion the vessel was cut into four sections and farmed out to shipyards along the Atlantic seaboard.

3-7 An ice belt runs aft from the new bow section to the after section (which was strengthened internally) along each side. It is a twenty foot belt projecting approximately 9 feet from the ship's side at its upper edge and eight inches at its lower edge. At the stern it cuts in to meet the old ship's side -- thus creating a harpoon barb effect. The plating of the ice belt is 1¼-inch steel. The belt was built in 22 sections which were linked together to form the run on either side.

3-8 MANHATTAN was fitted with new high strength propellers. These were five bladed, 23 feet in diameter and weighed 70,210 lbs each. The twin rudders, shipped one abaft each propeller, are floating rudders and are canted outwards at an angle of fifteen degrees from the vertical. A metal pad was fitted between their upper edge and the hull to prevent ice from jamming them. The fitment restricted the rudder angles to five degrees in ice.

### **The Equipment**

3-9 The equipment fitted in MANHATTAN can be divided into instrumentation required to analyze her performance in ice and equipment required to navigate and to communicate. Instrumentation was required to record motion, pressure, torque and power plant performance; in addition, records were required of the surrounding ice flow and breakage patterns. Analyses equipment was required for infra-red and laser ice reconnaissance missions. Ice description of the immediate field was very important and required details of thickness, salinity and temperature to give ice age and strength. Frequency and dimensions of ridges and hummocks were required in order to chart most favourable routes.

3-10 The instrumentation fitted in MANHATTAN for these purposes were treated as "secret" but through observation and discussions some generalizations are possible. The thrust or pressure on the bow was measured by strain gauges -- some three hundred of these were fitted on the bow, across the deck and on the longitudinals. These were scanned every ninety seconds (this long-time interval is inadequate as a specific "force" cannot be measured from all positions). The torque being experienced was measured from the ship's torquometers and revolutions from the ship's revolution counters. A vertical gyro gave roll and pitch (this idea was considered most "secret" and the gyro kept under two locks). The ship was fitted with six accelerometers; three forward for horizontal vertical and sway movements,

one amidships and two aft. These measured from 1/10 G to 50 G. The analysis was most impressive with digital recording and oscillograph monitoring before taping. The ship was fitted with a computer which worked in conjunction with the head office machine.

3-11 The prime contractor for MANHATTAN's communication equipment was COLLIN's RADIO COMPANY. The communications "imperative" was radio telephone communications at all times with CEDAR RAPIDS, IOWA. This was achieved with a directional antenna in MAN HATTAN and a power output of 3000 watts on 16-18 megs, US government assistance was available for shore-side message interfacing into the US worldwide communications system. The communications systems fitted were R/T Voice, R/T Data, and R/Ts Morse on power outputs approximately 500 times normal commercial requirements. The aerials were designed to withstand 80 mph winds and temperatures of -40 degrees F. Intra task force communications included radio beacons, radio homing, distress signaling and hand held radio beacons for recce parties.

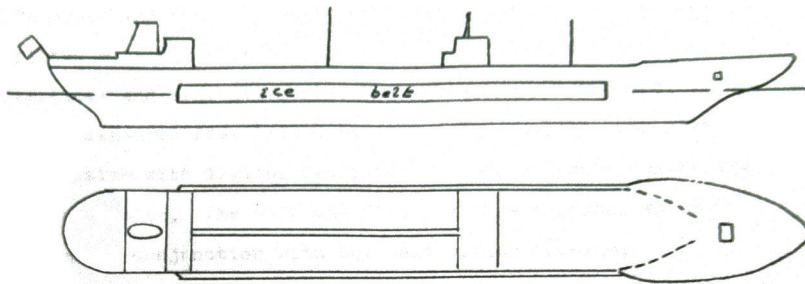


Figure 3-3: Plan and side view of MANHATTAN showing the "barbed harpoon effect" at the join of the new bow and aft where the ice belt runs tack into the old ship's side.

3-12 The prime contractors for the navigation systems was LITTON SYSTEMS INC. The computer system was the responsibility of DIGITAL EQUIPMENT CORPORATION. The navigation system was complicated by the requirement to feed forward speed, ship's head, side-slip, acceleration and deceleration into a computer to correlate ice thickness, bow strain and horsepower being developed. In order to achieve this a custom-built system

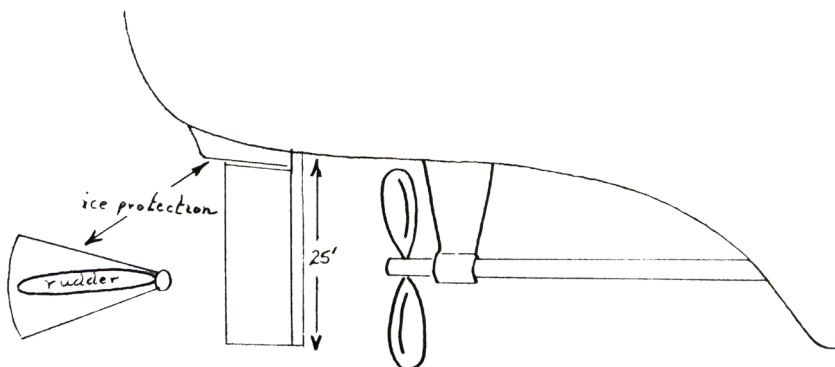


Figure 3-4: The stern arrangement showing the ice protection pad fitted between rudder and hull. The ship was fitted with twin rudders angled out 15 degrees from the vertical.

was produced called “INTEGRATED POSITION/NAVIGATION AND IMPACT/ SIDESLIP MEASUREMENT SYSTEM”.

The inputs to the system were:

- A. Navigation Satellite Receiver (ITT AEROSPACE) using input from special purpose earth satellite in polar orbit (US NAVY NAVIGATION SAT SYST)
- B. Pulsed Doppler Sonar (MARQUARDT CORPORATION). The principles were developed in co-operation with MIT and/USN Deep Submergence Systems
- C. Accelerometer readings, Gyro signals etc.

The accuracy expected of this system was position to within 500 feet and speeds to within 1/10 knots. Accurate velocity was considered the most important feature. Gyros were SPERRY Mk 14 and 227, radars were Decca Mk 729A and Radio Marine G104 Echo sounders were SIMRAD and BLUDWORTH, TAFT BROADCASTING COMPANY was prime contractors for the close circuit television which was time synchronized with all other instrumentation.



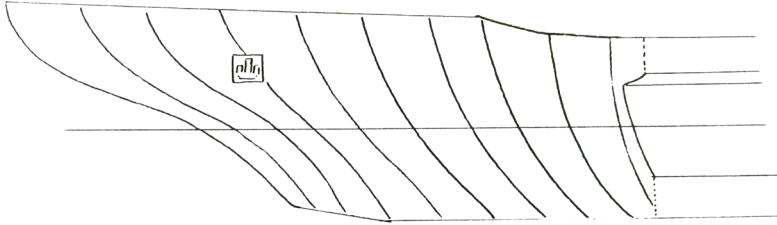


Figure 3-5: “The bow was a compilation hard to describe.” At the waterline the angle between stem and keel was 18 degrees and increased under water to 30 degrees. The start of the ice belt can be seen on the right.

### Manoeuvrability

3-13 MANHATTAN is extremely manoeuvrable for her size; her turning circle at five degrees helm and twelve knots is one mile in radius. At full rudder angle she can complete a ninety degree turn with an advance of about two ship lengths. She was observed to complete a Williamson’s turn in under five minutes within a circle of about one mile.

3-14 Her manoeuvrability in 10/10 ice, 6-8 feet thick was poor, for several reasons. Her speed under these conditions was low, about six or seven knots and frequently less (if, in fact, she was not slowly grinding to a halt) and her helm was restricted to five degrees because of the limitation of ice protection fitments. Her beam to length ratio was unfavorable (1/6) for course alterations in ice. Ice breakers were required on several occasions to help alter course. Stations were inboard bow and, if two breakers, out-board quarter. The inboard bow position relieved pressure in that area and forced MANHATTAN’s bow in the desired direction of turn. The outboard quarter position was considered “last resort” and removed ice to allow the stern to shift laterally. On one occasion two icebreakers were required on the outboard quarter, flushing ice, for about three hours in order to complete a 120-degree turn. The occasions when ice-breaker assistance was required for a turn were also occasions when the pressure and thickness of ice impeded MANHATTAN’s forward progress.

3-15 A fundamental requirement in a polar icebreaker is the ability to readily proceed astern and this not always through pre-cut ice. In order to have this ability, the after-body should repeat the form of the fore-body as closely as possible. The ability to proceed astern is required in order to “buck” the ice. Pressure and snow can halt the vessel and ridges and floes require repeated “blows” before they give. An additional reason for going astern is to clear the masses of ice which accumulate, cling and “blunt” the bow, thus rendering it inoperative.

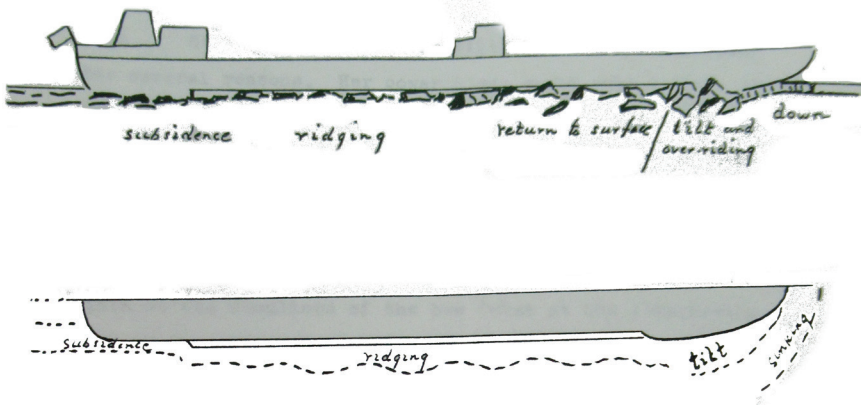


Figure 3-6 shows the general pattern of ice behaviour. Radial cracks occur in the sinkage area and the ice fractures at 90 degrees from these. The majority of the pieces are over-ridden but some return to the surface along the ship's side producing a ridged effect.

3-16 MANHATTAN's astern capability in ice was very bad for several reasons. Her power plant could only deliver 14,000 SHP astern, hardly equal to that of MACDONALD. Ideally, she should have had a centre-line shaft with which to keep clear water aft by flushing away the larger pieces of broken ice. The major reason for her poor astern capability was the double “harpoon brb” effect caused by the increased waterline width at the shoulders of the bow (when at the icebreaking trim of 52 feet) and the more pronounced effect where the ice belt cut in, a total distance of eight feet either side, to trim of 52 feet) and the more pronounced effect where the ice belt cut in, a total distance of eight feet either side to meet the old ship's side

at the internally strengthened stern. The inability to proceed readily astern in order to “buck” the ice was MANHATTAN’S Achilles heel.

3-17 Successful polar icebreakers have a power ratio of approximately three horsepower per ton displacement. MANHATTAN’s ratio was approximately 0.3 horsepower per ton. This is not to say that the power ratio of future “ice-tankers” should approach that of polar icebreakers; however, MANHATTAN’S ratio was inadequate. Several factors enter the power/ton ratio; too great a ratio increases the size of the ice “breakage” making disposal, (under the hull) difficult. These larger pieces also prevent stern way when “bucking” ice. Disposal of ice by thrusting aside does not occur at slow speed in 10/10 ice. Too small a ratio prevents a rapid buildup of momentum when charging the ice (pressure may reduce a ship’s fore and aft freedom to a hundred feet or less.)

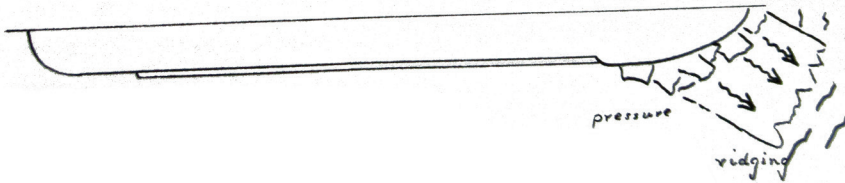


Figure 3-7: In snow covered ice, increased friction “blunted” the bow resulting in an icy bow wave. Increased speed may have overcome this.



Figure 3-8: MANHATTAN’s mass made her a potent ice cutting machine. Here she plows through multi-year polar ice



Figure 3-9: The contrast between the unbroken ice ahead and the “chewed up” seas astern is marked. Note the decrease in breadth at the waterline at the end of the ice belt.

## **Ice Operations**

3-18 MANHATTAN'S bow is of a complex form hard to describe See figures 3-5. The official designation is the MIT Bow (Wilson) M Type Mk 13, 18° - 300. Along the sides of the bow, from the stern to the beginning of the ice belt on either side are a series of crosses painted about ten feet above the water line and about six feet apart. These are used to position observances more accurately than would be possible with estimations from prominent features such as the hawse pipe. There are twenty of these marks on either side and location is given with respect to them when making an observation. The marks are numbered consecutively from the bow.

3-19 When cutting through six to eight foot ice (first and second year but no multi-year) most of the action seems to occur between marks 8 and 14. The ice sinks below the water level here, tilts upwards to line up with the vertically orientated angle of the bow, and starts to disappear. The majority of the work is occurring on the shoulder or hip of the bow which is located at about number 14. When proceeding at 7-8 knots, the pressure and impact centred at 10-12 and at 14 causes spray from the "exploding ice" to rise as high as the gunwales.

3-20 The ridges of ice produced along the bow and the ship's side reach the height of the ice belt. The first build up occurs between 8 and 14, where the ice is being over-ridden, this subsides somewhat as the ice reaches the start of the ice belt (the extreme breadth of the hips decreases here). The ice proceeds down the ship's side without much rise or fall until the end of the ice belt is reached when it quickly subsides into the additional space caused by the eight foot decrease in breadth at this point. Considerable pressure is taken off the ice here. MANHATTAN's screws and rudders are excellently arranged for the ice now seems to pass, or be swept, down between the two screws, underneath the hull, rather than to pass through the races. This also keeps the rudders from harm.

3-21 A high proportion of the "debris" in MANHATTAN'S wake is composed of small bits of ice -- the wake looks as if the ice had gone through a meatgrinder. The ice, of course, also breaks into larger chunks and these are strewn on either side or, if overrun, fall or move back into the wake as the ship passes. The wake itself, at eight knots in light three or four foot first year ice, is about two-hundred feet wide and strewn with little "bits" two or three feet across; the majority of the area looks as if it were covered

with pulverized ice. In heavier ice the “swept path” is much reduced and in 10/10 ice of six to eight feet the path is just about the width of the ship, herself, 148 feet. Pressure can close this [to] a couple of hundred feet astern.



Figure 3-10: MANHATTAN's bow at rest in a ridge.



Figure 3-11: MANHATTAN's ship side being cleared of ice by MACDONALD. Note the lead being developed between the two vessels and the broken ice towards the stern.



Figure 3-12: Leads opening up between MACDONALD and MANHATTAN. This view gives some ideas of the unevenness of polar ice – its undersurface is equally uneven.



Figure 3-13: MACDONALD's helicopter flies down MANHATTAN's port side. The ice is multi-year polar ice with frozen melt ponds.

3-22 It is difficult to see MANHATTAN's bow "in one's mind's eye". It seems that the waterline shape from number 6 to number 12 is a straight edge. When the ship comes astern in heavy ice, particularly the first astern, after grinding to a halt, a great regurgitation of ice occurs along this straight edge area. Great slabs of ice, some at least fifty feet across, are coughed up as the ship moves back. It seems as if, in forward motion, the ice was not being removed quickly enough from this region and gets concentrated into a great "log jam" under the bow. This phenomenon can be seen in the buildup as the ship is forced to a halt. A blockage appears between 6 and 12 causing a lateral movement of ice away from the bow.

3-23 The dread of an icebreaker Captain is snow on the ice. This raises the co-efficient of friction between the ice and the ship. MANHATTAN's surface "skin" area is large in comparison to her power and the increased friction caused by snow on the ice can reduce her to a crawl or to no progress at all. Instead of cutting through the ice and having it pass down



Figure 3-14: Considerable effort was devoted to describing and measuring the broken ice. The man with the "rake" is measuring selected pieces of ice.



Figure 3-15: Looking aft down the starboard side. Note how the pressure falls away and the ridging subsides aft of the ice belt.



the ship's side, the snow-covered ice is carried along with the ship and the bow soon becomes completely "plugged" up. A mass of ice accumulates ahead of the ship which does not sink under the bow but moves out laterally and builds up pressure ridges about a hundred feet from the bow. More speed at this point might re-introduce the "cutting" capability of the bow but one thing is certain -- she cannot operate with a bow wave of ice being pushed ahead.

3-24 MACDONALD frequently cut up alongside the MANHATTAN to ease the pressure and allow her to back "down" for a repeat run. When doing so the first cracks to open up lead from one ship to the other. The "major" lead appears when MACDONALD's bow (shoulders) are abeam MANHATTAN's bow (shoulders). As the ships proceed ahead a series of leads open running between the two ships. Towards sterns the "races" from the screws tend to sever the ice from the lead and disperse it through the races. The following was observed on October, MANHATTAN was heavily trapped in pressure and when MACDONALD's bow came abeam her shoulders, a large lead appeared running from one to the other, as MACDONALD came astern to do another run. A terrific "welling up" of ice occurred from MANHATTAN'S ship's side about 70 feet aft the join of her bow. This ice regurgitated out filling and opening the lead which had appeared, pushing out to more than 100 feet. This ice must have been trapped under her ice belt, which under water fits proud by about eight inches.



Figure 3-16: Sometimes large slabs appeared which, if forward of the bow, could not be over-ridden and rose in awkward angles impeding progress.

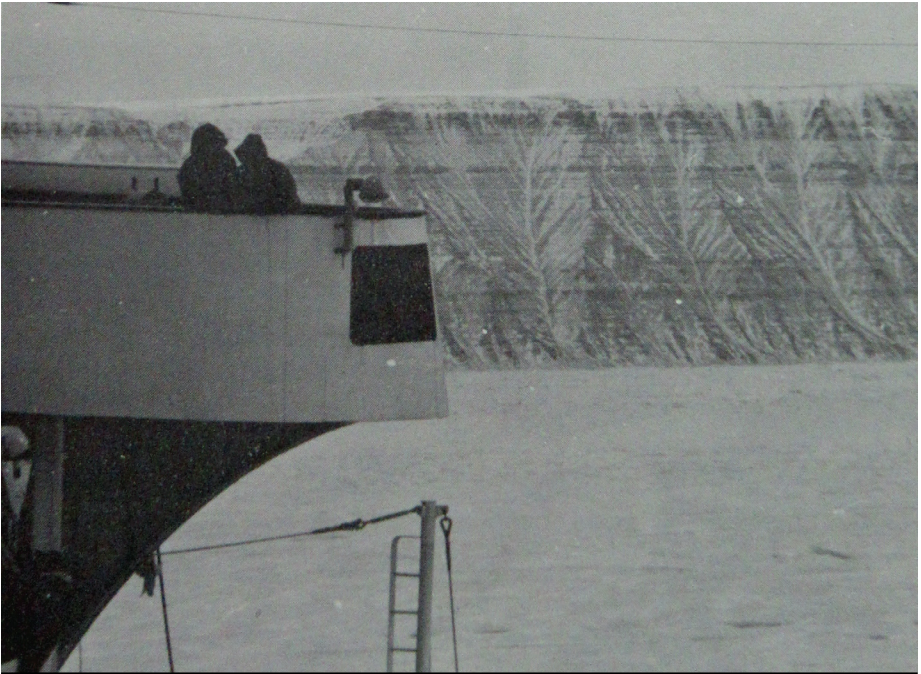


Figure 3-17: The lonely shores of Banks Island form the background to a serious discussion.



Figure 3-18: This view shows the sinking of ice under this bow. Note the large section of ice to the left and the thin sheets of fresh water ice which it has pushed aside.



Figure 3-19: MANHATTAN working through an active pressure ridge, covered in fresh snow. Snow increased friction and frequently caused the bow to “plug-up”.



Figure 3-20: Stopped in the ice--note the great “regurgitation” of ice into the melt pond to the left. The breadth of the ship decreased where the bow joined the ice belt.



Figure 3-21: MANHATTAN's wake was restricted to her width in ten/tenth's ice and composed of finely broken ice in which floated larger lumps from 2-6 feet in diameter.



Figure 3-22: "The combination worked well." MACDONALD frequently eased the pressure on MANHATTAN's side enabling her to back and charge again.



Figure 3-23: This view shows the lead developing between the two ships. MACDONALD is working forward while MANHATTAN has eased astern for another charge.



Figure 3-24: MANHATTAN bucking ice. Note the radial cleavage of the ice at her furthest forward point and the vast amount of broken ice which must be disposed of.



Figure 3-25: Leads opening out from the ship -- sometimes running for hundreds of yards along the natural breakage points of the ice.



Figure 3-26: Trials on an ice island. MANHATTAN closes to test her bow.



Figure 3-27: The bow climbed six feet and the island, estimated to be 250,000 tons, moved bodily away. The movement can be seen against the backdrop of the ice.

3-25 During October's ice trials in Viscount Melville Sound, the ships stopped every night. MANHATTAN's large skin area and her low power ratio made her difficult to start in the morning. An effective heating system and a good wetting system would be of great value. MANHATTAN'S heeling system was capable of 3 degrees and her wetting system consisted of over the side discharge.

3-26 The movements of MANHATTAN's bow when breaking ice are of importance. Normally, no appreciable movement is felt in the ship. Ice may be exploding and large pieces being ground under foot, but little of this is evident from the ship's motion. It is reported in one instance when she hit a large flow (estimated to be 60 feet thick and several hundred feet across) that the jar was felt throughout the whole ship, especially on the catwalk. The bow slewed about ten degrees when the floe broke unevenly. It is the opinion of all concerned that the bow does rise when the ship comes upon a tough floe. This is supported by photographic evidence on trials during 19 October when MANHATTAN made four runs at slow speed against an ice island 435' by 223', 14 feet above the waterline and estimated one hundred feet below, with a slope angle of 75 degrees. During the four runs she cut slightly further in each time and on the last run at 3.1 knots her bow can

distinctly be seen to rise. Her bow, in fact, did rise some six feet and the edge of the ice island sank an estimated four feet. The whole island, displacing about 250, 000 tons, moved bodily away from the ship.

3-27 Oil pollution is a hazard associated with tanker operations. Some of this results from negligence and malpractice and the cumulative effect is significant. This type can be controlled by legislation, inspection and co-operation of the oil companies concerned in tanker operations. The greater hazards arise from accidental damage to a ship and the total volume of oil discharged in this fashion each year is astonishing. MANHATTAN struck an iceberg on her return journey which holed one tank and ruptured two others. There is no doubt that the opening of the Northwest Passage to tanker trade will introduce oil pollution into the Arctic. The frequency and degree are matters policy i.e. safety standards in construction, masters and mates, provision of ice pilots and aids must all be laid down early in the game.

## CHAPTER FOUR

### Polar Icebreakers

4-1 Icebreakers are of three types; *harbour*, small vessels designed to cut homogenous sheets of light harbour and river ice; *non-polar*, larger vessels designed to assist shipping and for flood control in more temperate regions, (these vessels deal with first year ice); *polar*, vessels designed to operate in low temperatures of the Arctic, Antarctic and Northern Siberia (these vessels are designed to deal with multi-year ice). The bow design varies with the intended role of the vessel.

4-2 The polar ice breaker is expected to break ice by virtue of weight and power. To do this she rides up on the ice with her full convex bow and as her weight comes to bear the ice breaks at right angles to the radial cleavage pattern which develops. The broken pieces are then forced under the hull and thrown clear by the wash of the screws. The efficiency with which an icebreaker disposes of the broken pieces of ice beneath her hull depends on the size of the pieces. It is vital that these are not so large as to prevent the wash from throwing them clear. For the conventional polar bow, the power



Figure 4-1: A polar icebreaker bucking the Arctic Pack. MACDONALD with her working the ice in Viscount Melville Sound.

requirement for successful breakage and disposal of ice is taken to be approximately 2.90 horsepower per ton displacement. Power in excess of this ratio generally causes ice to break in such large pieces that when passed under the vessel they surface and may prevent her from going astern.

4-3 The conventional polar bow is fully convex as opposed to the sharper less convex bows of non-polar icebreakers. The angle between stem and base is generally 30 degrees. This assists her in riding up on the ice and the fully convex sections and waterline of the bow minimizes her chances of becoming stuck in the ice. The full width forward enables her to cut a suitably wide track through the lee.

4-4 Because a polar icebreaker is designed to climb ice (this mode of operation is called *bucking*) several requirements and safety features must be designed into her hull. As seen above, her bow is fully convex to minimize her chances of becoming stuck; however, this does occur frequently and heeling and trimming tanks are required to break her free. A large bilge radius is required for these to be effective. A high freeboard is required in order that she may list heavily before her decks become awash. She is also built wide of beam to give a high meta-centric height required for stability when ice is being formed in the top-hammer. Underwater protrubances such as bilge keels cannot be fitted in icebreakers and heavy rolling at sea is controlled by the heeling system.



4-5 Propulsion systems, in icebreakers, must be flexible and achieve full power, ahead and astern, in short time intervals. Emphasis on power requires large screws shipped so that the upper blades do not touch the underside of the ice. This requires the icebreaker to be deep draughted. Screws are generally four or five bladed to prevent massive pieces of ice from jamming between their tips. The most successful propulsion systems are diesel-electric on three screws having power ratios of one-quarter, one-half and one-quarter. The centre screw is required to keep clear water astern when bucking ice. Bow propellers and thrusters are of no use in polar icebreakers.

4-6 Icebreakers operate to a large extent astern and it is important that the hull form in the after body repeat the fore body as closely as possible. It is difficult to repeat all the characteristics here and the screws and rudders require special strengthening to withstand the impact of large pieces of ice. An additional hazard in ice is pressure on the hull. Icebreaker design avoids vertical and concave planes and the sideplating amidships is inclined 15 degrees from the vertical so that pressure tends to lift the ship instead of crushing it. Icebreaker hulls are designed for the ice in which it is intended to work, for example, polar icebreakers such as MOSKVA are designed to withstand 1000 tons/metre squared forwards and 800 tons/metre squared aft compared with an average ships design of 30/metre squared and 15/metre squared. Canadian ice breakers are designed for an assumed band of pressure of 20-30 tons per foot run.

4-7 Ice is relatively weak in tension but strong in compression. Depending on the character of ice; its age, temperature, and constituency, the compressive strength varies from St Lawrence River ice of 300 lbs/square inch to multi-year polar pack of 1000 lbs per square inch. Resistance of ice to fracture is only one of the forces which impedes an icebreaker. Friction plays a large part and the solution to this problem starts with the hull form - - an unsuitable form squeezes out the film of water between hull and ice and the coefficient of friction rises rapidly. Ice mixed or covered with snow produces the highest coefficient of friction which can approach that of steel upon steel. Wetting down the hull can be done to reduce the power required in breaking ice -- and wetting systems are built into the hulls.

4-8 There are three modes or aspects to icebreaking. The first is "steady speed" breaking in firm homogenous ice of such thickness that the icebreakers speed does not vary appreciably. The second is bucking where the

icebreaker is required to rush at the ice in a series of onslaughts to break a path. The third is working in moving, twisting ice pack and produces the greatest difficulties and challenges because unpredictable conditions of the ice produce unpredictable results. The basic forces involved in all three modes are inertia, vertical crushing of the ice and friction between ice and hull. Inertia is the force transferred to the ice by kinetic energy of the icebreaker coupled with the breadth of the ship and the thickness of the ice.

4-9 Icebreaker design has requirements additional to those already mentioned. Steering equipment must be extra powerful and incorporate safety devices against shock loading. Sea suction should be placed aft and fitted with steam coil baffles to keep the openings ice free. Damage control subdivision and special fire and flooding precautions are vital as these vessels operate alone and far from assistance. Smaller icebreakers have a stepped forefoot to prevent the bow riding completely up on ice too thick to break causing a dangerously low stability situation. Underwater appendages of any sort must be avoided.

4-10 Icebreakers work long months in Arctic isolation deprived of most outside stimuli -- even the sight of navigation lights at night is non-existent. Lack of outside stimuli force men to rely on themselves and measure reality from within their own consciousness. Working conditions are exacting and often uncomfortable and weaknesses in character soon become apparent, training schemes are desirable to weed out misfits and orientation is necessary to teach men to cope with problems of Arctic living. Two basic philosophies exist -- one advocates a scheme based on military discipline and delegation of duties and works as long as a sense of purpose exists. The other compensates man with high standards of accommodation, recreational facilities and pay and expects him to discipline himself and accept his duties as they arise. The later system seems best and produces strongly motivated, independent character. It also requires less men to accomplish a specific task than does a military scheme.

4-11 The designed role of a polar icebreaker is aid to shipping. In her environment, ice, an icebreaker is noisy, she operates with restricted mobility, frequently goes astern to buck ice and sometimes becomes "beset" for long periods of time. She is, of necessity, deep draughted which denies her much Arctic water and makes her cargo capacity incidental and in addition to her primary role. Discussions frequently occur and assumptions are made that an icebreaker has military purpose, from this the conclusion is

drawn that she has a military role. Noise in ice precludes this ship from successful sonar operation, in addition, mobility lies completely with the submarine. Her role as an A/S vessel is marginal. How does she fare in a surface role? Sea and ground forces cannot exist in the Arctic without large scale logistic support. Geographical realities are such that a potential enemy could neither land nor support forces covertly in the Canadian Arctic. To do so openly would risk nuclear escalation without compensating advantages. Arctic icebreakers do not enter this equation.

4-12 An icebreaker has an important role as an expression of sovereignty and, when providing services to world shipping in the Arctic, she becomes a tangible expression of Canada. The tangibility of the expression does not lie in military manning of the vessel. It seems fair to conclude that, in the Canadian Arctic, the icebreaker has no military role to play.



REPORT ON THE VOYAGE IN  
THE CANADIAN ARCTIC  
OF  
CCGS JOHN A. MACDONALD  
SUMMER 1969  
PART TWO  
EXTRACT'S FROM THE OBSERVERS JOURNAL



Figure 5-1: MANHATTAN's forecast passage covered many possibilities. The actual voyage traversed Prince of Wales Strait both west and east bound.

**Friday, 11 July**

**N.P**

**At Montreal**

Two Department of National Defence "observers" have been invited by the Department of Transport to join the Coast Guard Ship JOHN A MACDONALD during her Arctic summer employment. The DND observers are Lieutenant John Nethercott and I. Our instructions are to join today at Montreal (Shed 66) where the ship is loading cargo for Alert. This cargo is to be transferred to aircraft at Thule, Greenland, for the last leg of the delivery.

Of particular interest in the Arctic, this summer, is the attempt which will be made by the SS MANHATTAN to transit through the Northwest Passage to Prudhoe Bay, Alaska, and return to the eastern seaboard. This concept of forcing a supertanker, such as MANHATTAN, through the Northwest Passage is imaginative - the route is shorter by several thousand miles than any other Europe-Pacific passages, and Canada stands to gain from a successful venture.

**Saturday, 12 July**

**N.P.**

**At Montreal**

We sailed at 1700 this evening for Thule, Greenland.

The ship's company consists of Captain P. Fournier, 98 officers and men. The day was spent in touring the ship and becoming familiar with the features which make her an icebreaker. She is 6100 DWT, 18,000 HP on three engines, 318 feet long, 70 feet in breadth and draws 30 feet when at icebreaking trim. MACDONALD has a conventional icebreaker's bow. There are new developments in this field such as the ALEX bow which is something like a snow plow in shape and in operation. This bow lifts and throws the ice left and right out of the ship's way as opposed to the conventional bow which breaks ice downwards and disposes of it by overriding until the wash can flush it clear astern. Some ice is disposed of by being thrown to port and starboard but in consolidated Arctic pack, apparently the majority of the broken ice passes under the hull. A controversy is raging between the adherents of the ALEX BOW and the conventional bow -- PANARCTIC consider that the ALEX BOW has potential while NRC and most of the ARCTIC icebreaker men don't. MANHATTAN is a test of a supertanker fitted with an MIT bow which was developed from conventional bow configurations.

**Sunday, 13 July**

**N.P.**

**Off Bois Vert**

The day was spent listening to the “old timers” talking about the ARCTIC. Those who have been there are delighted to find an audience and those who haven’t have theories about the north which are nearly as interesting as the reality. Apparently, enjoyment of the ARCTIC is an attitude and the man who goes north to make money cannot wait to get out to spend it. The man who goes north to “escape” generally succeeds unless it is himself he is trying to escape from. There should be a psychological means of testing people before they go north because a misfit in the Arctic is harder to bear than a misfit elsewhere. There is a theory that men who often see a doctor for trivial matters or who travel with tons of pills, men who rush to PX’s to gaze at the bargains and men who must have the noisy jangling of television and radio constantly assaulting them are unfit for the ARCTIC. The big problem in the ARCTIC is to get Canadians to move north and settle as if in part of Canada. Propaganda can be used to get young Canadians north but what is really required is a “Siberia” complex to keep them there. The men of the north must have self-discipline above all other traits.

This evening we had dinner and drinks with the Captain. It was very much a “seaman’s” affair with the topics of conversation, degree of participation and the timing controlled by the “old man”. One of the topics of conversation was amalgamation of the Coast Guard with the Navy. This rather foundered over the thought of becoming Majors, Colonels and Captains in an organization which was thought to be geared to political expediency. The problem of rank/grade and tenure is real and would be a challenge to the present Coast Guard officers. The grading of jobs, ashore and afloat, into precedence for seniority purposes and the requirement for present officers holding tenure in these positions to move, without volition, from one to another would upset many an apple cart. Presumably a rank/grade seniority system will have to evolve within the Coast Guard now that the Coast Guard College has started to send young officers into the fleet. This idea is still nebulous and certainly not yet fully understood.

**Monday, 14 July**

**N. P.**

**50-00N 62-02W**

We have been on board for three days. Life is pleasant, accommodation is excellent, public rooms such as the lounges etc. are well appointed and, so

far, the food is good. The backgrounds of the various officers are sufficiently different to give a depth of experience and interest which is lacking in the one-dimensional world of the “navy”. The third officer is from South Africa, the electrical officer served in the German Navy during the war, and the Chief Officer is an ex-China Skipper. One of the helicopter pilots is from an army background and the other is ex-fleet air arm.

The officers of the DOT vessels are members of a Guild concerned with conditions of work, pay, etcetera. Basic pay may seem low but it is [augmented] by overtime, i.e. a forty hour working week plus time and a half in excess of this. A watchkeeper (mate) in a one in three system works 56 hours a week on watchkeeping at the higher rate of which 16 hours are at the higher rate. Saturdays and Sundays are considered entitled leave periods and are paid for in lieu. A record of “work” on weekends is kept and paid for once a year. This can amount to \$2500 -\$5000 depending on how long a ship was away during the year. Officers are not entitled to take time in lieu of pay except for six weeks per year if they can be spared.

The crew are members of a union (federal government) which is not militantly active. Conditions are good and a billet onboard a DOT vessel, (except for some “casual work categories”) is considered desirable by the local maritimers.

Discipline is not a problem as the man who repeats an Arctic voyage is generally self-disciplined but if the Captain disciplines a man, he must propose and explain the circumstances to the personnel department ashore. This department lacks firsthand knowledge of conditions at sea.

Apparently the sign of a contented icebreaker is the usage rate of the lounge - so far MACDONALD is contented but as old George, the chopper pilots says, “Before four months are out we’ll all go through a phase where -- I am sane but all the rest of you bastards are owly--”. Apropos to the lounge, this evening an historical “first” will occur in MACDONALD, the grand opening of a BAR in a Canadian Coast Guard Vessel. The event came about in this fashion; Admiral A. Storrs, RCN (ret’d) called on Captain Fournier concerning “booze” for the hoards of press and television reporters expected to haunt the ship once MANHATTAN becomes the “message”. The Captain insisted that if “booze” was made available in his ship for the fourth estate everyone in the ship should have controlled access to it. After what, one gathers, were painful moments during which giant wills clashed, the



Admiral consented and 60 cases of hard “booze” and 500 cases of beer are now comfortably stowed in the bowels of the ship for our consumption and enjoyment. This evening from 7pm to 8pm “booze” will be available in the lounge after which a Bridgette Bardot film will be shown. It will be interesting to see if this promised golden hour changes behaviour patterns and assists in keeping social niceties and exchanges on a more civilized level than, one gathers, has been the case in other ships and eras. In the Navy the Bar is a meeting place where the trials and tribulations of the day assume their rightful proportions and where “old Joe” doesn’t seem the bastard he was during the forenoon watch.

**Tuesday, 15 July**

**N. P.**

**51-52N 55-53W**

We passed through the Straits of Belle Isle during the forenoon and set course up the coast of Labrador to meet C.D. HOWE and exchange helicopters with her. MACDONALD rolls considerably in a beam sea, the reason is her shape and the absence of bilge keels which her role in life precludes her from carrying.

The opening of the BAR was successful. There was a slight impression of “farmers at the vicar’s tea party” as we all stood in our second best uniforms and made small talk against the background tinkle of ice in tall glasses. The gem of wisdom from the evening; was someone’s remark, “To survive in the Arctic -- if you are not at work -- be with people.” Presumably this applies to the expansive extrovert because an egghead might sooner be with books. There is a danger in a small world such as a ship of developing a “clique” – nothing is more annoying to an outsider than a small group with its own jokes and self-interests. Presumably all men must feel welcome and this requires, in some cases, for the foibles and mannerisms of others. Exclusion from the “group”, if done by the group, can lead to unhappiness; if done by the individual himself can be considered a sign of mental instability.

**Thursday, 17 July**

**N. P.**

**59-50N 62-30W**

The helicopter transfer went smoothly once C.D. HOWE was encountered. The ships exchanged positions and attempted to rendezvous in this fashion. DF bearing between ships would have made the procedure more certain and less worrisome. On completion of the transfer we set

course 025 to make the Greenland Coast near HOLSTEINBERG. This keeps us south of the sea ice.

One of the delights of being an Arctic novice lies in anticipation of wondrous things to come. One of these is encountering the Eskimo and the days and evenings pass listening to those who saw and knew these people before government bureaucracy took to “fathering” them. Otherwise reasonable men become abusive in describing the harm this has done. For instance, moving them to areas where it is administratively easy to “care” for them and where indoor toilets, Hershey Bars and soda pop can be provided doesn’t make very self-reliant people. An Eskimo who is torn from his hunting ground and ancestral lands, given his “civilized” pittance to eat and carefully manipulated loses all dignity and pride. All he really required was a subsidy on what he could produce and then allowed to come to terms with civilization in his own way. “Pacification” of the north consists in spending money so that the white administrators feel they are serving in a community with amenities similar to down “home”. The Eskimo has less and less place in the “civilizing” of the north.

**Friday, 18 July**

**N. P.**

**63-25N 58-23W**

We shook off a weather pattern caused by a persistent LOW and broke into beautiful ARCTIC weather. Clear skies, terrific visibility and beautiful sunset effects which last half the night are now the order of the day. The sea is calm and this evening, heading into the northern sunset, one had the impression of riding on the surface of a globe. On the port side were the first traces of ice-blink and with glasses one could see miles and miles of ice edge. The air is pure and as heady as champagne.

The ship has no physical training facilities. Keeping in shape becomes a problem particularly for an AEROBICS addict. In order to get the same points each day as at home, it is necessary to walk for half an hour after each meal along a sinuous path leading from port to starboard via the Helicopter deck and return -- a 720 foot route which if done 45 times per day giving six hard earned miles. The crew are starting to break out their hobbies -- painting, boat building, studying et cetera. The Doctor has been walking around looking at the activity and can predict, barring accident, the likely mental and physical state of each man four months from now, according to the degree of his participation in a hobby or outside interest.

**Saturday, 19 July**

**N. P.**

**67-57N 55-30w**

We reached the Greenland coast off HOLSTEINBERG this morning and set course to run up the coast to 75N. We have been running about twenty miles from the ice edge and the day has been filled with ice blink and ice bergs.

The big event of the day was crossing the ARCTIC circle. King Neptune's court held sway at 1330 and consisted of the King, the Queen, the Barber, the Greeter and the Cook. Two set of guards were provided to bring on the victims. The ceremony was simple and effective and will never be forgotten by the initiates. First came the handshake by the Greeter -- a mitt full of cold porridge, then a spoonful of chopped celery boiled in cod liver oil followed by a concoction of rancid fish-oil, strawberry jam and mustard pickles which gave most victims the dry heaves -- the more fortunate got rid of it at once. As one was recovering from this trauma the guards backed the victim into the Barber's chair for a quick shave and haircut in fish-oil shampoo. Then came the backward summersault into a dinghy filled with ice water. The fish-oil was impossible to get rid of -- soap and water had little effect and hair oil and shaving tonic had no power against the odour. The engineers shut off the showers for repairs as their contribution to Neptunes tunes.

**Sunday, 20 July**

**N. P.**

**72-18N 58-50W**

The coast we are following is a calving ground of icebergs. Newfoundland and Labrador specimens are worn out bergs which originate here several years earlier. The biggest we saw today was 210 feet high and as yet unturned -- on its tilted slope it carried the dirt and debris of its glacier origins and interspersed in this roosted hundreds of sea birds. It is hard to find an adjective to describe an ice berg -- lame, majestic, awesome, etc., but the best adjective to describe its "soul" is stupid. An ice berg is so overwhelming in its bulk, so frightening in its latent power, so beautiful in its reflecting facets that one unconsciously supposes it to have purpose. It doesn't. For thousands of years these eerie monsters have plowed the seas in dumb response to insensate nature and have achieved nothing.

Today we have been onboard for just over one week. Time flies at sea and only lags when a ship turns for home. Then the days are long and the

nights are lonely and it seems as if home port will never be raised. Still to be outwards bound across the top of the world is a wondrous thing.

**Monday, 21 July**

**N. P.**

**75-52N 69-06W**

We arrived at Thule, Greenland at 1645 and are anchored awaiting an alongside berth. At the moment the WESTWIND, SOUTHWIND and the WYNDOTT are alongside. The north side of the jetty can take vessels up to thirty feet in draught. No fuel is available and ships must use their own cranes to off load.

Thule is built on the edge of a sloping valley which climbs northeast to the Ice Cap. The Valley is surrounded by 1000 foot hills upon which are built radar sites, aerobeacons and communication aerials for the combined BMEWS station and US Airforce Base. The base itself is rather forbidding in appearance with little colour contrast to relieve the monotony. Everything is painted a uniform silvery grey colour.

**Tuesday, 22 July**

**At Thule**

Thule consists of a large camp and air field. The lease area runs 12 miles north and 18 miles south of the field and this area contains the requirements of the combined BMEWS Station and the Air Base.

The camp was originally designed for 6000 men and now operates with 1300 USAF personnel and about 1300 Danes who have taken over most of the services such as the PX, Canteen etc. Liquor is plentiful and cheap and there is a good hobby shop. Thule has its own Television Station showing a mixture of slapstick comedy, old westerns, wrestling and quaint "brain washing" commentaries designed to keep the boys alert for "mum" and country. This "brainwashing" consists of constant coverage of awards and citations for men and units who "done real good" and canned and taped exhortations by senior officers. The techniques must have been learned from Chairman Mao and the results are probably equally effective. The whole thing seems a bit sick.

**23-26 July**

**At Thule**

The offloading of our cargo is being done by Danes on contract to PACER GOOSE. They are inexperienced -- in fact, it is rather amazing to see Scandinavians so disorganized. A Danish village exists two miles north of the Thule base. This village has fifty Danish families and the menfolk are those who man the various communications nets in this region. Occasionally a new US commandant attempts to legislate to these villagers and the results are chaotic.

The Captain held a dinner for various US authorities and twelve turned up. The meal was beautifully prepared and served with appropriate wines. It was eaten in HOOPLE boarding house style and conversation was sadly lacking. The guests knew nothing of the ecology, land, people, history and explorations which have occurred in this part of the world. The most interesting bit of conversation concerned the hobby shop monopolized by the Danes who did beautiful work. The US boys, we were told, spend their time in profanity and hard drinking waiting to get back to God's Country. The average stay in Thule is one year broken by a "morale" trip home for one month in the middle of the deployment.

Lieutenant Nethercott flew home for leave. MANHATTAN has been delayed repeatedly: now for another month and two idle observers are too many. John has been away from home a lot this year. He will rejoin in Resolute or Frobisher Bay.

**Sunday, 27 July**

**At Thule**

We sailed from Thule at 2000 on passage to the southern tip of Baffin Island where we intend to join the DOT replenishment convoys supplying the east coast of the island.

**Monday, 28 July**

**N.P.**

**74-00N 60-00W**

Once again we are skirting the ice pack. There has been considerable shift and breakup in the ice since we were here before. This ice is actually last winter's ice from the shores of Greenland which breaks free from the shores and joins the center Baffin Bay pack driven by the West Greenland Current. In the vicinity of 76N there is generally open water leading west to

Lancaster Sound. On the Baffin Island side of the Bay the ice is still solid and hard against the shore. The first leads through this will appear in August and reasonable passage north and south will not be available until September.

The MACDONALD can break through 3-foot February river ice at about three knots. In the spring and summer she can go through new ice up to six feet thick with no trouble at all. She should be able to get to the Polar pack in McClure Straits with little trouble. She has broken through ridges up to eighteen feet thick.

I got up in the helicopter this afternoon. From the deck the mountains of Greenland looked like large square apartment buildings but as we climbed through the two hundred foot mark they rapidly assumed their normal Greenland appearance, in conditions of anaprop, in the direction opposite the sun, a thin yellowish brown film is visible at the altitude of the temperature change -- this looks like funnel gas from a distant ship. The ocean was dotted with iceberg as far as eye could see, and in the distant west one could see the edge of the great ice field of centre Baffin Bay.

There are two helicopters on board and the associated personnel are two pilots and two engineers.

**Tuesday, 29 July**

**N. P.**

**69-07N 58-45W**

The defence of the Arctic seem an insurmountable problem, but two questions - What purpose would an enemy have in using the area and what harm would this do to us - gives some indication how to tackle the problem. The most pressing danger may be friendly neighbors moving in to exploit the riches of the empty land and turning it, forever, into a source area for raw material rather than a land in which people settle and live. Defence measures appropriate to a "sovereignty" threat are quite different to those required to counter an "aggressor nation". No case for special Arctic measures need be made to counter the later threat.

**Wednesday, 30 July**

**N.P.**

**64-38N 58-50W**

This evening we reached the loose floes guarding the Baffin coast. These varied from the size of a ship to the size of a cottage and were about 3-4 feet

thick. MACDONALD hit several at 9-10 knots. The impact was sufficiently powerful to knock an unalerted man off his feet. The skin of the ship, in the ice zone is 1 7/8 inches thick and the internal strengthening is such that she cannot harm herself at these speeds. The ice conditions deteriorated progressively as the loose floes consolidated into pack. The floes are low in the water and do not paint well on radar -- there are also so many of them that a vessel cannot dodge them all. The fact that there is open water between the floes allows the ship to accelerate and the subsequent impacts are accentuated. This is a potentially dangerous situation for an unprotected vessel such as a DDE/DDH.

**Thursday, 31 July**

**N.P.**

**At Anchor-Brevoort Island**

We are at anchor at Brevoort awaiting the arrival of the replenishment group scheduled for the 3rd. CCGS MONTCALM is also at anchor.

The ice lies all around; the anchorage is thus protected from any swell. The movement of the ice in response to the tide is pronounced, the small bay alternately fills and empties and masses of ice ground and refloat in the ebb and flow.

We went ashore by helicopter to look at the station but fog quickly closed in so we landed at the beach area instead. Off-loading is done from barges across a bulldozed "hard". The boulders have been cleared away from the foreshore to allow the barges to ramp down. From here a single lane road leads up the cliffs to the station. Winding along with it is a small bore pipe line used to pump fuel from the shore dump.

**1-4, August**

**At Anchor Brevoort Island**

Time has passed rapidly whilst at anchor. On the whole the stay has been more pleasant than at Thule. On Sunday I accompanied the Captain, Chief Engineer and Doctor up to the station for dinner. The station lies on top of the highest land about a mile and a half back from the shore; cliffs and the ice strewn sea lie all around. The beauty on a summer's day is incredible and has a physical impact on the beholder -- much the same feeling one frets from the sight of a beautiful woman. Slightly below the station lies a 2500 foot runway with the round down at the edge of the cliff and the inboard end in a small valley. The strip can take DC3's and below

the station itself is a relay link with two 10 metre billboards facing Cape Dyer, 250 miles to the northwards and two disc aerials facing Resolution about 90 miles to the south. Between the aerial arrays lies a control station which sorts out the incoming signals for onwards transmission.

The DEW line works on a contract let by the American Air Force to the Federal Electric Corporation of Illinois, a subsidiary of ITT. The main stations have military personnel in addition to civilians, a station such as Brevoort (relay) is manned by civilians, and has ten employees; a station chief, three electricians or rather electronic watchkeepers, a communications expert, two “outside” men, a cook and a transportation mechanic. Wages run up to \$6.30 per hour for a forty-hour week plus 14 hours guaranteed at time and a half. Additional hours are at double time. Occasionally two electronic watchkeepers will share the load and they clear about \$2300 a month. An interesting observation is the number of personnel who are Canadian and ex RCAF. Persons with radar or communications background and good characters, etc. can apply for a job and are given training at the Federal Electronics School in Illinois. The station chief at Brevoort has been in the Arctic since 1957 and several others are almost as venerable.

The hazards of weather with long cold spells and the isolation and uncertainty of aid in an emergency require duplication of the necessities for survival. The main building is separated into compartments or rather units by means of fire proof spacing. This gives the inhabitants peace of mind in the long winter’s nights.

The DOT replenishment of the DEWLINE is under an agreement with MATS [Military Air Transportation Service].<sup>1</sup> In talking with [Military Airlift Command] representatives one gets the impression that MATS could very easily proceed on their own with big helicopters and containerization; however, for harmony, “their Canadian cousins”, the Canadian government and the Coast Guard are allowed to assist. The DOT is progressive in its outlook and is turning to containerization where possible -- this is not necessarily the complete answer because of lift restrictions. Helicopters

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<sup>1</sup> *Editors’ note:* Military Air Transportation Service. From 1948-1966, MATS consolidated the US air force and navy transportation services into a single joint command. In January 1966, the Air Force and Military Airlift Command (MAC) formed a separate strategic airlift command until 1992. Stanley M. Ulanoff, *MATS: The Story of the Military Air Transport Service* (Washington: Moffa Press, 1964).



lifting containers from ships directly to the stations which are back from the beaches and on high land is not the answer because the heights are often shrouded in fog.

A couple of days ago the JOS SIMARD, tanker, on contract to DOT from Branch Lines, anchored off the beach, floated a hose ashore and off-loaded POL. The JOS SIMARD has an ice breaking potential built into her summer bow -- the forward tanker section of the ship which is welded on each spring in order to "oil" the north country. In the fall she gets her cement carrying "front end" welded on and works on contract to a cement company.

**Tuesday, 5 August                      N.P.                      Off Brevoort**

We sailed at 0500 this morning to rendezvous with FEDERAL PIONEER about thirty miles off shore. FEDERAL PIONEER is one of the vessels used each year to assist in the replenishment of the DEW stations. At 0900 we made contact with her and commenced to work towards shore through the ice belt surrounding the land in this area. When proceeding through loose pack (one to two tenths) the idea is to hit or shoulder aside as many as possible in order to make a wide channel for the ship astern. By giving the floes a lateral movement away from the track a path considerably wider than the breaker can be made. The Primary concern is, of course, speed as the breaker varies continuously due to deceleration when hitting floes. The vessel astern is given an estimated speed at which to steam and the ice breaker uses full speed, if necessary, in order to keep ahead. If the ships close dangerously the ship astern veers off heavily to port or starboard and does not attempt to avoid by going astern.

The ships returned to Brevoort at 1230 and when within visibility distance off the shore (about 3/4 miles in the fog) we altered to proceed again to the ice edge to escort the NARWHALE in. We returned to harbour with NARWHALE at 1430.

**Wednesday, 6 August                      N. P.                      63-28N 62-08W**

Weighed and proceeded at 0400 on passage to Cape Dyer with FEDERAL PIONEER and NARWHALE in company. In order to avoid the Baffin

Coast ice our track takes us 120 miles off shore and cuts west again at the latitude of the cape.

**Thursday, 7 August                    N. P.                    65-43N 58-00W**

We commenced to skirt the ice towards evening and came into the 7-9 tenths field shortly after altering course towards Dyer at about 1900. The fog which had been bad all day lifted dramatically as we entered the pack. The rest of the day, until 2330 was spent breaking ice. FEDERAL PIONEER is not very manoeuvrable and is not ice protected, hence very vulnerable so it was decided to stop for the night.

**Friday, 8 August                    N. P.                    66-41N 60-22W**

The ships got under way at 0330. We are approximately 50 miles from Cape Dyer. The ice is the thickest we have been in this year and MACDONALD had to buck to break through several thick patches. In one area we ran back and forth for several hours until the ice had broken into sufficiently small pieces to allow FEDERAL PIONEER passage through. The route was necessarily sinuous and on several occasions FEDERAL PIONEER would come to a bend which she could not negotiate -- she would ease up against the broken field keeping her screws going ahead and MACDONALD would back down to her inboard bow and pull ahead. This generally started the ice moving and the FEDERAL PIONEER would clear the bend. Icebreaking is an art and Captain Fournier does it with "éclat".

We reached the anchorage in Exeter Bay at 1550. At present there are MACDONALD, NARWHALE, FEDERAL PIONEER, SKUA, and MONTCALM in harbour. SKUA is an LST from the war and carries a 45 Ton barge which is driven to the beach, to the loading area, and is used to off load the barges.

**9-10 August**

**At Cape Dyer**

Exeter Bay is a deep fjord running well into the mountains. At about its mid point, where the beach lies, it opens out slightly along the north shore. Here one can see the storage area used during the time when the station was built. One can also see the dumps -- of discarded material and equipment

which were used for the construction -- heavy 16 wheel cement mixers, bulldozers, etc. the contractors arranged special deals with the manufacturers for this equipment and one stipulation was that the equipment did not return to the USA. From the beach area a dusty road climbs steeply up the hillside to the 1300 foot mark and skirts an airfield, hidden from the shore. It then winds amongst the peaks to the station about five miles away. The quietness of the Arctic is broken by the labouring of truck motors as provisions are driven over the trail. Four large oil tanks have been constructed on the beach plus a beachmasters telephone which connects to Dyer and thence to the outside world through Rimouski exchange or the Goose Bay facilities. The beach hut flew the Stars and Stripes and the Canadian Flag.

**Monday, 11 August**

**N. P.**

**At Cape Dye**

We departed this afternoon in company with FEDEAL PIONEER and NARWHALE on passage to Broughton Island. NARWHALE is used as a dormitory ship for the beach crews. Towards evening the sea fell calm, with a stillness hard to imagine, and a long Arctic sunset seemed to suspend the ice floes in a sea of colour. The distant ice pack blurred sea and sky in such a way that one was quickly hypnotised into a state of anti-gravity -- having no up or down -- responding only to the light as if on an LSD trip. Out to port rose the snow-covered Baffin mountains and the rocky capes and headlands of the shoreline. They also reflected upside down in the mirror sea, their harshness tempered in the orange, pink glow.

**Tuesday, 12 August**

**N. P.**

**At Broughton Island**

We arrived at Broughton Island at 0900. In the afternoon the third officer and I took the rubber boat in to shore to see the community -- about 500 people, a Hudson[s] Bay Store, RCMP, and the mission.

At the store we were told that a Mr. Markoosie Audlakiuk, Bldg 504 might have some carvings for sale. We called at the house and found his wife who spoke no English. By picking up a stone and drawing a figure on it we let her know what we wanted. She invited us inside and brought out twenty carvings, one by one from a back room. Some were good and showed the

same understanding of animals which one associates with rock painting, cave art and early artifact of other hunting cultures.

The community is surrounded on three sides by water. The point of land is 3-400 acres in area having a bight on two sides, and opens out to sea on the north and to the fjord to the south. The houses are well built, small bungalows with low pitched roofs and built above the ground because of permafrost. Mr. Markoosie's house was very bright and fresh looking. It consisted of a large front or main room which combined the living, dining and kitchen areas, two bedrooms opened off the back and a bathroom to one side. The bathroom had a chemical toilet and a bathtub in which, when not used, sat a stand containing a hand basin. The stove was in the centre of the main room and in one corner was a furnace/heater arrangement. Included in the furnishings [were] a new sewing machine, record player and tape recorder, and a radio. On the walls were pennants announcing ESQUIMALT, B.C. and several VISIT BEAUTIFUL BRITISH COLUMBIA posters. The men catch a lot of seals. Skinned, disemboweled bodies lie on the beaches with piles of offal to aid to the natural charm. Some of the animals have lain so long that the meat is pitch black --- but not decayed. Apparently these carcasses are not going to waste but just getting into good eating condition, something like hanging beef.

**13-14 August**

**At Broughton Island**

After the first day here the Eskimoes took to visiting the ship. Captain Fournier knows how much this visiting means to the community and makes a point of having the main gangway lowered so the old and the young can also get on board. Men, women and children come out on these delightful, exciting outings. They are so happy and enthusiastic that their good humour infects the crew giving to all the enjoyment of "family picnics". The more enterprising of the visitors discovered the canteen the first day on board and from then on the hordes rushed down the passage-ways like lemmings to the sea and engulfed poor Joe, the boatswain, who also takes a turn as canteen manager. The children are adorable, the little boys are solemn Japanese dolls and the little girls are "sugar and spice and everything nice". At about twelve years old their body proportions seem to change and their trunks tend to become bulkier than their arms and legs would indicate. Their faces also become flatter and longer — apparently this is a cold weather phenomenon

which also occurs in Siberia and amongst the Lapps. The young teenage girls are beautifully fresh and healthy looking specimens of womanhood. An Eskimoe's face is very expressive, if one watches closely one sees a continuous play of emotion originating from the eyes and mouth rippling across their faces, which are never still but always seem to mirror their thoughts. They should be called "the people of the crinkly, happy eyes".

**Friday, 15 August**                      **N. P.**                      **67-32N 63-41W**

We sailed this morning in company with FEDERAL PIONEER on passage to Cape Christian. The same beautiful calm waters and reflections of land and sky exist which we had inbound to Broughton.

**Saturday, 16 August**                      **N. P.**                      **70-54N 68-43W**

Woke to find a cold, drizzly day with sleet and northerly winds sweeping down from the Arctic pack. At 0930 FEDERAL PIONEER detached for Clyde Inlet and we proceeded independently for Resolute Bay, Cornwallis Island. Shortly before noon we got into heavy ice and had to buck and trim to break through. The ship's movement feels like one is standing in the junction between two fast moving railway carriages rushing down uneven railway lines. Every once in a while we hit solid, multi-year ice which snaps the bow to one side or the other in unexpected, rapid movements and raises it, to drop as quickly, with a plus and minus force of one G. By afternoon we were in consolidated pack.

At about 1800 we came upon a large, yellowish polar bear who began to run before the ship, turning first one way then the other in a disastrous zigzag. The ice was heavy and the ship was grinding at full power to keep way on when the bear turned too soon and was over-run presumably he was knocked out and forced under the ice as we never saw him again -- poor beast! Someone said, "there is nothing as lonesome as a polar bear on ice". This one looked both lonesome and frightened as he rushed to escape the iron monster invading his land.

**Sunday, 17 August**

**N. P.**

**73-49N 79-07W**

This morning we turned west to enter Lancaster Sound. To be entering these waters at last, where so much of mankind's finest history has been written, is a humbling and joyful occasion.

At about 1100 the Captain invited me to come ashore with him, by helicopter, to see what he considers to be one of the most beautiful glaciers in the north -- situated on the west side of Queen Maud's Bight. We saw the glacier from about eighteen miles away and as we closed the details became clearer and clearer, the ice edge was about a mile in width where it overhung the water, and incredibly pitted, creased and cracked. A medium sized swell dashed against the foot of the sheer ice cliff and the reflected counter-waves rushing seawards wave the water a Pyramid-like appearance -- the impression was akin to coming alongside a large ship to refuel at sea. A tremendous amount of gravel and finely ground rock is always associated with a glacier and builds into great moraines on either side. The moraine to the west has stopped about one hundred yards short of an old wooden sailing ship wrecked probably a century ago. What remains visible is sadly worn by time and ice but the iron work is still intact. The vessel was obviously a whaler as an object resembling a blubber hopper lies close alongside. The large timbers and beams of the interior were unfinished except where joining other timbers -- therefore the vessel was not Royal Navy.

After inspecting the wreck we flew along the beach towards Cape Hay for a departure point to return towards the ship which was out of sight over the northern horizon. About a mile from the glacier we came upon a mother polar bear and her cub eating from the remains of a narwhale lying half buried in the gravel above the water line. The bear took off up the cliff seeking safety in the high tundra, climbing incredibly fast for their ungainly shapes. Once up the top they lit out for the mountains, the young cub tripping the female as she ran snarling and snapping at us over her shoulder. The Captain's dog, Midnight, got excited and jumped at the bubble trying to claw her way out -- she also tangled with the controls causing the pilot an anxious moment. As we turned back to the beach we saw a large male watching us from a rise. He turned to the beach, waded into the water and started swimming towards Devon Island well to the north.

**Monday, 18 August                      N. P.                      Off Resolute Bay**

We arrived off Resolute Bay at 0845 and stopped in the ice until high water 1500. We then entered harbor and anchored. The ice is thick in the bay and hinders offloading. The ships present D'IBERVILLE arrived to take on bunker from MACLEAN and sailed on completion.

**19-20 August                              N. P.                      Off Resolute Bay**

The Captain invited me to see a plane which wrecked herself in a belly landing about five miles from the airport. The lunches in the plane still looked as fresh as the day of the crash, some two years ago. After seeing the plane we proceeded east to Assistance Bay where Captain Penny wintered with LADY FRANKLIN and SOPHIA in the winter of 1850. A third ship, FELIX, belonging to Captain Austin's squadron wintering between Griffiths and Cornwallis Islands, also wintered in Assistance Bay. There is nothing to see in the area except a few cairns, some tins and a few bits of wood.

**Thursday, 21 August                      N. P.                      At Resolute Bay**

We slipped and proceeded at 2000 to assist LABRADOR, escorting the tug IRVING BIRCH which is towing and pushing two barges on passage to Point Rea, Melville Island, Point Rea is the main camp for the Panarctic consortium which is drilling for oil in the region. The actual drill sites are about 125 miles from Point Rea. The lead barge being pushed by the tug is Learmount fitted with an ALEX bow. The pack is heavy this year and the little group is not getting anywhere. Barges are funny vehicles for supplying the Arctic but they have been successful in previous years when there was no ice so, logically, it was decided they would be okay this year.

We have now received word that the LEARMOUNT, fitted with the ALEX bow, has sunk. This barge contained four drilling rigs and a deck cargo valued at about \$5,000,000. She hit a ridge, one side heaved up and over she went.

The ice is getting heavier each mile.

**Friday, 22 August**

**74-54N 102-48W**

We arrived at the scene of the sinking (74-54N 102-48W) at 1015 and found LABRADOR and IRVING BIRCH standing by the JOHN A. NORBURY, the remaining barge which is holed in three tanks from the pressure of the ice and is sinking. Her sides are up and down instead of at an angle. Her cargo is JP5 and AVGAS which is leaking and contaminating the immediate area.

At about 1800 LABRADOR set sail for Resolute Bay to pick up THOR DAN carrying cargo for Point Rea. We will remain in this vicinity until the barge sinks.

**Saturday, 23 August**

**N.P.**

**74-53N 102-50W**

The barge is still afloat but lower in the water. IRVING BIRCH attempted to tow her but was unsuccessful -- the barges flat bow cannot be forced through the ice. The staggering ineptitude and opportunism which sent these barges northwards is unbelievable.

**Sunday, 24 August**

**N. P.**

**75-13N 105-24W**

We set sail at 0200 for Point Rea with IRVING BIRCH in company. It is important that a depth survey is done at Point Rea before the THOR DAN arrives and IRVING BIRCH will be used as a sounding vessel. The hydrographer at the site is Mr. Williamson.

We arrived at Point Rea at 1400 and proceeded to break up the harbour ice so that IRVING BIRCH would be able to move as necessary to take soundings. At 1500 we set course for Resolute Bay.

**Monday, 25 August**

**N. P.**

**74-53N 98-36W**

We met LABRADOR at 1000 and commenced taking on fuel we hope to get 300 T but the rate is appalling -- 10 T Per hour.

LABRADOR is serving as a cadet training vessel this summer and I met Mr. Peter Thomas, Chief Officer of VANCOUVER who is acting as



training officer during the cruise. The cadets are forthright and independent and are enjoying the Arctic.

**Tuesday, 26 August**                      **N.P.**                      **74-37N 94-44W**

We reached Resolute Bay about 1400 and sent the chopper in for mail and set course for Frobisher Bay where are to pick up the Press and TV teams. We were hoping to get to visit Beechey Island, Franklin's first winter quarters, but the weather was unfavourable for flying.

**Wednesday, 27 August**                      **N.P**                      **73-22N 75-00W**

On passage to Frobisher Bay.

**Thursday, 28 August**                      **N. P.**                      **70-53N 60-45W**

We reached the edge of the Baffin Pack at about 0500 (72-13N 66W). The ice is thick -- up to twenty feet in spots and the ship shakes, groans and shudders when she hits. The bow accelerometer registered one G, but it was not recording when we hit our hardest ice.

**Friday, 29 August**                      **N. P.**                      **65-24N 59-50W**

On passage to Frobisher Bay.

**Saturday, 30 August**                      **N.P.**                      **63-06N 67-39W**

Came to anchor at Frobisher Bay at 1520 and are waiting for the DOT DC3 to arrive with the press and TV teams.

The press embarked at 2100, PR officer is Ray Stone of the DOT and senior boy of the group is Norman Depoe.

**Sunday, 31 August**

**N. P.**

**61-59N 64-01W**

We are proceeding to rendezvous with SS MANHATTAN. The Press is occupied getting sea-legs, background material and taping noises, which is done with an obtrusive “sock” that a long-haired “creature” pokes into the most unlikely places.

2325- R/V with SS MANHATTAN in position 62-04N 58-58W. Set course north for the Baffin Ice Pack in which MANHATTAN will blood herself. She is powerful looking with a wicked, snarling snout. We should arrive at the ice edge about 1700 tomorrow.

**Monday, 1 September**

**N.P.**

**65-07N 58-00W**

The decision was made this morning to continue further north before penetrating the ice.

At noon, Mr. Tom Pullen, Department of Transport and the Canadian Government representative on board the MANHATTAN and Mr. S. Haas, project manager for MANHATTAN's journey came on board for lunch.

**Tuesday, 2 September**

**N.P.**

**69-29N 58-00W**

MANHATTAN edged into the ice this morning (light pack) with her speed initially restricted to 2 knots while her scientists checked and calibrated her instrumentation.

The PRESS VISITED MANHATTAN in relays and enjoyed themselves thoroughly. Various reports are filtering back -- the Satellite navigation system is 18 miles out and not working very well. The bow steel is 2½ inches thick. When she hits ice the bow seems to oscillate independently from the rest of the ship and the movement is transmitted throughout in dampened form. The bow moves up and down but the ice is not heavy enough to make this movement pronounced. Her bow side-slips in the ice if the breakage is even and more pressure occurs on one bow than the other.

She was trimmed four feet by the bow according to her load line – 49 feet at the stern and 52 feet at the bow.

The ice trials were centered in position 69-29 60-15W and the official description of the ice was: 23. 10 ; TN MY 8-10 2Y 6-8 FY 36-54 Ridges max 15-18 old weather Floes small-300.

At 1600, initial trials were completed and the ships left the field and set course for Thule, Greenland.

Further reports from MANHATTAN's ice trials. At 40 revolutions – approximately 7 knots – she hit an ice floe which was estimated to be, (by a Mr. Frankenstein and hence known, the floe that is, as Frankenstein's monster) 60 feet thick and approximately 1/2 acre in area. Ship's personnel on the catwalk at the time felt the blow most strongly as did people asleep. The bow slewed about ten degrees to one side as it bit in and broke the floe. Smaller floes 18-20 feet thick gave her no trouble at all. However, the ice was open, light and rotten and Frankenstein, although an Arctic ice expert, may be prone to hyperbole.

**Wednesday, 3 September      N. P.      74-15N 64-21W**

The ships continued northwards and at sunset we arrived in an area of iceberg concentration. At one time over 700 were on the radar screen. Against the back-drop of the lowering sun the scene was eerily like movie shots of pachyderms scattered across the Serengeti Desert in Africa. It was decided to hove to for the night in area 75-30N 68-51W. The super tanker of the future must be able to cope with bergs. This is a matter of manoeuvrability but to do initial trials in a concentration of this sort is not seamanlike.

During yesterday's trials a piece of ice went through MANHATTAN's screws and some damage is feared. On arrival at Thule our divers will inspect her screws, rudders and underwater fittings.

**Thursday, 4 September      N.P.      Anchored 71-30N 69-00W**

At anchor in the channel between Saunders Island and the mainland, approximately 1/2 mile from the MANHATTAN. She is at her normal, non-ice-breaking trim -- 48-1 by the bow and 48-7 by the stern - as opposed to her ice-breaking trim of 49' by the stern and 52' by the bow. She trims 52' by the bow because this is the draught the bow was designed to cut at.

We went on board this afternoon -- the ship has the appearance of an immense factory -- at any moment one expects to hear clanking and see flames as large ladles of molten steel go rushing past. The bow is a complication hard to describe.

However, her curvature is concave, working from the keel up. The official designation is the M.I.T. Bow M Type MK 13, 18° - 30°.

The bridge is surprisingly compact for a ship her size and after MACDONALD's roomy command position one feels a sense of restraint. This area of the ship is completely remote from the noise and rumblings of the lower regions.

Much of the equipment is standard and familiar to seaman. The SIMRAD Echo sounder has a warning buzzer which triggers at a predetermined depth. This is valuable when in uncharted water.

The Satellite receiver aerial is on the port king-post. Satellite position input is integrated with a Doppler Sonar input which should give instantaneous and reliable position (accurate to within 300') This is considered important because acceleration, deceleration, side-slip and the bucking itself which occur in a ship breaking ice make DR-ing an impossible task -- at best, an estimate by an experienced ice officer is as reliable as any other means, MANHATTAN'S glorified system should solve all the problems and is a triumph of technology - especially as no one has figured out how the Sonar is going to work in ice where even a crude echo sounder is blanketed by noise. The chappy in charge said that the system developed an unfortunate earth [*sic*] during the ice trials, otherwise it would have proved to be a significant breakthrough. The transducers are fitted in the after-pump space.

**Friday, 5 September**

**N. P.**

**75-16N 75-00W**

Weighed anchor at 0600 and proceeded on passage to Resolute. At one time we had both Ellesmere Island and Devon Island in sight. Visibility is excellent up here.

**Saturday, 6 September**                      **N. P.**                      **74-32N 95-00W**

Arrived off Resolute Bay, Cornwallis Island, at 1100 sent the helicopter in for Adm A. Storrs RCN (Ret'd) Director of Marine Operations, Department of Transport, who will ride with us until the ships arrive at Prudhoe Bay, Alaska. We also met CCGS LABRADOR and USCG NORTH WIND. The latter will accompany us during the transit west.

MANHATTAN proceeded west of Lowther Island to break ice for the VIP's who have swarmed on board, each one undoubtedly believing that the transit west would not have historic significance without his attendance at some stage. Ice was broken at speeds of up to 15 knots (little pieces that is). At this speed the bits simply exploded, obviously there was nowhere for them to move as the pressure from MANHATTAN's bow came on them suddenly -- they simply disintegrated. Speed was quickly reduced to more prudent levels and MANHATTAN spent the night south of Lowther Island. We anchored in position 74-40N 96-29W, in thick fog, for the night.

**Sunday, 7 September**                      **N. P.**                      **74-37N 95-35W**

Weighed anchor and closed Resolute to pick up stores, at 1038 set course to join MANHATTAN and at 1715 in company with MANHATTAN and NORTHWIND set course for Winter Harbour, Melville Island.

**Monday, 8 September**                      **N. P.**                      **74-36N 102-20W**

During the morning watch the MANHATTAN nosed into a tough, old ridge and got stuck. The ridge was estimated at 12-15 feet thick and as the field was not under pressure, nor the cover ten-tenths, she should not have stuck, however, an inexperienced Captain (one of the three who also stand watches) didn't appreciate the situation. He should have altered to avoid the ridge or rung on more power and belted through (they had the power to show-off with yesterday). Instead he let the monster grind to a halt. The halt was taken as an opportunity to test the trim and tilt tanks. She heels about three degrees either side. A scientific party was also landed to take samples of the ice. Up to this point the MANHATTAN only used 1/3 power which is between 80 and 90 revolutions, however, at 1315 she belted out about 80 percent, and after two asterns she broke through the ridge and was on her way.

The satellite navigation system is still not working properly and MANHATTAN is fixing 18-30 miles from her actual position. We are proceeding west and the ice cover is increasing with the percentage of multi-year rising. Along the sides of MANHATTAN'S bow, from the stern to the beginning of the strengthened side belt on either side, there are a series of crosses painted about ten feet above the water line and about six feet apart. These are used to position various observances more accurately than would be possible with simple crude estimations of distance from prominent features such as the hawse pipes, etc. There are twenty of these crosses on each bow, and location will be given with respect to these, numbered consecutively from the bow when making ice observations.

Observations:

- A. When plowing through eight to ten foot ice (first year and some second but no multi-year) the bulk of the action seems to occur between number 10 and 12 marks. The ice sinks below the water level here and tilts upwards to line up with the vertically orientated angle of the bow, i.e., the 18-30 angle which is built into the MK 13. The ice, is tilting up and disappearing or rather starting to disappear in this area. The majority of the work is occurring on the shoulders or hips of the bow which are located at about number 14.
- B. When plowing through eight to ten foot ice, the ridges produced along the ship's side reach to the height of the ice-strengthened belt along the sides. The first build up occurs between number 12-16 and then the ridge subsides as the ice reaches the ice-belt. When the ridges reach the end of the ice-belt, they quickly subside as the extra space caused by the additional eight feet takes pressure off the ice,
- C. When proceeding at 7-8 knots the pressure and impact at number 10-12 where the ice tilts up and the impact at number 14 (the hips) causes spray from the exploding ice to rise as high as the gunwales.
- D. An astonishing occurrence or rather observation is the number of small bits of ice left in MANHATTAN'S wake - the wake looks as if the ice had gone through a fine meat-grinder. The wake itself (at 8 knots and in three to four feet 1st year ice) is about 200 feet wide, i.e., a swept path through the ice of this width, and this is strewn with small hits of ice, 2 or 3 feet across and much of it even smaller. The area looks as if it were covered with pulverized ice. In heavier ice the swept path is

much reduced and in 10/10 field of six to eight foot ice the path is just about the width of the ship herself, 148 feet. The ice, of course, also breaks into larger chunks and these are strewn on either side or, if over-run, fall or move back into the wake when the ship has passed. One observer in MANHATTAN rightly describes the process of breaking ice at higher speeds as “exploding the ice”.

**Tuesday, 9 September**

**N. P.**

**74-22N 110-14W**

During the morning watch, the ships came into increasingly heavy ice and NORTHWIND, with only five engines functional, began to falter and to lag behind. She had to be assisted twice by MACDONALD, the over-all result was the MANHATTAN also had to slow her progress in order to keep the three ships together. Then, on a ridge, not very large but of good blue ice, the mighty “M” slowed and came to a halt. Nothing could budge her. At about 1000 she asked us to cut alongside her to ease the pressure. This we did in fine style, bucking four or five times up her length until the icy clutches relaxed and allowed her to slide astern, gather head-way again and then break through the ridge. After proceeding for an hour or so, we stopped in a polynia and came alongside, port side to, and took on fuel. Our fueling point was placed just abaft her island (about 70 feet) and a three inch hose gave us 75 T per hour.

At 2000 we slipped and proceeded to cut NORTHWIND free. She will retrace her course and proceed via Peel Sound and Coronation Gulf and rejoin us in the Beaufort Sea. Without full power she is a hindrance in this ice.

Stephen Nagle, Junior Engineer in MACDONALD, has produced the following sketch of the underwater fitting on MANHATTAN, which he observed when inspecting her whilst at anchor in the Thule approaches. (See Chapter 3)

**Wednesday, 10 September**

The day proceeded apace after an early morning effort to free MANHATTAN from some thicker ice than the normal 4-6 foot to free stuff we had been transiting through. Most of her problems seem caused by inexperience but she certainly is under-powered when coming astern. It is

considered that she can only produce 14,000 H.P. astern which is very little different from ours. In the afternoon MANHATTAN developed rudder troubles which delayed us for several hours. This time was spent in landing scientists on the ice to bore holes and take samples, etc. At about 1530 we received a request to rescue MANHATTAN's helicopter which had landed a party on the ice and one of whose wheels had broken through. The chopper was about two miles away. As we closed we could see her canted over on one side, resting on her fuselage. The Captain manoeuvred close alongside to enable the Chief Officer to get men on to the ice and secure a hoist to her lifting point, which is the engine shaft, the manoeuvre of approaching was done carefully as any cracking of the ice may well have occurred on the floe in which the chopper was imprisoned and thus shot the whole thing under. Once the line was secured the ship was eased astern as the crane took the strain. When the line was up and down the chopper was hoisted inboard. The scope of the crane is sufficient to put men ashore and recover them from unbroken ice. The men wore lifejackets and life-lines when working on the chopper or where the ice appeared to be fractured. Aside from this they moved with all the skill of Newfoundland sealers. The helicopter, 11316Y, was returned to MANHATTAN at 1930.

**Thursday, 11 September      N.P.      74-13N 115-45W**

MANHATTAN stuck several times today as she tried out the tougher ice in the entrance to McClure Strait. She is almost impossible to turn in ice and has difficulty in backing up. Although the eight foot "steps" along her side do remove some pressure from her sides when going ahead and assist in removing friction, they are like barbs in a harpoon when the ship tries to go astern. A decision has been made to attempt McClure Strait. If successful, this will be the first west bound passage through Parry Sound. Heavier ridges lie ahead.

Mr. Haas, project manager, computes a properly designed super-tanker round trip as lasting 35 days, three of these would be earmarked for days lost in ice. He also envisions ice-breakers being available, on a 24 hour or rather within a 24-hour period, for any tanker which would be trapped. From what we have seen at the moment, it seems as if the tanker will aim herself in a desired direction and hope that the ridges and pressures on her hull will allow her to continue along her track, and then proceed as fast as possible in



order to keep enough momentum to break through the ridges. She can't do much dodging in ice if the field is 10/10 and over six to eight-feet thick. This is amazing in a way since MANHATTAN has twin rudders and is incredibly maneuverable at sea. She can complete a Williamson's Turn in about five minutes with a turning circle under a mile and can dodge icebergs most handily.

Further Ice Observations:

- A. It is difficult to "see" MANHATTAN's bow in one's mind's eye. It seems that the waterline shape from number 6 to number 14 is a straight edge. (The hawse pipe is situated between 6 and
- B. When the ship goes astern in heavy ice, particularly the first astern after coming to a halt, a great regurgitation of ice occurs in this straight-edge area. It looks as if, in forward motion, the ice is not being removed from this region but rather being stuffed in a large "log-jam" under the bow between numbers 6 and 14. Great slabs of ice, some up to 50 feet across are coughed up as the ship moves astern. This phenomenon can be seen in reverse as the ship grinds to a halt. The blockage which appears to build up between 6 and 14 causes a lateral movement of the ice away from the bow.

**Friday, 12 September**

**N.P.**

**74-15N 116-51W**

This has been a difficult day of little progress but of much effort. MANHATTAN became stuck last night at 1825, in a westing of 117-25W. The ice description:

10/10 3/10 MY 7/10 2Y 20% ridging

The ridges were up to 15 feet thick and pressure was caused by NW winds of 25-30 knots.

All day the assumption has been that MANHATTAN would have to back her way out of the ridge and that the McClure Strait transit would be abandoned. The sternboard is at least one and a half miles and with the present wind from the west she will be unable to control her stern, as her bow will tend to pay off. The narrow channel she made coming west has not closed completely and the slightest slewing of her bow will jam the stern hard against the ice. In fact, to come astern in a head wind of 20-30 knots

and still remain in a relatively rough-cut narrow channel will require MACDONALD secured snug astern on a short bridle in order to have any chance of keeping her stern in the stream. The danger to rudder and screws are immense.

Towards evening the winds dropped and the pressure eventually eased on the ice: 9/10 3/10 KY 6/10 2Y little pressure and some open water. The biggest patch of lighter ice lies ahead at about two miles where the ice is also thinner than it is here and more homogenous. The easing of the pressure should allow her to go ahead and this will be attempted. Going astern out of this patch is very dangerous as full power will be required and if rudders and screws are affected we may have to winter here. At about 1600 the decision was made to attempt to turn MANHATTAN by going ahead into easier ice (several hundred acres lie ahead in which she should be able to turn). The decision has also been made to abandon the McClure attempt and to use Prince of Wales, which is reported almost ice free.

At 2000, after assistance in easing the pressure along her side MANHATTAN began to move ahead towards the easier ice. An indication of conditions during the day is that at noon MACDONALD attempted to cut back a couple of miles along the previous days track in order to open it out in case MANHATTAN was to come astern. When attempting to turn, it took MACDONALD from 1230-1318 to complete the manoeuvre. At 2200 MANHATTAN was in the easier ice and starting to turn. After a turn of 90 degrees to starboard she stopped for the night, in order to do some



trials and calibrations. ETD tomorrow is 0600.

In announcing his decision to abandon the attempt to transit McClure Mr. Haas said that the MANHATTAN had more than exceeded her planned performance to date. She is simply not designed for McClure concentrations, either by horse-power or general hull design. Later vessels will be. He also stated that the information gleaned by MANHATTAN would be available to the Canadian Government, but not to subsidiaries in which the government does not hold majority stock.

The drift during the 26 hours we were stuck in the ice was estimated by MANHATTAN to be 1/2 knot to the eastwards. This is very high and may have been caused by the high northwesterly winds which blew for several days. These winds have also sent a 45-mile-long "plug" of ice down into Prince of Wales Straits, into what had been, up to a day ago, clear water.

**Saturday, 13 September            N. P.            74-04N 114-09W**

We got under way at 0600 and proceeded towards Prince of Wales Strait taking a wide sweep to the northwards to stay clear of heavier ice concentrations. The ice in Prince of Wales has set in solidly and the pressures which forced it into the straits have caused great ridges in the ice. The MANHATTAN's path closes solidly astern of her as soon as she is clear. At 1800, in a ridge area, a solid floe closed in ahead and astern of us, blocking us. The ship had little room to manoeuvre, but repeated charging ahead and astern at full speeds and with heeling tanks going full blast we soon got sufficient room for some solid runs ahead and one hour and forty minutes after being caught we broke free. Some say it was because the Captain heard MANHATTAN condescendingly ask, by radio, if we wished her to slow down and wait. Capt Fournier is a master at breaking ice and in circumstances like this, one can see him at his best -- as he says "I just talk to the ice and the ship a little bit". What he says at times must help because it certainly blasts the paint off sections of the bridge. The ice description where we were stuck was:

10/10 2/10 MY 8/10 2Y ridging and hummocking 45%

At 2015 MANHATTAN stuck in the ice and requested our assistance. Some concern was expressed for her rudder and once free she remained stopped for the night to effect repairs and inspect the machinery.

**Sunday, 14 September**

**N. P.**

**73-24N 115-17W**

We got underway at 0618 and set course for Prince of Wales Strait. The ridging is pronounced as are the hummocks from previous pressures. Some of the ice blocks which are being forced up are the size of trucks and the serried ridges run row upon row, as far as the horizon. MANHATTAN worked well as her "drivers" are now more familiar with her moods and are driving her around the ridges if possible; a change from driving her through them. As an indication of conditions, the following extracts from the log are appended: (M is MANHATTAN)

0801 M stopped by a ridge - 5 charges to break through

0852 M stopped by a ridge

0924 M underway after four prolonged charges at the ice

0930 M stopped again

0940 M underway

0950 M stopped in ice attempting to break through

1035 M calls for assistance

1100 M attempts further breakthrough

1130 Macdonald completed three charges and cleared [*sic*] pressure

1135 M underway

The new ridges in this old hummocked ice are a sight to see. Some of the ridges are as high as the bulwarks -- they seem to be all on the surface of the ice and little has been forced below. We worked down the strait most of the afternoon and at about 1700 broke through into clear water a few miles north of Princess Regent Island. Speed was increased to 12 knots and our ETA at Sach's Harbour should be tomorrow night.

**Monday, 15 September**

**N. P.**

**71-50N 125-30W**

The ships arrived at Sach's Harbour at 1320. MACDONALD went alongside MANHATTAN to take on oil and water. We had a suspected damaged starboard screw and divers were sent down to examine it. They reported that one blade had been broken off about eight inches from the boss. The screws are four bladed so the unbalance forces which result from one blade missing are not too great.

**Tuesday, 16 September**      **N.P. 70-56N 128-00W**

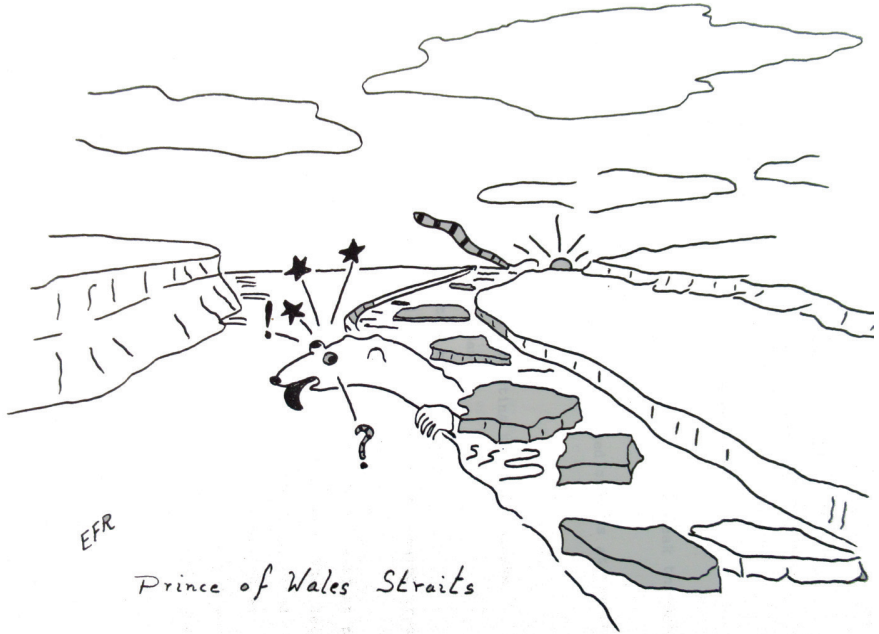
We slipped at 0130 and proceeded in company with MANHATTAN on course for Barter Island. The water is discoloured and became progressively more so as we approached the silt area of the Mackenzie River which apparently is one of the world's worst "silters". The ice is dirty -- almost black in spots and looks like backyard snow in an industrialized city. The ice edge itself, lies to the north of us, but many floes interposed with smaller multi-year masses cover the area. The ice is more hummocked and ridged than we have seen before (including the ridging at Prince of Wales Strait), and the hummocks and ridges are more sharply defined. The pressures that produce these during the time when the ARCTIC Pack bears on the shoaling waters of the northern shores of Alaska and Canada must be enormous. I reckon that this part of the passage will prove impassible during certain parts of the year.

Our communications with lower Canada have been good. The teletype has operation on 4 megs (6 and 8 are also available) with no trouble. From Sach's Harbour area we have worked Frobisher successfully. MANHATTAN'S equipment is 16-18 megs and 3000 watts, working Idaho. Their communications have also been successful. Of course, 1969 is a good communications year and there have been no "blackouts". In other years MACDONALD has had up to three days of "blackouts" in succession. MANHATTAN's Satellite navigation, and the sonar-doppler have not been successful.

We are navigating on the Hooper-Herschel Decca Lambda chain which was installed this spring for the 1969 Geophysical year. The purpose is to take soundings on the northern shelf using a hover-craft -- 1650 miles were done successfully in ice-free waters but the craft has blown up (engine room). The chain will stay active until we clear again to the east. The system seems to be working properly but the teletype does cause lane slippage.

**Wednesday, 17 September**      **N. P. 70-45N 137-38W**

On passage to Barter Island. Three members of the National film Board are with us to make two films - a 16 mm and a 35 mm. They are quiet people after the noise and confusion of the CBC crowd.



**Thursday, 18 September**      N. P.      70-17N 143-43W

Came to anchor off Barter Island at 0930. Because of the shoal water we anchored quite a ways off shore. At this distance nothing can be seen except the 10 metre “billboards” the station and several of the low lying, islands. Anchor of was weighted at 2148 and course set for Prudhoe Bay.

**Friday, 19 September**

We arrived at Prudhoe Bay at mid-day. MANHATTAN came to anchor and MACDONALD remained steaming in the area.

At 1140, the following dignitaries arrived for lunch; H.E. The Governor of Alaska, Mr. K. Miller; Admiral Willard Smith, Commandant, USCG; Rear Admiral K.W. Goehring, Director of Operations, CSCG; Rear Admiral R. Hammond, Commander, USCG 17th District; Mr. Jones, Director, Humble Oil; and Mr., Gallen, Director, Humble Oil. An excellent dinner was produced and the gathering broke up at 1400, well dined and wined. The Governor was suitably lubricated and in rood voice

for the ceremony of the “Barrel” which was to take place later in the day. This ceremony is the presentation of a barrel of oil to the MANHATTAN to indicate that the transit of the northwest passage is, in fact, a commercial venture.

At 1813 the Barrel finally arrived from shore and presumably was properly dealt with by the PR gang and the wheels aboard the mighty “M”. We proceeded at 2000 in company with MANHATTAN and also the NORTHWIND which joined after a transit of Coronation Gulf. NORTHWIND is now the first ship to have completed both an east and a west bound transit of the Canadian north in the same year.

**Saturday, 20 September            N.P.            71-31N 154-50W**

At 1920, after a long, and foggy run we arrived at Point Barrow. STATEN ISLAND is also in this area and the three icebreakers - MACDONALD, NORTHWIND and STATEN ISLAND secured side by side riding comfortably on NORTHWIND’s cable. Visits were exchanged, coast guard “patches” traded for lighters, etc. Our bar proved popular. At about 2230 a large floe drifted down on the three of us and put a great strain on the cable. The current here is from the southwest and runs about three knots (71-23N 156-40W). How much of this is due to immediate meteorological conditions and how much to the normal inflow from the Chuckchi Sea is difficult to estimate.

**Sunday, 21 September            N. P.            71-23N 156-36W**

The ship remained at anchor all day. During the afternoon the barge went away to pick up stores and parts from the shore.

We have now completed the western transit of the North-west Passage, an accomplishment which few have achieved. The circumstances of our journey are so different from those of Parry in 1819-20 and McClure in 1850-54 that one would hardly know the voyages cover the same waters. The odd snow storm and the biting wind from the north which blew a few times hinted at the miseries which the early explorers must have suffered when “wintering” in the north. Parry wintered in Winter Harbour, Melville Island, during the winter of 1819-20, we used Winter Harbour as an airstrip to bring in mail and stores; McClure wintered in Mercy Bay, Banks Island,

in the winter of 1851-2. We reached that longitude before turning back towards Prince of Wales in our 1969 attempt. McClure crossed from Mercy Bay to Winter Harbour during the winter of 1852 to get food and became the first man to complete the Northwest Passage; we crossed these waters twice by ship and complained if the showers didn't work and fresh grapefruit ran out. Such is life!

**Monday, 22 September            N. P.            71-15N 152-40W**

Weighed anchor at 0100 and proceeded in company with MANHATTAN on course for Sach's Harbour. We have now commenced our return voyage through the North-west Passage. The USCG Icebreaker STATEN ISLAND is to accompany us. She is ahead at approximately 20 miles.

Throughout the day we passed through scattered floes of ice which consisted of 5/10 MY and some first year. The ice is closer to shore than it was on our westerly leg a few days ago.

**Tuesday, 23 September            N.P.            70-20N 141-39W**

The day proceeded without incident except for the poor visibility and light snow. At 1645 we entered the Arctic pack in position 70-18N 139-28W, and by 1850 MANHATTAN was solidly stuck. The new snow on the surface of the ice acts as sand-paper and makes it virtually impossible for a ship of MANHATTAN's surface "skin" area and relatively low power to proceed. We came up on her starboard side to assist at 1940 and about an hour later STATEN ISLAND was asked to come up on her port side - this the STATEN ISLAND was unable to do. The whole night was spent grinding up and down alongside MANHATTAN, full speed ahead and full speed astern.

**Wednesday, 24 September            N. P.            70-18N 137-31W**

At about 0455 MANHATTAN began to move ahead but at 0620 she was stuck again. Total distance run in the last twelve hours has been 11 miles. We continued to work to clear MANHATTAN and at 1000 she had to cool her astern turbines. The power arrangements of steam turbine drive



is not satisfactory and the tanker of the future may well have a turbo-electric arrangement. The flexibility of Diesel/Electric is attractive.

The ice through which we are traversing is: 9/10 MY 1/10 2Y 100% snow covered heavily ridged and hummocked and under pressure. At noon we eased into lighter ice and MANHATTAN finally started to use the leads for transit – even if some of these did not seem to bear directly east.

**Thursday, 25 September      N. P.      71-19N 127-19W**

The day was spent creeping along or going flat out in MANHATTAN'S wake. MANHATTAN seemed to have no clues as to position, programme or intentions. We are fixing again on the Hooper Island Decca chain which has remained especially active for us. MANHATTAN sent two positions to us - one OMEGA and one SATELLITE - these fixed respectively 27 and 31 miles from our corresponding decca position.

When Decca was compared with a radar fix on making Banks Island, it was found 7 miles in error because of lane slippage (caused by the teletype fitted on board). The true errors for Omega and Satellite worked out to be 20 and 24 miles. Neither one of these two gadgets are very satisfactory.

We came to anchor in Sachs Harbour approaches at 1701. At 2150 we weighed and proceeded again on passage to Prince of Wales Strait.

**Friday, 26 September      N.P.      72-23N 118-57W**

During the forenoon MANHATTAN increased speed unannounced to 17 knots and by 1400 she had left us 6 miles and STATEN ISLAND 16 miles astern. The purpose of this aberrant behaviour is not known but the usual excuse is - "testing scientific equipment".

At 1430 we came abeam Princess Royal Island and at approximately 1730 the ships were at the ice edge. A lead exists on the port hand up against the Banks Island shore and several large floes of MY ice are in the area. Ice reconnaissance missions were flown and at 2135 the ships secured for the night.

**Saturday, 27 September**      **N. P.**      **73-19N 115-46W**

The vessels remained stopped for the forenoon and ice proceeded from all three cut holes in and sample the ice. The holes are cut with a four-inch coring device which brings up a 2 ½ inch core. These are laid out on a measuring table and at regular intervals selected by the party, holes are drilled and temperatures taken. At the same time a sample of ice is cut from the core and put in a sample box for subsequent analysis for salt content. From the temperature and the salt content the bending moment of ice can be determined. MANHATTAN's party are fitted with a crushing device which measures compression.

**Sunday, 28 September**      **N. P.**      **73-49N 114-03W**

The day was spent in heavy ice; 3/10 MY 6/10 2Y. MACDONALD assisted MANHATTAN several times. Ice parties were also landed and samples taken.

Total distance run was 46 miles. At 2046 the ships secured for the night.

**Monday, 29 September**      **N.P.**      **73-57N 113-10W**

Ice parties were landed during the forenoon and at 1500 the ships proceeded towards Winter Harbour. Total run 22 miles. The ships secured at 2055.

**Tuesday, 30 September**      **N.P.**      **74-20N 111-04W**

The ships got under way at 0840 and stopped again at 1130 to land ice parties. Early in the afternoon a thick fog came on the parties secured at 1443 when the ships again got under way.

At 1900 the ships secured for the night. Securing like this every night relieves a lot of the pressure to which the human being is subject when serving in an icebreaker. The constantly high level noise and the erratic movements in a ship breaking ice are difficult to endure.

**Wednesday, 1 October**                      **N. P.**                      **74-22N 111-02W**

At 0800 STATEN ISLAND's diving team carried out an inspection of MANHATTAN's stern tubes, propellers and rudders. These are in very good condition.

The CCGS LOUIS ST LAURENT is lying approximately thirty miles to the northeast and during the day her helicopter flew several sorties to MACDONALD. ST LAURENT is 27,000 SHP with a turbo-electric propulsion system on three screws. It will be interesting to watch her do her paces and compare her to an "ace" icebreaker, J.A. MACDONALD.

MANHATTAN now intends to start working more easterly. At 2000 the ships secured for the night.

**Thursday, 2 October**                      **N. P.**                      **74-19N 102-24W**

The ships proceeded at 1025 and at 1130 MANHATTAN stopped at her "ice floe" for the day. The ice parties swarmed forth, measuring, probing, boring and sampling the ice. From MACDONALD they resembled dozens of ants leaving a large cockroach in search of fresher victuals.

At 1613 MANHATTAN got under way to proceed through the thoroughly inspected floe in order that the "boffins" could record the power required to move the ship through the ice. This type of work is important but infinitely trying on the patience of active men. It may go on for weeks and no programme has yet been published.

**Friday, 3 October**                      **N.P.**                      **74-16N 109-19W**

The forenoon was spent cutting MANHATTAN out of various ridges in which she became caught. This is now such an everyday occurrence that it hardly draws comment. Only a few romantic souls, or gleeful ghouls turn up to watch, the ghouls hoping that the big ship will disappear so that we can all go home.

At 1425 MANHATTAN landed her ice parties.

**Saturday, 4 October**                      **N.P.**                      **74-20N 109-26W**

Ice parties spent the morning on the ice testing floes and in the afternoon the ships tested the floes.

**Sunday, 5 October**                      **N. P.**                      **74-27N 109-35W**

The ships got under way at 0340 and at 1000 MANHATTAN had found her floe and set out the ice brigade. In MACDONALD the routine was somewhat varied in that our "seismographic anarchists" Mr. C. Kershaw, of Hunters Ltd, and Mr, J.C. Pelletier of Pollister Ass't, Calgary, came out on the with the ice party armed with dynamite, caps, fuses and explosive intentions. As soon as the ice party completed a hole these gentlemen moved in with the determination of a lady raven stealing a nest for her eggs and set off one and a quarter pound charges at eighty feet. A recorder dealt with the reverberations and indicated various geological layers and hence the likelihood of oil. I was allowed to fire one charge which made a gratifying thump. The recording of this explosive may be the cause of a second "gold rush" in oil.

**Monday, 6 October**                      **N.P.**                      **74-27N 108-51W**

We got underway at 0830 and proceeded up MANHATTAN'S port side to work her loose -- at 0942 she was free and attempting to alter to a westerly heading but the ice conditions 9/10 MY 1/10 new ice 100% snow covered 40% ridging proved too much for her. We remained on her port quarter and the ST LAURENT, who joined Saturday, came up on her starboard bow. The turn took until 1425, with two icebreakers working at full power on the bow and quarter. Eventually both worked on her port quarter. The ice breaker tanker of the future is going to have to be cleverly designed to solve this problem. Turning ability is associated with beam to length ratio which in a polar ice ice-breaker is about 1/4.5. MANHATTAN's ratio is about 1/6.5. The greater the beam the more ice to be disposed of and the greater the power requirements, etc.

At 1830 the ships secured for the night.

**Tuesday, 7 October**

**N.P.**

**74-23N 107-45W**

At 0800 ST LAURENT and STATEN ISLAND detached and proceeded towards WINTER HARBOUR to transfer mail and passengers. The ships closed in order to reduce helicopter flying time and as a safety measure in case of poor visibility which can occur rapidly in the Arctic. We have been waiting approximately a week to do this transfer but have been foiled by bad weather in Resolute Bay which kept ATLAS AVIATION's Otter grounded.

MANHATTAN requested assistance at 1148 to help work free from the night's position. Her large "skin" area and her relatively low power make her awkward to start after a night's freeze-in. Her heeling system should prove of greater value than it has. This is another vital matter for the new ice-tanker designers to worry about.

During the afternoon MANHATTAN once again found it impossible to alter course on her own -- ice conditions 8/10 MY 1/10 2Y 1/10 new ice -- and MACDONALD was called in to assist. The turn took from 1430 to 1800 to complete. At 2030 the vessels stopped for the night.

At 2155 ST LAURENT came alongside with the mail, the first since 17 Sept.

**Wednesday, 8 October**

**N. P.**

**74-30N 106-51W**

The ships got underway at 1000 and at 1148 MANHATTAN stopped, landed ice parties and carried out her daily ice tests.

At 1355 MANHATTAN got under way again and by 1500 she had come to a halt in a large ice floe. The remainder of the afternoon, until 1635, was spent freeing her.

MANHATTAN'S screws, rudders and their arrangement seem excellent - in the sense that little damage has come to them in spite of difficult conditions of ice in which they have operated. The ice seems to be swept between the two screws rather than pass through the races. This also keeps the rudders from harm. After six weeks intensive work in ice - and four inspections by diving teams - no damage or unusual wear is evident.

MANHATTAN'S manoeuvrability, outside a heavy ice field is excellent for a ship of her size. At twelve knots and with five degrees or rudder she

turn with a radius of one mile full rudder angle she turns 90 degrees in a little over her own length (as per her Captain).

In ice her manoeuvrability is affected by her vast length compared to her beam measurement, plus the fact that the rudder is restricted to 5 degrees. Her only saving grace here is that there is one rudder aft of each screw (the new design will have the third centreline screw but it would be better to retain the present twin rudder arrangement). The five degree restriction is imposed because the protective pad between the rudder and hull has these angular dimensions. A greater rudder angle in ice would be of assistance.

At 1826 the ships secured for the night.

**Thursday, 9 October**

**N.P.**

**74-13N 106-30W**

MANHATTAN landed various ice parties by helicopter and people bustled all over. As one wit said, "They must have had a pep talk from the boss". She also pre-empted our ice floe much to Mr. [L.I.] Kawerninski's chagrin (an NRC<sup>2</sup> scientist from Ship's Laboratories) however, we got our floe back later in the day and smashed it to pieces in the subsequent ice test with which we celebrated its return.

At 0930 MANHATTAN steamed off to find "the floe" which Mr. Frankenstein and his MANHATTAN monsters have been looking for weeks. This particular floe is rather like the HOLY GRAIL, its perfection lies in and mind of the beholder. Frankenstein has been unable to find or identify it.

MACDONALD's ice party returned on board at 1445 and after the ice test the ship proceeded alongside ST LAURENT, for the night, ST LAURENT is in the midst of her teething troubles and, as with most things "different" in life, she is subject to much criticism. Her control systems are complex and the personnel to run them have had little indoctrination and training in their capabilities. The Navy would have given the key personnel, at least, a year's course in equipment of this sophistication.

At about 2200 two polar bear came sniffing, around the ships. Search lights were trained on them and they stood looking or obliquely shuffling

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<sup>2</sup> *Editors' note:* National Research Council of Canada. Kawerninski was a member of the Ship Section.

around what they considered “many potential dinners” which lined the rails taking pictures. The bear made noises which sounded like cows mooing in a barn only their “call” was more rapid in execution and repeated at a greater frequency. At the stern of the ship lay several patches of open water and the bear stepped in and swam across these with no hesitation -- the miserable cold night of early fall holds no terrors for them. The original Eskimo who hunted this ice and attack the bear with hand weapons must have had much primitive “beast” in him; modern man could not cope with such apparently unfavourable odds. It was nice to see the bear but nicer to see them from the ship.

**Friday, 10 October**                      **N. P.**                      **74-21N 105-54W**

Visibility is excellent - on a clear morning land is sometimes visible forty or fifty miles away.

The ships were under way by 0850 and the day was spent in ice parties and ice testing.

**Saturday, 11 October**                      **N.P.**                      **74-27N 104-31W**

The day was spent stopped in the ice. No further activity.

The ships are using reports from MANHATTAN's Satellite Navigation System to position themselves. There is, however, no way of checking the accuracies of these positions. Any cross checking that has been done during this voyage had proved that MANHATTAN'S Satellite system is not very accurate.

**Sunday, 12 October**                      **N.P.**                      **74-27N 104-21W**

The ships lay quietly all forenoon and in the afternoon ice parties were landed. We now have seven complete tests. A complete test consists of three ice observations (holes bored through the ice to give thickness, temperatures and samples for salt analyses) at measured distances from the ship. The ship is then run through these positions and time-distance measured to give speed. NRC instrumentation gives horsepower and bow pressure. Speed measurements are a great problem -- MANHATTAN's INTEGRATED

POSITION/NAVIGATION AND IMPACT/ SIDESLIP MEASUREMENT SYSTEM with speed measurements to 1/10 knot, etc, etc. has proved about as useful as a piglet feeding system on a boar. MANHATTAN now measures speed by fleet-footed ice scientists who form an endless chain on the starboard side forward, and in succession rush aft past several measured marks on deck yelling "Mark" when abeam. They gear their speed to an object, angle or other observable occurrence in the ice. Every time one pants out, "Mark", the taskmaster presses a stopwatch and the results are fed into the DIGITAL OSCILLOGRAPHIC ANALYSES COMPUTER as ship's speed. There are three ice BODIES represented on board MANHATTAN. CRREL (Cold Region Research and Engineering Laboratory, Hanover Mass, run by US Army). These people are top notch experts in icemanship, brilliant men with excellent equipment and ideas. The next group are University of Alaska ice boffins, a bit long-haired but responsible for much research into ice-islands, etc. The third group is the US Coast Guard which is interested in original ice research in addition to ice reporting and reconnaissance. The US Coast Guard do the speed measuring on board MANHATTAN a bit differently from CRREL, they man the port side and throw little bits of wood over the side and yell "Now" (in order not to be confused with "MARK" on the starboard side) every time the little bit of wood comes in transit with marks situated on deck.

Our ice party returned on board at 1500 and found that ST LAURENT, who had been refueling alongside MANHATTAN, was to detach shortly and proceed to Resolute Bay for parts. Kawerninski, who was to proceed with her[,] did one of the quickest "packs" on record after we completed our ice test and joined ST LAURENT at 1715.

**Monday, 13 October**

**N.P.**

**74-30N 104-10W**

The weather is turning colder, day by day, and each morning less water is visible between the floes, MACDONALD has finished her ice testing and our role is now to trail after MANHATTAN as she does her trials.



**Tuesday, 14 October**

**N. P.**

**75-03N 105-32W**

ST LAURENT reported that large concentrations of ice have come south through Austin Channel and have made progress to the eastward difficult and in places impossible. Some of the floes are nine miles across.

MANHATTAN's helicopter flew in to Rea Point this afternoon to pick up mail and parts. We received our "bubble" for one of the helicopters. This is complicated to fit but the helicopter engineers, Mr. Ironside and Mr. Craggs commenced work at once with the keenness of artificers long deprived of a worthwhile cause,

Once again we received no mail. This "one delivery a month if we are lucky" approach to mail is annoying in the extreme. It is utterly unnecessary. Apparently our mail is being forwarded to Humble Oil, USA.

**Wednesday, 15 October**

**N. P.**

**74-31N 101-27W**

Today was miserable, with snow, poor visibility and wind from the north west at 20 knots. Temperatures hovered around 3 degrees F.

MANHATTAN did engine trials during the forenoon. The ice is fairly heavy -- 8/10 MY 2/10 Light Grey, 70% hummocks and ridges and 100% snow cover. MANHATTAN had difficulty turning.

**Thursday, 16 October**

**N. P.**

**74-30N 101-20W**

Ice conditions continue bad, the ships are in the ice pattern from Austin Channel and several days of wind from the north west have increased pressures on the ice. The ridging is interesting to observe. Great "swathes" of ice run every-which-way in ridges which sometimes rise to ten or twelve feet in height. These are composed of various sized blocks and pieces of ice ground from opposing ice edges. The ridges and the small "clean" patches of ice between them are something like the rows of stones which separate the small bare patches of fields in the poorer regions of Scandinavia. The remarkable thing is how many ridges have formed and in how many directions they run.

By noon the ships were beginning to experience difficulties with the pressure, STATEN ISLAND dropped astern in a "squeeze" and we

attempted to free her. This proved our undoing and we got caught between two floes which closed rapidly like the jaws of a vise. Meanwhile, snow decreased the visibility and the temperature dropped to 3 degrees F. MANHATTAN in easier ice conditions about two miles ahead, disappeared from view. Under the circumstances, wintering in the Arctic took on a more likely aspect than here-to-for. The margin between operating successfully or wintering ignobly is getting smaller every day. During the "Dogs" MANHATTAN managed to turn around and swing in from the south to "rescue" us. This was a vain and foolhardy attempt as she stuck solidly herself about three cables on our port quarter.

All operations have ceased and the ships remain "beset" waiting for the pressure to ease.

**Friday, 17 October**                      **N. P.**                      **74-27N 101-12W**

The Captain called on MANHATTAN this morning to discuss the situation in which we find ourselves. The wind is WNW and backing which will eventually ease the pressure in the field. At 1400 MANHATTAN proceeded to break free and STATEN ISLAND followed soon afterwards. The floe in which we were trapped still seemed to have a lot of pressure and every opening we made closed again. Astern the same situation prevailed and we scarcely had water in which to back. Eventually, at 1627, we broke free. All afternoon our luckier friends, MANHATTAN and STATEN ISLAND, hovered around offering veiled advice and consolation which the Captain detests more than the fact that he is stuck. At 2000 we secured for the night and observed a drift of ½ knot to the south east.

**Saturday, 18 October**                      **N. P.**                      **74-41N 100-19W**

The ships got under way at 0900 and the two icebreakers performed their morning chore of unsticking the MANHATTAN. At 1000 Cape Cockburn was visible at 22 miles.

For several days we have been seeing, a mysterious discoloration along the waterline of the ice, as if the underlayer had been dyed with an aniline stain. At about ten thirty I got away in the chopper with Mr. Schwenk, the pilot, to pick up samples which will be sent to the Bedford Institute or Mount Royal University (if it is caused by oil) for analyses.

On our way back to the ship we stopped by MANHATTAN in order to pick up Mr. Guy Blanchard, a British freelance film producer who is on contract to make a film for British Petroleum, one of the consortium for MANHATTAN's journey through the north west passage. The trip from MANHATTAN back to MACDONALD was exciting as we found the ship bearing down on a large polar bear who was loping along at a furious pace, skirting a lead ahead of the ship. We set down a short way off and watched the chase but the bear veered off, and blowing heavily with great clouds of "steam" escaping from his nostrils, he was last seen heading west by south.

**Sunday, 19 October**                      **N. P.**                      **74-50N 98-30W**

MANHATTAN spotted a nice little ice island (dimensions 435' by 223', 14 feet above the waterline and estimated one hundred feet below, angle of slope of the edges 75 degrees) which she used for trials. She made a total of four runs at slow speeds against the ice, coming to rest slightly further "in" each time. The last run was made at 3.1 knots and the bow raised an estimated five feet as she halted. MANHATTAN's distance from us was 10.1 cables. (Speed was measured by Hasting Raydist from STATEN ISLAND who was stationed astern of MANHATTAN.)

On completion of the tests the ships proceeded between Garret and Lowther islands and secured operations south of Lowther for the night.

**Monday, 20 October**                      **N. P.**                      **74-31 N 96-44W**

MACDONALD proceeded at 1000 to rendezvous with ST LAURENT who has been lying off Resolute Bay for about a week awaiting parts for her evaporator pump. The ships met during the afternoon and we received mail which had been accumulating for us at Resolute. The National Film Board team, leader Bernard Gosselin, embarked in ST LAURENT for passage to Resolute where they will get the plane for Montreal tomorrow.

Capt T. Pullen spent the day with us as a break from MANHATTAN.

**Tuesday, 21 October**                      **N. P.**                      **74-23N 97-28W**

The day was spent testing ice and the ships secured at 1740.

**Wednesday, 22 October**            **N.P.**            **74-31N 96-34W**

MANHATTAN spent the forenoon testing ice and in the afternoon at about 1740 MACDONALD went alongside her starboard side and STATEN ISLAND her port side for the night. We took the opportunity to top up the water tanks.

**Thursday, 23 October**            **N. P.**            **74-14N 98-02W**

MACDONALD slipped from MANHATTAN at 0345 and the remainder of the day was spent accompanying her on ice trials.

**Friday, 24 October**            **N. P.**            **74-45N 97-58W**

The ships got underway at 0900 and proceeded to the vicinity of the ice island on which MANHATTAN performed trials on the 19th. On arrival MANHATTAN did one run in slow and then secured the tests. The island is estimated to weigh 250,000 tons and a new assessment of its depth is 100. On the tests on the 19th MANHATTAN's bow rose 6 feet and the island is reported to have "listed" about 4 feet as the MANHATTAN's bow climbed. The island also moved bodily away due to the momentum from the ship.

**Saturday, 25 October**            **N. P.**            **74-53N 98-42A**

Ships got underway at 0920. MACDONALD went alongside MANHATTAN for fuel when the ships secured for the night.

**Sunday, 26 October**            **N.P.**            **74-34N 98-40W**

MANHATTAN'S trials completed officially today. Ships will proceed to Resolute Bay tomorrow and start south on the 28th.

– The End –

## Appendix 1: Ice Nomenclature

*New Ice:* A general term used for recently formed ice which includes frazil ice, grease ice, slush ice, and shuga ice. These types of ice are composed of ice crystals which are only weakly frozen together. They have definite form only while they are afloat.

*Frazil Ice:* Fine spicules or plates of ice suspended in water.

*Grease Ice:* The later stage after frazil ice when crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light giving the surface a matte appearance.

*Slush Ice:* Snow which is saturated and mixed with water on land or on ice surfaces; or as a viscous floating mass in water after a heavy snowfall.

*Shuga Ice:* An accumulation of spongy white ice lumps, a few inches across; formed from grease ice or slush and sometimes from anchor ice rising to the surface,

*Nilas:* A thin elastic crust of ice, easily bending on waves and swell and under pressure thrusting in a pattern of interlocking fingers (finger rafting). Has a matte appearance and may be up to 4 inches thick. Subdivided into dark nilas and light nilas. (Abbreviated N)

*Dark Nilas:* Nilas which is under two inches in thickness and dark in colour.

*Light Nilas:* Nilas which is more than two inches thick and light in colour.

*Ice Rind:* A brittle shiny crust of ice formed on a quiet surface by direct freezing or from grease ice. Thickness about 2 inches. Commonly breaking into rectangular pieces.

*Pancake Ice:* Predominantly circular pieces of ice 9-12 feet in diameter and up to 4 inches thick, with raised rims due to the edges crushing into each other. It may form in a slight swell from grease, slush or shuga ice; or as a result of the breaking of nilas; or, under severe condition from grey ice.

*Young Ice:* Ice in the transition stage between Nilas and first year ice. Young ice is from four to twelve inches thick. It is subdivided into grey ice and grey white ice.

*Grey Ice:* Young ice 4-6 inches thick. Less elastic than nilas and breaks in a swell. Usually rafts under pressure. (Abbreviated G)

*Grey-white Ice:* Young ice 6-12 inches thick. Under pressure more likely to ridge than raft (Abbreviated Gw)

*First Year Ice:* Sea ice of not more than one winter's growth developing from young ice. Thickness from 12 inches to 6 feet or more. Subdivided into thin first year/white ice; medium first year ice; thick first year ice. (Abbreviated Fy)

*Old Ice:* Sea ice which has survived at least one summers melt. Most topographical features are smoother than First Year Ice. Subdivided into Second Year Ice and Multi-year Ice.

*Second Year Ice:* Old ice which has survived one summers melt. It is thicker and less dense than First Year ice and stands higher out of the water. In contrast to Multi-year ice, the one summer melt has produced a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish-blue. (Abbreviated Sy)

*Multi-Year Ice:* Old ice up to nine feet or more in thickness which has survived at least two summers. Hummocks smoother than in second year ice and the ice is almost salt free. Colour in bare spots is usually blue. Melt pattern consists of large interconnecting, irregular puddles and a well-developed drainage system. (Abbreviated My)



REPORT ON THE VOYAGE  
in the  
CANADIAN ARCTIC  
of  
CCGS LOUIS S ST LAURENT  
Spring 1970  
(MANHATTAN'S JOURNEY)

by  
LIEUTENANT COMMANDER E. STOLEE

Queen's Printer for Canada  
Ottawa, 1970



EXTRACTS FROM A JOURNAL KEPT DURING THE  
VOYAGE OF  
CCGS LOUIS S ST LAURENT  
during her  
SPRING JOURNEY  
1970

**Sunday 5 April, 1970                      N.P.                      At Halifax**

The DND observers were instructed to join CCGS Louis S ST LAURENT at 1000. The second observer is Lieutenant [Thomas] Mayno TAYLOR, Ottawa, representing DGFO.<sup>1</sup> He will be with ST LAURENT for the first half of the journey.

ST LAURENT has just come out of refit with all the subsequent difficulties associated with dockyard “mateys”, oily rags and wiring diagrams awry. She spent the last three days at sea qualifying for full power. We are now underway, having sailed at 1500, and will rendezvous with SS MANHATTAN at midnight in position 44-16N 62-40W. With luck we should be mechanically and electrically sound for the ice trials in the vicinity of BYLOT ISLAND which is the object of MANHATTAN’s spring journey.

Our passage lies eastwards of NEWFOUNDLAND, thence to GREENLAND and up the west coast to the “open water” in the latitude of THULE. Here the vessels will cross to the heavy ice of BAFFIN ISLAND in the POND INLET area.

Captain Paul Fournier is in command having taken the ship from Captain Dufour on his retirement. The ship carries a compliment of 107, including press and observers.

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<sup>1</sup> *Editors’ note:* acronym unknown. Lieutenant Taylor, RCN (born 1936), served in HMCS *Stadacona* at the time. “Taylor, Thomas Mayno,” *The Nauticapedia*, <https://www.nauticapedia.ca/dbase/Query/Biolist3.php?&name=Taylor%2C%20Thomas%20Mayno&id=1748&Page=20&input=1>.

Rendezvous with MANHATTAN was made earlier than expected and we proceeded in company throughout the night.

**Monday 6 April, 1970                      N.P.                      45-14N 58-01W**

The Captain “chopped” to MANHATTAN this morning to discuss passage plans, etc. He asked if our Press and TV representatives could visit the ship for interviews and background material. Apparently HUMBLE OIL’s policy is NO at this time which leaves our fourth estate mortified and in a quandary. Wild headlines will flash across Canada tonight.

**Tuesday 7 April, 1970                      N.P.                      48-47N 52-06W**

The helicopter was sent to ST JOHN’S at first light taking N. Chris Heap, General Electric, for spare parts and Mr. E Deslaurier, DOT Press Representative, for phone calls relating to “our problem”. On return course and speed were set to rejoin MANHATTAN who had proceeded ahead. The forenoon was spent flying newsmen around the ships for pictures.

There has been considerable speculation regarding HUMBLE OIL’s Press embargo. At 1430, Mr. Alex Lawrence, Canadian Government representative in MANHATTAN, came to board for a conference. The embargo is temporary as the ship is not ready for visitors to tramp through her labyrinths, neither is the company prepared to make profound policy statements at this time. At 1800, Mr. Stan Haas, project manager for HUMBLE OIL and Captain Smith of MANHATTAN came on board for a quick natter with the press which took the “monkey” off their backs.

**Wednesday 8 April, 1970                      N.P.                      32N 51-21W**

At 0830, a CAF Albatross (304) closed USCGS MORGENTHAU, in our vicinity, on a search and rescue mission to pick up and fly a sick man to GANDER. He is suffering from meningitis. As a result the ship must stay at sea an extra ten days in quarantine. At 1130 MORGENTHAU (Hull 722) closed our starboard side for pictures. She is fitted with twin side by side funnels and looks like a thorough- bred yacht.

This afternoon we toured the engine room, CCGS LOUIS ST LAURENT is the most powerful conventional icebreaker in the western world --- her displacement is 13,000 tons --- her horsepower 27,000 --- LOA 366' --- breadth 30' --- and draught 30'. Her radius of action is given as 16,000 miles but this is under ideal conditions and at reduced power. Maximum speed is 17½ knots. She is fitted with a water jet bow thruster, heeling tanks and a patent FLUME-TYPE passive roll stabilization system. Her propulsion consists of three steam turbines driving nine generators which in turn drive the three electric motors – one per shaft.

**Thursday 9 April, 1970                      N.P.                      59-08N 51-08W**

From Mr. Haas's remarks, (when on board Tuesday,) the purpose of the second MANHATTAN journey is to pin down power requirements for successful ice tankers. Hull formation, bow design, propeller and rudder arrangements, heeling systems, etc., have been established from information derived last year. Power requirements are critical and it is hoped that by steaming MANHATTAN through even thickness, confined ice, as in ECLIPSE SOUND, absolute power values can be acquired and suitable curves plotted for large ships. Distant winds and currents may cause unsuspected pressures in an ice field and power values derived in such ice may reflect these pressures as opposed to pure field states. Pure ice values should be available from ECLIPSE SOUND ice as it is homogenous with no pressure possibilities.

**Friday 10 April, 1970                      N.P.                      66-34N 59-08**

Ice reconnaissance is available to the ships from a DC4 stationed at FROBISHER BAY. DOT contract for these services and the contract, at present, is held by KENT AVIATION. Local reconnaissance flights can be done from the ship with helicopter and DOT ice observers. this year, the elaborate system of laser beam, infrared and sideways looking radar will not be used. Visual observation and ship's radar are adequate for BAFFIN BAY and LANCASTER SOUND ice.

By 0800, we were 70 miles from GODTHAB and 200 miles from the ice edge. We are proceeding through broken ice with occasional icebergs and growlers relieving the even monotony of the scene. The temperature is

dropping steadily and reached 12 degrees by 1600. Our barometer has remained high for this time of year --- 30.04 mb.

At 1900, a CAF Argus circled overhead but no communication was established with her. the ships crossed the ARCTIC CIRCLE at 2230 and reduced speed for the night.

**Saturday 11 April, 1970            N.P.            68-03N 56-25W**

At 0800 MANHATTAN stopped for ice trials in 7/10 First Year ice -- 1/10 Grey White ice -- approx. thickness 2½. The pack appears homogenous with few lines of weak ridging. Winds NW at 28 knots.

At 1400 the vessels got underway and we took station three-quarters of a mile astern, which has been our usual station. The ships secured at 1930.

**Sunday 12 April, 1970            N.P.            68-48N 56-25W**

MANHATTAN landed her ice parties at 0600 and proceeded on trials. At 1000 our helicopter commenced flying the Press to the tanker for familiarization and briefings. Duenna of the Press corps is John Drewery of CBC TV.

It is HUMBLE OIL's opinion that the ice tanker concept is sound, the number of tankers required to move crude from ALASKA to the EASTERN SEABOARD (at a rate equal to the proposed PRUDHOE BAY-VALDES pipeline) lies between thirty and forty. The spread reflects yet unknown factors in the concept. Present statistics for first generation ships are as follows:

LOA	1100 feet
BREADTH	170-190 feet
DRAUGHT	60-80 feet
SHP	100,000 (plus)
	Astern approx. 70%

With a thirty five day turn around, one tanker per day will pass any particular point on the route. The aim is to build a ship which can steam at steady speed through eight foot ice. This will require a ship three times more

powerful than any known icebreaker today and reduces ST LAURENT to a third rate "power".

This evening Captain Fournier, who has not been well, developed serious internal bleeding. The ship got underway to close GODHAVN, on DISCO ISLAND, in order to land him at a hospital. At 2110, MANHATTAN's helicopter took off with the patient and Dr. Hermann but found weather conditions unsuitable for landing. The flight was cold and the Captain's feet were nearly frozen. Tomorrow he will have "purser's" wool socks and mukluk liners to keep him warm.

The ships continued to approach DISCO during the night with MANHATTAN leading the way through the ice in order that ST LAURENT should ride easily in her wake.

**Monday 13 April, 1970            N.P.            69-05N 54-47W**

The helicopter got under way again at 0400 for EGEDESMINDE and landed the Captain at a three hundred bed hospital which serves this section of the coast. It has been decided that an air evacuation will take place in two days --- meanwhile Doctor Hermann will remain ashore with the Captain; MANHATTAN will carry out ice tests along her intended route and we will lie-off awaiting the return of the Doctor and the arrival of Captain Burdoch who is to be flown in to replace Captain Fournier.

**Tuesday 14 April, 1970            N.P.            68-40N 53-35W**

Captain Burdoch and Dr. Moore landed at SANDRE STROM at 1530 and a chartered helicopter took them to EGEDESMINDE, where they arrived at 1830. EGEDESMINDE has a good helicopter pad but no airstrip.

The ship closed to four miles from the settlement whilst waiting for the transfer. The ice in DISCO BUGT is 10/10 with considerable ridging -- several icebergs lay in the Sound like stranded whales upon a beach and some of the rocky islets have huts tucked away in their more sheltered parts. These are probably summer fishing huts or seal-hunter's huts as no smoke is visible from their chimneys.

Some of GREENLAND's shores are spectacular -- like the west coast of DISCO -- but much looks bleak and cold at this time of year. The early VIKINGS who inhabited south and west GREENLAND from 984 to the 15 century used to come north to DISCO from AUSTERBYGD AND VESTERBYGD to hunt. They called the land NORDSETTR and hunted seal, walrus, polar bear and gathered wood along the beaches. The latter was essential and became scarcer and scarcer as successive generations scavenged the region for fuel and building materials.

Captain Burdoch and Doctor Hermann landed on board at 1736 and the ship set course to intercept MANHATTAN in position 70-00N 57-07W. Ice conditions are 1/10 Second Year and 8/10 First Year -- 1/10 Grey White.

**Wednesday 15 April, 1970      N.P.      69-44N 57-03W**

We closed MANHATTAN to three miles at 0650 -- she was stopped awaiting the return of her helicopter which proceeded ashore to land a compassionate case.

At 1130 we proceeded up her starboard side to free her from the ice which had frozen her into a "drydock". Her heeling system had broken her loose from the ice in immediate contact with the ship's side but the breakage wasn't enough to give her room to gather momentum and the ice was too unyielding for her to back down and ram free.

At 1445 the vessels stopped for ice tests. MANHATTAN carries the same scientists as last year from CRRL,<sup>2</sup> etc., and valuable results are being collected on BAFFIN BAY winter ice. At 1530 the ships got underway to commence the power phase of the testing. The vessels secured at 1900.

**Thursday 16 April, 1970      N.P.      70-37N 56-32W**

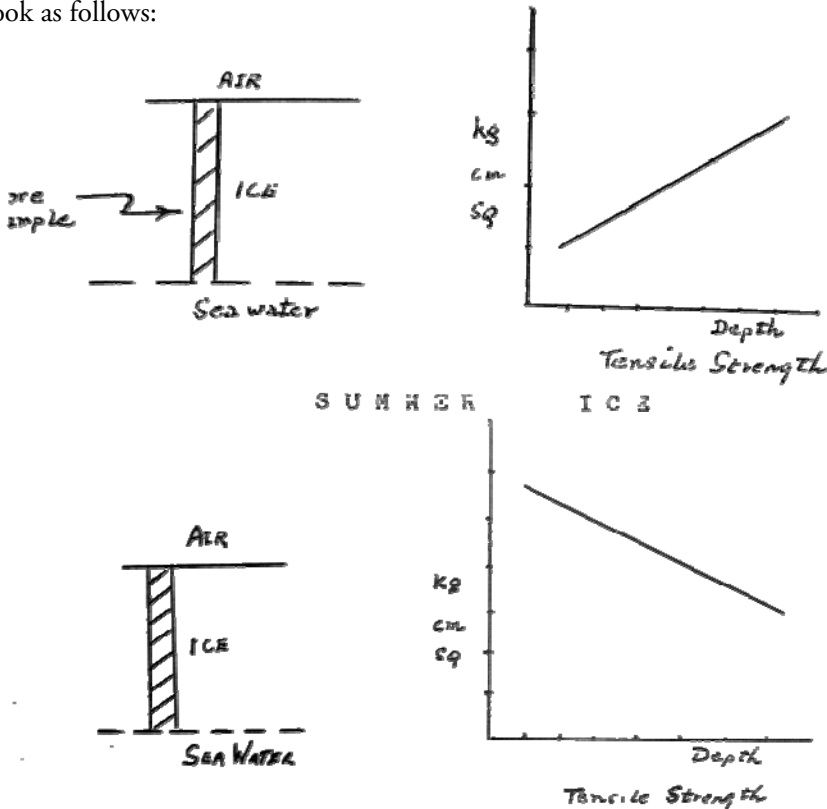
The ships got underway at 0700. The weather has been extremely settled with NW winds and the barometer steady at 30.04 mb. The ice is 10/10: 2/10 Second Year - 7/10 First Year and 1/10 Grey White. This ice behaves

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<sup>2</sup> *Editor's note:* Stolee is presumably referring to the Cold Regions Research and Engineering Laboratory (CRREL), a U.S. Army Corps of Engineers research and development centre located in Hanover, New Hampshire.

differently from the warm ice of summer months. Its tensile strength is averaging 5 kg/cm sq. as opposed to three for VISCOUNT MELVILLE's ice of last September. The readings of tensile strength taken regularly through the thickness of ice are almost straight line when plotted. Unless this is kept in mind, the poor performance of MANHATTAN and ST LAURENT in this ice (21-4 feet) is difficult to understand. Winter ice has its greatest tensile strength at the surface. It is here that the initial breakage must occur when cutting ice and a tremendous amount of power is required to start a fracture. Small angular pieces break jam against the unbroken field. The ship must expend her force grinding these pieces to "slush" before she comes in contact again with the unbroken ice and can re-exert a forward breaking force to start the fracturing process anew. Ice with winter tensile strength has no weak outer skin to initiate a break --- much pressure must be exerted; fracture occurs suddenly and tends to curve bank to its starting point.

A hypothetical piece of VISCOUNT MELVILLE summer ice might look as follows:



The plot shows that the weakness of this ice lies at the surface.

It “rips” apart relatively easily and once this starts the fracture continues, as the initial break allows full pressure to bear at this point, warm summer ice cracks in long meandering lines, gracefully yielding to the force being applied.

**Friday 17 April, 1970**                      **N.P.**                      **70-53N 57-17W**

The ships proceeded at 0756. Captain Burdoch has been on board four days and is at home manoeuvring ST LAURENT up and down MANHATTAN’S side. Iceanship requires vessels to work close and at full power. The vagaries of ice cleavage shift the bow left and right at the whims of chance and constant attention is required. Instantaneous engine response is needed from the three engines to give flexibility in manoeuvring.

Mr. S. Haas, Captain Smith and Mr. Alex Lawrence arrived on board for lunch with the Captain. This was the first contact between Captain Burdoch and the MANHATTAN team. As usual, DOT produced a superb meal à la Cunard and we lingered over coffee until 1430.

At 2030, three polar bear[s], a mother and two cubs, were sighted to port. The mother became aware of the ship (presumably by noise or from tremors in the ice) and stood upright, did a half turn and stared at us for a long while, then went back on all fours and shuffled away with the cubs weaving in and out between her legs. The ice is 10/10 but much of it is dark gray so, presumably, the mother can smash a larger opening than required for a seal to breathe and thus catch food for her young.

**Thursday 18 April, 1970**                      **N.P.**                      **71-00N 57-38W**

One of MANHATTAN’s test requirements is recording ship’s speed at any instant to within tenths of a knot. This is done by a HASTINGS HAYDIST, which is a transmitter similar, in principle, to a DECCA slave.

The RAYDIST can be mounted on the ice ahead of the ship but preferably in another vessel which remains stationary during trials. The equipment will be fitted in ST LAURENT tonight when we fuel.

The ships got under way at 0600 and ice testing parties were flown ahead to set up necessary coring positions and mark out the test area. The ice has



increased in thickness and strength and is 10/10 First Year with approximately 5/10 ridging (from 15-25 feet thick).

An occasional ridge has measured 45 feet thick. The problem of breaking this cold-packed snow is augmented by fine-grained snow which acts as sandpaper and “grits” us to a stop.

At 1725 we secured port-side-to on MANHATTAN and commenced taking bunker and water. The fuel is high grade Bunker C -- a proprietary brand of HUMBLE OIL’s -- almost as good as Bunker A for which our boilers are designed.

At 1850, ST LAURENT’s divers landed on the ice (Mr. Marsden, 2nd Officer; Mr. Adams, 3rd Officer and two seamen) and dove to inspect MANHATTAN’s bottom. Visibility was good -- 75 feet plus -- and all underwater conditions are in excellent condition.

Mr. Haas and Captain Smith were co-hosts at dinner this evening. The sumptuous quarters which, tradition says, were fitted out by Mr. Onassis for a voyage of discovery with Marie Callas (in the days before his second marriage)[,] were used as the dining room. Conveniently locate[d] across the open foyer was the “place d’aisement” designed for the great diva --- this included a bidet. Imagination is a baneful curse!

The cocktail hour preceding dinner was “happy”. Dinner was served by two worried but determined stewards dreading the “unforgiveable sin” of whose personal consequence they were fully aware -- but of whose nature they were not. Dinner was followed by coffee and superb brandy which, as it flowed, gracefully dimmed the lights.

Apparently, the evening ended with a most successful movie called “MANHATTAN’S VOYAGE” followed by raucous, off keyed singing of finer, bawdy songs known to seamen the world over.

**Sunday 19 April, 1970**

**N.P.**

**71-22N 57-53W**

A day of penance: At 0800 two keen technicians called concerning the care and maintenance of the RAYDIST equipment for which I volunteered myself custodian last night. At 1000 the “inquistadors” left, satisfied that they had done their best and unaware of the “broken reed” into whose hands they had committed the electronic monster.

**Monday 20 April, 1970**      **N.P.**      **71-47N 58-25W**

The ships got under way at 0600. Ice conditions 10/10 First Year - 3 to 4 feet thick and ridged 4/10 to 25 feet. Our standard operating procedure 13 stationed alongside MANHATTAN's forward section between 140-300 feet, weaving slowly in and out as ice resistance increases or decreases on either ship.

The ice is cold and shatters like peanut-brittle -- instantaneous cleavage lines appear in great curves between the ships. Resonance within the section snaps it into wedge shaped daggers of ice which are emphasized by the inky black water.

The Press spent the day in MANHATTAN. They have established "rapport" with the ship and a friendship has developed which makes the passage to POND INLET a pleasant adventure.

Fuel embarked on the 19th -- 4256 BBIS of Bunker C and 93 T of fresh water.

**Tuesday 21 April, 1970**      **N.P.**      **72-12N 53-40W**

Both ships are working hard in the ice -- neither would be successful without the other. Together we manage to make slow progress -- eighty-eight miles in the last four days and the rate is decreasing as we progress north. ST LAURENT's high fuel consumption and her inadequate distilling capacity give her limited endurance. She can only operate for a week and a half in heavy ice.

**Wednesday 22 April, 1971**      **N.P.**      **72-23N 58-34W**

The ships got underway at 0600 and at 1000 Lt. Taylor and I proceeded to MANHATTAN to spend the day with Mr. Lawrence. We spent the morning wandering around the ship mentally fitting together the components of the instrumentation which form the basis for her ice experiments. In marked contrast to last year, all compartments were open to us -- presumably HUMBLE OIL consider their lead cannot be challenged.

One of the tests is an experiment by NASA involving the ATS-5 SATELLITE, in stationary orbit over GUADALOUPE. MANHATTAN

was chosen as test vehicle because her intended track is along the boundary of direct line communications with the satellite -- the angular distance above the horizon is 2-3 degrees. Our high latitude introduced variations in geographical contours, meteorological conditions are special and ionospheric propagation is peculiar. All these are good points in an experiment of this nature. The frequencies are L Band -- 1535-1660 MHZ. The plan is to place several satellites in orbit -- the first two equatorially at 5 and 5D degrees West -- which will provide the ATLANTIC with excellent navigational facilities having instantaneous and continuous coverage.

ST LAURENT's flight deck lift was unserviceable and it was impossible to send the helicopter to collect us. When the vessels secured we returned on ice, walking against an easterly wind, over hummocks and ridges and along the flats like noble explorers of old.

**Thursday 23 April, 1970      N.P.      72-37N 58-42W**

Ice conditions continue to be difficult. During one four hour period the ship advanced 1300 yards. Either ship alone is borderline in this ice and together we just manage to advance. Our distance steamed during the past week is 168 miles.

**Friday 24 April, 1970      N.P.      73-13N 60-05W**

At 1330, Mr. Haas came on board for a Press conference. The main reason for holding a Press conference today is to enable Mr. Drewery, et al., to prepare their weekly programmes which are phoned south via MANHATTAN's communication links.

**Saturday 25 April, 1970      N.P.      73-48N 60-09W**

The ships got under way at 0600. We spent the day steaming side-by-side as the crunching of ice between us eases pressure and assists in forward motion. At 11.00 Mr. Lawrence brought six scientists and representatives from BP and ATLANTIC RICHFIELD on board for lunch and a tour of the ship.

**Sunday 26 April, 1970**      **N.P.**      **74-19N 61-40W**

The day ran from 0600 to 2215. Distance run 14 miles.

**Monday 27 April, 1970**      **N.P.**      **74-19N 61-40W**

The ships are within flying distance (MANHATTAN's helicopter) of THULE. It is intended to transfer personnel ashore and bring-off Mr. Nixon, the US president's brother, Mr. Curtis, senior executive of HUMBLE OIL, and Mr. Mojhock, a scientist in charge of the MANHATTAN team. They will stay several days and fly ashore on Friday via POND INLET.

A naval architect from DUD, Mr. Colin Revill, is flying to RESOLUTE today and will join us when a flight is available.

At 2030, ST LAURENT stopped for inspection of the port shaft. A loud report was heard from the area. The diving party found nothing amiss and the likely cause is the packing of the stern tube or the "A" bracket.

The ice conditions are: 6/10 First Year – 4/10 Grey White. Temperature is -2 degrees and has run below zero for quite some time, the sun sets NW and rises NE. Refraction holds it above the horizon except for a brief dip at 0030

**Tuesday 28 April, 1970**      **N.P.**      **74-48N 63-50W**

The ship has been having trouble with domestic water. The taps give out foul brown liquid heavily charged with salts which is unfit to drink and impossible to wash in. This morning we were down to three tons remaining.

The only thing fit to drink is "booze" or coffee which the stewards make from water, fetched by bucket, from the boiler feed tank. It seems funny to be offered a glass of fresh water as a special treat from the bar.

MANHATTAN's helicopter proceeded to THULE this afternoon and returned at 1700 with the VIPs. At 1900 we went alongside, starboard side-to to bring on fuel and water. The ships secured in a "V" with our bows snugged in, our stern out thirty degrees and two lines holding us slack. At 2000, the ice opened off MANHATTAN's port bow and she paid off. The tension grew on our lines, we had to let go, re-flash the boilers and attempt

to come alongside again. Re-flashing takes two hours and before we were re-secured the ships had to proceed eight miles ahead to find an old floe in which to bury MANHATTAN'S nose. The "V" moor was designed for an easy get-away in the morning.

**Wednesday 29 April, 1970      N.P.      05N 65-08W**

We remained alongside MANHATTAN until 1500. Fuel embarked 5930 bbls [barrels of crude oil] - water 249 T.

At noon, Mr. Nixon, Mr. Curtis, Mr. Mojhock, Mr. Haas and Captain Smith arrived for lunch. After the meal Mr. Haas and Captain Smith returned to MANHATTAN to get under low and the rest of the guests did a quick tour of the ship before proceeding to the bridge to watch MANHATTAN. After an initial ice trial during which we remained astern for RAIDIST readings, we came up on her starboard side and watched her bow break ice. Mr. Nixon seemed impressed with the grandeur of the scene around us. This morning he spent three hours walking and snow-mobiling around the ships.

We have turned west and are proceeding through an area where the ice is lighter than it has been for some time. 9/10 First Year and 1/10 Grey White - no pressure. Leads and openings direction we wish to go are occurring more frequently, running in the direction we wish to go. We remained underway all night and covered 53 miles from 1500 to midnight.

**Thursday 30 April, 1970      N.P.      74-58N 71-40W**

We continued to steam parallel to MANHANAN throughout the night, rendering assistance when required. During the forenoon, the Press were flown to MANHATTAN for an interview with Mr. Curtis and Mr. Nixon. They were suitably impressed. Mr. Nixon is a geologist working for SMITH UNIVERSITY. He is up here because of an Interest in marine biology.

**Friday 1 May, 1970      N.P      74-56N 72-25W**

Mr. Nixon and Curtis were to have flown-off via POND INLET today but poor visibility ashore made the plan marginal. At 0720 the ships altered

to close THULE; and steamed north until noon when MANHATTAN's helicopter proceeded ashore (distance 115 miles). Through some communications foul-up the arrival message was not received on board for twenty minutes after her ETA. This caused alarm as twenty minutes was the overdue safety margin. The chopper returned at 1500 with several junior officers and some mail. This is our first mail since we left and is very welcome. The ships remained within range of THULE for tomorrow's flight which will bring off several more junior officers.

**Saturday 2 May, 1970**                      **N.P.**                      **74-59N 72-31W**

The vessels got under way at 0700 and MANHATTAN's helicopter arrived soon after to pick up our mail and Lt. Taylor who is returning to OTTAWA. He should be home in a couple of days.

The ice is heavy today - 10/10 first Year and 60% ridging -- some of the ridges are over thirty feet thick. The vessels spent two hours turning to a course of 240 which will take us to NAVY BOARD CHANNEL. The turn was accomplished by ST LAURENT breaking a large area of ice on MANHATTAN's port bow so that the ice broken by her on that side would have some-where to go and thus ease pressure and bring her head around.

The helicopter returned at 1030 with five junior officers and Mr. Colin Revill, the naval architect, who will spend several weeks on board.

**Sunday 3 May, 1970**                      **N.P.**                      **74-30N 76-20W**

We are within range of THULE radio station and have been listening to appropriate Sabbatical addresses by Catholic, Protestant and Jew. One seldom hears them follow one another in such close order. All the slickness of Madison Avenue reflects in their unctuous voices.

At 0800 we entered a lead of grey ice and increased speed to 12 knots. There are many subtle signs of life in the area -- little "slurp" marks in frazil ice which punctuate a seal's nose as he rises to breathe -- polar bear tracks impressed to leewards of a ridge and lost in open sweeps of ice -- and saddest of all, the blood stains of an ARCTIC feast, a seal reduced to tufts of fur and bits of gut to feed the bear and fox. Three birds flew by this morning -- one with an olive leaf in its beak -- land is near.

This afternoon we came into radar range of land – CAPE SHERARD at 36 miles and CAPE LIVERPOOL at 49 miles. The visibility was poor and at ten miles CAPE SHERARD was not visible.

**Monday 4 May, 1970**                      **N.P.**                      **74-21N 30-47W**

MANHATTAN commenced ice tests and completed them by 1220. We acted as anchor-man for RAYDIST readings.

The day passed without incident 'until 2000 when the bridge messenger rushed down telling me to bring the telescopic lens to the bridge to "take a picture of the biggest bear that the Cap'n done seen for quite a spell". From the bridge we saw a large bear lurching towards us -- nose in air sniffing like a skid-row bum down wind of a brewery. A "belt" of hydrogen sulphide gas from the funnel assailed him and he turned astern for fresher air. From the rear he looked like a baby with "full" diapers waddling down the hall on all fours.

**Tuesday 5, May, 1970**                      **N.P.**                      **73-57N 83-05W**

The ships got underway and at 0830 our helicopter flew Mr. A. Jorgensen, Canadian Press, and our ship's mail to MANHATTAN for a flight to ARCTIC BAY to be picked up by ATLAS AVIATION which is flying a team of GERMAN and MILNE personnel on board for ice testing.

GERMAN and MILNE are the firm that designed ST LAURENT and are, to some extent, traditionalist in their bow design. They probably produce the best all-round bow now in existence. It cuts well in new or old ice, in summer or winter temperatures and in snow cover.

MANHATTAN's helicopter has done several trips today bringing GERMAN and MILNE personnel and equipment on board. The last trip of the day brought Mr. German with 1000 lbs of equipment.

**Wednesday 6 May, 1970**

**N.P.**

**73-15N 81-13W**

The ships were committed to ADMIRALTY INLET at one stage of proceedings because of heavy ice concentrations in the approaches to NAVY BOARD CHANNEL. ADMIRALTY INLET is a compromise and does not give ideal, homogenous, pressure free ice required for MANHATTAN'S tests. Several ice reconnaissance flights have been done and at 0640 we got under way for the entrance to NAVY BOARD CHANNEL to assess more closely, and with the ships, the ice ridging which blocks the entrance.

At 1000, the Captain and Mr. Bourbonnais, senior ice observer, proceeded with Captain Smith of MANHATTAN and team to reconnoiter the ridges. The ships, meanwhile, come to rest in the first of these which extended in a straight-line, east and west, across the entrance, the seaward side of the ride looked as if formed by a snow plow which had scooped out a narrow trench of "water" covered with dark grey ice. MANHATTAN came to rest two-third's her length into the ridge and ST LAURENT, a cable to port, about a half-length in.

The Captain and Mr. Bourbonnais returned on board at 1330. The ridges run for miles east and west and repeat themselves, in sequence, to the south well into NAVY BOARD CHANNEL. Our advance, in these conditions, would be measured in feet per hour and once into the pattern there would be no turning possible for MANHATTAN. It has been decided to proceed to the south east entrance of ECLIPSE SOUND and attempt entry there. At 1340 course was set for POND INLET.

The "Dogs" proved a difficult watch for the engineers. The ice is fragmented into 300-400 foot floes which slew in the open leads and block the ship by squeezing her against the unbroken edges; or they absorb the ship's momentum as they raft over the edges of the leads. The ship has taken many hard knocks and power failed twice. In addition, she halted because of plugged intakes.

The ships secured at 2100.

**Thursday 7 May, 1970**

**N.P.**

**73-56N 78-33W**

The ships got underway at 0400 and at 0600 ST LAURENT suffered another power failure which lasted an hour. At 0700, Bridge Control once more has four boilers, three turbines, and seven of the nine generators on



line. Ice conditions remain difficult with much ridging and great pressure in the field. The wind is from ENE at 18 knots distance to POND INLET is 140 miles.

We have been catching glimpses of CAPE FRANSHAWE all day. At our present rate of progress we will be seeing it for a long time.

The ice, last night, pressed heavily on the beam. In MANHATTAN the effects were interesting – for over an hour she was forced to starboard at approximately 20 feet per minute and the ice eventually mounted over the ice belt and on to the deck – A height of 17 feet. Previous to stopping last night, her track which measures 152 feet in width closed, in less than ten minutes, to a width of zero feet and the debris ice, normally seen in her wake, was forced under and the unbroken edges came together with hardly a scar to mark her passing.

**Friday 8 May, 1970**

**N.P.**

**73-41N 76-59W**

The ships proceeded all night in a ceaseless, full powered battle through tough ice. By morning we had advanced 8 miles. The ice is 8/10 First Year and 2/10 Second Year – under pressure and heavily ridged. It is also snow covered which increases friction and slows our progress. The critical factor, however, is pressure. One can see blocks of ice shifting and grinding together as the larger floes bear heavily against each other.

At 0900, Mr. Bradford and I went up in the helicopter – he to record pressure patterns from the appearance of our wake and I to take photographs. At 1100 CAPE [FRANSHAWE] bore SW at 11 miles.

Mr. V.L Jones, our chief steward, is ill with an infection of some sort, as is Mr. Godyer, the purser. Mr. Jones' condition was not good this morning. He is not responding to treatment. ATLAS AVIATION arrives at POND INLET this afternoon with Admiral Storrs and Captain Pullen and the Doctor has arranged to evacuate the patient. This will be done with MANHATTAN's helicopter as [ours] cannot take a stretcher.

At 1445, Admiral A.H.G. Storrs, RCN (ret'd) and Captain T.C Pullen, RCN (ret'd) joined the ship from POND INLET. The returning helicopter's crew reported many open leads ahead. If we can reach them the possibility exists of arriving at POND INLET in a day or so.

The afternoon and evening was spend assisting MANHATTAN and at 2200 we entered the first of an extensive network of leads running southerly in the direction we wish to go. The midnight to midnight run was 58 miles.

**Saturday 9 May, 1970**                      **N.P.**                      **72-52N 75-35W**

The ships steamed all night in easy ice and open leads -- 6/10 First Year and 3/10 new ice -- wind SW at 25 knots. At 0900 we stopped six cables astern of MANHATTAN as she entered shore-fast ice ten miles off the entrance to POND INLET. The winds veered westerly and increased to Force 7, fine-powered snow blew along the surface of the ice building new banks and drifts between old ridges and "valleys". The open water steamed and sea smoke flew like ribbons of cotton down wind. In the distance the mountains of BYLOT hunched under the snow waiting a warmer day.

At noon Mr. Haas, Captain Smith and Mr. Lawrence came on board for lunch. Guests of honour were Admiral Storrs and Captain Pullen.

MANHATTAN prepared for ice tests during the early afternoon. On completion we went alongside to fuel and bring on water. Divers inspected the under-water fittings of both ships.

Our chief steward, who was evacuated on the eighth died whilst on flight from CAPE DORSET to FROBISHER BAY. This comes as a shock and, as the purser's symptoms are similar, it has been decided to evacuate him also. MANHATTAN's helicopter took him to POND INLET with Doctor Hermann in attendance. Human nature being what it is, many on board are now experiencing twinges of disease, however, as Mr. Jones' and Mr. Godyer's symptoms are obscure and the malady unknown, the type of "twinge" is left to the imagination of the suffer.

**Sunday 10 May, 1970**                      **N.P.**                      **72-48N 75-49W**

We are in a "monolithic" confined sheet of ice. 10/10 land-fast, First Year and covered with two to four inches of snow. The ice is uniformly four feet thick.

At 0930, fueling was completed -- B184 BB1s and ice parties landed. Mr. German's team (for which I volunteered) proceeded two miles ahead of

the ship to drill and measure thickness. A test area was marked out for our subsequent trials.

Three Eskimo Skidoo teams arrived late last night. Their leader was the local school principal. They came forty miles across the ice, running down wind in a thirty knot blow with the “at home” attitude we have crossing a street. We offered them shelter for the night and thought we saved them from a fateful encounter with the elements. This morning, in less than an hour, they constructed an igloo, nine feet in diameter and five feet high. I went inside and found it like the interior dome of a quiet country church – the light was translucent blue and all was hush and still. The party would have spent a more comfortable night here but a night on board is more exciting.

Ice trials commenced at 1345 with full power (27,000 SHP) on the line.

The Press representatives are leaving tomorrow for POND INLET and thence via ATLAS AVIATION for RESOLUTE to catch the scheduled NORDAIR flight to MONTREAL. At 2000 a farewell party was held in the Officer’s Lounge to which Mr. Haas, Captain Smith, Captain Graham and Mr. Lawrence were invited.

**Monday 11 May, 1970                      N.P.                      72-46N 76-20W**

The ships got under way at 0830 and at 0910 Admiral Storrs and the Press party proceeded ashore in two helicopter lifts provided by MANHATTAN’s helicopter.

The day was spent testing ice. As we proceed westward into POND INLET the ice thickens at a rate of an inch per mile. This gives ideal conditions in which to test as resistance is a logarithmic function and an inch increase in thickness increases power requirements considerably.

By 1600 MANHATTAN completed her trials releasing for ours. At 1840, we were stuck fast in the ice, having ridden up so too far. Without our heeling tanks, hours are sometimes required to break free. This is done by going full speed ahead and astern and using combinations of these as the rudder is put back and forth to “rock” her free.

**Tuesday 12 May, 1970**      **N.P.**      **72-47N 76-30W**

The ships got under way at 0300 and proceeded slowly westward into heavier ice. A pronounced pressure area lies ahead in the narrows. This consists of one half mile of ridged and hummocky ice in which are imbedded second year and occasional multi-year floes of ice. Silhouetted in the low sun, the region looks like the “land God gave to Cain”, to quote an old French description of Quebec’s hinterland seen from the St Lawrence River.

At 1000 we developed engine trouble and didn’t regain power until 1100.

In the afternoon, Doug Bradford, Colin Revill and I went for a tour of MANHATTAN. Mr. Lawrence was our patient guide and host. We managed to get into the bowels of the bow just before a ten knot charge into heavy ice. The noise and vibration was indescribable. Crescendoes of sound rose and fell and weird harmonies amplified each other into death cries of anguished monsters. When the charge halted eerie silence reigned in the vast, cold tomb where seconds previously a host of VALKERIE [*sic*: Valkyrie] shrieked their GOTTERDAMNERUNG [*sic*: Götterdämmerung, the last in Richard Wagner’s Der Ring des Nibelungen musical dramas]. It is a chill and wretched place.

**Wednesday 13 May, 1970**      **N.P.**      **72-47N 76-36W**

The day was spent assisting MANHATTAN through ridged ice which blocks the narrows. The vessel was operating her limits; bucking and smashing and pounding all day with 13,000 tons and 27,000 horsepower. The advance for each charge was measured in feet and by 2300 we were through the worst of it.

**Thursday 14 May, 1970**      **N.P.**      **72-47N 76-53W**

The ice we are in, to the west of the narrows, is First Year and varies in thickness from 5’11” to 6’. Although it contains some ancient floes it fills the requirements for MANHATTAN’s programme. The RAYDIST is still mounted on our bow and precludes us from proceeding independently on our own test programme. Mr. German has arranged Mr. Haas to land the

outfit on the ice, leave it switched on (it will run three days on its batteries) while we proceed east of the narrows to do our “thing”.

**Friday 15 May, 1970**                      **N.P.**                      **72-48N 76-42W**

We proceeded east to an area of six foot ice and spent the morning drilling cores and measuring thicknesses. The HYDRODIST, with which we measure distance during tests, was placed ahead of the ship, two and a half miles, and at 1200 we commenced power and bollard trials. Trim was altered by pumping seawater into the forepeak. This is done to change the water plane shape of the shin and to add weight where it is needed when cutting ice. We secured at 2100.

**Saturday 16 May, 1970**                      **N.P.**                      **72-48N 76-41W**

The ship continued ice trials during the forenoon, alternating between full power and the “hung-up” position. At 1300 the ship was retrimmed and the last of the bollard trials carried out. On completion, course was shaped to rejoin MANHATTAN, lying six miles to the west of us. Proceeding along a previously cut channel is difficult as the broken ice refreezes into awkward masses which break along weaknesses and not stress lines set-up by the bow. The bow ricochets from side to side and the ship gets caught as large pieces slew across the “channel”. We hit one large floe (200 by 150 feet) of old ice which would not break and the ship over-rode it 100 feet, sinking its burdened edge 30 feet below the surface. When we went astern it cleared and surfaced with a tremendous mass of water welling from the deep. A second charge failed to break it and the ship backed and filled for an hour trying to come to grips with it.

At secure, several Skidoos and a dog team came alongside. Alas! heroic sleds and teams of yore do not exist. The sled was of unfinished lumber constructed with the finesse of a cement boat. Harness and traces were a patched-up mess in the best “bailing wire – prairie farmer” technique and the dogs looked mangy and awkward – as if suffering from rickets and piles. Instead of yelling “Gee” or “Haw” or some such stirring expression to guide the team, the Eskimo owner hops off the sled, rushes forward and attempts to kick the lead dog in the slats on the side to which it should have veered. He then plunges headlong for the sled before the dogs can run away or eat him. Tomorrow is a day of rest and MANHATTAN has flagged a race

course off her port side on which eight teams will compete for the POND INLET STAKES.

**Sunday 17 May, 1970**                      **N.P.**                      **72-47N 76-53W**

Steam was raised and we proceeded alongside MANHATTAN at 0830 to bunker and bring on fresh water. Theoretically we produce 75 T per day, and so say the Designers, Builders and Shore-Bond-Cavants [sic], but the ship has never produced that amount. We are on rations. Water is turned on from 0600 to 1300 and from 1600 to 1900 each day. Replenishment from MANHATTAN is essential for our continued operations in these waters. It is incredible that the ship cannot operate for more than a week and a half in ice without a resupply of fuel and water. Officially she can last a whole ARCTIC summer (the Replenishment Run) because she then steams at one third power and spends most of her time at anchor waiting off-loading. These “nitty gritty” little PR tales told by Departments to save face, are not only done by DOT. No rationalization will make LOUIS S ST LAURENT an effective ARCTIC icebreaker with her limited range and endurance.

During the afternoon, a dozen leaders of the community came out from POND INLET -- included were RC and Anglican clergy. The smell of mothballs and creases in suit and dress showed the occasion merited their sartorial best. Divine services were held in adjoining rooms and the singing made a “wee” sound until the audience tuned their voices to the ecclesiastical key. The “padre” was High Church from the Midlands and prayers contained fulsome solicitation from Her Majesty and “all the Royal Family”. The MANHATTANITES, who considered this appropriate only for the President, shuffled their feet in anguish.

By 1850, fueling was complete – 8514 bbls [barrels of crude oil]. The dog races were cancelled because of poor visibility.

**Monday 18 May, 1970**                      **N.P.**                      **72-47N 75-55W**

At 0600 we completed bringing on water – 293 L – and cleared MANHATTAN. Ice trials in the land fast ice of ECLIPSE SOUND have been completed. Trials will, continue at specified thickness and conditions as the ships retire to the east. The HAYDUST was disembarked and established on the line to the east of MANHATTAN and we proceeded on separate trials.

Before clearing the area it was necessary to assist MANHATTAN in her turn to rejoin her inbound track. Ice had to be broken in an area almost the size of BEDFORD BASIN to affect the alteration.

At 1200, a group of Eskimo school children arrived at the edge of our track and were brought on board by MANHATTAN's helicopter for a tour of the ship. They ranged in age from 8 to 14 with a few older girls to keep the little tykes in line. They are inseparable little people with a mysterious charm. When they smiled their faces shine like sun through a rain cloud. After lunch, games, tour of the ship, movies, and a gooey snack of ice-cream, cake, soft drinks and candy they were landed back on the ice to commence the twenty mile journey home.

MANHATTAN commenced ice trials along her inbound track which is frozen over but "open" as no pressure has distorted its sinuous route. At 2100, ships secured for the night.

**Tuesday 19 May, 1970                      N.P.                      72-46N 76-19W**

The day was spent setting up an ice test range and doing power runs. The range was two and a half miles long with the HYDHODIST at the outboard end. Ice samples and thicknesses were taken at half mile intervals and the locations marked with flags. Average thickness 14' 2".

During the forenoon we saw tracks of a polar bear leading up from the south -- staggering and clumsy - footed like a child in "sleepers" -- wending a crooked path between hummocks and ridges end stopping at seal holes to sniff for fresh food. One hole obviously sniffed right for he had clawed the ice to enlarge it. Further north a "bloody" aside showed where a seal was dragged, a crimson stain to mark an "oursine" dinner. Standing alone on the ice causes one to ponder the adage, "DOG eats DOG". We held target practice on an ice core and fired our rounds with excellent results.

On returning to the ships, by helicopter, we did a divisionary run over BYLOT ISLAND to see if we could find the bear. At the foot of the cliffs of the southern mountains we hovered briefly, then the pilot leaned the chopper into the strong up-draft and away we went, as if hoisted by the hand of the Lord, soaring to the mountain tops. As we shot up the cliff seemingly feet from disaster, a snowy white owl interrupted his noon day sleep, spread his wings and soared away below us blinking his eyes and

calling "WHO? WHO?" We scudded across the mountain top, caught the down draft and left stomach and eyeballs high aloft as we plummeted down the lea side. It was the roost marvelous ride imaginable.

We returned on board for ice trials which witnessed from the crow's nest. The ship made charge after charge against the confined white ice which yielded grudging yards to the twelve knot blows.

**Wednesday 20 May, 1970      N.P.      72-45N 76-07W**

The ships remained stationary during the forenoon awaiting the arrival of the ATLAS AVIATION OTTER (WWP) which has been chartered by Mr. German to fly out his trials team. She arrived at 1100 and landed on the snow covered ice to port of the ship. She was fitted with ski/wheel landing gear required a short landing run. Ten passengers plus their gear were loaded and the aircraft departed at 1145.

**Thursday 21 May, 1970      N.P.      72-45N 75-44W**

The ships got under way at 0830 and proceeded east to carry on with MANHATTAN's programme. At 1730 we closed her to assist with a turn to the north-east and at 2230 we secured for a twenty four hour maintenance period.

The trials are nearly over and the tension is easing. People are beginning to think of home and speculate on the arrival date -- probably in a couple weeks.

**Friday 22 May, 1970      N.P.      72-53N 75-34W**

It appears that the Minister of Northern Affairs, the Honourable Mr. J. Chretien wishes to visit the ships on Saturday and Sunday. For chauvinistic reasons, best known to parliamentarians, it has been decreed that the "royal entourage" will transfer in our short range helicopters. This ties us immobilized for three days, as our choppers are restricted to twenty miles over ice. One wonders why the visit could not have done when the ships were working at POND INLET. It is annoying to be diddled by politicians.



Captain Smith of MANHATTAN and Mr. Haas came on board to commiserate this morning and offered to do anything in their power to help. This afternoon the Captain called Admiral Storrs on MANHATTAN's phone. Our choppers, it is to be. We are now back-tracking to POND INLET to close the range to twenty miles. MANHATTAN will remain where she is.

**Saturday 23 May, 1970**      **N.P.**      **72-47N 76-57W**

At 0400 we stopped at our previous furthest west -- twenty miles from POND INLET. Ice is 10/10 landlocked -- six feet thick. During the forenoon MANHATTAN's chopper brought us our mail.

The day was spent in idleness -- around noon a speck detached from BYLOT's shores and proved to be a dog team. The Eskimo sat a cross-wise on his sled, feet sticking straight out and his back to the ship, ashamed of his "image". The dogs argued about canine matters and the correct road home. They wandered back and forth across the wind swept trail, stopping to scratch fleas and swearing when run down by the slow moving sled. Several hour later they were still sight, bickering in the west and the Eskimo sat silhouetted against the sun, discouraged with his progress.

At 2000 the ministerial party started to arrive -- two by two -- as was the exbarkation of Noah's passengers. His was the gangway check-list problems; ours -- the little helicopters. The party consisted of thirteen members with baggage and in our little two seaters the exbarkation went on until late. Drinks were held in the Captain's cabin and a late Buffet Supper spread in the Senior Dining Rooms.

**Sunday 24 May, 1970**      **N.P.**      **72-47N 76-30W**

Power was available on the Bridge Control at 0800 for an ice breaking demonstration. The Minister and several of his party expressed keen interest -- some remained in bed to rest.

At 1030 the Captain proceeded to MANHATTAN with the party. From all reports the visit was a success. On return one of the helicopters (CCA) force-landed because of oil pressure failure. The passengers, Mr. Fournier and Mr. Lake, of Canadian Press, were flown back to the ship by the other

chopper. MANHATTAN's helicopter was graciously put at disposal to fly the party ashore.

The ship proceeded to the vicinity of the downed helicopter and recovered it with the 45 T crane – and then rejoined MANHATTAN.

**Monday 25 May, 1970**                      **N.P.**                      **72-53N 75-22W**

The ships are experiencing heavy pressure. Most of the night was spent attempting to turn MANHATTAN. The lack of communications between the two ships as to intentions led, on this occasion, to a most ludicrous situation. We thought she was doing turning trials and kept to her port bow to help her around and she, wishing to turn, tried desperately to steady every time we swung her past her intended course. Our Captain was at a loss to explain her behavior and she must have thought us bereft of sense. The base course of 330 was achieved at 1055.

Ridging is extensive and our headway measured in feet. At 1620 we secured having found conditions impossible.

**Tuesday 26 May, 1970**                      **N.P.**                      **72-54N 75-14W**

Ice conditions are bad-8/10 First Year -1/10 Grey White Snow cover about twenty inches - heavy ridging and pressure.

We commenced battling ice at 0600 and by 1125 came to a halt sixty feet from MANHATTAN's beam waiting for the pressure to ease. Conditions were absolutely impossible with pressure grinding the floes together in ever increasing ridges of riven, splintered ice.

At 1400, the ice to starboard between the two ships split and forced us down on her. The Captain requested her to go full speed ahead as we attempted to back clear. To no avail! At 1425, we were forced on her, such that the starboard side was creased for 56 yards, fracturing five frames and buckling six. The ice which had been between two ships was forced under our bow and trimmed us ten and a half feet by the stern. We also listed two degrees to port.

The large floe on our side continues to press and the two ships, in turn, act as a focal point and press against the floe on MANHATTAN's starboard

side. Our floe has crunched and pulverized against us and raised a ridge ten feet high along our side.

**Wednesday 27 May, 1970**      **N.P.**      **72-54N 75-1W**

We are still tightly forced against MANHATTAN. The sharp turn of her upper ice belt is like a serrated blade ready to slice us open if we go ahead or astern. The Captain says it will be necessary to wait for the pressure to ease in order to get baulk timber between the two ships before attempting to clear.

At 1340, ST LAURENT gave three sharp jerks (as if a four inch shell was fired). This movement was repeated about 2000. We are either settling down or up. The pressure is still going on and ridging extends a great distance from the ships. Draughts are 23'6" forwards and 33'0 aft.

At 2200 we completed taking water from MANHATTAN in order to trim tanks and heel the ship.

**Thursday 28 May, 1970**      **N.P.**      **75-54N 75-15W**

Pressure continues and patience wears thin! Everybody is in an owly mood.

This afternoon Mr. Bradford and I went out on to the ice and wandered through the ridges. They looked impressive from this vantage point. Three patches of open water exist to starboard of MANHATTAN in which four CANADA King Eider swim and flirt. One male was not well and allowed us to approach without trying to escape. He eventually flapped his way on to the ice and resignedly composed himself for death. His trouble seemed digestive and his body reposes in the deep-freeze, preserved for an autopsy when we get home.

**Friday 29 May, 1970**      **N.P.**      **72-54N 75-11W**

We are still caught in the ice. The bow paid-off ½ degree to starboard and settled six inches this morning so something is going to give, eventually.

We have transferred fuel and fresh water to port and have heeled the ship to 7 ½ degrees in order to present a flatter side to MANHATTAN's ice belt.

At 2125 Mr. Black and Mr. Wilson, helicopter pilot and engineer, proceeded to CAPE GRAHAM MOORE via MANHATTAN's helicopter to catch the ATLAS AVIATION flight to RESOLUTE BAY. We received mail.

**Saturday 30 May, 1970**                      **N.P.**                      **72-54N 75-07W**

The pressure has eased but the ships are still together. We flashed up and at 1430 MANHATTAN proceeded ahead and astern and "darned" near ripped open our side -- screeching metal and smoke rising from the working surfaces. We attempted to open a gap between the two ships and place baulks of timber but to no avail.

We have challenged MANHATTAN to a game of Broomball on the ice set for 1800-2000. The idea came from two junior officers, Fred Guse and Bill Corkum who spent the day mutilating brooms, building a "ball" and marking the ice. By 1800 hordes of players and spectators materialized on the floe and the game began. At first it was chaos -- to relieve each other without checking whether MANHATTANITE or Coast Guard. At one time there were twenty two players on the field -- later, to the consternation of the Yanks, the Canucks had relieved everybody. Order was restored by bull-horn and blasphemy and the game settled down to six-a-side. It was glorious smashing into six Yanks and they took delight in slowing six Canadians. Every one received wounds and gave back double in the most rewarding two hours of the week. By 2000 there were no brooms left and we claimed victory 2-0. On board, fresh water was left on for showers, in honour of the occasion.

**Sunday 31 May, 1970**                      **N.P.**                      **72-54N 75-03W**

The ships attempted to separate again this morning but gave up at 0930. We could get free but will rip our side open -- a risk the Captain will not take.

At 1015 we commenced drilling holes in the ice along the port quarter to free a wedge which prevents our stern from breaking free. Ice parties from

both ships worked until 1700, accomplishing little but boosting morale a great deal. At 1700, MANHATTAN's Chef Engineer, with Yankee ingenuity, rigged closed circuit steam hoses which, flaked in a bight on the ice, ate through it like a hot knife through butter. The ice on the quarter is now sectioned and should part easily in the morning. Deo Volonte!

**Monday 1 June, 1970**                      **N.P.**                      **72-51N 75-03W**

We commenced manoeuvring at 0800 -- as we backed and filled to clear MANHATTAN, 12 by 12 baulks of timber splintered like matchsticks or reared on -- end smashing their secured lines and falling between the vessels. At 0900 (watched by 200 men with hearts in throats) we were clear and stopped a few yards astern. The ice was so heavy that it took until 1130 to clear MANHATTAN. In the next three hours we advanced one ship's length. By 1600 the ice improved -- 8/10 First Year -- 1.10 Grey White -- heavy ridging with snow cover. The 1/10 open water and the lack of pressure spelled success and the night was spent making steady progress to the east.

**Tuesday 2 June, 1970**                      **N.P.**                      **72-48N 71-00W**

The ice is getting better; 7/10 First Year - 2/10 Grey White. We are staying in open leads most of the time and there is "water sky" around us.

**Wednesday 3 June, 1970**                      **N.P.**                      **72-38 62-47W**

Base course was altered to 120. Ice conditions are 6/10 First Year and 1/13 Grey White. Icebergs are numerous.

**Thursday 4 June, 1970**                      **N.P.**                      **71-18N 57-16W**

Ice conditions are 5/10 First Year -- 3/10 Grey White with some ridges and icebergs.

KAP CRANSTOWN bore 091 at 48 miles this morning at 1000. We are truly across the Bay and home lies "down hill all the way".

At 1600, visibility decreased in snow flurries and the vessels secured until it improved. It is difficult to see the open leads and icebergs and neither ship is in fit state for much more ice-bashing. MANHATTAN has several openings in her stern and is ballasted high which reduces her potential and we are plagued with mechanical difficulties.

**Friday 5 June, 1970**

**N.P.**

**70-34N 56-46W**

This evening Captain Burdoch invited Mr. Haas, Captain Smith, Captain Graham, Chief Engineer Bennet and Mr. Lawrence for farewell drinks. We presented plaques which the Doctor and I made during the voyage and the MANHATTANITES presented illuminated certificates. There was a feeling of "an elite band" in the air when we said goodbye.

**Saturday 6 June, 1970**

**N.P.**

**66-30N 55-14W**

At 0800 we had cleared the ice and saw it drop astern a thin white line across the north west horizon. Several more hours of patchy ice took us to clear water. Course was then altered for ST JOHN'S, NFLD, where we intend embarking FLUME TANK experts for trials enroute to HALIFAX. MANHATTAN continued on her course, gradually fading from the scene, leaving naught but seagulls and ourselves in the grey green sea.

The Captain received the following from MANHATTAN which is a fitting summary of the cruise:

Captain GEORGE S BURDOCH

Master CCGS Louis S St Laurent

At this point of our voyage where we shall be proceeding independently, let me express on behalf of HUMBLE and those of us onboard SS MANHATTAN our deep appreciation for the assistance you have provided, without which this test voyage would not have been possible. You will be interested to know that the quantity and quality of the test data we have exceeds our expectations and will permit, we believe, design and construction of safe and adequate vessels for year around trading in ARCTIC

regions. If this objective can be realized then our two ships and the personnel who manned them will have contributed to the future growth of development and well-being of our respective countries and indeed, of the world. Let me express again our appreciation and our kindest regards to you and your officers and men and to LOUIS S ST LAURENT. We trust and hope that our paths may cross again,

Signed Stanley B. Haas  
Project Manager

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# In *Manhattan's* Wake

Fifty years ago, the American icebreaking supertanker *Manhattan* tested the waters of Canada's Northwest Passage. During its epic 1969 transit, *Manhattan's* task was to determine the feasibility of shipping oil from newly-discovered fields of the North Slope of Alaska to North America's Eastern Seaboard. In so doing, the massive vessel raised pivotal questions about safe navigation, sovereignty, and environmental protection, prompting new discussions about Arctic political and economic development.

Often told from the vantage point of the politicians and diplomats involved, the *Manhattan's* story was also one of an integrated Canadian-American expedition dedicated to cooperative exploration and innovation. This volume publishes the reports of Lieutenant Commander Erling Stolee, the Royal Canadian Navy's observer aboard *Manhattan's* two Canadian Coast Guard icebreaker escorts – *CCGS John A. Macdonald* and *Louis St. Laurent* – which offer detailed, first-hand accounts of Canadian contributions to the test voyages.

"Arctic ice along the route intended for *MANHATTAN's* voyage had not previously been described and identified sufficiently for her purpose. The problems of a tanker in an ice environment were unknowns in 1968 and as the ice and the ship intimately affect each other, Humble Oil's problem was analogous to that of a doctor prescribing medicine for a disease that has neither name nor patients. The world's foremost ice authorities were brought together and a major part of the *MANHATTAN* effort was devoted to the problem of defining ice."

Lieutenant Commander E.B. Stolee, RCN (1970)



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