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The Passage of the Manhattan: An Example of Military Spinoff

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There have been many cases in which civilian commercial endeavors have been aided by technology previously acquired by the military for a related purpose. One outstanding example of this was the utilization of the experience of the Navy and Coast Guard in the design and planning for the passage of the icebreaker-tanker "Manhattan" from the eastern coast of the United States to Prudhoe Bay, Alaska. By the late 1970's a fleet of such tankers may operate regularly in the Northwest Passage, carrying domestic petroleum to the industrial Northeast.

THE PASSAGE OF THE MANHATTAN
AN EXAMPLE OF MILITARY SPINOFF

An article

by

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High on the North American Continent lie rich deposits of natural resources. Although the area has long been known to contain substantial mineral wealth, the difficulty of traveling in the Arctic environment has delayed the discovery and exploitation of these resources. New strikes of oil in a massive petroleum formation on Alaska's North Slope in 1968, however, have reopened the question of economic sea transportation in Arctic waters. The day is at hand when the ice-choked waters of the North American Arctic may be developed into commercial shipping lanes.

The fabled "Northwest Passage" was not successfully transited by any vessel until Roald Amundsen made the passage in 1905-06 in the 57-foot sloop *Gjoa*. During the late 1940's and early 1950's, various routes through the Canadian Archipelago were cautiously transited by exploring icebreakers and scientific parties. When the Canadian icebreaker *Labrador* led a four-ship United States/Canadian convoy through Bellot Strait in August 1957, there was no longer any question that a deep-water shipping route for oceangoing vessels was available.

Whether or not the route is commercially practical, however, is an entirely different consideration. What is feasible for a specially equipped icebreaker may not be feasible for a money making freighter with a tight time schedule. The daily operations of a commercial vessel result in steady overhead costs, and the loss of a few days in shifting ice or the cost of an accompanying icebreaker can make the difference between profit and loss. Taken together with the requirements for special ice-strengthened hulls and higher insurance rates, it is no wonder that commercial shippers have been reluctant to allow their ships to transit the shorter but more treacherous Arctic waters in search of quicker transoceanic routes. The difficulty and dangers of operating in the ice, together with the lack of a compelling commercial incentive, have combined to leave the Northwest Passage and the ice-choked straits of northern Canada virtually untraveled, save for occasional research vessels and summer high-latitude military resupply missions.

Post-World War II years, however, saw a number of discoveries of natural resources in the American and Canadian Arctic regions that pointed toward new Arctic development. Uranium on the shores of the Great Bear Lake and iron in the wilds of Arctic Labrador were among the first mineral deposits to be exploited. Nickel, asbestos, and forest products from the northern stretches of Canada have also been developed. Other valuable deposits have been discovered and then forgotten, the victims of cheaper and more accessible deposits of commercial quality in southerly areas.

In the past 2 years, however, so many more discoveries have been made that the economic facts of life in the Arctic regions may change. The big boom at hand now is oil. Spectacular strikes of high-grade oil near the Arctic coast of Alaska in 1968 have driven the price of "worthless" tundra sky high. The Prudhoe Bay State No. 1 strike and Sag River State No. 1 strike 7 miles away have made it clear that a major field has been discovered.[1] Estimates of the new reserves run from 5 billion to 40 billion barrels, a pool of black gold possibly larger than all heretofore known oil reserves in the United States.

In September of 1969 the State of Alaska auctioned off oil leases on the North Slope for over $900 million, a clear indication of the wealth beneath the permafrost. With that much oil at stake and a relatively easy-to-load cargo at hand, Arctic shipping suddenly had both the market and the money to justify a new look at the Northwest Passage. Atomic icebreakers, 250,000-ton tankers, and navigational assistance from orbiting satellites all became commercially attractive with oil money to back them. Feasibility studies quickly became the order of the day.

Because of the Navy's unique fund of knowledge dating from the last century and the accumulated ice expertise of the U.S. Coast Guard, these agencies quickly became the focus of thoughtful questions from potential shippers considering the use of the Arctic seas. MSTS, as the only American "merchant shipping line" to have had significant ice experience since American whalers went out of business, also was queried.

The bank of knowledge thus sought for commercial exploitation was vast, but scattered. In some cases, such as the Navy's in-house icebreaking expertise, the knowledge was also dissipating, as the icebreaker-trained officers from the Navy icebreakers were shifted into non-Arctic jobs. Written information such as operational reports and research data were available, but they required collating and careful analysis.

Collecting and analyzing the information was not easy, even though ships of all sizes and descriptions have plied the passages of North America's Arctic archipelago. What was available was of great interest, however. The Navy built three ice-strengthened cargo ships in 1956—the *Mirfak*, the *Eltanin*, and the *Mizar*. The Arctic records of these ships, two of which are now in research work, were available for the naval architects to examine. Similarly, the Navy has had ice-strengthened tankers in use in both the Arctic and the Antarctic—including the *Alatna* (T-AOG-81) and the *Chattahoochee* (T-AOG-82). Although these latter vessels, with a carrying capacity of only 2,730 tons d. w. t. (30,000 barrels), could not provide an economical commercial tanker prototype because of their modest size, the lessons of Arctic naval architecture were useful.

Of greater interest was the MSTS plan to ice-plate portions of the hull of a T-5 tanker, the USNS *Maumee*, for use in the Antarctic. The *Alatna*, which had been used for Deep Freeze resupply at McMurdo, normally had made five trips per season to provide the wintering-over POL supplies, while the New Zealand Navy provided another two shiploads. The larger T-5 has a capacity in excess of the required annual supply of 150,000 barrels and, when modified for operations in the ice, can deliver the entire winter's load of POL to McMurdo in a single voyage, with room to spare. Even this ship, however, would not present the same problems as a commercial carrier: a T-5 is over 600 feet in length, with a beam of 83 feet, but is still just a fraction of the size of the 250,000-ton icebreaking tankers now contemplated.

The economics of operating commercial tankers is the determining factor in the tankers-through-the-Arctic concept. To be economically feasible, the tankers must save enough in time and distance "over the top" to justify the risks of this route in preference to the longer but ice-free southerly routes. If the destination of Alaskan oil were refineries in New York and the vessels were too large to navigate the Panama Canal, we would be speaking of an 8,000-mile, 20-day differential. The cash value of this differential would have to cover higher construction costs, increased insurance rates, possible hull damage, special pilotage fees, and, possibly, icebreaker costs. To justify that financial burden, the ships on the northern route would have to be certain of their ability to move reliably through heavy sea ice.

This, then, is the background of the *Manhattan* experiment. The parameters of the problems were clearly spelled out: an economically sound tanker route may prove feasible, *if* a year-round route can be maintained through the Arctic ice, *if* these ships can alone—or with moderate assistance—transit the ice-choked passages of northern Canada, and *if* they can be made large enough to provide a per-barrel transportation cost sufficiently low to underprice alternative methods of getting the oil from Alaska to market.

With these parameters in mind, three oil companies—Humble, Atlantic Richfield, and British Petroleum—began a preliminary inquiry into the feasibility of such mammoth icebreaking tankers. Economics was one of the first *ifs* to be dispensed with. It was quickly determined that tanker passage from Prudhoe Bay to New York via the Arctic would save approximately $0.60 per barrel, or $1,200,000 per trip with a cargo of 2,000,000 barrels. This financial benefit, spread over the producing life of the oilfield, was estimated at no less than a billion dollars.

The second question was the design of a tanker-breaker for this northern route. This is the phase where civilian oil companies began their quest for Arctic knowledge. Granting a contract to a Maryland-based consulting firm, CONSULTEC, the companies paid $135,000 for feasibility studies on the project, studies which involved an examination of great masses of historical data, cumulative weather and ice records of the region, and models—mathematical and physical—of the proposed vessels. Work quickly expanded into Government channels where access could be had to a Navy ice tank (NEL San Diego), Coast Guard icebreakers (for icebreaking capabilities tests and personnel indoctrination north of Alaska), and voluminous governmental records and reports. The Office of Naval Research[2] became a focus of interest because of its Arctic programs; the Navy Weather Central, Suitland, was tapped for its knowledge of Arctic weather and climatic trends; and the Oceanographic

Office contributed its expertise on Arctic oceanography, charting, and ice forecasting. The Coast Guard, now operating all of this country's icebreakers, also became a focal point and was designated the coordinating agency within the Department of Transportation.

The masses of data, the knowledge of experienced Arctic sailors, and the theoretical computations which grew out of intense and high-priority studies quickly developed into a search for a suitable test vessel. All concerned with the project agreed that the icebreaking tanker was theoretically practical and stood a good chance of success. All that was needed was a test platform.

Quickly the choice was made. The SS *Manhattan*, a U.S. built, twin-screw, steam-turbine driven vessel of 106,000 tons deadweight was selected. Completed in 1962 to rugged near-military standards, the *Manhattan* was the sturdiest supertanker available and the largest commercial vessel under the American flag. The ship was leased from its owners and was promptly sent to Sun Shipbuilding and Drydock Corporation yards near Philadelphia.

The modification of the *Manhattan* was typical of this entire epic: it was unprecedented, it was fast, and it was expensive. The ship was cut into four sections in January of 1969, and the pieces were delivered to different yards where manpower and industrial resources were available to go to work immediately. Management of the project was contracted to Sun Shipbuilding, where the bow remained. The afterbow was sent to Newport News and the midsectiou went to Mobile, Alabama. The stern section also remained for modification at Sun's Chester, Pa., yard, were the strengthened and heavily plated bull was reassembled in June and July.

The design and construction of an icebreaking bow was the key to the unique reconstruction of the giant icebreaking tanker. Using a general concept developed in a doctoral thesis at MIT in 1965 by Comdr. Roderick M. White, USCG, the 65-foot long, 735-ton upswept bow section was designed to permit more of the weight of the giant ship to bear down on the ice and increased from a gentle 18° angle at the extreme bow to a 30° maximum. It also was designed to push broken ice away from the ship through the addition of extra-wide "cheeks," which added 23 feet to *Manhattan's* beam. According to preliminary estimates, the bow had the capability of cracking 15-foot sea ice and 60-foot pressure ridges. Fabrication of the bow was divided between Sun and Bath Iron Works.

Thus outfitted with a hard nose, strengthened structural members, and a waterline ice belt that girdled most of the hull, the *Manhattan* was prepared for her carefully instrumented test voyage into the icefields of the Canadian Archipelago. A sizable ship by normal maritime standards, it was nevertheless clear in the minds of her sponsors that she would simply be a half-size model and a $39,000,000 experiment in space age Arctic technology.

The structure of the ship, of course, is only a first step in making a workable sea route out of the frozen Arctic Ocean passages. It is apparent that a big bulldozer will push more dirt than a smaller one; similarly, it takes no imagination to conclude that a powerful, well-built ship of substantial dimensions can force her way through the polar icepack, if size and power are the only criteria. If ship coustruction costs are to be minimized, however, while load carrying ability is maximized, every opportunity presented by the Arctic environment must be carefully exploited. To do this, the latest scientific knowledge, reconnaissance techniques, and ice forecastiug experience must be utilized.

In the knowledge of the Arctic and the instrumentation for ice reconnaissance and navigation, military know-how paid off once again. From their work with various Arctic studies, the Office of Naval Research and the Naval Arctic Research Laboratory at Point Barrow were able to make significant contributions to the data bank. The Army's Cold Regions Research and Engineering Laboratory provided expertise on sea ice qualities and characteristics. The Naval Oceanographic Office and the Navy Weather Central at Suitland were major sources of information on climate, ice conditions, and ice forecasting. Weather satellite data was already permitting ice forecasters to relay provisional ice charts to ships resupplying Arctic bases.[3] The Navy's "Transit" navigation satellite system was available to give positions accurate to one-tenth of a mile in uncharted and hazardous waters. Sophisticated reconnaissance aircraft using infrared film, laser profilometers, and side looking radars could contribute their military-perfected technology to the ice surveillance efforts. Closed circuit TV would permit a constant watch on broken ice as it bumped its way along the ship's hull, while hull-mounted sonar would seek submerged ice formations.

Backed up with all that modern technology and past experience could provide, the *Manhattan* began her historic voyage on 24 August, turning her bow north for the Arctic. Carrying a handpicked crew of 57 and a larger complement of scientists, liaison officers, and technicians, the ship, newly reclassified by the Coast Guard as a "tanker-oceanographic research vessel," reached Baffin Bay and her first exposure to the icepack on 2 September. Stopping briefly at Thule, Greenland, and at Resolute, Cornwallis Island, Canada, the captain carefully tested the ship in the available ice.

Reaching the approximate midway point of her voyage on 8 September, the ship found herself in heavy ice in Viscount Melville Sound. Here, only 25 miles from the North Magnetic Pole, the ship stopped and placed five research parties out on the ice. This procedure, which was to become familiar as data gathering became a routine, permitted the scientists to gather ice core samples and other data for study and collation. This kind of activity, which sometimes was almost obscured by the sensational nature of the trip itself, was, of course, the major mission of the ship. In fact, other than a token cargo of Arctic oil—a gold-painted 55-gallon drum that was airlifted from the oilfields to the ship—scientific data was the *only* cargo the ship carried.

The rest of the voyage has been well reported in various press stories and journals. The ship continued to break ice with her escorts, the USCGC *Northwind* and the Canadian icebreaker *John A. MacDonald*. On 11 September the *Manhattan* reached her furthest penetration of the ice-clogged McClure Strait and became stuck fast. Even with all auxiliary equipment shut down, the ship could not muster enough horsepower to back free of the tenacious icepack. The *John A. MacDonald* was called in for assistance, and after the ice was carefully broken away from the giant tanker, the ship moved once again. The decision was made not to try to force McClure Strait, and *Manhattan* turned south for Melville Sound and Prince of Wales Strait.

The rest of the trip was almost anticlimactic. Relatively little ice obstructed the further westward travel, and *Manhattan* finally anchored off the Prudhoe Bay oilfields on 19 September. The ship loaded the symbolic barrel of Alaskan crude and then moved on to Point Barrow, the final stop of her westward voyage. From then on, the novelty of the cruise was a thing of the past. For more than a month after leaving Barrow the ship continued ice tests in Melville Sound, collecting data in great quantities from literally hundreds of sensors. Finally, in late October, the ship left Resolute, Canada, and headed home. The data were packaged for later analysis, and the world's largest half-scale model returned to a hero's welcome in Halifax and New York. Within weeks of her return she was on commercial service, a moneymaking cargo vessel once again, carrying huge loads of oil in coastal trade between east coast and gulf ports.

The success of the *Manhattan*, despite her underpowered steam-turbine power plant, was almost a foregone conclusion. From the inception of the voyage it was clear that the greatest value would not be in the ship's physical accomplishments but in her ability to gather meaningful data for the icebreaking tankers needed for the Arctic oil runs of the midseventies. In this she has been successful, and a second trip will contribute further data to this unique search for maritime know-how. For this reason, the fact that she did indeed make it all the way "across the top" is almost irrelevant. The trip, however, served to focus attention on the final goal: the economical commercial exploitation of the frozen North American water routes.

In March of this year Humble Oil contracted with Newport News Shipbuilding and Drydock Company to design an icebreaking tanker for Arctic service. Thus it seems almost certain that the fleet of icebreaking tankers which has been envisioned for the Northwest Passage Alaska to New York route will come into being. Humble Oil, sponsors of the *Manhattan* have estimated that 25-30 icebreaking supertankers might be operating across the top of North America by the late 1970's. By 1980 the Alaskan oil production might reach as much as 2 million barrels per day, fully justifying the construction of the $50 million cargo-carrying icebreakers that would carry the black gold to market. In a summer's time, the *Manhattan* has leapfrogged the liquid cargo technology of the Arctic, while making a quantum jump in the scale of icebreaking capability.

The transit of the *Manhattan* does illustrate a significance too often overlooked. It represents the payoff to the civilian economy of the years of Arctic sailing and exploration, the millions of dollars of research funds, and the countless man-hours of personal experience that have been gathered over the years by our sea services. In times such as the present, when budgets are tight and usable civilian "spinoffs" from military projects are hard to find, the military contributions to the success of such an expedition as the *Manhattan* are of great satisfaction. More than anything else, the success of the *Manhattan* is a tribute to the years of pioneering in the Arctic and Antarctic by the U.S. Navy, the U.S. Coast Guard, and the Military Sea Transportation Service. The research, the perfected technology of military hardware, and the collected experience of thousands of half-frozen officers and men have all contributed to the success of one of the most imaginative commercial enterprises of the century.

BIOGRAPHIC SUMMARY

A 1958 graduate of the U.S. Naval Academy, Lt. Comdr. Robert D. Wells served aboard destroyers for 4 years. He then attended the Defense Intelligence School and the Defense Language Institute, where he studied Russian. After serving as an assistant naval attaché in Istanbul, Turkey, from 1944 to 1966, he served on temporary duty as Russian language interpreter in the Coast Guard icebreaker *Northwind*. He left the service in March 1967 to serve for 2 years as Legislative Assistant to a member of the House Armed Services Committee. Returning to active duty in March of 1969, Lieutenant Commander Wells is currently serving as Faculty Adviser to Attaché Department, Defense Intelligence Agency School.

FOOTNOTES

1. The Prudhoe Bay fields are about 120 miles southeast of Point Barrow, where the Navy finished mapping the huge Naval Petroleum Reserve #4 in 1953.
2. For discussion of ONR's "field station" in Alaska, see Robert D. Wells, "The Naval Arctic Research Laboratory," *United States Naval Institute Proceedings,* September 1969, p. 39-45.
3. "Navy Ice Forecasters . . . ," *Armed Forces Journal,* 14 June 1969, p. 8.

An excerpt from *United States Naval Institute Proceedings* September 1970

The U.S. military officer traditionally isolates military power from national policy. The American diplomat isolates policy from war. Yet, the purpose of military power is to achieve a political goal. Hence, how can the military professional isolate himself from the study of national politics or the diplomat from study of the role of power in policy? How do the various forms of power affect policy and how do economic or psychological considerations augment or undermine military power? Our narrow view of the role of military power is such that despite the greatest air power in history presently wielded by the United States, for example, we have never really analyzed the basic difference between the *punitive* versus the *persuasive* role of air warfare. Such doctrinal failures in the air war in Vietnam, I believe, have crucified our strategy there.

Because of the gaps in our professional education, we must all, senior and junior, begin at the beginning by a process of self-education, and this is slow and inefficient. Let our younger officers take the initiative; let them take correspondence courses and see what the Navy currently has to offer in many professional fields related to strategy and war. Let them also contribute to the dialogue, and we will all benefit from the results. I shall never forget the tremendous eye-opener it was to receive literature in anticipation of my orders as a student at the Naval War College and the new world which that literature opened for me. Even then, it was a self-education course, but I loved it. From that day, I have regretted the vast amounts of time which I spent previously in other pursuits in my carefree junior officer days, which might well have been used to lay a professional groundwork . . . .

After all, Alfred Thayer Mahan could not publish an article in the *Proceedings* until he was a commander for at least two reasons—there was no Naval Institute and no Naval War College, and he was a captain before his orders to help establish the War College first opened his eyes to the new world around him.

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