

On the Exploration of the Arctic Ocean

by Dmitri I. Mendeleev

The author of this memorandum, Russian scientist Dmitri Ivanovich Mendeleev (1834-1907), is most famous for his discovery of the Periodic Table of Chemical Elements. His contributions to science and the physical economy of Russia go far beyond that, however; the Russian editor of the text we publish below characterizes him as a “scientist and polymath, public figure, chemist, physical chemist, physicist, metrologist, economist, engineer, geologist, meteorologist, teacher, balloonist, instrument maker,” as well as a professor at St. Petersburg University and a corresponding member of the Imperial St. Petersburg Academy of Sciences.

An outspoken opponent of British free trade, Mendeleev was an advocate of American System economics, as propounded by German-American economist Friedrich List. He attended the 1876 U.S. Centennial Exhibition in Philadelphia, which was organized by the circles of Henry Carey (who had been an economic advisor to President Abraham Lincoln). Mendeleev authored, among other relevant articles and books, “A Literate Tariff, or an Investigation of the Development of Russian Industry in Connection with the General Tariff of 1891.”

He passionately rejected the anti-human tenets of Malthusianism, and in his last book called for Russia’s pop-

ulation to rise to 500 million. He also wrote, “The philosophy of Jean-Jacques Rousseau and now of Tolstoy, for a ‘back to nature’ existence, is semi-childish. Because in a patriarchal society, as well as among higher animals, there is a definite limit to growth; but human beings taken as a whole recognize no such limit.”

*Mendeleev was an avid explorer, as shown by the memorandum we publish here, in what we believe to be its first English translation (by **EIR**). It is a letter to Finance Minister Count Sergei Witte (a leading American System advocate in the Russian government), and was first published in **The Soviet Arctic**, 1937, No. 6.*

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It is to the expedition under [Vitus] Bering’s command, commissioned by Peter the Great, that mankind owes the discovery of the strait that separates the Old World from the New, and connects the Pacific Ocean to the Arctic, along whose coasts Russian Cossacks and industrialists had long sailed. That was the origin of the famous attempts of the 18th and 19th centuries to find a northeast or northwest passage from the Atlantic Ocean to the Pacific, to join the two northern halves of the globe by the shortest water route, just as at the high latitudes of the Southern Hemisphere. Everyone knows about the intrepid persistence with which



Mendeleev Museum-Archive, St. Petersburg State University

“Having won a scientific name for myself,” Mendeleev wrote to Count Witte in 1901, “I am not afraid of disgracing it in my old age by charging off to the North Pole.” This portrait of Mendeleev was painted by I.N. Kramskoy in 1878.

the peoples of Western Europe and North America pursued this challenge, fearing neither the human nor the financial costs. People today, having encountered unusual obstacles in the Arctic ice, seem to have completely abandoned this effort. But even now, a great deal of work is continuing in this area, although the flag of industry has been replaced by that of science, and the goal is to reach the North Pole. In my view, the efforts of [Rear Adm. Robert] Peary, [Fridtjof] Nansen, and other explorers to get there by dogsled and on skis should be considered a most admirable kind of sport, but incapable of yielding any serious practical results. Conquering the polar ice is especially desirable and necessary for man's direct industrial use, at least as much as it is for the triumph of knowledge. It will be possible to consider the victory complete, however, only when a vessel outfitted in Europe sails quickly and directly to the Bering Strait, across those 2,500 versts¹ where man has not hitherto gone either by foot or by ship. If one ship manages to do it quickly (i.e., in no more than one month), reasonably, and confidently (i.e., ending up where it was intended to go), it will soon probably become possible to have, if not continuous, then at least regular passage, just as a multitude of ships followed upon Magellan's and Cook's voyages. The trial run will give an indication of what technical means will make it possible—after appropriate improvements—to achieve this, and if the power of technology can burst open primordial rocks in a mountain massif, then certainly ice cannot hold people back when they use the appropriate tools to combat it. As a result, of course, a special new type of ship and new tools will come into being, but all this will pay for itself by shortening of the sea lanes, which more than anything else advance civilization and industry.

Russia should desire a real victory over the polar ice—i.e., by ship—more than any other nation, because no other possesses such a huge coastline on the Arctic Ocean. Into it pour enormous rivers that flow through the greater part of the empire, which there has been little chance of developing, not so much because of the climate, as the lack of trading outlets across the Arctic Ocean. For the future of northeast European Russia and almost all of Siberia, conquering the Arctic ice is one of the key economic issues, because the only profitable way to market timber, grain, and other heavy raw materials from these remote places, to destinations both at

home and abroad, is by sea. But apart from the great economic value, the country's naval defense stands to gain a great deal when it becomes possible—without the Suez Canal or other canals in countries with warm climates—to sail its naval ships, or even some of them, around its own coastline from the Atlantic Ocean to the Pacific and back, because Russia needs to keep a strong Navy in both places in order to protect its vital interests.

Having grown up myself in cold Siberia, continually following descriptions of polar travels with the greatest attention, and learning a lot about them from my late friend [A.A.] Nordenskiöld, who had made a number of famous expeditions to the icy regions, I acquired a staunch belief in the possibility of completely conquering the polar ice with the appropriate equipment and, most important, a clear understanding of the forces that have so far prevented ships from penetrating into the unknown circumpolar region, whose area is about 4 million square versts—i.e., almost as large as European Russia. During the time (1891-1893) that I was working on smokeless pyrocellulose gunpowder and trying to understand the conditions under which gun barrels burst, I came up with several proposals for techniques that might be used to clear pathways for ships through the ice. These days, when liquid air is easily obtained in large quantities, it would seem to be easy and cheap to blow up the layers of ice, since liquid air, with a small amount of coal dust mixed in, produces explosions which are already beginning to be used to tunnel through solid rock. But technology can only promise practical success if guided by a clear understanding of all the obstacles it has to overcome, to make sure that its power is not wasted. So I will try to briefly describe the essence of the obstacles that are keeping human curiosity from having access to the enormous region of the Arctic Ocean.

Northern polar ice, whose average least thickness is at least 3 arshins,² is in almost constant motion, even in the Winter. This is evident from all the voyages there, but was observed with particular clarity during Nansen's three-year expedition on the [icebreaker] *Fram*. Wintertime movement of the ice is mainly from the Bering Strait toward Greenland, and the other way in the Summer; but these general directions are continuously subject to local changes. The great and uneven thickness of the ice and its constant motion are the obstacles that block access to the Pole. But therein we

1. A verst is about 2/3 of a mile, or 1.06 km.

2. An arshin is 71 cm.

FIGURE 1
Siberia's Arctic Coastline



must find the key to the victory we desire. The movements are caused by the prevailing currents and winds pressing against the lateral, upper, and under surfaces of the ice. And since land nearly surrounds the Arctic Ocean and exists within it in the form of islands, and the main outlet to the Atlantic Ocean is the strait between Greenland, Iceland, and Spitsbergen, the continuous movement of ice has a great number of important consequences, which must be considered first and foremost when thinking about sending ships across the Arctic. The following three consequences are especially important:

1. Part of the ocean remains unfrozen all year 'round, and in the Summer, when storms and changes of direction of the ice's motion are more frequent, and when there is a constant release of ice into the Atlantic Ocean, the surface of the Arctic Ocean is very unevenly covered with ice. Masses of ice accumulate along the coasts, particularly the steep ones (Greenland and other islands to the north of Canada). There are no such ice accumulations near the Siberian coast during the Summer for two reasons: first, because abundant rivers empty into the sea there; and second, because the sea off Siberia is not deep (an average of 10-15 sazhen³ on the route that the *Vega* took), whereas the ocean ice is often very deep and stands at anchor, so to speak, far from shore, leaving a strip of water with a small accumulation of ice (as shown by Russian voyages and by

3. A sazhen is 2.34 meters.

Nordenskiöld aboard the *Vega*). There is an especially large accumulation of ice above North America, from Greenland to the Bering Strait, because there are so many islands, as has been discovered by polar explorers. Taking into account the quantity of ice exiting [the Arctic] around Greenland, direct observations of frequently visited parts of the Arctic Ocean (near Novaya Zemlya, Franz Josef Land, and Spitsbergen), and the fact that some of the ice melts in warm weather, from the Sun that never sets and

from the warmth of the Gulf Stream, all recent observers concur that, in the Summer months (June, July, August, and early September), an average of at least one third of the Arctic is ice-free.

But because the central and main part of the ocean, which has not yet been explored, probably does not produce new ice floes in the Summer, I believe that at least half of the surface must consist of free water (especially if there are few islands, as we have reason to believe); this is the more likely, because many observers have more than once come upon so-called "open sea" just beyond the locations to which they sailed. This clearly indicates that dogsleds and skis offer no hope of achieving any serious goal in the Summer; and of course Winter frosts present extraordinary obstacles to observers and "living engines." A strong ship and ice-free waters are the first means at our disposal to defeat the obstacles presented by the Arctic Ocean.

2. Moving ice floes, pressing against each other, cause cracks, creases, and pile-ups (ice ridges) which make travel by sled more difficult and seriously obstruct the passage of ships, because these pile-ups thicken both the tops and the underwater parts of the ice. For ships like the icebreaker *Yermak*, ordinary one-year-old polar ice is much less of an obstacle than are these ridges that cover the ice floes in all directions. These pile-ups, in my opinion, should be cleared away with explosives, and not just by pressure or ramming from the ship, which would be a waste of time and coal.

3. To find the most ice-free waterways in the Arctic Ocean in the Summertime, we therefore need look in two directions: first, along the Siberian coast; and, second, at the center of the unknown parts of the Arctic Ocean, provided there are not many islands there. The water along the Siberian coastline is rather shallow and suitable only for the free navigation of small vessels; furthermore, this route is almost twice the length of the direct route across the Pole, if we take the extreme points of the journey to be the coast of Norway and the Bering Strait. Everything that was learned from the three-year drift of the *Fram* suggests that the center of the Arctic Ocean is quite deep (2-3 versts or more), and would not be able to hold deep-seated ice floes. Only here can we also hope to find a passage for large ships across the Arctic, if they get past the belt of ice near Spitsbergen and Franz Josef Land. Chances are that these islands also block the masses of ice that are visible here annually. Beyond them, in the Summer, there should be a lot of ice-free water.

From what I have discussed above, the basics (principles) are already evident that would, I do believe, now make it possible to decide to do battle with the Arctic Ocean.

When, in 1897, Admiral S.O. Makarov published his design for a powerful icebreaker, I not only responded with complete sympathy, but gave all the assistance I could to help realize his idea. This led to my appointment as a member of the Finance Ministry commission that discussed how the *Yermak* would be constructed. As I agreed in many respects with the Admiral at the time that the ship was being built, he and I submitted a plan for an expedition in the Summer of 1899 to conduct scientific research in the Arctic Ocean. All the preparations, including assembling staff, were made by me in the Spring of 1899; but I had to give it up because the Admiral, in the end, wanted to remain the sole leader of all the research, wanted to have me and all my staff at his command, and would not even agree to take us on as passengers, although the expedition was registered in principle in both of our names. While refusing to participate, I wished him every success in his enterprise, but could not agree, not only to the scientific staff being subordinated to the ship commander, but also to the general plan of the whole expedition, as well as many particulars. Admiral Makarov

FIGURE 2



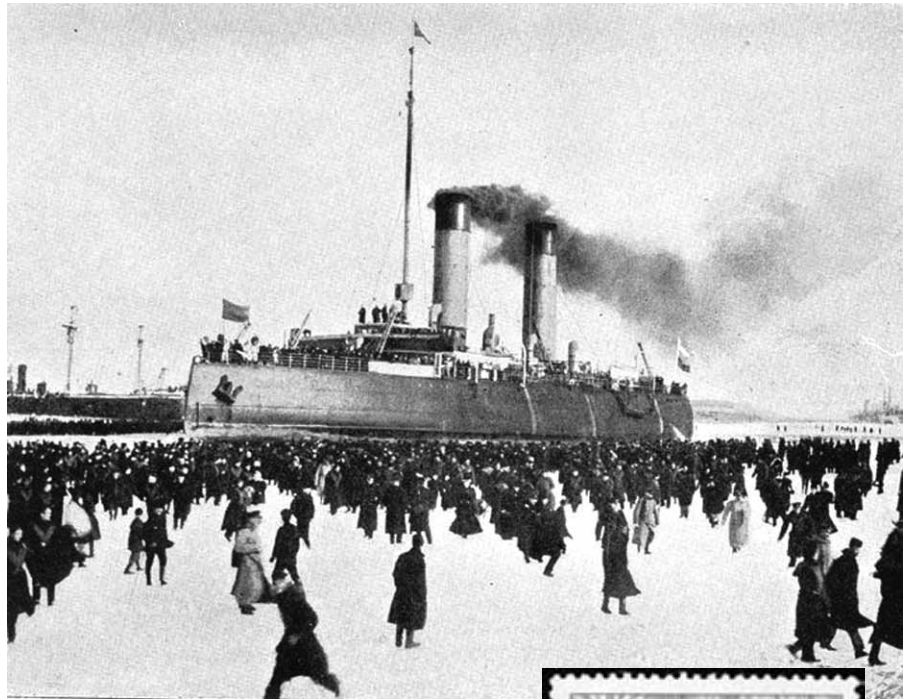
thought that it would be pointless to attempt to cross the Pole to the Bering Strait, and aimed to sail the icebreaker to the mouths of the Ob and Yenisei rivers, hoping to lead the way for trading vessels and to extend the navigation season for reaching the mouths of these rivers, by passing to the north of Novaya Zemlya on a direct course. That goal seemed to me of little importance for Russia, because [Joseph] Wiggins had already conducted trading ships to the mouth of the Ob several times. But the idea of using the power of the icebreaker was boldly expressed in the Admiral's publication *Yermak in the Ice* (1901), inasmuch as he had titled his 1897 lecture simply "To the North Pole: Straight Ahead!" I, on the other hand, believed that it was impossible to go straight to the Pole by ship alone, even if the ship were an icebreaker with 10 or even 20 thousand horsepower. The ship's acceleration is good enough to break up the ice by direct pressure in the Baltic Sea and any river or lake, but alone, it is insufficient for the Arctic Ocean; there we will have to bypass the ice wherever possible rather than smash through it, and breaching massive ice ridges should only be done after they have been broken up by explosives. In his three expeditions on the icebreaker

Yermak, the Admiral tried to get to the Pole by going “straight ahead”; he was able to break the ice, but in the end he never went further than his predecessors had done in ordinary ships that were not adapted for ice-breaking. Therefore, it was clear that I could not agree with Admiral Makarov on many key points; but because he was the real initiator of the *Yermak*, I gave all the honor of these first trials to this worthy figure, who had contributed quite a bit to the study of the distribution of temperatures and densities [of water] in oceans and seas.

This Summer, 1901, S.O. Makarov, having steered the *Yermak* into the ice surrounding the northern part of Novaya Zemlya, got stuck there, struggled in vain to go “straight ahead,” freed himself from the ice only thanks to a change in the wind, and, upon reaching Franz Joseph Land, met with a fairly ice-free sea, and therefore would have been able to

continue. But due to the lateness in the season and lack of supplies, he decided to turn back, having added nothing fundamental to our knowledge of the Arctic Ocean, precisely because he went “straight ahead,” and set as his only goals the study of the properties of the ice and the icebreaker. These properties show clearly that for a few days, the *Yermak* can successfully cope with ice that is not very thick; and I think that is more than enough for an attempt to penetrate this unknown territory surrounding the Pole using this icebreaker, and then go on to the Bering Strait. Therefore, I have decided now, after three Summers of experience with the *Yermak* in the hands of the Admiral, to request permission to conduct an experiment with the same icebreaker under my direction, to penetrate the unknown region of the ice.

Nothing ventured, nothing gained, of course, and an attempt to proceed nonstop to the Pole and the Bering Strait merits a full-scale effort, which, as far as I can judge, could probably succeed in three years. In the first year, I think we should just try to get approxi-



Mendeleyev wanted to command his own scientific/economic expedition to the Arctic aboard the icebreaker Yermak, which had previously been used by Adm. S.O. Makarov. The photo, taken in 1898, is from Makarov’s book on his voyage; the commemorative stamp is from the Soviet Union in 1976.



mately to the Pole, to make a general investigation of how much ice there is in the Summer months, and whether there are any islands on this side. With success—i.e., if the assumption that there is “open sea” turns out to be correct—even the first voyage could lead to the Bering Strait, because the distance to there from Spitsbergen is only about 3,600 versts and, at an average speed of 6 knots through the ice (the *Yermak* can make 12 knots in ice-free water), this route would take no more than 15 days, if the fuel were sufficient. But I do not flatter myself that I would be so lucky, and so propose to achieve it only in the second and third year, once we have gained experience with sailing the icebreaker not simply straight ahead, but also through open water, to the extent possible, and by exploding the ice ridges and any other large ice formations. While confident in the success of a three-year effort, I am nevertheless presently asking only for resources for

the coming year, 1902. My request essentially consists of three parts.

1. I request the resources to equip the icebreaker *Yermak* for ease of navigation in the Arctic Ocean. To do this, it seems to me exceedingly important, first of all, to remodel all or at least half of the furnaces for oil heating. The importance of this is that then the furnace would require little servicing by the crew (stokers), whereas the 100-man crew of the *Yermak* includes 24 stokers and 12 coalheavers. Secondly, I think the cabins have to be remodeled for spending the Winter in the Arctic Ocean, because the unpredictability of an unknown sea could force us to stay there for the Winter, and the *Yermak's* cabins, distributed at different parts of the ship, are not suitable for this purpose. Such alterations, according to my information, could definitely be completed within two months, without having to stop the *Yermak's* work in the Baltic Sea.

But it is obvious that the alterations need to be authorized at least by February and started in March, so as not to arrive too late in the Arctic Ocean.

2. I request the opportunity to have charge of the *Yermak*, starting in June 1902, with the condition that I may remain in the ice, if necessary, for the entire coming Winter. The captain and other personnel of the icebreaker must be informed of this in advance. To demonstrate clearly that, in my view, a decision to spend the Winter would be made only in case of urgent need and would not present any particular dangers, I propose to bring along my son, who is finishing gymnasium,⁴ and wants very much to accompany me.

Neither I, at my advanced age, nor my son, who needs to continue his studies, is well suited to stay the Winter; so my request to be permitted to inform the crew about the possibility is intended only against the eventuality that extreme need and direct benefit to the cause might make it necessary. If this extreme situation should occur, I anticipate great benefits from a Winter stay of the *Yermak* in the ice, because I would hope to test its capacity to move about, even in the Winter cold,



<http://opwww.narod.ru/img/ark.jpg>

A modern Russian icebreaker plies the Arctic ice. Mendeleev wanted to figure out how to cut a path for ships from Norway to the Bering Strait, to expand Siberia's trade with Europe and, ultimately, America.

by using explosives; that is, I hope to gather data that will allow us to judge the possibility of passage through the Arctic Ocean in Winter.

3. The two above-mentioned requests cannot be implemented without the appropriation of special funds. By my calculations, these should not exceed 200 thousand rubles, as follows: approximately 25 thousand rubles for remodeling, about 60 thousand rubles for fuel (oil and coal), about 60 thousand rubles for a full year and a half's supply of provisions for all participants, about 10 thousand rubles for instruments, and the rest (45 thousand rubles) for remuneration to the scientific staff, for explosives, for stocks of all sorts of materials required for three years, and for operating expenses as far as Spitsbergen. In any case, it would be impossible to organize the desired expedition for less than 150 thousand rubles. If it ends in September 1902, then a significant amount of the supplies will remain in reserve (for other expeditions), but I consider it impossible to start on the right footing without supplies for one and a half years.

If the circumstances encountered in the unknown region surrounding the Pole were to turn out to be completely unfavorable to completing the entire plan outlined above, I still hope that the requested funds would not have been wasted, because I think they will enable making a number of scientific observations which might explain aspects of many polar phenomena that we do not understand. Having won a scientific name for myself, I am not afraid of disgracing it in my old age by charging off to the North Pole, and if I appeal to Your Excellency with a frank expression of my thoughts, it is

4. Classical high school.

only in the confidence that you know me well enough as a naturalist, and by no means a dreamer. You have obtained funds from the Sovereign Emperor for construction of the *Yermak* and for three expeditions by Admiral Makarov, and have now taken the icebreaker under your supervision. The *Yermak*, having saved the 5-million-ruble battleship *General-Admiral Apraksin* from destruction, has in effect already paid for itself; so therefore do not turn down the chance to try again to accomplish, with this ship, what has long fascinated inquisitive people the world over. I am motivated only by the hope that at the end of my life, I may still serve the glory of science and the benefit of Russia in such an enterprise, whereby the experience I have gained in life and in science will be fully put to use. Do not worry about the fact that I am not a sailor. Nordenskiöld and Nansen were not sailors, but naturalists, and trust was placed in them not in vain, because they honestly and precisely carried out what they had undertaken to do. Although totally untrained, I satisfactorily completed my utterly unexpected flight from Klin in a balloon, despite my unfamiliarity with it; but as you know, I have been deeply interested in the icebreaker *Yermak* ever since its conception, and therefore, I venture to think that I am sufficiently well acquainted with it to use it wisely and to take advantage of the available opportunities. But if you should agree to the expedition I am proposing, I humbly beseech you not to disclose the proposal I am making to Your Excellency before its completion, because the success of the whole plan depends a great deal on diverse contingencies. I myself will try not to spill the beans about the true aims of the expedition; it will be presented as a simple exploration of the Arctic Ocean. In conclusion, I repeat: Without bold attempts and without reasonable donations, one cannot hope to do battle successfully with nature, just as this cannot be done with people.

P.S. If I had the opportunity to organize a polar expedition completely anew, from the start (in three years, according to the above-mentioned plan), I would build an easily maneuverable (like the *Fram*) steam-powered icebreaker, not with 8 tons at 10 thousand horsepower, like the *Yermak*, but only 2-3 tons at 3-4 thousand horsepower, with a strong steel frame and mounting, and a double hull—steel on the outside and wood on the inside—at the cost of about 500 thousand rubles, including an oil furnace. The total cost would then be approximately as follows: construction, 500

thousand rubles; first year of the expedition, about 130 thousand rubles; second year, about 100 thousand rubles; and third year, about 70 thousand rubles, for a total of about 800 thousand rubles; the total number of observers and crew should be no more than 30. Such an icebreaker could be built and outfitted in approximately one year or not more than a year and a half, and the expedition would be much more reliable than with the *Yermak*.

Editor's note: *Mendeleyev unfortunately did not get the funding he requested, and did not make the trip. Count Witte sensed that "things had changed" at the Court, and in the end the plan was quashed by Grand Duke Alexander Mikhailovich, the head of the Department of Merchant Shipping and Ports. Indeed, the Grand Duke—the Tsar's cousin and brother-in-law—was part of a British-connected coterie in the Russian Court, which was working to oust Count Witte during these years. Their scheme to seize the Korean Peninsula was a provocation of Japan that Witte fervently opposed, knowing that war with Japan would disrupt his plans for transcontinental development, and could fatally damage Russia's economy and security. This group's ascendancy over Witte, who was fired as Minister of Finance in 1903, helped precipitate the disastrous Russo-Japanese War of 1904-05, an important way-station in the half-century-long British drive against nation-building in Eurasia, culminating in World War I.*

More on Mendeleyev

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