

THE ICE-BREAKER "ERMACK":

A SHIP THAT MAY YET NAVIGATE TO
THE POLE.

BY EARL MAYO.*

"I BELIEVE that the future of Arctic and Antarctic exploration, including the discovery of the Poles, will depend mainly upon the use of powerful ice-breaking vessels."

This opinion was uttered by Vice-Admiral Makaroff, of the Russian Imperial Navy, as we sat together in the cabin of the only vessel of this sort in existence to-day—a ship that has penetrated already a distance of 200 miles into the eternal ice of the Arctic. Admiral Makaroff spoke as a practical man, giving utterance to a statement that he has proved by observation and experience. He has done more than navigate the Polar ice. For thirty-five years he has been in active service as an officer of the Russian Navy, and he has written important scientific books. When such a man suggests a new plan of Polar exploration, he is likely to have excellent reasons for so doing. I expressed a desire to hear the reasons.

"It is very simple," said Admiral Makaroff, who is a true Russian as to the patriarchal length of his beard and in his excellent command of English. "Dr. Nansen proved the utility of building a ship strong enough to resist the ice, and of permitting it to be carried along by the drifting ice current. My suggestion looks merely to the adoption of offensive tactics in place of this defensive plan. Instead of a ship which can only withstand the ice, I would attack the Polar waste with a vessel strong enough to cut her way through any ice in existence."

"But is it possible to construct such a ship?"

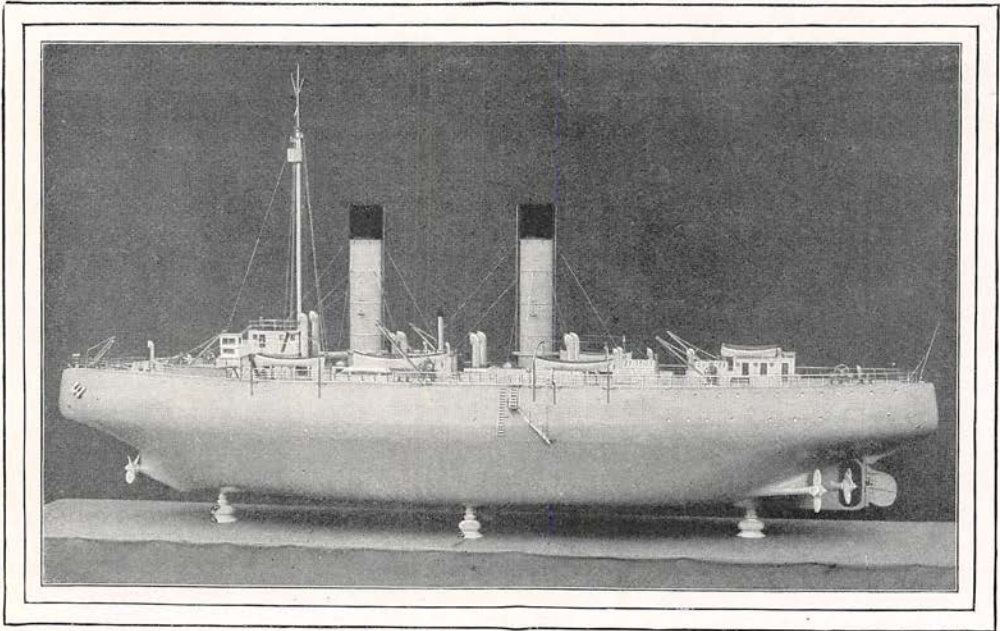
The Admiral smiled. "You are now on board such a ship," he said. "At least, you are on board a ship that has gone through ice as thick, I believe, as any that lies between us and the North Pole. The *Ermack* has cut her way through the thickest ice of the Spitzbergen Region, ice that may have been frozen long before you and I were born. She is by all odds the strongest ship in existence." As he said this the Admiral approached a small model of the *Ermack* that stood beneath a glass case at one end of his cabin, and raised it by placing his forefingers beneath bow and stern. "What would you say of a ship that could be lifted thus without breaking in the middle?" he queried.

"Marvellous!"

"It might be done with the *Ermack*. No other ship could endure such a strain. What would you say of propellers that could be brought up short against the most formidable obstruction without breaking, although the full power of the engines were urging them on?"

"Impossible!"

"It has been done with the *Ermack*. I tell you this simply to show you that the ship that would navigate the regions of perpetual cold must be not only strong, but symmetrically strong—unbreakable in every part. It is impossible to make a ship too strong to deal with the ice. Even the *Ermack* is not so strong as I should wish her



A MODEL OF THE "ERMACK," SHOWING HER PECULIAR LINES AND THE FORWARD PROPELLER.

From a photograph furnished by the Armstrong Whitworth Co.

to be, although she can charge anything less formidable than an iceberg, ahead or astern, without injury to herself."

Then the Admiral went on to explain point after point and detail after detail of this Hercules among sea-going ships. She is intended to carry neither cargo nor passengers nor guns. The single aim of her builders was to make her as strong as possible. Therefore she differs in many respects from the ordinary steamship. To begin with, she has a double skin throughout, instead of merely a double bottom. The epidermis is a layer of steel plates an inch and a quarter in thickness, extending from the keel to the deck level, forty feet above. Within this is another steel surface half as thick. The two walls are firmly braced by steel supports, and the space between them is divided into watertight compartments from three to ten feet in diameter, extending entirely around the vessel. She has a double deck, a double set of cabin skylights, and an extra wooden partition around the outside of the cabin within the second steel skin. The latter provision is not so much for safety as for warmth. Heat from the ship's boilers is applied through a series of steam pipes that run between the two inner walls; and with the help of the outer air-chamber to prevent this heat from escaping, the interior of the *Ermack's* cabins is kept at a comfortable

temperature, even in the highest latitudes. She is divided by an unusual number of watertight bulkheads—forty-eight in all—and most of these extend to the deck level. After the boilers and machinery were all in place, these various compartments were filled with water to their full height. Not only did the walls endure the strain, but the *Ermack* floated as serenely as before. No ordinary accident could send her to the bottom.

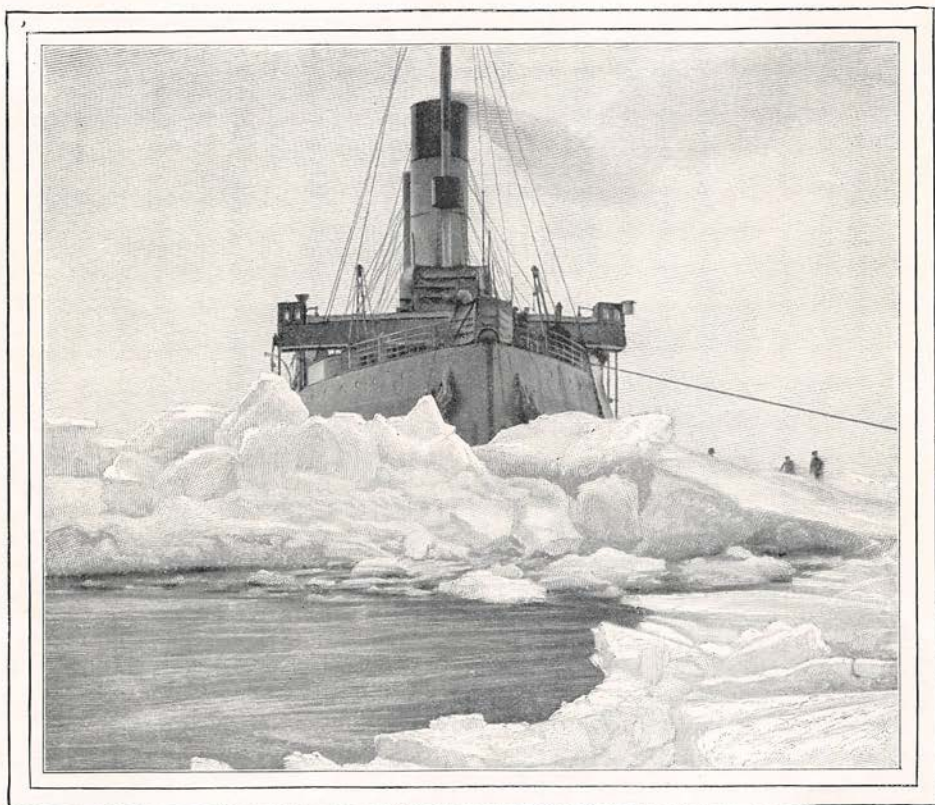
The provision of so many watertight compartments reduces the amount of room in the interior of the ship very considerably. Of the remaining space, a large part is occupied by the propelling machinery, which is located amidships and extends both forward and abaft. There are four propellers, three located at the stern and one at the bow. They are connected with separate engines, in order that any one of them may be operated independently, if this is desired. Each of the engines develops 2,500 horsepower, so that the total driving strength of the ship is 10,000 horse-power. The fore propeller is an American device, and was first employed in the ice-breaking vessels of the Great Lakes. Its effect in action is to suck the water from beneath the ice, thus greatly reducing the resisting power of the ice and causing it to break more easily. This propeller is useful in another way, when the

ship's progress is retarded by accumulations of ice below the surface and before her bow. By reversing the motion of the screw, the blocks of ice thus crowded together are driven forward out of the ship's path. The remainder of the interior is given up to cabins, scientific laboratories, the quarters of officers and crew, and the bunkers, in which are carried 3,000 tons of coal. In spite of her great strength, the *Ermack* is not a large ship, as we reckon size to-day, and with bunkers filled her displacement is only 8,000 tons.

In external appearance, as in interior arrangement, the *Ermack* is unusual. Her bow, stern, and sides are all cut away sharply. Instead of meeting the surface of the water at right angles, they project above it. The slant of the bow is seventy degrees, of the stern sixty-five, and of the sides twenty. Consequently the ship looks top-heavy, as though sitting entirely on the surface, although, as a matter of fact, she draws twenty-five feet. She has, too, a blunt look, on account of her great beam of seventy-one

feet, fully twice what it would be for an ocean liner of her length—305 feet. But the *Ermack* was not built for beauty or for speed. In clear water she can make only fifteen knots, the pace of a heavy battleship. At first glance one would be likely to imagine her some new-fangled warship. Her black sides and heavy look suggest this. And, in fact, though not a naval vessel, she is a fighting-ship in the truest sense of the term, and her foe is one worthy of any steel that can be sent against it.

How does the *Ermack* break the ice? Where water freezes to a thickness nearly three times the height of a man, its resisting strength is enormous. It may be better imagined than described. What is the ice-breaker's plan of attack when facing an opponent of such power? The natural inference of one who knows nothing of the subject is that the ship charges the ice barrier like a battering-ram; but this method would be as futile as attempting to fell a redwood giant with a paper-cutter. In exact terms, the *Ermack* is an ice-crusher. That



THE "ERMACK" TAKING AN ARCTIC ICE-PACK.

In the foreground is an Arctic lake—a lake not of salt water, but of melted ice and snow.

accounts for her peculiar lines. When she steams against the ice, her bow does not encounter it horizontally—in the line of greatest resistance. Instead, it rises upon the surface. As the engines urge the ship forward, more and more of her weight is thrown upon the ice, until it breaks beneath the strain. This is not, however, a new idea. It was adopted in an ice-breaker constructed by a Russian, M. Britneff, twenty-five years ago, and it is followed to-day in the ice-breakers on the River Volga, in the North Sea, and on the Great Lakes.

For work amid the ice a ship must possess unusual agility. This is imparted to the *Ermack* in various ways—by her four powerful nickel-steel propellers, which enable her to manœuvre in the narrowest quarters, and by a great rolling chamber which occupies the whole lower portion of the vessel in the space formed by the double bottom. This space is divided into four compartments, one occupying each quarter of the vessel, and each large enough to contain the 200 tons of water that she carries as ballast. A big salvage pump located amidships is able to send this entire weight of water from one side to another, from fore to aft, or *vice versa*, as may be necessary. Suppose the *Ermack's* bow to be run upon ice thick enough to stand under the 900 tons pressure thus imposed: to this, within the space of twenty minutes, the great pump can add 200 tons more in the

effort to break down the barrier; or it can send the 200 tons charging to the other end of the vessel, in order to get her out of a dangerous situation.

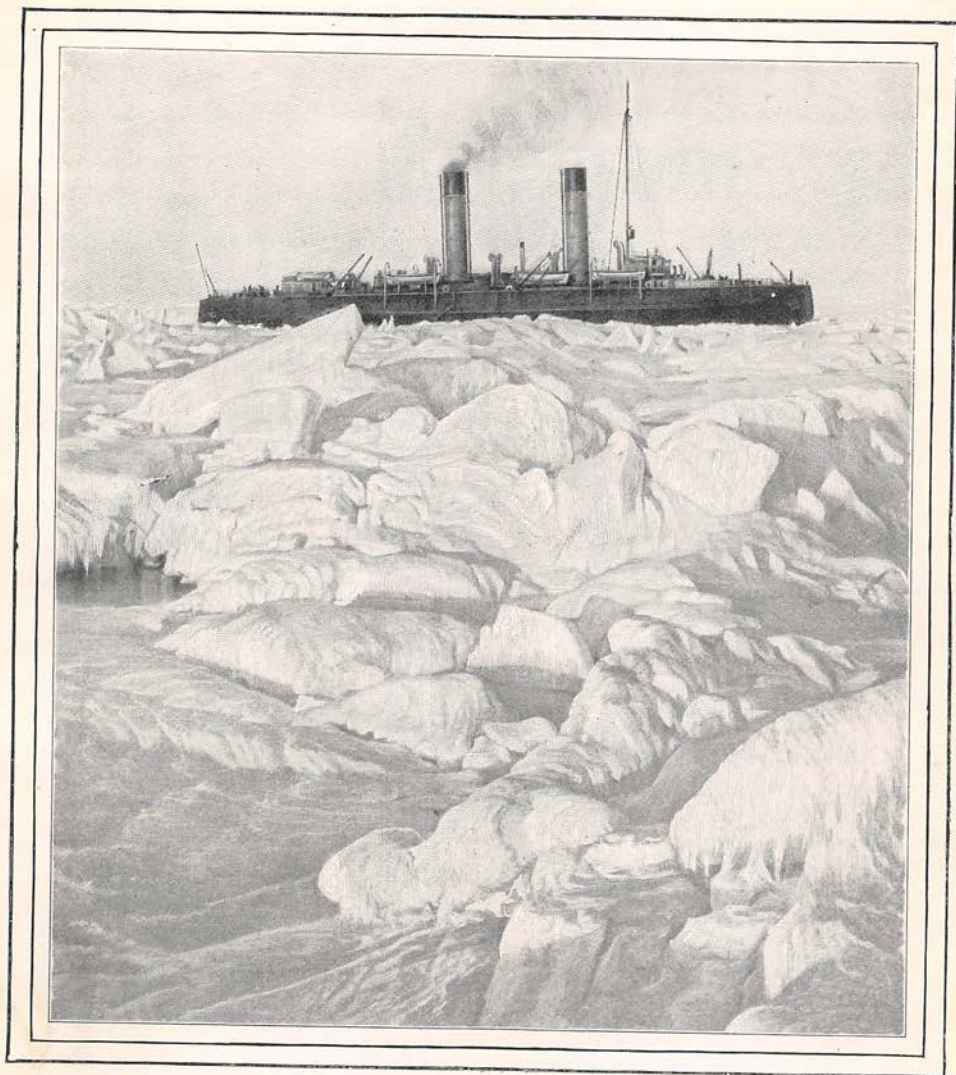
The vessel is equipped for every imaginable contingency. Even though her machinery were disabled and she lay helpless in the grip of the ice, she would suffer no serious inconvenience. The enormous and steadily increasing pressure would crumple in the steel sides of an ordinary ship, or at best would rack her so that she would certainly spring a leak. But the sloping walls of the *Ermack* are fifteen times as strong as the sides of the ordinary vessel; moreover, by reason of their slope, as the ice presses harder and harder upon them, the ship simply rises, as does a glass ball if you compress it between thumb and finger, until at length she rests secure upon the surface of the ice.

Newcastle-upon-Tyne, the scene of many inventions, from Stephenson's first locomotive to Parson's recent *Turbinia*, was the birth-place of the mighty ice-breaker. Here, in the great shipbuilding establishment of which Lord Armstrong is the head, she was gradually wrought out, and when given to the waves received the name of *Ermack* after the Cossack warrior who conquered Siberia, and whose feat she was intended to repeat in a more peaceful manner by sea. For it must not be supposed that the study and skill and money that have been expended to make the *Ermack* what she is were intended primarily to aid the cause of Arctic exploration. If she succeeds in reaching the North Pole, that achievement will be merely an aside to a career of purely commercial usefulness.

Russia has the longest coast-line of any country in the world. But the greater part of this coast lies along the Arctic Ocean, and there is only one month in the year when ships can have a reasonable assurance of reaching the northern ports, a number of which are of the first importance. For the other eleven-twelfths of the year they are closed by the ice, which attains a thickness of from eight to ten feet, and is sometimes heaped into hummocks twenty feet in height. Even in the Baltic, the port that is the commercial gateway to the capital is closed for five months of every year by the intense cold. It converts the surface of the Gulf of Finland and a good portion of the larger sea into an expanse of solid ice that sometimes extends 200 miles from land. If a ship is caught in this ice, it means either a delay



ADMIRAL MAKAROFF.



THE "ERMAK" MAKING HER WAY THROUGH A FIELD OF HUMMOCKY ICE IN THE BALTIC.

that destroys her profits for the season, or, more probably, her destruction.

When the Russian Government began to give serious attention to the enlargement of Russian commerce, it deputed Admiral Makaroff to make a careful study of the subject and plan an ice-breaker capable of opening the way to the Kara Sea, which receives the important Siberian rivers Obi and Yenisei, and which is closed by ice during eleven months of the year. Admiral Makaroff, in the course of his investigation, visited America and went up the Straits of Mackinac, and there studied carefully the ice-breakers that have been in use in the Great Lakes for the past twelve years. The *Ermaak*

is the result of this investigation; and she is constructed on the same general principle as the American ice-breakers.

The *Ermaak* was completed in February of last year. She at once set out for Kronstadt at a season when it would have been ridiculous for any other boat to attempt to approach the frozen Baltic port. The ice was encountered at a distance of 160 miles from Kronstadt. At first the *Ermaak* went through it readily enough. Her fore propeller sucked the water from beneath the ice, which broke as soon as her bow began to rise upon it, and she was able to maintain a speed of from four to six knots an hour. But as the more shallow and fresher portions



A FLEET OF ICE-BOUND VESSELS BEING CONDUCTED INTO KRONSTADT BY THE "ERMACK."
*The snow, which lay about a foot deep on the ice, retarded the progress of the ship more than did the ice itself.
 The picture shows into what fine pieces the "Ermack" breaks the ice.*

of the Gulf of Finland were approached, the task became more difficult. Here the ice, being packed to a thickness of several feet, offered a very great resistance. The *Ermack* did not fail to break this ice also, but her progress was slow. Sometimes, when she charged the field at full speed, she would advance no more than half a length before she was brought to a standstill, and then it was necessary to go back and charge again. In other places the wind had broken the ice earlier in the season, and piled it in huge windrows, sometimes extending six feet above the surface of the water and twenty-seven feet below. These ice-banks consisted of separate blocks from two to three feet thick, frozen together into one mass. Against them the *Ermack* charged with every engine at full pressure. Usually they gave way at the first onslaught, and with a tremendous crunching and grinding and groaning the stout ship ploughed through walls almost as high as her own sides, leaving behind her an agitated wake of bobbing pieces broken to dimensions of a foot or less by her powerful screws.

At Kronstadt it had been rumoured that a great ship was approaching, crushing the ice beneath her. But the inhabitants shook their heads. Such a thing was unheard of—impossible. They had come to look upon the ice as an impassable barrier. Nevertheless, one day the smoke from the *Ermack's*

funnels proclaimed undeniably that she was approaching, and the entire population of Kronstadt turned out to welcome their mid-winter visitor with cheers and jubilation. The *Ermack* steamed up to the landing, her propellers crushing and crunching the ice. She turned to port and then to starboard, moved backward as well as forward, treading out a path for herself in every direction.

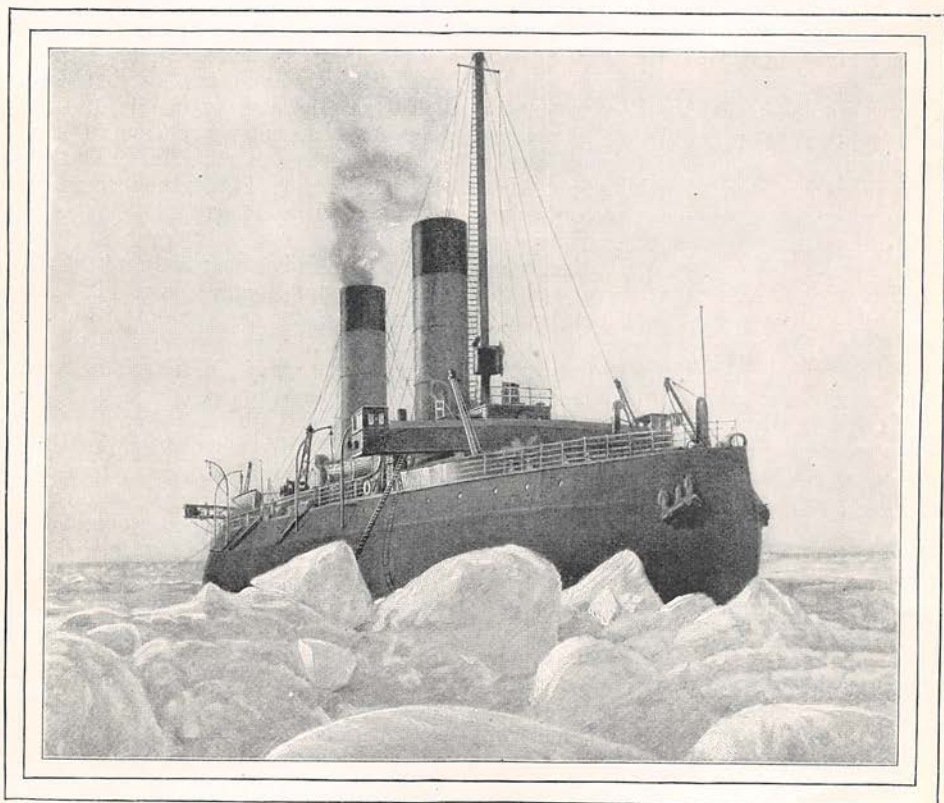
At that time a number of steamers were imprisoned in the Baltic, and the *Ermack* proceeded to their rescue. She went first to Revel, and from there conducted thirteen ice-bound steamers to port. One of these was leaking badly at the time of the rescue. But her bow was run into the stern of the *Ermack*, which is cut away for the special purpose of allowing this to be done, and the disabled vessel was thus conducted safely to port. Altogether the *Ermack* helped forty-one steamers through the ice during the brief remainder of the winter season. She had saved to commerce already more than the cost of her construction, and had demonstrated beyond any doubt her commercial utility.

But in the judgment of her commander there was still another world for the *Ermack* to conquer. She had broken ice of one season's freezing in the Baltic; could she force her way through the ice that had been freezing for years in the farther North? This was the point that Admiral Makaroff set

out to settle at the beginning of August, 1899. The *Ermack* carried on this occasion a number of scientists—a geologist, a botanist, and a chemist—as well as an artist, who was to reproduce on canvas, as accurately as possible, the glories of the Polar Zone. On board was also a photographer with a full equipment of kinematograph apparatus, his office being to portray the ship in the actual operation of breaking her way through the heavy ice of the North. The expedition was also fully equipped for a scientific study of ice in all its forms.

Although the expedition was undertaken, not for the purpose of reaching a high latitude, but to test the ship under the severest conditions, the story of the voyage, as narrated to me by Admiral Makaroff, with the aid of the ship's log, is highly interesting. The first thing discovered was that the forward screw, which had done such excellent service in the Baltic, was a positive hindrance when the enormous thickness of the Arctic ice was encountered. Accordingly, the ice-breaker returned to port and un-

shipped this propeller before proceeding on her journey. She re-entered the ice to the north-west of Spitzbergen on August 6th, and in eight hours she travelled thirty miles to the northward along a zigzag course, through ice of constantly increasing thickness. Then she was halted for three days, while a minute inspection was made to learn whether she had sustained any injury from the encounter. It was found that her sides had acquired a brilliant polish from constant contact with the ice. A few bent plates gave evidence of the need of local strengthening to resist the enormous pressure of the ice-field, but the ship had come through the ordeal practically unharmed. Her screws were now set in motion again, and in eleven hours she advanced thirty miles farther. At this point it was found that the ice was frozen solidly to a thickness of fourteen feet. In spite of its tremendous resisting power, the *Ermack* was still able to make her way forward. The progress was very slow, as it was necessary to charge the ice repeatedly before it would give way. At one time four hours were



THE "ERMACK" MAKING A CHARGE.

The ship's bow is here raised, by the pressure of the ice, nine feet above the usual water-line.

consumed in making an advance of two miles. The greatest bar to progress was not the depth of the ice, although the strength of a solid stratum of fourteen feet is, of course, enormous. A greater difficulty was the pressure of the moving ice-field, which increased with every mile of the advance. The *Ermack* stood up staunchly under this pressure, but Admiral Makaroff decided that progress would be easier at a point farther east. Accordingly, turning to the south, he cut his way slowly out of the encircling field and skirted its southern boundary to a point near the Seven Islands, where he again turned northward. During this part of the journey the *Ermack* encountered ice-hummocks piled up by the action of the wind to a height of thirty feet or more, but in every case they gave way and scattered before her charges.

In the region to which the expedition now advanced, it found ice of a different character, in the form of vast floes. Some of these floes were many miles in extent, made up of ice of great thickness and lined with hummocks of such height that the look-out stationed in the crow's-nest could hardly see over their summits. At the first impact the ship's speed did not slacken perceptibly, but it was noticeable that the bow began to rise slowly into the air as though she were being lifted from below by a giant hand. The ice showed no sign of yielding, and the ship moved on, going more and more slowly, until perhaps nine feet of the glistening surface usually below the water-line was exposed to view. At length she seemed to stand still. Her engines had not ceased their efforts; the screws were whirling at their highest speed and churning the water at her stern; but progress had decreased until it could hardly be observed by the eye. She was pressing upon the ice with a weight of 900 tons, and it was still firm. She even slipped back a few inches. It seemed as if she were going to fail. Then, suddenly, a crack which, beginning below the surface, had not before revealed itself, appeared in a long, irregular line extending from the ship's side. Sharp reports like the barking of quick-firing guns were heard. The whole field trembled as though moved by an earthquake shock. A great strip of it, a mile across and weighing in the aggregate thousands of tons, detached itself from the principal mass and moved slowly off. After remaining poised motionless for some minutes, the *Ermack* now darted forward swiftly, like a

living thing. Giant ice boulders, detached by the shock, plunged into the water, while others rising from great depths sprang into the air, looking as green as emeralds and as clear. They fell back into the water, and were crushed by the flying screws as in the jaws of a monster. Proceeding in this manner, the *Ermack* made her way through ice-ridges that sometimes rose to a height of eighteen feet above the surface of the water and extended to a depth of nine fathoms below.

By this unparalleled achievement the *Ermack* seems to have demonstrated that vessels of her kind are an entirely practicable means of reaching points in the frozen regions that have thus far proved utterly unattainable. Of this Admiral Makaroff himself is thoroughly convinced. "The thing required of a ship for Arctic navigation," said he, "is not tremendous engine power, but the greatest possible strength of frame. The *Ermack* has been strengthened once, and now she is being strengthened again, to make her more effective in this direction. The ice of the Baltic or the American Lakes offers a greater skin resistance than ordinary Arctic ice. What is needed to break it is engine power. But neither in the Baltic nor elsewhere below the Arctic Circle does one encounter the tremendous local pressure imposed upon a vessel by the great Polar ice-packs. This is the principal lesson of our experiences thus far."

In another year it is possible that a companion ship equal in strength to the *Ermack* may be completed. Then, if Admiral Makaroff obtains the consent of the Russian Government, he may endeavour to see how far north he can go in his ice-breakers. It is his opinion that two such vessels could work together to great advantage in Polar exploration. In anticipation of this, the stern of the *Ermack* was shaped especially to receive the bow of another vessel of the same kind. By thus joining two together, an engine of attack would be devised against which, it is believed, no conceivable thickness of ice could stand.

Admiral Makaroff has all the caution of the scientific man and all the modesty of the sailor. His final words as we parted on the deck of the *Ermack* were: "Mind you, I do not prophesy that I shall ever reach the Poles with an ice-breaker. But nothing can change my opinion that the future exploration of the Arctic and the Antarctic ought to be with the aid of ice-breaking ships."