

HIGH LATITUDE EXPEDITION ON THE RUSSIAN ICE-BREAKER « SADKO ».

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September 28, 1935, the expedition on the *Sadko* returned to Archangel.

This Expedition, which had been organized by the Chief Administration of the Northern Sea Route, had two main objects :

1. — The collection of material for the further development and elaboration of ice predictions for long periods ahead.
2. — The exploration of unknown or little known regions in high latitudes of the Arctic Ocean.

Both these problems are closely connected with the problem of investigating and mastering the main Northern Sea Route and navigation in the Arctic.

The expedition was under the leadership of the eminent Polar explorer G.A. USHAKOV; his assistant and head of the scientific research section was Professor N.W. ZUBOV.

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Although the expedition was not to spend more than four months at sea, it was provisioned for a possible two years' absence. Besides necessary supplies of food and warm clothing, it had a number of pneumatic rubber boats, plywood buildings, in sections, three dog teams etc. The Expedition had two small flying machines.

The complete staff of the expedition on the *Sadko* including the crew consisted of 78 persons.

The ship sailed from Archangel July 6. On July 13 she sighted North Cape where she started her scientific work.

A section with a series of oceanographic stations was made from North Cape via Medveji Island to South Cape, the southernmost extremity of Spitsbergen, for the purpose of determining the thermal conditions of the waters of the North-Cape current and of the cold currents passing from the Barents Sea westward between the above-named island and Südkap.

July 17 the *Sadko* headed from Südkap westward along parallel 76°. The expedition met the edge of the pack ice in the west on July 19 in longitude 8° 31' W. This was evidence of favourable ice conditions for the current navigation. In latitude 78° the ship made straight for the shores of Spitsbergen; July 22 she arrived in Ice Fjord and left Barentsburg July 29 to continue her work in the northern region of the Greenland Sea. A number of stations were made with soundings of over 2000-3000 m. On reaching long. 3° 40' E., lat. 80° 44' N., the *Sadko* followed the northern coast of Spitsbergen to the east; August 3, at a distance of about 50 miles to the southwest of the Seven Islands, the icebreaker entered into open ice. Pack ice lay to the north and northeast of these Islands (large ice blocks and floes). Only close to the shores of the Seven Islands, on their eastern side, could a strip of open water, with rare blocks of ice, be observed.

Two flights were made in the region of the Seven Islands in an easterly direction. They determined the condition of the ice, the second flight discovering the existence of open sea to the east of Foyn and Brock Islands. On the basis of these observations the icebreaker made her way through the ice and on August 6 reached open water to the northeast of Brock Island and sailed over this water south to the northeastern extremity of Spitsbergen, Cape Leigh-Smith. In addition to several oceanographic stations made along this route it was also possible to make, thanks to the clear weather, a marine description of the coast line from Cape Platen to Cape Leigh-Smith, which will considerably improve modern charts of this region. During the ship's stay at Cape Leigh-Smith two flights were made, one to the west and the other to the east of the Cape to collect hydrographical material and take photographs.

August 7 the expedition renewed its course eastward at first along open water. Ice was met to the west of White Island (Gilles). Rounding White Island on the north through

ice of different forms, the *Sadko* got into heavy pack ice accumulations in the channel between that island and Victoria Island. A thick fog hindered orientation, and it was therefore decided not to wait a bettering of conditions here, but to return westward to the known open sea. On reaching this last, the *Sadko* headed north till, in lat. $81^{\circ} 5' N.$, she met the edge of the pack ice, lying to the north.

The *Sadko* drifted with the ice in this region from August 10 to 14 in a north-westerly direction to lat. $81^{\circ} 12' N.$, long. $26^{\circ} 10' E.$ During this time flights were made to explore the region of the so-called Gilles Land. Although in 1928 the *Krassin* explored that region of the sea, where this hypothetical land is marked by dotted lines (on British charts), and did not find it, still the expedition on the *Sadko*, on the basis of S. Makarov's data after his cruise on the *Yermak* to the north of Spitsbergen in 1899 and of *Worsley's* data on the *Iceland* in 1925, admitted the possibility of the existence of this land further to the west than is shown on charts. During the last flight on August 14 made by M. S. BABUSHKIN with the leader G.A. USHAKOV on board, when lat. $82^{\circ} N.$ was attained, there was unfortunately such a dense fog in the north-eastern part of the horizon that the problem of Gilles Land could not be finally solved.

It was decided on August 15 to turn south from latitude $81^{\circ} 23' N.$, long. $30^{\circ} 30' E.$, and to search for a passage there so as not to lose coal and time in either attempting to force a passage or waiting for better conditions. The *Sadko* again sailed to White Island. A fresh north-westerly wind had cleared wide spaces of water to the south of the island and further to the south-east. The *Sadko* by drifting with the ice was carried with it to this open water but, further on, ice was again met with.

The ice conditions induced the leaders of the expedition to decide to sail still further south along the eastern coast of Spitsbergen, namely to lat. $79^{\circ} 15' N.$

From here the ship turned south-east and began to meet easier ice, making oceanographic stations every 30 miles. In lat. $78^{\circ} 30' N.$, long. $36^{\circ} 50' E.$, the expedition reached open water in the Barents Sea. The ship first headed for the western extremity of Franz-Josef Land, but then the course had to be changed for Russian Harbour to free the S/S *Spartak* which was waiting there with a cargo of coal for the expedition.

The *Sadko* reached Russian Harbour August 21 and after coaling left for the north east on August 24. The chief aim of the expedition now was to explore the extensive "white spot" marked on charts above the northern part of the Kara Sea in the triangle formed by Franz-Josef Land, Severnaya Zemlya, and Wiese Island. From Cape Zhelanye the *Sadko* headed for Wiese Island and simultaneously started its main scientific-research work. From here the ship turned northwards. No ice had been met on the passage from Cape Zhelanye to Wiese Island. Going northward the *Sadko* continued for a considerable time to move through absolutely open water, but on all attempts to deviate her course north-east she met with open ice.

On reaching latitude $80^{\circ} 48' N.$, long. $73^{\circ} 40' E.$, the expedition headed for Graham Bell Island keeping approximately to parallel 81° . Instead of drift ice the ship had now to push her way through heavy close ice often with the help of impacts. On August 29 the *Sadko* reached the eastern coast of the island a little to the south of its north-eastern extremity. The island was surrounded by land-floe, but further out to sea there was a large open space with a small channel near the northern shore of the island.

Observations showed the eastern coast of the island to be a little more to the south-east than shown on charts. From Graham Bell Island the *Sadko* sailed east. The ice here was markedly easier. Thus one of the most difficult parts of the Soviet Arctic region from the standpoint of ice conditions (viz., the region of the sea directly east of Franz-Josef Land) was found to be navigable this year for a ship of the *Sadko* type and could even be explored to a certain extent.

On reaching open water again on August 31 the *Sadko* turned northwards in long. 72° . The ship had close ice on her west which thus gradually pressed the ship somewhat eastwards. Soundings were slowly but surely getting deeper, and reached over 600 m. The *Sadko* was coming to the continental slope leading down to the depths of the Polar basin. The temperature of the water, marine organisms, and bottom deposits indirectly confirmed this.

However, in lat. $81^{\circ} 38' N.$ pack ice stopped all further progress northwards. The ship turned to the east. The soundings, which had attained 638 m., now began to decrease quickly and showed a depth of less than 200 m. The ice also began to grow closer eastward and compelled the ship to turn first south and then south-east. Whole groups of icebergs began to appear, mainly of a tabular form. Whenever the ice permitted, the *Sadko* tried to

push eastwards. The relief of the sea bottom became very irregular. The soundings fluctuated very sharply from 200 m. to several tens of metres and even less. Moving in a south-easterly direction across this wide shallow bank, extending so far out to the north, the *Sadko* discovered in September (in lat. $80^{\circ} 50' N.$, long. $79^{\circ} 20' E.$) an island, named Ushakov Island. A temporary clearing of the fog enabled the determination of an astronomical point off its north-western coast to be made, also the marine description of its northern shore and western and eastern coasts. The southern coast was inaccessible by reason of pack ice, but it was traced by one of the flying machines.

The island was found to be oval in form, extending from east to west and measuring $13\frac{1}{2}$ miles in length. The whole island is totally covered by an ice-shield whose height above sea level is about 250-300 m. As was discovered later, the island is situated in the central part of a bank, named by the expedition the *Sadko* bank.

The enormous quantity of icebergs made one suspect that they could not originate from only one such island, and therefore the *Sadko* undertook further explorations of the area occupied by the bank. An attempt to push eastward from Ushakov Island failed because of the pack ice brought hither by the constant eastern winds.

It was decided to pass westward for a further exploration of the south part of the bank; so, after finding no more land northwards the *Sadko* headed south, keeping to the western edge of the pack ice.

Rounding the pack ice on the south and cutting across the south-western part of the bank covered by open ice, the *Sadko* reached open water in long. 82° . From here the expedition made for Severnaya Zemlya which it reached September 8, moving through open water, in the region of Cape Litvinov.

Three small low-lying islands were discovered off this cape. On one of them a landmark was erected for navigation purposes. From Cape Litvinov the *Sadko* sailed westward to the eastern boundary of the above-mentioned central bank, oceanographic stations being made along the whole route.

The *Sadko* pushed north along the western edge of the ice to lat. $81^{\circ} 31' N.$ and then turned eastward to Cape Molotov. However, a storm began blowing from the south and developed a large wave over the wide expanse of open water to the south. The *Sadko* was compelled to steam slowly against the wind and waves; she thus again found herself more to the south in the vicinity of Cape Litvinov among open ice, probably carried out from the Red Army Strait.

The *Sadko* made for Schmidt Island, which it rounded on the south, making a description thereof, and reached Cape Molotov. Considerable open spaces were visible in the Laptev Sea. There fog still continued.

Fifteen miles to the north of Cape Molotov the *Sadko* met the edge of the ice and moved along it to the north-west. The ice had a wide fringe of sludge, small pieces of the ice broken up by the preceding storm. In lat. $82^{\circ} 15' N.$, a sounding of 2200 m. was made, thus showing that the ship had emerged to the region of great oceanic depths of the Polar basin.

Continuing her exploration, the *Sadko* reached in long. $87^{\circ} 04' E.$ the latitude $82^{\circ} 41.6' N.$ thus making a record for free cruising in the Arctic waters. There a complete oceanic station was made with a sounding of 2365 m., samples of animals and bottom deposits being collected, the first from this region of the sea.

The edge of the ice from here turned to the southwest thus forming in the region of the *Sadko's* record an open space of water penetrating far into the north. Continuing her work to the southwest and meeting with considerable areas of slush, young ice, and pancake ice, the *Sadko* explored the edge of the ice and the eastern part of the bank in that area where it had before been hindered by the ice. The expedition did not succeed in rounding the bank on the north because of the ice.

The ship then laid her course across the southern zone of this bank. Further, she approached Ushakov Island from the south-west and discovered as formerly pack ice to the south-east of the island, retained in its position by the stranded icebergs. To the west of the bank the ship again headed for the north, hoping to attain a high latitude on this side also. Notwithstanding clear weather, in contrast to the weather during former visits to this region, no new land was discovered from the ship. This time also the ice stopped the ship in latitude $81^{\circ} 40' N.$ — perhaps this was due to a north-easterly wind arising.

Sailing along this parallel till meridian 73° the ship then turned south-west along the ice edge to the south-western extremity of Graham Bell Island. The ice edge was this time much more to the north-west than at the end of August. The temperature of the air fell to -10° C.

From the south-eastern extremity of Graham Bell Island the ice edge turned south, gradually disappearing from view. To the east of it the sea was covered for 15-20 miles by new ice.

On reaching parallel 80° the *Sadko* sailed along it to Wiese Island with a section, and from there made for Cape Zhelanye and then through the Kara Sea to Yugor Strait. After stopping at the Anderma settlement the *Sadko* left September 25 for Archangel through Yugor Strait.

The expedition on the *Sadko* had succeeded during its cruise in carrying out a large quantity of work in the regions visited. Extensive material on the oceanography of the Greenland Sea was collected in the form of hydrographical data and abundant hydrological material. This, together with the data of former Soviet expeditions on the *Perseus* will enable a more or less complete conception of this important basin to be worked out. The biological collections, samples of the bottom deposits etc., will undoubtedly supply new information about this water area. Much material has been collected in the region to the north-east of Spitsbergen.

The discovery in the extreme north of the Kara Sea of an extensive shallow bank, whose southern boundaries were discovered by the expeditions on the *Sedov* in 1930 and on the *Taimyr* in 1932 and were later investigated by the expedition on the *Sedov* in 1934, is an important factor in the ice and hydrological regime of the Kara Sea.

Besides the extensive material collected at 107 deep-sea oceanographic stations (15 of which were at depths of over 2000 metres), at which hydrological, hydrochemical, biological work was carried out, and at which bottom deposits were studied, much work has been done in other branches of science. For instance, the geodesist of the expedition made determinations of gravity at 51 stations in the Arctic, some of which had hitherto been inaccessible. Thirteen magnetic points; 2400 miles of ice mapped; 2500 soundings; a number of radio sounding-balloons sent up to a height of 20 kilometres; extensive actinometric observations; other geophysical observations; a study of synoptical conditions in high Arctic latitude; special ice observations; and the study of the vessel's behaviour in ice made in the interests of shipbuilding — all this together supplies very much material for further investigations and for the mastering of our Arctic regions.

