

**Royal
Geographical
Society**
with IBG

Advancing geography
and geographical learning

Proposal for an Expedition to Sannikoff Land

Author(s): E. von Toll and P. Kropotkin

Source: *The Geographical Journal*, Vol. 12, No. 2 (Aug., 1898), pp. 162-172

Published by: [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1774464>

Accessed: 14/09/2014 11:58

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



The Royal Geographical Society (with the Institute of British Geographers) is collaborating with JSTOR to digitize, preserve and extend access to *The Geographical Journal*.

<http://www.jstor.org>

its left bank, and this view was still maintained by Ernst Curtius in his latest work, 'Stadtgeschichte von Athen' (1891). But Dr. Dörpfeld, relying on the statements of ancient writers concerning the objects which are in its neighbourhood, and especially on the remark of Callimachus, that in his time its water was so foul that cattle would not drink of it, concludes that the Eridanus flowed from the south-western slopes of Mount Lycabettus, and passed through the northern part of Athens, in doing which it would easily be converted into a public sewer; and these arguments appear to Mr. Frazer to be conclusive.

The maps and plans which accompany these volumes are of great service in elucidating the text, and the numerous illustrations will be invaluable to students of Greek sculpture. Altogether, Mr. Frazer is to be congratulated on having produced a monumental work, which is a storehouse of learning and research.

PROPOSAL FOR AN EXPEDITION TO SANNIKOFF LAND.

By Baron E. von TOLL.

ON the oldest map of the New Siberia islands, dating from the year 1811, the outlines of two lands are marked, and they bear the inscription, "Land sighted by Sannikoff." One of these stretches on the map from the meridian of the northern point of the Fadéyev island to the longitude of the "High Cape" of the New Siberia island, while the other is marked in the north-west of the island Kotelnyi.

Jacob Sannikoff was a Yakutsk merchant,* who undertook a series of bold journeys to the New Siberia islands from 1805 to 1811, and was first a *promyshlennik* (hunter) in the service of Syrovatski, who had then the monopoly of exploitation of mammoth-tusks in the Liakhov islands; later on he accompanied Mathias Hedenström in his journeys. Sannikoff was one of the discoverers of the New Siberia islands, and we are indebted to him for some very important information concerning the peculiar nature of the islands, which information was transmitted to the world through Hedenström's writings. The first, although unsatisfactory, topographical survey of the islands was made by the topographer Pshenitsyn. Sannikoff was also the first to spend a full summer on the northern island of the New Siberia archipelago. During that stay, he had the opportunity of sighting with his sharp eyes, on clear summer days, those two lands situated the north of the islands, Kotelnyi, Fadéyev and New Siberia, and their supposed outlines were marked on the above-mentioned map according to his indications. His and Hedenström's attempts to reach those lands in sledges drawn by dogs were, however, unsuccessful, because open spaces amidst the ice (*polynias*) soon compelled both explorers to return.

Ten years after the completion of the Hedenström and Sannikoff's journeys, the Imperial Russian Ministry of the Navy sent out the well-known expedition of Lieut. Anjou, which had to settle the topography of the New Siberia Islands, as well as the question relative to the existence of the lands sighted by Sannikoff. After two unsuccessful attempts, made in 1821 and 1822, to overcome with dogsledges the obstacles offered by the *torosses* (ice-heaps) and *polynias*, Lieut. Anjou declared, in a report addressed to the authorities in 1822, that he was ready to renew the attempt in a boat, starting from the island Kotelnyi, or Fadéyev, but

* More correctly a burger (*myeschanin*) of Zyryan origin, as his descendants said.

that it was impossible to attain those lands in dog-sledges. However, his proposal was not accepted, on account of the considerable danger which it offered, and Anjou returned in 1823, after having made his last sledge-journey along the coasts of the New Siberia Islands, with the full conviction that, "within the distance which could be attained with the means at hand, there was no land in the north of the islands, Kotelnyi, Fadeyev, and New Siberia."

On the authority of Anjou, the "lands sighted by Sannikoff" disappeared from the maps, until full sixty years later, *i.e.* in 1881, the tragical expedition of De Long confirmed, by the discovery of Bennet Land, the existence of the land sighted by Sannikoff from the "High Cape" of New Siberia. This discovery gave support to the idea that the other land, which Sannikoff saw from the Kotelnyi island, but of the existence of which Anjou was doubtful, was not merely an optical mistake, and consequently a dotted shore-line reappeared on the maps, with the name of "Sannikoff Land."*

In the mean time, the tradition about the existence of the land that Sannikoff saw in the north of Kotelnyi island was maintained amidst the *promyshlenniki* (hunters), because those of them who had visited the Kotelnyi island confirmed Sannikoff's statements. In reality, I could convince myself of the exactitude of this affirmation in 1886, during the expedition which was sent out by the Imperial Academy of Sciences, under the leadership of Dr. A. Bunge. On August 13th I saw, during quite clear weather, from the mouth of the Mogur river ("Sannikoff river" on Anjou's map), under 79° N. lat. and 139° E. long., in the direction N. 14° to 18° E.,† the sharp outlines of four truncated cones like table mountains, from which a low foreland extended towards the east. At that time I had no possibility of making an attempt to reach that land. A solid ice-crust seemed to stretch from Kotelnyi island to Sannikoff Land. Perhaps the *polymia* was at that time closed by floating ice, or it opens only during the cold season and after strong storms. At any rate, in order to cover the distance of about 200 kilometres (130 miles) to Sannikoff Land, both dog-sledges and a good boat would have been required, while I had at my disposal only ten worn-out reindeer, with which I had undertaken to make the round of the island. I was bound to return southwards to my headquarters, the winter hut at Uralakh, where my dogs recovered their forces for the return journey to the mainland. True that a boat had been made there in the mean time out of driftwood, with the aid of a keel and ribs which had been brought from the mainland. But, "uneven-bowed and leaky" as that boat was, it could only be used on August 23 to 25 for a few trips along the coast amidst the ice-floes; it was impossible then to think of a dash towards Sannikoff Land.

In the year 1893 I once more put my foot on the Kotelnyi island, during a rapidly organized excursion, which lasted from May 2 to June 8, and which I made on dog-sledges, but having no boat with me. My main working field was at that time further west, on the Anábar. While I was there, in August and September, the *Fram* sailed along the coast of Siberia towards the New Siberia islands, and passed by Sannikoff Land. Fridtjof Nansen's diary has, under the date of September 20,

* This was done, first, at the proposal made by A. Grigoriev, in his paper, "Sannikoff Land," in connection with the discovery of the expedition of the *Jeannette* (*Izvestia* of the Russian Geogr. Soc., vol. xviii. (1882), fasc. 4, pp. 264-267); also Fr. Schmidt, "Remarks concerning Nordenskjöld's 'Circumnavigation of Asia on board the *Vega*,'" in *Beiträge zur Kenntniss des Russischen Reiches*, II. series, vol. vi. (1883), pp. 355-356.

† Anjou determined the position of the mouth of Sannikoff river as 76° 2' 3" and 136° 33' E. of Paris. His magnetical constants are 16° 40' E. and 82° 57'. Consequently, the mountains of Sannikoff Land ought to have been marked on the map due north of the northern extremity of Kotelnyi island.

the following inscription : " We now held (in lat. $77^{\circ} 44'$ N.) north-west along the edge of the ice. It seemed to me as if there might be land at no great distance ; we saw a remarkable number of birds of various kinds. A flock of snipes or wading birds met us, followed us for a time, and then took their way south. They were probably on their passage from some land to the north of us. We could see nothing, as the fog lay persistently over the ice. Again, later, we saw flocks of small snipe, indicating the possible proximity of land. Next day the weather was clearer, but still there was no land in sight. We were now a good way north of the spot where Baron von Toll has mapped the south coast of Sannikoff Land, but in about the same longitude. So it is probably only a small island, and in any case cannot extend far north " (' Farthest North,' I. p. 203).

It appears to me, from Nansen's words, that in his opinion the *Fram* was on that day on the north of Sannikoff Land, and that the birds which he saw were returning from some other unknown land. I believe, however, that the flocks of snipes must have been flying from Sannikoff Land, and that the *Fram* probably was at that moment south of that land. I myself am, to some extent, the cause of that mistake—if mistake there is—because Nansen based himself on my preliminary sketch-map, upon which I had roughly traced the southern extremity of Sannikoff Land in the year 1887. I think, however, for reasons which will be better understood from the following, that in reality Sannikoff Land is situated further north than where I had traced it on the said sketch-map. If it be so, the considerations which made Nansen conclude that that land is but a small island are removed.

The mountains of Sannikoff Land, which I saw through the telescope, very much reminded me by their shapes of the basalt cones of the Svyatoi Nos, as they appear to the eye from the southern shore of the great Liakhov island. The forms of the mountains of the Sannikoff Land thus authorize us to believe that these mountains consist of basalts, like the mountains of Bennet island, the southern point of which (Cape Emma) is said to consist of the same rock, according to the diary of De Long. As to the distance between Sannikoff Land and the Kotelnyi island, we may estimate it as follows:—

When we take into account that the height of the trap, or basalt mountains, in Arctic Siberia altogether is subject to but small oscillations, and, at any rate, seldom exceeds 1200 feet, and that the mountains of the Svyatoi Nos, looked at from the south coast of the Liakhov island, at a distance of about 45 miles, appear to be twice or thrice as high as the mountains of Sannikoff Land, we may conclude that the distance between Kotelnyi and Sannikoff Land is twice or thrice as great as the above—that is, from 100 to 125 miles, or from $1\frac{1}{2}$ to 2 degrees. I conclude, accordingly, that the south coast of Sannikoff Land must be located under about the 78th degree of northern latitude.

As to the probable extension of Sannikoff Land, and the question whether there are to be expected other islands besides those which have been discovered by De Long,—the Bennet, Henrietta, and Jeannette islands—we have, in my opinion, some established points, which permit us to express, with due caution, the following suppositions:—

1. It must be remembered that the traps, which have a wide extension in Siberia, always appear in massives not far apart from each other. Their distribution answers to certain tectonic lines, along which they pierce the sedimentary rocks, whether the latter, being horizontal, build up plateaus, or whether they take the shape of folded series of parallel ridges. The trap mountains are volcanic mantles which spread over the sedimentary deposits ; occasionally they have maintained the forms of volcanoes with well-determined craters. Bennet island seems also

to contain, besides the basalts, beds of lignite, which may be considered with great probability as a continuation of the tertiary lignite beds of New Siberia which appear under the same longitude, and are known as the "Wood mountains." The similarity of structure between New Siberia and Bennet island is thus evident, and it is permissible to suppose that Sannikoff Land and Bennet island represent only parts of a trap region having a certain extension.

2. De Long found on Bennet island the antlers of a reindeer, about which he was not certain whether they belonged to a recent or to a fossil individual. In the first case, we could admit either that Bennet island has such a climate as permits reindeer to sojourn there—which would naturally seem highly improbable—or we should be bound to admit that the antlers belonged to an animal which came from New Siberia, and would have been killed in the island, which also seems to me a rather forced explanation. But if these antlers were fossil, then the other contemporaries of the reindeer, the mammoth, the rhinoceros, the musk-ox, etc., whose remains are so characteristic of the New Siberia islands, must also have lived in Bennet island. We should then expect to find in Bennet island and Sannikoff Land the same geological features as in New Siberia. Further, we should then have to conclude that the coast-line of the Post-pliocene Siberian continent not only included the New Siberia islands—which has been firmly established by the two last expeditions of the Academy of Science—but that this old coast-line must be traced still further northwards. How far this old continent—which, like New Siberia, is now broken into an archipelago—stretched northwards, and whether it ended at the spot where Nansen found, in 79° N. lat. and 140° E. long., a depth of 1050 feet, or whether it stretched further to the north and the north-east of the course of the *Fram*, is precisely a most interesting geographical question.

3. One of the results of Nansen's *Fram* expedition is the highly important fact that the drift of the *Fram* was not a continuation of the drift of the *Jeannette*, but, although both had the same origin, the latter was to the north of the former.* What is there producing this bifurcation of the current? I cannot answer this question otherwise than by the supposition that there are lands lying in the north of the New Siberia islands, which lands need not stretch, of course, as far as the pole, but must have a sufficient size to produce the said bifurcation of the current.

4. In the drift course of the *Fram*, as well as along the route followed by Nansen and Johansen, it appeared that floating ice always drifted with a greater facility northwards, while it was mostly blocked when it was pushed south-eastwards—that is, in the direction of the archipelago which I suspect to exist.

If these considerations relative to the probable extension of Sannikoff Land and its belonging to an undiscovered archipelago be true, the whole matter is, of course, only about such masses of land as may have the size of Franz Josef's Land, but hardly the size of Spitsbergen or Greenland. *But even if the archipelago consisted only of Bennet island and Sannikoff Land, the urgency, from a scientific point of view, of an exploration of these two islands would not be smaller than if we expected there the presence of larger extensions of land.*

I will mention briefly the scientific aims of an expedition to Sannikoff Land.

It would be needless to bring further proof for the assertion that such an expedition, made with a ship, would have to solve a series of *oceanographic problems*, of which the first would be the investigation of the dependence, so unexpectedly found by Nansen, of the Atlantic ocean on the polar basin.

The *topographical* and *geographical* questions which the expedition would have

* Cf. also A. Supan, "Die Norwegische Polarexpedition, 1893-96," in *Petermanns Mitteilungen*, Band. xliii., 1897, pp. 130 *seq.*

to solve, are already indicated in what has just been said. It need only be added that the working field of such an expedition would touch part of the unknown, *i.e.* never yet visited polar regions which reach the lowest latitudes in the eastern hemisphere.*

Among the physico-geographical researches, *geological* problems stand foremost. Some remarks on this subject have already been made in the exposition of the reasons which make one believe in the existence of an undiscovered archipelago in the north of the New Siberia islands. I will only add what solutions may be found in this region for most important questions relative to the latest periods of the history of our globe.

In the study of the Tertiary sediments which, as already said, must be expected to be found at Cape Emma, on Bennet Island, as a direct continuation of the New Siberia deposits, we meet with one of the most interesting problems, namely, How could sub-tropical plants thrive so near the pole under the present position of the Earth's axis of rotation? It is well known that in Greenland, Grinnell Land, Spitsbergen, and New Siberia, there are Tertiary deposits (Miocene?) which contain impressions of leaves and fruit-cones of several species of *Sequoia*, *Dammara*, and so on, as also large leaves of poplars and other trees which belong partly to a sub-tropical flora. Basing himself upon the words of Schiaparelli, who thinks that astronomy has nothing to object to a change in the position of the Earth's axis of rotation, if geologists prove the necessity of such an admission, Neumayer attempted to explain the, in his opinion, abnormal grouping of the Tertiary floras round the pole by the supposition of the pole having moved since the Tertiary age ten degrees from Northern Asia in the meridian of Ferro. In such case the pole of the Tertiary age would have been situated in the latitude of 80°, where this parallel passes through the archipelago which it is now proposed to explore. However, Nathorst, who has further worked out this theory, thinks that the pole ought to have been situated ten degrees southwards in the direction of North Asia, in which case, what was then the 80th degree of latitude would have passed, as it passed now, through the same archipelago.

The flora of the Tertiary "Wood Mountains" of New Siberia, which is now situated under the 75th degree of latitude, tells, in my opinion, against the theory of Neumayer and Nathorst. But Nathorst remarked that the fossil plants which I brought home in the year 1886, and which represent only fifteen species, are not sufficient to settle the point at issue. In that year I had but a few days for the exploration of the island of New Siberia and its "Wood Mountains," and I had but two dogs to transport my collection, my food supplies, and my baggage. How much better could the Tertiary deposits be explored during a year's stay in Bennet island, and how much more could be collected from the "Wood Mountains" if the collectors had a ship at their disposal for the home journey! I have no doubt that this new expedition would definitely settle the above question.

Another equally important problem is the Quarternary age. The original characteristics of the deposits belonging to that period have long since been explained for Europe and North America by the admission of a wide glaciation during the glacial period. As regards Asia, Prince Kropotkin was till lately alone in maintaining that parts of Asia, and especially middle Siberia, were also glaciated during the Quaternary period; but Northern Asia was considered till quite recently as having not been glaciated at all during the age when the Ice-period prevailed in the two other parts of the globe. Only my observations in the New Siberian islands in the year 1886, and at the mouth of the Anábar in 1893, and the testimony of

* Cf. A. Supan's 'Map of the Limits of the Unknown Polar Regions,' in *Petermanns Mitteilungen*, Bd. xliii., 1897, p. 15, plate 3rd.

Nansen about moraines and glacial striæ on the Taimyr peninsula gave positive evidence for the acceptance of glaciation in Northern Asia.* However, the observed facts seem to offer certain peculiarities, and to somewhat differ from the well-known traces of glaciation in Europe, so that a strict verification is required in order to levy *all* doubts. On the New Siberia island it is the "rock-ice," or the fossil glaciers as I have described them, which can be considered as the last vestiges of a former glaciation. The points of comparison between these fossil masses of ice and the present glaciers of the arctic regions cannot easily be found—the more so as the latter have been but insufficiently studied. Only the detailed investigations of E. von Drygalski, whose beautiful work has just been published, contain the basis upon which "rock-ice" can be better investigated.

If the rock-ice of New Siberia be a remnant of the old continental glaciation, as Drygalski is also inclined to accept with me, we may expect to find, on the islands farther north, the centre of radiation of that glaciation. A number of observations indicate that the motion of the continental ice-mass must have taken place in the New Siberia islands in a meridional direction. The exploration of the archipelago on the north of New Siberia will show whether this movement was directed from the north or not. Moreover, it will show whether I am right in my supposition that the Quaternary mammals of New Siberia inhabited a continent which had once a wide extension towards the north and the east, possibly being connected with America, and only gradually was cut into an archipelago. The sum total of the geological exploration of that archipelago, in connection with the comparative study of arctic literature of other regions, must finally throw new light upon the question whether the arctic islands altogether, with the exception of the New Siberia islands, which are undoubtedly continental islands—are remains of a broken up continent or not.

Going hand-in-hand with the geological observations, the *zoological* and *botanical* investigations will give further information concerning the just-mentioned question relative to the origin of these islands. It will appear whether their sweet-water fauna and flora are akin to the flora and fauna of the Asiatic continent only, or also contain an admixture of American species, or of such species as are characteristic of all other arctic lands. An equally great interest must be offered by the study of the *marine fauna*, and a still greater interest by the study of the *micro-organisms* in the snow flora and fauna, and especially in the fossil masses of ice.

The *meteorological* observations which would be made at a spot situated as far as possible north of the Siberian coasts would be of the greatest importance. They would give, so to say, a basis for the highly interesting meteorological observations which were made during the drift of the *Fram*, and consequently related, like all other travelling observations, to some new spot nearly every day.

As to the importance and necessity of observations on *terrestrial magnetism*, I permit myself to give, in connection with the subject, the following quotation only:—

"For our knowledge of the magnetic conditions of the Earth, the observations which we may make in the course of ten years cannot be a substitute for those observations which we lose the opportunity to make. What has not been done to-day is lost for ever; and the absence of these data will remain for ever a gap and a hindrance. Later on, but only after a long interval of time, it will, perhaps, be possible some day to reconstitute the present conditions in a theoretical way. But the perfection of the theory, which will be required for that end, will only

* Subsequently Vysotsky, who explored the lower Ob in 1896, and Inn. Lopatin, in the diary of his journey of 1866, which was only published in 1898, brought further proofs in favour of the glaciation of these regions.

then be attained when we shall have made for a long time consecutive observations over the whole surface of the Earth.”*

I now will pass from these theoretical considerations to the practical question, *How can Sannikoff Land be reached?* The attempts of Sannikoff in 1806–1811, and of Lieut. Anjou in 1821–1823, have shown that with dog-sledges the land lying in the north of the New Siberia islands cannot be reached, on account of the *polynias* (open spaces). On the other side this can easily be done in summer, in a boat, as has been proved by De Long, on his return journey from Bennet island to New Siberia. However, a serious scientific exploration of those lands would be impossible under such conditions. For science' sake, it would be necessary to winter on Sannikoff Land, and in such case the shipping of the necessary provisions on sledges or in boats would evidently be impossible.

The only appropriate way to reach Sannikoff Land would be to make the passage in a ship—from the mouth of Lena, as will presently be shown. As might have been expected, the *Fram* expedition has proved that it is possible to attain the latitude of 78°—that is, the latitude of Sannikoff Land—in a few days by simply following the ice-free drift of the waters of the Lena.† True that in this latitude the *Fram* was frozen, and the famous drift of the unconquerable ship began therefrom. But it must not be forgotten that the *Fram* was very much belated, and that it was frozen on September 25. To avoid such an issue, which would be quite undesirable, it is evident that the journey should be made earlier in the season, and this can only be accomplished with certainty if the ship starts from the mouth of the Lena. That this last is quite free of ice in August is proved, besides many other testimonies, by my boat journey in the delta of the Lena in the year 1893.

There would also be another reason for taking the mouth of the Lena as the starting-point for an expedition to Sannikoff Land; namely, the possibility of providing the explorers with the necessary number of dogs, and the provisions for them. The best draught dogs in Siberia, and in the whole world, are found in the delta of the Lena. So that, if it were intended to reach Sannikoff Land in the course of one summer by starting from a European port, it would still be necessary to call at the mouth of the Lena to take the dogs, or at least (for the sake of saving time) at the mouth of the Olenek, where the dogs would have been prepared in advance. It is self-evident that in such case there would be the risk of missing that part of the season which would be best suited for reaching Sannikoff Land. It would thus be necessary, in order to be sure to attain the aim and to be well equipped, to spend two summers—not to mention that the ship which will next sail past Cape Chelyuskin may be less lucky than its three predecessors, the *Vega*, the *Lena*, and the *Fram*—and in such case may be compelled to winter at Cape Chelyuskin, and then spend a third summer on the way.

Consequently, it seems to me that the surest way would be to charter for the expedition a ship which would lie at anchor in the Lena the winter before. The steamer *Lena* is still there, but she is hardly in a state which would allow her to sail in the polar sea. It would thus be necessary to have another new ship. In case the available means would not allow of building or buying a new vessel, it seems to me reasonable to follow the example of the *Lena* of 1878, that is, to send a ship to the mouth of the Lena for purely commercial purposes. Such an enterprise, especially if a customs-free entrance of the goods at Yakutsk be granted, would be without doubt highly profitable; and it hardly would be advisable that such

* A. Schmidt, “The Geographical Problems of the Exploration of Terrestrial Magnetism,” in *Verhandlungen des XII-ten Deutschen Geographentages*, 1897, p. 127.

† The *Fram* passed the mouth of the Olenek on September 15, and on September 20 she was in the supposed latitude of Sannikoff Land.

a ship should attempt to return the same summer with a cargo of goods exported from Siberia. Besides, the visit to the mouth of the Lena by a strong ice-resisting ship, under the guidance of an experienced Norwegian walrus-hunting captain, and the experience which would be thus won in the navigation of the Arctic sea in the waters surrounding New Siberia, would be an epoch-making fact. A successful navigation of the New Siberia waters would mean, on the one side, the beginning of a solid scientific exploration, and of a systematic study of the mammoth tusks wealth of these islands; and on the other side, it would be a prelude to the navigation eastwards of the Lena, to the mouth of the Kolyma, which would answer to a most pressing need of the population settled along this river. As an illustration of this need, it may be mentioned that, in consequence of the difficulties of transport by land, along the nearly 670 miles' long road from Yakutsk, across the 5000-feet-high Takulan pass of the Verkhoyansk range, the *puđ* (36 lbs.) of rye-flour costs the Government 7 roubles 57 copeks (15s. 4d.) at Verkhoyansk; and from this last place the flour has to be taken nearly another 670 miles, until it reaches Kolymsk. What is the price of a *puđ* of rye-flour at Nijni-Kolymsk, I don't know,* while the price of flour at Verkhoyansk is taken from an official communication which was made to me, in the year 1893, by the governor of the province of Yakutsk. It is evident that if the flour were sent every year on board ship from the mouth of the Lena, along the coast, to the mouth of the Kolyma, as also of the Indigirka, the Government would find in this mode of transport a great benefit.

As for the sale of European goods, if such be shipped from Europe, they would find, first, the Yakutsk market, and then the market of the gold-mines scattered on the large tributaries of the Lena. The returns of the Yakutsk fair, which takes place in summer, from July to the end of August, attain, according to official data, the figure of 2,000,000 roubles (£200,000), of which one-half represents the value of imports—chiefly cotton and woollen goods, china and earthenware, various colonial produce (excepting tea), and different chemical produce, while the other half represents the exports of fur goods and mammoth tusks.

As to the gold-mines, they are situated chiefly on the tributaries of the Vitim and the Olekma, and lately have been spread to those of the Aldan. The administrations of the two former regions spent, in 1889, the sum of 4,174,150 roubles (£417,415) for goods sold to the workers only. As to the needs of the gold-mines for technical purposes, it will be sufficient to name only dynamite, of which about 900 *puđs* (about 33,000 lbs.) were used in 1889. It is certain that the orders for goods from one single of the larger gold-mines would be sufficient to richly pay the journey of a steamer *viā* the polar sea to the mouth of the Lena.

The idea of a navigation between the mouths of the Lena and the Kolyma is so little new that Baron A. E. Nordenskjöld, more than twenty years ago, made the proposal to open a regular navigation between the Lena and Bering strait, and soon after that proved the possibility of realizing his scheme by his *Vega* journey. I was brought to the idea of the Lena and Kolyma navigation partly through my own knowledge of part of these regions, and partly directly by a considerable Siberian export firm, Gromoff & Co., and their representative, M. Pikhtin. This shows that there is already a demand for that navigation. My proposal is certainly not meant to be opposed to Nordenskjöld's plan, but, on the contrary, I consider its realization as equally desirable and practical.

* According to the testimony of a gold medallist of the Russian Geographical Society, who stayed at Kolymsk for four years and wrote a book about those regions, signed "Dioneo," the price of a *puđ* of rye-flour is 14 roubles 70 copeks (£1 10s.). As to salt, its price raises to 1 rouble (2s.) the pound in the spring, and none is to be had at any price. All fish is eaten frozen and raw, for want of salt. (*Note of the translator.*)

The *realization of the expedition* would be, in short words, as follows:—

1. Next summer, in 1899, the ship—a good sea-going Norwegian walrus-hunter—ought to try to make its way *viâ* to Kara sea and past Cape Chelyuskin, to the mouth of the Lena. If the ship succeeds, as was the case with the *Lena* in 1878, to make its way through one of the arms of the mouth of the Lena, it must go up the river to Yakutsk, and, after having unloaded its cargo of goods, winter at Yakutsk or above that town in the Lena. If, however, no passage which would be suitable for the draught of the ship could be found in the delta of the Lena, the ship would find a good anchorage on the west coast of the Borkhaya bay. With the establishment of the winter, the goods could be easily carried by reindeer over the usual commercial road, about 67 miles long, and over the 1500-foot-high pass, across the 250-foot-high Kharaulakh mountains, to Bulun on to Lena, and from this depôt they would be carried further on on board the steamer *Lena*.

2. Next summer the expedition would start, after having provided itself at the mouth of the Lena with a number of the best dogs and reindeer, and previously, with a few Yakut ponies and with the necessary provisions for the animals. In August, taking advantage of the favourable Lena drift, the expedition could easily call at the New Siberia islands in order to establish there depôts. Then, judging from the experience of the *Fram*, it could reach the coast of Sannikoff Land in a few days. It would be desirable, if open water permits it, to penetrate as far north as possible, and to stop at one of the farthest northern spots of the discovered archipelago, or at the north end of Bennet island, in case the latter has a greater extension towards the north than Sannikoff Land.

3. Here the expedition would land, and the ship return to the mouth of the Lena. One part of the expedition would begin then the building of the house which they would bring with them, for establishing their winter quarters, and begin at once the meteorological and magnetical observations which would have to be carried on for a full year. In the mean time, the other part of the expedition may carry on the topographical and geological survey of the archipelago, so long as weather permits this to be done. In the spring and the summer the same work would be continued, so long as the ship does not come to take the expedition home.

4. On the return journey it is desirable to enlarge the field of observations by taking some other course, such as along the eastern coast of New Siberia, in which case a landing at the “Wood Mountains” would be most necessary in order to widely explore them and to make collections.

5. As to the composition of the expedition, it would be sufficient for me to have three collaborators,—an astronomer, a meteorologist, and a topographer. Besides, I would choose among the best *promyshlenniki* (hunters) a few Yakuts or Tunguses to act as hunters and dog-drivers.

NOTE BY THE TRANSLATOR.

The translator of Baron Toll's admirable paper asks the author's permission to add the following considerations. If five-and-twenty years ago the necessity of exploring the flora of the Tertiary deposits *as near to the pole as possible* was considered as a weighty argument in favour of arctic exploration, the force of this argument is only the greater now. Four important sets of facts have been brought to bear since upon the solution of the question indicated by Baron Toll. On the one side, it has lately been maintained that the Tertiary vegetation which was discovered in polar regions may not have been so much sub-tropical as it had been supposed to be. But making full allowance for possible exaggeration of the amount of sun-heat (though not of *light*) that would be required by the Tertiary plants to grow in high latitudes, and fully admitting that these plants may have grown in

a northern temperate climate, the fact still remains that no imaginable redistributions of seas and sea-currents would account for the growth of even temperate-zone trees and shrubs in those high latitudes, especially when those latitudes were occupied by a large arctic continent. More fossil material from the highest latitudes is therefore required now, even much more than it was required when the remarkable conclusion of Oswald Heer as regards Tertiary vegetation became first known. The great question raised by Heer—and there is no other question of equal importance in the whole domain of Tertiary and Quaternary geology—will remain unsettled so long as we have not more fossil Tertiary plants from very high latitudes, in order to determine the true character of the sub-arctic Tertiary flora.

The latest discoveries relative to the changes of position of the Earth's axis of rotation have given new support to the hypothesis mentioned by Baron Toll, according to which hypothesis the pole may have been situated in Tertiary times several degrees southwards from its present position. The curve which the pole has described within the last few years is—we now know—a spiral, not a closed circle. But, with all that, the distribution of the tertiary vegetation round the pole seems to indicate that the climate was warmer in *all* directions from the pole. A change in the position of the axis may thus be insufficient to explain the facts relative to the Tertiary flora when these become known in their totality. We *must* therefore know the Tertiary flora of high latitudes *in its entirety*; otherwise we are bound to float in incertitude amidst the different hypotheses.

A third set of facts which have lately been discovered, especially due to the latest investigations in the southern hemisphere, is the astounding similarity of the Tertiary flora all over the surface of the globe. These researches are far yet from being complete, but already they seem to indicate that during the Tertiary age the distinctions between the different zones of the Earth were not so sharp as they are now; the climate on the surface of the globe seems to have been more equal than it is at the present time. If this be true, if the sharp climatic distinctions which we now see between the different zones did not exist in Tertiary times to the same extent and with the same sharpness as they do exist now, a great question arises; namely, was not that relative uniformity of climate due to a different composition of the atmosphere of our globe? And this question, of highest importance for geology, can only be solved by getting considerable quantities of fossil Tertiary plants from both the arctic and antarctic regions.

And fourth, a new hypothesis, which assumes, indeed, a change in the composition of the atmosphere, has been brought to the front by the great physicist, Arrhenius, and has been further developed by one of the greatest authorities on the recent geological history of the globe, Prof. Chamberlin, of Chicago. According to this hypothesis, the immense change in the climate of the globe, which took place between the Tertiary times and the Glacial period, may have had its cause in an increase of percentage of carbonic acid in our atmosphere. The volcanic eruptions which took place on an immense scale at the close of the Tertiary age in America, and in the arctic regions (and I will add, in the antarctic regions as well, and on the immense Vitim plateau and its border-ridges in Siberia), may have thrown into our atmosphere considerable quantities of carbonic acid; and Arrhenius has shown that even a very small addition of this gas to the atmosphere would considerably reduce its transparency for the heat-rays of the sun. Besides, one is naturally brought to the suggestion that the gases newly discovered in our atmosphere may also have varied in quantity at different geological epochs, the more so, as one of them, helium, is known to appear in a relatively great proportion in the waters of mineral springs, such springs being closely connected with volcanic outbreaks. In short, the variable constitution of the atmosphere may have been

the cause of changes of climate all over our globe, and one of the most vital geological questions is now to ascertain what was the real composition of the Tertiary flora, not only in the temperate zone, but especially in the arctic and antarctic regions. What was the extent of change in climate which we are bound to admit?

Let me also add that, since botanists have so well proved lately that the flora of each separate region of the globe is a direct descendant, and bears the stamp of the flora which clothed that same region in Tertiary times, the thorough and full knowledge of the Tertiary flora, in all the parts of the globe, becomes a matter of first importance for the evolutional botanist.

Taking everything into consideration, it is no exaggeration to say that, once there is a hope of discovering new beds of Tertiary plants in Sannikoff Land and Bennet islands, *this hope alone*, apart from all other geographical and oceanographical considerations so well indicated by Baron Toll, *would be a sufficient reason for sending out an expedition for the exploration of these Tertiary deposits.*

The same applies in full, and even much more, to the necessity of sending out an antarctic expedition to explore the Tertiary plants, the presence of which has been indicated by both Carlsen and Borchgrevink.

P. KROPOTKIN.

RUSSIAN NAVIGATORS IN THE ARCTIC OCEAN IN 1895-96.*

Communicated by Colonel J. SHOKALSKY.†

THE special expedition organized by the Ministry of Marine in 1894 to explore the estuaries of the Obi and Yenisei and part of the Kara sea, wintered at Yeniseisk, and on the approach of spring was engaged in repairing the vessels—the s.s. *Lieut. Otsin* and sailing barge *Lieut. Skuratov*, the former drawing $8\frac{1}{2}$ feet of water.

In the previous year (1894) they had made a successful trial of the coal obtained from the Alexander Nevsky mine, near one of the right tributaries of the Yenisei—the Dudiuka, and, finding its quality to be not inferior to that of English coal, decided on making exclusive use of it for the future.

While these preparations were being made, the commander of the expedition, Lieut.-Colonel A. J. Vilkitsky, together with Lieut. K. V. Ivanov, determined by telegraph the difference in longitude between Yeniseisk and Krasnoyarsk, the former serving as the base for the astronomical work of the expedition. Vilkitsky also conducted, in 1894 and 1896, a series of observations with an apparatus of reversible pendulums by Repsold belonging to the Imperial Russian Geographical Society, by whose desire these observations were undertaken.

On June 15 the expedition left the town of Yeniseisk by the river, and on their way down fixed the position of the village of Gelahino, and observed the magnetic elements at this place and at Dudinsk, where they also took pendulum observations. On July 17 they reached the estuary of the river, and entered the sea to the west of Sibiriakov island. Finding, however, the Gulf of Yeniseisk still

* Map, p. 224.

† Colonel Shokalsky, who has obligingly forwarded this report containing data from unpublished sources, and three charts of this northern navigation, corrected according to recent observations, besides the sketch-map alluded to hereafter, is the Secretary of the Physical Section of the Imperial Russian Geographical Society. He was one of the Russian delegates and a Vice-President at the International Geographical Congress held in London in 1895, at which he communicated a paper on the "Maritime Route to Siberia" (see 'Report of the Sixth International Geographical Congress,' p. 239).