The Arctic region in the economic and geographical concept of Vladimir Dehn

S B Ulyanova¹, N E Anosova¹ and A A Fisheva²
¹Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia
²The North-West Institute of Management, branch of The Russian Presidential Academy of National Economy and Public Administration the President of the Russian Federation, St. Petersburg, Russia

oulianova@mail.spbstu.ru

Abstract. The article discusses the views on the Arctic region of Russia expressed by V.E. Dehn (1867–1933), an outstanding Russian researcher in the field of economic geography who developed the theoretical background of this science and contributed to the organization of teaching economic geography in the universities of St. Petersburg (Leningrad). The analysis of the book collection created by V. Dehn in 1902 at the Economic Geography Department at St. Petersburg Polytechnic Institute which was regularly replenished with various publications on commodity science, railway engineering, aviation, statistics, geopolitics and other materials enabled the authors to look into the «intellectual laboratory» of V. Dehn. In his assessments of the prospects for the Arctic region development, V. Dehn used the descriptions of sea polar expeditions, ethnographic surveys of the life of the aboriginal population, governmental reports and scientific reviews of the regional economy development, etc. Within the framework of sectoral economic and geographical concept, V. Dehn's interest in the North region was due to the prospects for the development of forestry and timber industry in Russia. V. Dehn referred to transport inaccessibility and low population density as the main obstacle for the economic development of the Arctic territories and Siberia. Hence, the researcher paid special attention to railway construction projects developed in the early twentieth century, considering them the primary factor in the colonization of the North. The historical development has shown that the colonization of the Arctic in the twentieth century was associated with the discovery of rich mineral deposits in the region and their industrial production. The researcher highlighted the global importance of the Northern Sea Route as a transport corridor.

1. Introduction
The exploration of the Arctic region, the rational use of its resources and the preservation of its natural and cultural heritage involve a multidimensional scientific study. Oceanographers, hydraulic engineers, economists, archeologists and other specialists are developing the scientific background for practical activities in the Arctic region [1]. Economic geography, which studies nature resource potential and models of economic development in the region, is very important in this regard [2].

In the early twentieth century the world-known scientific schools of economic geography were founded by V.P. Semenov-Tian-Shansky, S.V. Bernstein-Kogan and V.E. Dehn. This paper analyzes the views of Vladimir Dehn (1867–1933), the founder of one of the first Russian schools of economic geography.
The obituary published in The Economic Journal in 1934 called Vladimir Dehn the «father» of economic geography in Russia and the author of books on various topics related to agriculture and industrial economy, including a large Course of Economic Geography (1924), a systematic and complete exposition of the subject. It was also mentioned that the commitment and dedication of Dehn to Russian economics and his outstanding claim to its recognition were brought to realization in his teaching activities at the Saint-Petersburg (Leningrad) Polytechnic Institute, where he worked from its foundation in 1902 until its reorganization into five technical schools in 1930 [3]. Dehn laid the scientific basis for training economic geographers of higher qualification, and his students worked after graduation in research institutes, colleges and universities.

Vladimir Dehn was born in St. Petersburg in 1867. In 1890, he graduated from the law faculty of Moscow University, and in 1894, after a three-year internship abroad, he received a Master's degree in political economy, statistics and financial law. Dehn began his career as an officer at the Ministry of Finance, but two years later left it for teaching (at the Alexander Commercial Lyceum and as a visiting Associate Professor at Moscow University from 1898). Dehn gave lectures on «Commercial geography», «Economic history of Russia in the XIX century» and «Forms of economy in their historical development»[4].

In 1902, Dehn was invited to St. Petersburg Polytechnic Institute, a new institution of higher education that was established in 1899 and opened its doors to the students in 1902. S. Witte, Minister of Finance and founder of the Institute, put forward a concept that implied the integration of technical and economic education to train highly qualified professionals for the national industry. V. Dehn worked at the department of economic geography, which was the first department of economic geography in the country, until 1931. His contemporaries noted that Dehn was an exception teacher, devoting his whole time to his students. His seminars at the Polytechnic Institute were especially popular.

The biography of V. Dehn (together with M. Chatelen, A. Radzig, V. Grum-Grzhimailo and others) is an example of how representatives of the so-called «old professorship» found their place in the conditions of the systemic transformation that Russian society experienced after the revolution of 1917–22.

In the 1920s, V. Dehn contributed a lot to institutionalizing economic geography as a special scientific field. Simultaneously with his work at the Polytechnic Institute, he headed the Economic Geography Department at the Military Economic Academy of the Workers' and Peasants' Red Army (1920–24) and the Department of Economic Geography at Petrograd (Leningrad) State University (1918–30). The researcher made considerable efforts to organize the Geographic and Economic Research Institute and was an active member of the Russian Geographical Society[5].

The methodological principles laid down by V. Dehn and his followers (V. M. Stein, V. Chetyrkin, B. Semevsky and others) contributed to the further development of economic geography in the USSR. However, the life of V.E. Dehn and his students was tragic: Dehn’s school of economic geography closed, economic geographers L. Sinitskii and S. Bernshteyn-Kogan were imprisoned and A. Rybnikov was sentenced to death. The geographers Grigoryev, Berg, Semyonov-Tyan-Shanskiy and Baranskiy were not deprived of freedom but were forced to restrain from expressing their views. They were also subject to inner-party criticism [6]. The books written by Dehn disappeared from scientific discussion, and his views were declared bourgeois and anti-Soviet. The name of an outstanding scientist was forgotten for a long time in Russia and abroad. In the early twenty-first century the scientific heritage of Dehn was acknowledged in the history and methodology of science.

2. Findings
V. Dehn was a proponent of a sectoral approach to geographic research. The scientific school founded by him used statistical methods to analyze the distribution and functioning of economic objects. His main works were devoted to metallurgical, cotton manufacturing, forestry and other industries [7]. The works of V. Dehn also contain the assessment of the territorial organization of economy. Thus, in his statistical essay «Russia's Position in the World Economy», the researcher highlights three factors that
determine the specifics of the Russian economic life. He proposed the idea of taking into account the continental character of the Russian territory, the slight angularity of the coastline, the remoteness of many parts of the country as well as the geographic nature of the seas adjacent to Russia and the lack of convenient access to the open sea. He also mentioned the low population density in Russia as one of the factors of North Russia. All this could explain the underdevelopment of communications in Russia [8]. In this connection, V. Dehn’s interest in geopolitics [9], the rapid development of which started in the early twentieth century, is quite understandable.

It became possible to look into the «intellectual laboratory» of V. Dehn with the help of the materials created by him in 1902 at the Economic Geography Department at St. Petersburg Polytechnic Institute. The laboratory aimed to maintain practical classes compulsory for all students in this discipline. The book collection of the Department of Economic Geography was the largest and unique in the USSR in the early 1930s. The Cabinet has rare and short-run editions on merchandising, railway business, aviation, statistics, geopolitics, etc., in its collection. The book collection (about 4 thousand units of storage currently) also includes cartographic materials on economic and physical geography, guidebooks, economic and statistical maps of Russian cities, scientific works of V. Dehn and other authors. The collection contains various publications such as the following: reports on the work of various ministries and their departments (ministries of commerce, foreign trade, communication, etc.); reports of government committees; annual journals of foreign countries; industrial reports of Germany, England, USA, France and Russia; Russian regular publications on economic issues; geographical and economic maps; publications of international organizations (including the League of Nations); works and dissertations of the representatives of German universities (in 1927–1928 V. Dehn was working in Germany); foreign publications on economics in English, French and German colonies; Russian monographson agriculture, transport and other industries [10].

There are also publications about the Arctic and the Russian North in V. Dehn’s collection. Formally, they can fall into several groups.

Firstly, these are the descriptions of the history of the conquest of the Arctic and the materials of various expeditions [11]. For example, an essay about the commercial expedition of G.L. Brusilov in 1912–1914 on the ship «St. Anna» was published in the appendix to the journal «Notes on Hydrography» in 1917. The purpose of the expedition was to get from Murmansk to Vladivostok by the northern searoute. As a result, the ship was icebound in the Yamal area and drifted for many months. Due to illnesses, hardships, hunger and conflicts, part of the crew left the ship and tried to get to Franz Josef Land on skis. The history of this northernmost (at that time) Russian expedition ended tragically: all those who remained on the ship died, and only two people out of 11 who left the ship in search of land survived (including V. Albanov, the navigator and the author of the notes) [12].

Dehn’s collection contains scientific and popular geographical works related to the Russian Arctic history and development [13]. These works emphasized the great role of the Northern Sea Route. The Arctic was bound to open the shortest link between Europe and the Pacific Ocean basin, but it could become possible only after the conquest of the polar region. M. Bodnarsky believed that no matter how large the expenditures on the study of the Northeast Passage, or, as we still call it, the Great Northern Sea Route were, they were fully justified by the importance of this path for the relationship of Europe with East Asia, and especially Siberia. He said that the establishment of permanent maritime relations with the mouths of the great Siberian rivers would mean opening the way for Siberian goods to the world market and reviving the deserted coastlines of the Arctic Ocean and the terrain along the great Siberian rivers flowing into the Arctic Ocean [14]. The author points out that this project is considered by European countries as a scientific and geographical problem (the reason is the opening of the Suez Canal and changing the global system of maritime communications), while for Russia this project is of practical importance, starting with the Russian-Japanese war of 1904–1905 [15]. These books also mention the goals for the resource development of this territory. The authors state that the use of the Arctic region had great future. The books dwell on the great prospects for the
use of large natural resources of the Arctic lands, which are likely to be rich in gold, coal and other valuable minerals. In view of these prospects, the inherent rights of the Soviet Union to the Arctic region were highlighted [16].

Finally, the third group of «Arctic» publications in V. Dehn's collection is the works of ethnographers and economists devoted to the traditional economy of the region — reindeer herding, sea animal hunting and fishery [17]. Thus, two reports of V. Aleev, the specialist of Arkhangelsk Department of Agriculture and State Property on the survey of animal and fishing industries in the White Sea contain not only their general characteristics and the characteristics of some regions, but also the description of the organization and material support of the industries (the publication also contains photos) [18]. However, it is difficult to say whether the scientist ever used these materials, as there are no works devoted to this branch of the economy written by V. Dehn. However, these materials might have been used by the students of the Faculty of Economics who studied the North under the supervision of V. Dehn in 1922 [19].

What conclusion can we draw about the views of V. Dehn on the Russian Arctic based on the study of such diverse materials?

It should be noted that this region was not the major issue for the researcher. V. Dehn could not yet see the industrial prospects associated with the development of mineral resources (the industrial development of the Arctic regions started in the 1930s known as the period of the first five-year plans). V. Dehn pointed out that Russia was an agrarian country and referred to the Arctic regions as the «unarranged lands». He said that in the far north, nothing grew except mosses and berries and only fishing and hunting on fur-bearing animals and marine mammals could draw people to those regions [20]. In his famous course of lectures on economic geography for students of the Polytechnic Institute we will find only a few lines about the «pasture system» in the Far North that is wide-spread among indigenous people («reindeer-breeding indigenous dwellers», by the definition of the author), i.e. Samoyeds (Nenets, Entsy, Nganasan, Selkups), Lapps (Saami), Zyrians (Komi) [21]. So, the Russian North drew the attention of Dehn only as a forestry region, with no serious coverage of fishing or sea animals hunting in his review.

In his works, V. Dehn repeatedly stressed the importance of forestry for the Russian economy. He was sure that forests gave a whole range of products that satisfied the most important human needs such as materials for buildings and various utensils, fuel, tar, resin and its products, wood pulp for paper production, etc. Dehn expressed his concerns about the overuse of Russian forests by the population and insisted on the nationalization of forestry. He believed that administering forestry in the lands that belong to the state was more effective than in privatized ones. He also said that the state ought to give more importance to the national economic value of forests in terms of climate, soil and irrigation of the country [22]. Large-scale state-run forestry (forest roads, the fight against forest fires and insect pests, cutting of glades, etc.), according to V. Dehn, could also contribute to an increase in population density in the «deserted» areas.

V. Dehn highly appreciated the quality of Russian timber despite the fact that a significant part of the forests belonged to the category of «unarranged». The scientist advocated the development of the timber industry in the northern regions to export timber products rather than raw materials, and to provide the national market with pulp, paper, millwork, etc. V. Dehn noted that in the early twentieth century the demand for timber in Russia was not satisfied by the national industry [23].

It was precisely the forestry prospects that drew V. Dehn’s attention to the development of the Arctic region. For V. Dehn the Arctic region was important, mainly, in terms of transport accessibility of the regions of the European North, Siberia and the Far East. In his writings, the scientist emphasized the fact that most part of Russia’s forests is concentrated in the northern regions of Arkhangelsk, Olenets, Vologda, Vyatka, Perm and Siberia. The possibilities for their commercial use were extremely limited for two reasons: the harsh climate and sparse population (in some cases even «desertedness»), on the one hand, and the lack of communication lines, on the other hand. V. Dehn wrote that the Siberian rivers froze for a considerable part of the year, there were practically no railways in the north, and railway construction had not yet begun in those parts of Siberia where it was
mostly needed. Sea transportation in the Arctic Ocean was extremely difficult (in addition to opening the maritime routes, it was necessary to organize the meteorological service all over the Arctic territory, monitor ice cover, provide radio stations, build shelters and food stores in case of storms, etc). However, V. Dehn considered it inevitable to relocate timber export centers from the Baltic ports of Russia (many of which were lost after the First World War) to the ports of the northern seas [24].

In his review of the work «Urban and rural areas in European Russia» written by V.P. Semenov-Tian-Shansky [25], another prominent researcher in the field of economic geography, V. Dehn pointed out to the emergence of new factors determining the economic dynamics, i.e. the development of the railways, the growth of industrial development related to technical-economic specialization and the emergence of new branches in trade [26]. Transport accessibility, in his view, plays a larger role in the economic development of individual regions, urban centers and the whole country. Therefore, V. Dehn called for the continuation of work on laying the Murmansk railway, as well as the development of navigation on the Arctic Ocean to the mouths of the great Siberian rivers [27]. Most likely, this was the reason for the careful collection of various materials made by the researcher about the sea polar expeditions to the Northern Sea Route that is now stored in the Economic Geography Office of the Polytechnic Institute. The collection also contains the information about the hydrographic expedition to the North Arctic Ocean, which worked in the western part of the North-East Passage from 1898 to 1905 and outlined the sea route to the estuary of the Yenisei river.

Considering various prossects for the economic development of the northern regions of the country in his work «Russia's Position in the World Economy», V. Dehn analyzed the transport projects of the forest regions in the European North and Siberia, which started during the First World War. In particular, he dwelt on the «Government’s regular tasks of forest management after the war» issued in 1916. The document is primarily about the construction of the Murmansk railway, the decision about which was made by the tsarist government in 1915, and the railway traffic was opened in November 1916, which played a huge role in the development of the Murmansk port [28].

Another project, which V. Dehn paid attention to, was the construction of the Ob–Kotlas railway, which could link Siberia with European Russia and open direct access of Siberian goods to European markets [29]. However, this railway was never built due to insurmountable technical and financial obstacles, and later it was no longer necessary due to the construction of the Northern Sea Route.

Surprisingly, the views of V. Dehn did not practically influence the changes in the scientific views and public attitudes towards the Arctic, which came into being in the Soviet society at the turn of the 1920s–1930s.

The discoveries of A. Fersman, G. Chernov, P. Shrubko and others as well as the works of joint Karelian and Murmansk and Kamchatka expeditions of the USSR Academy of Sciences revealed enormous resources in the depths of the North region. The first five-year plan (1928–1932), in addition to other tasks, stipulated the exploration and development of these resources, the construction of new enterprises in the Polar regions and the construction of new industrial cities – Apatity, Vorkuta, Naryan-Mar, Sangar, and others [30]. The northern regions became a resource base for the development of the all-Union industry. The working youth and the students were enthusiastic about solving those ambitious tasks. The profession of a polar explorer acquired a heroic aura and a particular attraction.

However, V. Dehn did not go beyond the traditional paradigm of agricultural and transport colonization of the Arctic. In our opinion, this can be explained both by the age of a scientist (in 1927, V. Dehn celebrated his 60th birthday), and by the atmosphere of political repression that he was surrounded by at the end of his life, which could not but affect his professional activities.

3. Conclusion
The views of V. Dehn on the Arctic region development reflect the significance that the Arctic region had in the economic system of Russia in the early twentieth century. Then it was a low-populated area with an uncoordinated climate, almost inaccessible in terms of transport communication. The attempts to open the sea route through the Arctic Ocean, as evidenced by numerous writings on polar expeditions
by both Russian and overseas researchers, were often fatal. The inhabitants of these regions were only involved in reindeer herding, fishing, and hunting on marine animals, but it did not contribute much to the economic development of the country.

The interest in the Arctic territories could only be evoked by the need for the development of communications that could reliably connect the European part of the country with the north of Siberia, Kamchatka and the Far East. Thus, in the concept of V. Dehn, the transport development of the Arctic region was bound to contribute to the economic growth of Siberia and the development of Siberian industry. Another focus made on the Arctic in the works of V. Dehn is the development of forestry, timber exports and timber industry in Russia.

The term «colonization of the North» was repeatedly mentioned in the works of V. Dehn. The scientist was confident that this task had to be fulfilled. Historical development has shown that the colonization of the Arctic in the twentieth century was associated with the discovery of rich mineral deposits in the region and their industrial production, as well as the development of transport communications of global importance.

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References
[1] Aksenov Y et al 2017 On the future navigability of Arctic sea routes: High-resolution projections of the Arctic Ocean and sea ice Marine Policy 75 300–17
Hacquebord L and Avango D 2016 Industrial heritage sites in Spitsbergen (Svalbard), South Georgia and the Antarctic Peninsula: Sources of historical information Polar Science 10 433–40
Arctic: Past and Present 2016 ed. S V Kulik (Moscow: Science) (in Russian)
[2] Lazhentsev V N 2015 Socio-economic geography and interdisciplinary synthesis in the study of the North and the Arctic of Russia Spatial Economics 4 117–30 (in Russian)
Selin V S, Vasilyev V V and Shirokova L N 2011 Russian Arctic: Geography, Economy, Zoning. (Apatity: Publishing house of the Kola Scientific Center of the Russian Academy of Sciences)(in Russian)
[3] Vladimir Dehn (1867–1933) 1934 The Economic J. 44 157
[4] Cheparukhin V V 2001 Vladimir Eduardovich Dhen - the known and unknown facts in his biography Russian researchers of the XIX – XX centuries via http://elib.spbstu.ru/dl/729.pdf (in Russian)
[5] Anokhin A A 2010 V.E. Den and modern socio-economic geography Geographical education and science in Russia: history and current state (St.Petersburg: VVM) pp 425–32 (in Russian)
[6] ShawDJBandOldfieldJD2008Totalitarianismandgeography: L. S. Bergandthedefenceofacademicdiscipline in the age of Stalin Political Geography 27(1) 96–112
Tammiksaar E, Pae T and Kurs O 2013 A continuity of ideas? Salme Nõmmik, Edgar Kant and the development of economic geography in Soviet Estonia. Geografska Annaler 8 95(1) 51–70
[7] Heavy Industry in the USSR. Coal, Oil, Iron and Copper 1926 ed. V E Dehn (Moscow-Leningrad: Gosizdat)(in Russian)
Dehn V E 1905 Forest and Forestry in Russia (St.Petersburg: Schroedertypography)(in Russian)
Den V E 1912 Coal and Iron Industry (St.Petersburg: I. Trofimov Lithography)(in Russian)
[8] Dehn V E 1922 Position of Russia in th World Economy. Analysis of Russian Exports before the War. Statistical Essay(Petrograd) pp32–3 (in Russian)
[9] Dehn V E 1997 The teachings of Rudolf Kjellénon the subject and objectives of geopolitics News of the Russian Geographic Society 129(1) 26–38 129(2) 28–41 (in Russian)
[10] CheparukhinVV 2007 Memorial Book Collections of the Early XX Century and their Creators (St.Petersburg: PolytechnicUniversityPress)(in Russian)
[11] AmundsenR 1936 The Northeast Passage. Expedition to the «Maud» along the Northern Coast
of Asia 1918-1920 (Leningrad: Glavsevmorput Publishing House)(in Russian) 
BěhounekF 1928 7 Weeks in Polar Ice(Leningrad: Krasnaya Gazeta publishing house)(in Russian) 
[12] Albanov V I 1917 To the south to Franz Josef Land. Hike of V.I. Albanov on ice from the schooner «St. Anna»of G.L. Brusilov Expeditions. With a sketch of G.L. Brusilov expedition compiled by L.L. Breitfus Notes on Hydrology 4–5 1–68 6 69–194(in Russian) 
[13] Wiese V Yu 1932 International Polar Year (Leningrad: Publishing House of the All-Union Arctic Institute at the CEC of the USSR)(in Russian) 
Breitfus L L 1928 The Arctic Region, its Nature, and Objectives of the Study (Leningrad: AeroracticPressAssociation)(in Russian) 
[14] Bodnarsky M S 1926 Great Northern Sea Route. Historical and Geographical Essay on the Opening of the Northeast Passage (Moscow–Leningrad: Gosizdat) p 5(in Russian) 
[15] Bodnarsky M S 1926 Great Northern Sea Route. Historical and Geographical Essay on the Opening of the Northeast Passage (Moscow–Leningrad: Gosizdat) pp141–2(in Russian) 
[16] Aleksandrovsky A and Matveeva P 1928 Fight for the Poles of the Earth from Nansen to the Present Day. Popular essays (Leningrad: KrasnayaGazetaPublishingHouse) p 111(in Russian) 
[17] Volens N V 1926 Colonists of Murman and their Economy: Materials of Statistical and Economic Research of 1921–1922 (Moscow: Himtechizdat) (in Russian) 
Volens N V 1924 Crafts and Agriculture of the Pechora Territory (Report of a Reconnaissance Economic Study for 1921) (Moscow–Leningrad: NHTI) (in Russian) 
[18] Aleev V 1913 Report on the expedition to the White Sea coast in the winter of 1911. Statistical and economic survey of the coast and fishing area (St.Petersburg: Kirschbaum Typography) p 32 (in Russian) 
Aleev V 1913 Report on the Trip to the Sea Animal Trade in the Throat of the White Sea in 1911 (St.Petersburg: KirschbaumTypography)p 330(in Russian) 
[19] Smelov V A 1999 Some Facts from the History of Engineering and Construction (Hydraulic Engineering) faculty. 1918–1930 (St.Petersburg: Publishing house of St. Petersburg State Technical University) p 93 (in Russian) 
[20] Dehn V E 1908 Essays on Economic Geography. A course of Lectures Delivered at the Economic Department of the St. Petersburg Polytechnic Institute. Part 1. Agriculture (St.Petersburg: Pravda Typography) p 55 (in Russian) 
[21] Dehn V 1904 Lectures on Economic Geography (St.Petersburg: I.Trofimov´sLithography)p 330(in Russian) 
[22] Dehn V E 1908 Essays on Economic Geography. A course of Lectures Delivered at the Economic Department of the St. Petersburg Polytechnic Institute. Part 1. Agriculture (SPb.: Pravda Typography) pp142–7 (in Russian) 
[23] Dehn V 1922 Position of Russia in the World Economy. Analysis of Russian Exports before the War. Statistical Essay (Petrograd: North-Western Industrial Bureau of the Supreme Economic Council) p 32 (in Russian) 
[24] Dehn V 1922 Position of Russia in the World Economy. Analysis of Russian Exports before the War. Statistical Essay (Petrograd: North-Western Industrial Bureau of the Supreme Economic Council) pp 145–52 (in Russian) 
[25] Semenov-Tian-Shansky V P1910 Urban and Rural areas in European Russia. An Essay on Economic Geography with 16 Maps and Cartograms (St.Petersburg: KirschbaumTypography)(in Russian) 
[26] Dehn V E 1916 Review of the Work of V.P. Semenov-Tian-Shansky: Urban and Rural Areas in European Russia (Notes from the Statistical Department of the Imperial Russian Geographical Society. Vol. 10. Issue 2 and last, ed. by V.O. Struve) (Petrograd: Typography of the Imperial Academy of Science) p 108 (in Russian) 
[27] Dehn V 1922 Position of Russia in the World Economy. Analysis of Russian exports before the War. Statistical Essay (Petrograd: North-Western Industrial Bureau of the Supreme Economic Council) p 164 (in Russian)
[28] Fedorov P V 2009 The Northern Vector in the Russian History: the Center and the Kola Arctic in the 16th-20th Centuries (Murmansk: MGPU) pp160–1 (in Russian)

[29] Dehn V 1922 Position of Russia in the world economy. Analysis of Russian exports before the war. Statistical Essay (Petrograd: North-Western Industrial Bureau of the Supreme Economic Council) p 159 (in Russian)

[30] Ulyanova S B and Ofitserova N V 2016 Laying of Soviet Arctic: the historical experience of early Soviet Arctic development projects (1920–1930s) Arctic: Past and Present ed SV Kulik (Moscow: Science) pp 268–9 (in Russian)