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HALF A CENTURY IN THE NORTH: THE 50th ANNIVERSARY OF THE LABORATORY OF GEOECOLOGY OF THE NORTH, FACULTY OF GEOGRAPHY, LOMONOSOV MOSCOW STATE UNIVERSITY

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The article is devoted to the history of the laboratory of geoecology of the North (LGN) of the Faculty of Geography, Lomonosov Moscow State University, established in 1969 as a research laboratory for development of northern territories. The prerequisites for establishment of the laboratory by the former head of the Glavsevmorput (Chief Directorate of the Northern Sea Route), Engineer Rear-Admiral Vasily Fedotovich Burkhanov, and the history of research conducted by the laboratory scientists are described. The idea promoted by V.F. Burkhanov was to develop a consistent integrated strategy for development of the North based on consideration of both anthropogenic and natural factors. It is shown that this basic principle laid down by V.F. Burkhanov has been preserved in the modern activities of the laboratory, which has been headed by Professor V.I. Solomatin for forty years. During half a century of the laboratory's existence, well-known researchers, who made a significant contribution to the study of the northern territories, worked in the laboratory: S.A. Rakita, I.D. Danilov, N.F. Grigoriev, N.G. Patyk-Kara, B.A. Popov, L.A. Zhigarev, V.A. Sovershaev, V.Y. Biryukov, K.S. Voskresensky, etc. With the advent of a new generation of young researchers, the laboratory has received a new impetus for growth: the researchers are using innovative methods of research and are viewing the future with confidence.

Geoecology of the North, history of geography, permafrost science, geomorphology, socioeconomic geography

...It is only a comprehensive approach that will allow us both to carry out a sensible economic policy in the North and to preserve its nature!

V.F. Burkhanov, 1974

THE PREREQUISITES FOR ESTABLISHING THE LABORATORY

In the mid-1950s – early 1960s of the last century, serious changes took place in the Soviet science of Polar territories. The system of Glavsevmorput (GUSMP, the Chief Directorate of the Northern Sea Route) gradually ceased to exist, which for 25 years had united the efforts and performance of dozens of research and research and production institutions. In 1954, the process of mapping of the entire Arctic territory of the USSR had been completed, and the Arktikrazvedka (Arctic survey) trust was disbanded. In 1958, the leading research subdivision of GUSMP, the All-Union Arctic Institute (AUAI), became the Arctic and Antarctic Research Institute (AARI), as in 1955–1956 the Comprehensive Antarctic Expedition (CAE) was formed, later to become the Soviet Antarctic Expedition (SAE). In 1963, the AARI, together with a well-established and one of the world-best networks of polar stations, became subordinated to the system of Hydrometeorological Service of the USSR. In December 1963, the scientific institution Obruchev Permafrost Institute, AS USSR, with strong potential was split into several organizations.

The leading specialized geological institution of GUSMP, the Arctic Geology Research Institute (AGRI) continued its stable functioning, in 1953 subordinated to the system of the Ministry of Geology and of Protection of Mineral Resources of the USSR. Besides, the All-Union Aerogeologiya Trust (AUAGT), established in 1944, started active work in the North. Later it was renamed to become Aerogeologiya ('Aerial Geology'). In 1953, a gas blowout emerged in Berezovo, that prompted the creation of powerful trust Glavtymengeologiya in the north of Western Siberia. The largest mineral deposits were discovered in many regions of the North: Vuktyl (1964), Urengoy (1966), and Medvezhye (1967). Production of tin (Valkumey, Krasnoarmeysky, Deputatsky) and of gold (Kular, Schmidt Cape) grew. In Chukotka, to provide electric supply for the rapidly growing Chaun-Chukotsky industrial region, the

Bilibino nuclear power plant was built in 1974–1976. Intensive study of the previously inaccessible regions continued.

However, it was not carried out on a general basis, as intended by GUSMP, which had concluded contracts with subcontractors and provided them with transport vehicles and other assets. Now each agency pursued its own interests, and they often did not match, thus decreasing the effectiveness of investments. In addition, environmental issues that would accompany industrial development of the region could be already predicted. The projects of the first northern natural preserves were proposed, which were discussed in the late 1940s to become a reality in the mid-1970s.

BURKHANOV'S TIME

Vasily Fedotovich Burkhanov (1908–1982), Engineer Rear-Admiral, the Second World War Veteran and Commander of Support of the Pacific Navy in 1939–1945, could foresee and realize all of it very well. Beginning from 1947, he worked in GUSMP, and in 1953–1955, he headed this legendary organization. It was Vasily Burkhanov who in the spring of 1954 headed the first publicly open high-latitude expedition "Sever-6", which was unprecedented for the scope of its activities. The expedition had aircraft groups, two drifting stations "Severny Polus" (SP-3 and SP-4) ("North Pole"), with hundreds of pilots and supporting specialists working and dozens of correspondents describing the events. They wrote dozens of books and shot several films about this expedition. Vasily Burkhanov was one of the first participants of the Comprehensive Antarctic Expedition organized by GUSMP (Fig. 1). He was acquainted with the former chairman of the Government Alexey Kosygin and, as the head of GUSMP, knew all the problems of the exploration of the North very well. Therefore, when after the reorganization of GUSMP he joined the Polar Countries Chair of the Geography Faculty of the Moscow State University, he contemplated establishment of a subdivision in the university, which would provide scientific support to the projects of industrial development of the North. He prioritized the idea of the comprehensive nature of this support [*Burkhanov, 1967, 1970*].

Burkhanov's initiative was supported by the Rector of the MSU I.G. Petrovsky and deans of the Geography Faculty A.M. Ryabchikov and A.P. Kapitsa. By the University President's Order # 151 of March 15, 1969, the problematic laboratory for exploration of the North (PLEN) was created, headed by Vasily Burkhanov, with M.A. Dvorin working as his deputy [*The Chronicles..., 2004, p. 226*]. Burkhanov stated the following tasks to be solved by the laboratory workers:

– engineering and geographical zoning of the northern territories;

– modeling and optimization of the economic development of the concrete regions of the North, with selection of different options for industrial and construction sites;

– optimization of the use of the sea, river, motor, air, and pipe transport vehicles, as well as of other vehicles, for the newly developed regions of the North;

– economic exploration of the natural resources of the offshore zone of the Arctic seas and providing advice on the possibility of producing oil and gas there.

Having taken the comprehensive approach, so characteristic of GUSMP, Vasily Burkhanov organized the structure of the new subdivision. The team consisted of about 40 people, who were specialists in different areas, united into departments, sectors and groups. S.A. Rakita, the former worker of the Magadan North-Eastern Complex Research Institute, headed the largest department, the economy and geography department, in which D.N. Lukhmanov, L.M. Pukshanskaya, N.T. Shabanov, A.A. Chekalina, I.N. Sutt, hydrologist V.K. Panfilova, computer programmer I.S. Matlin and others worked. The department of the comprehensive studies of the littoral zone and of the offshore areas of the Arctic seas of the USSR was first headed by N.F. Grigoryev. Among the first researchers of the department were the war veteran B.A. Popov (1918–1996), who joined the laboratory after working in the All-Union Research Institute of Fishing and Oceanography, the famous specialist in the sea bottom geomorphology V.Yu. Biryukov (1940–2018), and the specialists in placer deposits N.G. Patyk-Kara and V.I. Novikov. Vasily

Fig. 1. The head of the Antarctic expedition Hero of the Soviet Union Doctor of Geography M.M. Somov (*right*) is reporting to the Head of the Chief Department of the Northern Sea Route, Deputy Minister of the Marine Fleet of the USSR V.F. Burkhanov on expedition preparation.

The photo was borrowed from the reserves of the Russian State Museum of Arctic and Antarctic (RSMAA) [http://polarpost.ru].

Burkhanov invited a recent graduate of the faculty, the head of the North-Eastern Expedition M.A. Velikotsky to head the expedition sector: he is working in the laboratory now. Recent MSU and MIIGAiK (Moscow Institute of Aerial Photography, Geodesy and Mapping) graduates (N.S. Fokht, Z.E. Runova, S.V. Chistov) came to work in the mapping sector. Vasily Burkhanov ensured the funding of PLEN not only from the state budget but also from the budgets of the numerous contracts signed. For example, one of such contracts was related to making specialized motor vehicles for the northern territories (with the Likhachev Automotive Plant), the other contracts dealt with analysis of the current state and the perspectives of development of the industrial and transport complex of the Magadan region, the use of wheeled and caterpillar tractors with trailers for off-road cargo transportation in the Yakut Autonomous Republic, the method of mathematical modeling of the complex of the transport and construction processes to find optimal solutions in designing non-ferrous metals production facilities in northern regions (in cooperation with the Gipronikel research institute). The titles of the budget-funded research sounded significant, too: "Evaluation of the economic effect of diamond production in the basin of the Anabar River" (1970), "The study of the social and economic problems related to exploration of the new regions of the North" (1972). Vasily Burkhanov believed that nature was needed not as an aesthetic complement to our being but as the necessary condition for modern production. To implement such plans, not only geographers were needed, and Burkhanov was seriously considering expansion of PLEN's activities and its transformation into the Research Institute of Exploration of the North. By the way, such an institute was founded nearly twenty years later, in December 1985, in Tyumen as the Institute of the Problems of Northern Development SB AS USSR (now the structural subdivision of the Tyumen Scientific Center SB RAS). At that time, contracts were mainly concluded through the Northern Expedition previously established in the cryolithology chair.

Vasily Burkhanov even found a building for such an institute, near Rusakovskaya Street and next to PLEN, which occupied two premises at 2/1 Krasnoprudnaya Street, building 1, and at 3/1 Gavrikov Lane. However, the initiative of establishing the institute was not supported at the faculty, and Vasily Burkhanov had to quit not only from the position of the head of the laboratory but also from the chair and the faculty. He became the senior researcher of the Council for the Study of Production Forces under Gosplan (State Planning Agency) of the USSR and a doctor of economics. It is evident that Vasily Burkhanov was far ahead of his time.

FROM ECONOMIC GEOGRAPHY TO GEOMORPHOLOGY AND CRYOLITHOLOGY

In 1972, Doctor of Geology and Mineralogy I.D. Danilov (1935–1999), an outstanding specialist in the quaternary deposits of the North and one of the classics of 'marinism', became the head of the labora-

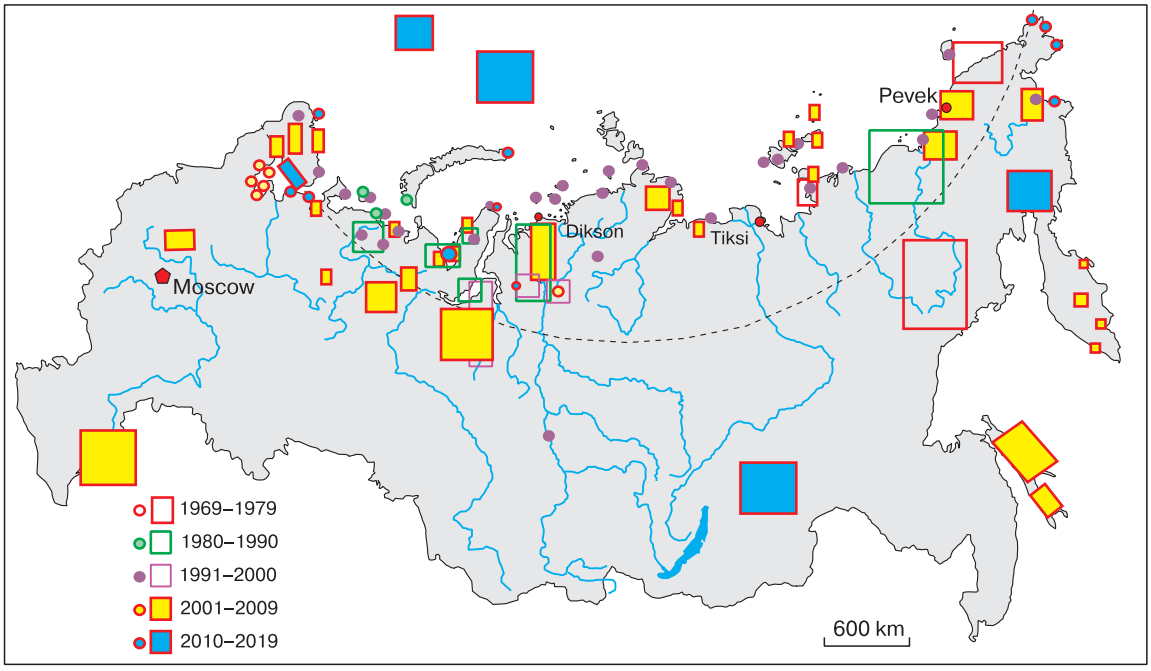

Fig. 2. Regions of the field works carried out by the workers of the laboratory of the North over half a century.

tory. Under his guidance, PLEN gradually stopped investigating the subjects distant from geography and geology, like the already mentioned subject of the motor vehicles. The geological and geomorphological direction became noticeably stronger, and large-scale studies began to be carried out related to the conditions of forming placer deposits (tin and gold) in the area of the Vankina Bay, in Kular, and in Western Chukotka (Fig. 2). Lev Andreevich Zhigarev (1931–1998), who, after working in the then Moscow-based Permafrost Institute, joined PLEN from its foundation, started his investigations of underwater permafrost (Fig. 3). In the late 1950s, he worked for several years at the Anadyr permafrost monitoring station, where he carried out unique for that time observations over solifluction [*Zhigarev, 1967*]. Based on the materials of the Yakut expeditions, Zhigarev was one of the first scientists to develop the theory of thermal denudation [*Zhigarev, 1975*].

I.D. Danilov carried out extensive field works, including well drilling, in Western Chukotka and European North. The collected materials allowed him to have a number of monographs published, widely used nowadays [*Danilov, 1978a,b*]. Under his guidance, a whole team of geologists and geomorphologists worked, including A.A. Arkhangelov (1943–2002), L.A. Zhindarev, L.N. Morozova, O.N. Fishkin, and L.V. Tarakanov, the authors of original and interesting works on the geomorphology of Artic and permafrost [*Danilov, 1979*].

After participation in the 14th Soviet Arctic Expedition and the winter season at the Mirny station in the Antarctic, V.A. Sovershaev (1930–1999) jointed the laboratory team (Fig. 4). Born in the North in the village of Lyamza located on the Onega shore of the White Sea, he graduated from the hydrology faculty of the famous Makarov Leningrad Marine Engineering School, and worked for some time in the Department of Polar Stations of GUSMP and Goskomgidromet (State Committee for Hydrology and Meteorology) guided by the famous explorer of the Arctic B.A. Kremer (1908–1976). Their articles and essays about the life of the polar stations in the "Komsomolskaya Pravda", "Vodny Transport" and other newspapers were signed by the common pseudonym B. Kresov.

In PLEN, B.A. Popov and V.A. Sovershaev developed the method of calculating the energy of surge affecting the shore (the Popov-Sovershaev method). It was Sovershaev who in his candidate's thesis clarified the role of the fetch in the shore dynamics of the northern Arctic seas. The 'on-shore' studies in PlEN continue to determine one of the most important directions of research, especially after S.A. Ogorodov headed the laboratory.

Economic and geographic research was actively conducted in PLEN. S.A. Rakita invited specialists in different areas of knowledge (A.A. Chekalina, I.N. Sutt, Suvorov, Chestnov, mappers N.S. Fokht and Z.E. Runova, hydrologist V.K. Panfilova), and this team carried out excellent regional studies. S.A. Rakita was full of energy and knowledgeable in various aspects, so, the economic and geographic research flourished [*Rakita, 1977; The Geographical Issues..., 1977*]. He believed that protection of nature was not limited to liquidation of harmful waste, reduction or even complete elimination of poisonous waste in rivers, as those were the forms of passive protection. The only way out is to determine the principles of interactions between the production and natural processes, to be followed by planned regulation of the production activities [*In search..., 1974; Rakita, 1980, 1983*].

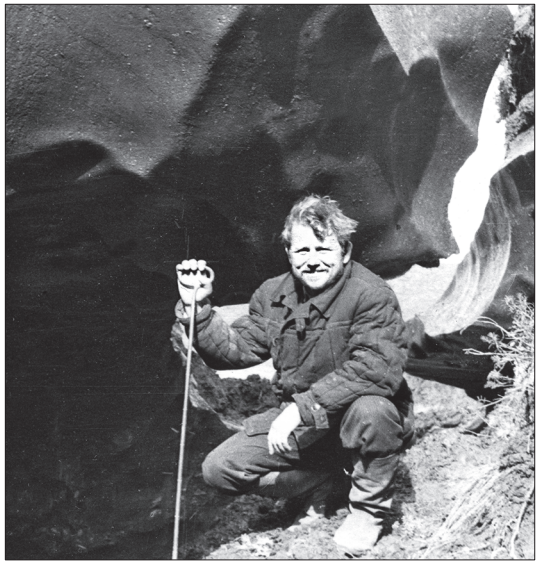

Fig. 3. L.A. Zhigarev in Chukotka near an ice vein the end of the 1950s.

The photo was borrowed from the archives of LGN.

Fig. 4. V.A. Sovershaev, as a true man from the seacoast, always brought fish for tea-drinking.

In the basement in Rusakovskaya Street, the 1980s. The photo was borrowed from the archives of LGN.

In 1970s, several remarkable researchers worked in PLEN, who left behind outstanding heritage of Arctic exploration. For example, in the economic and geographic department of the laboratory, V.M. Klimovich, an experienced explorer of the North and a worker of the Amderma Department for Hydrometeorology, worked in PLEN for several years. He was one of the initiators and organizers (together with A.N. Chilingarov) of a new transport operation in Arctic, which was later named the 'Ice Pier'. In the early 1970s, the geologists who searched for the new oil and gas fields in Western Siberia, started working on Yamal, but it was impossible to deliver heavy drilling equipment only by air. The Soviet of Ministers of the USSR passed a decision to organize the Kharasavey base site in Western Yamal. By proposal of the hydrologists of Amderma, in April 1976, the *Pavel Ponomarev* diesel electric ship led by the *Lenin* nuclear ice breaker approached the edge of the shore ice belt and cut into it. The cargo was unloaded onto the trucks delivered there previously. The operation turned out to be successful and was repeated several springs on end. A beautiful settlement was built, consisting of white-and-blue houses, with a slogan "Kharasavey is my biography".

Nikolay Filippovich Grigoryev, one of the pioneers of the Russian permafrost studies, worked in PLEN, too (1911–2005). Back in 1933, he, having sold his gold watch, used the money to hire a guide and became the first to explore the northern part of the Anabar-Olenek interfluve, a region totally unknown at that time. In the spring of 1942, he crossed Chukotka from Anadyr to Pevek using a team of dogs as transport. Grigoryev did not work in the laboratory for a long time, but his daughter Natalya (1954–2010) successfully worked in it for many years.

Collaboration of remarkable scientists in one laboratory was not always cloudless. Each head of a department or sector believed his or her direction to be most promising, and in 1979, serious changes took place in the personnel composition of PLEN. N.G. Patyk-Kara, S.A. Rakita left the laboratory for other institutes, and I.D. Danilov left the laboratory for the geology faculty. V.I. Solomatin, who had graduated from the polar countries chair and who by that time had successfully headed a number of large expeditions in the north of Yakutia, was appointed the head of the laboratory.

AT THE TURN OF CENTURIES, STATES, AND CONCEPTS

In the 1980s, four main directions of research in PLEN were clear: the permafrost and cryolithic studies, headed by V.I. Solomatin (M.A. Konyakhin, D.V. Mikhalev, O.Yu. Parmuzina, E.V. Aleksandrova), geomorphological studies (L.A. Zhigarev, K.S. Voskresensky, V.Yu. Zemchikhin), on-shore studies (B.A. Popov, V.A. Sovershaev, V.N. Novikov, V.Yu. Biryukov, E.V. Fedorova, A.M. Kamalov), and landscape-and-environmental studies (V.G. Chigir, N.G. Grabetskaya, G.A. Kryuchkova, N.N. Grigoryeva).

The main achievements of the laboratory in this period include development by V.I. Solomatin of a teaching of formation of underground ice of glacial origin [*Solomatin, 1986, 1992*], the first generalization by *L.A. Zhigarev* [*1997*] of all the information on permafrost available by that time, revealing by N.G. Grabetskaya of the role of the cryogenic factor in weathering of soils, analysis by V.A. Sovershaev of the influence of sea ice cover of the Arctic seas on the shore dynamics, generalization by K.S. Voskresensky of data on the spread and thermal erosion and thermokarst in Western Siberia [*Voskresensky, 2001*], development by V.I. Solomatin, M.A. Konyakhin and D.V. Mikhalev, together with the researcher from the glaciology department of the Geography Institute V.I. Nikolaev (1951–2017), of the methods of reconstructing paleotemperatures by the isotopic composition of different types of underground ice [*Konyakhin et al., 1996*].

When the famous physical geographer Yu.N. Golubchikov came to work at PLEN, he reinforced the landscape-and environmental direction of the laboratory. In the late 1980s, reflecting the social processes which took place in the country, the scientific and practical interest of the society in protection of the Arctic nature rose. The historical meeting in Yamburg [*Geocryological studies..., 1990*], which revealed the effects of uncontrolled "development" of the oil and gas resources of the north of Western Siberia for many specialists and journalists, brought about an upsurge of public interest for the environmental issues of the North. As a result, large funds were allocated for research and development related to protection of nature. PLEN was involved in the process, too, and in 1988, at the proposal of Yu.N. Golubchikov and by decision of the scientific and technological council supported by the faculty administration, was renamed to become the laboratory of the geoecology of the North (LGN) [*Solomatin, 1988*].

Resulting from this renaming was preparation of a collective monograph "Geoecology of the North", which was published at the time of great changes, in 1992. In it, the foundations of the new direction of the science, geocryoecology, were laid down. Here the prophetic words by Dr. Burkhanov said in 1974 at the large press conference in the "Vokrug Sveta" magazine: "Many of my colleagues and myself, the 'northerners', see sometimes the North as a certain all-embracing university teaching the culture of the future economy, the culture based on scientifically grounded criteria of interaction between Man and the Nature" [*In search..., 1974*]. Many years ago, at the time of PLEN's creation, Burkhanov and his closest associa-

tes were sure that exploration and development of the North should go hand in hand with the nature.

The 1990s were not easy years for the laboratory, just like for the whole country, but, due to the clever, consistent and well-wishing guidance of V.I. Solomatin and due to the robust team of scientists, the laboratory commendably lived through the period (Fig. 5). Field works continued, collected papers and monographs were published [*Solomatin and Sovershaev, 1998; Solomatin, 2001*], and dissertations continued to be defended. As always, the meetings of the scientific and technical council were held every Tuesday in an exciting and lively manner. As the system of grants was introduced, the laboratory workers' applications were regularly supported, which allowed the scientists not only to go to expeditions but also to do data analysis and radiocarbon dating. Contract works were actively conducted in cooperation with the other subdivisions of the faculty and with associated organizations, like the laboratory of soil erosion and of river channel processes (K.S. Voskresensky and F.A. Romanenko), the State Oceanography Institute (V.A. Sovershaev, A.M. Kamalov), the Engineering Survey and Construction Research Institute and TIGMI (V.I. Solomatin, M.A. Konyakhin) and the Institute of the Environmental and Evolutionary Issues, RAS (F.A. Romanenko). Under supervision of V.A. Sovershaev, extensive works were carried out on the shore of the Baidaratskaya Bay, where in 1988 the workers of LGN organized an observation network over the shore dynamics [*Natural Conditions..., 1997*]. Every year in the period of 1988–1997, expeditions were organized, in which about one-third of the workers of LGN took part. The expeditions continue today, too, and the duration of some of the observations has already reached 30 years.

At the turn of the 1980–1990s, the Yuzhno-Solenoye gas field in southern Gydan served as the laboratory's test site for several years, where the gas production engineers modeled construction of a pipeline with large-diameter pipes, preparing for development of the Bovanenkovo gas condensate field. It seems like all the workers of the laboratory visited the site. Using original equipment, K.S. Voskresensky (Fig. 6) measured the solifluction rate, having discovered upward soil movement on the slope, and A.P. Kholnov successfully modeled formation of patterns grounds [*Romanenko et al., 1998*]; several time a year, he tested the thawing depth at the profile sites along the perimeter of the test site of the pipeline with 1420-mm diameter pipes. The CALM project was not yet functioning, but the laboratory workers were already solving the similar problems. S.A. Konstantinov discovered a transitional ice-rich horizon at the boundary of the active layer. The landscape group guided by V.G. Chigir (N.N. Grigoryeva, G.A. Kryuchkova et al.) made the first cryogeoecological maps. In 1992, A.P. Kholnov, in cooperation with F.A. Romanenko, canoed down the Messoyakha River as far as the mouth of the Bolshaya Kharvutayakha River, investigating the outcrops of loose deposits.

In the second half of the 1990s, close cooperation, under guidance of V.G. Chigir, started with Urengoygazprom. V.G. Chigir, M.A. Velikotsky, K.K. Skripchinsky (1925–2003), A.P. Kholnov, fol-

Fig. 5. The laboratory workers and guests celebrating the 25th anniversary of the laboratory (1994).

Left to right: the upper row – N.M. Kopylov, V.V. Denisova, the bottom row – Z.E. Runova, S.V. Chistov, N.N. Grigoryeva. The photo was borrowed from the archives of LGN.

Fig. 6. K.S. Voskresensky and V.P. Marakhtanov (*right*) near the Baidaratskaya Bay of the Kara Sea (August 1991).

The photo was taken by F.A. Romanenko.

lowed by V.P. Marakhtanov, regularly visited the pipelines of the Urengoy-Tazovskoye districts to monitor the situation. The group headed by K.S. Voskresensky carried out monitoring of the thermal erosion processes at the Bovanenkovo gas condensate field, where V.I. Solomatin, together with the Chinese colleagues, investigated ice sheets (Fig. 2), whereas Yu.N. Golubchikov and the young scientists V.A. Zaitsev and G.A. Ushakov were concentrated on the issues of geocology. The expression by Yu.N. Golubchikov "Yamal is an ice-floe that has taken the ground" is still quoted in the laboratory.

It would seem that Arctic research was under way, despite the objective hardships experienced by the whole country. Yet, in the late 1990s, the laboratory experienced a series of unexpected blows. One after another, the people passed away, who in the 1990s were the stronghold of the laboratory's activities. In 1998, L.A. Zhigarev passed away, having managed to issue the fruit of his many years' work, the book "The Submarine Permafrost Zone" [*Zhigarev, 1997*]. After two failed attempts to write a perfect application, he received a grant of RFBR for publication of this book. In August 1999, V.A. Sovershaev suddenly, after a short illness, passed away, having left a successor behind, the young Ph.D. S.A. Ogorodov.

On August 10, 2000, K.S. Voskresensky suddenly died. The entire faculty mourned his demise, as everybody loved him, and in the laboratory, he was simply adored. Anyone who came to him for help, immediately received it. Konstantin Sergeevich was a valuable field worker, as he could fix anything, drove all kinds of motor vehicles and had the qualities of a leader in addition to all that. His sudden death shocked the laboratory, and it was difficult for the laboratory employees to recover after all those losses.

IN THE NEW MILLENNIUM

Yet, work had to be done, and the laboratory gradually recovered from the blow. The impetus for this recovery was moving to the new premises in 2002–2003 in the main building of the Moscow State University in Leninskiye Gory, where the faculty allocated premises to the laboratory, instead of two basements, which it was no longer possible to maintain.

V.I. Solomatin summed up his many years' field and experimental works on investigating the mechanism of formation and spread of the genetic types of the underground ice in the permafrost zone [*Solomatin, 2013, 2017*]. He stated the principles of structural genetic analysis of ice and proved the glacier origin of the ice sheets of Western Siberia. The concept of cryogenic formations proposed by Prof. Solomatin, in addition to the theory of conservation of the ancient glacier ice, allowed identification of the new spatial and temporal structure of ground glaciation and its

Fig. 7. The team of LGN, October 2017.

Left to right: the bottom row – A.K. Vasilchuk, A.M. Kamalov, V.I. Solomatin, A.A. Maslakov, F.A. Romanenko; the upper row – N.G. Belova, O.S. Shilova, E.A. Skripchinskaya, D.M. Aleksyutina, A.A. Ermolov, S.V. Maznev, A.V. Baranskaya, M.A. Velikotsky, A.P. Vergun, V.P. Marakhtanov, D.V. Mikhalev, V.M. Fedorov, A.V. Novikova, S.A. Ogorodov. The photo was borrowed from the archives of LGN.

relation to the other ice formation zones in permafrost.

S.A. Ogorodov continued the works of V.A. Sovershaev, having brought young graduates of the geography and geology faculties of MSU (Fig. 7). Together with the scientists from the State Oceanography Institute, extensive works on Baidaratskaya Bay were deployed again (Fig. 8), started by A.M. Kamalov back in 1988. The works continued on a high-tech platform using (V.V. Arkhipov, A.A. Yermolov, A.I. Noskov, D.E. Kuznetsov, A.P. Vergun) the new geodetic, geophysical and diving equipment. S.A. Ogorodov successfully continued the works of V.A. Sovershaev on investigating the role of sea ice in the shore dynamics [*Ogorodov, 2011*], eventually bringing it to completion of a doctorate (2014). V.G. Chigir, followed by M.A. Velikotsky and V.P. Marakhtanov, continued the study of the mutual influence of pipelines and natural environment. V.P. Marakhtanov developed a unique software program, *Econorth*, to evaluate the dynamics of the lithogenic foundations of permafrost landscapes exposed to anthropogenic impact and proposed a new mechanism of formation of frost mounds, having conducted a series of field experiments. V.I. Solomatin and his followers D.V. Mikhalev and N.G. Belova reconstructed the conditions of formation of sheet ice of the Yugra Peninsula and of wedge ice of the Kolyma Plain. In the first studies of sheet ice on the Yugra Peninsula near the crossing site of the pipeline across the Baidaratskaya Bay, the worker of LGN T.A. Ampleeva took part. V.A. Sarana was able to investigate, after a long pause, the mysterious glaciers of the north-eastern Taymyr (Neozhidanny Glacier and other glaciers), the last white spot on the map of the USSR, colored only by 1954. For this, he had to make a long walking trip, fully autonomous, in totally uninhabited areas.

The Quaternary direction, started by N.G. Patyk-Kara and I.D. Danilov, continued to be investigated. Diatomist O.S. Shilova and palynologist A.K. Vasilchuk, who joined the laboratory's team [*Vasilchuk, 2007*], performed reconstructions of the natural environment of different Arctic regions. V.E. Tumskoy, supported by V.I. Solomatin, essentially expanded the studies of the sheet ice of the New Siberian Islands during his relatively short period of working in the laboratory. Young candidates of sciences N.G. Belova, A.V. Baranskaya, D.M. Aleksyutina, A.A. Maslakov and graduate students S.V. Maznev and A.V. Novikova introduced new modern methods into investigation of formation of the relief, loose deposits and ice. Every year beginning with 2000, the winter White Sea expeditions were held, together with the geomorphology and paleography chair, organized by F.A. Romanenko, which covered over the period of 2000–2019 practically the entire coast of the White Sea. The main characteristics of the impact of the shore ice on shores of different types were revealed, and the volumes of the transport of materials by ice were identified.

Fig. 8. Before takeoff. The Yugra shore of the Baidaratskaya Bay, 2006.

Left to right: F.A. Romanenko, O.S. Shilova, N.G. Belova, V.I. Solomatin. The photo was borrowed from the archives of LGN.

Continuing the works on the pipelines of Western Siberia, M.A. Velikotsky revealed the previously unknown behavior of different types of metal corrosion in the pipelines. He also wrote a substantial work on the history of the main concepts of the Quaternary geology – "glacialism" and "marinism" [*Velikotsky, 2016*]. All his works are based on the substantial foundation of his predecessors, the works of whom (especially those of R.I. Murchison and P.A. Kropotkin) he consistently propagates.

In the mid-1990s, a new direction of research appeared in the laboratory, connected with the name of V.M. Fedorov. Having started with the Bolshezemelskaya tundra, he passed on to analyzing the global behavior and revealing the causes of changes in the characteristics of the natural environment of the Earth, in particular, of glaciers, sea waves, volcanic eruptions, and solar radiation. Together with the well-known Polar explorer V.S. Chukov, V.M. Fedorov took part in the expedition to Antarctic. Before him, the older-generation PLEN researchers had traveled there – N.F. Grigoryev (2nd Soviet Antarctic Expedition, SAE) and V.A. Sovershaev (14th Soviet Antarctic Expedition, SAE). V.M. Fedorov is also the pioneer of geographic ballooning: he enthusiastically promotes the idea of using balloons in geographic explorations.

The format of a brief essay is insufficient not only to describe all the achievements of the laboratory of the geoecology of the North but even to mention all the workers who worked there. Yet, the "hostesses" of

the laboratory deserve special mentioning, among whom E.E. Pavlenko, E.V. Aleksandrova and E.A. Skripchinskaya should be named first of all. Thanks to them, the laboratory was always a cozy and warm place to be in. Summing up, the laboratory was born, grew, changed the vectors of its activities, preserving the main vector established by the laboratory founder V.F. Burkhanov.

The author has worked in the laboratory for 30 years and is deeply grateful to his colleagues for those wonderful years. Now, as the young scientists have joined the laboratory team, the laboratory is entering the period of new prosperity, despite all the obstacles on its way. Cognition of the North is endless, just as the North itself, explored by the laboratory workers. Many happy returns, the laboratory of the geoecology of the North!

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References

Burkhanov, V.F., 1967. Criteria of the engineering and geographical boundary of the north of the USSR. Vestnik Moskovskogo Universiteta, ser. 5, geography 5, 82–90. (in Russian)

Burkhanov, V.F., 1970. Current Problems of Development of the USSR North. Moscow University Press, Moscow, 172 pp. (in Russian)

Danilov, I.D., 1978a. Polar Lithogenesis. Nedra, Moscow, 238 pp. (in Russian)

Danilov, I.D., 1978b. The Pleistocene of the Sub-Arctic Marine Plains. Moscow University Press, Moscow, 198 pp. (in Russian)

Danilov, I.D. (Ed.), 1979. The Study of the Coastal Plains and of the Shelf of the Arctic Seas. Moscow University Press, Moscow, 136 pp. (in Russian)

Geocryological studies in the Arctic regions: Materials International Symposium (Yamburg, Aug. 1989), 1990, Tyumen. (in Russian)

In search of the northern algorithm, 1974. Vokrug Sveta 12. – http://www.vokrugsveta.ru/vs/article/5204/ (in Russian)

Konyakhin, M.A., Mikhalev, D.V., Solomatin, V.I., 1996. The Isotopic Composition of Underground Ice. Moscow University Press, Moscow, 156 pp. (in Russian)

Natural Conditions of the Baydaratskaya Bay, 1997. GEOS, Moscow, 432 pp. (in Russian)

Ogorodov, S.A., 2011. The Role of Sea Ice in Coastal Dynamics. Moscow University Press, Moscow, 173 pp. (in Russian)

Rakita, S.A. (Ed.), 1977. Socio-Economic Studies of Northern Regions. Moscow University Press, Moscow, 151 pp. (in Russian)

Rakita, S.A., 1980. Sustainability of geosystems: approaches to practical assessment. Geography and Natural Resources 1, 136–142.

Rakita, S.A., 1983. Nature and Economic Development of the North. Ed. by A.I. Popov. Moscow University Press, Moscow, 189 pp. (in Russian)

Romanenko, F.A., Holnov, A.P., Zaretskaya, N.E., 1998. Features of Taimyr tundra microrelief development. Geomorfologiya 1, 100–106.

Solomatin, V.I., 1986. Petrogenesis of Underground Ice. Nauka, Novosibirsk, 215 pp. (in Russian)

Solomatin, V.I. (Ed.), 1988. Research of Stability of the Northern Geosystems. Moscow University Press, Moscow, 213 pp. (in Russian)

Solomatin, V.I. (Ed.), 1992. Geoecology of the North (introduction to geocryoecology). Moscow University Press, Moscow, 270 pp. (in Russian)

Solomatin, V.I. (Ed.), 2001. Problems of General and Applied Geoecology of the North. Moscow University Press, Moscow, 352 pp. (in Russian)

Solomatin, V.I., 2013. Physics and Geography of Underground Glaciation, 2nd ed. Academic Publishing House "Geo", Novosibirsk, 346 pp. (in Russian)

Solomatin, V.I., 2017. Geocryology: Underground Ice. Urait Publishing, Moscow, 345 pp. (in Russian)

Solomatin, V.I., Sovershaev, V.I. (Eds.), 1998. Dynamics of the Arctic coasts of Russia. Moscow University Press, Moscow, 248 pp. (in Russian)

The Chronicles of Moscow University, 2004. Moscow University Press, Moscow, vol. 2, 494 pp. (in Russian)

The Geographical Issues of Studying the North, 1977. Moscow, Moscow University Press.

URL: http://polarpost.ru (last visited: 21.05.2019).

Vasilchuk, A.C., 2007. Palynology and Chronology of Polygonal Ice Wedge Complexes in the Russian Permafrost Zone. Moscow University Press, Moscow, 488 pp. (in Russian)

Velikotsky, M.A., 2016. In the world of ideas: Marinists, Cryolitologists and Glacialists. Moscow University Press, Moscow, 448 pp. (in Russian)

Voskresensky, K.S., 2001. Modern Relief-forming Processes on the Plains of the North of Russia. Moscow University Press, Moscow, 263 pp. (in Russian)

Zhigarev, L.A., 1967. The Causes and the Mechanism of Development of Solifluction. Nauka, Moscow, 158 pp. (in Russian)

Zhigarev, L.A., 1975. The Thermodenudation Processes and the Deformation Behavior of Thawing Soils. Nauka, Moscow, 109 pp. (in Russian)

Zhigarev, L.A., 1997. The Submarine Permafrost Zone. Moscow University Press, Moscow, 319 pp. (in Russian)

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