History of Leningrad Mathematics in the First Half of the 20th Century

by Alexander I. Nazarov [*†] and Galina I. Sinkevich[‡]

Abstract. The first half of the 20th century in the history of Russian mathematics is striking with a combination of dramaticism, sometimes a tragedy, and outstanding achievements. The paper is devoted to St. Petersburg-Leningrad Mathematical School. It is based on a chapter in the multi-author monograph [1].

Introduction

Russian sciences, including mathematics, came into being in St. Petersburg. Peter the Great founded St. Petersburg in 1703. The St. Petersburg Academy of Sciences was created in 1725 in accordance with Peter's Decree. Whereas there were no local scientists as yet, academicians were invited from other countries and obligated to transfer their knowledge to Russian students. Mathematicians, mechanicians and astronomers, like L. Euler, brothers D. Bernoulli, and N. Bernoulli, J.N. Delisle, and A.J. Lexell, were among Russia's first Academicians.

In the 19th century, higher learning institutions began to be massively created. Such prominent mathematicians as M.V. Ostrogradsky[1], V.Ya. Bunyakovsky[2], P.L. Chebyshev[3] appeared. In the second half of the 19th century St. Petersburg mathematical school was formed to comprise such areas as the number theory, real and complex analysis, probability theory, differential equations, theoretical mechanics. The names of E.I. Zolotarev[4], A.A. Markov, A.M. Lyapunov graced the history of mathematics of this city. Many Russian scientists, who graduated from St. Petersburg University, have maintained the specific features of the Petersburg school in their activities: rigorous algorithmic thinking, engineering set up of the problem, presentation of results in a form convenient for further use.

The 20th century had leaded to social shocks. Even the name of the city was changed three times: from 1914 to 1924, it was Petrograd; from 1924 to 1991, Leningrad; from 1991 it is again St. Petersburg.

World War I, revolutions, and the Russian Civil War disrupted the peaceful life of this city. However, despite the hardships, fruitful scientific life

[*] St. Petersburg Dept of Steklov Mathematical Institute, Fontanka 27, St. Petersburg, 191023, Russia
[†] St. Petersburg State University, Universitetskii pr. 28, St.Petersburg, 198504, Russia
[‡] St. Petersburg State University of Architecture and Civil Engineering, 2nd Krasnoarmejskaja ul. 4, St. Petersburg, 190005, Russia

[1] Mikhail V. Ostrogradsky (1801–1861) was an outstanding Russian mathematician, mechanician and organizer of mathematical education, Academician. He made the essential contributions in many fields of mathematics and physics.

[2] Victor Ya. Bunyakovsky (1804–1889) was a famous Russian mathematician and mechanician, Vice President of the St. Petersburg Academy of Sciences. His key works were devoted to probability theory and its applications, number theory and analysis. Bunyakovsky played an important role in the organization of mathematical education in Russia.

[3] Pafnuty L. Chebyshev (the right pronunciation is Chebyshóv) (1821–1894) was an outstanding Russian mathematician and mechanician, founder of St. Petersburg mathematical school, who is remembered primarily for his works on number theory, probability and approximation theory.

[4] Egor I. Zolotarev (the right pronunciation is Zolotaryóv) (1847–1878) was a prominent Russian mathematician, a student of P.L. Chebyshev, Adjunct of the Academy; specialized in the integration theory, complex variable, and number theory; author of one of the simplest demonstrations of the reciprocity law. Died tragically at the age of 32.

Figure 1. 1915 year, Petrograd Imperial University. Professors and students of the Mathematics and Physics Faculty. Professors E.V. Borisov, Ch.Ya. Gobi, D.S. Rozhdestvensky, A.I.Voeikov, N.A. Bulgakov, Yu.V. Sokhotsky, S.P. von Glazenapp, A.A. Ivanov, Kostyakevich.

went on. St. Petersburg may be proud of such names as V.A. Steklov, B.G. Galyorkin, N.M. Günther, A.N. Krylov, S.N. Bernstein, V.I. Smirnov, G.M. Fichtenholz, A.A. Friedmann, B.N. Delaunay, N.E. Kochin, P.Ya. Polubarinova-Kochina, D.K. Faddeev, S.G. Mikhlin, S.L. Sobolev, L.V. Kantorovich, A.D. Aleksandrov, Yu.V. Linnik. In defiance of the dramatic events, the success of Leningrad mathematical school suits the names of its founders and forerunners, Euler and Chebyshev.

I

In the early 20th century, St. Petersburg was the capital of the Russian Empire. The Academy of Sciences was in this city. Petersburg Mathematical School was one of the leading in Europe, the University trained professors for the entire Empire. A strong mathematical community formed in the city: Members of the Academy A.A. Markov[5], A.M. Lyapunov[6], V.A. Steklov[7], and A.N. Krylov[8], Professors

[5] Andrey A. Markov (1856–1922) was an outstanding Russian mathematician, a student of P.L. Chebyshev, Academician; author of important results in the number theory, differential equations, function theory and probability theory. He introduced an important class of stochastic processes later named after him.

[6] Alexander M. Lyapunov (1857–1918) was a great Russian mathematician and mechanician, a student of P.L. Chebyshev, Academician. He created the stability theory of the dynamical systems and established several breakthrough results in mathematical physics and probability theory. Lyapunov shot himself dead when his wife died.

[7] Vladimir A. Steklov (1864–1926) was a prominent Russian mathematician, mechanician and physicist, Vice President of the Academy of Sciences; originator of Leningrad school of mathematical physics. He holds the credit of preserving the Academy in the post-revolutionary period. He founded the Institute of Physics and Mathematics (1921). Nowadays, the Mathematical Institutes in Moscow and St. Petersburg are named after Steklov.

[8] Alexey N. Krylov (1863–1945) was an outstanding Russian and Soviet mathematician, mechanician and theorist of ship design, Academician, three-star navy general. His main areas of research were ship theory, the theory of magnetic and gyro compasses, hydrodynamics, and computational mathematics. He also wrote works devoted to magnetism, gunnery, mathematical physics, astronomy, geodesy, insurance business, history of mathematics, and issues in education. He translated Newton's *Philosophiae Naturalis Principia Mathematica* into Russian. Together with V.A. Steklov, Krylov played the most important role in the survival of the Academy of Sciences in the early 1920s.

Yu.V. Sokhotsky[9], N.M. Günther[10], D.F. Selivanov[11], and A.V. Vasiliev[12] determined both the research and educational levels, carrying on traditions of the previous century. In 1890, a Mathematical Society appeared in St. Petersburg (the first President of Society was V.G. Imshenetsky[13], from 1892 it was headed by Yu.V. Sokhotsky). As of 1913, series of translations, *New Ideas in Mathematics*, established by A.V. Vasiliev, were published.

The Europe-wide rise in education in the early 20th century, caused by the need in technical specialists, was conductive to alignment of mathematics taught at secondary schools with the progress of science. This was the period of pedagogical activity and high professionalism of teachers of mathematics. The amount of educational and popular scientific literature has grown; special journals appeared in Russia, e.g. *Elementary Mathematics Journal, Bulletin of Experimental Physics and Elementary Mathematics*. F. Klein, D. Smith, and E. Borel were leaders of this movement in Europe and America; N.Ya. Sonin[14] and K.A. Posse[15] played such part in St. Petersburg. Mathematical circles for pupils, which were run by university teachers, appeared at grammar schools. For example, in St. Petersburg Grammar School No. 2, Teachers of Mathematics N.I. Bilibin and Ya.V. Iodynsky established a private mathematical research circle, and A.A. Markov guided the steps of some grammar school students in their studies. Having entered the University, the leavers of this school, V.I. Smirnov[16], Ya.D. Tamarkin[17], and A.A. Friedmann[18], together with Ya.A. Shohat[19], A.S. Bezikovich[20], and Ya.V. Uspensky[21], created a mathematical workshop, where they delivered lectures in classical and modern sections of mathematics to each other. On the recommendation of V.A. Steklov, they were retained at the University for preparation for professorship[22] and soon achieved significant research results.

[9] Julian V. Sokhotsky (Sochocki, 1842–1927) was a famous Polish-born Russian mathematician. His works are devoted to the number theory and complex variable theory. He is the author of a theorem on behaviour of analytic function in a neighbourhood of an essentially singular point (1868), and the Sokhotsky–Plemelj formulas (1873) which are used in quantum physics to the present time. He was President of the St. Petersburg Mathematical Society from 1892.

[10] Nikolai M. Günther (1871–1941) was a famous Russian and Soviet mathematician, Corresponding Member of the Academy. His main works are devoted to the theory of differential equations and mathematical physics. Günther was the first to provide a rigorous and systematic presentation of the potential theory (1934).

[11] Dmitry F. Selivanov (1855–1932) was a Russian mathematician and educator, a student of Chebyshev and Sokhotsky. After 1917, he was the first democratically elected University Rector. However, in 1922, he was ordered out of Russia for teaching mathematics "not the way the Reds should". He lived the rest of his life in Prague.

[12] Alexander V. Vasiliev (1853–1929) was a Russian mathematician, mathematics historian, and famous public figure. In 1920, he initiated the creation of the Petrograd Physical and Mathematical Society. He worked in the history of mathematics, popularization of new mathematical theories in Russia, and organizing scientific life throughout Russia and worldwide.

[13] Vasily G. Imshenetsky (1832–1892) was a Russian mathematician and mechanician, Academician, expert in partial differential equations. He was the first President of the St. Petersburg Mathematical Society.

[14] Nikolay Ya. Sonin (1849–1915) was a Russian mathematician, prominent figure in the sphere of organizing education. He worked in St. Petersburg as of 1893. His works are devoted to the theory of special functions and its applications.

[15] Konstantin A. Posse (1847–1928) was a Russian mathematician who played a significant role in the reform of mathematical education.

[16] Vladimir I. Smirnov (1887–1974) was a famous Russian and Soviet mathematician, Academician; outstanding educator and organizer of science; excellent lecturer, creator of a *Course of Higher Mathematics* in five volumes, which was reissued numerous times and translated into eight languages. He created an Institute of Mathematics and Mechanics at the University and headed it for 20 years. His main works are devoted to the complex variable theory, partial differential equations, calculus of variations, and to the wave propagation theory. All pre-war Leningrad mathematicians and mathematicians of the first post-war years attended his lectures. He also played a great role in the organization of historical mathematical researches in Leningrad.

[17] Yakov D. Tamarkin (1888–1945) was a famous Russian and American mathematician. In 1925, he illegally emigrated from USSR, then lived in the United States. Tamarkin's work spanned a number of areas of mathematics. He was a proponent and a founding co-editor of the *Mathematical Reviews*, together with O. Neugebauer and W. Feller. He was also an active supporter of the American Mathematical Society, a member of the council starting 1931, and a Vice President in 1942–1943.

[18] Alexander A. Friedmann (1888–1925) was a prominent Russian and Soviet mathematician, physicist, and geophysicist, founder of modern physical cosmology. He worked also in atmospheric physics, hydrodynamics and aerodynamics. He discovered non-steady solutions to Einstein's equations, which gave rise to the development of the model of nonstationary Universe. Friedmann died of typhoid.

[19] Yakov A. (Yankel) Shohat (1886–1944) was a Russian and American mathematician. After 1923, he lived in the USA. Shohat was the first to provide a systematic presentation of general theory of orthogonal polynomials. He was one of the editors of the *American Mathematical Society Bulletin* for several years.

[20] Abram S. Bezikovich (1891–1970) was a prominent Russian and British mathematician. Since 1924, he illegally emigrated from USSR, then lived in England. His monograph *Almost periodic functions* (1932) had won D. Adams prize (Cambridge), and the class of functions he had introduced was called Bezikovich functions. He achieved substantial results in the theory of fractal sets.

[21] Yakov V. Uspensky (1883–1947) was a Russian and American mathematician and historian of mathematics, Academician. Since 1927, he lived in the USA. His works pertain to the number theory, probability theory, and algebra; research of mechanical quadrature convergence; history and methodology of mathematics. He translated J. Bernoulli's treatise *About the Law of Large Numbers* into Russian.

[22] The preparation for professorship was similar to the contemporary PhD program. See [2, Ch. 6].

Figure 2. 1913–1914 years. Left-to-right, first line: unknown (P. Ehrenfest?), A. Friedmann, G. Weihardt, unknown. Second line: E. Friedmann, A. Shohat, E. Weihardt, Ya. Tamarkin, unknown, unknown, M. Petelin. Third line: V. Smirnov.

The World War I of 1914–1918, the revolution and Civil War of 1917–1920 disrupted the untroubled scientific life. The city was flooded by numerous ruined peasants. Authorities assigned living quarters to the urban and country poor families in apartments consisting of several rooms, leaving one room to former owners of these apartments. People were coming short of foodstuffs, heating, lighting, and bare essentials. Academician Markov complained that he could not attend meetings of the Academy as he had no shoes. The following records about Sokhotsky can be found in archives: "On 10 April 1919, Professor of the First Petrograd University, Yu.V. Sokhotsky, was put on the list of those entitled to a reinforced ration in kind. Rations will be issued at the distributing station of the People's Commissariat for Education. Bread will be issued once per week. Please have a bottle for sunflower oil with you[23]." Sokhotsky's letter of 1922: "Having spent three winters in succession in an unheated apartment, I have completely upset my health. Now, because of my weakness and in view of the upcoming winter, I have to contact KUBU[24] and ask them to provide me, if it turns possible, with suitable accommodations where I could spend winter months in bearable living conditions which pose no hazard to life[25]." Classes at the University were given in cold rooms without lights. The salary was not paid regularly, often a meager food ration was given instead of money. Most professors were compelled to teach at several learning institutions.

Based on the decrees of the *Sovnarkom* (the Council of Ministers) passed in 1918–1919, free schools and new rules of enrolment in higher learning institutions were introduced. All working people were granted the right to enter any high school regardless of their previous education, without presenting a certificate of secondary education. A bylaw was adopted to grant the right of priority access to the universities for workers and peasant poors. In 1920, an illiteracy liquidation campaign began, when primary education was provided to all adults aged 16 to 50. In 1919, *Rabfak* (the remedial schools for young workers) was formed. In fact, those were preparatory departments designed to provide pre-entry training to those who wished to enter a higher learning institution. One could enter this remedial school on recommendation of his trade union or party authorities. New curricula were created to fit the poor level of students' training. Academic degrees and titles were abolished (to be reintroduced in 1934).

All these measures caused professors' resistance. For example, Ya.V. Uspensky wrote: "Taking into account the fact that to succeed at the university, a student should be adequately trained, prospective students must be admitted at the university in virtue of their knowledge, not their class affiliation or political commitment[26]." In response, the authorities enacted measures intended to "re-educate the bourgeois professors" and punitive measures like preventive detention, execution, or exile. Only in September and November 1922, 160 scientists were exiled from St. Petersburg to Stettin against their will on board the German passenger vessels[27]. Mathematician D.F. Selivanov was among them.

Many scientists emigrated, including mathematicians A.S. Bezikovich, Ya.D. Tamarkin, Ya.A. Shochat, and later on, Ya.V. Uspensky.

V.A. Steklov, A.N. Krylov, and A.A. Friedmann played an important role in the search for the ways to collaborate with the new authorities and in the preservation of the mathematical community. Serving as Vice President of the Academy of Sciences from 1919 to the end of his life, Steklov made an immense

[23] Central State Historical Archives of St. Petersburg. F. 14. Schedule 1. No. 6646, 201 leaves. L. 178.

[24] KUBU (Commission for the improvement of the life of scientists) was established in 1920 in Petrograd on the writer M. Gorky's initiative. It served as the foundation of the first House of Scientists in Russia. There was a boarding house for the elderly scientists.

[25] Central State Historical Archives of St. Petersburg. F. 184. Schedule 2. No. 770, 50 leaves. L. 50.

[26] Central State Historical Archives of St. Petersburg. F. 7240. Schedule 14. No. 16. L. 185 recto.

[27] L.D. Trotsky, Chairman of RVSR (the Revolutionary Military Council) in 1922, commanded upon this campaign: "We exiled these people as there was no grounds for shooting them dead, but it was impossible to tolerate them." In 2003, a memorial sign was installed in St. Petersburg to commemorate the place the so called 'Philosophers' Ship' departed from.

Figure 3. V.A. Steklov.

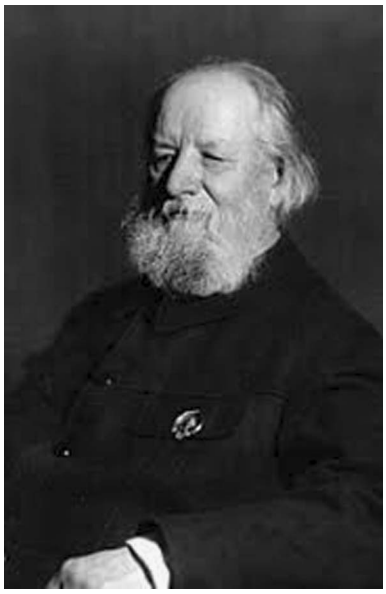

Figure 4. A.N. Krylov.

contribution in its preservation. In 1921, the Institute of Mathematics and Physics was established on his initiative, and he was its first Director until 1926 when he died. Thereafter, its directors were, in succession, A.F. Ioffe[28], A.N. Krylov, I.M. Vinogradov[29].

[28] Abram F. Ioffe (1880–1960) was a famous Russian and Soviet physicist, outstanding organizer of science, referred to as the "father of Soviet physics", Academician, Vice President of the Academy of Sciences of the USSR (1942–1945). As of 1930s, he insisted on the need to conduct intensive nuclear research, which in 1942 marked the start of Soviet nuclear programme. The major merit of A.F. Ioffe was founding a unique physical school which enabled the Soviet physics to go global.

[29] Ivan M. Vinogradov (1891–1983) was a prominent Soviet mathematician, Academician. His works are devoted to the analytical number theory. His main achievement was the creation of the trigonometric sums method which is currently one of the key methods in the analytical number theory. With the help of this method, he solved some problems which seemed to be out of the reach of the mathematics of the early 20th century (investigation of Waring's problem; solving the ternary Goldbach conjecture for all sufficiently large numbers).

It was not an easy thing to teach students almost in lack of new textbooks. On assignment of *Narkompros* (the Ministry of Education), the urgent compilation of new textbooks on mathematics and physics was started. Ya.I. Perelman[30] played an important role in this process. Many of his textbooks were written in the form of wonder-books. Ya.I. Perelman also engaged in promotion of the metric weights and measures introduced in Russia in 1918.

The work of the first Mathematical Society was gradually fading away, and the Society ceased to exist after World War I. In 1920, a mathematical circle was created on initiative of A.V. Vasiliev. A year later, it was reorganized into the Petrograd Physical and Mathematical Society. A.V. Vasiliev was President of the Society for two years; thereafter, it was presided by N.M. Günther. Among members of this Society were A.S. Bezikovich, S.N. Bernstein[31], B.G. Galyorkin[32], V.I. Smirnov, V.A. Steklov, Ya.D. Tamarkin, Ya.V. Uspensky, G.M. Fichtenholz[33],

[30] Yakov I. Perelman (1882–1942) was a Russian and Soviet mathematician and physicist, outstanding exact sciences promoter and communicator, originator of the recreational science genre. Only in the USSR, his books *Physics for Fun, Mathematics for Fun, Astronomy for Fun*, and many others, were published 449 times, their total print being more than 13 million copies. In other countries, his books were published 126 times in more than 20 languages. Despite the common misconception, Ya.I. Perelman was unrelated to G.Ya. Perelman who proved Poincare's conjecture in 2002–2003.

[31] Sergei N. Bernstein (1880–1968) was an outstanding Russian and Soviet mathematician, Academician. His results and methods he had created had great effect on the development of mathematics in the 20th century. He provided the first solution to the 19th Hilbert problem. He laid the groundwork for the constructive function theory. When proving Weierstrass theorem, he built polynomials which are now named after him. He was the first to propose axiomatics of probability theory (1917).

[32] Boris G. Galyorkin (1871–1945) was a prominent Russian and Soviet mechanical engineer and mathematician, Academician, engineer-lieutenant-general. He is most famous for his results in the elasticity theory. He designed and consulted on large hydroelectric power station projects and projects of other industrial facilities. The approximate method of solving boundary value problem for differential equations, he propose in 1915, was named after him.

[33] Grigory M. Fichtenholz (1888–1959) was a famous Russian and Soviet mathematician; brilliant lecturer, author of a three-volume textbook *Differential and Integral Calculus*. The workshops he had created are underlying the Leningrad school of the theory of real variable functions and functional analysis. Most mathematicians in Leningrad in the pre-war and the first post-war years attended his lectures.

V.A. Fock[34], and A.A. Friedmann. As of 1926, *The Journal of Leningrad Physical and Mathematical Society* founded by Steklov began to be published (after Steklov's death in 1926, the editorial staff of this Journal was headed by Ya.V. Uspensky). It was one of the few mathematical journals published in the USSR at that time.

In the middle 1920s, the generation of students enrolled in higher learning institutions after the revolution, completed their education and entered their career, truly believing to the new authorities. The new mathematical community was painfully formed in confrontation of the old versus new. In 1927, the All-Russian Congress of Mathematicians was held in Moscow. Soviet mathematics was declared to be a 'party and class science'. The authorities began chasing 'wreckers' in all spheres of life; politically motivated trials began. Old professors vindicated their traditions, ethics, the right to freedom of research, the right to freedom of conscience. This struggle reached its climax in 1929. The Ministry of Education issued instructions: in spite of the university charter, professors might be dismissed from their positions by resolution of administration. In Moscow, D.F. Egorov[35] was dismissed from his offices in 1929, and in 1930, he was arrested.

The authorities set the course for industrialization. To create strong industry, the country needed skilled engineers. To replace the old 'bourgeois' specialists and train the new ones, the authorities decided to enrol in higher learning institutions workers sent by the Communist party; facilitate curricula as much as possible; reduce the duration of study and attendance at higher learning institutions and technical schools; and give top priority to the ideology component of learning. In opposition to the Academy of Sciences, the Communist Academy was established[36]. Under this Academy, various societies of scientists were formed, including the Society of Marxist Mathematicians. Being desperately inferior to the traditional mathematical community professionally, Marxist mathematicians converted competition into ideological struggle with 'bourgeois' professors, which caused new political trials. Historical, mathematical, and methodological issues associated with the new educational programmes formed the battlefield. Textbooks were abolished in schools to be replaced by books of problems (out of the public eye, old teachers continued using the classical textbooks by A.P. Kiselev[37]). 'Laboratory team training'[38] was introduced, and other experiments were carried on. It was only in 1936 that scientists managed to protect schooling against incompetent reforms thanks to the presentation G.M. Fichtenholz made at the session of the mathematical group of the Academy of Sciences.

The elections to the Academy of 1929 were protectionistic. The government insisted on electing their nominees, members of the Academy opposed. There was a threat that the Academy will be wiped out. A.N. Krylov saved the situation, having insisted that they should comply with the demand of the authorities[39].

In 1930, OGPU[40] conducted mass arrests of "underground anti-Soviet parties" on fabricated evidence. In Moscow, OGPU ascribed leadership of the 'Party of Russia's Renaissance' to academicians

[34] Vladimir A. Fock (1898–1974) was an outstanding Soviet theoretical physicist, Academician. His works pertain to quantum mechanics, quantum electrodynamics, quantum field theory, statistical physics, relativity theory, gravitation theory, radio-physics. He also worked on philosophical problems of physics.

[35] Dmitry F. Egorov (1869–1931) was a famous Russian and Soviet mathematician, worked in Moscow. As of 1910, Egorov conducted mathematical research workshops which paved the way for Moscow school of the theory of real variable functions. Since 1921, he was Vice President, and as of 1923, President of the Moscow Mathematical Society. In 1929, was persecuted for religious views, and in October 1930, arrested. Together with a famous philosopher A.F. Losev, he was targeted in the investigation of the All-Union Counter-revolutionary Organization, the Genuine Orthodox Church (catacomb church). He was exiled to Kazan for five years even before the proceedings were over. He died in a hospital after he had launched a hunger strike in prison.

[36] After the Academy of Sciences was transferred to Moscow, the Communist Academy was liquidated in 1936 as superfluous.

[37] Andrei P. Kiselev (1852–1940) was an outstanding author of school textbooks in mathematics. Graduated from St. Petersburg University (1875), where he attended lectures of P.L. Chebyshev. He worked at grammar schools and non-classical secondary schools. By the beginning of the 20th century, he had created a brilliant line of textbooks in mathematics for grammar schools and non-classical secondary schools. His study books covered practically all school mathematical subjects: arithmetic, algebra, geometry, fundamentals of analysis. For more than 60 years they were the most sustainable textbooks for the national school thanks to their high theoretical level, consistency, clarity, and brevity.

[38] Each class was divided into teams; each team worked on an assignment; the team leader, or at least one team member, reported the progress to the teacher, and the entire team had a pass. This system was abolished in the USSR in 1932.

[39] Krylov said: "There is nothing to speculate, we must do what the government demands us to do $< \cdots >$. We have to elect them. Otherwise, the government will send the Academy to the devil together with all academicians." [3, p. 444].

[40] OGPU (the Joint State Political Directorate) was the name of the secret police of the Soviet Union from 1923 to 1934.

N.N. Luzin[41] and S.A. Chaplygin[42]. These allegations were much-publicized, there was much discussion at meetings and rallies, however, matters didn't come to arrests of the members of the Academy.

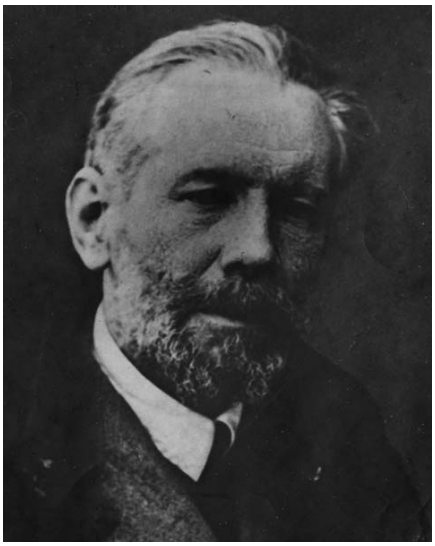

Figure 5. N.M. Günther.

In Leningrad, Professor N.M. Günther was the leader of the old school mathematicians. He was President of the Physical and Mathematical Society, Corresponding Member of the Academy. The Society of Marxist Mathematicians was in opposition to him. They accused the Academy, the University, and mathematical community of Leningrad at large, of being separated from practice, opposing the teaching reform, 'kiselevschina'[43] and cliquishness. In 1931, the Society of Marxist Mathematicians published a pamphlet entitled *"On the Leningrad Mathematical Front"* [5]. They faulted 'Günther's faction' for contemptuous disregard of professionalism of Marxist mathematicians. S.A. Bogomolov (1877–1965), who defended in his works G. Cantor's assertion that "the essence of mathematics is in its freedom" and the right of the mathematician to designate his own scope of research, was also criticised. A.V. Vasiliev, Ya.V. Uspensky, and S.A. Bogomolov were criticised for political apathy and academicism of their views on history and teaching of mathematics.

After the hate campaign against Günther, on the advice of V.I. Smirnov, the Physical and Mathematical Society was dissolved to save its members from political repressions.

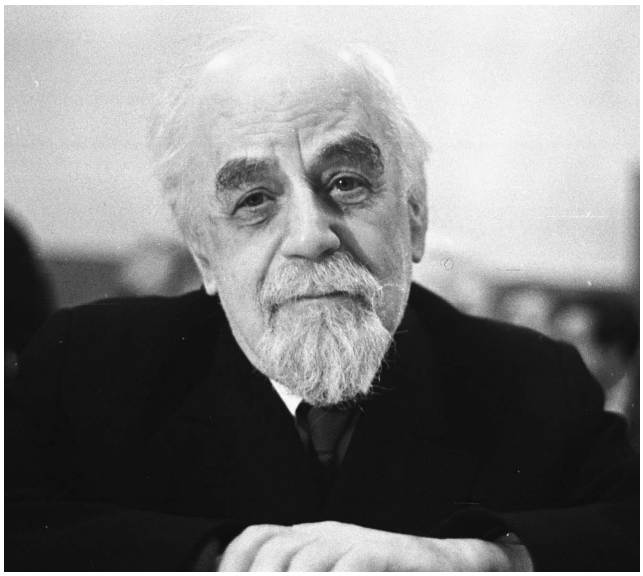

Figure 6. V.I. Smirnov.

Günther was forced to write a letter of contrition[44]. Having given up the Chair, he managed to escape arrest. However, he remained at the University as a professor and could continue his scientific activity. Günther died on 4 May 1941, having left his mathematical library for the Institute of Mathematics.

In the end of 1933, the Academy of Sciences, which was formerly within the jurisdiction of the CIK[45], was transferred under the jurisdiction of the Sovnarkom[46]. It was resolved to move its institutions, including the Institute of Physics and Mathematics, from Leningrad to Moscow in order to centralize research and publications, to make it closer to government, and to facilitate science management. The

[41] Nikolai N. Luzin (1883–1950) was an outstanding Russian and Soviet mathematician, Academician; one of the originators of descriptive theory of sets and functions. Together with D.F. Egorov, he founded the Moscow mathematical school and the famous community of Luzin's students, 'Luzitania'. Luzin's educational outcome was immense – it was the one-off event when an outstanding scientist nurtured equally outstanding scientists. Many of them created their own scientific schools. Luzin's life was spoiled by political harassment orchestrated around him in 1936. See [4].

[42] Sergey A. Chaplygin (1869–1942) was a prominent Russian and Soviet mechanician and mathematician, Academician; one of the founders of modern aeromechanics and aerodynamics. S.A. Chaplygin's key works were devoted to aerohydrodynamics, non-holonomic mechanics, theory of differential equations, and theory of aviation.

[43] Literally 'kiselev-ism'. They meant the use of A.P. Kiselev's textbooks, which were abandoned in the course of the educational reform of 1918–1932. This reform proved to be unsound. The new curriculum in mathematics of 1935 implied the return to Kiselev's textbooks.

[44] It should be noted that the "red professor" L.A. Leifert, main initiator of the hate campaign against Günther, was later, in 1938, arrested in Voronezh, without due grounds accused of "participating in a terrorist sabotage and wrecking organization" and shot dead.

[45] CIK (the Central Executive Committee of the Soviet Union) was the highest governing body in the Soviet Union in the interim of the sessions of the Congress of Soviets of the Soviet Union, existed from 1922 until 1938.

[46] Government of the USSR in the period from 1923 to 1946.

library of the Academy of Sciences, Archives, Publishing House, and some institutes affiliated with the Academy, were left in Leningrad. On 28 April 1934, Presidium of the Academy resolved to divide the Institute of Physics and Mathematics into the Institute of Physics and the Institute of Mathematics. I.M. Vinogradov was elected as a Director of the latter one.

In 1936, the so-called "Pulkovo Case[47]" was framed up in Leningrad. As a result, more than one hundred employees of Leningrad astronomic institutions were arrested and sentenced to various terms of imprisonment.

Political trials affected all segments of Soviet society. However, the scientific and engineering and technical community, as well as party and top military elite, was in the first place in these trials. Investigations were initiated by colleagues' and students' delations, declarations in newspapers and at meetings; thereafter, OGPU pursued the case. Using heavy-handed approach and provocative investigative interview methods, they compelled the alleged offender not only to confess to untruths, but to bear false witness against the ambit of acquaintances; thus the number of alleged offenders expanded.

II

In spite of the stressful environment, mathematicians continued working hard.

A.V. Vasiliev wrote a historical sketch on integer numbers (1919) and a book entitled *"Mathematics. Issue 1 (1725-1826-1863)"* (1921), the first significant work on the development of mathematics in Russia, where he analysed in detail works of Lobachevsky[48] and Chebyshev. Initiated by Vasiliev and Steklov, a formal meeting was held in 1921 at the Academy devoted to the 100th anniversary of Chebyshev.

In 1922–1924, A.A. Friedmann's results appeared based on his research of relativistic models of the universe and of non-stationary solutions of Einstein's equations. In 1922, Friedmann published an article entitled *"On the curvature of space"* and his lithographed thesis, *"Essay on Compressible Fluid Mechanics"*, which laid the groundwork for theoretical meteorology. In 1923, his famous book *The World as Space and Time* was published.

G.M. Fichtenholz worked in St. Petersburg as of 1915; S.N. Bernstein, as of 1933. V.I. Smirnov, R.O. Kuzmin[49], A.A. Markov Jr.[50], and physicist V.A. Fock played important roles in the mathematical community. A new generation came in 1920s: I.A. Lappo-Danilevskij[51], N.E. Kochin[52] and P.Ya. Polubarinova-Kochina[53], G.M. Goluzin[54], I.P. Natanson[55], S.G. Mikhlin[56], S.L. Sobolev[57], D.K. Faddeev[58],

[47] "Pulkovo Case" was a criminal case commenced against a group of Soviet scientists built on a baseless accusation of "participating in a terrorist organization whose goal was to overthrow the Soviet government and establish fascist dictatorship in the USSR". The first large group of arrests in autumn 1936 affected astronomers of the Pulkovo Observatory. Therefore, the case was called so. 12 people were shot dead, including B.P. Gerasimovich, Director of the Pulkovo Observatory, and B.V. Numerov, professor of the University, Corresponding Member of the Academy, founder and director of several astronomic institutes.

[48] Nikolai I. Lobachevsky (1792–1856) was an outstanding Russian mathematician, one of the originators of non-Euclidean geometry; Rector of Kazan University (1827–1846).

[49] Rodion O. Kuzmin (1891–1949) was a Soviet mathematician, Corresponding Member of the Academy. His main works are devoted to the number theory, analysis, probability theory, and elasticity theory. Together with N.M. Günther, they were co-authors of the famous *A Collection of Problems in Higher Mathematics* (1930s).

[50] Andrey A. Markov Jr. (1903–1979) was a famous Soviet mathematician, Corresponding Member of the Academy; founder of the Soviet school of constructive mathematics; the son of outstanding Russian mathematician A.A. Markov.

[51] Ivan A. Lappo-Danilevsky (1895–1931) was a Soviet mathematician, a student of V.I. Smirnov, Corresponding Member of the Academy. His key works are devoted to the theory of analytic matrix functions and to its applications in the theory of linear differential equations, where he achieved a number of fundamental results. The scientist died of acute heart failure during a professional business trip in Germany.

[52] Nikolai E. Kochin (1901–1944) was a famous Soviet mathematician and physicist, Academician, one of the creators of modern theoretical meteorology. He died in Moscow of a serious disease.

[53] Pelagea Ya. Polubarinova-Kochina (1899–1999) was a famous Soviet expert in fluid mechanics, Academician; spouse of N.E. Kochin. Her works are devoted to continuum mechanics, hydrodynamics, history of mathematics. As of 1935, she worked in Moscow and later, in Novosibirsk.

[54] Gennady M. Goluzin (1906–1952) was a Soviet mathematician specialized in the complex variable theory; author of the widely known monograph *Geometric Theory of Functions of a Complex Variable*.

[55] Isidor P. Natanson (1906–1964) was a famous Soviet mathematician, a student of G.M. Fichtenholz; founder of Leningrad school in constructive function theory; brilliant lecturer. His son, Garald I. Natanson (1930–2003), also was a mathematician specialized in constructive function theory.

[56] Solomon G. Mikhlin (1908–1990) was a famous Soviet mathematician working in analysis, integral equations and computational mathematics. He is best known for the introduction of the concept of symbol of a singular integral operator.

[57] Sergey L. Sobolev (1908–1989) was an outstanding Soviet mathematician who paved the way for a number of new research areas; Academician; a student of N.M. Günther and V.I. Smirnov. Based on the notion of distributional derivative, he introduced new function spaces which were later called Sobolev spaces. He also developed the theory of distributions. As of 1934, he worked in Moscow. He was among the founders of the Siberian Branch of the Academy.

[58] Dmitry K. Faddeev (1907–1989) was a prominent Soviet mathematician, Corresponding Member of the Academy, leader of Leningrad school of algebra; creator of the theory of cohomology groups, who substantially developed Galois theory; expert in numerical analysis. His wife, Vera N. Fad-

Figure 7. L.V. Kantorovich, I.P. Natanson, and D.K. Faddeev, 1938.

L.V. Kantorovich[59]; and in the late 1930s–early 1940s, A.D. Aleksandrov[60], S.M. Lozinsky[61], Yu.V. Linnik[62], B.Z. Vulikh[63].

Before the World War II, many branches of mathematics and applications were actively developed in Leningrad. We can list complex variable theory, theory of functions of real variable, constructive function theory, functional analysis, ordinary and partial differential equations, numerical analysis, number theory, algebra, geometry, probability theory, as well as the classical mechanics, fluid and gas dynamics, theoretical meteorology, astronomy, ballistics, and quantum mechanics.

In 1934, the Second All-Union Congress of Mathematicians was held in Leningrad. In 1940, Leningrad Department of Steklov Mathematical Institute was set up.

After 1933, many West European scientists came to Russia. Those were communists and communist-leaning, those were also Jewish intimidated by fascist regime. In particular, C. Burstin[64] (differential equations, differential geometry, algebra), H. Müntz[65] (differential equations), and S. Cohn-Vossen[66] (differential geometry) worked for Leningrad University.

As of 1934, initiated by B.N. Delaunay[67], mathematical competitions began to be held at schools. G.M. Fichtenholz arranged a mathematical circle for school children at the University; leading mathematicians gave lectures for them.

In 1934 Ya.I. Perelman, together with colleagues, founded the Russia's first interactive museum for children – The House of Recreational Science[68].

As the new requirements to the higher education were introduced in USSR, new courses were developed to combine apprehensibility with sufficient rigor. Many textbooks were written in Leningrad before the war, addressed various sections of mathematics and mechanics. Several of them became classi-

deeva (Zamyatina, 1906–1983), was a famous specialist in numerical linear algebra. His son, Ludvig D. Faddeev (1934–2017) was an outstanding Soviet and Russian mathematician, Academician, founder of Leningrad school of modern mathematical physics, President of the International Mathematical Union (1987–1990).

[59] Leonid V. Kantorovich (1912–1986) was an outstanding Soviet mathematician, Academician; author of fundamental works devoted to functional analysis and numerical analysis; one of the originators of linear programming and its applications in economics; Nobel laureate in economics (1975). As of 1960, he worked in Novosibirsk; as of 1971, in Moscow.

[60] Alexander D. Aleksandrov (1912–1999) was an outstanding Soviet and Russian mathematician, Academician; founder of Leningrad school of geometry in the large; author of breakthrough achievements in geometry, theory of partial differential equations, and mathematical crystallography; Rector of Leningrad University (1952–1964); from 1964 to 1986, worked in Novosibirsk.

[61] Sergey M. Lozinsky (1914–1985) was a famous Soviet mathematician. His research was mainly focused on two areas – constructive function theory and numerical analysis.

[62] Yury V. Linnik (1915–1972) was an outstanding Soviet mathematician, Academician; author of important achievements in the number theory, probability theory, and mathematical statistics. He was a founder of Leningrad school of Probability and Statistics.

[63] Boris Z. Vulikh (1913–1978) was a Soviet mathematician specialized in functional analysis; a student of G.M. Fichtenholz; author of famous textbooks in the theory of functions of real variable and functional analysis. His father and grandfather were famous experts in mathematical education.

[64] Celestin Burstin (1888–1938) was born in Ternopol, graduated from Viennese University, worked in Austro-Hungary. In 1931, he worked at Leningrad State University and thereafter, he was a Director of the Institute of Physics and Technology in Minsk. In 1937, he was arrested and died in the prison hospital.

[65] Herman (Haim) Müntz (1884–1956) was born in Lodz, graduated from Berlin University, was teaching in Germany and Poland, worked together with A. Einstein. As of 1929, he was a professor at Leningrad University although remained to be a citizen of Germany. On 1937, he was exiled from the USSR and lived in Sweden.

[66] Stephan Cohn-Vossen (1902–1936) was born in Breslau (Wroclaw), where he graduated from the university; as of 1930, was teaching at the University of Cologne and as of 1933, in Zurich. With D. Hilbert, he was an author of *Geometry and the Imagination*. In 1934, he moved to the USSR. He worked in Leningrad State University and in the Mathematical Institute. He died in Moscow of pneumonia.

[67] Boris N. Delaunay (Delone, 1890–1980) was a famous Soviet mathematician, Corresponding Member of the Academy; worked in the area of algebra, number theory, computational geometry, mathematical crystallography, and history of mathematics. Since 1934 lived in Moscow.

[68] There were more than 500 major exhibits and numerous smaller ones (film transparencies, mock-up models, instruments, schemes, and diagrams). All of them were grouped in four departments (1939): astronomy (together with meteorology), geography (together with geology), mathematics, and physics (with a room of optics). In 1940, they opened new departments: Electricity and Jules Verne Hall. In 1941, the museum was closed, its employees went off to war. Almost the entire exposition was destroyed during the Siege of Leningrad.

Figure 8. Ya.I. Perelman.

cal ones, were republished many times and translated into other languages.

In 1938, Presidium of the Academy organized a Commission for the History of the Academy in Leningrad. This Commission was headed by S.I. Vavilov[69]. In the first half of 1930s, the translation and publishing of mathematical classics was resumed. As a rule, these translations were supplied with detailed comments. The works of Kepler, Galileo, Cavalieri, Descartes, Fermat, Newton, L'Hospital, Euler, L. Carnot, Monge, Galois, Dirichlet, etc., were published. In 1932–1938, Leningrad Institute of History of Science and Technology published 10 volumes of its Archives and studies in honour of Euler (1935) and Lagrange (1937).

III

On 22 June 1941, fascist Germany attacked the Soviet Union. The striking force of German troops was moving towards Leningrad; Finnish troops were approaching from the North. On 8 September 1941, they tightened the assault. Leningrad was blocked from all transport directions except for the Ladoga Lake. The siege was overcome but in January 1943 to be finally raised on 27 January 1944.

Mobilization began in the very first days of the war. Teachers, students, employees of institutes went

[69] Sergey I. Vavilov (1891–1951) was an outstanding Soviet physicist, founder of the Soviet school of physical optics, Academician, President of the Academy of Sciences of the USSR in 1945–1951; younger brother of Nikolay I. Vavilov (1887–1943), outstanding biologist who was arrested and died in prison.

Figure 9. Leningrad University in 1941.

Figure 10. B.G. Galyorkin.

up the line. 2,500 people – employees, postgraduates, students – were conscripted from the University alone. A great number of volunteers signed up in Leningrad people's volunteer army too[70].

Many people were engaged in building defences around the city. Academician B.G. Galyorkin played the most important role in organizing this process.

By no means all of the scientists' requests to put them into the field were satisfied. In the course of the war, some scientists were recalled from the battlefields and were able to continue their research.

Right from the first days of the war, all institutes, museums, libraries, and archives took prompt action to preserve valuable scientific assets – collections of books and manuscripts, archive documents, and in-

[70] Only on 22 and 23 June 1941, around 100,000 people came to the collecting stations of Leningrad Military Registration and Enlistment Office. Seven squadrons were formed of students and teachers of Leningrad State University – all in all 1,671 men [6].

struments. The personnel (mostly women) packed it in boxes and bags, and fetched them to the ground floors and cellars. Fire-safety measures were also taken. Manuscripts of M.V. Lomonosov and J. Kepler, and other unique documents from the Archives of the Academy were evacuated to Sverdlovsk (at Ural) together with valuables from the Hermitage. In October 1941, under hostile fire, the staff of the Astronomical Observatory rescued the instruments and collections of books of the Observatory remaining in Pulkovo.

In the beginning of July 1941, the city's major scientists were taken to the country's safe regions. A.N. Krylov and S.N. Bernstein were evacuated among others. In August 1941, the evacuation was suspended to be resumed only after Leningrad was sieged. In autumn 1941, some of the scientists were evacuated by air, and in winter 1942, according to the standard procedure – overice across the Ladoga Lake. The evacuation continued in summer 1942 as well.

The University was substantially sent to Kazan and Yelabuga[71], where, under the authority of the Vice-Rector of Leningrad State University V.A. Ambartsumyan[72], they set up a branch of the University. In March 1942, some faculties were evacuated to Saratov, on Volga, where, under the direction of Dean K.F. Ogorodnikov, classes for students were resumed.

Being evacuated, Leningrad scientists turned their focus toward the needs of the defence industry, making every effort to resume and maintain educational process and intellectual assets for the benefit of the victory.

In Yelabuga, V.V. Sobolev, astronomer, who later became Academician, solved problems related to the object visibility calculation, Professor V.V. Sharonov drew up tables for such calculations. Under the direction of V.I. Smirnov, mechanical engineers (I.P. Ginsburg, M.A. Kovalev, P.G. Makarov) accomplished works in the theory of motion and rotation of jet-powered vehicles.

In Saratov, employees of the University conducted researches on propagation of explosive wave in various media (A.A. Grib), stability of anisotropic plates (S.G. Lekhnitsky). In Yaroslavl, L.V. Kantorovich performed works on optimal mine disposition and metal cutting.

In 1943, the Academy held a formal meeting in Moscow to celebrate the tercentenary of Newton. Also a book "Isaac Newton (1643–1943). Collection of Articles to Commemorate His 300th Birthday" was published. A.N. Krylov and other Leningrad scientists were among the authors of this work. In 1943, a Commission for the History of Mathematical Sciences was formed to be presided by A.N. Krylov.

Figure 11. Cold winter of 1941 in Leningrad. Nevski prospect, people take water from urban water supply.

The Siege of Leningrad lasted for almost nine hundred days. Day by day, it was harder and harder to live and work in Leningrad. Bombardments were followed by starvation. As of 13 November 1941, subject to presentation of redeemable coupons, 300 grams of bread per day was provided to workers and 150 grams, to office employees including research workers. However, even this bread allowance was reduced, and as of 20 November, workers were provided 250 grams per day and office employees, 125 grams. The bread allowance was increased, although bitterly moderately, on 25 December 1941: 350 grams of bread per day began to be provided to workers and 200 grams, to office employees. As of 24 January 1942, this allowance was increased again: 400 grams of bread per day for workers and 300 grams for white collars. 98% of the population suffered dystrophy.

The winter of 1941/42 was the coldest winter of the 20th century in the city (the air temperature fell to -34 degrees Celsius). Houses were not heated, water pipes were frozen. Leningraders had to take water from ice holes on the Neva, Fontanka, and other rivers. During the bombardments and artillery attacks, window glasses were broken by bomb blasts. People had to close up windows with plywood or just curtain them. Electric power was strictly limited. In December 1941, public transport stopped.

More than four thousand people died every day in the city. There were days when up to seven thousand people died. All in all, around eight hundred thousand citizens were starved or frozen to death over the period of the siege, and around seventeen thousand people were killed during air strikes and artillery attacks. Ya.I. Perelman, professors of mathematics B.M. Koyalovich and N.N. Gerneth, and the

[71] Yelabuga is a small town in the Republic of Tatarstan, located 200 kilometers east from Kazan.

[72] Victor A. Ambartsumyan (1908–1996) was a prominent Soviet astrophysicist, founder of the Soviet school of theoretical astrophysics; Academician; President of the Academy of Armenian SSR (1947–1993); President of the International Astronomical Union (1961–1963).

founder of the first photoelasticity lab in the USSR L.E. Prokofieva-Mikhailovskaya were among them.

Leningraders helped anti-aircraft defence of the city by organizing fire-safe teams. Thus, students and employees of the Library of the Academy of Sciences, who kept the watch of its roof, saved the library from fire when it was attacked with fire bombs on the night of 10 September 1941. Not only did the fragile women, who worked in the library, weakened by cold and dystrophy, manage to preserve its collections of books, they replenished its funds, having preserved libraries of deceased scientists. The Archives of the Academy protected historical documents; its employees delivered documents and materials of deceased scientists to the Archive, sometimes carrying them on their own shoulders or on sledges.

Figure 12. Anti-aircraft guns on University embankment, 1942.

On the 1st of September 1941, studies began at the University, first years of education began at the First and Second Medical Institutes, the Paediatric Institute, the Institute of Civil Engineering, and at other higher learning institutions. Senior students began their studies earlier, on the 1st of August. Studying at the institutes and universities, students worked at the same time at various enterprises and hospitals. In September–October, 40 higher learning institutions were functioning in the city.

Academic and sectoral research institutes did not stop their research work. In July 1941, they established a Defence Proposals Implementation Commission, academician B.G. Galyorkin to become its member. This Commission dealt with the challenges related to the creation of effective ways to protect ships against mines, technical support of supplying the city with food and evacuating its residents by the Ladoga Lake, and many other issues. Headed by Professor I.D. Zhongolovich, a group of employees of the Institute of Astronomy, who remained in the city, was engaged in preparing astronomical almanacs and drafting various navigation and ballistic tables. Academician V.A.

Figure 13. December of 1941, end-of-term test on experimental physics in the Pedagogical Institute.

Fock stayed in Leningrad in the first several months of the siege. He and his collaborators were engaged in calculation of ballistic tables and performed various other kinds of defence work. In 1943, Professor B.N. Okunev published in the sieged city three monographs on ballistics. In 1941–1942, Ya.I. Perelman gave lectures on inland navigation without instruments for reconnaissance men from Leningrad front and Baltic Fleet, and for guerilla fighters. The House of Scientists kept working.

L.V. Kantorovich taught algebra, geometry, and probability theory at the Higher Naval Engineering Technical School. In winter, the exploration of the Ladoga Lake ice sheet and investigation of opportunities of its use for military purposes were of vital importance for the sieged Leningrad. Food was delivered to the besieged Leningrad by lorries which were moving overice across the Ladoga. They used to call this route “The Road of Life”. A group of scientists including Kantorovich calculated the ice sheet strength under load. They viewed the ice as an engineering structure; when calculating the strength, they took into account quality of the material, meteorological situation, and load conditions. In 1943, they derived formulae to calculate the load-bearing capacity of the ice sheet in various situations: under stationary load, slowly moving load, movement at an average speed. Essentially, they found the optimal solution for movement depending on the changes in the environment. Results of this research found a striking application in practice in December 1943–January 1944. Recommendations of L.V. Kantorovich and S.S. Golushkevich enabled the vehicles to force through the ice at maximum speed beyond its sturdiness: propeller-driven sledges crossed the Ladoga breaking ice underneath. In this case, strength conditions were calculated for an expendable engineering structure [7].

In the beginning of 1943 the siege of Leningrad

Figure 14. The Road of Life. Lake Ladoga in spring 1942.

was broken, which enabled to improve Leningraders' working and living conditions a little.

The repressions on false charges persisted in Leningrad even during the siege. In winter 1942, on the charge of "counter-revolutionary activities" and for the "willingness to cooperate with the invaders", a big group of scientists from the city's academic institutions, the University, and other higher learning institutions was arrested. Absurd charges were filed against them – they allegedly colluded and planned to assassinate Stalin and form a "…puppet government in Russia which would obey to Nazi" (the role of the Prime Minister in this government was ascribed to V.I. Smirnov, who escaped the arrest, as he had been evacuated). Exhausting interrogations and tortures forced them to testify against their colleagues[73], the number of arrested people was growing and reached 127 men. Among the arrested scientists were V.S. Ignatovsky, physicist, Corresponding Member of the Academy (shot dead); mathematicians, Professor B.I. Izvekov and Assistant Professor B.D. Verzhbitsky (both died in prison). N.V. Rosé, the Dean of the Mathematics and Mechanics Faculty, died during the investigation.

Corresponding Member of the Academy N.S. Koshlyakov, the head of the Department of General Mathematics at the University, and A.M. Zhuravsky, Director of Leningrad Department of the Mathematical Institute, were victimized on the same charges. They were sentenced to death and thereafter, this verdict was replaced by 10 years of imprisonment. A.M. Zhuravsky was sent to a 'sharazhka'[74], where samples of weapons were developed. N.S. Koshlyakov stayed in a camp; in 1944, was transferred to work in Moscow at the theoretical department of an Experimental Design Bureau. In 1951–1952, they were set free, and in 1954, rehabilitated. Speaking of his involvement in defence work, A.M. Zhuravsky admitted: "I do not work for Bolsheviks, I work for Russia which must be a superpower, no matter who rules it."

[73] The only two persons, who did not bear false witness against anyone, were V.N. Churilovsky, professor of Leningrad Institute of Fine Mechanics and Optics, and P.P. Obraztsov, a laboratory assistant of the University.

[74] Informal name for Experimental Design Bureaux, secret research and development laboratories in the Soviet Gulag labour camp system.

IV

Mass re-evacuation of Leningrad institutions began in the second half of 1944 and was completed by summer 1945. Some institutes, as well as certain scientists, remained to work in Moscow. By summer 1944, educational process began to recover in Leningrad, scientific life was resuming. Leningrad rose from the ruins.

The war has done immense harm to the industry, urban economy, housing stock. Buildings of many institutes were damaged by artillery attacks and air strikes. The Pulkovo Observatory was ruined. Quite a number of scientists, who returned to the city, found that they had lost their lodgings.

Figure 15. The Pulkovo Observatory in 1944.

Many employees of institutes were killed in the lines and in the sieged city. The lack of teachers and academic specialists created such staffing bottleneck that, for example, V.I. Smirnov had to hold the Chair at several university departments at a time. Smirnov assigned the Chair to young professors as they were raised [8].

In the late 1940s, the practice of 'bashing' scientists was resumed. They were accused of departuring Marxist positions. The best known example was the session of the All-Union Academy of Agricultural Sciences (1948). In the course of this session, the outstanding Soviet school of genetics was actually destroyed. Mathematicians also had to fend off ideologists' assaults.

In 1947–1949, they launched a campaign to promote "purity of physical and mathematical sciences in the socialist environment". The constructive mathematics developed by A.A. Markov Jr. and cybernetics were supposed to be declared as pseudosciences. According to reminiscences of G.I. Petrashen', thanks to the presentation of A.D. Aleksandrov at an ideological seminar at the University, they managed to advocate constructive mathematics[75].

Figure 16. A.D. Aleksandrov.

In the end of 1940s–beginning of 1950s, skies over mathematics darkened to such extent that the very existence of it as an independent science was at threat. Leading scientists felt that it had to be protected from anti-scientific attacks of that time. The book project of A.D. Aleksandrov, *Mathematics: Its Content, Methods and Meaning*, had served this purpose. It was published in 1953 in an edition of 350 copies with a stamp "Printed for discussion in a limited range". Aleksandrov himself, A.N. Kolmogorov[76], and M.A. Lavrentiev[77] acted as editors; leningraders D.K. Faddeev, L.V. Kantorovich, V.A. Zalgaller[78], O.A. Ladyzhenskaya[79] were among the authors of this book. In an intelligible form, the authors justified the role and importance of mathematics in the modern world. The goal was accomplished – the frontal assault on mathematics was stopped[80].

The first post-war decade was marred by burst of anti-Semitism, which affected prospective students, university teachers, and staff of research institutions. Thus, in 1953, G.M. Fichtenholz was forced to leave the Chair at the Department of Mathematical Analysis he had himself established. To prevent an insufficiently competent person from being appointed to hold the Chair, Academician V.I. Smirnov took part in the competition to fill the vacancy and obtained the Chair. Thus Fichtenholz could stay at the University as professor. In 1956, Smirnov assigned the Chair to S.M. Lozinsky.

After Stalin died (1953), no more attempts were made to destroy whole sections of mathematics, although some scientists were still plagued on account of their ethnic descent or for political reasons. Unspoken ethnic restrictions on admission in the University and doctorate existed until mid-1980s.

V

The city's scientific life was reviving quite quickly after the war, as people were extremely enthusiastic. The country was in need of professionals; battlefront veterans and school leavers were eager to enter higher learning institutions and were very fond of their studies regardless of their stringent budget and household difficulties.

Many graduates of Leningrad University were involved in defence calculations, including the development of missile-borne nuclear weapons. In 1948, a group of 15 people under the leadership of L.V. Kantorovich was formed in Leningrad Department of

[75] Scientific community is aware of A.D. Aleksandrov's prominent services to the cause of protection of scientific biology. Thanks to his support, Leningrad University resumed teaching Scientific Genetics in 1950s, while in other universities in this country, including Moscow University, this happened much later.

[76] Andrey N. Kolmogorov (1903–1987) was a great Soviet mathematician, Academician; one of the originators of the modern probability theory. He also achieved breakthrough results in topology, geometry, mathematical logic, classical mechanics, theory of turbulence, algorithmic information theory, function theory, theory of trigonometric series, measure theory, set theory, dynamical systems, functional analysis, and several other areas of mathematics and applications thereof.

[77] Mikhail A. Lavrentiev (1900–1980) was a prominent Soviet mathematician and mechanician, founder of the Siberian Branch of the Academy, Academician; Vice President of the Academy of Sciences of the USSR (1957–1976). He worked in the area of the complex variable theory, calculus of variations, and mathematical physics.

[78] Victor A. Zalgaller (born in 1920) is a Soviet and Russian mathematician. His works are devoted to geometry in the large and linear programming. Since 1999, he lives in Israel.

[79] Olga A. Ladyzhenskaya (1922–2004) was an outstanding Soviet and Russian mathematician, Academician. Her focus areas were partial differential equations and mathematical hydrodynamics. In her works written in co-authorship with Nina N. Uraltseva, the solution of the 19th and 20th Hilbert problems was completed.

[80] Later, the book was published in large edition in Russia (1956). It was also translated into English (7 editions) and Spanish. See [9].

Figure 17. September 1, 1948. First day of classes. G.M. Fichtenholz lectures to first-year students at the University.

Figure 18. V.A. Zalgaller and Yu.F. Borisov. Leningrad Department of the Mathematical Institute, 1963.

Figure 19. O.A. Ladyzhenskaya and V.I. Smirnov, 1968.

Steklov Mathematical Institute. It was charged with calculation of plutonium critical mass. They used semi-automatic calculating machines and later, tabulating machines to make these calculations.

The role of Leningrad mathematicians was important in other post-war scientific and technological achievements. In 1954, the first nuclear power plant was put into operation, and in 1957, the first artificial Earth satellite was launched.

The new generation, which joined the mathematical community after the war, gradually began to take the lead – those were V.A. Zalgaller, O.A. Ladyzhen-

Figure 20. Foreign participants of the Euler jubilee session. From left to right: E. Marczewski (Poland), M. Katetov (Czechoslovakia), H. Grell (GDR), K. Schröder (GDR), W. Sierpiński (Poland) and M. Fréchet (France). April 15, 1957.

skaya, and thereafter, G.P. Akilov[81], Z.I. Borevich[82], V.A. Yakubovich[83], M.S. Birman[84], and others.

Established in 1943, the Commission for the History of Mathematical Sciences continued its work. A.N. Krylov, S.I. Vavilov, V.I. Smirnov served successively as its chairmen. The book series "Classics of Science" has been published since 1945 to the present time. In 1953, Leningrad Department of the Institute of History of Natural Science and Technology was opened. In 1957, a Jubilee Session of the Academy of Sciences was held in Leningrad to commemorate the 250th anniversary of Euler.

In the post-war period, the scope of mathematical studies was substantially expanded in Leningrad. Many conferences and scientific workshops had formative influence and were instrumental to attract young people to new areas of theoretical and applied mathematics. The most important research centres were in Leningrad Department of Steklov Institute and in Leningrad State University as before. However, mathematical research was conducted in other higher learning institutions as well. Scientists from Leningrad were involved in training researchers and teachers for the entire Soviet Union as well as for foreign countries. Those were mathematicians from Leningrad who formed strong research teams in many cities of the country.

The modern Petersburg mathematical school is proud of the results in many areas: functional analysis, constructive function theory, complex variable theory, algebra and number theory, geometry and topology, ordinary and partial differential equations, diffraction and wave propagation theory, spectral theory, mathematical physics, dynamic systems, probability theory and mathematical statistics, control theory, numerical analysis, mathematical logic, computability theory and theory of computation, history of mathematics.

L.D. Faddeev (Shaw prize winner); M.L. Gromov (Abel prize winner); Fields medalists G.Ya. Perelman and S.K. Smirnov; and many other outstanding mathematicians are among those who were trained by this school.

[81] Gleb P. Akilov (1921–1986) was a Soviet mathematician specialized in functional analysis. Since 1964, he worked in Novosibirsk.

[82] Zenon I. Borevich (1922–1995) was a famous Soviet and Russian mathematician specialized in algebra and number theory.

[83] Vladimir A. Yakubovich (1926–2012) was a prominent Soviet and Russian mathematician, Corresponding Member of Russian Academy. He made a fundamental contribution in the modern control theory and was a creator of Leningrad school of control theory.

[84] Mikhail S. Birman (1928–2009) was a prominent Soviet and Russian mathematician, founder of Leningrad school of spectral theory of operators.

Acknowledgements

We are grateful to Professor S.S. Kutateladze for several valuable comments.

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