

Mathematics and Politics in the Soviet Union from 1928 to 1953

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*Affairs of long forgotten days,
of deep antiquity the chronicles.*

Pushkin (Ruslan and Lyudmila, first song, epigraph)

The paper describes the influence of politics on the life of Soviet mathematicians in Stalin's era 1928–1953, years that witnessed the full unfolding of the dictator's power. A few years following Stalin's death are also covered. Various publications, private manuscripts, and recollections of my own experiences at the University of Leningrad served as sources. Leading themes include the administrative talent of Egorov, Lusin's School, and the genius of Kolmogorov. © 2002 Elsevier Science (USA)

INTRODUCTION

This paper describes Soviet mathematics of Stalin's era as seen from Leningrad (St. Petersburg). Transferred from the Polytechnic Institute of Tbilisi, Georgia, during the years 1928–1942, I was successively a student, assistant, and docent at Leningrad University. My personal experiences underlie this paper. Nevertheless, it is a piece of history of mathematics in the 20th century rather than a memoir of my life. For two reasons, I had to devote much attention to the mathematical life in Moscow. The original rivalry between Moscow and Leningrad in the early 1920s turned into Moscow's domination and leadership of the whole country. One cannot understand Leningrad's mathematics without its counterpart in Moscow. The second reason was my attraction to Moscow's theory of real functions. In fact, indirectly, Lusin and Kolmogorov were my teachers.

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Sections 1 and 2 provide background material, reaching into imperial Russia. In all other chapters, I link mathematical developments with the political characteristics of periods of Stalin's era. During the Turnabout of 1928–1932, the collectivization of the peasants and the forced speed of industrialization were the main political events. Revolutionary, eager, middle-level Party members such as Kolman and Leifert were given considerable freedom. Sections 3 and 4 show how this freedom was used to eliminate the old, non-Soviet leadership in mathematics. The period of 1932–1936 in Section 5 was a time of stabilization, a return of certain conservative and hierarchical trends. Emphasis on good education and the establishment of new institutes of teaching and research signaled the beginning of the “Golden Years” of mathematics. The extremely cruel Great Terror of 1936–1937 victimized several particular population groups and many individuals at random from all groups. By considerable moral sacrifices made during Lusin's trial at the Academy, Moscow mathematicians were able to gain the Party's trust and relative safety from persecution. This forms Section 6. However, the next section shows that the Party mistrusted its scientists at the critical time of Leningrad's blockade in 1941–1942. Even after victory in WWII, living conditions continued to be hard. “Show trials” sprung up for newly invented types of “enemies of the people.” Mathematicians had to fight new ideological battles. Section 8 ends with a description of the leaders of the mathematical communities of Leningrad and Moscow.

Numerous descriptions from various points of view have focused on the interplay of mathematics, ideology, and politics during Germany's critical years 1933–1945. In this paper, I attempt to cover a similar theme in the Soviet Union's Stalinist era, an investigation that has met with several difficulties. My original sources reflected a time when people did not dare to write candidly in their newspapers and memoirs and were accustomed to read between the lines. Certain topics were avoided outright: Some events became nonevents, some persons became nonpersons. I hope that our friends, the Russian mathematicians, will help to answer questions that remain.

I am grateful for the many useful observations on the manuscript of this paper that I received from the referees and the editors.

1. MOSCOW

The reigns of Aleksander III and Nikolai II from 1881 to 1917, politically stagnant and reactionary, with revolutionary-minded intelligentsia, were nevertheless a time of economic growth, innovation, and cultural flowering. In art, it was the Silver Age of Russian poetry, bringing forth

new theaters, new trends, Chagall, Kandinsky, Stravinsky, Prokofiev, and, much later, Shostakovich. A wave of new mathematicians came somewhat later. At the beginning, Moscow would be hard put to prove that in mathematics it was second only to St. Petersburg. The best professor of the time, Bugaev, was better known as the father of the poet Andrei Belyi. His simple investigations in number theory opened no new horizons to students. For some time, Moscow University was better known for philosophers of Orthodox Christianity who began their study with mathematics. The mystic path of their greatest, Vladimir Solovyev (1851–1900), was followed by many distinguished Orthodox thinkers all over the country. Closer to earth was P. A. Florenskii (1882–1937). A contemporary and friend of the mathematician N. N. Lusin (1883–1950), he was sometimes called the Russian Leonardo Da Vinci. He excelled in geology, electrical engineering, and mathematics. Ordained as a priest, his faith was strong and naive, his goodness incorruptible.

The situation in Moscow changed with the arrival of the gifted and active D. F. Egorov (1869–1931). He understood the importance of the new ideas of Cantor, Borel, and Lebesgue. He contributed a basic theorem of the new theory about the essential uniformity of the convergence of function sequences. Aleksandrov [4] recalls that Egorov's seminars in 1912 discussing fresh mathematical discoveries were visited by the entire mathematical Moscow. Due to Egorov's efforts, W. Sierpinski, a German citizen and prisoner of war during WWI, was allowed to live and work in Moscow, fully participating in mathematical life. After the war in Warsaw, Sierpinski became one of the leaders in Polish mathematics. The Polish school of set theory he founded could be considered a sister of Lusitania, as the circle of Lusin and his students was called.

Egorov's abilities as a leader and organizer were significant. A well-liked administrator, he was a staunch defender of mathematicians' interests and a protector of academic traditions. He had several good students including Golubev, Stepanov, Razmadze, Privalov, and Lusin. For Lusin, the most talented of them, he recognized the necessity of the best possible foreign contacts. He arranged Lusin's 3-year visit to Göttingen and Paris where he met Hilbert, Borel, and Lebesgue. Lusin would never forget France; he often exclaimed "la belle France" in his far from perfect French. With his work, "Integral and the Trigonometric Series" in *Matematicheskii Sbornik*, Lusin earned his doctorate (the second academic degree in Russia following the magister, later called "candidate," something like our Ph.D.) and a professorship.

From 1915 to 1917, the close cooperation of the young Professor Lusin with his students led to a real triumph. D. E. Menshov (1892–1988) disproved the uniqueness hypothesis for trigonometric series, showing that there may be several series converging almost everywhere (a.e.) to the same

function. Another student, P. S. Aleksandrov (1896–1982), proved Cantor's conjecture for Borel sets by showing that all of them either are countable or have the power of the continuum. Using some of Aleksandrov's ideas, M. Ya. Suslin (1894–1919) found a new class of sets, much wider than Borel sets, which possess similar useful properties. In a fourth paper, Lusin continued the study of Suslin's sets. In spite of WWI, all papers were swiftly published in Lusin's beloved journal, the *Comptes Rendus, Paris*.

Nobody engaged in mathematics in 1917, the year of the two Russian revolutions. Moscow and St. Petersburg became Bolshevik bastions during the subsequent Civil War that ended in mid-1921 when General Vrangel was forced out of the Crimea and the Red Army of Trotsky and Tukhachevskii was unable to take Warsaw. Conditions in the two cities during the years of "War Communism," described in Pasternak's "Doctor Zhivago," were abominable. Not only was there widespread hunger, but people were also forced to share living space with strangers assigned arbitrarily by the Office of City Soviets. The population of Moscow and St. Petersburg shrunk to a quarter of its prewar number, exactly as happened in Leningrad during the German blockade in WWII.

For his group of Menshov, Suslin, and A. Ya. Khinchin (1894–1959), Lusin found refuge in Ivanovo to the northeast of Moscow where a new Polytechnical Institute was founded. Lusin persuaded rector Brelov to take the greenhorn student Suslin as an associate professor. But Suslin got into increasing conflict with the rector. Alienating also his teacher, he did not take the required magister examinations [18, pp. 163–168]. Finally, Suslin resigned and returned to his native village near the Volga. He died there from an infection of typhoid fever.

During this time Egorov remained in Moscow protecting the university. Aleksandrov, without Lusin's help, was trying to prove Cantor's hypothesis for arbitrary sets, an impossible task, as we now understand. Disheartened by his failure, he left Moscow for the western provinces where he successfully experimented with staging classical plays in a local theater. According to hearsay, he had intended to join the theatrical profession and gave it up only because he anticipated political problems. After the peace treaty with Poland in 1921 and the introduction of Lenin's New Economic Policy (NEP), conditions of life improved with the exception of housing. Science and industry progressed. Mathematicians could return to Moscow. In 1921, Moscow University had a great reservoir of student talent. The years immediately following, enthusiastically described by Lyusternik [26], were the happiest, most successful period for Lusitania.

M. A. Lavrentiev (1900–1980) and N. K. Bari (1911–1961) became Lusin's students. The latter, one of the best female Russian mathematicians, demonstrated excellent taste; some of her discoveries predicted greater things to come. Her theorems about superpositions of absolutely

continuous and of monotone functions were similar to Kolmogorov's formulas for the solution of Hilbert's 13th problem. She wrote a book on trigonometric series, parts of which proved to be better than the "bible of harmonic analysts," the books of A. Zygmund.

The appearance of P. S. Uryson (1898–1924) and A. N. Kolmogorov (1903–1987) on the mathematical scene was particularly striking. Beginning with analysis, Uryson became a topologist under Egorov's influence. He became the founder of the Moscow topological school, and Aleksandrov joined him. Uryson's main achievement was the development of dimension theory whose foundations had been laid down by L. E. J. Brouwer, Poincaré and Lebesgue. Aleksandrov and Uryson became friends, publishing several papers together—the beginning of the Moscow topological school. The friendship overshadowed even Aleksandrov's impending marriage. He describes it this way [4, p. 243, 249]: "The night of March 30–31, 1921, we spent with Uryson walking the streets of Moscow. At five o'clock we separated, agreeing to consider this the first day of our friendship. The next development was my marriage to Ekaterina Eiges on April 2. The marriage lasted only a few days." A. R. Eiges (her brother) loved his sister very much and felt deeply the misfortune of her family life. "[However], not once did I hear or feel [from him] a reproach in this respect."

Aleksandrov and Uryson were the first Soviet mathematicians allowed foreign travel in the summers of 1923 and 1924. The main trips took them to Göttingen with contacts to Hilbert and Emmy Noether, but they also visited Hausdorff and Brouwer. The devastating end came on August 17, 1924. Swimming dangerously in the surf of France's Normandy coast, Uryson was thrown against a cliff and killed. In spite of the immense shock he suffered because of this tragedy, Aleksandrov's good relations with Göttingen and Hausdorff continued for many years. In Moscow, he soon had his first student, the blind P. S. Pontryagin (1908–1988).

Against the rich background of talented, brilliant young mathematicians in Moscow, Kolmogorov was particularly outstanding. He could be called Lusin's student but was completely able to make breakthroughs on his own. He achieved the first one at the age of 19, in 1922. One of Lusin's famous problems was the invitation to prove the almost everywhere convergence of the Fourier series of any square-integrable function. For a larger class of integrable functions, Kolmogorov constructed a function that did not satisfy this, whose Fourier series diverges almost everywhere. The situation became clear only 40 years later with the establishment of one of the main theorems of harmonic analysis. It was shown that functions of all spaces L_p , $1 < p \leq \infty$, have almost everywhere convergent Fourier series. Thus, Kolmogorov's result described exactly the range of validity of this theorem. Today the greatness of this result can be seen

because (a) the proof was difficult and (b) the importance of the result increased with time. Indeed, at first everybody believed that Kolmogorov's result was only a first step toward a refutation of Lusin's conjecture, toward the construction of a function in L_2 , perhaps even of a continuous function, with divergent Fourier series.

Kolmogorov's other major early achievement was the axiomatization of probability theory by means of measures on the sets of elementary events. This paralleled the complete axiomatization of geometry by Hilbert. Kolmogorov became one of the great mathematicians of the first half of the 20th century. His main creative period ended fairly early, perhaps with his 1959 paper on metric entropy with Tikhomirov. He remained, in V. I. Arnold's terms [15, p. 68], a mathematical alpinist conquering single outstanding mountain peaks rather than a mathematical road builder constructing comfortable roads of access to the peaks. Sometimes he found the best unimprovable result where nothing had been known before him, like his solution of Hilbert's 13th problem. At other times he produced a seminal result, one of several possible, which exemplified and illuminated a whole new landscape, ready for exploration. His paper on widths in 1936 was an example.

Egorov's success peaked in 1929. President of the Moscow Mathematical Society (MMO) from 1923 to 1930, Egorov also served as editor of the journal *Matematicheskii Sbornik*. At the university, he was a well-liked and energetic dean. At the age of 61, he was elected to honorary membership of the Soviet Academy of Sciences together with the algebraist D. A. Grave (1863–1939) from Kiev. At the same time, other great Russian mathematicians, N. N. Lusin, I. M. Vinogradov, and S. N. Bernstein, became members. Ideas of Cantor, Lebesgue, and Lusin were still considered a peculiar kind of mathematics. To Lusin's disappointment, his election placed him in the section of philosophy.

In the Ukraine, pure mathematics fared less well. The Ukrainian Communist Party decided sometime in the 1920s that only applied mathematics was to be developed in this region. The algebraic school of Grave in Kiev was closed; his gifted and very successful students, N. G. Chebotarev (1894–1947), B. N. Delone (Delaunay) (1890–1980) and O. Yu. Schmidt (1891–1956), moved from the Ukraine to Kazan, Leningrad, and Moscow, respectively. At Kharkov, the other important Ukrainian city, the specialties of Grave's colleague S. N. Bernstein (1880–1968), namely approximation theory, probability, and partial differential equations, were closer to applications. A research institute for Bernstein was planned for 1930. Unfortunately, instead of being able to enjoy it, he was forced to leave Kharkov. Nevertheless, approximation theory became a leading field of mathematics in the Ukraine. Results of Akhiezer, Brudnyi, Dzyadyk, Korneichuk, M. G. Krein, S. M. Nikolskii, Remez, and A. F. Timan amply attest to this.

2. LENINGRAD

Called Sankt Petersburg in 1701 by its founding father, Peter the Great, the city became Petrograd in 1914 until Lenin's death in 1923, and Leningrad until 1991. For 80% of its life, the city of my birth was the country's political, spiritual, and architectural center. When I returned there in 1928, I still believed that its dialect, only slightly different from Moscow's accent, was the correct classical Russian.

It is said that the best mathematicians of all ages were Archimedes, Newton, and Gauss. The fourth very well may be Leonhard Euler (1707–1783), son of a Swiss Lutheran pastor in Basel. With an important interlude at the Prussian Academy of Sciences (1741–1766), he spent the beginning and the end of his (mathematical) life in St. Petersburg. In 1766, empress Catherine the Great offered him and his sons financial rewards not matched anywhere else. Euler worked in all mathematical fields known at that time: analysis, number theory, variational calculus, series, and all branches of the exact sciences accessible to mathematical methods. A simple example of his power is Euler's formula

$$e^{i\pi} = -1$$

which connects the three basic constants of analysis: π , e , and $i = \sqrt{-1}$.

Euler's legacy continued to live on in St. Petersburg. Soon there were several mathematicians of world fame. P. L. Chebyshev (1821–1894) studied polynomials of best approximation, distribution of primes in number theory, and probability, disciplines that later came to represent Russian strength in mathematics. Some discoveries of E. I. Zolotarev (1847–1878), who died young, could be fully appreciated only later. Chebyshev's students, A. A. Markov (1856–1922) and A. M. Lyapunov (1857–1918), together with V. A. Steklov (1864–1926), were to define St. Petersburg's mathematical personality for a long time.

Chebyshev's best student, Markov, followed him in the same subjects with even more vigor and depth. In number theory, he investigated quadratic forms; he applied continued fractions as a tool. In probability, he and Lyapunov proved fundamental limit theorems under fairly general conditions. Many stories about Markov were told to me by both my father who took his courses for a year and by Markov's son, A. A. Markov, Jr. (1903–1979), himself an excellent mathematician. Markov the elder told his son that Chebyshev, a well-known tightwad, died in the presence of his doctor, clutching in both hands banknotes of three and five rubles; he could not bring himself to hand them to his caretaker. However, it is also known that he gave luxurious dinners for his friends.

Markov's lecturing was a great success, even financially. Copied by scribes, well-bound copies of his lectures were commercially available. The first lecture in his course would begin with the words, "Disorder is defined as follows." He would then explain that 2, 4, 1, 3 was a disorder because an odd number of permutations was needed to transform it into 1, 2, 3, 4. This was the beginning of the theory of determinants. Markov liked to needle the imperial government and the Orthodox Church from his lectern. He would compute the probability that orally circulated reports of biblical events contained no error. After the Orthodox Synod excommunicated Leo Tolstoy, Markov applied for and got a similar excommunication.

In his early fifties, Markov started investigating the frequencies of the appearance of different letters of the alphabet in the Russian language, referring to the first chapter of Pushkin "Evgenii Onegin" as an example. Thus, the letter "a" has a certain probability in the language. It has another, different probability if it is known to follow an "r." This probability will change again if the "r" is known to be preceded by a "t." In general, Markov considered a sequence or chain of events $A_1, A_2, \dots, A_n, \dots$, each dependent on the preceding ones, this dependence becoming weaker and weaker with distance and disappearing at some point. People thought that this was a whim of an aging professor. Actually, this was the beginning of Markov chain theory, a chapter of probability that has produced scores of books, a theory indispensable in life, technology, and the sciences.

A colleague of Markov in the Imperial Academy of Sciences and his friend, A. M. Lyapunov, is important to our history because he represented another sphere of mathematics at the cross-section of physics, mathematics, and astronomy richly present in St. Petersburg. His main achievements were in the mathematical theory of stability of equilibrium or of movement of mechanical systems. His memoir about the movement of three bodies received a prize from the French Academy. In probability theory, he invented the method of characteristic functions.

V. A. Steklov, another academician, was elected at the ripe age of 48. With wide interests, he was more applied than theoretical, more organizer than scholar. He could not offer new exciting problems to his numerous students as Lusin did in Moscow. In good relations with Lenin after the revolution, Steklov became vice-president of the Academy. He belonged to many government planning committees and organized the physical and mathematical research institutes of the Academy, the latter bearing the name "Steklov Institute" to this day.

Simultaneously with the rise of Lusitania in Moscow, a generation of outstanding talent also came forth from St. Petersburg University: A. A. Friedmann (1888–1925), Ya. D. Tamarkin (1888–1945), V. I. Smirnov (1887–1970), Steklov's students, and A. S. Besicovitch (1891–1970), a student of Markov. I found only Smirnov when I came to Leningrad in

1928. This group was joined by Kolosov, Kuzmin, Shokhat, and also Muskhelishvili, founder of the National Mathematical School in Tiflis, along with Razmadze.

Toward the end of WWI, the German army threatened St. Petersburg. Its university was evacuated to Perm, close to the Ural mountains. Many mathematicians went along, among them Friedmann, Besicovitch, Kuzmin, and Gyunter, returning only at the end of the Civil War. During this time, Markov preferred to remain in a village close to St. Petersburg teaching school. Lyapunov fled to non-Bolshevik Ukraine and died there in November 1918.

Friedmann's grandfather was a medic of the Preobrazhenskii regiment of guards who protected Russian emperors, and his father a musician and composer. While still in high school, Friedmann and Tamarkin wrote a number-theoretic note praised by Hilbert and published in *Mathematische Annalen*. Friedmann had exuberant, overflowing talents and limitless energy. Having worked in pure mathematics with Steklov, he was attracted to physics and the mathematical aspects of several exact sciences. He discovered that Einstein's relativity theory allowed also for universes with an increasing or periodically oscillating rather than a constant radius. It took time for him and one of his students to persuade Einstein to accept the correctness of this deduction.

During WWI, Friedmann became interested in plane navigation and construction and even took part as a pilot in the bombing of the Austrian stronghold Przemysl. After returning from Perm to St. Petersburg, he continued his feverish activity. Working in the Main Geophysical Observatory, he discovered his new field of specialization, dynamic meteorology, and attracted gifted coworkers: N. E. Kochin (1901–1944), later an academician, B. I. Izvekov (1894–1942), and I. A. Kibel (1904–1970). To explore the atmosphere, he ascended in a gas balloon to a height that achieved the world record of that time. Friedmann also initiated a book project, "*Mathematics for Physicists*," with Smirnov and Tamarkin; their names appeared on two volumes. After Friedmann died and Tamarkin fled to the United States, Smirnov completed the project in five volumes, the last one devoted to functional analysis.

The death of the elder Markov in 1922 and Friedmann's death three years later can be considered the end of Leningrad's greatness as a mathematical center. The departure of Besicovitch and Tamarkin, who escaped together in 1924 by illegally crossing the Soviet border, contributed to this decline. However, other mathematicians moved to Leningrad: B. N. Delone and V. A. Tartakovskii (1901–1973) came from Kiev, and G. M. Fichtenholz (1888–1959) from Odessa. Even with Markov gone, Leningrad's main strength, unmatched by Moscow, remained its number theory group including the academician Ya. V. Uspenskii as well as Vinogradov, Venkov, Koshlyakov, and Kuzmin.

The best of them, Vinogradov, was deeply introverted, a lifelong bachelor with down-to-earth tastes. He was as strong as a bear, with a rightfully feared handshake. Climbing under a large piano, he could lift and balance it on his shoulders. Living near a student dormitory, Vinogradov would be often seen participating in a volleyball game. Any rough remark by a player who did not know him would be stopped by the others: "Shut up, he is an academician."

As a beginner, Vinogradov found a simple proof of a famous estimate that contained the integer n . He and Smirnov offered the paper to Markov for publication. The new estimate contained an extra $\log n$. "The logarithm is a slowly increasing function, this is a small improvement on the old estimate," remarked Markov. "No, it is worse by this factor, not better. However, the proof is very simple," said Vinogradov. "But $\log n$ is large, it tends to infinity," Markov protested. However, he finally accepted the paper.

Vinogradov made his main contributions in additive number theory. He completely mastered the Hardy–Littlewood approach, working with estimates of certain trigonometric sums. The 250-year-old conjecture of Goldbach, still unproved, asserts that each even natural number is the sum of two primes, for instance, $100 = 11 + 89$. Vinogradov's weaker version of this stated that each large odd number is the sum of three primes. He apparently had no students working with him. Yet, at the end of the 1930–1931 academic year, he gave a lecture especially for Izya Gordon and me explaining his theories. To his disappointment, we did not understand much. We could not even identify which one of his lemmas was the most important for the proof. I. M. Gelfand, after his election to the presidency of the Moscow Mathematical Society, warned his colleagues in his acceptance speech against becoming pure "technocrats," urging them to emphasize good ideas, which he called the soul of mathematics. I am sure that Gelfand did not mean Vinogradov, whose work would have been impossible without excellent ideas. Nevertheless, the word "technocrat" seems to be strangely descriptive of Vinogradov's work.

At the University of Leningrad, two teachers predominate from 1928 to 1930, attracting the love and admiration of students: Smirnov and Fichtenholz. The first was a passionate and effective lecturer, explaining his ideas with crystalline clarity and without excessive rigor. A student of Steklov, he worked in many fields, from elasticity to what we now call Hardy spaces. S. L. Sobolev (1908–1989) and I. A. Lappo-Danilevskii (1896–1931), both excellent, were his students. Sobolev, who soon left Leningrad for Moscow, became known for his differential inequalities and for participating in the creation of distribution theory. He used spaces of functions with finite L_p -norm whose derivatives are distributions: Sobolev spaces. The spaces W_p^r with distributions replaced by ordinary functions

are, by extension, also called Sobolev spaces. Lappo-Danilevskii died in Germany, unable to complete his dissertation. His subject was the construction of systems of linear differential equations with given monodromy. As an unselfish service to mathematics, Smirnov, with the help of Kochin, completed and published the dissertation that earned for Lappo-Danilevskii a corresponding membership in the Academy.

The small group of Fichtenholz, Besicovitch, and Tamarkin represented a counterpart to Moscow's Lusitania: they studied real function theory. Tamarkin became a valued professor at Brown University. The star of the group, Besicovitch, obtained several famous results. He solved Kakeya's problem about the rotation of a needle in a domain of least possible area, produced several deep theorems about covering of sets, and studied almost periodic functions. At the end of his career, he became the successor to Littlewood at Cambridge.

Fichtenholz, the only member of the group remaining in the USSR, was more teacher and able administrator of his chair (Kafedra) than researcher. Although he taught real functions, his most popular lectures focused on analysis, that is, on differential and integral calculus, the university's basic course for the first three of five years. With silky black locks and an Assyrian beard, immaculately dressed, he was a striking figure. His presentations were logical, clear, exact, smooth, and artistic. Students admired his wit. Here is an example. A lemma of analysis says that if $a_n \leq b_n \leq c_n$, $n = 1, 2, \dots$, and $\lim a_n = A = \lim c_n$, then also $\lim b_n = A$. Fichtenholz called this the theorem of the two policemen: if two policemen walk to the precinct, then the man between them also walks there.

Students accepted his insistence on proper behavior. In front of 200 students, he expelled from his class the future world chess champion Spassky for analysing games on his portable chess set instead of concentrating on the lecture.

During WWII, Fichtenholz completed a three-volume set (2,800 pages) of books on analysis—a "Cours d'Analyse" in the style of Goursat or de la Vallée-Poussin. His was perhaps the last analysis textbook of this length without the use of Lebesgue integration.

3. THE TURNABOUT: EGOROV AND KOLMAN

To properly understand mathematical life in 1930–1931 in Moscow and Leningrad, one must be able to imagine the political background of the period. The Turnabout (Velikii Perelom) of 1928–1931, also called Stalin's Revolution from above, replaced Lenin's tolerant era of the New Economic Policy of 1921–1927. The economy of NEP was based on small business entrepreneurs ("nepmen") and on successful peasants who had profited

from land redistribution at the beginning of the Civil War. This half-planned, half-market economy all but repaired the destruction left by the Civil War. For most Party members, among them Stalin's chief rival Trotsky, progress was too slow to "catch up with and overtake (dogmat i peregnat) the capitalist world." In addition, the peasants did not cooperate, refusing to sell their produce at government prices.

There were struggles in the Politburo, the governing center of the Party. At the beginning, Lenin's line was supported by the right wing that included Stalin, Bukharin, and Rykov and opposed by the left wing headed by Trotsky. After the crushing defeat of Trotsky's opposition, Stalin borrowed from him his basic ideas of collectivization and industrialization. In 1928, Stalin was finally able to act independently, disregarding his Party adversaries. He realized the ideas of the left wing in a very extreme way.

At the 1930 Party congress, Stalin preordained the "advance of Socialism on all fronts," the Turnabout. The change was most obvious on the economic front. The nepmen were eliminated by excessive taxation of their property or by deportation. During the Civil War, the Bolsheviks had gained peasant support and sympathy by helping to expropriate the landlords' estates. Now the land was taken away. Classifying peasants into groups of poor, middle, and kulak, the Party started collectivization under Stalin's slogan: "Liquidation of kulaks as a class." Actually, it was "Liquidation of peasants as a class." Kulaks and their families were expelled from their villages, the wealthier ones exiled to Siberia, the more stubborn shot or sent to concentration camps. The rest "voluntarily" donated their land, animals, and agricultural tools to a kolkhoz (collective farm) under administration designated by the government.

In 1929 Stalin appointed a commission of 21 important Party members including Molotov, Yagoda, and Kossior to supervise collectivization and liquidation of the kulaks. Fierce resistance forced Stalin to take a step back. In his article in the *Pravda* "Dizziness from Success," he stated that "certain comrades," dizzy because of the multitudes wishing to join kolkhozes, have applied excessive pressure to the peasants. The guilty were identified as "malicious distorters of the Party line," therefore subject to secret police (GPU) trials. Of the 21 commission members, 19 perished [8].

It took more pressure and a winter of hunger to complete collectivization, which became an economic failure: grain exporting Russia became a grain importer. The injustices were never redressed.

Actually, industrialization was nurtured by collectivization. Young, energetic country men and women, members of peasant families of all categories, flocked from villages to cities to work in factories or to find their educational opportunities. The social outcome was an upward movement of a large part of the population. Workers and peasants and their sons and daughters became white-collar workers, employees, and

students at high schools (VUZ). An open road to high administrative positions, to directorships of various factories and institutions, beckoned the young communists. Unfortunately for the country, this road discouraged originality and personal moral principles. The objective of this process, replacement of the old technical elite by people of worker or poor peasant descent, proved to be not always possible.

Spectacular trials, trumpeted by radio and the newspapers, targeted leading engineers of the old regime, those in mining (Shakhty) in 1928, and those in the Industrial Party in 1930. At the trials, the accused accepted all charges of sabotage and conspiracy. The Polish-American mathematician, A. Zygmund, said that lies were the most repellent trait of Soviet Communism. Statements of the official propaganda, no matter how unbelievable, were never to be contradicted; openly expressed doubts and disagreements counted as counter-revolutionary activity and were punished by concentration camps.

How much the Party believed its own trials is seen by the example of Professor Ramzin, director of the Moscow Technological Institute. As the "leader" of the officially fabricated Industrial Party, he was sentenced to be shot as an enemy of the people, a filthy saboteur, a traitor who had discussed military intervention in the USSR with members of the French government. However, he was found irreplaceable for the institute, returned to his old post, and was awarded a Stalin prize for technical achievements. Books by Volkogonov [37] and Gill [14] provide information about the period 1928–1953.

All spectra of life in the Soviet Union were effected by the Turnabout; mathematics was no exception. From 1915 to 1927, in Moscow it was dominated by Lusitania, a circle of Lusin's students. Without Lusin, there would be no Lusitania, without Egorov, no Lusin. History is full of cases when the rise of a historic development would have been impossible without the preparatory work of a talented, dedicated, and energetic predecessor. A famous example is the Macedonian King Philip who paved the way for his son, Alexander the Great.

D. F. Egorov was a gifted if not a great mathematician. The years 1929–1930 were the summit of his success as the president of the MMO and the chief editor of *Matematicheskii Sbornik*. The deeply religious Egorov did not hide his mistrust of the Communist Party. This could not coexist with the new politics of Moscow State University (MGU) and its director A. Ya. Vyshinskii, later a harsh and sadistic prosecutor at the three show trials in 1936–1938. In an *Izvestia* article calling professors class enemies, Vyshinskii mocked statements like: "science is objective" or "Newton did not need Marxism to find his laws" [12, 38]. One could hear the first rumblings of an approaching political storm. A group of students and doctoral candidates attacked the content of mathematical courses

proposed by Egorov. They criticized “Egorov’s ossification and lack of political zeal in reforming the pedagogical and research activity.” Worse was to come.

The Sixteenth Party Congress in Moscow and the First All-Union Congress of Mathematicians in Kharkov convened almost simultaneously in June 1930. At the Party Congress, Stalin proudly proclaimed that “The characteristic tendency of our Party at this moment is the shift from socialism’s advancement on certain parts of the economic front to its advancement on the whole front.” This also meant the “science front” and the “mathematical front.”

The mathematical congress was planned as a showpiece of Soviet mathematics. Egorov and Bernstein (the latter representing Kharkov) invited foreign scientists, with Blaschke, E. Cartan, Denjoy, Hadamard, and Montel delivering plenary addresses. Lusin was present, arriving from Paris. On a trip to Germany and France, Kolmogorov and Aleksandrov did not participate. A group of activists at the congress, led by O. Yu. Schmidt, proposed a telegram greeting the Party Congress. Egorov refused to add to it the name of the MMO. In addition, S. N. Bernstein argued that when inviting foreigners he promised them the absence of political pressure; therefore, they should not be offered the opportunity to sign. After feeble attempts on his part, Gyunter, the president of the Leningrad Mathematical Society, was silenced and the telegram sent.

Party reaction was cruel. In September, Egorov was arrested by the GPU. In a fake trial closed to the public he received a jail sentence. Now the Party staged protests against the “reactionary churchman” Egorov and his friends, for example a declaration by “proletarian students,” some of them with names later recognizable in science.

The disorganization of the MMO followed. There was a real possibility that the society would be disbanded altogether. A letter by some first class mathematicians, L. A. Lyusternik, L. G. Shnirelman (1905–1938), A. O. Gelfond (1906–1968), and Pontryagin, appeared in the journal *Nauchnyi Rabotnik (Scientific Worker)*. Calling themselves the initiative group for the reorganization of MMO, they put all blame on Egorov, stating: “We owe thanks to the brilliant efforts of the GPU for uncovering the crimes of a whole series of scientific big-heads.... Active counter-revolutionaries appeared even among mathematicians. Professor Egorov was arrested for participation in a counter-revolutionary organization.”

The most serious and persistent threat to mathematicians and scientists in general came from outside the university, from Ernest Kolman, a “Red” professor and member of Moscow’s Communist Academy. His actions followed press and radio attacks on saboteurs in industry, campaigns that culminated in the monster trials of “Shakhty” and of the “Industrial Party.” Kolman’s article “*Sabotage in Science*,” published in the Party’s

theoretical journal *Bolshevik*, attacked several leading scientists by name calling their theories “liberal” (that is, not militant communist) and “reactionary.” Egorov and Bogomolov, a writer of popular mathematics, were named in the article. Kolman found support in the pre-WWI book of Lenin “*Materialism and Empirio-Criticism*.” Trying to refute some arguments of Mensheviks based on ideas of a minor philosopher, Mach, Lenin uttered his famous words: “bourgeois science is in deep decadence leading to decay.”

If some discoveries in the exact sciences made the Bolsheviks uncomfortable, they tried to fight them. In physics, Heisenberg’s uncertainty principle of the quantum theory of Planck and his followers represented a particular source of discomfort. The expanding universe of Einstein’s relativity theory seemed to imply the existence of God.

Some sciences, such as genetics, eugenics, and ecology, led to social implications. Mendel’s laws of heredity, giving mathematical formulas independent of exterior influence, present an example. Determined to reform the population rapidly by state-directed education, the Bolsheviks regarded these laws with suspicion. They supported the agriculturist T. Lysenko who used his political advantage against the academician N. I. Vavilov. Lysenko designed, and Vavilov opposed, a project for the improvement of the declining grain harvests in the Soviet Union by gradually moving the fields of wheat north to acclimatize the cereal to the cold. Lysenko’s plan failed. The state destroyed the flourishing Soviet school of genetics with strong ties to T. H. Morgan and other American biologists. Vavilov died in jail. The voice of Kolmogorov raised in defense of Mendel’s laws in a *Doklady* paper was ignored.

The book “*Struggle for Materialistic Dialectics in Mathematics*” [34] by the Communist Academy in Moscow was a collection of articles discussing relations between mathematics, philosophy, and history and calling on mathematicians to adopt the dialectical materialism (or Diamat, as we university students called it) of Marx and Engels in their research. What were the main features of this philosophy? How did working mathematicians relate to it?

Materialistic philosophy assumed the dominance of matter over ideas: “existence determines our consciousness.” Idealistic philosophy was teaching the opposite. Thus, Berkeley and Hume asserted that the only access to the knowledge of objects was gained through our perceptions, through our ideas about them. Therefore, ideas of objects are the primary, objects themselves the secondary category of reality.

“Dialectics” was a mode of reasoning that Hegel and others before him adopted in philosophical discussions. If we call a notion, a social class, or a condition a thesis, then its opposite is the antithesis. Often they both exist or are correct at the same time. Then a notion, a class, or a condition

obtained by removing the contradiction is a synthesis. For example, we are in a train that leaves a railway station. First, we have the sensation that it is the station that moves past us. This is the thesis. Then we realize that it is the train that moves: the antithesis. A synthesis would be the realization that both statements are partly true and partly false: both the train and the station are moving objects in the solar system. Another example: the thesis is capitalism; the antithesis is the dictatorship of the workers; the synthesis is a social state in which contradictions of both systems have disappeared, a state of communism.

For working mathematicians it is difficult to decide which kind of philosophy they use in their work. Do integers, circles, and lines exist in reality? Should we consider their imperfect examples in real life as primary or our perceptions of ideal, perfect integers, circles, and lines? In modern mathematics, both the complex number $\sqrt{-1}$ and the infinite-dimensional Hilbert space, whose points are functions, are absolutely necessary. Both exist only in our imagination. (Complex numbers were called imaginary numbers in the 18th century.)

Most mathematicians are stubborn in their laziness; they do not want to answer questions. Only when they find an inquiry worthwhile do they apply all their creative resources, small or great, to its clarification. Mathematicians do not know or do not want to reveal what their philosophy is. There are two realms in mathematics, both nebulous, veiled in mystery, resisting understanding. One of them consists of the discipline's lower reaches, its foundations and its axioms. Not all questions that arise here can be completely resolved; they can only be reduced to other, perhaps simpler questions. To prove something, one must start with some assumptions. More important are the unexplored upper regions where mathematics grows, where discoveries are made. In both areas, we look for new ideas from any source.

Experience shows that dogmatic prescriptions from outside of mathematics cannot help. We find examples in the book "*Struggle for Materialistic Dialectics in Mathematics*" [34]. In a particularly aggressive tone, the introduction, in all probability written by Kolman, attacked the "arch-reactionary [old] Moscow mathematical school of Tsinger and Bugaev" who uses "analysis of continuous functions to counteract revolutionary theories, number theory as triumph of individualism and cabalism, and probability theory for purposeless events." Following attacks on Egorov, the introduction quoted Lusin: "Apparently the sequence of natural numbers 1, 2, ... to infinity is not an objective notion but is a function of the head of the mathematician who is talking about it." This statement, shared by the intuitionist mathematicians of the time, prompted Kolman to cry out: "It is clear that the fortress of idealism in mathematics should be conquered and torn to the ground."

An article by S. A. Yanovskaya (1896–1966) in the above-mentioned book (pp. 222–251) described the disagreement between the intuitionists (Brouwer and Weyl) and formalists (Hilbert). She found these schools of thought almost identical because both were based on idealistic philosophy. The disagreements between them could not be solved within bourgeois mathematics where theory was separated from practice. The article ended with a warning: “To give a [sound] foundation to mathematics means to rebuild it on the basis of theoretical understanding of the practical problems of constructing Socialism.”

The highest political echelons lavished attention on the Great Soviet Encyclopedia (BSE) that began to appear in the mid-1920s. The Party demonstrated support for mathematics by appointing O. Yu. Schmidt as editor-in-chief, who invited articles by leading mathematicians. Evaluating articles by Schmidt and his friend V. F. Kagan in ideological rather than scientific terms, Yanovskaya (pp. 305–315) characterized the mathematics section of BSE as antimarxist and idealistic, citing the omission of Engels and Lenin at a time when the ideological struggle in this branch of science should be particularly intense. She disapproved of Schmidt’s article “Algebra” as a distortion of the history of science, based on the ideas of the German philosopher Mach (severely criticized by Lenin).

One of the main actors of the period, E. Kolman (1892–1979), an Austrian citizen born into a German-Jewish family, earned his doctorate at Prague University. Taken prisoner in WWI, he remained in Russia, joined the Communist Party and participated in the October Revolution. He organized attacks on Egorov in 1930–1931 and on Lusin in 1936. His high positions in the Party culminated in heading the Department of Science of the Moscow Party Committee. After that department’s dissolution in the 1930s, he was jailed but eventually regained his freedom. Returning to Czechoslovakia after WWII, Kolman apparently supported the Czech governments even when they were opposed by the Soviets, an activity that led to his imprisonment in Moscow for three years. Eventually, he emigrated to Sweden. His posthumous book bears the significant title “*We Should Not Have Lived That Way*” [19]. To me he remains an enigmatic figure, a somber “black angel.”

Some of the main actors were absent from the critical 1930 congress of mathematicians, perhaps in foreknowledge of possible trouble. Lusin returned in the second half of 1930 after two years in Paris, where he wrote his book on analytic sets. He encountered problems in Moscow, together with his friend Egorov. The trial of the “Industrial Party” of engineers accused of sabotage triggered protests by French scientists expressed in a letter to their Soviet colleagues. The response from Moscow indignantly denied all charges. Egorov and Lusin refused to sign it. As a consequence, Lusin had to abandon his professorship at Moscow University. These

anguishing events gave Kolman the opportunity to write again about “the counter-revolutionary Egorov and his friends,” meaning Lusin. Lusitania—an astonishing, innovative development in Russian mathematics that had propelled Moscow to the top as one of the strongest mathematical centers of the world—ceased to exist.

Following a long trip to the Caucasus in the summer of 1929, friends Aleksandrov and Kolmogorov established a joint home near Moscow on the river Klyasma. Early in 1930, they left for Germany and France with Aleksandrov continuing to the United States. Completely missing the conference in Kharkov, they returned home the following year.

There is apparently no substantial documentation of the activities of MMO between the arrest of its president Egorov and the end of 1932, but the facts available point to serious problems. Vice-president Lusin silently abandoned this post as he had abandoned the university. According to Lyusternik [10, p. 7] the “initiative group” took over making Kolman president in oi the society. Then Aleksandrov took this post and held it for 32 years, ceding it at the end to Kolmogorov. The Society’s journal, *Matematicheskii Sbornik*, continued to appear although it struggled with adversities, first edited by Lyusternik and Gelfond, two members of the initiative group, then temporarily by Aleksandrov and, beginning in 1932, by Schmidt as a long-standing chief editor. Reorganized as a new series (N.S.), for some years the journal even paid honoraria to the authors. I remember that for my two articles with a total length of 17 pages, I received an amount larger than half of my monthly docent’s salary.

In the opinion of the editors of [10], the Party’s and Kolman’s hostility toward Egorov and Lusin endangered the very existence of MMO. It could have shared the fate of many other scientific societies in the country, among them MMO’s sister, LMO, in Leningrad, and been shut down. After Egorov’s disappearance and the ensuing cataclysm, the Party helped to select, or had appointed, new leaders. P. S. Aleksandrov and Schmidt took over, rendering many years of leadership and restoring stability. Schmidt eventually achieved fame as an explorer of the Soviet Arctic.

Although Egorov’s achievements in forming a new Mathematics Department at Moscow University were remarkable, he did not fit into the political atmosphere of the Turnabout. After his arrest in 1931, he was removed from Moscow to a jail in Kazan where he became ill and died on September 10 of the same year. During Stalin’s era and beyond, Egorov became a nonperson in the USSR, not to be mentioned in public addresses or in print. A long review article finally appeared in *Uspekhi* [22] praising Egorov’s work and activities but remaining silent about the date and circumstances of his death. After 1971, only positive references to Egorov were made in the USSR.

4. ON THE LENINGRAD MATHEMATICAL FRONT

Stalin hated St. Petersburg (Leningrad), city of emperors and empresses, this window to Europe opened by Peter the Great. He hated the wonderful city for its classical architecture and its flowering bouquet of imperial palaces in surrounding villages, with names like Tsarskoe Selo, Peterhof, or Pavlovsk. (The present name of Tsarskoe Selo is Pushkin. I think the poet would have disliked the renaming of Selo (village) to his name). Stalin detested the independence of St. Petersburg-Petrograd, its display of superiority toward Moscow, its poets Blok, Gumilev, Akhmatova, and Yesenin. He despised the city of Lenin and its politicians opposing him, like Trotsky who saved St. Petersburg from the attack of General Yudenich, and Zinoviev, the first president of the communist Third International. He hated the island fortress Kronstadt for its sailors revolting when the Civil War had already been won and for his enemy, Marshal Tukhachevskii, who stormed the island over the frozen Finnish gulf.

The political cleansing of the student body was probably much more severe in Leningrad than in Moscow. Students who displayed anything but communist loyalties or had politically tainted parents were expelled. One of these students, a Jewish girl, succeeded in fleeing to the United States with a Rand typewriter as her most valuable possession. Her experiences in St. Petersburg made her a staunch anti-communist; her typewriter helped her achieve fame as a writer. Eventually she took Ayn Rand as her new name.

To prepare an attack on the LMO, the Party organized in December 1928 a group of mathematicians calling themselves "mathematicians-materialists," or even "militant materialists," belonging to the Leningrad branch of the Communist Academy that later became the Society of Mathematicians-Materialists in order to compete with the LMO. I had the impression that the group consisted mainly of former secondary school teachers, only temporarily associated with Leningrad University and even with Marxism: L. A. Leifert, A. R. Kulisher, V. I. Milinskii, V. V. Lyush, and A. D. Drozd.

These people gradually disappeared. Only Milinskii was still active at the University in 1941 when he was shot by the NKVD during the early months of Leningrad's blockade. Kulisher, appointed professor and dean, was well meaning and kind, but not of the caliber necessary for these roles. He would compare himself to a Kabuki theater worker rearranging the stage with a fan in his hand indicating his invisibility. He vanished in the second half of the 1930s without fanfare. Docent Lyush, another militant materialist, tried to be mathematically creative. Unfortunately, his "discovery" was a theory of functions of the argument $x + yi + zj$ (with three variables, x , y , z), which paralleled the theory of analytic functions of

$x + yi$ (with two variables, x and y). But the great founders of analysis have already tried this generalization and found it impossible. Thus Lyush's construction was incorrect. After this embarrassing disappointment, Lyush also had to go. A Leningrad-based publisher released a calculus textbook by Drozd that became a sensation. It linked mathematical arguments with those of dialectical materialism. None of the mathematicians in Leningrad considered the book anything but a tentative experiment.

The leader of the mathematicians-materialists, docent L. A. Leifert, a zero of a mathematician, was primitive, loud, aggressive, and obnoxious. As a student, I attended some of his lectures. One was about "the Bolshevik's way to integrals." He brought with him a German reference book, "*Hütte*," with many formulas and wrote values of several integrals on the blackboard. As an explanation, he claimed that the formulas were useful in practical computations and that their proofs were immaterial. For some of his integrals, Leifert conducted a poll to determine whether the audience agreed with his formula or not. Most of those attending did [27, p. 5]. In 1929 and the spring of 1930, the Leifert group organized several lectures under such titles as "Mathematics and the Class Struggle."

Leifert's group prepared a political classification of Leningrad's active mathematicians. Into the rightist group they put N. M. Gyunter, Fichtenholz, and Smirnov. Fluctuating and intermediary were Vinogradov and the algebraist Zhuravskii. Leifert's own circle was termed the left group. Actually this classification assessed the professors' relations to Leifert rather than their political views. For example, the maligned Fichtenholz and Smirnov rendered good service by saving the high scientific quality of the university's mathematics. As we shall see, they succeeded in this, but lost the battle for the LMO. Its temporary president, N. M. Gyunter (1871–1941), was a naive and ineffective shield for others; he was greatly helped by the academician Ya. V. Uspenskii (1883–1947) who had recently returned from America with his new wife.

One of Leifert's pet enemies was Professor Fichtenholz whom Leifert called reactionary and his mathematics idealistic. In response, Fichtenholz announced at an open meeting that he intended to work on "new ways in the interest of the construction of socialism." Apparently this annoyed Leifert. To mock Fichtenholz, he quoted to us students a line of Yesenin from 1924 when the poet made an effort to join the communists: "Pulling up my pants, I rush after the Komsomol." At the time of Leifert's reference, Yesenin was already five years dead by his own hand. The Leifert group did not fear authorities; it would lustily attack old Bolshevik stalwarts of great value to the Party. They criticized the philosophical position of known communist O. Yu. Schmidt for his "idealistic" articles in the Great Soviet Encyclopedia or of Steklov, dead in 1926, after whom the recently created Mathematical Institute of the Academy was named.

In 1930, I was too young to regularly attend the meetings of the LMO. Rumors circulated in the student body that mathematics was in serious trouble because of the clash between the intuitionists and the formalists. To counteract these rumors, the LMO presented a lecture on the subject. Entitled "About the So-Called Crisis of the Exact Sciences," the lecture was entrusted to H. Müntz, a German citizen and recent arrival from Berlin, and professor at Leningrad University. He was selected because as a foreigner he was seen as less susceptible to Party pressure than Soviet citizens. Moreover, intuitionism was his side interest.

Arriving at the lecture with my friend Izya Gordon, I found the entire mathematical Leningrad present. There were many faces I did not know. Uspenskii, on the podium, was pointed out to me. As expected, Müntz asserted that there was no bourgeois mathematics; the controversy between intuitionists and formalists affected only the discipline's foundation without creating any crisis and disturbing the work of the average mathematician. A mathematician, he argued, uses neither materialistic nor idealistic philosophy in his work.

After the lecture, Gyunter, presiding, invited the audience to pose questions. Suddenly Leifert climbed on the podium yelling insults at the LMO and Gyunter. In vain did the latter protest: "I did not give speaking rights to docent Leifert." Many students applauded Leifert and shouted. The meeting was dissolved. In the wake of this disastrous event, using their still valid visas, Uspenskii and his wife left for the United States where he accepted a Stanford University professorship offered to him by Szegö.

Was Gyunter a reactionary? We were told that he was the only professor who did not join the Union of Education Workers. He called the interval between the fall and spring semesters "Christmas vacation," revealing tolerance for religion. Even worse from the Party's point of view, when the government experimentally introduced the five-day week to replace the traditional seven days, he refused to lecture on Sundays. During the worst hardships of the Civil War, Gyunter asked the university to provide him with shoes in order to go to his lectures. This was a sign of protest, expressed in his characteristic modest and methodical way. One could not imagine him posing any dramatic opposition to something as important as collectivization.

Returning from my usual summer trip to Tiflis in September 1930, I found the climate at Leningrad University greatly changed. A tragic revolution in mathematics, pushed by Leifert (1884?–1938?), was in full swing. The implication for us students started with administrative changes and then grew ever more significant. Many subjects needed for graduation were dropped from our program, reducing it from five or more years to only four years. There were to be no examinations. The secretary of our Komsomol cell, Markovets, told me gleefully that the Faculty of Mathematics and Mechanics of the University (MMF) would soon become a

mathematical “tekhnikum” with a program somewhat between secondary school and university, dedicated to technical subjects. Fortunately, it did not go that far. Nevertheless, only some 30 students remained in my class, six of them in mathematics, the rest in mechanics. Learned Marxists, among them B. I. Segal, presented talks about mathematics in the main hall of our university.

A version of the story of the tumultuous year of 1931 was described in the booklet “*On the Leningrad Mathematical Front*” [29] by Leifert and Segal. Leifert claimed that the whole history of mathematics in St. Petersburg since Chebyshev was determined by class struggle. According to Leifert, the “preaching of pure mathematics” by the group of Gyunter, Fichtenholz, and Smirnov was a form of sabotage (vreditelstvo). In his fiery appeals, Segal insisted on the use of dialectical materialism in mathematical investigations. Proclaiming a deep crisis at the very roots of mathematics, he declared that capitalist science will not be able to resolve it because it is completely alien to dialectical materialism. His demands, as many similar ones, had the obvious defect that they gave no examples of how to apply this philosophy. He argued that raising new cadre from men of the working class will solve all complex problems. Turning against their former ally, Drozd, the materialists found his calculus textbook unsatisfactory, a mechanical pasting together of philosophy and mathematics, and as such, a “discredit to dialectical materialism.”

In February 1931, the Leifert group started to circulate a declaration with violent accusations of, and demands to, the LMO and the mathematical community of Leningrad. In response, Gyunter acknowledged his errors as president of the society and expressed the hope to continue to be a useful teacher.

As in Moscow, an initiative group for the reconstruction of the LMO was formed. It again castigated Gyunter (“We must expel from our midst reactionaries of Gyunter’s type.”) and formulated its requirements. Here are the main points from the group’s declaration [29, p. 38]:

The LMO has the following urgent objectives:

1. *Struggle for a revolutionary Marxist world view in mathematics*
2. *Political education of its members for their work of the construction of Socialism; fight all manifestations of bourgeois ideology, neutrality, individualism, preaching of pure science; fight tolerance of religion, and idealistic philosophy*
3. *Struggle to free Soviet science from the ideological prison of bourgeois science and to influence the latter*
4. *Participation in the planning of mathematical work in the USSR*
5. *Realization of a union of mathematicians working in universities and secondary schools*

We saw among the authors of the declaration the influential mathematicians Delone, Fichtenholz, Kantorovich, Kulisher, Segal, Tartakovskii, and Vinogradov. From Leifert's group Kulisher and Lyush were present, but not Leifert himself. One noticed also the absence of Smirnov, Koshlyakov, and Zhuravskii. Nobody was involved from mechanics or astronomy. While the LMO sank into complete passivity, the membership of the Society of Mathematicians-Materialists steadily increased. The young co-workers of Smirnov (G. M. Golusin and V. I. Krylov) and of Fichtenholz (I. P. Natanson) joined. One would assume that Leifert was satisfied with his victory, but he wanted to go farther. At a meeting of mathematician Party members and Komsomol members with almost no professors among them, Leifert discussed the criticism of the situation in the exact sciences by the USSR's Central Party Committee. At his urging the audience formulated demands for the domination of Party members in mathematical life. "Part of the old professorial body [that had been] tested [by the Party] in practical work, should cluster around the Party core [the Party members of the new LMO] to ensure a firm Party leadership in the Society" [29, pp. 39–40]. Actually, top Party officials would never allow Leifert's group and its lowly Party members to determine the Party line for mathematics.

Leifert's downfall came in February 1932. The Communist Academy found that "his criticism of bourgeois mathematics was superficial, he was engaged in leftist deviations and committed gross errors in the interpretation of dialectical materialism" [12]. He was stripped of all his positions including the presidency of the Society of Mathematicians-Materialists, which was disbanded. Leifert was exiled to the University of Rostov-on-Don. According to some reports [36], he appeared in several cities trying to politically undermine some local mathematicians. At one such attempt, against the geometer N. V. Efimov, Leifert was arrested and probably shot by the KGB because of his connections with Bukharin.

Before the beginning of the war in 1941, Kantorovich circulated among the MMF faculty a proposal to revive the Leningrad Mathematical Society. This, and a similar attempt by Smirnov in 1953, failed. Only in 1959 did Yu. V. Linnik succeed in reestablishing it. A mathematical society for the whole USSR with a list of names and addresses of its members never existed. There were not even telephone books for Moscow and Leningrad.

Leifert hurt several people seriously. According to Ermolaeva [12, p. 383], due to Leifert's efforts some able graduates of the university, for example S. G. Mikhlin, were not accepted into the program of the study for the candidate degree (the aspirantura). I had the same misfortune because my "political face was not clear." My friend I. Gordon escaped this fate. He was accepted by Moscow University and wrote a good dissertation with Pontryagin as his adviser.

Mathematics was affected by ideological controversies all over the country. In the Ukraine, the departure of S. N. Bernstein left his school of approximation without a natural leader. The aggression of materialists against idealists was exemplified by the University of Rostov-on-Don where the gifted historian Mordukhai-Boltovskoi tried to examine in depth the interrelation of mathematical ideas, down to their conception. Materialists found his insistence on the "necessities of our intellect" in his discussion of the genesis of the calculus or of the concept of real numbers contradictory to their "requirements of social practice." Today we would think that both approaches had their merits.

In retrospect, it appears that the impact of the critical years in mathematics was milder in Moscow than in Leningrad. The meetings of the MMO could function as before while the revival of the LMO came only in 1959. It seems that the Party found the initiative group in Moscow and its supporters Aleksandrov, Kolmogorov, and Sobolev more important professionally and closer to the Party line than Smirnov and Fichtenholz in Leningrad. The best efforts of the Party were reserved for Moscow.

The two antiheroes, Kolman and Leifert, played similar roles in Moscow and Leningrad, in spite of the considerable difference between them in scientific competence. Both were almost forgotten by succeeding generations. Although their dismal activity paled in comparison to the atrocities of 1936–1937, they were notable as forerunners of the Great Terror.

5. AFTER THE TURNABOUT: TOWARD THE GOLDEN YEARS OF MATHEMATICS

The Turnabout, with its extreme revolutionary zeal, was carried out with complete disregard for the enormous annihilation of human life it caused. The liquidation of the kulaks was followed in 1932–1933 by terrifying hunger in the Ukraine, Kazakhstan, and North Caucasus, the major suppliers of grain to the Soviet Union. Having resisted joining the kolkhozes, the peasants saw their entire harvest confiscated without compensation. Millions starved to death. The loss caused by this nameless eradication of life across the peasantry was much larger than the loss in the Great Terror of 1936–1937 when victims were individually selected for destruction. Big cities suffered much less. Food ration cards were introduced. However, I experienced no hunger in those years in Leningrad. Prices for food and lodging were low. Medical services were free, with doctors even making house calls.

Some annoying changes were experiments, later abandoned. All religious holidays of the tsarist calendar, including Christmas and Easter, were abolished. Only five free days remained: Lenin's birthday, the October

Revolution (November 7–8), and International Workers Day (May 1–2). As compensation for the elimination of holidays, a five-day week was introduced. The number of free days in the year remained the same, but connections with religion disappeared. The free day of the week was variable, determined by one's employer. This helped factories work smoothly throughout the year, but disrupted relationships between friends. During the first years of WWII when the USSR was not yet involved, the five-day week was changed to six days and finally to the old seven days with ordinary Sundays. Another innovation introduced in all schools of higher learning (VUZ) was the "brigade" teaching method based on educational ideas of American and British schools. Former lectures and exercises, declared reactionary, were replaced by the study of textbooks by groups of 4–6 students, called brigades. The professor would walk up and down the classroom answering questions and helping if difficulties arose. Grades were given to brigades, not individuals.

The stabilization period of 1932–1936, which continued until 1941, was quite different from the Turnabout. Radicalism was replaced by conservatism, the equality doctrine of the proletarian revolution by the hierarchical status system of the bureaucracy. It was Trotsky in Mexico who first noted this trend. He compared the triumph of Stalin's Turnabout with the counterrevolutionary French Termidor ending the Jacobian revolution and eliminating the extremists Robespierre and Saint-Just. We can have only a brief glimpse here of developments of this period at the economic, social, cultural/ideological, and political fronts. On the economic front, the Turnabout created a planned or command economy, replacing reliance on the market. Considerable improvements in living conditions of the era were highlighted by Stalin with the slogan: "Life has become better, life has become merrier, comrades."

On the social front, a new respect for position, rank, and status, formerly despised as bourgeois relics, appeared. I remember how astonished I was seeing Molotov wearing a hat, heretofore a capitalist symbol. Ranks of lieutenant, captain, and general with corresponding insignia were introduced in the Red Army and even in the hierarchy of railway workers. My friend A. V. Pataleev became a four-star general of railways; the people's commissars were named ministers. With a return to old-fashioned morality, divorces were made more difficult. Abortions, originally the main birth control technique in the Soviet Union, were forbidden. By not reporting "undesirable" events such as crime, prostitution, plane crashes, and homosexuality, the media tried to make them nonexistent. Homosexuality was sometimes used as a pretext to jail undesirable people, as was the case with filmmaker S. Paradjanov (1924–1990), whose hallucinatory account of the life of the Armenian poet Sayat Nova was banned in the 1970s for its religious sentiment.

Stalin's era was a time of rapid upward mobility for all classes of society. Gill [14] provides a table of the change of the population status in the USSR for 35 years. Its last column includes the category of lishentsy, members of the tsarist elites deprived of the right to vote.

| | Blue collar workers (%) | Peasants (%) | White collar workers (%) | Lishentsy (%) |
|------|----------------------------|-----------------|-----------------------------|------------------|
| 1924 | 10.4 | 76.7 | 4.4 | 8.5 |
| 1959 | 59.2 | 31.7 | 18.1 | 0 |

On the cultural/ideological front, Lenin's hate of Grand-Russian chauvinism, the self-aggrandizement of the purely Russian element of the empire, was completely forgotten by Stalin. Russian nationalism was on the rise in the mid-1930s, growing stronger with time until Stalin's death and contributing to the Soviet victory in WWII. This nationalism was conservative, glorifying elements of the Russian past, and exclusionist, downgrading the history of other ethnic groups in the USSR. It led to ignoring the achievements of non-Soviet scientists and to the isolation of Soviet sciences. Another feature of the period was the declining importance of Marxism. One saw more references to Stalin's book "*Problemy Leninizma*" than to Marx or Engels.

The changes at the university, as at all schools of higher learning, reflected the trend toward conservatism: they often represented a return to old, prerevolutionary ways. At LGU, the brigade teaching system lasted only a few years, disappearing without a trace. It became unlawful (on paper) to use social origin of candidates for students or aspirant acceptance decisions. Study at the university became very rigorous, 24–30 class hours a week were required, with difficult examinations twice a year. As a result, one half of the MMF students dropped out after two years. After this, the classes stabilized, with about 1/3 of the freshmen getting a diploma after five years (something like our masters degree). Student dedication and morale were very high; it was a pleasure to teach. Mathematical competitions for high school students (olympiads) were initiated in Leningrad in 1935. The winners were admitted to the university without entrance examinations. As a result, many highly talented students entered the university during this period.

The candidate and doctoral degrees were reintroduced in 1934. At good schools, they were required for the positions of docent and professor, respectively. Both degrees, awarded to older scientists for their previous work, had to be hard won by the younger generation by the defense of a dissertation. It was permitted to submit a dissertation without having

a supervisor from the university. The much higher doctor's degree was given for several good papers or an exceptionally outstanding one. All degrees needed the approval of the Ministry of Education. A chair or kafedra, an administrative unit headed by a senior professor, consisted of faculty members working in the same field of specialization. The ranks of assistant, docent, and professor were strongly differentiated with respect to teaching hours and salary. In 1931, assistants were responsible for 25 teaching hours a week; the others taught less. Salaries in 1936 were 500, 750, and 1500 rubles. Corresponding and full members of the Academy of Sciences, standing above university faculties, were often teaching at universities. "One does not contradict an academician" was a popular saying. There were also titles such as "honored scientist," awarded by the State, and Stalin prizes for extraordinary achievements.

Scientific research can profit from planning. The first Soviet effort for mathematics was made at the Planning Conference for Mathematics in June 1931 in Moscow, described in the article of "Mathematics in the Building of Socialism" [28, pp. 1-14]. The recommendations of the conference, based on a talk by E. Kolman, included a direct planning line from technical institutes as users of mathematics to applied and then to pure mathematics; development of new mathematical research institutes; and guidelines for the preparation of aspirants. I will illustrate this through ideas relevant to problems of mathematical analysis. The process would start in technical institutes: the Central Institute for Aero- and Hydro-mechanics (ZAGI) and the Geophysical Institute of Moscow, the Physico-technical Institute of Leningrad and others, identifying a series of conformal mapping, stability, and boundary value problems, essential for their work. These problems should go to people working in applied mathematical disciplines of variational calculus, partial differential equations, and numerical analysis, and then reach pure mathematicians. Functional analysis, to become so important in the future, was rather narrowly described in the recommendations as giving "theoretical generalizations of a series of topical problems of analysis." Ideas from topology and abstract algebra were mentioned as relevant.

Soviet mathematicians were warned against either conducting science for science's sake in an ivory tower or indulging in overly business-like activity, restricted to practical problems (delyachestvo). Both these extremes were characteristic of capitalist societies, we were told. The "dying class" of capitalists was described as unable to plan science. With economic depression spreading in America and Europe, these statements in 1931 appeared to have merit to us students.

The planning conference proposed new mathematical research institutes at the universities of Leningrad and Kazan, an institute for computing in Moscow, and a drastic increase in the number of physico-mathematical

colleges at universities; they would also prepare teachers for the new technical institutes of higher learning (VTUZ). It was recommended that the preparation of aspirants in mathematics be conducted only at universities. Special admission policies to ensure a sufficient number of aspirants who were Party or Komsomol members or of working class origin, already in place, were confirmed.

What came of these planning efforts? The recommendations for research institutes and aspirants were achieved and surpassed. Several large cities, among them Leningrad, benefitted from new branches of the mathematical institutes of the Academy. Compared to pure mathematics, its applied branch was favored by better employment possibilities and more state (Lenin or Stalin) prizes. But policies never went as far as the restriction of the most important freedom for scientists, the freedom to select their own fields of research. Thus, the Conference's strict prescriptions for research planning were much softened in practice.

Publication of books and journals reached a high level. Foreign books were translated and edited. I remember a translation of G. D. Birkhoff's book by A. A. Markov, Jr. who made sarcastic corrections of some of its errors. The first edition of A. Zygmund's *Trigonometric Series*, 325 pages long, had a price tag of 10.3 rubles. As a comparison, one kilo of butter cost 30 rubles; a volume of Lenin's collected works, 6 rubles. No wonder that in spite of large editions, good books instantly sold out. Two journals merit attention: *Uspekhi Matematicheskikh Nauk* (*Advances of Mathematical Sciences*) and *Doklady* (*Reports of the Academy of Sciences*). The first, comparable only to the *Jahresberichte der Deutschen Mathematiker-Vereinigung*, published reviews of new developments in different fields of mathematics by Soviet and, rarely, foreign experts and chronicled Soviet mathematical life and activities of the MMO. The second journal, with a publication run of only a few months, brought out notes of length at most four pages. Usually the notes offered results with proofs to be published later—important in discussions of priority in publishing.

During my time, Leningrad gained only one first class mathematician, the elder S. N. Bernstein. He could not remain in Kharkov after his trouble at the 1930 congress. He came to Leningrad as if through the back door, joining the Leningrad Polytechnical Institute rather than the university. Some mathematicians came from Germany. H. Müntz (1884–1956), the father of Müntz polynomials came in 1929 but had to leave in 1937 because he was not a Soviet citizen. He eventually moved to Sweden. S. Cohn-Vossen, with attractive work in geometry at large, co-authored with D. Hilbert the remarkable book "*Descriptive Geometry*." Cohn-Vossen came to Leningrad in 1934 and died after a short illness. The USSR was an intermediate stop to America for S. Bergman and Emmanuel Lasker (1868–1941), the world chess champion in 1894–1921. Earning a doctoral

degree in Erlangen, Germany, Lasker was the only chess master with a substantial mathematical education. One of his theorems was reproduced in van der Waerden's textbook of modern algebra. Probably based on his creativity in chess and mathematics, Lasker was awarded an honorary membership of the Academy of Sciences of the USSR.

The 1934 transfer of the Academy of Sciences to Moscow was a great drawback for Leningrad. We lost Vinogradov and two applied mathematical academicians; Delone from LGU also went along. As always, Moscow remained a center of attraction for Leningrad's scientists. Similar to French but unlike American patterns, research in the Soviet Union was strictly centralized. Moscow became the dominant core of mathematical culture. The possibility for professors to change universities being limited, Leningrad had to raise its own young talent in order to prosper. During my time, we were proud to have A. D. Aleksandrov (1912–1999), D. K. Faddeev (1907–1989), L. V. Kantorovich (1912–1986), Yu. V. Linnik (1915–1972), and A. A. Markov, Jr.—all of them becoming doctors and professors early. Thus, the mathematical faculty of LGU in 1939 was stronger than in 1928.

Volumes have been written about the achievements of Russian mathematicians; I cannot even begin here to assess their work. But I will pause for the special case of Kolmogorov. Astonishingly, he is famous as a pure mathematician although much of his research covered applied mathematics and probability. I think the explanation is that he started papers with applied themes and then transformed them into pure mathematics, important in their own right. Kolmogorov also worked in approximation theory. I have reproduced many of his results in my books as an absolutely indispensable part of the theory. Kolmogorov became one of the mathematical giants of the first half of the 20th century, together with D. Hilbert and H. Poincaré.

The years after 1932 are justifiably called the Golden Years of Soviet mathematics (in accordance with the title of the book [15] edited by Zdravkovska and Duren). Indeed, Soviet mathematicians produced excellent work and, compared with the population at large, they enjoyed better living conditions and higher prestige. At the same time, many of them suffered persecution. Is this a contradiction? Some would say yes. But looking deeper, we find a different answer. Freedom is a necessary condition for an intellectual, specifically freedom in one's field of creative work. Mathematicians in the Soviet Union were free to select the subject of their endeavor. In general, they were not harassed in their work and the discipline flourished.

Had mathematics not been a favored science, useful for Party goals, the situation would have been different. A comparison of mathematics with poetry is revealing. After the Golden Age of Russian poetry at the

beginning of the 19th century with Pushkin, Griboedov, and Lermontov, the Silver Age stretched from the last quarter of the 19th deep into the 20th century. These poets were the literary analogues of the members of the Lusitania. Raised in imperial Russia, in Soviet times they preserved their independence, even those, who, like Mayakovskii, allied themselves with the Party. The book by Shentalinsky [31] covers important Russian writers of the Soviet period describing their harrowing encounters with NKVD.

I have selected ten poets whom I consider to be the greatest of the Silver Age: A. A. Akhmatova (1889–1966), A. Belyi (1880–1934), A. A. Blok (1880–1921), N. S. Gumilev (1886–1921), N. A. Klyuev (1887–1937), O. E. Mandelstam (1891–1938), V. V. Mayakovskii (1893–1925), B. L. Pasternak (1890–1960), M. A. Tsvetaeva (1882–1941), and S. A. Yesenin (1895–1925). And this was their fate: three were shot or died in a concentration camp (Gumilev, Klyuev, and Mandelstam); three committed suicide (Mayakovskii, Tsvetaeva, and Yesenin); Blok died in despair, broken and disillusioned; three became internal refugees in the USSR, isolated and unable to publish (Akhmatova, Belyi, and Pasternak). One could ask: why was the fate of those visionaries so much more tragic than the life of mathematicians who were persecuted but not annihilated? The Great Turnabout brought forth socialist realism in literature, mandated, or at least strongly supported, by the Party. It prescribed not only the form of a literary work, but also its content—in service to Soviet political goals. Unable or unwilling to follow these requirements, unlike the mathematicians, they lacked the necessary freedom to create. Their downfall was inevitable.

Both Lusitania and Russian poetry's Silver Age had their roots deep in pre-Revolutionary Russia, proving that at that time the country was more than revolutionaries and inefficient, reactionary, tsarist bureaucrats, as sometimes depicted. Lusitania's members were educated and formed as scientists either before the Revolution or at a time when communist influence at the universities was still weak. But the subsequent flowering of mathematics was the result of energetic government support. Lenin, Stalin, and the Party had great respect for the exact sciences and mathematics based on the naive belief that the future of communism was ensured by following Marx's prescriptions and having science as an ally. They considered Marxism itself an exact science. The slogan "catch up with and then surpass the foreign countries" applied also to the sciences.

There were several reasons why mathematics was the Party's favored science: (a) mathematics offered many applications, and one could not predict from which part they would come; all mathematical disciplines produced them; (b) competent teachers of mathematics were required for all technical high schools, such as the polytechnical institutes; (c) mathe-

matics was apolitical. This is why the rantings of Kolman, Segal, Leifert, and others about dialectical materialism had no effect. This is why Fichtenholz and his students, Kantorovich, Natanson, and I, could continue to work in our selected fields; (d) mathematics was inexpensive—computers were not yet known. A good library and ease of discussion with colleagues were all that we required. Personal contacts within the USSR were encouraged. The name “Golden Years” for all of Soviet mathematics is justified.

6. THE CASE OF THE ACADEMICIAN LUSIN

*With scoffes and scornes and
contumelious taunts*

Shakespeare (Henry VI, 1, iv, 39)

The years 1928–1953 encompass three particularly violent periods of Soviet history, each claiming millions of innocent victims: the Turnabout of 1928–1931, the Great Terror of 1936–1937, and the Second Great Patriotic War of 1941–1945 (the first was the war against Napoleon in 1812). The Great Terror was organized by the Secret Police (GPU, later NKVD). Unlike the two other disasters, it was directed against a special group of the population only, those who were suspected of harboring opinions different from Stalin’s Party line. Its purpose was to terrorize the Soviet middle class whose core was the intelligentsia and, by establishing the cult of Stalin, to stabilize the dictatorship in one person. The terror was random: in a suspect group the less prominent victims seemed to be selected without rational justification. This way everybody was constantly afraid, making the terror more effective. Some groups were hit hardest: higher and middle rank military and certain Party clusters. The question remains why terror of this extent was necessary to accomplish the Party’s purpose. Later, in Khrushchev’s and Brezhnev’s times, similar aims were achieved by the threat of loss of job, not loss of life.

By some counts, in one of the Great Terror’s worst years one million people were condemned, 10% shot, the rest sent to concentration camps. The politicians Trotsky (in Mexico) and Bukharin were killed, as were Marshal Tukhachevskii, Babel, the author of the book “*Red Cavalry*,” and the theatrical genius Meyerhold. The composer Shostakovich fainted in panic when Stalin walked out of the performance of his opera *Katerina Izmailova*.

Leningrad’s mathematicians did not suffer much during this period; this was not true of physicists and astronomers. When I arrived in Leningrad in 1928, astronomers made up about one third of the large university’s college

of mathematics and mechanics (MMF). By 1937, only two of them remained, Ambartsumian from Armenia and his assistant. The astronomers also worked in the Main Soviet Observatory in Pulkovo, a suburb of Leningrad. Smog and a rainy climate made their trips to foreign observatories at higher elevations, often initiated by the Government, an absolute necessity. Now they had to answer for their foreign contacts. From October to December 1936, 15 leading astronomers were arrested. In jail, all but one signed confessions, among them the director of the Astronomical Institute, B. V. Numerov, the vice-director N. I. Dneprovskii, and the observatory director V. P. Gerasimovich. The consequences were particularly grim. The renowned Numerov was shot, all others sent for 10 years to concentration camps and their wives exiled.

Astronomers did not qualify for a *sharashka* (part of a camp with better conditions where specialists worked on some technical problems), so only few survived. The young N. A. Kozyrev returned home much later—he was known for his studies of volcanic activity on the moon, which earned him an American gold medal [32].

We return to the situation in Moscow during the Turnabout. The years 1930–1931 were critical for the distinguished mathematician Lusin. Forced to leave Moscow University, he found a niche at ZAGI in the subdivision of his friend Chaplygin, where he wrote several long but not very profound papers in applied mathematics. Then Lusin withdrew to the Academy improving his position there, moving from the philosophy section, which he disliked, to mathematics. His influence was still remarkable and his mathematical problems inspired others, including his new students P. S. Novikov (1901–1975) and A. A. Lyapunov (1911–1973). Lusin was investigating projective sets, his discovery. Feeling safe, he imprudently accepted administrative positions to which he was ill suited: chairmanships of the mathematical group at the Academy and of the Mathematical Qualification Commission.

Not fully realizing it, Lusin lived under an ominous cloud of political suspicion. At the Planning Conference for Mathematics in 1931, Kolman criticized “idealism as the basis of the French-style theory of functions of Sierpinski and Lusin” [34]. Indeed, Lusin was known for his lack of support of socialism, but that was not the same as an “idealistic” philosophy underlying mathematical work. Why didn’t Kolman similarly accuse Lusin’s students, for example Suslin and Menshov in analysis, or Aleksandrov in topology? Probably because Kolman did not want to hurt important and influential students of Lusin. To this hypocrisy Kolman added political slander, referring to “Lusin’s teachers, teachers of fascist science.” This meant Lusin’s French friends, E. Borel and H. Lebesgue, called fascist because at that time France was the USSR’s main political foe.

The manuscript of Kolman’s book [18] completed in April 1936, was sent to the publisher on July 14. The rather pedestrian text contained

nothing new except more attacks on Lusin. Later, Kolman [19] defended himself, recalling that Aleksandrov and Kolmogorov had read his manuscript before its publication. Meanwhile in Leningrad, we students discovered Kolman's personal message hidden in his book. The first letters of its chapters, when read in sequence, spelled out the words: "Moey Katinke" (to my Katinka). She turned out to be the author's wife. In retrospect, this romantic gesture and his vociferous hostility to idealism formed a strange contradiction in character.

A trap was laid for Lusin by inviting him to witness an examination in mathematics in one of the middle schools. Lusin's reaction to the students' performance was positive, calling it in a letter to the editor "a pleasant surprise." At once, the school's principal responded in the Party's organ *Pravda*, angrily rejecting "false praise" for an institution where, actually, many students were very weak in mathematics. The article in *Pravda* implied that by praising a weak school Lusin meant to indirectly harm the entire school system.

The denunciation by the school principal was followed by a real smear campaign. Between July 2 and July 16, 1936, *Pravda* produced eight long articles about Lusin. He was insulted as "the so-called academician," and addressed as "*gospodin Lusin*" (a term literally meaning "sir" and reserved for foreign dignitaries, but understood as insult and mockery when thrown into the face of an ordinary Soviet man). He was depicted as an enemy in contempt of his homeland, hiding under the mask of an honest scientist.

Lusin was condemned at meetings held as far away as Belarus. The main anti-Lusin lecture at MGU was delivered by Mrs. Yanovskaya, a professor of philosophy. Following her lecture, Lyusternik, Bukhholz, and Aleksandrov concurred with the speaker. Pontryagin remarked that Lusin prevented publication of a very short proof by a young mathematician that had intended to replace Lusin's lengthy arguments. Moreover, "Lusin has destroyed the talented Suslin" and "appropriated a paper of his student Novikov." Kolmogorov reminded those assembled at the meeting of Lusin's good services to mathematics before his "moral and political decay." Much later, in 1979, Aleksandrov echoed this double-edged portrayal by writing: "Lusin was for me [in 1915–1916] a man in the highest sphere of human virtues, a sphere he subsequently abandoned." Quoting Goethe, Aleksandrov continued: "Lusin fell under the domination of powers which seduce a man to guilt and then leave him to his bitter pain, for no guilt remains without punishment" [14]. Nobody praised Lusin's latest book and his discovery of projective sets. According to contemporary hearsay in Leningrad, Nina Bari and Menshov tried to defend Lusin.

Before discussing Lusin's trial at the Academy that took place July 7–15, 1936, I will chart profiles of some of its actors.

Lusin was born and grew up in Tobolsk, Siberia. He had a complex and highly excitable nature. His lectures were excellent, full of new ideas, hypotheses and suggestions for investigation. He used to charm people at the first meeting. To his “teachers” Lebesgue and Borel, he showed adoration, sometimes attributing to them his own discoveries. He expected adoration from his own students. His detractors found him theatrical and insincere. Sometimes he would praise somebody’s work that he had not read. He had a following of devoted students but also some bitter enemies, notably Aleksandrov and Khinchin.

According to Hardy’s classification, Lusin was a “fine” mathematician (mathematician of ideas) as opposed to a “powerful” mathematician (characterized by powerful proofs, for example Menshov). Sometimes he worked too closely with his students. It is revealing to read his own account [10, p. 280]: “When working with a student, I not only gave him a problem but also often invented the method of its solution, for otherwise he would not be able to continue. And after obtaining his final results, on my insistence he published them under his own name. Sometimes I returned to the [same] method, and used it in my own work. This often created a very strong interlacing of [our] ideas.” I would add that in most cases, the interlacing of ideas with a great mathematician is very valuable for a student. But not all Lusin’s students were happy with the process claiming that he overestimated the influence of his own ideas. However, Lusin’s trial discovered no unethical conduct on his part. According to Professor Isaak Yaglom, Lusin, in his confrontations with the Soviet regime, often allowed himself practical jokes demonstrating the absurdity of its essential features.

Aleksandrov’s background, stature, and attitudes were quite different. Having enjoyed a rich cultural upbringing, he was at home with literature, especially German, and the theater. As rumor had it, after his disappointment in Moscow in 1917–1918, he seriously considered a theatrical career in the Western provinces and gave up the idea only because of the possibility of political problems under the Bolsheviks. Extremely ambitious, he befriended two of the best Soviet mathematicians, Uryson (who died prematurely in 1924) and Kolmogorov. With Uryson, he published joint papers and founded the Moscow topological school. Aleksandrov was popular in Germany, where he had many friends. He was a good lecturer, a witty raconteur, but his status as mathematician was definitely below Lusin’s. A strange antipathy, even hate, separated him from his teacher. In his speeches, Aleksandrov liked to offer charades, daring the audience to decode them. Talking at a colloquium in Leningrad during 1936–1937, he mentioned that sessions of the Academy in which he participated were immortalized by Pushkin’s verse. In the audience, the meteorologist Kibel and I exchanged knowing glances. Aleksandrov had alluded to Pushkin’s

ambiguous epigram about the hapless prince Dondukov-Korsakov, one of the Academy's presidents. The epigram alluded to homosexual relations between the prince and the minister of people's education, S. S. Uvarov.

Another actor in Lusin's trial was the interrogating commission of the Academy chaired by vice-president G. M. Krzhizhanovskii, an old Bolshevik. The commission's membership changed somewhat during the trial's five sessions. Pro-Lusin were only the three mostly passive mathematical academicians, namely Vinogradov, Bernstein, and A. N. Krylov, the first absolutely silent at the trial, the second an outspoken Lusin defender. Anti-Lusin forces actively engaged in the proceedings were headed by MMO's president Aleksandrov. Three members of the 1930 initiative group, Lyusternik, Shnirelman, and Gelfond, were joined by Khinchin, Sobolev, and the academician O. Yu. Schmidt. Kolmogorov attended only one meeting. His presence rather than his largely insignificant questions addressed to Lusin provided moral support to Aleksandrov. It is essential to note that, except for Schmidt (Party member) and Sobolev (Komsomol member), none of the mathematicians in the commission belonged to the Party.

Lusin's faithful students remained outside of the investigation, including Menshov, Lavrentiev, Lyudmila Keldysh, Novikov, Lyapunov, and Nina Bari. Anti-Lusin influence outside the trial was provided by L. Z. Mekhlis and Kolman, the first as editor-in-chief of *Pravda* which had initiated the hunt for Lusin and published several articles with "scoffes and scornes and contumelious taunts" for Lusin, the second submitting his book with anti-Lusin defamations [18] for publication during the trial. At the time, Kolman headed the Science Department of Moscow Party Committee. By their denunciation of Lusin to the highest authorities (Stalin and Molotov), Kolman and Mekhlis tried to bring about a severe outcome of the trial. On the other hand, Aleksandrov, one of the orchestrators of the trial, probably expected a milder outcome. Otherwise, his assertions that Lusin had made no anti-Soviet statements could have damaged his relations with the Party.

In the background, always prepared to strike, worked the GPU/NKVD. They had prepared compromising materials about Lusin. His friend, P. A. Florenskii, mathematician, engineer, and orthodox priest, arrested in February 1933 together with a friend, was broken by the GPU. They confessed to belonging to the Party for the Rebirth of Russia, invented by the secret police, with a future government including Lusin as foreign minister and another mathematician, the academician Chaplygin, as prime minister [31, pp. 101–123]. This material with potential deadly consequences for Lusin was never used.

To understand Lusin's trial at the Academy, one must forget analogies in American and West European legal practice. There were two types of trial in the USSR. The secret and speedy ones by the GPU/NKVD were based

solely on the confessions of the accused obtained by torture, threats to family, or statements by other broken accused, for example, in the cases of the Pulkovo astronomers or the group Rose–Koshlyakov. The show trials were reserved for particularly important “enemies of the people,” for engineers of the Industrial Party or the leading Party members of the Trotskyist–Zinovievist Terrorist Center. The accusations and confessions were steadily broadcast by radio and newspapers, loudly supported by mass meetings organized by the Party throughout the country, and confirmed at the trial by the accused eager to pile guilt on themselves and each other. The proceedings were fully published by the media.

Lusin’s trial was neither of these types. The media behavior was that of the show trials, but the proceedings were secret. The secret police was not involved and the charges were not formulated in terms of the criminal code. Of course, Lusin had no lawyer to represent him. Usually he was called in for the second part of a session to defend himself and answer questions. The records of the trial were believed lost or destroyed by members of the interrogating commission. Only in 1993 was a stenographic copy of the proceeding unearthed by the eminent historian A. P. Yushkevich. After his death it was published [10] by S. S. Demidov and B. V. Levshin with a wealth of additional material and commentary.

The trial was a response to the second of *Pravda*’s articles published on July 3, 1936, “On enemies behind a Soviet mask.” Leaving aside the direct insults, the accusations might be summarized as follows: (a) Lusin gave positive recommendations to undeserving people, even recommending professorships or doctoral degrees for them, with the purpose to pollute the faculties of universities; (b) Lusin published poor papers in the Soviet Union and his best ones abroad; (c) his best papers were not independently written but contained results appropriated from his students, in particular from Suslin and Novikov; (d) Lusin tried to keep young talent from the Academy; (e) Lusin tried to hide and disguise his anti-Soviet beliefs; (f) Lusin was connected with the bleakest tsarist ideology based on monarchism and Orthodox Christianity.

The article compelled the Academy to take action. Its presidium proposed the following reply. Acknowledging the validity of *Pravda*’s accusations, the Academy should recommend to remove Lusin from his two important chairmanships and either consider his expulsion from the Academy (the harsh alternative) or warn him that his behavior was incompatible with membership in the Academy and that in case of continuance expulsion might follow (the milder alternative).

It is not known what happened next. Events developed with lightning speed. Four days after publication of the crucial *Pravda* article, the interrogation commission was appointed by the Academy; the first session of the trial took place on July 7. It was a victory for the “progressive wing

of Moscow mathematicians” and for Aleksandrov, president of the MMO, that Kolman was excluded from the interrogation commission. Indeed, Kolman’s repeated claim that Lusin’s sets were inspired by idealistic philosophy because they did not exist in material reality could have been applied to the work of all members of Lusitania regardless of their ideological persuasion.

The first session of the trial opened with Bernstein paying homage to Lusin’s immense service to Soviet mathematics, but his voice was drowned out by the choir of the young assailants. This often groundless aggressiveness increased, climaxing at the third session on July 11. The most acrimonious and biting denunciation was voiced by Aleksandrov with passionate, one would say, perverted, anger, with the evidence presented in a way most unfavorable to Lusin.

On the morning before the second session on July 9, another lead article appeared in *Pravda*, “Traditions of servility.” Directed at all Soviet scientists, it focused on mathematicians as an example: “While Lusin published his papers abroad as a form of sabotage, also Aleksandrov and Kolmogorov, Bernstein and Khinchin did this, forgetting their national pride and Soviet patriotism. New scientific centers are established in countries like Poland and Holland, putting the USSR at a disadvantage.” Members of the interrogatory commission mentioned in the article had to accept these accusations and promised to improve their behavior.

Even before Lusin was called in, the third session began with a dangerous attack on him. The Academy’s code that allowed expulsion of its members based on activity harmful to the USSR served as background. In Sobolev’s words: “In our broad democracy, all important issues are discussed by the people. [Thus] we can consider here measures such as expulsion without [the permission of] the Ministry of Interior” [meaning NKVD]. Supported by Khinchin and made more precise by Segal, this statement was voted into a resolution by the commission in Segal’s formulation: “In recent years, Lusin’s activity caused harm to Soviet science and the Soviet Union” [10, pp. 129–130]. This wording was extremely dangerous for Lusin because it meant the transfer of his case to the NKVD.

At this session, Lyusternik criticized Lusin’s departure from MGU and his recommendation letters written for undeserving people. The expression of gratitude by Suslin to his teacher: “To him [Lusin] I owe the idea behind my results” [35] was interpreted by Aleksandrov as written under pressure by Lusin. With Lusin protesting in vain and Suslin dead, Aleksandrov ended the session with these words: “I do not believe you.... Before your appearance, we talked with much less passion. Your presence... creates the impression of complete insincerity. You harm yourself by your petty defense” [10, p. 174].

To the fourth session, commission chairman Krzhyzhanovskii brought a set of instructions from the Kremlin introduced by the unmistakable manner of Stalin: "Yest sovyet" ([here] is advice). The instructions implied that Lusin's vilification should continue by adding more details and examples. However, the main message of the directive was relatively harmless in the sense that it saved Lusin from a concentration camp. Praising the commission's official resolution, Stalin actually "advised" essential changes in its text. Charges against Lusin should be formulated in the commission's "academic language" rather than in the style of *Pravda*. Segal's legally damning words in the original resolution should be changed into a nonlegal phrase calling "Lusin's behavior unworthy of a Soviet scientist and incompatible with the dignity of a Soviet citizen." Thus Lusin's official image was transformed from criminal to socially undesirable. The Kremlin's instructions also absolved Lusin from the charge of plagiarism. The fifth and last session was almost completely Bernstein's act. With the conclusion of the trial already set and the proceedings secret, Bernstein and A. N. Krylov, newly arrived, devoted the entire time to Lusin's defense.

This is how *Pravda's* main accusations were ultimately answered by the trial: (a) undeserved recommendations given. This was largely accepted by Lusin and his defenders with the stipulation that they were given to less than significant people and did not lead to any important appointments; (b) plagiarism. This accusation was not endorsed even by Stalin. Lusin never tried to expel Suslin from Moscow as *Pravda* alleged but provided him with an associate professorship in Ivanovo where Suslin went on his own volition. There Suslin resigned either because of lack of interest, according to Lusin, or because of sickness [17]; (c) anti-Soviet attitudes. Aleksandrov stated twice during the trial [10, pp. 61, 97] that no evidence existed to validate this charge. (Nevertheless, there is no doubt that Lusin's sympathies were anti-Soviet—his love was with France); (d) publications abroad. With a snarl for his tormentor Kolman, Lusin explained at the trial that several Soviet newspapers had published Kolman's statements that his [Lusin's] theoretical investigations were harmful, advising Lusin to work on practical problems. Lusin continued: "This I did, publishing a series of papers in the Soviet Union on applied matters, not my strength. I sent my theoretical work abroad in order to avoid polluting Soviet mathematics" [10, p. 144]—a good example of Lusin's ironic style. Lusin showed considerable courage by this statement since Kolman was still holding his positions in the Party. Only after Kolman lost them, in 1938, did Shnirelman and Gelfond, themselves anti-Lusin, attack Kolman's book [18] by a devastating review in the *Uspekhi*.

For Aleksandrov, the trial was a victory over Lusin and, with equal importance, over Kolman with his "Diamat." A third victory at the trial

was, according to Lyusternik's statement, [10, p. 151], the acceptance of the value of purely theoretical sciences without immediate applications. Aleksandrov, firmly established in mathematics by his own work as well as by friendship with that giant of Russian science, Kolmogorov, obviously had Stalin's trust and approval. As president of MMO he was the leader of the progressive wing of young mathematicians who more than counterbalanced for the Kremlin the conservative wing of Lusin's friends. The foundation for the Golden Years of mathematics in the USSR was complete.

The trial is an excellent resource for further research. For instance, it allows us to convincingly answer the question: "Who discovered the analytic (or Suslin) sets and the corresponding set operation?" [24] As the editors of the proceedings disclose, in 1938, L. G. Shnirelman committed suicide immediately after a visit to the NKVD [10, p. 8]. Perhaps this is an indication that the secret police had tried to break into the small group of the Academy's mathematicians.

Lusin died in 1950, but not before a final violent collision with Aleksandrov and Kolmogorov. In 1946, the Academy had to elect a new group of members, this time with preference to the applied sciences. This allowed Lusin to vote against the topologist Aleksandrov. To everybody's consternation, as a reaction, Kolmogorov slapped Lusin's face on the floor of the Academy. The president of the Academy, S. I. Vavilov, was at a loss of what to do. Finally the incident was reported to the Kremlin. It was said that Stalin was not astonished. "This happens even among us," was his reply. In other words, Stalin recommended to do nothing. But the Academy did. Kolmogorov lost all his administrative positions; in particular, he was fired from the directorship of Mathematical Research Institute of the MGU.

Lusin's splendid service to mathematics remains unaffected by time, political changes, and cultural trends. Without him, there would be no Lusitania as we know it. His book [25], not acknowledged at the trial, significantly contributed to the discipline. He had many brilliant ideas and was able to bring them to his students who enthusiastically followed him. But his breakthrough power was not as great as that of his best students. Some, in particular Kolmogorov, were able to overtake him in creativity. In the tradition of great teachers, he had every reason to be proud of his circle.

The decades of 1930–1950 must have been a bitter disappointment for Lusin. His audiences dwindled and then vanished; the importance of his publications diminished. The loss of Lusitania was probably his saddest experience. However, the impact of Lusitania survived him. In Russia and abroad, he is recognized as one of the brilliant lights of Moscow mathematics and as one of the initiators of the Golden Years.

“Lusin cases” were tried also in other cities. With the involvement of the NKVD, they all had tragic endings. In 1933, the German mathematicians Fritz Noether (brother of Emmy Noether) and Stefan Bergman left for the Soviet Union. In Tomsk (Siberia), they published their own German language mathematical journal. Bergman escaped to the United States, to Stanford, but Noether was arrested and accused of “suspicion of espionage.” This category of the official criminal code, making suspicion a crime [8, p. 285], drew a standard eight-year sentence. Noether was sent to a concentration camp where eventually he was shot.

From 1936 to 1940, I paid only sporadic attention to events outside of mathematics at the university. I had my own personal problems. In 1937, my father, Rudolf F. Lorentz, a professor of railway engineering at the Polytechnical Institute in Tbilisi, Georgia, was arrested and accused of “suspicion of espionage.” Sixty-five years old and sentenced to concentration camps, he soon died there. Therefore, I knew little about the persecution of Yu. A. Krutkov (1890–1952), a gifted mathematical physicist. His life showed what happened to excellent scholars who earned the Party’s disfavor but were found irreplaceable.

Shortly after receiving my university diploma, I met Krutkov in the Institute of Meteorology where he worked. I was impressed by his immaculate manners, his profound, original knowledge, and the interest he took in my work. In his youth he belonged to the circle of the physicist–mathematician–astronomer A. A. Friedmann who died prematurely in 1925. Krutkov worked in the broad area between mathematics, mechanics, and physics, one of his specialties being statistical mechanics. He visited France and Germany on a Rockefeller stipend. It was he who helped Friedmann convince the doubting Einstein of the correctness of his teacher’s theory about an expanding universe. His best students were G. A. Gamov, a famous Russian physicist who defected to France, and V. A. Fock, a professor of Leningrad University who also had to taste the bitterness of the concentration camp. Arrested in December 1936, Krutkov spent the years 1937–1939 in a dreadful camp. His conditions improved during his work with the plane designer Tupolev and then in a secret institute at the Black Sea with a German Nobel laureate on problems of atom decomposition. In 1947, he returned home to LGU, still under a dark cloud and with his health ruined. However, for his last work he was awarded a government prize in the days before his death.

7. LENINGRAD DURING THE BLOCKADE

Both dictators, Hitler and Stalin, detested St. Petersburg (Leningrad). I have described Stalin’s dark, bitter images of this unrivaled city. Hitler carried his own resentments. We can imagine that he was again and again

reminded of Russia's power under Peter I in the 18th century and of the splendor of Catherine II's imperial court that left Prussia and Berlin in its shadow. The only sculpture of a military leader seen today in Frederick II's palace Sans Souci is the bust of Sweden's soldier King Karl XII, the unsuccessful adversary of Peter. Hitler must have remembered also that during the Seven Year War, Frederick several times stood on the brink of an abyss, saved only by the inconsistencies and whims of Russian imperial policy. First, Empress Elizabeth, allied with Austria, was Frederick's enemy. Then, astonishingly, the half-mad Peter III, Frederick's admirer, became an ally. Catherine's neutrality finally led to peace. When German armies reached the outskirts of Leningrad in early September of 1941, Hitler considered several contradictory plans of what to do with the city's population of three million in case of surrender. One of his plans was to raze the city to the ground and transport the remainder of its population south, into the area of Russia already occupied by him. This was a fantasy, impossible to achieve.

June 22, 1941, marked the beginning of the Soviet-German war with the invasion of the Soviet Union by the German army. Due to the earlier lightning-fast victories, the Germans had first a tremendous psychological superiority. The distance from the German border to Leningrad by air was 450 miles, yet German artillery hits on the LGU buildings were recorded on September 21. In early fall the Germans had a real chance to take or isolate Leningrad. Their units penetrated some suburbs, but had to be withdrawn to strengthen the German army's concentration on Moscow.

Nevertheless, the Germans held a narrow strip of land ending at Shlisselburg, where the river Neva leaves Lake Ladoga. Consequently the only connection of Leningrad to the rest of the Soviet Union was by boat across Lake Ladoga, or on truck over the ice in the winter, and then by railway from Volkhov to Moscow. The situation depended upon the attitude of the Finns, only 50 miles north of Shlisselburg, and at war with the USSR. By pushing south, the Finns could easily have set a siege, rather than just a blockade of Leningrad. However, the Finns preferred to keep their promise of the 1920s never to endanger Leningrad. Also, the Germans could have cut the Volkhov-Moscow railroad line. They had succeeded in doing this at Tikhvin, from where they had to retreat a month later.

Leningrad was in a desperate situation. The population, three million at the beginning of the war, shrunk to 700,000-800,000 in the summer of 1942. At least 850,000-950,000 died of starvation; others were evacuated [30, p. 685]. Many scientists still remained in Leningrad. In the midst of the suffering, they hoped for help from the government that did not come. Instead, the NKVD made sure that people were more afraid of their own police than of the Germans.

I had my own encounter with the secret police. Each large Soviet institution had an NKVD office. I knew that room at the LGU through a

woman who worked there as a courier. She got railway tickets for professors for an additional 30 rubles, eliminating the dreaded waiting in line often for a couple of nights. I was to become acquainted with the room's more sinister function when in October 1941, during the blockade, I was asked to report there. Two men were waiting for me. One had the uniform of junior lieutenant of the NKVD. The other, in civilian clothes, watched our conversation in silence. After some trivial questions, the lieutenant said that they needed my help. He asked whether I knew anybody who favored the surrender of Leningrad to the Germans.

At that moment I remembered my father on a fateful day in May 1906 during the 1905–1906 Revolution when the minister of transportation asked for his help to suppress the restless railway workers. He refused, the bloodshed was avoided, and he lost his position as the chief engineer of the little railway and the possibility of state employment. I felt I had to emulate his attitude. I knew I walked along an abyss and decided to walk to its rim as close as possible. I should not show fear, should appear to be frank. I answered “yes.” “Is this a woman?” “Yes.” “How old is she?” “Seventy years old.” At that time I had no real person in mind, but I hoped that the NKVD did not arrest very old women. I would have been in trouble had the lieutenant insisted on details, but he did not. He simply pressed further his demand for information, this time about my university friends, suggesting I talk with them about such matters. “I cannot do this, I would be at once discovered,” I said. “So you do not want to help the NKVD?” “I want to help you, but not in this way.” He gave me pencil and paper: “Here, write down what you just said.” I wrote “I want to help the NKVD, but not in the way suggested, because I would betray myself. I am asking the NKVD to assign me another job.” Then I looked up and said “You probably know that my father was arrested and sentenced. Do not think that I am responding this way because of him.” “Of course, you are. And if you are sent to the front, you will shoot your comrades in the back.” After some pause, I said, “No, I would not.” “Of course, you would.” To this I did not reply. Then the lieutenant gave me his name (which I do not remember) and ordered me to come next Thursday to his office on the Liteinyi Prospect (the headquarters of the Leningrad NKVD) at 4 p.m. Instructing me to keep our conversation secret, he let me go.

On the next Thursday, at 3 p.m., I found myself a few blocks from my home, undecided. I still had time to see the lieutenant. Suddenly, air raid sirens screamed: German planes were approaching. I ran to the nearest shelter. This was a cellar without a door, one could see the planes through the open entrance. People shouted that I was attracting bombs, should hide. But I was happy. The alarm solved my problem. I had an excuse for not showing up at the lieutenant's office.

For a couple of weeks I was convinced that “they” would come for me. Later I heard that one should obey only written summons of the NKVD. My friend Boris Platonov told me of a similar experience before the war. Somebody came to his apartment in Tiflis asking him to become an informer. Thinking this a joke, Boris vigorously helped the individual to descend the wobbly stairs from his third floor apartment. Two hours later a policeman came to take Boris to the local precinct. “Take him and lock him up!” shouted Boris’ earlier visitor who was sitting at a desk. However, after a couple of hours of solitary confinement, my friend was released without harm.

Were the NKVD’s suspicions justified? Nobody in Leningrad would speak openly about capitulation, not even to best friends, fearing the anger of the NKVD. Moreover, during the winter, broadcasts of German reversals made patriotic feelings run high. People were thinking less of the city’s surrender.

According to an article in the Soviet tabloid *Ogonyok* [16] by May 1942, 127 Leningrad scientists were arrested. Most died in jail. Mathematicians suffered from the activity of the informer (stukach) Markulov. During the blockade, his first victims were assistants of LGU, Milinskii and Verzhbitskii. I recall my meeting with the latter just before his arrest when he told me that his family ate their cat for dinner. Then came the “group of V. S. Ignatovskii.” The elderly Ignatovskii unwisely advertised his German connections, calling himself W. von Ignatowsky in his publications. According to Solzhenitsyn, Ignatovskii was accused of contacts with Germans during WWI, when he supposedly accepted an assignment as a mole and then waited for the next war between the two countries. He, his wife, and docent Artemyev were shot on November 4, 1941 with two others. But Professor K. I. Strakhovich from the same group was not executed. Beaten and tortured, he was starved by withholding his meals.

Through Strakhovich’s case 13 other mathematicians, the group Rose–Koshlyakov, were discovered. It included N. V. Rose, dean of the Mathematical-Mechanical Faculty of LGU, counter-admiral of the Soviet Navy, and author of many textbooks; N. S. Koshlyakov, corresponding member of the Academy; and Professors B. I. Izvekov and A. M. Zhuravskii. I knew all of them personally. Koshlyakov and Zhuravskii were my teachers. Izvekov and his family were close friends with the family of my wife Tatyana Belikov. They were sentenced a few days after Tatyana and I were evacuated from Leningrad across the ice of Lake Ladoga.

The article in *Ogonyok* [16], the NKVD report provided to the family of one of the victims [9], and [21] are my sources for the trial of the group Rose–Koshlyakov. They illustrate very well the standard (by no means worst) practices of NKVD during the blockade. The main purpose was to obtain signed “confessions” from the accused as proofs of their guilt.

Among other charges, the mathematicians were accused of (1) formation of a large group of professors in order to spread anti-Soviet lies and defeatist, slanderous rumors among the population; (2) preparation of a friendly reception of the German army in case of Leningrad's fall and joining the Germans in the struggle against the Party and the Government; (3) delay of their own evacuation from Leningrad as long as possible to carry out their plan. The time of the group's formation was given as July–August 1941. In light of Germany's impressive successes at that time, to some a Blitzkrieg resulting in the fall of Moscow and Leningrad seemed probable.

The trial was conducted by a junior lieutenant of the NKVD, Kruzhkov, on April 23–25, 1942. In his confession, Rose said: "I did not accept the Soviet government. I did not agree with the organization of the kolkhozy and with the fast tempo of industrialization, deeming these reforms to be premature.... I am the leader of a counter-revolutionary organization, which originated in the counter-revolutionary surroundings of Professor A. A. Friedmann." Indeed, the group of the talented physicist–mathematician Friedmann, who died prematurely, was scientifically active throughout the revolutionary years, with many good mathematicians including Rose, Smirnov, Tamarkin, A. S. Besicovitch, Krutkov, Koshlyakov, and Izvekov participating. But their activity was not political in nature. The communists considered the group reactionary because they were unable to forget that Tamarkin, Besicovitch, and Krutkov's famous student Gamov fled the Soviet Union.

By April 1942, after seven hungry months, the accused were suffering from acute starvation; many of them had lost 1/3 of their normal weight and were close to death. It is humanly understandable that an offer of a bowl of soup was sufficient to force them to sign a "confession," an ultimate proof of guilt. Forced to stand for hours was another form of torture. No wonder that Koshlyakov signed: "I intended to establish relations with the German commandant.... I would like to atone for my guilt, be it in a small measure, by participating in our working front.... In particular, would be very happy to complete my work on summation formulas which I have been conducting for 30 years...."

All 13 of the group, assembled in a room, heard their death sentence. Then they were left alone. They fell on one of them who, they believed, had betrayed them by his confession. The unfortunate man was saved by Izvekov, son of a priest, who pleaded for mercy. A few days later all death sentences were replaced by 10 years in camps. The older men soon died, Rose in jail, Izvekov on his way to a camp. The only woman, Polosukhina, was released. The younger and stronger ones, Koshlyakov, Strakhovich, and Zhuravskii, good mathematicians, survived in special camps (sharashkas) for working on war-related problems. The rehabilitation

process went particularly well for Koshlyakov. In the camp he wrote two good research papers which prompted his recall to Moscow at the end of 1944, where he was allowed to work in a construction bureau on practical problems. In February 1953 he received a Stalin prize and a medal. His sentence of 1942 was repealed in 1951. All others in the group of 13 were rehabilitated in 1954, after Stalin's death, when most of them were dead. Only Strakhovich and Zhuravskii were able to return to their positions in Leningrad. The sentences had also included confiscation of all private property of the condemned. The families lost most of their valuables and relics including art objects, which remained in the possession of state-owned museums even after the repeal of the sentences.

Were the accused sympathizing with the Germans? We have no means to know. It is possible that they preferred a German victory to the continuation of the Stalinist regime. Later, as the treatment of the Russian population by the Germans became widely known, such feelings diminished. We can assume also that a change of mind would occur (or had already occurred in April 1942) with the appearance of the United States as a powerful military ally to the USSR and the success of the Soviet defense of Moscow in the winter 1941–1942. But few intelligent people expected serious political improvement in case of a Soviet victory.

I assumed that the group of 13 in their meetings discussed ways of finding food, and of the political or military situation, but without the Party's supervision. The Party was not really afraid of single individuals, but could not tolerate any group not initiated or supervised by it. This was possibly the reason of my survival, although, in the eyes of the NKVD, I was probably as "guilty" as the group of 13. But I had few close friends, and the ones I had, Markov, Natanson, Platonov, and Pataleev, were above suspicion politically. So I was allowed to be evacuated to the Caucasus.

It is possible that the information the NKVD wanted from me related to the unfortunate group of 13. Had I agreed to be an informer, I would have been forced to spy on my friends, acquaintances, and teachers or suffer disastrous consequences. I even suspect that the junior lieutenant who had interrogated me was the same Kruzhkov who later falsified the confessions of Leningrad's mathematicians.

8. AFTER WORLD WAR II

After the war, the Mathematical-Mechanical College of LGU was rebuilt, with many members returning from evacuation. The fate of others gradually became known to the scientific community. Many were lost,

some through the 1941–1942 trials. Gyunter died quietly in 1941 before the beginning of hostilities. Zhitomirskii, Yanchevskii, and some others died of hunger. Ya. S. Besicovitch, the brother of the outstanding mathematician A. S. Besicovitch, disappeared without a trace, as far as I know; I edited his approximation theory book in 1939–1940. Only G. M. Golusin (1906–1952) remained in Leningrad during the blockade and in spite of his poor health produced an important book on the geometric theory of analytic functions.

Mathematicians connected with the Academy, Bernstein, Markov, and Linnik, were evacuated individually, the latter after an idealistic escapade into the people's militia (*opolchenie*) until he was extracted from there by a demobilization order given from above. Two groups were evacuated in order to preserve the teaching potential of the college. One, led by V. I. Smirnov who was made a regular member of the Academy on this occasion, moved to Yelabuga, some 500 miles east of Moscow. Later in the winter of 1941–1942, the group around Fichtenholz relocated to Saratov.

At LGU, the faculty was treated according to the inherent hierarchy. Even in the war's bleakest years, people with degrees received preferential consideration. Holders of a doctor's degree were exempt from military service; candidates were sent to the front only as officers. Young candidates who had acquired a lieutenant's rank during their studies were treated fairly well. S. M. Losinskii (1914–1986) taught during the war at an air force academy. The injured N. P. Erugin (1907–?) [13] and the pilot S. V. Vallander (1917–1975) survived. The two brothers of my wife, an engineer and a geologist, ended the war as colonels. However, candidates with the designation of common soldier in their military passport were often politically suspect and caught in a strange situation—nobody wanted them. I was one of them and ended up in Leningrad's paramilitary Air Defense Corps. Much worse was the fate of aspirants and students who had no degree. Most of them volunteered for the people's militia for the defense of Leningrad. Ill trained and equipped, these regiments sustained enormous losses. Mathematics lost many highly gifted aspirants including Sirvint, Yudin, Maslov, Meier, Liberman, and Olovyanishnikov. After the war, LGU suffered further losses. Kuzmin died in 1949. Bernstein left for Moscow very early, perhaps he did not even return to Leningrad after the war; Markov followed him in 1959. Organized by mathematicians Lavrentiev, Sobolev, and Kristianovich, the new Scientific Center Novosibirsk in Siberia attracted many talents, in particular during its peak years, 1964–1971, when A. D. Aleksandrov and Kantorovich went there. The interests of Kantorovich, who was awarded the Stalin Prize in 1949 for his work in mathematics, had turned to mathematical economics already before the war. He explained his main ideas in 1939 in the modest brochure "*Mathematical Methods of Organization, and Planning of the Production*

Process” and in his main work, “*The Best Use of Economic Resources*,” written in 1942. He discovered linear programming and used it to obtain a scientific basis for optimality in economics. N. A. Voznesenskii, one of Leningrad’s Party leaders, read both manuscripts and recommended them to Stalin. Moscow’s economic experts, strict Marxists, condemned them. The book, published in Russian in 1959, and in English in 1965, earned its author a 1975 Nobel prize [7].

I remember meeting my friend I. Natanson during the blockade on the Palace Bridge of Leningrad. He was about to cross the frozen Neva on his way to the university; I walked part of the stretch with him. At that time, with the German army on the defensive and America our new ally, victory seemed imminent. I talked about my expectation that it would bring improvement into our lives, but Isidor was pessimistic. And he was right. Freedom had no chance as Stalin started to send Soviet soldiers who had been German prisoners to concentration camps.

On the “political front,” cleansings of the Party membership followed one another. Why did Stalin need to order a new purge shortly before his death? With the country quiet, and relations with the West fairly tolerable, he could have complacently looked forward to the festivities of his 70th birthday. However, during 1949–1950, he engaged Malenkov to start the trials of the “Leningrad anti-Party organization.” The leaders were A. A. Kuznetsov and N. A. Voznesenskii. The first, before his transfer to Leningrad, had been the secretary of the Party’s Central Committee—one of several positions within the Party second only to that of Stalin’s. Voznesenskii was a gifted economist and Stalin’s adviser, while his brother, A. A. Voznesenskii, served as the war time rector of LGU. Altogether, about 2,000 Party members were arrested, about 200 of them shot. At the trial, some of the accused did not meekly succumb to the accusations but declared their innocence and loyalty to the Party [37, vol. 2, p. 464].

Stalin invented a new type of enemy of the people: the “homeless cosmopolitans”—people who spoke a second language or had an additional cultural background and thus were suspected of easily changing their allegiance. Jews fit this definition perfectly. There are indications, supported by the following story, that toward the end of his life, Stalin planned a new purge of the Party and of the Jewish population. It is well known that after the war the USSR was the first to recognize the state of Israel. Israel’s future prime minister, Golda Meir, was a celebrated guest, feted and courted in Moscow. Mrs. Molotov, with a maiden name Perelman, was invited to participate. She befriended Mrs. Meir and even took her to Moscow’s synagogue. But Israel selected the United States instead of the Soviet Union for its main ally. Mrs. Molotov was arrested for Zionist sympathies and exiled to Kazakhstan. Her husband reacted exactly as was expected from a good communist. He did not protest. This

might have been the beginning of Jewish or Party persecution. The depth and rage of Stalin's anti-Semitism, especially during his final years, are dramatically represented by the transcripts of the trial that took place in 1952 [33].

In the cultural-ideological sphere, after the victory the strengthening of both conservative and nationalistic trends and further isolation of Soviet sciences continued. This is how the editors of *Delo Lusina* [10, pp. 13, 43] describe Stalin's ideas in this report: Soviet sciences should be centralized [with center Moscow], ideologized [by Marxism-Leninism], and rendered controllable [by the Kremlin]. University students were taught that Soviet science was a leader, the avant-garde of world science. This was also what the Party hoped to achieve. But Stalin's direct intervention in the sciences made this impossible: in biology, because of Stalin's protégé Lysenko and in linguistics because of Stalin's own "scientific" contributions. In other fields, results were not much better. However, mathematics, the favored science, almost achieved the Soviet goal; the USSR became the world's second in this discipline, after the United States, while the defeated Germany lost its leading position.

A strong factor in the postwar rise of mathematics in Soviet society was the beginning of nuclear bomb construction. A very substantial salary increase for mathematicians ensued. Nevertheless, if one would classify countries according to the size of salaries in this field, the order would be the following: (1) United States, (2) Germany, (3) USSR. With respect to the status of mathematicians in the population, this order would be reversed: (1) USSR, (2) Germany, (3) United States.

For Stalin, "writers [were] engineers of human soul." He also cared about Soviet art, but in a different way. In 1946, Stalin's adjutant A. A. Zhdanov gave a stern lecture to the cultural elite of Leningrad. He accused writers and musicians, among them Shostakovich and Prokofiev, already famous in the West, of formalism and neglecting the requirements of the "socialist realism." He called the poetess Akhmatova a "half nun, half harlot" concerned only with personal matters and condemned the "vulgar parodies" of the great writer Zoshchenko, popular for his short stories describing the lives of ordinary Soviet people.

During the war, there was no time to discuss ideological problems in science. In prewar years, attacks by the hack T. Lysenko had cost many distinguished geneticists their lives. At a session of the Agricultural Academy in 1948, he renewed his attacks using the slogan: "Science is enemy of chance [read: of probability theory]." Anybody responsible for anti-Lysenko statements in the past had to "confess his sins" and to withdraw his words. Bernstein, whose manuscript of the 4th volume of his collected works contained applications of Mendel's laws refused to change his text. The book was suppressed. Kolmogorov also suffered. Eight years

earlier he published in the *Doklady* an article "On a new confirmation of Mendel's laws." Now he had to publicly retract it. Another case when Kolmogorov was forced to act against his principles occurred later in his and P. S. Aleksandrov's joint letter to the daily *Pravda* in February 1974, about the dissident writer Solzhenitsyn:

NO PARDON FOR TREASON

We learned with deep satisfaction that Solzhenitsyn has been deprived of Soviet citizenship and bounced out of our country. Soviet intelligentsia are characterized above all by their high civic consciousness, feeling of duty to people and state, respect for traditions and emblems of the people and pride in the high achievements of the Soviet people building communism. In his creations, published in the West, A. Solzhenitsyn blackens our social structure, desecrates the memory of those fallen in the battles of the Great Patriotic War and purposefully gives a distorted picture of the life of Soviet people. In his way he not only violates Soviet laws but also trespasses in the inner sanctum of our people. He has put himself outside of our society. Such persons have no place in our country.

P. S. Aleksandrov, A. N. Kolmogorov

After the war, ideological problems started again to plague Soviet scientists. Lysenko, Stalin's protégé since 1935, was the main speaker at the 1948 meeting of the Soviet Agricultural Academy. He was trying to establish his own brand of "dynamic Darwinism" which denied the existence of competition among members of the same species, the cornerstone of Darwin's theory of evolution. He invented derogatory names, like "Mendelists" and "Morganists," for geneticists who dared oppose him. They lost their positions and were lucky to retain their lives.

This controversy highlights Stalin's personal involvement in exact sciences and his attitude toward them. Stalin carefully read and edited Lysenko's manuscript, eliminating several pages. He replaced everywhere the epithets "bourgeois, [capitalist]" and "soviet" for biology and genetics by "reactionary" and "scientific," respectively. Particularly important for us was Stalin's reaction to the statement: "Any science is class-oriented by its very nature," namely: "Ha, ha, ha!! And what about mathematics? And about Darwinism?" [6, pp. 249–251]. Nevertheless, Stalin welcomed Lysenko's main ideas. His approval made them part of Party dogma, models for imitation in other sciences. Indeed, after Lysenko's triumph, Party ideologues planned a series of conferences matching the biological session of 1948.

This plan was carried out in medicine, linguistics, and chemistry. Next should be mathematics, with A. D. Aleksandrov as the main speaker, and

physics. They were abrogated by L. Beria, at that time chief of Atomic and Missile Projects (and minister of the Secret Police for many years), since influential physicists explained to him that this may damage these projects. The material for the mathematical session was then published as a set of three volumes [3]. This was a new version of Kolman's book [18] with almost the same title, intended to explain mathematics from a "correct" point of view, this time written by highly competent mathematicians. In its 1964 English edition, Aleksandrov's introductory chapter on philosophy was omitted.

A. D. Aleksandrov, the rector of LGU and a gifted geometer, has described his troubles [27, pp. 49–52]. A letter addressed to the mathematics group of LGU asserted that set-theoretic disciplines such as topology were based on bourgeois philosophy. As usual, discussion sessions were held in the university's main auditorium. The idea that set-theoretic methods were idealistic found little support and was replaced by the secretary of the Party cell by the accusation of "formalism." In particular, abstract investigations by A. A. Markov seemed to fit this label. Alarmed, Aleksandrov traveled to Moscow to look for help. As a solution, I. M. Vinogradov proposed the above-mentioned books. This was probably the best approach possible while Stalin was still alive.

Cultural politics of the Stalinist era led to isolation and nationalism in Soviet mathematics. As we know, already in 1931 the editors of the new series of *Matematicheskii Sbornik* invited Soviet mathematicians to use their journal in preference to publication abroad. Ambitious young mathematicians seeking international fame did not respond to this invitation, continuing to send their best work abroad. This custom was not ended by the wishes of the Soviet mathematical community, as A. D. Aleksandrov [2] insists, but by *Pravda's* article "Traditions of servility" in 1936. Directors of research institutes were held responsible for the enforcement of the publish-in-Soviet-journals rule, exempting only results obtained by Soviet scientists while on leave abroad. Another exception was a dispatch of several Soviet mathematical papers to the United States as a sign of friendship following the attack on Pearl Harbor. With few exceptions, these papers were published in excellent U.S. journals. The paper of my friend I. Gordon on what is now known as Gordon rings appeared in *Annals of Mathematics*, but for a long memoir by L. V. Kantorovich about his semi-ordered (K)-spaces a reduction of length was proposed and the author decided a Russian journal for its publication.

Collegial relations with foreign mathematicians were often disrupted. This led to curious and unfortunate cases. A French mathematician, Favard, published certain formulas in the bulletin of his society in 1937. The Ukrainians Akhiezer and Krein found very interesting consequences and published them. However, Favard's paper had a continuation in the

next issue of the bulletin, with exactly the same results. This would never have happened if Akhiezer and Krein could have simply sent Favard a letter. They probably knew that correspondence with a foreign scientist could endanger them.

The farther into the forest, the more the wood, says a Russian proverb. Soon articles for Russian journals would be acceptable only if written in Russian, even by foreigners. As a next development, tables of content and abstracts in foreign languages were forbidden. A whole new industry of translation of scientific journals into English began to flourish in the United States. With a year's delay, one could read the translation of any important Russian paper.

Authority to grant permission of foreign travel for scientists was transferred from Soviet diplomatic services to the Party's Central Committee. Soon two categories of scientists emerged: "traveling" (vyezdnye) with foreign travel possible, and a much larger category of "non-traveling scientists." Those who went abroad usually had a small hard currency allowance and a tight timetable disallowing any sightseeing or visits to friends. A secret political supervisor was attached to important travelers or large delegations. Organizers of western conferences had trouble inviting Soviet participants because after original acceptance, they would often cancel their visit at the last moment under the pretext of work overload at home.

Each scientific community needs leaders respected for their position, scientific achievement, and prestige. The Party was keenly aware of this and the necessity to have people of trust in these posts. In the exact sciences at my time, the Party was usually unable to find potential leaders in its own ranks. In Leningrad, Professor V. I. Smirnov, later elevated to Academy membership, was not a Party member. Of crystal-clear honesty, deeply religious, he was still favored by the Party. Even his refusal to sign the declaration of Leningrad's "initiative group" did not harm him. Helped by Kochin, he selflessly completed, edited, and published the unfinished manuscript left after Lappo-Danilevskii's death in Germany. He sent part of his honorarium to the United States to the "traitor" Tamarkin, co-author of two of Smirnov's books. He never joined or opposed an ideological trend or made advantageous compromises.

Another leader in Leningrad was A. D. Aleksandrov, rector of LGU before 1942 and in 1952-1964, a Party member with unconventional points of view. Defending a scientist accused of "idealistic" statements, Aleksandrov suggested that Lenin also had, at one time, criticized similar statements because they "may lead" to idealistic philosophy. However, continued Aleksandrov, Lenin did not use the words that such statements "must lead" to idealism. Aleksandrov argued that, consequently, the opinion of the scientist in question should be judged on its own merit. At

that time, it was refreshing to find such arguments in print. Students liked Aleksandrov, who was an excellent alpinist and athlete, calling him by his patronymic Danilych. They even joked that he gave the highest grades to those who could make headstands. One can fully understand his problematic situation if one remembers that the energetic A. A. Voznesenskii, rector of the university during Aleksandrov's absence, lost his life as a result of the 1950 purge of Leningrad's Communist leaders. After Stalin's death, Aleksandrov became one of the Party's enlightened philosophers of science with a Marxist point of view. He protected Einstein's relativity theory that was still under attack. As the university's rector, he played a key role in its de-Stalinization. By 1957, he supported the reestablishment of the academic area of Soviet genetics [7].

It is remarkable that both important universities, LGU and MGU, had mathematicians as their longtime rectors, A. D. Aleksandrov in Leningrad and I. G. Petrovskii (1901–1973) in Moscow. Two obvious leaders in Moscow were P. S. Aleksandrov and Kolmogorov, and later I. M. Gelfand, the first as the president of MMO and Kolmogorov's friend, the second because of his scientific achievements. But there were more MMO members whom the Party could trust. It is interesting to compare the information prepared for Stalin by the NKVD about the characters of the great mathematicians Kolmogorov and Vinogradov, almost complete opposites of each other: "Kolmogorov is widely known in the USSR and abroad. Hard working, he has a firm and quiet character and a strong will. Having the ability to attract talented students, he pays great attention to their scientific education. He does great work in examination and in the preparation of programs and textbooks for the secondary school. Exceptionally modest in his life, he enjoys well deserved respect. Vinogradov is a mathematician with a global name. Unsociable, unacquainted with other fields of science, he has great authority only among mathematicians. A bachelor, he uses great quantities of alcohol" [5]. One can see from these profiles that Stalin was interested in the characteristics of individual Academy members.

Stalin trusted Moscow mathematics, at least those in the "progressive wing" because they helped him after Egorov's arrest in 1930, and again in 1936 when Lusin was persecuted. But why did he trust Kolmogorov? I am not the first to hypothesize that his "trust" was based on blackmail. The book "*Golden Years*" [15, pp. 129–153] contains an intriguing article about Kolmogorov by one of his best students, V. I. Arnold (1937–). Omitting passages that do not directly relate to our subject, we find statements about the relationship of Kolmogorov to the Party and to Stalin:

"“Sometime I will explain everything to you,” Kolmogorov would say each time he would act in a way that clearly contradicted his principles.... Kolmogorov regarded [his] hope that arose in 1953 [after Stalin's death]

as the main reason for the success of [his] work. Like most people of his generation... he feared "them" [the Party] to his last day." Nevertheless, "Kolmogorov spoke about Stalin with gratitude... because [Stalin] forgave him his brawl [at the Academy after Aleksandrov's failed to be elected]." Then comes Arnold's conjecture about Kolmogorov's hint at feeling the need to explain his out-of-character actions: "Apparently he was experiencing pressure from some kind of evil genius whose influence was enormous (well-known mathematicians had the role of a link transmitting the pressure)."

Who was the "evil genius?" Stalin? And who were the "well-known mathematicians" who mediated the pressure to Kolmogorov? His friend Aleksandrov? While there was and is definite gossip concerning the nature of possible blackmail, it never rose above gossip. Yet blackmail of some sort must have been involved. How else to explain Kolmogorov's constant support of Aleksandrov, their joint letter to *Pravda* about Solzhenitsyn, the public retraction of his article about Mendel (political behavior contrary to his known beliefs), and several strange passages by different authors in "Golden Years" [15]?

The Moscow school of real functions and set theory had started with Egorov at the beginning of the 20th century and ran its course with the solution of Hilbert's 13th problem by Kolmogorov in 1957. With its roots in tsarist Russia, this important strain of research was carried on successively by Egorov, Lusin, Kolmogorov, and their numerous students and followers. (It was continued by Gelfand with his functional analysis.) In spite of the persecution and harassment by the Soviet government that these three leaders suffered, they helped to establish the Golden Years, a period of quiet work and good conditions for the mathematicians of Moscow and the Soviet Union. It is impossible to describe the significance, depth, and beauty of the contributions of these heroes to mathematics. I have attempted to do this in an article [23] for a small but important part of Kolmogorov's work. A recent book [20] offers an account of the whole range of the creativity of this great mind.

The Golden Years of Soviet mathematics continued long after 1931. According to some sources [15, pp. 220–222] they ended only in 1968 when relations between the Party and the mathematicians at MGU soured because of the persecution of A. S. Yesenin-Volpin (son of the poet S. Yesenin), a mathematical logician and a dissident, and subsequent protests by mathematicians at the university.

Maybe it would be more accurate to assume that the Golden Years were doomed at the beginning of the mass exodus of Russian mathematicians. The first wave consisted of Jewish scientists leaving for Israel and the United States. The next massive movement, maybe still in progress at a slower pace, was prompted by the opening of all former Soviet borders. One might say that the Golden Years of Soviet mathematics began with

one kind of freedom, the choice of one's research fields, and ended with another kind of freedom, the choice of one's country. And so a very significant phenomenon of Russian cultural life came to a close.

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