Memorials of Mathematicians in Moscow

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Does your hometown have any mathematical tourist attractions such as statues, plaques, graves, the café where the famous conjecture was made, the desk where the famous initials are scratched, birthplaces, houses, or memorials? Have you encountered a mathematical sight on your travels? If so, we invite you to submit an essay to this column. Be sure to include a picture, a description of its mathematical significance, and either a map or directions so that others may follow in your tracks.

➤ Submissions should be uploaded to http://tmin.edmgr.com or sent directly to **Ma. Louise Antonette N. De Las Peñas,** mathtourist1@gmail.com.

Our recent book *Science in Moscow*[1] stated boldly that the capital of Russia may have more memorials to scientists—statues, busts, reliefs, and memorial tablets—than any other city in the world. London may be a competitor, where the magnificent network of blue plaques and plaques of other colors considerably enhances the number of scientists remembered. The special interest distinguishing the Moscow memorials from those in London and other cities in the Western world is explained by the often secretive world of Soviet/Russian science. Here we introduce the reader to a sampler of the memorials to mathematicians and computer scientists in Moscow.

The well-known tower of the Lomonosov Moscow State University (MSU), at 1 Lenin Hills, is by itself a memorial to science and learning. We will refer to it simply as Moscow University (or MSU), because it is not the only institution of higher learning bearing Lomonosov's name, even in Moscow, let alone in Russia. The address also warrants clarification. The hills overlooking Moscow used to be called the Vorobyovy Gori (Sparrow Hills), and then in Soviet times, the Lenin Hills. Today, they are again the Sparrow Hills. However, names and addresses that did not exist in pre-Soviet times retained their earlier designations.[2]

The Lenin Hills campus of MSU opened in 1953. It and its surroundings were carefully planned to radiate grandeur, including a number of memorials to the greats of Russian science. To this we may add a caveat. There used to be claims ascribing many more discoveries and innovations to Russian scientists than the rest of the world was prepared to accept. In contrast, some unsubstantiated claims then caused disbelief and hesitation when genuine Russian contributions should have been recognized, even though there have been many of these. Furthermore, many Russian geniuses in the history of science remained unrecognized due to isolation and lack of international communication. There are examples of Russian and Soviet scientists who should have been inscribed in the roster of Nobel laureates. The very Soviet authorities that complained about anti-Soviet bias in the Nobel Prize institution hindered their scientists and their discoveries from entering the international scene.

Ivan G. Petrovsky (1901–1973) has a rather peculiar memorial plaque on the façade of the tower building (Figure 1, left). Petrovsky studied mathematics at MSU, but graduated rather late, in 1927, since what would have been his student years coincided with the period of the Russian Civil War. He remained at his alma mater and was already a professor at the age of 32. He was appointed head of the

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[1]I. Hargittai and M. Hargittai. *Science in Moscow: Memorials of a Research Empire*. World Scientific, 2019.

[2]The best-known example is Leningrad, which is again called Saint Petersburg, except that Saint Petersburg continues to be located in the province (oblast) of Leningrad.

department of differential equations in 1951, and in the same year also rector of MSU. He served in both these positions to the end of his life. He is buried at the Novodeviche Cemetery (Figure 1, right), where many of the most famous politicians, military leaders, artists, technologists, and scientists are buried.

There is some hierarchy among burial places in Moscow. The Lenin Mausoleum is iconic, of course, and for a few years, it was Stalin's resting place as well. When his crimes came out in the open, he was taken out of the mausoleum and reinterred in an exclusive plot between the mausoleum and the Kremlin wall. A dozen such exclusive plots are there for Soviet political leaders, and their tombstones are marked by their busts, Stalin's included. The next most prestigious burial place is the Kremlin wall itself. From among the scientists figuring in this compilation, only Mstislav V. Keldysh was so honored, and not for his science, but for his leadership in the Soviet space program. The Novodeviche Cemetery is the most prestigious among all Moscow cemeteries. This relatively small cemetery has been closed, and no new burials can take place there except for close family members of those who are already buried there. The Novodeviche Cemetery came closest in the ostensibly classless Soviet society to having a Socialist nobility. Other cemeteries of high prestige in Moscow where great scientists and other contributors to world and Russian culture rest include the Donskoye, Kuntsevskoye, Kuzminskoye, Mitinskoye, Pyatnitskoye, Troyekurovskoye, Vagankovskoye, Vostryakovskoye, and Vvedenskoye Cemeteries.

The tower of MSU has a big Ceremonial Hall whose entrance lobbies display scores of mosaic portraits of Russian and international scientists, among them mathematicians; see Figure 2. Higher in the tower, the Faculty of Mechanics and Mathematics occupies floors 12–16. It is an internationally renowned institution whose graduates have become professors in many colleges and universities and leading specialists of the nuclear weapons and space programs. During the Soviet regime it practiced

Figure 1. Left: Bust of Ivan G. Petrovsky (by I.M. Rukavishnikov) on the façade at the students' club entrance to the university tower. Right: Ivan G. Petrovsky's tombstone at the Novodeviche Cemetery. Photographs by the authors.

anti-Semitic discrimination and accepted hardly any Jewish students.

Nikolai N. Luzin (1883–1950) was one of the most famous mathematicians of MSU until he lost his job; see Figure 3. Today a modest memorial plaque marks the lecture hall named after him. He built up a strong school, and the circle around him was named "Luzitania." He was a member of the Academy of Sciences, an academician—the highest designation a scientist could achieve. He was also a representative of the old intelligentsia. In 1936, he was about to fall victim to Stalin's Great Terror, endangering not only his employment but his life—as many others had perished in the mid-1930s. Among other "crimes," newspaper accounts accused Luzin of publishing his best papers in international, rather than Soviet, periodicals. The Academy of Sciences endorsed the anti-Luzin attacks in the newspapers, though it did not terminate his membership. Some of Luzin's former students—famous mathematicians—turned against their mentor, among them Pavel Aleksandrov and Andrei N. Kolmogorov. Other luminaries of science, such as the chemist Nikolai S. Kurnakov, the geologist Vladimir I. Vernadsky, and the physicist Petr L. Kapitsa, defended Luzin. Kapitsa sent a letter to Vyacheslav Molotov, chairman of the Council of People's Commissars of the Soviet Union, explaining that it was in the national interest that scientists publish their best papers in international journals. Nonetheless, the Soviet authorities continued to prevent international publication. As for Luzin, he was among the lucky victims; although he lost his university professorship, he was otherwise left alone. The resolution of the Academy of Sciences condemning him was annulled only in 2012, finally putting an end to the infamous "Luzin affair."

There are two memorial plaques with reliefs on the façade of the professorial residential quarters of MSU, Pavel S. Aleksandrov and Andrei N. Kolmogorov, two outstanding and trendsetting mathematicians; see Figure 4. Pavel S. Aleksandrov (1896–1982) studied mathematics at MSU. Following graduation, he visited Germany in the early 1920s. There, he developed fruitful interactions with several of the great German mathematicians, including David Hilbert, Richard Courant, and Emmy Noether. He and Heinz Hopf wrote a very successful book on topology, *Topologie I*. It was published in 1935 by Springer, and its latest edition appeared in 2011. Aleksandrov founded the Department of Geometry and Topology at MSU in 1933 and chaired it for the rest of his life. Concomitantly, between 1935 and 1950, he was in charge of the Division of Topology at the Steklov Institute of Mathematics of the Academy of Sciences. He was recognized by memberships in international learned societies, among them the U.S. National Academy of Sciences.

Andrei N. Kolmogorov (1903–1987) graduated from MSU and in 1930 went on a study trip to Germany, where he visited David Hilbert and Richard Courant. In 1931, he was named full professor at MSU and kept that position for the rest of his life. He was a pioneer of mathematical linguistics in the Soviet Union and founded the Department of Probability at MSU. Much later, he founded the Department of Mathematical Statistics. He interrupted his fundamental

Figure 2. Top row: René Descartes, Leonhard Euler, Carl Friedrich Gauss. Bottom row: Isaac Newton, Nikolai Ivanovich Lobachevsky, Johannes Kepler. Photographs by the authors.

Figure 3. Left: Luzin's portrait displayed in the gallery of renowned former institute members on the ninth floor of the Steklov Mathematical Institute of the Academy of Sciences. Right: Luzin's tombstone at the Vvedenskoye Cemetery, 1 Nalichnaya Street. Photograph by and courtesy of Nikolai Andreev.

Figure 4. Memorial plaques of academicians Pavel S. Aleksandrov (left) and Andrei N. Kolmogorov (right) on the façade of one of the smaller residential towers adjacent to the central tower of MSU. Both individuals, as we learn from the plaques, lived here from 1953, i.e., from the inauguration of the building, until the end of their lives. Both photographs by and courtesy of Olga Dorofeeva.

research for the duration of World War II, devoting his efforts to assisting the artillery. Later in his career, he helped to reform the teaching of high-school mathematics. After the collapse of the Soviet Union, many of his disciples became professors of mathematics in leading Western universities.

When one walks from the university tower in the direction of downtown Moscow, one sees a reflecting pool between the tower and Universitetsky Prospekt (University Avenue). There are two rows of busts of scientists, one on each side of the pool. One of the busts on the west side is of Lobachevsky, and one on the east side is of Chebyshev (Figure 5).

Nikolai I. Lobachevsky (1792–1856) graduated in 1811 in physics and mathematics from Kazan University, where he remained, rising to a full professorship in 1822 and appointed rector in 1827. Kazan University dismissed him in 1846, and he died blind and in poverty in 1856. Lobachevsky was a pioneer of non-Euclidean geometry, independently of the Hungarian mathematician János Bolyai (1802–1860). Lobachevsky's non-Euclidean
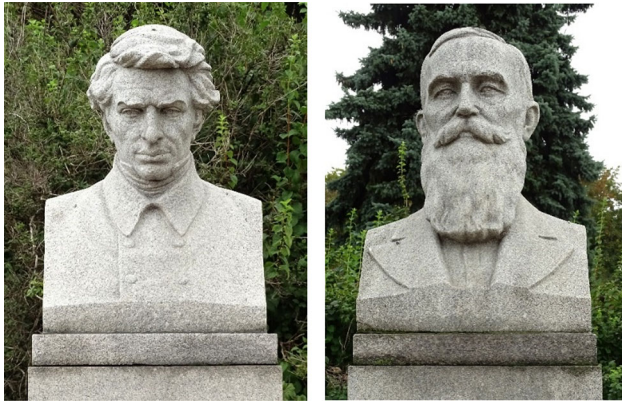
Figure 5. Left: Bust of Nikolai I. Lobachevsky by N.V. Dydykin, west of the reflecting pool in front of the MSU tower. Right: Bust of Pafnuty L. Chebyshev by I.A. Rabinovich, east of the reflecting pool in front of the MSU tower. Photographs by the authors.

geometry is often referred to as Lobachevskian geometry or hyperbolic geometry.

Pafnuty L. Chebyshev (1821–1894) graduated in 1841 from Moscow University. From 1847 he was a member of the professorial staff of St. Petersburg University. He was interested in mechanical devices, and this interest was further enhanced during his visit to Western Europe in 1852. The principal areas of his research were the theory of numbers, the theory of probability, and mechanics. He is considered one of the greatest mathematicians of the nineteenth century; he was elected a member of 25 academies of sciences.

Andrei N. Tikhonov (1906–1993) studied at Moscow University, where he majored in mathematics (Figure 6). Upon graduation, he remained at his alma mater in the Faculty of Physics and Mathematics, which in 1933 was divided into the Faculty of Mechanics and Mathematics and the Faculty of Physics. Tikhonov moved with the Faculty of Physics, where he worked at its Department of Mathematics, serving as its chair between 1938 and 1970. At the same time, he held leading positions at three research institutes of the Academy of Sciences. In 1970, at Tikhonov's initiation, Moscow University established the Faculty of Computational Mathematics and Cybernetics and appointed him as its dean. A stain on his vita is that he was one of four academicians who in 1983 signed a letter of condemnation of Andrei D. Sakharov's activities. It accused Sakharov of having lost his honor and conscience and of treason. Besides Tikhonov, the other signatories were Anatoly A. Dorodnitsyn (see below), the Nobel laureate physicist Aleksandr M. Prokhorov, and the microbiologist and long-time powerful permanent secretary of the Academy of Sciences Georgy K. Skryabin. At the time of this public letter, Sakharov was living in internal exile under severe conditions. The Soviet authorities liked to have letters published as part of the persecution of their perceived enemies in order to lend credence to the idea that they were acting in concert with broad public opinion. Usually, such letters carried many signatures, and no one knew whether they were all genuine. Sometimes, some of the signatories discovered that they had supposedly signed such a letter only when they read about it in a newspaper. In this case, however, because the letter had only four signatures, there was no doubt that the four academicians had expressed their own opinions by signing this letter.

Lev S. Pontryagin (1908–1988) experienced a childhood tragedy. When he was 14 years old, an oil stove exploded near him. His face was badly burned, and he lost his eyesight. From that point on, his mother became his eyes. He graduated from Moscow University in 1929, where he remained, being named professor of mathematics in 1935. He was also a leading associate at the Steklov Institute of Mathematics; see Figure 6. He was very successful in the applications of mathematics to practical problems. The dark side of his career and personality was his rabid anti-Semitism. He was successful in preventing even the most outstanding Jewish mathematicians from attending

Figure 6. Memorial plaques on the façade of the Faculty of Computational Mathematics and Cybernetics of MSU. Left: Andrei N. Tikhonov. Right: Lev S. Pontryagin. Photographs by the authors.

Figure 7. Left: Memorial to Ivan M. Vinogradov at the Steklov Institute of Mathematics of the Academy of Sciences, 8 Gubkin Street. Right: His tombstone at the Novodeviche Cemetery. Photographs by the authors.

international gatherings and being elected to the Academy of Sciences. He was helped in this by his high administrative positions and the active cooperation of Ivan M. Vinogradov, the long-time director of the Steklov Institute. In the background, of course, were the general anti-Semitic policies of the Soviet state and the Communist Party.

Ivan M. Vinogradov (1891–1983) was the director of the Steklov Institute for half a century (Figure 7). The Institute was originally established in Leningrad, but in 1934, it moved to Moscow. Vinogradov's directorship achieved international notoriety for its anti-Semitism, which manifested itself in his rigorously discriminative hiring practices. The Soviet authorities practiced ill-masked anti-Semitism, especially in hiring, but Vinogradov went even further than what was expected of him. Nonetheless, the Steklov Institute was always very strong professionally, and at least two other academic institutes formed from it as spinoffs.

In 1966, a new institute was spun off from the Steklov Institute, which is now the Keldysh Institute of Applied Mathematics. Its origins reach back to 1953, when the need arose to assist ongoing government programs including the nuclear project, the conquest of space, missile defense, and fusion research. More recently, computational biology and robotics have been added to its profile. Mstislav V. Keldysh (1911–1978) graduated in 1931 from Moscow University, where Nikolai N. Luzin was his mentor; see Figure 8. Keldysh began his research career in aerohydrodynamics. From 1934, he worked at the Steklov Institute of Mathematics under the mentorship of his long-time friend Mikhail Lavrentiev. From 1953 to the end of his life, he directed what is now the Keldysh Institute of Applied Mathematics. He had an important but not very publicized role in the Soviet space program. He was also a professor at Moscow University and a scientific organizer, serving as president of the Academy of Sciences from 1961 to 1975.

Sergei L. Sobolev (1908-1989; see Figure 9, left) lost his father early in his childhood. His mother, a teacher and physician, was determined to provide the best possible education for the boy, who appeared to be very gifted. He had a meteoric career in mathematics, graduating from Leningrad University in 1929, where internationally renowned mathematicians were among his professors. After graduation, he worked in mathematical physics, and in 1934, he joined the Steklov Institute. Sobolev worked for the nuclear project from 1945. Parallel to this work, he completed his principal monograph on the fundamentals of mathematical physics. In 1952, he was appointed to a professorship at the recently organized Department of Computational Mathematics of MSU. Eventually, the computational center of the university developed from this department. He was among the initiators of the Siberian Branch of the Academy of Sciences, and from 1957 to 1983, he directed the Institute of Mathematics in Novosibirsk. His activities promoting computational technology were the more remarkable because in the 1950s, cybernetics, that is, computational technology, along with genetics, was considered pseudoscience and ideologically alien in the Soviet Union. Already in the mid-1950s, he fought for reversing this approach and for the recognition of the importance of computational technology. In the mid-1960s, he defended Leonid V. Kantorovich when the latter was being attacked for applying mathematics to economics, which was declared contrary to Marxism–Leninism.

The Dorodnitsyn Computing Center grew out of applied mathematics and can be considered a spinoff of the Keldysh Institute, which itself was a spinoff of the Steklov Institute. Its founding director, Anatoly A. Dorodnitsyn (1910–1994; Figure 9, right), worked at the center, now bearing his name, between 1955 and 1994.

Israel M. Gelfand (1913–2009; Figure 10, left) had a brilliant career in mathematics despite the barriers put up by the Soviet regime and the fact that his anti-Semitic peers prevented his professional advancement and foreign travel. He organized a famous biological seminar for the application of mathematics to biology and served in a professorial appointment at the Belozersky Institute of Physical-Chemical Biology of MSU between 1965 and 1991. He had other jobs simultaneously at the Keldysh Institute of Applied Mathematics and at Moscow State University, where he taught mathematics beginning in 1935. He was one of the great mathematicians of the twentieth century, with broad international recognition long before he was

Figure 8. Left: Statue of Mstislav V. Keldysh by Yuri L. Chernov next to the monument "Explorers of Space" in Ostankino Park. Right: Memorial to Mstislav V. Keldysh in front of the Keldysh Institute of Applied Mathematics, 4 Miusskaya Square. Photographs by the authors.

Figure 9. Left: Tombstone of Sergei L. Sobolev at the Novodeviche Cemetery. Right: Memorial tablet to Anatoly A. Dorodnitsyn on the façade of the Dorodnitsyn Computing Center, 40 Vavilov Street. Photographs by the authors.
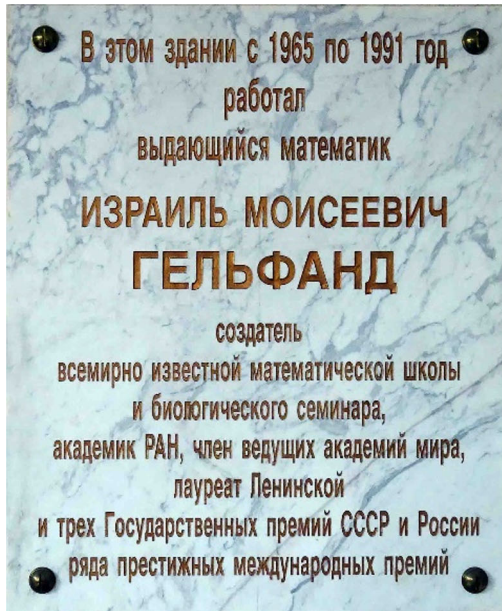
Figure 10. Left: memorial plaque to Israel M. Gelfand at the Belozersky Institute of Physical-Chemical Biology of MSU. Right: tombstone of Vladimir I. Arnold at the Novodeviche Cemetery. Photographs by the authors.

properly recognized in his own country. By the time he was elected a full member of the Soviet Academy of Sciences in 1984, he had already become a foreign member of the U.S. National Academy of Sciences (1970), the Royal Swedish Academy of Sciences (1974), the French Academy of Sciences (1976), and the Royal Society (London, 1977), and he had received the first Wolf Prize in Mathematics (1978). When he was finally allowed to travel, in 1989, the 76-year-old Gelfand moved to the United States and built up a strong research program at Rutgers University, in New Jersey.

Even among the conspicuous gravestones in the Novodeviche Cemetery, Vladimir I. Arnold's stands out with its many mathematical formulas and expressions carved into it (Figure 10, right). Here is a rough translation of the text beneath his portrait relief:

> Being a mathematician, I always have to rely on sensations, guesses, and hypotheses rather than on proofs, moving from one fact to another, relying on the special illumination that makes me consider common aspects of phenomena under study. To a bystander, these aspects may not even appear connected to each other.

Arnold studied at Moscow University, where Kolmogorov was his mentor, and continued at the university following graduation. Because of the anti-Semitic policies of the director of the Steklov Institute, Arnold did not join

the institute until the mid-1980s. His best-known achievements are in the area of catastrophe theory. During the last decade or so of his life, he commuted between Paris and Moscow.

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