Reasons for the Success of the Soviet Mathematical School

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It is widely known that Soviet school of exact sciences, was among the strongest in the world, particularly in terms of physics and mathematics. Why? This is the question we would like to address in this paper by collecting and summarizing different viewpoints on this issue expressed by prominent mathematicians. Many of them witnessed the most fruitful period, the "golden years" of Soviet science and played a major role in the subsequent development of Soviet/Russian mathematics. There is little controversy in the explanations provided by different people; the only essential differences are in the emphases. Thus the list of factors may be regarded as precisely determined. This paper simply aims at communicating them to a non-mathematical community interested in issues of science and education.

The 1950s–1960s are considered to be the golden years of Soviet mathematics. To be more precise, according to V. Tikhomirov [Ti], this was the second peak, the first one being the pre-war period of the 1920s–1930s.[1] Here, however, we will mostly write about the second period. It is important to note the following historical events that are relevant for defining the period: the death of Stalin in 1953 and the "Letter of 99 Mathematicians" in 1968.[2]

V. Vassiliev [Va] lists the following three major reasons for the success of Soviet mathematics:

- Significant support from the government and high prestige of science as a profession. Both factors are related to the rapid industrialization efforts of the USSR.
- Doing research in mathematics or physics was one of the very few intellectual activities that had no mandatory ideological content. Many would-be historians, philosophers or economists (even artists, musicians or computer scientists) became mathematicians or physicists.
- The Iron Curtain preventing international mobility. (Vassiliev adds that the relatively high share of Jews, who would traditionally opt for intellectual professions, proved to be advantageous too, cf. [Fu])

These are specific factors that shaped the structure of Soviet science. Certainly, factors 2 and 3 are more on the negative side and cannot really be called favorable but they essentially came together in combination with the totalitarian regime. Nowadays, it would be impossible to find a scientist who would want the three factors to be reproduced in their totality.

Basically, all the more specific explanations elaborate on one of the three factors just listed. Speaking of the state support, one may mention a very strong inclination towards physics and engineering across all educational levels. This manifested at school-level: mathematical curriculum in Soviet high school was by far more advanced than in most other countries, including modern Russia. Pierre Deligne [De] also mentions the Mathematical Olympiads tradition. The tradition of mathematical circles is obviously relevant too. At university level, there was significant demand for instructors of math and physics for engineers. Why were so many mathematicians, physicists and engineers needed? Experts refer to rapid industrialization, the space exploration program, the nuclear program and, more generally, to the fast growing military industry, cf. [Sm].

Elaborating on the ideology factor, M. Tsfasman [Ts] describes the period of about 20 years after 1953 as a unique combination of freedom and totalitarianism. Although it is hard to talk about freedom in its usual sense when referring to the 1950s–1960s, a number of barriers of the late Stalin period were removed, and the smell of freedom was distinctively recognizable in the air. As M. Tsfasman narrates in [Ts], "My teacher Yuri Ivanovich Manin once told me that the most significant visual impression of his youth was when in 1953 they demolished all the perimeter fences or, more precisely, only about half of the fences were left." Many career opportunities opened up around that time. However, only very few careers did not require their adepts to publicly express, in speech and writing, the loyalty to Soviet regime and communist ideology. A. Sossinsky [So] comments: "If you play the violin — it's great! But if you want to be a composer — too bad, since they will look not only at what you compose but also at how you do it". An advantage of being a mathematician (or a physicist) was that you did not have to lie.

Together with the impossibility of international mobility (very few exceptions notwithstanding), experts say that mobility within the country was heavily obstructed too by the fact that there were only very few centers (most of them situated in the biggest cities), where fundamental research was possible as a primary occupation. On the other hand, living conditions outside the biggest cities were poor. This, as V. Tikhomirov [Ti] confirms, created an unprecedented concentration of bright scientists in few places and led eventually to the development of a unique school. Commenting on scientific schools and their relative strength, M. Tsafsman [Ts] gives the example of the French mathematical school, which consistently produced first-rate results over a long period of time and where an extensive collaboration took place, and the British mathematical community, which gave rise to many prominent scientists but failed to form a "school" due to lack of collaboration. A school is not only a large group of closely collaborating individuals but also a group tied densely with student-advisor relationships. This is why the USA, currently the world's leader in terms of the level and volume of mathematical

research, does not have scientific schools in this sense: the level of mobility there is extremely high. One can talk not only about the Soviet school of mathematics but also, more specifically, of the Moscow, Leningrad, Kiev, Novosibirsk, Kharkov and other schools. In all these places, there were constellations of distinguished scientists with large numbers of students, conducting regular seminars. These were not merely advisors but also spiritual leaders.

Since 1970s, all the three factors have been gradually fading, and the level of mathematical research in Russia has been gradually declining too. According to [La], the situation has recently stabilzed but at a very low level.

REFERENCES

[1] The two periods are of course not independent. The development of science in between the two periods was obstructed by Stalin's repressions of the late 1930s and the Second World War. In the 1920s–1930s, Leningrad school of mathematics was a continuation of the pre-revolution tradition, whereas mathematicians in Moscow developed under strong influence of the French school.

[2] A letter signed by 99 Moscow mathematicians, addressed to Soviet authorities asking for the release of A. Esenin-Volpin, a prominent mathematician, poet and dissident, who was confined in an asylum against his will and without prior medical examination; see, e.g. [Fu]. Full text of the letter is available at ***http://www.math.ru/history/p99/index.htm*** *(in Russian).*

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A Metric View on Russian Mathematics and Russian Mathematical Diaspora

(A Study Based on Frequent Russian Surnames)

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What happens with Russian mathematics in terms of metric parameters? Where do Russian mathematicians work, where do they publish, how well are they cited?

"Russian" may refer to different things: to one's current workplace or to one's origin. First, let us consider "Russian" in terms of origin. We conducted a numerical experiment, which serves to approximate the dynamics of mathematical research produced by scientists originally from Russia. It is difficult to identify this group of mathematicians in citation databases. Instead, we picked some most popular Russian surnames and checked the publication output of people with these names in the Web of Science database. We hope that the chosen collection of scientists is somewhat representative because the authors with these surnames coauthored almost a third of Russia's articles and reviews across all disciplines in the Web of Science in 2014. We call our collection "frequent Russian surnames," or FRS. As of 1994, about 70% of all FRS-coauthored publications were affiliated with Russian institutions. This indicates indirectly that FRS may provide a fair representation of Russian mathematical community. In particular, we expect that FRS migration correlates with the migration of Russian mathematicians, etc. One drawback of the chosen scheme is that it does not distinguish between Russian and, say, Belorussian scientists (the latter form about 3% of the FRS). It is worth noting that those FRS which are also popular in Bulgaria (Ivanov, Antonov, Markov, etc.) were omitted.