Kerosinka: An Episode in the History of Soviet Mathematics

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"It gathers to a greatness, like the ooze of oil
Crushed…"
—Gerard Manley Hopkins

In the Western world, access to a mathematical education is not difficult for an eager and talented student. This was not the case in the former Soviet Union. Young people pursuing mathematical careers faced numerous obstacles. The market was particularly glutted with mathematicians from Jewish families, and these young men and women were routinely denied access to certain institutes and departments where they might have done fine work.

Consider the case of Edik, a young man who showed great mathematical promise very early. He had followed the course of study of the correspondence school established by I. M. Gelfand and had sought out a local mathematician to tutor him on topics such as p-adic numbers, Hilbert spaces, and topology. Because he lived in a provincial city, Edik did not have the opportunity to take advantage of two landmarks of Soviet mathematical life: the special mathematics school[1] and the mathematical study circle.[2] When he finished high school at the age of sixteen, he traveled from his home in Kolomna to Moscow to present himself to the examiners of the department of mathematics at Moscow State University (MGU), the most prestigious in the USSR. The year was 1984.

"What is the definition of a circle?" asked the examiner.

"It is the set of points in a plane, equidistant from a fixed point," Edik replied.

"Wrong," said the examiner. "It is the set of *all* points in a plane, equidistant from a fixed point." The examiner continued, in the fashion of the Red Queen interrogating Alice. He then passed to more serious questions, involving topics such as inversion in a circle, which ordinary high school students could not have been expected to know.

The story is a familiar one: students from Jewish backgrounds were asked questions significantly more difficult than those asked of other candidates, and reasons were found not to admit them.[3] In Edik's case, because of his strong background and ability, this process took more than four hours.

How did the examiners know that a given candidate was Jewish? This was a finely cultivated art in the former Soviet Union, where anti-Semitism was officially illegal but officially practiced. Every Soviet citizen was assigned a nationality, recorded on the internal passport that each carried. If one's parents were Jewish, then one's nationality was Jewish. But what of the descendants of mixed marriages? Late Soviet anti-Semitism proceeded under unwritten racial laws easily as strict as those of the antebellum South.

There were many ways to identify "Jewish" candidates. The simplest was the origin of the family name. (This method caught many ethnic Russians with foreign-sounding names as well as Jews.) Readers of Russian novels are familiar with another

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[1] *See A. Shen, Mathematical high schools: What are they?,* Notices Amer. Math. Soc. ***40*** *(September 1993).*

[2] *Dmitri Fomin, Sergey Genkin, and Ilia Itenberg,* Mathematical Circles (Russian Experience)*, Amer. Math. Soc., Providence, RI, 1996.*

[3] *See A. Shen, Entrance examinations to the Mekh-mat,* Math. Intelligencer ***16*** *(1994); or A. Vershik, Admission to the mathematics faculty in Russia in the 1970s and 1980s,* Math. Intelligencer ***16*** *(1994).*

The Institute for Petrochemical and Natural Gas Industry or *Kerosinka*.

method. A Russian middle name is derived, by law and custom, from one's father's given name. These patronymics are used in formal address and are very much part of Russian life. So it was quite routine to ask the full names of one's parents and thus to learn given names of a candidate's grandfathers. If one of these names sounded Jewish, the candidate was doomed.

In any case, it was decided that Edik was Jewish (in fact, his father was Jewish, but not his mother), and his examination results were graded accordingly. Not one answer was accepted as correct. He and his family chose not to go through the tedious and usually fatuous appeals process after his rejection from MGU.

Upon leaving the interview, Edik met his interrogator in the elevator. While some faculty members at MGU harbored anti-Semitic feelings, others were forced, by political circumstance, to go along with the exclusion of Jews from the university's departments. (Many Russian mathematicians to this day have troubled feelings about their actions at the time.) This faculty member may have been of the latter sort, or he may simply have been glad that Edik was not appealing the examination results.

Oddly, having just failed Edik on every question, the examiner now turned to him and said, "I was really impressed by your knowledge. I advise you to apply to the Institute for Petrochemical and Natural Gas Industry. They take people *like you* there."

Edik had not heard of this institute. It was founded in the early Soviet period[4] and, along with several other such schools, had done fine work preparing technicians for a particular industry. But such a place was hardly the object of the aspirations of a gifted young mathematician. Why this institute?

After 1968 political circumstances started an avalanche of anti-Semitism in the mathematics and physics departments of Soviet universities. The reverence with which scholarship was held in traditional Jewish culture often translated, in modern times, into an interest in mathematics, and there were many Jewish students of the subject. This factor, combined with the exclusion of Jewish students from particular academic departments, created a market for placements in mathematics for these students. Certain technical institutes of Moscow and other cities began to cater to these markets, benefiting from the anti-Semitic policies of other universities to get highly qualified students. A talented Jewish mathematician sometimes found an education at the Institute of Metallurgy or the Pedagogical Institute. Others would enroll in the Institute of Railway Engineers, whose Russian abbreviation sounded like MEED. This led to the saying, "*Esli zheed, idi v MEED*"—"If you're a Jew [the rhyme scheme requires a pejorative term here], then go to MEED." The slogan was typical of the mixture of pride and cynicism that was the Jewish student's only defense against a hostile environment.

The Institute for Petrochemical and Natural Gas Industry was another of those institutions that benefited from the prejudice against Jews at MGU. Its nickname, *Kerosinka*, reflected this same pride and cynicism. A *kerosinka* is a kerosene-burning space heater, a low-tech but effective response to adversity. The students and graduates of the institute quickly became known as "kerosineshchiks", and the school became a haven for Jewish students with a passion for mathematics.

The shared enthusiasm for their subject that is characteristic of the Russian mathematical community has been described elsewhere,[5] and by now the Soviet diaspora has allowed many Americans to experience this atmosphere firsthand. The Kerosinka story is but one example of the subtle interplay between passion and politics, a story of how individuals and institutions reacted to adversity in order to pursue mathematics.

How did fate choose Kerosinka as the repository of so much talent? This question is not easy to answer. We know that there were other institutions that benefited from the exclusion of Jews from MGU. We also know that the establishment of this exclusionary policy was a conscious act, which

[4]Bol'shaia Sovetskaia Entsiklopediia, *vol. 17, 1974, p. 38.*

[5]*For example, see M. Saul, Love among the ruins: The education of high-ability mathematics students in the USSR,* Focus ***12*** *(February 1992).*

probably met with some resistance at first. It may have been easier for some institutions to continue accepting Jewish students than for them to institute a new policy. But once the phenomenon grew and there was a cadre of Jewish students at Kerosinka, why was it tolerated? There are dark whispers of a plot by the secret police (KGB) to keep the Jewish students under surveillance in one or two places. But some of the motivation may have been more positive: the administration of the institute may have seen a good department developing and done what it could to preserve the phenomenon.

Once enrolled at Kerosinka, Edik studied pure mathematics at a high level, but not nearly so thoroughly as students at MGU. The course of study was designed, after all, for specific application to the petrochemical industries. So while Edik learned analysis, linear algebra, and differential equations quite well, his program also included significant work in applied mathematics and computer science. There were many areas of pure mathematics that Edik could not learn about in Kerosinka.

He and his fellow students found a way out. They would "climb the fence" (literally: the building was well guarded) to get into MGU and audit courses and seminars unofficially. Mathematicians such as Gelfand, Kolmogorov, and Kirillov often tolerated or even invited to their classes students who were not legally enrolled at MGU. Edik was the particular beneficiary of the kindness of Dmitri Fuchs and Boris Feigin, who spent much of their own time working with the young man. These avenues allowed Edik and his friends to explore such advanced topics as differentiable manifolds, Lie groups, representation theory, and topology.

In a development peculiar to Soviet life, this unofficial educational system had earlier spawned a complete institution: an evening "university" within MGU. Using space from university buildings, but without any official sanction, professors and students began to meet after hours, holding classes and seminars that extended and complemented the classes at Kerosinka and other institutions. Since many of the students in these classes were Jewish, the institution soon received the name "Jewish People's University" (*Evreyskiy Narodniy Universitet*). Well-known mathematicians such as D. Fuchs, A. Sosinsky, A. Onitschik, B. Feigin, V. Ginzburg, A. Zelevinsky, and A. Shen were among the professors in this unofficial institution. The Jewish People's University suffered a calamitous setback with the death of one of its chief organizers, Bella Muchnik Subbotovskaya, who was killed in a suspicious auto accident just after being interviewed by the KGB about her educational and mathematical activities.

It took a certain amount of courage to pursue mathematics under these circumstances. What impelled Edik and others to continue, like so many salmon swimming upstream? There was every indication that the discrimination they faced at the university level would continue into their professional lives. Why then should they prepare themselves so intensively and against such odds for a career in mathematics?

What can we learn from this story? Is it more than a footnote with a very strange name in the history of mathematics?

The answer strikes at the heart of Soviet mathematical culture and contributes significantly to the explanation of many phenomena in this period of the history of mathematics. In the totalitarian atmosphere of the former Soviet Union, most intellectual fields were put at the service, and the mercy, of the state. Mathematics was a significant exception. Because mathematicians were not dependent on laboratories or equipment but only on colleagues, they were relatively free from government control. For this reason many young people with active minds pursued this field rather than others. In the United States many young people look at the job market, then choose a career. In the former Soviet Union it was more likely that a young person would follow his or her personal inclinations in choosing a subject to study, then seek employment using his or her skills. This often worked. Kerosinka graduates found work in a number of technical institutions and also in high schools with special mathematics programs. Some room in the job market was made for them by yet another Soviet institution, the secret research facilities called "boxes" (*yashchiki*). Known only by their post office box address, these were laboratories and academic departments serving the military or sensitive industries. Employees of these departments had ready access to classified materials, and so anyone with less than a "spotless application" (*chistaya anketa*), including most Jews, was excluded.

But we know that political events overtook the plans of these students. The Russian academies are now more open, if less opulent, places to work, and the bursting of the Soviet Union has spilled its mathematicians all over the world. A Web page of Kerosinshchiks[6] provides a partial list of alumni. More than half of those listed work in technical

[6] `http://www.mng.com/yuri/KYP.html`.

fields in the U.S., another quarter or so in Israel, and a few more in other Western countries. Less than one-quarter of the listed alumni work in the former Soviet Union (although this statistic is probably influenced by difficulties in Web or e-mail access). The Kerosinshchiks' education has stood them in good stead.

And Edik? His real name is Edward Frenkel, and the examination in Moscow failed to reveal his abilities. Like many Kerosinshchiks, he has already made significant contributions to mathematics. After graduating from Kerosinka he was selected as one of only three Russian mathematicians to study at Harvard. He received his Ph.D. there in 1991, after one year of study, and became a full professor on the faculty of the University of California at Berkeley at the age of twenty-nine.

While Frenkel did not have the opportunity to attend the famous Moscow Math Circles, he provides support and inspiration for his wife, Zvezdelina Stankova-Frenkel (also a gifted mathematician), who founded the San Franscisco Bay Area Mathematics Circles for talented youth. Among the regular lecturers at these Circles is at least one other graduate of Kerosinka, Alexander Givental of Berkeley, as well as Dmitri Fuchs himself.

What can we learn from this story? Is it more than a footnote with a very strange name in the history of mathematics? We must be careful in taking lessons from experiences in other countries. The creative process seems to be highly sensitive to culture in ways that we do not understand.[7]

One thing we can note is that the development of Soviet mathematics was driven by forces quite different from those in U.S. American mathematics, like most American scholarship, is largely driven by publication. Certainly the university tenure and promotion processes are dominated by the need to publish. In the Soviet Union, however, a delicate set of cultural and political circumstances allowed for the flowering of a mathematical culture based largely on fellowship through mathematics. I have traced elsewhere its effect on talented students of the subject.[8] The Kerosinka story gives another view of this scene.

The pleasure of doing mathematics together was a powerful driving force in the former Soviet Union. Knowing of this force, perhaps we can harness it, for example, to include students of mathematics from populations heretofore underrepresented in our profession. It may also be that we can use it to attract gifted high school and undergraduate students, from whatever background, into mathematics. (Perhaps then we would be able to encourage more undergraduates in American schools to go on to graduate work in mathematics.) And some compassion for younger faculty members might go far towards ameliorating the rather difficult circumstances of their lives.

In the lines quoted at the beginning of this article, the poet Gerard Manley Hopkins is writing about "God's Grandeur", a rather broader topic than the joy of mathematics. And yet the mathematical community might learn from his words. If the creative urge found outlets in the harsh circumstances of Soviet life, we should be able to find ways for it to contribute to American mathematics as well.

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[7] *For more on this point, see Raymond Wilder,* Mathematics As a Cultural System*, Pergamon, 1981.*

[8] *See footnote 5.*