"We Teach Them to Be Free"

Specialized Math Schools and the Cultivation of the Soviet Technical Intelligentsia

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In the 1960s–70s, dozens of specialized physics and math (*fizmat*) schools mushroomed across the Soviet Union. Thousands of talented students were carefully selected and taught an advanced curriculum by the best teachers, producing several generations of well-educated intellectuals.[1] The government hoped that the math schools would create a cohort of loyal intellectuals who would harness the power of math and science in the service of communism.

In one way, the project was highly successful. According to a 1999 estimate, 80 percent of the country's professional mathematicians were graduates of math schools.[2] Several Fields medalists were educated at such specialized schools.[3] Many former math schoolers applied their skills and knowledge in the

[1] For very informative histories of Soviet math schools, see Mariia Maiofis and Il´ia Kukulin, "Matematicheskie shkoly v SSSR: Genezis institutsii i tipologiia utopii," in *Ostrova utopii: Pedagogicheskoe i sotsial´noe proektirovanie poslevoennoi shkoly (1940–1980-e)*, ed. Kukulin, Maiofis, and Petr Safronov (Moscow: Novoe literaturnoe obozrenie, 2015); Alexander Karp and Bruce R. Vogeli, eds., *Russian Mathematics Education: History and World Significance* (Singapore: World Scientific, 2010); Karp and Vogeli, eds., *Russian Mathematics Education: Programs and Practices* (Singapore: World Scientific, 2011); and Inna Tokar, "Schools for the Mathematically Talented in the Former Soviet Union" (PhD diss., Columbia University, 1999).

[2] Tokar, "Schools for the Mathematically Talented," 4.

[3] Vladimir Drinfeld (Kharkov School no. 27), Maxim Kontsevich (Moscow School no. 91), Grigori Perelman (Leningrad School no. 239), Stanislav Smirnov (Leningrad School no. 239), Vladimir Voevodskii (Moscow School no. 2), and Efim Zelmanov (Novosibirsk School no. 10).

computer industry, contributing to both the fame and the notoriety of "Russian hackers." A recent study of Russian computer scientists concludes that "the only elements of the Soviet system that are still directly traceable" to that group "are the schools they frequented (especially the *fizmat* high schools that specialized in math and physics), the curriculum they followed, the teachers they had, and the Math Olympiads they went to with their fellow math students."[4] However, math school graduates did not become scientists en masse. Many of them did not adopt Soviet ideals and remained a closely knit but isolated group. Some math schools churned out dissenters and independent thinkers, who were a poor fit for the Soviet system.

Studying and socializing at several top Soviet math schools shaped a distinct identity of the "math schooler." Math school graduates told their interviewers how deeply their learning and social experience at school affected their subsequent careers, making this experience "a mark of identity, not just of professional competence."[5] Their identity was based on the perception of their school years as "the Garden of Eden," the time when their "life began," "the main, most important three years," and "a paradise from which everything good in life springs."[6] Those math schools provided outstanding intellectual training and cultivated the habit of critical thinking, yet this explosive combination was a poor ticket into the Soviet elite. While some math schoolers made successful careers, many others were turned down by top universities due to their Jewish background or dissident activity. After college, they were often barred from academic positions.[7] The pedagogical practices of the math schools proved ambiguous, developing some useful skills yet limiting student experience in other respects.[8]

The phenomenon of Soviet math schools has been the subject of two competing interpretations. Speaking of the "second generation" of specialized schools, Il′ia Kukulin and Mariia Maiofis have suggested that the social and pedagogical concept behind these schools acquired "a distinct oppositional meaning," raising people who were not only thinking in a nonstandard way but who also possessed an inner sense of independence. For them, math

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[4] Mario Biagioli and Vincent Antonin Lépinay, "Introduction: Russian Economies of Code," in *From Russia with Code: Programming Migrations in Post-Soviet Times*, ed. Biagioli and Lépinay (Durham, NC: Duke University Press, 2019), 18.

[5] Ibid., 18.

[6] Facebook posts by alumni of Moscow School no. 57, September 2016.

[7] Slava Gerovitch, "Parallel Worlds: Formal Structures and Informal Mechanisms of Postwar Soviet Mathematics," *Historia Scientiarum* 22, 3 (2013): 181–200.

[8] Aleksandr Shen′, "O pol′ze i vrede matematicheskikh klassov," paper presented at the conference "Mathematics and Society," Dubna, September 2000 (http://vivovoco.astronet.ru/VV/PAPERS/ECCE/SHEN.HTM).

schools constituted artificially created "islands of utopia," a social space operating by rules different from those of the larger society. They argued that this phenomenon was not the outcome of a deliberate program but resulted from social and institutional developments and the "ethos of personal freedom, more widespread in math schools than in the Soviet educational system in general, and conditioned, in particular, by the influence of the academic environment."[9]

Alexei Yurchak, by contrast, has viewed similar phenomena not as a form of opposition but as examples of "deterritorialization," by which Soviet citizens led meaningful and creative lives while being simultaneously inside and outside the official discourse. In his conceptual framework, mathematics, as part of "theoretical science," belonged to the realm of "imaginary 'elsewhere,'" which also included ancient language, poetry, and religion.[10] Math school communities look like the groups of free-spirited academics and creative literati, whom Yurchak has described as "an indivisible, if somewhat paradoxical, element of the Soviet state's cultural project."[11] The educational policy of the Soviet state, he argues, served the dual goal of bringing up "well-educated and devoted followers of the party," while actively promoting "the types of knowledge, critical judgement, and independent thinking that taught children to question authority and ideological pronouncements."[12]

Several seminal studies of the Soviet academic environment and educational system help place this issue in a larger context. David Holloway's examination of the closed community of nuclear weapons scientists and Douglas Weiner's discussion of Soviet natural reserves draw on the same metaphor of "islands" or "corners" of intellectual freedom that informed Kukulin and Maiofis's interpretation.[13] This positioning of the scientific intelligentsia as "islanders" in the sea of hostile Soviet culture has been challenged by other studies, stressing the integration of scientists into the Soviet elite, their political conformity, and their skillful manipulation of the system to achieve specific institutional and personal career goals.[14] Many

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[9] Maiofis and Kukulin, "Matematicheskie shkoly," 313.

[10] Alexei Yurchak, *Everything Was Forever, Until It Was No More: The Last Soviet Generation* (Princeton, NJ: Princeton University Press, 2006), 288.

[11] Ibid., 141.

[12] Ibid., 135.

[13] David Holloway, *Stalin and the Bomb: The Soviet Union and Atomic Energy, 1939–1956* (New Haven: Yale University Press, 1994); Douglas R. Weiner, *A Little Corner of Freedom: Russian Nature Protection from Stalin to Gorbachev* (Berkeley: University of California Press, 1999).

[14] Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge, MA: MIT Press, 2002); Alexei B. Kojevnikov, *Stalin's Great Science: The Times and Adventures of Soviet Physicists* (London: Imperial College Press, 2004); Nikolai Krementsov, *Stalinist*

scientists strongly believed in the legitimacy of the Soviet state and shared Marxist philosophical and ideological commitments.[15] Benjamin Tromly has explored the role of postwar universities in the formation of a distinctly Soviet intelligentsia, which he describes as an "imagined community," characterized by its integration into society and close ties to Soviet culture and the state's enlightening mission. In the postwar years, he contends, Soviet universities raised a generation of technical intelligentsia enthusiastically working for the military and economic strengths of the Soviet state. "Even students critical of Soviet institutions or practices," stresses Tromly, retained important elements of the Soviet worldview: "a commitment to fundamental learning as a way of life, the belief that intellectual culture would civilize the Soviet system, and a predisposition toward idealism instead of narrow material goals."[16]

Several scholars have pointed out a key tension in the formation of a loyal Soviet intelligentsia. Douglas Weiner has chronicled "the death of the ideal of educating the critically thinking citizen—whether 'bourgeois' or Marxist—and the return of Soviet education to a tsarist model of producing obedient subjects" in the 1920s.[17] Loren Graham has shown how narrowly focused technical education and the suppression of dissenting voices among Soviet engineers led to disastrous failures of large technological projects in the 1930s.[18] In the postwar period, Tromly argues, the Soviets assigned a civilizing mission to the intelligentsia and simultaneously tried to bring it "closer to the masses."[19] Soviet ideological discourse thus placed contradictory demands on intellectuals—to be obedient state servants and, at the same time, to show creativity and independence of thought.

Soviet math schools were plagued by a similar tension—between the need to select and nurture the top talent and the demand to discipline that talent to make it suitable for subsequent service to the state. This article examines how that tension shaped the culture of several top specialized schools and affected the math schoolers' identity. Resulting from a combination of state-imposed programs and private and group initiatives "from below," the

Science (Princeton, NJ: Princeton University Press, 1997); Ethan Pollock, *Stalin and the Soviet Science Wars* (Princeton, NJ: Princeton University Press, 2006).

[15] Loren R. Graham, *Science, Philosophy, and Human Behavior in the Soviet Union* (New York: Columbia University Press, 1987); Maria A. Rogacheva, *The Private World of Soviet Scientists from Stalin to Gorbachev* (Cambridge: Cambridge University Press, 2017).

[16] Benjamin Tromly, *Making the Soviet Intelligentsia: Universities and Intellectual Life under Stalin and Khrushchev* (New York: Cambridge University Press, 2014), 12.

[17] Douglas Weiner, "Struggle over the Soviet Future: Science Education versus Vocationalism during the 1920s," *Russian Review* 65, 1 (2006): 72–97.

[18] Loren R. Graham, *The Ghost of the Executed Engineer: Technology and the Fall of the Soviet Union* (Cambridge, MA: Harvard University Press, 1993).

[19] Tromly, *Making the Soviet Intelligentsia*, 132.

history of specialized schools reflects a complex interplay of diverse agencies and interests. Intense intellectual exchange and the sense of closely knit community at the top math schools, together with a complicated relationship with the larger social and political world, created a formative environment that subtly undermined the state goal of raising a loyal Soviet intelligentsia.

Soviet Math outside Schools: Olympiads and Math Circles

In 1957, after the launch of Sputnik, US educators began looking for the roots of Soviet triumphs in space in the presumed excellence of Soviet math and science teaching. At the same time, ironically, Soviet educators discussed (behind closed doors) the inadequacy of math training in Soviet schools. Secondary school "gives young people absolutely unsatisfactory preparation for a higher technical education," a college professor complained at a closed meeting at the Ministry of Education in 1957.[20]

From the mid-1930s on, dissatisfied with the level of math instruction at schools, the Soviet mathematical community gradually built a network of math study circles and competitions that ran in parallel to the regular school system. Starting in 1934, leading mathematicians organized weekly meetings of math circles at Moscow and Leningrad universities to attract students to mathematics.[21] They combined lectures on interesting topics beyond the school curriculum with problem-solving sessions. The math circle at Moscow University greatly expanded and became more popular under the guidance of David Shkliarskii. He recruited university students to serve as instructors, began offering more challenging problems, including unsolved ones, and encouraged a competitive spirit.[22]

The first Math Olympiad for schoolchildren was organized at Leningrad State University in 1934, followed by competitions in Moscow and Kiev in 1935.[23] Unlike regular schools, Olympiads offered nonstandard, often entertaining problems, which presented math as a fun activity and stimulated interest among a wide range of students with diverse backgrounds. Given the popular association of math with seriousness and strictness, Moscow University Professor Andrei Kolmogorov felt the need to justify this playful

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[20] P. A. Bessonov, quoted in Maiofis and Kukulin, "Matematicheskie shkoly."
[21] In Moscow, the main organizers were Lazar´ Liusternik, Lev Shnirel´man, and Israel Gelfand; in Leningrad, Grigorii Fikhtengol´ts. See V. G. Boltianskii and I. M. Iaglom, "Shkol´nyi matematicheskii kruzhok pri MGU i Moskovskie matematicheskie olimpiady," in *Sbornik zadach moskovskikh matematicheskikh olimpiad*, comp. A. A. Leman (Moscow: Prosveshchenie, 1965), 9; Alexander I. Nazarov and Galina I. Sinkevich, "History of Leningrad Mathematics in the First Half of the 20th Century" (https://arxiv.org/abs/1812.03231), 14.
[22] Boltianskii and Iaglom, "Shkol´nyi matematicheskii kruzhok," 21–26.
[23] Tokar, "Schools for the Mathematically Talented," 41–46.

approach: "Problems offered at circles and Olympiads are often artificial and even humorous. This is not an issue if the problems are such that serious thinking is required to solve them, similar to the thinking of a grownup, independently working mathematician."[24] The broad appeal of the Olympiads was seen as a "democratizing" tendency "to make mathematics available to all students, even those whose ability might be high but whose backgrounds were weak."[25]

The informal style of the Olympiads and math circles, staffed by volunteers, presented a stark contrast to the narrowly focused, rigid curriculum at regular schools. A former instructor has recalled a "liberating feeling" among circle participants: "For many kids, it was an absolute revelation that there exists free math—the math that makes room for a flight of imagination and does not follow prescribed fixed steps."[26]

The study circles and the Olympiads fed off each other: talented students attended circles to prepare for competitions, while Olympiad winners, including Shkliarskii, later often returned to teach the circles. Several generations of leading Soviet mathematicians came out of the ranks of circle participants and Olympiad winners. The different approaches to math education in the circles and at regular schools, however, created a schism. The approach cultivated at math circles reportedly encouraged a "contemptuous attitude toward the school as an institution."[27]

The 1958 Education Reform and Debates over Math Schools

One year after the start of the Space Race, the two superpowers engaged in another kind of competition—a race to reform the education offered by schools. On 2 September 1958, US President Dwight D. Eisenhower signed into law the National Defense Education Act, widely expanding training in math, science, and foreign languages. Less than three weeks later, on 21 September, the Soviet press published Premier Nikita Khrushchev's proposal on the "strengthening of ties between school and life." Lobbied from different sides, Khrushchev attempted both to address the shortage of a skilled industrial workforce and to improve the training of future scientists and engineers, while also possibly attempting to control the rise of political

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[24] Andrei Kolmogorov, *O professii matematika*, 3rd ed. (Moscow: Izdatel´stvo Moskovskogo universiteta, 1959), 12. Kolmogorov also stressed the variety of types of mathematical ability—computational, visual (geometric), and logical—which were required to solve Olympiad problems.

[25] Mark Saul and Dmitri Fomin, "Russian Traditions in Mathematics Education and Russian Mathematical Contests," in *Russian Mathematics Education*, 238.

[26] Arkady Vaintrob, interview by author, Lexington, MA, 22 August 2017.

[27] Nikolai Konstantinov, quoted in Maiofis and Kukulin, "Matematicheskie shkoly."

dissent among university students.[28] The proposed reform would extend the term of study in schools from 10 to 11 years and impose the requirement of an obligatory two-year period of industrial work before one could apply for college. The proposal also included a provision for the establishment of specialized schools for children talented in math and science.

In the spirit of the "Thaw," Khrushchev opened a public discussion of the proposal. All interested parties—from teachers to education officials to academics—were invited to comment. In stark contrast to the Stalin era, the discussants displayed a surprising degree of criticism of the party leadership's proposal. Some argued that a two-year gap in studies would be ruinous for fledgling minds. Some condemned the idea of schools for the gifted as elitist. The psychologist Natal´ia Menchinskaia cautioned that schools for the gifted would raise students with "qualities totally unacceptable in our society."[29] Minister of Education Viacheslav Eliutin similarly warned that specialized schools might lead to the emergence of student groups with "sentiments alien to a socialist society."[30]

Soviet mathematicians also had reservations about the idea of specialized math schools. They had come to rely on the informal culture of math circles and Olympiads and harbored suspicions about the school system, which was controlled by conservative education officials. Despite these apprehensions, however, they sensed the opportunity that comes with any reform and began considering possible directions of reform that would benefit the mathematical community. Many took part in discussions, both behind closed doors and in the open press, generally supporting the idea of creating a network of specialized schools that would be exempt from the obligatory industrial work requirement.

Arguments in support of specialized schools fell into three categories, which Maiofis and Kukulin have associated with three distinct utopian visions: a managerial utopia, a pedagogical utopia, and a social utopia.[31] In our view, these visions may not be markers of separate interest groups but rather indicate different rhetorical repertoires that various speakers could employ, depending on the occasion and the audience.

The managerial utopia envisioned math schools as a selective breeding ground for skilled cadres for academia and the defense industry. In November

[28] A. I. Prishchepa, "O prichinakh shkol´noi reformy 1958 g.," *Vestnik Nizhnevartovskogo gosudarstvennogo universiteta*, no. 4 (2012).
[29] Quoted in Petr Safronov, "Ideia politekhnizatsii v otechestvennoi shkol´noi politike: Podgotovka reformy 1958 goda i krizis egalitarnoi ideologii," in *Ostrova utopii*, ed. Kukulin, Maiofis, and Safronov, 205.
[30] Quoted in Tokar, "Schools for the Mathematically Talented," 67.
[31] Maiofis and Kukulin, "Matematicheskie shkoly," 308–11.

1958, the leading nuclear physicists Andrei Sakharov and Iakov Zel´dovich publicly called from the pages of the party mouthpiece *Pravda* for the establishment of specialized physics and math schools. Mathematicians and physicists are most productive at a young age, they argued, and holding up their studies with the industrial-work requirement would "inflict damage on the development of science and technology."[32] The head of the Siberian Division of the Academy of Sciences, Mikhail Lavrent´ev, at first critical of the idea of specialized schools as "elite," soon became one of the most outspoken supporters of the idea. In a 1962 internal memo to the party and government authorities, he cited the urgent need for specialists in key defense areas—nuclear physics, missile technology, radar, and cybernetics—and argued that the creation of specialized physics and math schools would provide "at least a partial solution" of this problem.[33] According to this vision, such schools would be created outside the existing school network and be exempt from the rules for regular schools. Such a reform would not affect the rest of the Soviet educational system. The historian Peter Safronov has described this discursive approach as an "enclave modernization strategy."[34]

The pedagogical utopia aimed not at the utilitarian goal of cadre training but at a breakthrough in education for the gifted. Active research mathematicians, such as Israel Gelfand and Aleksandr Kronrod, argued that mathematics was not merely a tool for solving practical problems but a means to develop the mind, on a par with literature. "For the human intellect, the right attitude toward mathematics plays the same role as the comprehension of music or poetry," argued Gelfand. "One does not have to be a musician to learn how to listen to music and to draw pleasure from it. But if music does not exist for [a person], then a huge part of culture is lost, and his spiritual world is deprived. In this sense, mathematics is necessary for any human being."[35] This utopia envisioned exemplary schools in which advanced mathematical training would facilitate the full development of children's talents.

The third, *social utopia* imagined a fundamental transformation of Soviet youth into a generation of scientists and thinkers, a generation of "people of the future," potentially affecting pedagogical practices throughout the

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[32] Ia. Zel´dovich and A. Sakharov, "Nuzhny estestvenno-matematicheskie shkoly," *Pravda*, 19 November 1958, reprinted in *Kikoin: Kolmogorov. FMSh MGU*, ed. A. M. Abramov, 2nd ed. (Moscow: Fazis, 2009), 111–13.
[33] Mikhail Lavrent´ev et al., "Dokladnaia zapiska," 18 January 1962; History of FMSh collection, Open Archive of the Siberian Division of the Russian Academy of Sciences (https://goo.gl/eFjk5v).
[34] Safronov, "Ideia politekhnizatsii," 211.
[35] Quoted in Elena Glagoleva, "Matematika s chelovecheskim litsom," *Nauka i zhizn´*, no. 12 (2013): 40.

country. The well-known mathematicians and public intellectuals Andrei Kolmogorov and Aleksei Liapunov promoted a view of math schools as a testing ground for new school curricula and as engines of new thinking in higher education and in society at large.[36]

Such views provided appropriate ideological justification for the establishment of specialized math schools, yet the wheels of the Soviet bureaucratic machine were never greased by ideology. In a typical Soviet bureaucratic move, the final version of the reform, adopted in December 1958, presented a difficult compromise solution. The most controversial parts of the proposal were dropped. The reform did impose a two-year work requirement for college applicants, but many academic departments in math and science were exempt. All high schoolers were obligated to work two days a week at factories or collective farms, acquiring an industrial or agricultural profession. Specialized schools for the gifted were permitted, but only in music and art, not in math or science.[37]

Thus an open discussion, ironically, made the reform more moderate, which led the historian Laurent Coumel to conclude that "Khrushchev's education reform can be viewed as a victim of the 'Thaw.'"[38] Yet, also in a typical Soviet fashion, the formal adoption of the reform was not the end of the story. The machine of the Soviet state never strictly obeyed formal orders from above. Oiled by specific institutional and personal interests, it always left some room for maneuver. Specialized math schools did emerge—due to the local and loosely coordinated efforts of universities and academic research institutes, which intended to control the training of the next generation of scholars, and the initiative of individual scientists who wanted to provide a good education for their own children.

The First Math Schools: Riding the Computer Wave

Even though Khrushchev's initial proposal might have fallen victim to the Thaw, it was precisely the new Thaw policies that allowed subsequent modifications of educational policy and made the creation of math schools possible. One of Khrushchev's key policy innovations was the decentralization of government. Under the provisions of this policy, individual ministries and

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[36] Abramov, *Kikoin*, 115–31; N. A. Liapunova, A. M. Fedotov, and Ia. I. Fet, eds., *Aleksei Andreevich Liapunov* (Novosibirsk: Geo, 2011), 211–18.

[37] Laurent Coumel, "The Scientist, the Pedagogue and the Party Official: Interest Groups, Public Opinion, and Decision-Making in the 1958 Education Reform," in *Soviet State and Society under Nikita Khrushchev*, ed. Melanie Ilić and Jeremy Smith (New York: Routledge, 2009), 66–85. See also Coumel, "'Rapprocher l'école et la vie': Dégel et réformes dans l'enseignement soviétique (1953–1964)" (PhD diss., L'université de Paris, 2010).

[38] Coumel, "Scientist, the Pedagogue and the Party Official," 82.

even local officials had much leeway in shaping the character of institutions they controlled. Coumel has argued that this opened up the possibility of active lobbying by interest groups, particularly scientists, whose aim was "to protect their own patterns of training young scientists" and ensure the "self-reproduction" of the scientific community.[39]

In the late 1950s, mathematicians occupied key positions at the top level of the Soviet science and educational establishment: the presidents of Moscow and Leningrad universities, vice president of the Academy of Sciences, head of the academy's Siberian Division, and deputy minister of education were all mathematicians. Leading mathematicians' active involvement in the development of nuclear weapons helped them secure positions of power after the successful testing of the Soviet atomic and hydrogen bombs.[40] Wielding their influence, they took advantage of the ongoing reform to attain their own goals.

The acute shortage of specialists in electronics and computer programming forced the authorities to compromise on the issue of specialized schools. In the summer of 1959, the Ministry of Education formally authorized the establishment of experimental secondary-school classes specializing in mathematics and computer programming.[41] Several entrepreneurial school principals seized this opportunity to introduce training in these hot professions instead of less popular industrial occupations. They established contacts with academic institutions with access to computers and asked for their help in training. Training in new professions became a vehicle for upgrading the school curriculum by adding advanced math courses, making the schools attractive to mathematically gifted students and eventually transforming the student body into a very selective group.

In 1959, Moscow School no. 425 (which later became no. 444), affiliated with the Academy of Pedagogical Sciences, introduced computer programming classes, along with an innovative math curriculum developed by the teacher Semyon Shvartsburd.[42] In 1961, the mathematician Aleksandr Kronrod from the Institute of Theoretical and Experimental Physics of the Academy of Sciences organized a specialized class for mathematics and

[39] Ibid., 80.
[40] Slava Gerovitch, "Explosive Math: Soviet Mathematicians, the Bomb, and the International Community during the Cold War," paper presented at the conference "Transnational Perspectives on Soviet Cutting-Edge Technology," Bern, Switzerland, 31 January 2019.
[41] Tokar, "Schools for the Mathematically Talented," 71.
[42] E. Dynkin et al., eds., *Matematicheskaia shkola: Lektsii i zadachi* (Moscow: Izdatel´stvo Moskovskogo universiteta, 1965), 6:63–68.

computer programming at School no. 7, where his own son was enrolled.[43] Kronrod began teaching at the school and arranged for computer training at his institute.[44]

Also in 1961, after intense lobbying by the director of the Leningrad branch of the Steklov Mathematical Institute of the Academy of Sciences Georgii Petrashen´ and the mathematician Viktor Zalgaller, the city party committee gave permission to turn Leningrad School no. 239 into a specialized physics and math school with instruction in computer programming. Their children also attended the school.[45] The same year, other schools with specialized math and computer programming instruction opened in Leningrad (no. 30), Gor´kii (no. 40), Odessa (no. 116), and Tartu (no. 1). In 1962, a specialized physics and math school opened in Kiev (no. 145), in 1963 in Khar´kov (no. 27), in 1965 in Cheliabinsk (no. 31), and in 1966 in Saratov (no. 13).

The schools in which students were trained in the white-collar profession of computer programming, instead of factory work, and received expanded math instruction, attracted a large number of applicants, particularly from intelligentsia families. In 1963, the Moscow party authorities became alarmed by the large number of Jewish students enrolled in School no. 7, and they forced the school administration to limit the admission of Jews. Among others, the school principal turned away the son of the prominent mathematician Israel Gelfand, who worked on crucial calculations for the hydrogen bomb at the Institute of Applied Mathematics of the Academy of Sciences. The resourceful Gelfand quickly found a solution. Back in 1959, Moscow School no. 2 (the "Second School") had set up electrical engineering and computer programming courses with the support of the Institute of Precise Mechanics and Computer Technology of the Academy of Sciences, conveniently located across the street.[46] Gelfand convinced the school principal, Vladimir Ovchinnikov, to establish a class with expanded math instruction at the Second School and enrolled his son there, in exchange for his own teaching at the school. Ovchinnikov invited several other prominent mathematicians and physicists to teach advanced classes at the school as a "bribe" for the admission of their children. Among them were the mathematicians Evgenii Dynkin and physicists Moisei Khaikin and Viktor-

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[43] V. M. Tikhomirov, "A. S. Kronrod (1921–1986)," *Matematicheskoe prosveshchenie*, series 3, no. 2 (2006): 49–54.

[44] Aaron Futer, interview by author, Gansevoort, NY, 15 August 2017.

[45] M. G. Ivanov, ed., *Zametki po istorii 239-i shkoly (60-e–nachalo 80-kh)* (St. Petersburg: Izdatel´stvo Politekhnicheskogo universiteta, 2013), 58.

[46] Georgii Efremov and Aleksandr Koval´dzhi, eds., *Zapiski o Vtoroi shkole*, 2nd ed. (Moscow: Novosti, 2006) (http://ilib.mccme.ru/2/).

Andrei Borovik-Romanov.[47] Iurii Manin and Ernest Vinberg, both professors of mathematics at Moscow University, also taught at the school.[48] The Second School quickly reached a high level of mathematical instruction. In 1964, Liapunov's nephew, an alumnus of School no. 7, wrote in a letter to his uncle: "These schools [no. 2 and no. 7—S.G.] exist and improve exclusively due to their competition: each principal wants his school to be better and makes all sorts of concessions to mathematicians."[49]

While select city schools, with the help of local mathematicians and physicists, added computing classes and tacitly transformed themselves into specialized math schools, the leading universities also stepped into the ring. In Siberia, two influential mathematicians—Lavrent´ev and Liapunov—successfully lobbied the Ministry of Education for permission to open a physics and math boarding school affiliated with Novosibirsk University, which opened in January 1963.[50]

In the meantime, in Moscow, the mathematician Andrei Kolmogorov and physicist Isaak Kikoin lobbied the top echelons of the Soviet government to obtain a high-level authorization of specialized math schools. In April 1963, the heads of four defense industry ministries and other top officials in science and education sent a formal proposal to the Party Central Committee.[51] Eventually in August 1963, the Council of Ministers adopted a resolution formally authorizing boarding schools with advanced training in physics and mathematics or chemistry and biology, affiliated with four major universities—in Moscow, Leningrad, Kiev, and Novosibirsk. During the absence of Premier Khrushchev, the resolution was signed by Deputy Premier and Chairman of the Military-Industrial Commission Dmitrii Ustinov, indicating the significance of this initiative for defense.[52] Each boarding school would serve an entire region by admitting students mostly

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[47] Nikolai Konstantinov, interview with Liubov´ Borusiak, 29 September 2010 (http://www.polit.ru/article/2010/09/29/matheducation/); Aleksandr Krauz, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/07-krauz.htm). On the wide involvement of Soviet professional mathematicians in school education, see Alexey Sossinsky, "Mathematicians and Mathematics Education: A Tradition of Involvement," in *Russian Mathematics Education*, 187–222.

[48] Dynkin et al., *Matematicheskaia shkola*, 1:42–43.

[49] Askol´d Khovanskii to Aleksei Liapunov, 15 November 1964; Liapunov collection, Open Archive of the Siberian Division of the Russian Academy of Sciences (https://goo.gl/We7sPe).

[50] Liapunova, Fedotov, and Fet, *Aleksei Andreevich Liapunov*, 154–233.

[51] Abramov, *Kikoin*, 153–58.

[52] "Ob organizatsii spetsializirovannykh shkol-internatov fiziko-matematicheskogo i khimiko-biologicheskogo profilia," USSR Council of Ministers Resolution no. 905, 23 August 1963; reprinted in *Kikoin*, 159–60.

from outside the major cities, creating opportunities for gifted children from small towns and villages.[53]

Following the government resolution, Leningrad University forged an agreement with Leningrad Boarding School no. 45 and opened six specialized math and science classes with about 180 students in the fall of 1963. The Leningrad City Department of Education did not welcome the university's involvement in school activities and provided little help.[54] Moscow University made a similar arrangement with Boarding School no. 18, and enrolled about 150 students every year for a two-year term.[55] Kiev University engaged Boarding School no. 27, opening 12 specialized classes.[56] University professors, academic researchers, and graduate and undergraduate students were directly involved in forming the curriculum and in teaching at these schools. Soon similar boarding schools were established in the Soviet republics of Armenia, Georgia, Kazakhstan, and Lithuania, and in other regions of the Soviet Union.[57]

The central government formally authorized only boarding schools, while the city physics and math schools still existed in legal limbo. Responding to extensive lobbying by academics and defense industry leaders, and effectively legitimizing existing practice, government officials drafted another resolution, weakening factory work requirements and supporting city math and science schools, which they submitted to the party authorities for approval in May 1964.[58] "Physics and math schools, or schools with advanced math instruction," said Gelfand at a closed ministry meeting in June 1964, "are growing spontaneously, and there is no way back. No matter what resolutions are adopted, no matter what we do, life itself propels this forward."[59]

After Khrushchev's ouster, the entire school system was revamped with a counterreform. As in many other areas, Khrushchev's radical transformations were rolled back. In November 1966, a joint resolution of the Party and

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[53] The Moscow Boarding School admitted students from Central Russia and Belorussia, the Leningrad School from the Northeast and the Baltics, the Novosibirsk School from Siberia and Central Asia, and the Kiev School from Ukraine and Moldova. See A. N. Kolmogorov et al., "Fiziko-matematicheskie shkoly-internaty," *Kvant*, no. 1 (1970): 58.

[54] T. V. Burkova, *FMSh no. 45—Akademicheskaia gimnaziia: Ocherki istorii* (St. Petersburg: n.p., 1993) (http://www.agym.spbu.ru/lib/BurkovaTV.doc); A. A. Bolibruch, A. S. Merkur´ev, and N. Iu. Netsvetaev, *Mathematics in St. Petersburg* (Providence, RI: AMS, 1996).

[55] Abramov, *Kikoin*, 153.

[56] Anonymous, "Istoriia litseiu" (http://upml.knu.ua/pro-litsey/istoriya-litseyu/).

[57] V. Vavilov, A. Kolmogorov, and I. Tropin, "FMSh pri MGU—15 let," *Kvant*, no. 1 (1979): 55–57.

[58] A. A. Fursenko, ed., *Presidium TsK KPSS, 1954-1964*, vol. 3: *Postanovleniia, 1959–1964* (Moscow: Rosspen, 2008), 700.

[59] Quoted in Maiofis and Kukulin, "Matematicheskie shkoly," 301.

the government returned the secondary schools to the ten-year term and weakened requirements for factory training. It also permitted the opening of new specialized schools and classes in math, physics, chemistry, biology, and the humanities.[60]

"Shadow Pedagogy": The Spirit of Open Discussion at the Second School

The math school movement was a curious combination of official institutions, with their formal bureaucratic spirit, and the informal culture of the mathematical community, coming from voluntary study circles. In most specialized schools, the official norms prevailed, and they differed from regular schools only in the additional math curriculum. Several leading math schools, however, were distinguished not only by mathematical instruction but also by the liberal bent of their education, the encouragement of open discussion, and rich extracurricular activities. These schools facilitated the creation of closely knit communities, united by the spirit of free inquiry, whether into math or into literature or art. Two prominent examples of such schools in the 1960s were the Second School in Moscow and the Boarding School of Moscow University.

Since the 1950s, the Soviet mathematical community had continuously expanded the prewar network of extracurricular math activities for interested children. Besides the Olympiads and study circles at major universities (the study circle at Moscow University counted 200–300 students every year), multiple publishing houses issued series of publications aimed at schoolchildren and teachers, such as the journals *Mathematics at School* and *Quantum* and the book series Mathematical Education, Mathematical School, Physics and Math School Library, Math Study Circle Library, Popular Lectures in Math, and Quantum Library, authored by leading mathematicians.[61] Popular math books were widely available throughout the Soviet Union and could be bought even at newspaper stands.[62] Math competitions, open to all, attracted many students, and those who showed even minimal success were rewarded with popular math books, which further stimulated their interest. The prominent mathematician Alexandre Kirillov has recalled that at his first competition he did not win any

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[60] "O merakh dal´neishego uluchsheniia raboty srednei obshcheobrazovatel´noi shkoly," Resolution no. 874, 10 November 1966. For a partial English translation, see Tokar, "Schools for the Mathematically Talented," 223.

[61] Journals: *Matematika v shkole* (1928–), *Kvant* (1970–). Book series: Matematicheskoe pros-veshchenie (1934–38; 1957–61; 1997–), Matematicheskaia shkola (1965–68), Bibliotechka fiziko-matematicheskoi shkoly (1965–78, 2002–), Biblioteka matematicheskogo kruzhka (1951–89), Populiarnye lektsii po matematike (1950–92), and Bibliotechka "Kvant" (1980–).

[62] Vaintrob, interview by author.

prizes but received just an honorable mention, yet was rewarded with a handful of books from the Math Study Circle Library: "This was a total revelation for me that there existed books about math that had nothing to do with school textbooks and that talked about mathematics in a completely different language."[63] In 1964, Gelfand organized the All-Union Correspondence Math School at Moscow University, which enrolled more than 1,400 students across the country. His motto was "Learning must bring pleasure."[64] Many years later, Gelfand recalled, "More than 70,000 students graduated from the All-Union Correspondence Math School, which I organized in Russia more than 30 years ago. Most of them did not become professional mathematicians, but they learned to appreciate the immeasurable beauty of mathematics!"[65]

Teaching talented students required a new type of teacher. Math classes at the Second School were often taught by university professors, graduate students, or undergraduates. In particular, Gelfand brought four Moscow university students, recent graduates of the Second School, to work at that school as his assistants, and two of them, Andrei Zelevinskii and Boris Feigin, became outstanding mathematicians.[66] Such instructors were not part of the school staff, and this left them a lot of freedom in shaping the curriculum. One such instructor called this voluntary teaching movement "shadow pedagogy," which, like the "shadow economy," played a productive role while functioning outside official control.[67]

Instructors of math classes taught their students to think independently, instead of feeding them prepackaged chunks of knowledge. They urged students to discover everything for themselves and encouraged open debate. A school alumnus has recalled: "The main format of study was an open discussion. One could defend any nonsensical viewpoint, any opinion, even contradicting the teacher's, if only one had good arguments."[68] Rather than loading the students with information, the school taught them the main skill—how to think.[69] As a former instructor has recalled, volunteer teachers

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[63] Alexandre Kirillov, interview by author, New York, NY, 5 May 2011.

[64] Quoted in Glagoleva, "Matematika s chelovecheskim litsom."

[65] Quoted in Vladimir Nuzov, "Poverit´ algebroi garmoniiu…," *Vestnik*, no. 2 (209) (19 January 1999) (http://www.vestnik.com/issues/1999/0119/win/nuzov.htm).

[66] See Andrei Zelevinsky, "Remembering I. M. Gelfand," *Notices of the AMS* 60, 1 (2013): 47; Viktor Gutenmakher, interview by author, Brighton, MA, 15 July 2014; Boris Feigin, interview by author, Lexington, MA, 10 March 2019; Andrei Zelevinsky, interview by author, Cambridge, MA, 21 May 2011.

[67] Sergei Smirnov, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/29-smirnov.htm).

[68] Georgii Popkov, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/25-popkov.htm).

[69] Leonid Ashkinazi, "Shkola kak fenomen kul´tury," in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/44-fenomen.htm); T. I. Golenishcheva-Kutuzova et al., *Elementy matematiki v zadachakh* (Moscow: MTsNMO, 2010), 1:6.

were "oriented, from the very beginning, toward raising students who would be able to think, to understand, and to go very far in their studies. The idea was that, while you study, there is no limit: if you have learned something, you'll be given more, and more, and more …"[70] The education was founded on the principle that the value of knowledge is in the freedom it grants.[71] One teacher has confessed, "We don't teach people to be mathematicians—we teach them to be free."[72]

Ovchinnikov, the principal of the Second School, realized that to answer the questions of exceptionally intelligent students, one had to hire outstanding teachers not only in math and physics but also in the humanities and social sciences—teachers who would be "truly educated and possess sufficient courage to answer such questions."[73] The relative autonomy of specialized schools and the receptive pool of talented students made them attractive to unorthodox and liberal thinkers. One of the teachers Ovchinnikov hired was Anatolii Iakobson, an active participant in the dissident movement, who taught literature and history. Producing "intellectual fireworks," he lectured on forbidden historical subjects and on banned writers.[74] The students drew their values from unorthodox works of literature and history, which they read with the same critical and inquisitive eye as scientific reports or mathematical proofs. For example, the first literature assignment at the school in 1968 was to write a review of the Strugatsky brothers' novel *Trudno byt´ bogom* (Hard to Be a God), which was wildly popular among the intelligentsia but had nothing to do with the regular school curriculum.[75] Students staged controversial plays at the school theater and organized debates on contemporary literary works. While done within the framework of permitted afterschool activities, such discussions easily crossed into an ideologically sensitive territory, questioning or ridiculing official norms and clichés.[76]

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[70] Vaintrob, interview by author.

[71] Lev Lur´e, in "Fiziko-matematicheskie shkoly," TV program on Channel 5, Russia, 18 October 2008 (http://www.5-tv.ru/video/502760/). See also Alexandre Borovik, " 'Free Maths Schools': Some International Parallels," *De Morgan Journal* 2, 2 (2012): 28.

[72] Andrei Leman, quoted in Yu. S. Ilyashenko and A. B. Sossinsky, "The Independent University of Moscow," *EMS Newsletter* (March 2010): 38.

[73] Vladimir Ovchinnikov, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/08-VF-TV.htm).

[74] Andrei Zelevinsky, "Pamiati Anatoliia Iakobsona," Boston, 23–25 November 2010 (http://www.antho.net/library/yacobson/2school/2sc-zelevinsky.html).

[75] Mark Chulsky, personal communication, 21 September 2016.

[76] Juliane Fürst has noted a similar phenomenon in the postwar period, when *vechera samodeiatel´nosti* (evenings of homemade entertainment) became "occasions that provided local Komsomol activists with platforms for ironic and sarcastic joking—often to the displeasure of the authorities" (*Stalin's Last Generation: Soviet Post-War Youth and the Emergence of Mature Socialism* [Oxford: Oxford University Press, 2010], 320).

Second-schoolers came to think of themselves as a new generation that would combine scientific competence with a rich cultural background. Echoing the contemporary "two-cultures" debate framed in Soviet media as "physicists vs. lyricists," the charter of the Literature and Theater Collective at the school read: "Our formula is Physicist + Lyricist = Man of the Future."[77] While not explicitly challenging the concept of the New Soviet Man, they subtly switched the focus from "Soviet-ness" to the universalizing concepts of science and art.

Second-schoolers quickly acquired a reputation as a highly cultured and refined group of literature experts and poetry lovers and began to look down at students from other math schools, while being perceived by them as "snobbish—not in terms of math but in terms of general culture."[78] Even among the math schools, the Second School was rather an exception. Instruction in the humanities at most of the other math schools did not differ much from that of regular schools, being limited to prescribed ideological clichés and the works of a limited canon of socialist realist writers.

Trying to attract talented teachers, other math school principals occasionally took the risk of hiring potential troublemakers. One geneticist, who suffered persecution by the Lysenkoites and could not obtain academic employment, found a refuge at the Leningrad Boarding School as a biology teacher.[79] The dissident singer songwriter Iulii Kim worked at the Moscow Boarding School as a literature and history teacher. His "Desperate Song of the Social Sciences Teacher" (1967) mockingly depicted a narrow-minded teacher, who followed Marxist dogma and suffered from inquisitive math schoolers:

> Wunderkinder torture me
> With all their young might.
> They poke their sharp questions
> Into my behind.
> I point to their textbook stacks:
> "That's truth; the rest is lies."
> They tout me: "Where are your facts?
> Take off your lame disguise!"

In the end, the hapless teacher decides to commit suicide by dropping a weighty volume of *Das Kapital* on himself.[80]

[77] Isaak Zbarskii, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/11-zbarsky.htm).
[78] Vaintrob, interview by author.
[79] A. N. Veselkov, quoted in Burkova, *FMSh no. 45*.
[80] Iulii Kim, *Sochineniia* (Moscow: Lokid, 2000), 108–9.

The ideological transgressions committed by teachers from the Second School and a few nonconformist teachers from other schools did not go unnoticed by the authorities. Their spirit ran contrary to the principles of Soviet education, aimed at raising loyal citizens and communist believers. The support of influential academics whose children went to the Second School provided it with temporary protection, but eventually the authorities took decisive measures to restore order.

The Crackdown on the "Hotbeds of the Intelligentsia"

The Second School was a sore in the eye of the educational authorities. Invited professors lectured on topics outside the prescribed curriculum.[81] Too many math school students graduated with high honors, collecting an inordinate number of "gold medals" that gave them priority in college admissions. Parents of students who were not admitted complained to the authorities. Parents of students who were admitted but did not get a "gold medal" also complained to the authorities.[82] Almost all graduates entered college right after graduation, which, ironically, damaged local educational authorities' reporting figures.[83] In light of the government campaign for the "strengthening of ties between school and life," the schools were expected to send many of their graduates to factories and collective farms.

Leading math schools acquired a similarly bad reputation with the party authorities. Students' reading and discussion of underground literature raised concerns about lax ideological control. The high percentage of Jewish students was a source of concern.[84] Dissident activities and emigration to Israel by some teachers prompted investigations.[85] Vladimir Iagodkin, the party boss of Moscow University in 1967–71, vehemently opposed such math schools, arguing that they raised dissidents.[86]

University administrators, for their part, often viewed math school graduates as potential troublemakers. In the last two grades of high school, math school students, in effect, took university-level classes and came to university well equipped for more advanced courses.[87] They were bored by introductory classes and ridiculed the incompetence of some faculty.

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[81] Krauz, in *Zapiski o Vtoroi shkole.*
[82] Ashkinazi, "Shkola kak fenomen kul´tury."
[83] Vaintrob, interview by author.
[84] Krauz, in *Zapiski o Vtoroi shkole.*
[85] Ashkinazi, "Shkola kak fenomen kul´tury."
[86] Natal´ia Tugova, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/10-tugova.htm).
[87] Krauz, in *Zapiski o Vtoroi shkole.*

At Novosibirsk University, they had to be placed in a separate group.[88] At Moscow University, administrators considered them a "readymade rival group" and obstructed their admission. According to one report, one year, out of the entire graduating class of the Second School, no one was admitted to the Faculty of Mechanics and Mathematics (*mekhmat*) of Moscow University. All applicants were forcibly failed during the entrance exams.[89]

A crackdown on the Soviet dissident movement in the late 1960s, especially after the Prague Spring, hit the math community hard and, by implication, affected the graduates of the most ideologically suspicious math schools. In March 1968, 99 prominent Soviet mathematicians signed a letter protesting the forced institutionalization in a psychiatric hospital of the human rights activist and mathematician Aleksandr Esenin-Vol′pin.[90] The authorities responded by persecuting the signers and conducting a purge of *mekhmat*, replacing the dean and the head of admissions and unleashing antisemitic discriminatory practices in admissions and hiring. Starting in the early 1970s, Jewish applicants were systematically turned down by the Mechanics and Mathematics Faculty of Moscow University.[91] Jews were put into separate examination rooms, nicknamed with dark humor "gas chambers," where they were offered immensely difficult "killer problems." According to many reports, "the students were given these problems one after another until they failed one of them, at which point they were given a failing mark."[92] Even non-Jewish math school graduates occasionally ended up in the "gas chambers." One Moscow University professor, unable to stop discriminatory admissions policies, bitterly remarked, "The machine built to weed out the Jews began to be used against any able people."[93] A math school instructor once advised a non-Jewish girl, a math school graduate failed in a "gas chamber," to appeal to the Admissions Commission by explaining that

[88] Liapunova, Fedotov, and Fet, *Aleksei Andreevich Liapunov*, 172. See also Maiofis and Kukulin, "Matematicheskie shkoly."

[89] Konstantinov, interview with Borusiak.

[90] On Esenin-Vol′pin, see Benjamin Nathans, "The Dictatorship of Reason: Aleksandr Vol′pin and the Idea of Rights under 'Developed Socialism,'" *Slavic Review* 66, 4 (2007): 630–63. For the text of the letter, see Aleksandr Esenin-Vol′pin, *Filosofiia. Logika. Poeziia. Zashchita prav cheloveka* (Moscow: RGGU, 1999), 328–30.

[91] For a collection of contemporary reports and historical studies on this topic, see Mikhail A. Shifman, ed., *You Failed Your Math Test, Comrade Einstein* (Singapore: World Scientific, 2005).

[92] Tanya Khovanova and Alexey Radul, "Jewish Problems," 18 October 2011 (http://arxiv. org/abs/1110.1556), 2. For a firsthand account by a student subjected to this procedure, see Edward Frenkel, *Love and Math: The Heart of Hidden Reality* (New York: Basic Books, 2013), chap. 3, "The Fifth Problem."

[93] Iulii Il′iashenko, interview with Nataliia Demina, 28 July 2009 (http://polit.ru/ article/2009/07/28/ilyashenko2/).

she only looked Jewish because she had curly hair but was not actually a Jew. The commission accepted the argument and overturned the failing grade.[94]

The authorities' crackdown on dissident activities led to the persecution of several prominent instructors at math schools. In 1967, Dynkin—who had led math circles at Moscow University, taught at the Second School, and edited a series of brochures with lectures and problems for math schools—was fired from the university for signing a letter protesting the arrest of the dissidents Aleksandr Ginzburg and Iurii Galanskov. He continued meeting with students at an informal math seminar in his apartment.[95] In 1968, Kronrod, who taught at School no. 7, signed a letter in support of Esenin-Vol´pin and was fired from the Institute of Theoretical and Experimental Physics.[96] The same year, in order not to implicate the Second School, Iakobson had to quit his job there and soon became the editor of the underground *Khronika tekushchikh sobytii*, which covered dissident activities.

In 1971, Iagodkin was promoted to secretary for ideology of the Moscow Party Committee, and he launched a crusade against the Second School. In early 1971, a math teacher from the school applied for emigration to Israel, and this gave a pretext for a thorough inspection of the school. The inspection report was carefully phrased to avoid political accusations and cited only some irregularities in paperwork. This was enough, however, to fire the school principal and several leading teachers. Most other teachers were also forced out or left in protest.[97]

In October 1972, Iakobson reported on the purge at his former school in *Khronika tekushchikh sobytii*. "Students of the Second School are distinguished at college," he wrote, "not just by their strong background in math and physics but also by their love for literature, their sharp interest in social problems, by the nature of questions they pose to teachers of ideological subjects, and by their habit of not taking any unproven statement on faith." He argued that the main reasons for the purge were ideological, and the cited irregularities were just a pretext.[98] Several prominent academics

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[94] Vaintrob, interview by author.

[95] Ashkinazi, "Shkola kak fenomen kul´tury"; "Evgenii Borisovich Dynkin (on His Seventieth Birthday)," *Russian Math: Surveys* 49, 4 (1994): 183–91; "Evgenii (Eugene) Borisovich Dynkin (Obituary)," *Russian Math: Surveys* 71, 2 (2016): 345–71.

[96] Tikhomirov, "A. S. Kronrod"; "About Aleksandr Semenovich Kronrod," *Russian Math: Surveys* 56, 5 (2001): 993–1007.

[97] Sossinsky, "Mathematicians and Mathematics Education," 204–6; G. I. Kataev, "Ob A. N. Kolmogorove," in *Kolmogorov v vospominaniiakh*, ed. A. N. Shiriaev (Moscow: Nauka, 1993), 466; *Zapiski o Vtoroi shkole*.

[98] *Khronika tekushchikh sobytii*, 15 October 1972 (http://www.memo.ru/history/diss/chr/chr27.htm).

and government officials tried to intervene on the school's behalf but were reportedly told (in private) that this was a political affair.[99]

The authorities also cracked down on the Moscow Boarding School. In 1968, because of his dissident activity, Iulii Kim was forced to leave the school and banned from public performances.[100] In 1970, the flamboyant principal of the school, Raisa Ostraia, was fired and replaced with a mediocre bureaucrat with Communist Party membership. The boarding school was subjected to tight control by university administration and party officials, who began enforcing ideological discipline and uprooting dissent. The antisemitic discriminatory admissions policies at the university seeped into boarding school admissions. A 1973 alumnus of the Moscow Boarding School recalled that Kim's name had never been mentioned at school, even though his songs were quite popular among the youth. "No memory of such great teachers reached us, no free thought," he said. School officials and university professors organized music soirees, sports activities, and day trips, but there were no informal camping trips with dubious songs around a campfire. "They entertained us, but all these things were organized from above; no initiative was allowed from below," he recalled.[101] In January 1973, boarding school students rebelled, protesting against the ban on dancing at the New Year's Eve party and declaring a hunger strike. The conflict quickly escalated into demands for self-government and for relaxing disciplinary controls. The authorities did agree to create a student council to coordinate afterschool activities but expelled two leaders of the rebellion and restricted admission to the university for 1973 graduates. Dissent was effectively squashed. "There were no political discussions among the students," recalled the alumnus.[102]

In 1976, Leningrad party leaders, following the example of Moscow, cracked down on the city's math schools, which they viewed as "hotbeds of the intelligentsia." Under the banner of giving better training to the factory workforce, Leningrad officials began closing down these schools. The famed schools no. 30 (specialized in math) and no. 38 (physics) were merged and moved out to the outskirts of the city; School no. 121 lost its status as a specialized math school.

These events, especially the crackdown on the Second School, left a deep scar on the collective memory of the mathematical community. From then

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[99] Tugova, in *Zapiski o Vtoroi shkole*.

[100] Iulii Kim, interview with Aleksandr Mel′man, *Moskovskii komsomolets*, 22 December 2016 (https://www.mk.ru/culture/2016/12/22/bard-yuliy-kim-rabskaya-sostavlyayushhaya-eto-nasha-istoriya.html).

[101] Arkady Vaintrob, interview by author, Petersburg, NY, August 2015.

[102] Vaintrob, interview by author, 2017.

on, the existential threat of an impending purge hung over all math schools, and this prompted both teachers and students to adjust their behavior. As one teacher who stayed at the Second School after the crackdown noted, the students' outlook became "more sober."[103] Not to endanger the school, students tried to avoid overt political discussions. As a 1970 graduate of School no. 2 recalled, "the interest in politics in our class, compared to the 1969 class, was practically nonexistent. I recall no discussions of the Prague Spring among my classmates."[104]

The actions of the authorities did not hamper the freethinking spirit of math schoolers; if anything, they made the problem less visible and more acute. Sensitive discussions retreated from classrooms and afterschool lectures into semiprivate spaces. Smaller groups of students gathered at apartments or around campfires during hiking trips to sing forbidden songs, share samizdat literature, and debate political topics, which were too dangerous to discuss under the watchful eye of the authorities. The crackdown forced both teachers and students to draw a sharper line between public speech and private talk. The more students socialized, the closer became their circle of the like-minded. As a result, the skeptical attitude toward official rhetoric and values was reinforced, and students increasingly leaned toward samizdat literature and alternative value systems, such as Western democracy or Judaism. The teachers who were fired or left in protest often found employment at other schools, further spreading the freethinking spirit of the leading math schools.

Evading Control: Movable Math Classes

After the crackdown on the Second School, its former teachers who were fired or left in protest acquired legendary reputations. An affiliation with the troubled school was perceived as an "honorary title, a brand, a mark of quality."[105] Many of them, along with several alumni, began teaching at other schools, preserving and further cultivating the traditions of the Second School.[106] Yet school district administration now viewed with suspicion any attempts to set up new math schools, so math school enthusiasts came up with a different model. It was developed by Kronrod's former student Nikolai Konstantinov.

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[103] Smirnov, in *Zapiski o Vtoroi shkole*.

[104] Ivan Vorob´ev, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/27-karlsen.htm).

[105] B. P. Geidman, interview with Sergei Pavlovskii, 26 August 2010 (http://1543.ru/teachers/inter/geidman/bp.htm).

[106] See Nikolai Aleksandrov, "Na pike 'piatogo punkta,'" *Lekhaim*, no. 8 (244) (2012) (http://www.lechaim.ru/ARHIV/244/aleksandrov.htm). School no. 2 alumnus Iurii Shabat taught at School no. 7, where he "tried to instill the spirit of the Second School"; Natal´ia Markuzon, interview by author, Newton, MA, 9 March 2016.

In the early 1960s, Konstantinov developed an original discovery-based method for learning mathematics. He graduated from the Physics Department of Moscow University in 1954 and, while in graduate school, began teaching the math study circle at the university. In 1960, dissatisfied with a rather cursory coverage of topics by the circle, he set up his own much smaller but more intense study group, nicknamed Alfa Circle.[107] For this group, he developed a new learning method, based exclusively on self-study and problem solving. Every topic was broken down into a sequence of problems. At every lesson, instead of lecturing, Konstantinov handed out "problem sheets" (*listochki*)—typewritten notes with definitions, axioms, and a list of problems, which the students had to solve at their own pace and then explain the solution to the instructor. By solving a sequence of problems, the students were led to discover fundamental theorems and to understand deep connections among mathematical concepts. Without relying on textbooks or lectures, this method forced the students to discover mathematical truths by themselves, instead of being spoon-fed by the teacher.[108]

While working on handouts with problem sets, the students controlled the pace of study and their interaction with instructors. Once a student solved a problem, he or she would raise a hand, an instructor would come up, they would quietly discuss the solution, and then the student would move on to the next problem. In this setting, the students called on instructors, instead of instructors calling on students. This created a new type of interaction between the students and the instructors, broke the hierarchy, and accustomed the students to control their learning environment.[109] "At that time, I discovered a wonderful thing, which was entirely novel for me," recalled Konstantinov. "When a student explains the solution to the instructor, this creates an entirely new level of mutual understanding between them. When I am trying to understand your thinking, and you are trying to understand mine, this creates a rapport, which is totally different from the situation of lecturing."[110] In 1962, Konstantinov's adviser Kronrod invited him to teach at Moscow School no. 7, where the "handouts method" was systematically used in the classroom setting.

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[107] Member of Alfa Circle Gregory Margulis would later become a Fields medalist; Gregory Margulis, interview by author, Cambridge, MA, 31 August 2013.
[108] Golenishcheva-Kutuzova et al., *Elementy matematiki v zadachakh*. Konstantinov's method was somewhat similar to the Moore method, invented by the mathematician Robert Lee Moore in the United States in the 1910s; see John Parker, *R. L. Moore: Mathematician and Teacher* (Washington, DC: Mathematical Association of America, 2005).
[109] Alexei Kojevnikov, interview by author, Tokyo, Japan, 8 October 2012.
[110] N. N. Konstantinov, interview with S. Dorichenko, *Kvant*, no. 1 (2010): 20.

    In 1968, once Kronrod got into political trouble, and the authorities began to tighten the screws on the leading math schools, the principal of School no. 7 decided to take a cautious stand, and Konstantinov, who had just recruited students into a new math class, decided to "move" that class to another school. Thus he invented the idea of "movable" math classes. Such classes would operate at regular schools, something that could be done at the discretion of the school principal without the complicated change of the school's administrative status to a "specialized math school." In case of trouble, an entire class could be moved from one school to another.

    Konstantinov also identified schools that might take the risk of organizing math classes. In downtown Moscow, office space constantly expanded, while population numbers dropped, and centrally located schools suffered sharp declines in enrollment. Konstantinov persuaded several school principals to open math classes to attract students from other districts. In 1968, he moved the math class from School no. 7 to School no. 57, and he later opened math classes in schools no. 91 and no. 179. These three schools formed his mathematical archipelago. Although he did not teach there, Konstantinov made arrangements with the school principals and recruited talented teachers. All math classes in these schools used Konstantinov's "handouts method."

    Konstantinov's approach had implications beyond the goal of learning mathematics. As one teacher has put it, the handouts method "forced students to think independently."[111] Another instructor has remarked, "Reading textbooks was discouraged, because we were supposed to discover everything by ourselves from square zero, as if we were at a desert island."[112] The leading math schools cultivated the culture of universal skepticism, modeled on the demand for a rigorous mathematical proof. One alumnus has recalled: "Someone standing at a blackboard would often make a statement, claiming that 'it was obvious.' [The teacher] would say, 'Being obvious means easy to prove. Prove it.' In most cases, the statement turned out to be false."[113] As a result, math school graduates learned to demand proof and to question authority—the principles they took with them far beyond the realm of mathematics.

    The creation of math classes at regular schools could lead to conflicts with the authorities, and then the "mobility" of math classes proved very handy. For example, the math teacher Boris Geidman, who left the Second School after its purge, opened a math class in School no. 19, and soon a large group of students followed him from the Second School to School no. 19. Within

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[111] Mikhail Khmelnitsky, interview by author, Natick, MA, 19 July 2016.
[112] Vaintrob, interview by author, 2015.
[113] Andrei Dashevskii, Facebook post, 8 September 2016.

a few years, School no. 19 began attracting strong students, many of them Jewish, and the local party committee began investigating the school. The principal was forced to retire, and the math classes were closed. Geidman left for School no. 57 and brought his entire class with him.[114]

The system of math schools began to split into two parts. Most schools with the formal status of specialized physics and math schools, including university-affiliated boarding schools, were tightly controlled by the educational authorities, and they suppressed any signs of the free "spirit of the Second School." They followed the advanced math textbooks and curricula developed by School no. 444 and the Moscow University Boarding School but did not differ from regular Soviet schools in any other respect. The short-lived, semilegal "movable" math classes, in contrast, continued to carry the tradition of critical thought, and they cultivated an elusive but persistent culture of independent thinking and questioning that went beyond mathematics.

Evolving Identity: From a Utopia to an Oasis

Konstantinov's approach to teaching mathematics created a specific social structure, which fostered a distinct culture of the math schools under his tutelage. The "handouts method" demanded personal attention to every student, which required a large number of instructors. Volunteer groups of undergraduates, usually math school alumni themselves, were formed to teach by the Konstantinov method. The students and their instructors were often just a couple of years apart in age. This radically cut the difference in power between them, undermining the traditional hierarchy and shrinking the social distance.[115] The math schoolers and the undergrad instructors spent a lot of time together outside the formal classroom setting and quickly built close friendships. Together, they went to theaters, discussed books, hiked on weekends, and attended month-long summer camps, organized by Konstantinov and his associates. Initially the instructors addressed their students with the respectful second-person pronoun *vy*, until they "trekked many miles, ate a lot of salt, and solved a lot of math problems together," and then both sides would simultaneously switch to the informal pronoun *ty*, preserving equality in the relationship.[116] The grammar manifested the school's egalitarian spirit, mutual trust and respect, and the lack of a priori deference to authority.

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[114] Geidman, interview with Pavlovskii.
[115] Konstantinov, interview with Borusiak.
[116] Vaintrob, interview by author, 2017.

Outside school, intellectual exchanges mixed with political discussions and literature disputes.[117] "Spending time outside the classroom with university students was the most essential part of our education and growing up. They organized a whole bunch of events for us, one after another, around the clock," recalled a graduate of Moscow School no. 57.[118] The math schoolers and their undergraduate instructors felt as if they belonged to a kind of closely knit brotherhood. "I fell in love with this. I was struck by how the students addressed their teachers as *ty*. It was a very unusual relationship. The students and the teachers together worked on a common cause; they did something useful and good. They loved each other. This created a feeling of life that was special…. There was no sense that the students belonged to a separate world. They were absolutely wonderful, and I wanted to become close to them," recalled an instructor.[119] As the historian Diana Kurkovsky West has noted, the math schools became "places where students not only received rigorous math training, but also where deep social bonds emerged within the communities of politically liberal students, parents, and alumni." "These classmate ties are as strong as, I would say, a family," an alumna has recalled.[120]

One of the most popular pastimes was group hiking. On camping trips, math schoolers were given a lot of autonomy. "Nobody told them to line up or do a head count. They just ran around the forest, cut wood, and made a fire. Nobody told them what to do. From the standpoint of a regular school principal, this was extreme laxity."[121] The group leaders—teachers or undergraduate instructors—ruled by delegating tasks and authority to those students who were ready to handle it, not by issuing orders. Hiking for math schoolers was more than just walking in the woods: it was the creation of their own social space with their own rules. Perhaps Konstantinov had these connotations in mind when he half-jokingly remarked: "we choose students [for math schools] to go hiking. Math is just the means for uniting them."[122] One instructor even lamented that Konstantinov and his associates "diminished the significance of studying mathematics. For them, primary was the social side, such as hiking or organizing Olympiads."[123]

[117] Lev Iusufovich, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/32-yusufovich.htm). See also Kojevnikov, interview by author.
[118] Aleksei Barboy, interview by author, Needham, MA, 18 June 2014.
[119] Vaintrob, interview by author, 2017.
[120] Quoted in Diana Kurkovsky West, "Brain Drain and Boston's 'Upper-Middle Tech,'" in *From Russia with Code*, 301.
[121] Kojevnikov, interview by author.
[122] Nikolai Konstantinov, quoted in Khmelnitsky, interview by author.
[123] Vaintrob, interview by author, 2017.

The alumni of leading math schools easily picked each other out in a crowd by their distinctive style of speech. "In [our school] many students speak in a similar way; it's a product of group learning," recalled an alumnus of School no. 57.[124] A former instructor named two key features of math school talk: "First, don't take anything on faith. Reach your conclusions independently; subject any statement to doubt. Second, self-irony, directed at your own statements. If you don't believe in any authority, you shouldn't take your own claims too seriously."[125] Like Cyberspeak, which in the mid-1950s challenged the dominant role of Newspeak in the Soviet scientific community, the talk of math schoolers, loaded with skepticism toward any unsubstantiated claims, was an assault on the linguistic legitimacy of Soviet public discourse.[126] A proud display of intellectual prowess, the striving for precise formulations, skepticism toward authority, biting sarcasm, intellectual teasing, juggling quotes from cult novels and songs, and a mocking attitude toward clichéd official discourse distinguished math schoolers from many students of regular schools, in whom Soviet schooling inculcated conformity from an early age.

Studying at a math school proved a very challenging experience for many students. Before coming to a math school, many students had been the best in their old schools and thought of themselves as exceptional. Inside math schools, however, some differentiation quickly occurred, separating more advanced students from the rest, lowering the self-esteem of some students who might have thrived in a less competitive environment, and sometimes even diverting them away from mathematics. "It was difficult just to be there, because there were so many other clever people surrounding you, and sometimes you felt awfully weak for this challenge," recalled a graduate of Moscow School no. 7.[127] Afterschool math clubs also produced differentiation, which some students found frustrating:

> In math club the environment was difficult, at least for those people who were not on top, because I remember when I came there, obviously, in a normal school I was better than everybody in math, and in the club I wasn't even in the top half, and it was shocking.... It is a little bit soul-crushing for the people in the middle, not the stars of this class.[128]

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[124] Mikhail Finkelberg, interview by author, Luminy, France, 27 June 2011.

[125] Vaintrob, interview by author, 2015.

[126] See Gerovitch, *From Newspeak to Cyberspeak*.

[127] Larissa Itina, at "The Miracle of Soviet Mathematics," a roundtable discussion held by the author at Clementi House, London, UK, 6 February 2016.

[128] Anton Likhodedov, at "The Miracle of Soviet Mathematics."

Despite these challenges, many math schoolers came to view their school as an island of intellectual liberty in the sea of official ideology, rigid hierarchy, and universal deception. "There was a dissident, free spirit in the air. We were honest; there was no pretense," an undergraduate instructor from School no. 57 recalled.[129] When a student, just admitted to School no. 57, heard a classmate openly citing a song by the banned author Aleksandr Galich, he was shocked: "Since childhood, I had been told that we could listen to Galich at home but should never tell anyone. And suddenly I was in a place where this was permitted! There was a feeling that you could do it here, but not outside these walls. Here everything was allowed! … It was a watershed moment for me: I realized that I was in a different environment."[130]

At a math school, the study-oriented students no longer faced social pressures they had had to endure at their previous schools, such as bullying or ideological control, yet the specific culture of math schools left them unprepared to deal with social challenges after graduation.[131] "We all had this feeling of a cold shower," recalled a graduate of Leningrad School no. 121. "There was a huge contrast between what we saw at the school and after, in our life."[132] "It was this wonderful, special atmosphere, which finished abruptly when we finished school," remembered a graduate of Moscow School no. 7. "All of a sudden it turned out that we are living in the normal Soviet world. And that was a very big difficulty. I almost went crazy…"[133]

Math school alumni often returned to their schools to teach, finding the atmosphere of their alma mater friendlier and more intellectually challenging than the formal and stale environment of their universities and yearning for the school spirit.[134] Some would come back not to teach but just for fun: for hiking and social events.[135] According to an alumnus of Leningrad School no. 30, "many graduates come back to school to teach, to recreate, to reproduce the atmosphere of traditional intellectual comfort and to breathe it forever."[136] An alumnus of the Second School recalled:

> Upon entering *mekhmat*, I spent practically all my freshman year not at Moscow University but at the school. The bus I took to the university every morning would pass the school, and I would get off right there.

[129] Vaintrob, interview by author, 2015.

[130] Maxim Braverman, interview by author, Needham, MA, 16 November 2012.

[131] Shen´, "O pol´ze i vrede matematicheskikh klassov."

[132] Vladimir Dribinsky, at "The Miracle of Soviet Mathematics."

[133] Itina, at "The Miracle of Soviet Mathematics."

[134] Kojevnikov, interview by author; Vaintrob, interview by author, 2017.

[135] Vaintrob, interview by author, 2017.

[136] Mikhail Berg, *Tridtsat´ let spustia (o 30-i shkole)* (New England: Cambridge Arbour Press, 2010), 46 (http://mberg.net/tri_agr).

> Sometimes I would go to the university main building, ride up in a packed
> elevator, feeling lonely, open a classroom door, and then immediately
> close it and return to the school…. For many graduates, leaving the
> Second School and entering the airless Soviet space without a space suit
> turned out to be distressing, dangerous, and even impossible. Some took
> to drink, some to the dissident ITR movement, some to monasteries, and
> some to suicide.[137]

The sense of belonging to an exceptional group, nurtured at math schools,
often produced intellectual arrogance toward students from other schools.[138]
Constantly reminded by their teachers to study hard "as geniuses like you
should," math schoolers were convinced of their intellectual superiority
and their prodigy status.[139] "We belonged to an elite community of young
intellectuals and looked at everyone and everything from above," recalled a
graduate of Leningrad School no. 30. "The gleam of arrogance and superiority
could still be seen in the eyes of any good student of no. 30."[140] This echoed the
condescending attitude of Soviet scientists and engineers toward the "masses,"
which was part of what the cultural historian Mark Lipovetsky has called the
"double confrontation" of the intelligentsia—with the Soviet authorities and
with the "masses."[141]

As a result, math schoolers were often at odds with the local community.
"The whole of Leningrad hated School no. 239. The best students left all the
other schools," recalled a teacher.[142] Students came to math schools from all
over the city, and local boys from the neighborhood often provoked fights.
The principal of the Moscow Second School once had to run out to the school
yard to separate the fighters and got a black eye.[143] Similar fights erupted
between local boys and students from Moscow schools no. 57 and no. 91.[144]

In the 1970s, the central metaphor for math schoolers' self-identification
changed. Unlike most regular schools, which were run under tight ideological
control, a few top schools with math classes struggled to preserve their relative
autonomy. The math schoolers came to see their school not as a vanguard of

[137] Evgenii Bunimovich, "Deviatyi klass: Vtoraia shkola," *Znamia*, no. 12 (2012) (http://magazines.russ.ru/znamia/2012/12/b8.html).
[138] Shen´, "O pol´ze i vrede matematicheskikh klassov."
[139] Vaintrob, interview by author, 2017.
[140] Berg, *Tridtsat´ let spustia* (http://mberg.net/tri_doroga).
[141] Mark Lipovetsky, "The Poetics of ITR Discourse: In the 1960s and Today," *Ab Imperio*, no. 1 (2013): 109–39.
[142] Berta Gol´shtein, in *Zametki po istorii 239-i shkoly*, 71.
[143] Aleksandr Blinkov, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/38-blinkov.htm); Ashkinazi, "Shkola kak fenomen kul´tury."
[144] Vaintrob, interview by author, 2017.

the future, as the Second Schoolers used to do, but as an oasis of intellectual freedom in a desert of conformity and mediocrity. Instead of the forward-looking belief in the power of science, math schools began cultivating the sense of mission to save fragile cultural values, to protect personal and intellectual integrity against the pressures of the outside world, and to sustain the community of math school alumni—an invisible college of people sharing the same values.

Instead of viewing mathematical and scientific knowledge as a practical tool for understanding and transforming the world, math school students and teachers began to associate it with the notion of absolute truth and the sense of escape from ideological constraints. Math schoolers did not just learn extra mathematics and science but found a like-minded group, and often quickly absorbed the group's interest in half-banned literature and art, sarcasm toward official ideology, and a sense of intellectual superiority.

The "oasis" or "island" metaphor shaped math students' mentality. The line of "us vs. them" was drawn around the perimeter of the social space of math schools. School alumni recalled their perception of Soviet-era school existence almost as if they were under siege: "we were at war"; "we were in a ghetto"; "the closest analogy I could think of is Pushkin's Lyceum—'the whole world is a foreign country; our Fatherland is Tsarskoe selo,'" (where the Lyceum was located). "People try to find refuge on their islands," suggested one alumna, "where they attempt creating life for themselves outside the norms of the state, with which they got stuck." She called such spaces "islands of happiness and independence."[145]

The oasis metaphor shaped the sense of mission for the math school alumni who returned to their schools to help pass on cultural values as well as mathematical knowledge. "Math schools selected strong students, but this wasn't the main thing," argued a graduate of School no. 57 who became a school instructor. "They were taught in a special way, but this wasn't the main thing either. The main thing was that the school alumni had a mission to participate in the upbringing of new students, so that this community would be sustained."[146] Another instructor from School no. 57 recalled: "We believed we were creating an oasis, like a nature reserve, or an Indian reservation. We believed we were gathering the last remaining people, who were becoming extinct; we gathered them on tiny islands where one did not have to pretend to be someone else; one did not have to lead double life." For him, math schools were a "forge of freethinkers" who could "tell good from evil."[147]

[145] Facebook posts by math schools' alumni, September 2016.
[146] Braverman, interview by author.
[147] Vaintrob, interview by author, 2017.

Invoking a literary metaphor, a graduate of the Second School wrote:

> One of my favorite fairy tales is the tale of the ugly duckling. Perhaps any
> person, at least occasionally, feels like such a duckling. All people around
> you are different; they don't understand you and even insult you.…
> Yet one wants to believe that somewhere there exists your native flock,
> in which people resemble you much more; one wants to believe that
> life might be different out there.… I think this was the secret of math
> schools. You suddenly found yourself in a different world, a world where
> people were interested in the same things as you were, a world where they
> loved solving problems and laughed at your jokes. It's difficult for me to
> decide what was more important there: the love for math or the desire to
> live in *your* own world, where you will be understood and appreciated.[148]

Echoing such sentiments, the Strugatsky brothers, writers of social satire
posing as science fiction, captured the self-image of math schoolers in their
1967 novel, *The Ugly Swans*.

Math Schoolers' Self-Image: *The Ugly Swans*

> Truth and lie, you two aren't so different:
> Yesterday's truth becomes today's lie,
> Yesterday's lie will turn tomorrow
> Into the purest truth, the common truth.[149]

The popular writer Viktor Banev, the main protagonist of *The Ugly Swans*,
hears these sarcastic words from a student in a rather mysterious futuristic
school. Banev considers himself a liberal thinker oppressed by an authoritarian
regime, but he finds out that the young people dismiss his views as a pack
of lies invoked to fight other lies. They value scientific knowledge far above
Banev's old-fashioned moralizing. The students clearly despise the ignorance,
narrow-mindedness, and naiveté of the townsfolk. They believe that the old
world, including both the oppressive government and its inept opponents
like Banev, is beyond redemption.

Banev is struck by the children's sophisticated speech, forceful intelligence,
and remarkable education. He learns that the school has unusual teachers,
the so-called *mokretsy*, or "soggy men," who have a genetic "eyeglass disease,"

[148] Natal´ia Simanovich, in *Zapiski o Vtoroi shkole* (http://ilib.mccme.ru/2/22-simonovich.htm).
[149] Arkadii Strugatskii and Boris Strugatskii, "Khromaia sud´ba," in *Sobranie sochinenii*, 11 vols. (St. Petersburg: Stalker, 2001), 8:303. In this edition, *The Ugly Swans* was reprinted as part of the novel *Limping Destiny*, as in the first Soviet edition (1986). Unless otherwise noted, all translations are mine.

manifested by yellow circles around their eyes. They feed on books and possess extraordinary scientific knowledge, easily controlling weather and producing constant rain. Isolated from the locals in a fortress-like Leprosorium, the "soggy men" do secret military research. Banev realizes that the children, along with their teachers, are men of the future, while the townspeople belong to the past. Eventually the children leave town to stay with the "soggy men" in the Leprosorium. Banev panics when he himself discovers symptoms of the "eyeglass disease" but is relieved to hear that those are just hives. He is a "beautiful duckling," someone who will never turn into an "ugly swan," a sickly "soggy man" of the future.

Eventually the children create a shiny new world, in which there is no place for the backward townsfolk. Banev appreciates the appeal of the new world but is repelled by its hyperrationality and lack of compassion and realizes that he belongs to the obsolete, yet somewhat humane, old world.[150]

As was typical of the Strugatskys, the novel, although set in an imaginary capitalist country, was filled with allusions to Soviet reality. The "eyeglass disease" was a clear reference to the stereotype of intelligentsia wearing glasses. The genetic origin of the disease hinted at the Jews. The Leprosorium shared elements with Soviet closed defense research institutions, whose employees' privileged status as military researchers gave them protection from daily hardships and allowed a certain degree of ideological laxity. The circumstances of Banev's life were suspiciously reminiscent of the Strugatskys' own situation: in March 1966, the Department of Agitation and Propaganda of the Party Central Committee prepared a report on Soviet science fiction, accusing the Strugatskys of "ideologically harmful influences, idealistic philosophical concepts, and pessimistic attitudes" and recommending public criticism of their works.[151] *The Ugly Swans*, in particular, became the first victim of this policy. After the publishing house refused the manuscript, it was circulated in samizdat and eventually smuggled to the West. Its publication in West Germany caused a renewed wave of attacks on the Strugatskys. They were forced to disavow the publication, and *The Ugly Swans* would not be published in the Soviet Union until perestroika.

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[150] For the English edition, see Arkady Strugatsky and Boris Strugatsky, *The Ugly Swans*, trans. Alice Stone Nakhimovsky and Alexander Nakhimovsky (New York: Macmillan, 1979). On the Strugatsky brothers, see Yvonne Howell, *Apocalyptic Realism: The Science Fiction of Arkady and Boris Strugatsky* (New York: Peter Lang, 1994); Irina Kaspe, "Smysl (chastnoi) zhizni, ili Pochemu my chitaem Strugatskikh?" *Novoe literaturnoe obozrenie*, no. 88 (2007) (http://magazines.russ.ru/nlo/2007/88/ka9.html); and Il´ia Kukulin, "Al´ternativnoe sotsial´noe proektirovanie v sovetskom obshchestve 1960–1970-kh godov," *Novoe literaturnoe obozrenie*, no. 88 (2007) (http://magazines.russ.ru/nlo/2007/88/ku8.html).

[151] Reprinted in *Znanie—sila*, no. 7 (1993): 95.

This novel marked the Strugatskys' turn from their earlier optimistic outlook toward a vision of the future filled with anxiety, uncertainty, and ambivalence. There was no question that future technologies would become more sophisticated and powerful, but it seemed that people of the future would face increasingly difficult ethical questions. The Strugatskys feared that an insurmountable gap would emerge between "us," their contemporaries, and "them," the advanced people of the future, whose ethics and notion of happiness might not square well with ours. It might be a brave new world, but not for us, the people of today. To capture this ambivalence, one might call this vision an "ambi-topia."

The questions raised by the Strugatskys had very specific origins in their contemporary society. Complementing the school curriculum with various cultural activities, teachers at leading specialized physics and math schools often invited popular writers or singer songwriters to meet with students. In September 1966, Boris Strugatsky was invited to speak to the students of Leningrad School no. 239. He received 70 questions from the audience of 200 students.[152] Three months later, in December 1966, his brother Arkady visited the Novosibirsk University Boarding School.[153] Both were struck by the students' intelligence and by the depth of their questions. Within a few months, the Strugatskys completed *The Ugly Swans*.

The scene in the novel where Banev comes to the school and meets extraordinary students borrowed multiple details from the authors' actual meetings in Leningrad and Novosibirsk. The question posed by Leningrad students, "What would you like us to be in the future?" was quoted verbatim in the novel.[154] Recalling that event, Boris wrote, "I was deeply shocked by that question and responded with a banality, just like [Banev]."[155] Like the students of the Novosibirsk Boarding School, their fictional counterparts were separated from their parents. As in Novosibirsk, key subjects in the novel were taught by scientists, not regular teachers. Like actual math schoolers, the Strugatskys' fictional students had "a very strange manner of speaking," as if someone "mockingly overlapped a kindergarten with a dispute in a science lab."[156] Boris wrote about Leningrad math schoolers as "intelligent, even though just ninth-graders."[157] In the novel, the Strugatskys described fictional

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[152] S. P. Bondarenko and V. M. Kuril´skii, eds., *Neizvestnye Strugatskie: Pis´ma. Rabochie dnevniki. 1963–1966 gg.* (Kiev: NKP, 2009), 579.

[153] Ibid., 613.

[154] Strugatskii, "Khromaia sud´ba," 297.

[155] Boris Strugatsky, offline interview with readers, 5 July 2000 (http://www.rusf.ru/abs/int_t26.htm).

[156] Strugatskii, "Khromaia sud´ba," 223, 306.

[157] Bondarenko and Kuril´skii, *Neizvestnye Strugatskie*, 579.

students as "pathologically intelligent children," who were "like adults, and not merely adults, but outstanding adults."[158]

Themes raised by the Strugatskys clearly resonated with math schoolers. A 1967 anonymous survey conducted by Boris at a Leningrad math school showed that the Strugatskys' fiction had the highest approval rating among Soviet sci-fi writers (72 percent, just behind Ray Bradbury and Stanisław Lem).[159] Once *The Ugly Swans* began circulating in samizdat, scenes and images from the book became reference points for math schoolers' self-image. To capture the sense of a math school as a special place, a graduate of Leningrad School no. 30 employed the same metaphor of never-ending rain used by the Strugatskys in *The Ugly Swans*. He thus described an inspiring teacher:

> Sometimes he walked along the hallway, slowly and carefully, in the halo of his beard and in a cloud of strange sensations of softness, fragility, and mystery. Sometimes a cloud could turn into a storm…. Could a storm cloud teach? Yes, if it pours down with rain. It was raining all the time during the two years that we studied in no. 30. Fully contradicting all physical laws, the rain destroyed the radioactive field that began behind the gates of the school and magically protected us.[160]

The Strugatskys were delighted to learn that their portrait of math schoolers was right on target. In October 1967, Boris wrote to his brother:

> Wunderkinds from the Leningrad University's specialized physics and math school circled and grabbed me. I gave them an audience and enjoyed it. You and I did a great job in *The Ugly Swans*! I was just like Banev. No, they did not attack me; instead, they looked up with admiration and reverence, but when they began, interrupting one another, to tell me about their life, and started—offhandedly!—dropping terms from group theory, axiomatic geometry, and theory of functions, I felt just like Banev…. There is a cult of the Strugatskys at the school. I was told, "Come at any time, to any lesson, but better incognito, or you'd be stampeded by three hundred students." … It was a very interesting meeting with our future.[161]

More generally, as Lipovetsky has noted, the Strugatskys captured the self-image of the technical intelligentsia in the character of a "progressor,"

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[158] Strugatskii, "Khromaia sud´ba," 300, 311.

[159] S. P. Bondarenko and V. M. Kuril´skii, eds., *Neizvestnye Strugatskie: Pis´ma. Rabochie dnevniki. 1967–1971 gg.* (Volgograd: PrinTerra-Dizain, 2013), 36.

[160] Berg, *Tridtsat´ let spustia* (http://mberg.net/tri_ob_shkola).

[161] Bondarenko and Kuril´skii, *Neizvestnye Strugatskie, 1967–1971 gg.*, 137.

a missionary to backward worlds with a civilizing duty, whether a teacher leading a close-knit group of disciples or a space traveler to distant planets.[162] The progressor image strongly resonated with math school instructors' sense of mission. An instructor from School no. 57 argued that he and other instructors tried to "save" math schoolers from the "absurdity" of Soviet life, from the "ideological infection," to "save" them for mathematics—"not for Soviet mathematics, but for Mathematics with a capital M." "My friends kept asking me, 'Why do you spend so much time in school? You should be working for your own cause.' But I told them, 'This is my cause.' In my view, we were raising a generation of free people."[163]

As Kukulin has argued, the progressor image fit into a broader vision of alternative social blueprinting elaborated by the Strugatskys, the philosopher Georgy Shchedrovitsky, and others—a vision for deliberate transformation of human nature, based on the intelligentsia myths "of self-definition in a totalitarian society and of that society's gradual transformation."[164] The "soggy men" in *The Ugly Swans*, according to Kukulin, represented innovative Soviet educators, who "believed that, by influencing the new generation, they could 'stake out' within the Soviet regime a space for a different kind of interpersonal relationships (deideologized, humanist, and responsible)."[165] In their later novels, however, the Strugatsky's attitude toward the figure of the progressor evolved—from the early adulation to the dispelling of the civilizing myth.

Making a Difference, Producing Distinction

The network of Soviet math schools was a hybrid created by multiple contradictory forces. The military-industrial complex wanted the education of highly qualified future specialists who would put math and science into the service of communism. Education officials wanted the development and testing of new, more advanced math programs. University officials wanted a preselected pool of talented applicants. Academics wanted to raise a new generation of scientists and mathematicians. Liberal intellectuals wanted to shield their children from the ideological and social pressures of Soviet society and to inculcate in them a different set of cultural values. Enthusiastic teachers wanted to create a social environment that would foster broad learning and

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[162] Lipovetsky, "Poetics of ITR Discourse."
[163] Vaintrob, interview by author, 2017.
[164] Il´ia Kukulin, "Alternative Social Blueprinting in Soviet Society of the 1960s and the 1970s, or Why Left-Wing Political Practices Have Not Caught on in Contemporary Russia," *Russian Studies in History* 49, 4 (2011): 54.
[165] Ibid., 62.

encourage self-realization. Math schoolers wanted to socialize with students who had similar interests and cultural background.

These forces worked in two directions: to separate the math schools from the rest of the Soviet educational system, and to create differences within the math school network. Most math schools proved an efficient vehicle for the selection and education of competent technical specialists. Their graduates loyally served the government, whether in Soviet or post-Soviet days. For example, Eugene Kaspersky, the founder of the Kaspersky Labs, a leading global cybersecurity company, graduated from the Moscow University Boarding School. On graduation, he was recruited by the Technical Faculty of the KGB Higher School, and later served as a software engineer for Soviet military intelligence.[166] The KGB Higher School tried to recruit from Moscow School no. 57 as well, but with much less success. The critical spirit at School no. 57 and a few other leading schools did not square well with the moral compromises required for successful advancement under the Soviet regime. Many students "despised those who intended to make a Soviet career. Maybe 'despised' is too strong a word, but this was definitely not encouraged," recalled a School no. 57 instructor.[167]

Like many other closely connected social groups, or "publics of *svoi*" (Yurchak's term), the math schoolers found a source of meanings aside from the official discourse. Mathematics for them came to symbolize an ideal world in which truth claims could be checked and publicly proved or disproved—something that the social world around them failed to do. "Many graduates would have wanted to carry the school with them, like a turtle's armor," recalled an alumnus of Leningrad School no. 30, "because they felt comfortable only in the world of its precise and logically comprehensible norms."[168]

Being neither insiders of the authoritative discourse (communist activists), nor outsiders (overt dissidents), most math schoolers might be called "asiders"—those staying "aside from" political activity—who limited their dissent to reading samizdat and listening to subversive songs, while dutifully studying for exams to enter Soviet institutions of higher learning. A graduate of Moscow School no. 7 recalled that the math school completely changed her values: "I came from a more or a less [loyal] Soviet family, and my mother said, 'Oh, that school, it made you anti-Soviet!' It never did, because they [at school] never said anything openly, but history, literature,

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[166] Biagioli and Lépinay, "Introduction," in *From Russia with Code*, 14; Loren Graham, *Lonely Ideas: Can Russia Compete?* (Cambridge, MA: MIT Press, 2013), 93–94.
[167] Vaintrob, interview by author, 2017.
[168] Berg, *Tridtsatʹ let spustia* (http://mberg.net/tri_agr).

everything was taught in a completely different way. We had a chance to forget more or less about the Soviet [regime]."[169]

Like many other groups of Soviet intellectuals, the social clustering of math schoolers fostered the sharing of both intellectual and cultural interests. For example, according to Yurchak, theoretical physicists similarly combined "collective research, intellectual excitement, cultural pursuits, and summer vacations," creating a relatively independent professional milieu.[170] A high degree of cultural homogeneity was characteristic of Soviet space engineers as well.[171]

Created under the banner of preparing technical cadres, leading math schools soon outgrew this purpose and turned into a niche for intelligentsia children, a vehicle for self-reproduction of this social group. A graduate of Moscow School no. 710 recalled:

> There were many people in math schools, my mates, who actually from the very beginning knew that they didn't want to be mathematicians, they didn't want to do math afterwards, and their parents knew that too. But still they insisted to stay there [in the math school]. Just because in Moscow at that time (probably in Leningrad there was a similar situation) it was one of the few opportunities just to be in a good school, in good environment, have very good teachers in all subjects, and just to have your kid in more or less "normal" environment, more or less separated from all of those peculiarities of Soviet reality.[172]

The "island of freedom" mentality of math schoolers fit well with the broader outlook of the Soviet technical intelligentsia, characterized by the "essentialization of culture" and the "tendency to binarize, simplify, and resist complexity," which, as Lipovetsky has argued, led to the intellectuals' double confrontation with the authorities and the "masses," and their self-image of exceptionalism.[173] While math schools made a difference in the lives of many talented students, who found a congenial milieu and were able to pursue their passion for mathematics and cultivate critical thinking, those schools also constantly produced distinction, in the sense of Bourdieu.[174] Math schoolers drew constant distinctions between inside and outside cultural values,

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[169] Itina, at "The Miracle of Soviet Mathematics."
[170] Yurchak, *Everything Was Forever*, 140.
[171] See Slava Gerovitch, *Soviet Space Mythologies: Public Images, Private Memories, and the Making of a Cultural Identity* (Pittsburgh: University of Pittsburgh Press, 2015), chap. 2.
[172] Mikhail Soloveitchik, at "The Miracle of Soviet Mathematics."
[173] Lipovetsky, "Poetics of ITR Discourse," 118.
[174] Pierre Bourdieu, *Distinction: A Social Critique of the Judgement of Taste*, trans. Richard Nice (Cambridge, MA: Harvard University Press, 1984).

between official discourse and "the truth," and between the logical coherence and beauty of mathematics and the absurdity and ugliness of the Soviet social and political world. The cultural capital acquired at the school created the sense of belonging to an intellectual elite, even if many did not aspire or were not allowed to join the actual Soviet elite. In the early post-Soviet period, when many former math schoolers took up leading positions in business and politics, this mentality produced a paradoxical combination of liberal rhetoric with ingrained support for elitism and anti-democratic trends. The schools that were called to raise the New Soviet Man, in effect, produced the New Post-Soviet Man.

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