
Creative Discomfort: The Culture of the Gelfand Seminar at Moscow University

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1 Memory

Israel Gelfand's weekly seminar at Moscow State University, which ran continuously from 1943 to 1989, has gained a legendary status in the Russian mathematics community. It has been praised as "maybe the greatest seminar in the history of the Mechanical-Mathematical Faculty of Moscow University,"¹ "probably the best seminar in the history of mathematics,"² and even "one of the most productive seminars in the history of science."³ According to seminar participants, the seminar "ardently followed all that was new in mathematics anywhere in the world"⁴ and "made a decisive impact on mathematical life in Moscow."⁵ Many outstanding mathematicians remember the seminar fondly as their crucial coming-of-age experience.

Before we conjure up an idyllic image of a harmonic chorus of great mathematicians conversing magnificently on topics of utmost scholarly importance, let us read a bit more from the memoirs of the same seminar participants. The seminar has

¹Tikhomirov (2008), p. 10.

²Interview with Aleksei Sosinskii, 20 October 2009 (http://polit.ru/article/2009/10/20/absossinsky_about_imgelfand/).

³Tikhomirov (2008), p. 25.

⁴Landis (2007), p. 69.

⁵Arnold (2009), p. 40.

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been described as “a kind of theater with a unique stage director playing the leading role in the performance and organizing the supporting cast,”⁶ “like one-man shows, sometimes successful, sometimes rough,”⁷ which “sometimes unfolded more like math improv.”⁸ The participants perceived it as a “surrealistic show,”⁹ which was “exciting but frightening.”¹⁰ They admitted that “Gelfand ignored niceties”¹¹; at the seminar, “speakers and participants were subjected to ruthless ridicule,”¹² sometimes reaching the proportions of “extreme inhumanity.”¹³

The notion of civility, ingrained in the scientific myth since the Scientific Revolution, is thus called into question. The mixture of admiration and revolt, evoked by the Gelfand seminar, cries for an explanation. Did the style of the seminar merely reflect the eccentric personality of its leader, or did it indicate some broader cultural patterns? Did the seminar thrive despite its offensive style, or was the style part of the enigma? How does today’s perspective of the memoirists differ from the contemporary perceptions of the seminar? To start answering these questions, we will place the Gelfand seminar in the social context of postwar Soviet mathematics.

2 A Parallel Infrastructure

In the postwar period, the Soviet mathematics community was increasingly subjected to serious administrative constraints and pressures, including discriminatory policies in university admissions, hiring, and publishing toward the “undesirables,” such as Jews and political dissidents; severe limitations on foreign travel; inflexible university curriculum; and even restricted physical access to research institutions and universities. The mathematics community countered these official policies by creating a parallel social infrastructure for mathematical instruction and research. Elements of this infrastructure included a network of specialized mathematical high schools; afterschool study groups for talented high school students (“mathematical circles”); informal educational organizations (e.g., People’s University, a.k.a. Jewish University); creative editorial policies, broadening the scope of some mathematical publications; the establishment of pure mathematics research groups under the auspices of applied mathematics, computational, and biological institutions; and the

⁶Gindikina (1993), p. xii.

⁷Vershik (2012), p. 37.

⁸<http://www.nytimes.com/2009/10/08/science/08gelfand.html>.

⁹Nikita Nekrasov, “Not Exactly Crazy, Simply Beautiful,” (<http://www.math.rutgers.edu/~rwilson/gelfand-memorial-nekrasov.pdf>).

¹⁰Shiryaev (2009), p. 101.

¹¹Landis (2007), p. 69.

¹²Vladimir Retakh, “Ob Izraile Moiseeviche Gel’fande,” 21 December 2009 (<http://www.mccme.ru/gelfand/retakh1.htm>).

¹³Arnold (2009), p. 40.

practice of discussing mathematics outside of formal institutions—in private apartments, at summer dachas, or during nature walks.¹⁴

A key role in these efforts was played by open seminars on advanced mathematical topics, usually held at Moscow University. Open to all—from talented high school students to scholars barred from official institutions—such seminars fostered inter-generational and cross-institutional ties, and created a sense of unity in a community crudely divided by administrative barriers. The largest, most famous, and most prestigious of these open seminars was the seminar of Israel Gelfand.

3 Gelfand

An autodidact who did not finish high school, Gelfand (1913–2009) blazed a unique path in mathematics and in the Soviet academic environment. In 1932, having no high school or university diploma, he was able to impress the leading Soviet mathematician Andrei Kolmogorov so powerfully that he was admitted directly to graduate school. Soon Gelfand was teaching at Moscow University, and in 1943 started his seminar, initially devoted solely to his interest in functional analysis.¹⁵

In the postwar years, Gelfand contributed to the Soviet hydrogen bomb project, securing a powerful position as head of Heat Transfer Department at the Institute of Applied Mathematics of the Soviet Academy of Sciences. In 1953, after a successful test of the hydrogen bomb, he was elected a corresponding member of the Academy of Sciences, joining the Soviet scientific elite. Barred by administrative regulations from taking a faculty position at Moscow University, Gelfand was listed there as an adjunct lecturer, and used this tenuous affiliation to legitimize the continued operation of his weekly seminar.

As the range of Gelfand's own mathematical interests expanded, so did the scope of his seminar, which aimed to catch up with booming new fields, such as algebraic geometry and representation theory.¹⁶ Over the years, Gelfand made major contributions to Banach algebra theory, the theory of group representations, distribution theory and measures on infinite-dimensional spaces, ordinary differential equations, calculus of variations and soliton theory, integral geometry, the theory of general hypergeometric functions, and many other areas. He supervised dozens of doctoral students and collaborated with numerous co-authors in all these fields. All of Gelfand's 445 mathematical research papers and monographs, with few exceptions, were written with co-authors.¹⁷

¹⁴See Gerovitch (2013).

¹⁵On the early years of the seminar, see Vishik and Shilov (1958).

¹⁶The longterm seminar participant Mikhail Shubin took careful handwritten notes of the seminar proceedings for 25 years, 1964–1989. The Clay Mathematics Institute has made these notes available online (<http://www.claymath.org/publications/notes-talks-imgelfand-seminar>).

¹⁷“I.M. Gelfand's Publications—Extracted from Math Reviews” (<http://www.math.rutgers.edu/~sontag/gelfand-publics.pdf>).

In parallel with his main mathematical seminar, indefatigable Gelfand also organized a physiology seminar, a biology seminar, a specialized mathematical school, and a correspondence math program for school students across the Soviet Union. He established a laboratory for mathematical methods in biology at Moscow University, and hired many “undesirables.”

By 1967, Gelfand garnered enough influence to obtain permission to launch a new mathematical journal, *Functional Analysis and Its Applications*, and became its editor-in-chief. He interpreted the word “applications” in the title very broadly, welcoming papers in many different fields, including articles that could not be published elsewhere because of discriminatory policies of other journals toward the “undesirables.”¹⁸

In 1968, along with nearly 100 other mathematicians, Gelfand signed an open letter to the Soviet authorities, protesting against the forced hospitalization of the mathematician and political dissident Aleksandr Esenin-Volpin in a psychiatric facility.¹⁹ The authorities lashed back at the mathematics community, replacing the leadership of the Mechanical-Mathematical Faculty of Moscow University with Communist Party loyalists, barring the signers from foreign travel, and inflicting all sorts of other administrative punishments, big and small.

Despite the administrative restrictions, the Gelfand seminar in this period gained even greater popularity, and the network of his collaborations grew. Gelfand became the most cited mathematician in the world in 1978–79.²⁰ In 1978 he shared the first Wolf Prize in Mathematics, which the committee members decided to award to “the greatest living mathematician.”²¹

The activity of the Gelfand seminar at Moscow University declined when he moved to the United States in 1989. Gelfand continued holding weekly meetings at Rutgers University, where he taught after 1991, and pursued active research collaborations with mathematicians and biologists until his death in 2009 at the age of 96.

4 Space

The Gelfand seminar constituted an unusual semi-public, semi-private social space. It was not limited by any institutional affiliation and was attended by a wide range of practicing mathematicians, both from inside Moscow University and from

¹⁸When asked if an article fitted the subject of the journal, Gelfand reportedly replied, “A good article always fits the subject”; Kirillov (2003), p. 294.

¹⁹See “‘Pis'mo 99' v zashchitu A. S. Esenina-Vol'pina” (<http://www.math.ru/history/p99/index.htm>). The authorities suspected that Gelfand might be the initiator of the letter, and he feared an arrest; see recollections by Dmitry B. Fuchs (http://www.math.rutgers.edu/~rwilson/gelfand_fuchs.pdf). In fact, the letter was authored by the poet and dissident Iurii Aikhenval'd.

²⁰Garfield (1982).

²¹Lax (2013), p. 47.

outside, including independent scholars. As Gelfand liked to put it, his seminar was intended for ordinary “high school students, decent undergraduates, bright graduates, and outstanding professors.”²² Indeed, all these categories of people attended the seminar and engaged in discussion.

The seminar was held on the 14th floor of the main building of Moscow University, in Room 1408. Although the seminar was open to everyone, the Moscow University building was not. Fences and security guards blocked access to the university for any unaffiliated persons. In order to attend the seminar, mathematicians had to invent creative ways of circumventing the guards. Effective strategies included: presumption (busily walking through with an indifferent air), substitution (flashing a similarly-looking ID card from another institution), and brute force (plainly climbing the fence). One especially challenging method, suitable only for physically fit visitors, was to run through the guard booth and up the stairs. Experience showed that guards usually lacked the strength or motivation to run up to the 14th floor. The audience of the seminar was thus self-selected for creativity.

Regular seminar goers had their permanent seats. In the front row on the right, sat the most seasoned members of the Gelfand school; on the left—brilliant young mathematicians. In the second row on the left usually sat a high school student assigned the role of “designated listener.” At one time, this role was played by Maxim Kontsevich, a future Fields Medal laureate (1998). Gelfand liked to have people in their regular seats, carefully scanning the room for newcomers. If a seminar participant insisted on changing seats, Gelfand would reluctantly yield, remarking sarcastically, “You can sit even on the epidiascope, if you’d like.”²³

Room 1408 had 12 rows of benches with 11 seats in each row, plus a few extra chairs—fewer than 150 seats in total. Remarkably, memoirists often claimed that 200 or even 300 people attended the seminar.²⁴ Apparently the importance of the seminar translated in their memory into inflated figures of attendance.

5 Time

The seminar met every Monday night. Curiously, memoirists do not agree on the official starting time of the seminar: some say 6 pm, some 7 pm, some 7:15 pm, which is a bit unusual for mathematicians accustomed to clarity and

²²Retakh (2013), p. 26. For another version of this formula, ascribed to Gelfand, see Kirillov (2003), p. 293.

²³Anosov (2008), p. 101.

²⁴One participant put the seminar attendance at around 200; see Mikhail Verbitsky, Interview on Radio Liberty, 12 July 2005 (<http://archive.svoboda.org/programs/tw/2005/tw.071205.asp>); another claimed 200–300 participants; see “IPMU Interview with Maxim Kontsevich,” *IPMU News*, no. 4 (December 2008): 16.

precision.²⁵ They universally agree, however, that “the seminar never started or ended on time,” whatever that time was.²⁶ The seminar really started when Gelfand walked into the room, and he usually arrived with a delay, sometimes up to 2 h.²⁷ As soon as he came in, the doors closed. Because of the unpredictability of Gelfand’s appearance, the participants had to come early, and they talked mathematics among themselves, patiently awaiting his sudden arrival.

Seminar participants felt that the delays were “intentional”; Gelfand did it “on purpose”; it was “part of the scenario.”²⁸ The seminar attracted mathematicians from all over Moscow and often from other cities, and the hours between the announced opening of the seminar and its actual beginning turned into regular social gatherings of mathematicians, a mathematical club of sorts, where the most recent results and new ideas were informally discussed. This delay tactic, whether consciously employed or resulting from Gelfand’s idiosyncratic ways, effectively turned the seminar into a major communication hub. “People gathered at the blackboard and wrote formulas or walked back and forth in the hall and talked,” recalls one of the participants.²⁹ “A typical Russian formation—two people are discussing mathematics and slowly walk down the corridor, turn around, and slowly walk back,” recalled an American visitor.³⁰

The seminar did not merely ignore the division between university and non-university mathematicians; it practically forced them to socialize. By manipulating time, the Gelfand seminar created a social space lying outside the official institutional hierarchy of Soviet mathematics.

The ending of the seminar was as uncertain as its beginning. It would run until 11 pm or even later. The main factor usually limiting the length of the seminar was the appearance of a lady with a broom, wishing to clean the premises. Eventually forced out of the room, mathematicians continued discussion in the hall and on the stairs, gradually making their way down the 14th floor, as the elevators were usually shut down at such a late hour. Further complications were posed by locked exits on

²⁵According to Simon Gindikin, the official starting time was 6 pm; Gindikin (1993), p. xiii. Andrei Zelevinsky wrote that “the official starting time of the seminar was 7 pm (or was it 6:30?)”; Zelevinsky (2013), p. 48. Ilya Piatetski-Shapiro cautiously mentions “6 or 7 pm”; Piatetski-Shapiro (2007), p. 209. Aleksei Sossinskii quotes 7:15 pm; Interview with Aleksei Sossinskii. Robert MacPherson has remarked that the seminar formally started at 7 pm, but people began gathering around 6 pm, while Gelfand would actually start the seminar around 8 pm; Video interview with Robert D. MacPherson, 12 May 2011 (http://simonsfoundation.org/science_lives_video/robert-d-macpherson/).

²⁶Piatetski-Shapiro (2007), p. 209.

²⁷Zelevinsky (2013), p. 48.

²⁸“[I]ntentional”: Vasiliev (2008), p. 371 (on Gelfand’s biology seminar, which was run in a similar format); “on purpose”: Zelevinsky (2013), p. 48; “part of the scenario”: Gindikin (1993), p. xiii.

²⁹Aleksei Sossinskii calls it Mekhmat Club, referring to the Moscow University’s Faculty of Mechanics and Mathematics; see Interview with Sossinskii. Many seminar participants, however, came from outside the university.

³⁰Video interview with MacPherson.

the ground floor and by the end of bus and subway service late at night. A large group of students usually followed Gelfand after the seminar, waiting for their turn to discuss their work. Gelfand often took the last subway train home, and the last students in line, who accompanied him to his apartment door, then had to walk back home across Moscow.

One memoirist explicitly contrasted this feature of the Gelfand seminar with the rigid rules of mathematical meetings in the United States. Such meetings always end on time, even if this interrupts the proceedings in the middle of discussion.³¹ In Gelfand's world, nothing could take precedence over mathematics—neither administrative rules, nor family obligations, nor even physiological needs. Seminar participants stayed in the room for 3–5 h without a break. Visiting a restroom meant standing up and passing Gelfand on the way to the front door, and few people dared to risk that.³²

6 A Stock Exchange of Ideas

To newcomers, the seminar proceedings looked totally chaotic. At the end of each seminar, Gelfand usually announced the speaker for the next session. It was typical, however, to switch the speakers right before the seminar. A running joke among seminar participants was, “You never know what is going to happen at the seminar. It is certain, however, what is not going to happen. The announced speaker is not going to speak.”³³ If Gelfand heard a new fascinating idea or met a new promising mathematician during the week preceding the seminar, he would quickly change gears and engage a new speaker. It seemed as if he tried to make sure that every session of the seminar was devoted to the very latest and greatest in mathematical developments, even if he learned about such a development only on his way to the seminar. Foreign visitors and Soviet mathematicians returning from foreign trips were immediately asked to present at the seminar on the latest research trends. The unpredictable, chaotic trajectory of seminar proceedings might in effect be seen as a strategy to cover, perhaps, haphazardly, as wide an area of mathematics as possible, achieving some kind of universality, if not through a systematic approach, then perhaps by random walk.

These unpredictable forays into many different fields created an impression that the seminar covered “all of mathematics.”³⁴ A regular participant recalled, “It was Gelfand's intention to understand mathematics as a whole; no problem in mathematics was irrelevant to his seminar.”³⁵ Gelfand's agenda, moreover, was to tie it all together into a single vision. His close disciple has argued, for example, that the richness of research in representation theory, which “combines analysis, algebra,

³¹Ilya Zakharevich, interview by the author, Cambridge, Mass., May 19, 2012.

³²Interview with Sosinskii.

³³Rephrased from Vladimir Retakh, quoted in Kenneth Chang, “Israel Gelfand.”

³⁴Tikhomirov (2008), p. 10.

³⁵Piatetski-Shapiro (2007), p. 209.

and topology,” owes much to Gelfand’s “unique way of seeing mathematics as a unity of different points of view.”³⁶

One of Gelfand’s students called the seminar a “mathematical stock exchange.”³⁷ The seminar served this function in more than one sense—as a venue of exchange of ideas, as a forum for determining their true value, as a quotation board displaying calls for the supply and demand of concepts, conjectures, and proof techniques, and as a way to connect and balance various sectors of the mathematical economy.

7 Turbulent Flow

Although the seminar was public, Gelfand’s idiosyncratic style made it essentially a semi-private affair, an informal gathering that broke conventional social hierarchies and accepted rules of academic discourse. The seminar created a tense and thrilling environment, in which reputations were made and destroyed, and insights mixed with insults.

The unpredictability of the course of seminar did not end with the choice of the initial speaker. As one participant put it, “An important feature were improvisations of various kinds. The course of the seminar could change dramatically at any moment.”³⁸ Indeed, if the latest and greatest idea turned out to be disappointing or the speaker could not handle the pressure, Gelfand could curtly dismiss the speaker and call one of the participants to the front to continue the talk, or he might switch the topic altogether.

The flow of talks at the seminar resembled kayaking through the rapids. Gelfand’s hallmark behavior was to interrupt the speaker constantly. Few presenters could get several sentences out before being interrupted with a question. Gelfand often injected comments far exceeding in length the meager part of the prepared presentation that the speaker managed to deliver. In the end, Gelfand usually completely took over and replaced the speaker at the blackboard, explaining to the audience and to the speaker what was the “correct way” of speaking about the discussed topic. Gelfand practically always ended up speaking longer than any speaker at his seminar. One speaker even timed how long he managed to speak, compared to Gelfand. It turned out, out of a two-hour seminar, the speaker had 10 min, and Gelfand took up the rest.³⁹ He listened only as long as was needed for him to grasp the essence of the talk. Once he did that, the speaker became superfluous. Gelfand picked up the train of thought and directed it where he, not the speaker, wanted to go.

³⁶Kazhdan (2013), p. 29.

³⁷Retakh, (2013), p. 25.

³⁸Gindikin (1993), p. xiii.

³⁹Landis (2007), p. 69.

Some seminar attendants were highly irritated by this manner, for they rarely had an opportunity to hear what the speaker actually had to say. They usually stopped going to the seminar. Others found value in this free-style, unpredictable flow of conversation, and decided that “such a great learning experience was worth a little suffering.”⁴⁰ Gelfand’s improvised remarks often cut to the core of the matter more directly than the speaker’s carefully prepared guided tour. The jagged course of discussion, with numerous interruptions, clashes between Gelfand and the speaker, frequent questions from the audience, and dramatic calls of seminar members to the front to prove a statement or to reformulate an obscure point made a fascinating show, if somewhat unsafe for the viewer who could be called to the front at any time as well.

This strategy, however painful for the speaker, had a remarkable effect. Unlike other seminars, in which the speakers were allowed to drone on indefinitely and without interruption, putting the audience into a half-asleep mode, the Gelfand seminar captivated the audience and kept everyone on edge all the time, forcing seminar participants to focus and grasp the meaning of discussion.

The so-called “Zeigarnik Effect,” discovered by the Soviet experimental psychologist Bluma Zeigarnik in 1927, was perhaps at work here. According to her study, people remembered interrupted tasks better than completed tasks.⁴¹ Gelfand’s interruptions etched key points in participants’ memory, reinforcing intellectual impressions with an emotional impact.

Abrupt changes of speakers and sudden turns in discussion created a living experience of mathematics—not as an orderly, planned activity, but as an exciting pursuit, fraught with danger, serendipity, and discovery. By interrupting the speaker, Gelfand repeatedly broke accepted rules of academic behavior, emphasizing that his seminar was a special place where general norms did not apply. He frequently told jokes, sometimes rather risky ones, further breaking the boundary between academic and non-academic discourse. His seminar was a semi-private space ruled by playfulness and intellectual sniping, in which the regular rules of civil academic discourse did not apply.

8 Organized Skepticism

Mathematical seminars are usually designed to create the most comfortable conditions for the speaker, while making understanding an individual responsibility of each listener. Gelfand, by contrast, insisted on the total engagement of all participants in the understanding of talks, often at the expense of both the speaker and the audience.

The seminar was a tough ordeal for the speaker. On one occasion, Gelfand reportedly “interrupted [the speaker] many times, told him that he wasn’t a good lecturer, and that his results were neither interesting nor meaningful. After several

⁴⁰Zelevinsky (2013), p. 48.

⁴¹Denmark (1994), p. 593.

hours of torture [the speaker] became tearful.”⁴² Even Gelfand’s closest associates admit that he was not, to put it mildly, “the most delicate, polite person in the world.”⁴³ He spoke with bluntness blending into rudeness. Participants recall Gelfand’s “active and sometimes aggressive questioning” and open expressions of displeasure.⁴⁴ Members of Gelfand’s biology seminar, similar in style to the math seminar, reported “sarcastic and rude humor of Gelfand, endless repetitions and questions, sometimes slashing criticism, etc.”⁴⁵ “[P]articipation in the seminar was difficult, and often offensive,” they confessed.⁴⁶ If a harassed speaker lost the train of thought, Gelfand immediately addressed the audience, “Can anyone explain what this rubbish is about? I understand nothing. No, I’ll try to set it forth myself.”⁴⁷

Gelfand was particularly impatient with speakers who beautified their talks and glossed over difficult and rough points. He immediately interrupted them with a joke about memoirs written by a Leningrad actor: “He sent his manuscript to a friend in Moscow with a note saying, ‘I send you my memoirs. [I] hope, you will see yourself what is true and what is my talent [for invention]!’ ‘I think,’ said Gelfand, ‘we face a similar problem with your attempts to make the presentation more attractive. If I need something attractive, I visit cinema!’” In his view, if someone attempted to make a concept more attractive, then one “sinned against the truth.”⁴⁸

Audience members could barely feel any safer than the speaker. Gelfand could easily call any attendee to the front of the room and ask to restate some of the things said. Those unwilling could be asked whether they came to participate or to be a piece of furniture.⁴⁹ If a member of the audience asked a question that seemed trivial to Gelfand, he immediately snapped, “Don’t answer! Our seminar is for a competent audience.”⁵⁰ Everyone was forced to think intensely about the matters discussed and be ready to explain them in their own words. Gelfand especially liked it when a junior member of the audience explained an idea more cogently and lucidly than the speaker, and never missed a chance to point this out. On one occasion, Gelfand interrupted a talk, told the speaker that his approach was

⁴²Tanya Khovanova, “The Designated Listener,” 19 November 2008 (<http://blog.tanyakhovanova.com/?p=76>).

⁴³Zelevinsky, quoted in Chang, “Israel Gelfand.”

⁴⁴Vershik (2012), p. 34.

⁴⁵Vasiliev (2008), p. 372.

⁴⁶Abelev (1995), p. 32.

⁴⁷Vorob’ev (2008), p. 375.

⁴⁸Skulachev (2008), p. 380.

⁴⁹One young seminar participant at one point was jokingly promoted from “furniture” to “participant” status; see E. B. Dynkin, “Gelfand’s impact at the beginning of my mathematical life (1940–1944),” 1 December 2009 (<http://www.math.rutgers.edu/~rwilson/gelfand-memorial-dynkin.pdf>). Gelfand used similar “furniture” terminology at his seminar on biology and medicine, which reproduced the style of his mathematical seminar; see Malinetskii (2004).

⁵⁰Tikhomirov (2008), p. 26.

completely wrong, and asked a high school student in the audience to give a talk on this topic, with the right approach, at the next session of the seminar. (A few outstanding high school students regularly attended the seminar.) The speaker was publicly humiliated; it looked like he did not understand his own field and could not master techniques accessible to a high school student.⁵¹ Gelfand deliberately sacrificed the comfort and sometimes the dignity of the speaker to the task of achieving collective understanding.

As a result, the seminar audience learned to accept no claim merely on the authority of the speaker, cultivating well-organized skepticism on a scale that might be excessive even for Robert Merton's idealized norms of the scientific community. Neither high administrative position, nor previous reputation shielded any speaker from radical questioning. The only safe position was that of Gelfand himself, the chief interrogator.

Gelfand deliberately upset established social hierarchies, often pitting junior listeners against senior speakers. He thus made his seminar a place where only intellectual expertise counted, and mathematicians of different social status discussed problems on an equal footing. Junior scholars learned that one did not have to be a senior scholar to make discoveries. The Gelfand seminar attracted young talent not only because of its mathematical insights, but also because it offered participation in a closely knit community, which had its own internal mechanisms for establishing a scholarly reputation, independent of one's status in the Soviet institutional hierarchy.

9 An Omni-Ignorant God

Gelfand said that college freshmen should study mathematics not as it is today, but as it will be in ten years, to make it relevant to the needs of cutting-edge research at that time.⁵² Therefore, unlike other math seminars at Moscow University, which took a systematic approach, gradually introducing seminar participants to an advanced topic, the Gelfand seminar moved at breakneck speed. Speakers presented their latest research in a wide variety of fields, for which the audience could hardly have possessed adequate background. Each seminar, therefore, was a lesson in mastering key ideas in an unfamiliar field. To describe his approach, Gelfand often used the metaphor of running after a trolley car. Going step-by-step, he believed, one would never catch a moving trolley car. In order to jump into a moving trolley car, one has to run a bit ahead of the door, and his seminar fulfilled precisely this

⁵¹Interview with Sosinskii. On another occasion, when a speaker stated a new result, Gelfand immediately called a graduate student to the blackboard and ordered to prove it, thus demonstrating that the result was rather trivial. "Should I feel offended? Of course, not," philosophically remarked the speaker later; see Vershik (2012), p. 37.

⁵²Andrei V. Alekseevskii, quoted in "Matematik – tot, kto ponimaet," *Troitskii variant*, no. 45 (19 January 2010): 4 (<http://trv-science.ru/2010/01/19/matematik-tot-kto-ponimaet/>).

purpose. Students were deliberately invited to attend talks that were well above their heads and were motivated to find their way in the wealth of new material.⁵³

To foster collective understanding, Gelfand used several techniques, perhaps drawing on his considerable acting skills.⁵⁴ One such technique was feigned incomprehension. There are mathematicians famous for their ability to quickly understand the most complex mathematical argument. Gelfand was famous for his incredible skill of *non-understanding*. He frequently declared his lack of comprehension of the speaker's argument, interrupting the speaker with pretended modesty, "May I ask a stupid question?" Once Yuri Manin, a mathematician of the highest caliber and a well-known wit, immediately retorted, "No, [Israel Moiseevich], I don't think you are capable of such a thing!"⁵⁵ A seminar participant recalled that Gelfand "had the faculty of being 'unable to understand' in situations when everyone around was sure that everything is clear. What extraordinary vistas were opened to the listeners, and sometimes even to the mathematician giving the talk, by this ability not to understand." One of Gelfand's favorite jokes was about a math professor who says, "I have such stupid students: I explained them the proof five times, I finally understood it myself, and they still don't get it!"⁵⁶

What looked like a one-man show was in effect a lesson in understanding. In the words of a seminar participant, "Gelfand had chosen the hardest and most dangerous genre: to demonstrate in public how he understood mathematics."⁵⁷ One of Gelfand's collaborators recalled, "I was struck by Gelfand's virtuoso ability NOT to understand what someone tried to explain to him. Gradually the interlocutor realized that it was he, the interlocutor, who lacked understanding, while Gelfand's 'lack of understanding' precisely clarified the subject of discussion. Gelfand taught not to hurry; he taught to separate the essential from the non-essential, the important from the non-important."⁵⁸ Gelfand's student described the "non-linearity" of his thinking as "one of the many features that made his seminar so unique. He would spend an inordinate amount of time asking everybody to explain to him some basic definitions and facts, and just when most of the participants (starting with the speaker, of course) would get totally frustrated, [Gelfand] would suddenly switch gears and say something very illuminating, making it all worthwhile."⁵⁹

⁵³Verbitsky, Interview on Radio Liberty.

⁵⁴An American colleague recalled, "Gelfand gave a long discourse ... on Stanislavski. Apparently method acting was one of Gelfand's many artistic interests"; Kostant (2013), p. 39.

⁵⁵Zelevinsky (2013), p. 48.

⁵⁶Gindikin (1993), p. xiii.

⁵⁷Gindikin (1993), p. xii.

⁵⁸Grigorii L. Rybnikov, quoted in "Matematik s bol'shoi bukvy," *Troitskii variant*, no. 39 (13 October 2009): 10 (<http://trv-science.ru/2009/10/13/matematik-s-bolshojj-bukvy/>).

⁵⁹Zelevinsky (2013), p. 48.

Gelfand had a peculiar way of gauging the level of the audience's understanding. At the start of the seminar, he usually picked one listener, often a gifted high school student, to serve as a "trial listener."⁶⁰ One such listener, a young woman, later recalled: "This is how it works. The speaker starts his lecture and Gelfand interrupts him. He then turns to me and asks if I understand what the speaker just said. If I say 'no,' he says that I am a fool. If I say 'yes,' he invites me to the blackboard to explain. Usually, Gelfand finds some fault in my explanation and calls me a fool anyway. As a result, whatever I do, I end up as a fool."⁶¹ This could be another of Gelfand's stratagems: if he felt that the speaker was not getting a point across, he used a "trial listener" to initiate a discussion in which the obscure point would be clarified, and collective understanding sustained. A perceptive "trial listener" could usually feel it when Gelfand wanted an interruption and would loudly announce the lack of understanding and the need for clarification.⁶² For Gelfand, hurting the egos of the speaker and of the "trial listener" was collateral damage. "Keep your work and your self-esteem separate," he liked to say.⁶³

The young woman who felt so frustrated in the role of a "trial listener," ironically, "admired Gelfand for the way he conducted his seminars." "I went to so many [other] seminars where it was clear that no one understood anything," she recalled. "He was the only professor I knew who made sure that at least one person at his seminar—himself—understood everything."⁶⁴

Instead of starting with the Soviet cliché of an omniscient leader, Gelfand deliberately set himself up as an ostensibly slow thinker—if not a village idiot, then perhaps a shtetl simpleton. This was done, of course, in jest, and Gelfand enjoyed the dramatic effect of turning around and announcing "the truth" (the right approach to the problem), which he surely possessed all along, and just patiently waited for the speaker and the audience to prove their collective inability to find it.

For those who, despite all the effort, still could not follow very advanced talks, Gelfand had a word of consolation. "You won't understand anything of this talk, but it will be very important to you," he told one American student.⁶⁵ Seminar participants often reported that only years later they realized the importance of seminal ideas casually overheard at the seminar. More important than specific mathematical facts were general things they learned at the seminar—the ability to make connections across different fields, the habit of focusing on the simplest example that captures a phenomenon, and the skill to find the most appropriate language to formulate a problem. The style of Gelfand's thinking gradually shaped their vision of mathematics.

⁶⁰The Russian term "kontrol'nyi slushatel'" is also often translated as "control listener" or "designated listener."

⁶¹Tanya Khovanova, "The Designated Listener," 19 November 2008 (<http://blog.tanyakhovanova.com/?p=76>).

⁶²Gindikin (1993), p. xiii.

⁶³Vershik (2012), pp. 34–35.

⁶⁴Khovanova, "The Designated Listener."

⁶⁵https://golem.ph.utexas.edu/category/2006/10/categorified_gelfandnaimark_th.html.

10 Others

Besides Gelfand's seminar, several other open seminars played a prominent role in the parallel social infrastructure of Soviet mathematics. Each was centered around the figure of its leader, an outstanding mathematician, whose personality made a decisive impact on the character of his seminar. Vladimir Arnold, Yuri Manin, and Sergei Novikov in Moscow, and Vladimir Rokhlin in Leningrad educated large cohorts of brilliant disciples through their continuously run weekly seminars. Some of the features of their seminars were very similar to Gelfand's: the focus on cutting-edge research, the openness to students and researchers from outside the University, and the formation of a research school around the social hub of the seminar. Seminars often produced animated discussions, which prompted one Italian visitor to Moscow University to remark that "these seminars reminded him of political meetings at the University of Rome, while, conversely, [Soviet] political meetings reminded him of dreadfully boring scientific seminars in Rome."⁶⁶ Yet the widest coverage and the unusual style set the Gelfand seminar apart.

In terms of the rough treatment of the speakers and the audience, the Gelfand seminar had no rival. One memoirist described a typical math seminar at Moscow University as "democratic," where "all participants had equal say." This idealized image was constructed, perhaps, in contrast to the style of the Gelfand seminar, which struck this memoirist as "strange."⁶⁷ Gelfand's blunt manner of speech has been compared to the irreverent demeanor of the famous physicist Lev Landau, whom Gelfand respected highly and whose seminar he attended and perhaps even imitated.⁶⁸ According to some accounts, the blunt and offensive manner of speech was quite widespread at the Faculty of Mathematics and Mechanics. Instructors often ridiculed students' errors or lack of understanding, calling them "an ass or even worse." This came to be known as the "Landau-Gelfand style."⁶⁹ This presumably happened during classes and oral exams, but rarely seeped into the more refined environment of research seminars. From the point of view of style, the Gelfand seminar seemed to be an exception.

In terms of purpose and focus, it would be instructive to contrast the Gelfand seminar with two other prominent Moscow University seminars, those of Manin and Arnold. Manin ran a seminar which for several years focused narrowly on a single topic; then, as Manin's research interests shifted, the topic of the seminar changed as well. Like Gelfand, Manin covered a wide range of mathematical fields, from number theory to algebraic geometry to mathematical physics. Yet Manin's seminar focused on these fields in sequence, rather than in parallel. Manin's seminar never aspired to cover "all of mathematics" or to make it easily digestible for

⁶⁶Minlos (2007), p. 46.

⁶⁷Landis (2007), p. 69.

⁶⁸Vershik (2012), p. 37.

⁶⁹Pakhomov (2009), p. 54.

the audience. Members of his seminar had to develop significant technical skill in order to master the material of the seminar, unlike Gelfand's approach that emphasized conceptual understanding, rather than technical dexterity. This made the Gelfand seminar more appealing as an entry point for budding mathematicians.

Arnold started his seminar in 1966, after finishing a postdoctoral study in Paris, where he attended René Thom's seminar on singularity theory. Unlike Gelfand's, Arnold's seminar had a regular time slot, 4–6 pm on Tuesdays. The seminar focused on his own research interests, dynamical systems and singularities, and Arnold chose a specific research topic every year.⁷⁰ At the beginning of the academic year, he posed a set of new problems for seminar participants, which they worked on for the rest of the year.⁷¹ Only permanent seminar members had the privilege of occasionally giving talks on unrelated topics.⁷² An ardent foe of excessive formalization in mathematics, Arnold was fond of tangible concepts and lively illustrative examples. Arnold is said to have "insisted that every word of every talk be clear to everybody in the audience."⁷³ Although this description is obviously exaggerated, it suggests that Arnold did attach exceptional importance to clarity and ease of understanding, in contrast to the style of other seminars. This understanding, however, had a specific goal—to aid a collective research effort subordinated to his singular vision. Arnold remained "the only person in his seminar who would keep in mind everyone else's works-in-progress and understand their relationships."⁷⁴ Unlike Manin, who gave his students a lot of freedom, Arnold more tightly controlled the research agenda of his students.

Both Manin and Arnold had charismatic personalities, but the attitude toward them was very different from the attitude toward Gelfand. Arnold's students worshipped him and followed his lead. Manin's students noted his "agreeable personality"⁷⁵ and regarded him as a sage who answered their questions but never assigned them problems to work on. Gelfand's students, curiously, were both terrified of him and liked telling funny jokes about him. Too often, however, they became dependent on their mentor, both administratively (he gave them jobs) and intellectually (he often imposed his way of thinking on them). Some of his students were able to overcome this dependency and became outstanding mathematicians in their own right. Others remained reliant on Gelfand's leadership. In this sense, although Gelfand did create an alternative social environment, his relations with his students in some ways replicated the Soviet pattern of subordination. At the same time, however, Gelfand himself was dependent on his disciples, as he did all of his research collaboratively.

⁷⁰Khovanskii and Varchenko (2012), p. 393.

⁷¹Givental (2012), p. 383.

⁷²Fuchs (2012), p. 484.

⁷³Ibid., p. 483.

⁷⁴Givental (2012), p. 383.

⁷⁵Ginzburg et al. (2002).

Gelfand constantly expanded his research scope and was on a lookout for new, promising young mathematicians to fill vacant slots in his informal research teams. Some unusual features of his seminar stemmed from the fact that the seminar served as an effective recruitment tool for his school. Gelfand believed that he could awaken mathematical abilities in anyone and took delight in making people understand mathematics better, whether they were seasoned math professionals or just talented high school students. He once told his collaborator, “Do you know how I differ from Arnold and Manin? They are like sports coaches: their work only with stellar students, and I am like a physical education teacher.”⁷⁶

The scope of most seminars was limited by the range of research interests of their leaders, and none aspired to the wide coverage of the Gelfand seminar. The seminars of Arnold and Manin were largely the gatherings of their research schools, while the Gelfand seminar had a much wider audience. Although Gelfand might have viewed his seminar partly as a recruitment tool for his school, the social infrastructure that he created acquired a purpose and significance of its own. His seminar transcended the boundaries of his school and became an institution. In order to maintain his seminar’s status as the leading gathering of Moscow mathematicians, Gelfand had to appeal to a wider mathematical audience beyond the circle of his students. At the beginning, the character of Gelfand’s seminar was shaped by his own specific interests and idiosyncrasies. This character facilitated its unique social role in the mathematics community. This role, in turn, began to shape the character of the seminar.

The leading role of the Gelfand seminar in the Moscow mathematical community was acknowledged by its champions and skeptics alike. One student has recalled his meeting with a senior mathematician, at which the student confessed that he attended some seminars at Moscow University and understood very little. “Then you should go to the Gelfand seminar,” advised the senior mathematician. “If you come not to understand but to pray, you better do it at the main synagogue.”⁷⁷ The student went to the seminar and became one of Gelfand’s closest collaborators.

11 “Under-Soviet” Mathematics

Open seminars were a key component of the parallel social infrastructure of Soviet mathematics. They allowed the “undesirables,” who were denied formal education or jobs in mathematics, to participate fully in academic discussions, to keep up to date with the most recent trends, and to strike collaboration with colleagues. Not surprisingly, the authorities were not pleased. In 1977, the administration of the Faculty of Mathematics and Mechanics at Moscow University decided to crack down on the free-wheeling spirit of the open seminars and to subject them to tight

⁷⁶Vladimir Retakh, “Ob Izraile Moiseeviche Gel’fande.”

⁷⁷Vladimir Retakh, on his meeting with Aleksandr Kronrod; see *Ibid.*

regulation, if not close altogether. Gelfand's former student Felix Berezin, by then a noted mathematician, stood up courageously to oppose the official policy. Although personally he was not a fan of Gelfand's manners and even stopped going to his seminar, Berezin spoke out firmly in defense of the academic value of open seminars. He submitted a formal appeal to the Rector of Moscow University Rem Khokhlov:

[A]mong the traditions of our Department, there has always been a very free atmosphere of active participation of mathematicians, who are not members of the faculty, possibility to lead seminars or specialized courses (either without pay or on hourly payments). This possibility always raised the tonus of work with students and served as a versatile method for strengthening the scientific directions that required it. The current Administration is the first to regulate such a practice... I believe that it is necessary to restore the long-held tradition that every actively working mathematician, even not a member of the faculty, may lead a special seminar or read a special course either without pay or for hourly rates.⁷⁸

Khokhlov did not have a chance to act on the letter: he was tragically killed in a mountain climbing accident. After his death, the letter fell into the hands of the administration of the Faculty of Mathematics and Mechanics—the very same people about whom Berezin had complained. As a punishment, Berezin was forbidden to travel abroad; the restrictive policies towards open seminars, of course, did not change.⁷⁹

The rift between the official institutions of Soviet mathematics, whose affiliates enjoyed the privileges of the academic elite, and the parallel social infrastructure, where people worked without pay and studied without credit, gradually broadened. One of Gelfand's disciples has even suggested describing the mathematics community in the USSR not as "Soviet," but as "under-Soviet"—existing "under" the Soviet regime, despite its pressures, "trying, if possible, to avoid any contact with it."⁸⁰ Such contacts were unavoidable: seminars met in the main building of Moscow University; research results were published in official journals; and mathematicians were employed in government-controlled institutions, even if outside the academe. Yet this community cultivated a distinct marginal identity and formed an idealistic ethos, which valued mathematics not merely as an occupation but as a way of life.

12 A Way of Life

The Gelfand seminar drew on a long tradition of mathematical and physical seminars dominated by famous personalities in the 19th and 20th centuries (Hilbert, Klein, Bohr, Pauli, Landau, etc.). It shared many of its attractive and not-so-attractive features with some of its predecessors—the highest regard for the seminar leader, the generous sharing of the leader's expertise, the attendance by the luminaries in the field, the high academic prestige of speaking at a session, the tightly knit circle of

⁷⁸Felix Berezin to Rem Khokhlov [1977], in Shifman, ed., *Felix Berezin*, pp. 238, 240.

⁷⁹Nikita Vvedenskaya, "Reminiscences of a Close Friend," in Shifman (2007), p. 178.

⁸⁰Alexandre Kirillov, quoted in "Matematik s bol'shoi bukvy."

disciples, the unquestionable authority of the seminar leader, the relentless and sometimes rude questioning of speakers, and the importance of the seminar as a social hub.

In one aspect, however, the Gelfand seminar was different from the rest. It did not complement an existing institutional structure; it was an institution in its own right. The Gelfand seminar was a central component of a vast parallel social infrastructure, which supported educational and research activities of hundreds of mathematicians, young and mature alike, who did not have access to official institutions. In this sense, it transcended its purely intellectual function and created a lifeworld of its own, with its own time, space, ritual, speech style, lofty goals, and carnival entertainment.

The fluid time and semi-private space of the Gelfand seminar effectively blurred the boundary between the seminar proper and the informal conversations that preceded and followed it. It also blurred the boundary between mathematics as an academic activity and as a personal, even spiritual experience.

Around the Gelfand seminar emerged a community dedicated to mathematics far beyond any formal obligation of study or work. For them, mathematics was a way of life—not very comfortable, somewhat unsafe, but exciting and highly rewarding—not in the common sense of formal distinctions and institutional careers, but in the sense of hard-won recognition by peers and occasionally even by Gelfand himself.

One of Gelfand's closest collaborators recalled:

I remember our first meeting, when [Gelfand] walked with the four of us on the streets for hours, jumping, as usual, from subject to subject. I recall the powerful feeling, familiar to many, that you are being led into a captivating new world, where you will be working on the most important problems in the world in the company of enormously talented and enthusiastic people. And this new world is much closer and more accessible than you thought.⁸¹

The semi-private parallel social infrastructure of Soviet mathematics, in combination with other factors of everyday Soviet life, such as low geographical mobility, flexible work schedules at research institutions, and the high value of personal friendship, created conditions for the emergence of a large, closely knit, and actively interacting mathematical community in Moscow and Leningrad. Pressure from official institutions, closing career paths and forcing mathematical talent into this parallel infrastructure, created a high-density intellectual environment, which cultivated a distinct ethos of detachment from career concerns and of dedication to the sublime world of mathematical thought, which Western visitors regarded as a “paradise”—“socially and mathematically.”⁸² In the early 1990s, a young, promising Russian mathematician visited Harvard University for a semester, and at the end of his stay he had to decide whether to accept a generous offer in the U.S. or to go back to Russia, which was quickly falling into economic and social disarray. He consulted his older mentor, a student of Gelfand, who was also visiting

⁸¹Andrei Zelevinsky, quoted in “Matematik s bol'shoi bukvy.”

⁸²Video interview with MacPherson.

the U.S. For the mentor, the choice was obvious: only in Russia could one do good mathematics. He told his young colleague that life of material plenty would interfere with true scholarship: “You have to work hard, the way you were working in Moscow. Only then can you realize your potential. Here, in America, this is impossible. There are too many distractions and temptations. Life here is all about fun, enjoyment, instant gratification. How can you possibly focus on your work here?”⁸³

The young man stayed in the U.S. and made a brilliant career as a mathematician. The mentor went back to Russia and continued doing mathematics, despite the hardships of the post-Soviet times. For him, mathematical creativity could thrive only in the beauty and the discomfort of Gelfand’s lifeworld.

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⁸³Frenkel (2013), p. 149.

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