9-2017

"The computer does not believe in tears": Soviet programming, professionalization, and the gendering of authority

Ksenia TATARCHENKO
Singapore Management University, ktatarchenko@smu.edu.sg

"The Computer Does Not Believe in Tears"

Soviet Programming, Professionalization, and the Gendering of Authority

Ksenia Tatarchenko

> The head of the computational laboratory checks programs only on an exceptional basis—for this task we have mathematicians-programmers; there are two of them in our laboratory, and the authors erroneously keep on calling them "girls."
>
> —The Strugatsky brothers, *Monday Begins on Saturday*

By the middle of the 1960s, the Soviet press routinely exalted computers as the "machines of communism," and the new programming profession had become familiar enough to make a programmer the main hero of a science fiction novel. The Strugatskys' immensely popular *Monday Begins on Saturday*—the title referring to a kind of work that knows no holidays—is a satirical fable where scientific research masqueraded as magic.[1] The novel opens with a fantastical institute staff headhunting a young programmer, Aleksandr Privalov. At the heart of the plot is the inculcation of the protagonist with a scientists' work ethic as Aleksandr befriends other male co-workers interested in using the computer to advance their research projects. A critique of consumerist society and ever cautioning against the subversion of the meaning of human happiness, *Monday Begins on Saturday* depicts scientific experts as the true holders of socialist values, finding ultimate self-realization in their work. Its strong didactical agenda notwithstanding, the novel gained

Early drafts of this article were presented at "Russian Computer Scientists in Russia and Abroad" EUSP workshops, the Siegen University Workshop "Beyond ENIAC: Early Digital Platforms and Practices," and "Women in Computability Workshop," CiE-2016, Paris. I greatly appreciate the guidance provided by Andrew Jenks and the anonymous reviewers. I am especially grateful to Erika Milam, Mary Nolan, Emily Thomson, and Barbara Walker, who all contributed to shaping my engagement with questions of gender.

[1] A. N. Strugatsky and B. N. Strugatsky, *Ponedel'nik nachinaetsia v subbotu: Skazka dlia nauchnykh rabotnikov mladshego vozrasta* (Moscow: Detskaia literatura, 1965).

A Fictional Programmer, Aleksandr Privalov, Writing Commentary on the Strugatskys' novel, 1965
Illustration by E. T. Migunov.

immediate popularity thanks to its delightful satirical commentary on the techno-scientific ambitions of the party-state.[2]

The Strugatsky brothers, astute observers intimately familiar with the Soviet academic milieu, captured in their story the contradiction between the limitless promises of the new machines according to public discourse and the actual social status of the new experts, the programmers.[3] In an almost postmodernist fashion, an "addendum" to the novel contains the main protagonist's comments to the authors' text, an excerpt from which serves as the opening quote to this article. The fictional programmer's correction of the inappropriate reference to "girls" playfully revealed the existence of

[2] The Strugatskys' early works, including their first bestseller, *It Is Hard to Be a God*, were published by a youth literature press; however, a belief in the educational values of science fiction is a strong feature throughout their work. See Vladimir Gopman, "Science Fiction Teaches the Civic Virtues: An Interview with Arkadii Strugatsky," trans. Mark Knighton, ed. Darco Suvin, *Science-Fiction Studies* 18, 1 (1991): 1–10. For a classical study on how the theme of science and technology was presented in the Soviet literature after Stalin, see Rosaline J. Marsh, *Soviet Fiction since Stalin: Soviet Politics and Literature* (London: Croom Helm, 1986).

[3] For a somewhat dated English-language overview of the Strugatsky brothers' careers and main themes in their science fiction, see Stephen W. Potts, *The Second Marxian Invasion: The Fiction of the Strugatsky Brothers* (San Bernardino: Wildside Press, 1991). After graduating from the Department of Mechanics and Mathematics of Leningrad State University with the specialty of "stellar astronomer" and an aborted course of PhD research, Boris Strugatsky worked as an exploitation engineer at the Pulkovo Observatory's Computer Center. He became a passionate programmer. Boris Strugatsky's experiences at Pulkovo during the late 1950s and early 1960s informed the descriptions of the magical institute in the novel. For a Russian-language biography detailing some of these correlations, see Ant Skalandis, *Brat´ia Strugatskie* (Moscow: AST, 2008).

two images of programming that would be familiar to Soviet readers. The tension generated by the discrepancy between these images—a high-status, sought-after male occupation as represented by the main protagonist versus a low-status, supervised, and error-prone job made the domain of anonymous females—is the analytical focus of this study.

It is well known that women made up half the labor force in the late Soviet economy. However, notwithstanding Marxist ideological guidelines on the equality of the sexes and the numerical equality of female and male graduates by the late 1970s, the majority of female labor remained concentrated at the bottom of the job pyramid. Even as about 10 percent of women rose to the level of leadership in industrial enterprises, the common wisdom rationalized the male/female achievement gap by invoking women's lower level of commitment and lesser fitness for positions of authority.[4] The case of programming not only fits this well-known general pattern but reveals how such gendered stereotypes were reproduced and negotiated by individual participants, male and female, who were able to achieve positions of intellectual, pedagogical, or managerial leadership.[5] Expanding my research on the formation of an international community of computer experts during the Cold War, I ask: how did a new Soviet occupation employing significant numbers of women become associated with a masculine ideal practitioner?[6] I argue that while the female presence reflected the gender structure characteristic of the late Soviet workforce, the masculinization of authority in the field involved a combination of three factors: the Soviet mathematical and cybernetic tradition, the field's

[4] Statistics from Mary Buckley, "Women in the Soviet Union," *Feminist Review* 8 (Summer 1981): 79–106. Women's labor attracted constant attention among Western students of the Soviet Union. See, e.g., Norton T. Dodge, *Women in the Soviet Economy: Their Role in Economic, Scientific, and Technical Development* (Baltimore: Johns Hopkins University Press, 1966); Michael Paul Sacks, *Women's Work in Soviet Russia: Continuity in the Midst of Change* (New York: Praeger, 1976); and Buckley, *Women and Ideology in the Soviet Union* (Ann Arbor: University of Michigan Press, 1989).

[5] My approach to gender, encompassing the co-construction of femininity and masculinity, draws on classical scholarship in the history of science and technology. See Ruth Oldenziel, *Making Technology Masculine: Men, Women, and Modern Machines in America, 1870–1945* (Amsterdam: Amsterdam University Press, 1999). For a cluster of the latest works in the history of science, see Erika Milam and Robert A. Nye, eds., "Scientific Masculinities," *Osiris* 30 (Chicago: University of Chicago Press, 2015).

[6] Ksenia Tatarchenko, "'A House with the Window to the West': The Akademgorodok Computer Center, 1958–1993" (PhD diss., Princeton University, 2013); Tatarchenko, "The Cold War Origins of the International Federation for Information Processing," *IEEE Annals of the History of Computing* 32, 2 (2010): 46–57; and Tatarchenko, "'The Anatomy of an Encounter': Transnational Mediation and Discipline Building in Cold War Computer Science," in *Communities of Computing: Computer Science and Society in the ACM*, ed. Tom Misa (New York: ACM Books, 2016), 199–227.

status as an up-and-coming profession, and integration in the international community.

Multiple analytical stakes are at the heart of this argument. My account corrects the misleading notion that socialism succeeded in resolving the notorious "women question" plaguing today's information technology (IT) industry.[7] But first and foremost, my focus on programming and professional identity formation challenges the established narrative about the Soviet failure to enter the Information Age, a narrative that imposes a hardware-focused and America-centered model as a norm.[8] Instead of taking the Soviet case as a negative or positive counterexample, I study the interplay between the national dynamics of the gendering of professional authority and the transnational mechanisms of discipline building.[9] Instead of elaborating a Soviet-American comparison, I trace the domestic outcomes of professional encounters, exchanges, and networks operating across geographical and Cold War boundaries. Addressing the gendering of a new technological practice, my work stands alongside and complements scholarship on gender,

[7] For an example of a scholarly work making such claims based on a sample of evidence from Armenia, see Hasmik Gharibyan and Stephan Gunsaulus, "Gender Gap in Computer Science Does Not Exist in One Former Soviet Republic: Results of a Study," *ACM SIGCSE Bulletin* 38, 3 (2006): 222–26. For a collection of US-based, NSF-funded empirical studies of gender imbalance in computing, see J. McGrath Cohoon and William Aspray, eds., *Women and Information Technology: Research on Underrepresentation* (Cambridge, MA: MIT Press, 2006).

[8] The overviews of computing history typically omit the Soviet experience. See, e.g., Martin Campbell-Kelly, William Aspray, Nathan Ensmenger, and Jeffrey R. Yost, *Computer: A History of the Information Machine* (Boulder, CO: Westview, 2014). For a synthetic version of the declensionist argument that the Soviet Union failed to enter the "Information Age," see Manuel Castells and Emma Kiselyova, *The Collapse of Soviet Communism: A View from the Information Society* (Berkeley: International and Area Studies, University of California, 1995). The essay's arguments were integrated into Castells's bestselling trilogy The Information Age: Economy, Society, and Culture, including *The Rise of the Network Society* (Malden, MA: Blackwell, 1996), *The Power of Identity* (Malden, MA: Blackwell, 1997), and *End of Millennium* (Malden, MA: Blackwell, 1998). Slava Gerovitch's fundamental study of Soviet cybernetics also follows this logic but on methodological grounds, as it tells how cybernetics turned into a metadiscipline and was subjugated to the "newspeak" of the Brezhnev-era ideology (*From Newspeak to Cyberspeak: A History of Soviet Cybernetics* [Cambridge, MA: MIT Press, 2002]). A new work of note challenging some of the Cold War dichotomies is Benjamin Peters, *How Not to Network a Nation: The Uneasy History of the Soviet Internet* (Cambridge, MA: MIT Press, 2016).

[9] On the transnational approach and Soviet history, see Michael David Fox, "The Implications of Transnationalism," *Kritika* 12, 4 (2001): 885–904. For a study that integrates Soviet developments as part of the Cold War history of mathematics, see Ksenia Tatarchenko and Christopher Phillips, "Mathematical Superpowers: The Politics of Universality in a Divided World," *Historical Studies in the Natural Sciences* (*HSNS*) 46, 5 (2016): 549–55. For debates about "national," "international," and "transnational" in the history of science, see Simone Turchetti, Nestor Herran, and Soraya Boudia, eds., "Transnational History of Science," special issue of *British Journal for the History of Science* 45, 3 (2012).

consumerism, and reproduction as key aspects of coexistence.[10] Ultimately, questions about authority and labor in the field of programming open a new perspective on the late Soviet vision of a digital socialist modernity and its connection to the post-Soviet flows of code, capital, and bodies.

I follow Michael Mahoney's approach to the history of computing, which asserts a plurality born out of computing's tripartite nature—a science, a technology, and an encounter between the two.[11] This article is an answer to Mahoney's question about what it means for the computer to be masculine and how it became so.[12] Nathan Ensmenger has complemented the North American literature on women and computing by analyzing the transformation of the feminized activity of computer programming into a distinct masculine professional culture in the United States of the 1960s and 1970s.[13] I show that not only were Soviet programmers and journalists

[10] How Soviet women negotiated the contradictory demands of state, work, and family life has become an important topic of research since Vera Dunham's landmark study of the representations of everyday life (*In Stalin's Time: Middleclass Values in Soviet Fiction* [Cambridge: Cambridge University Press, 1976]). Consumption is another important direction of research. See, e.g., Sheila Fitzpatrick, "Becoming Cultured: Socialist Realism and the Representation of Privilege and Taste," in Fitzpatrick, *The Cultural Front: Power and Culture in Revolutionary Russia* (Ithaca, NY: Cornell University Press, 1992), 216–37; and Susan E. Reid, "Cold War in the Kitchen: Gender and the De-Stalinization of Consumer Taste in the Soviet Union under Khrushchev," *Slavic Review* 61, 2 (2002): 211–52. More recently, gender and consumption also include studies of masculinity, as in Lewis Siegelbaum, *Cars for Comrades: The Life of the Soviet Automobile* (Ithaca, NY: Cornell University Press, 2008); and Brandon Gray Miller, "Between Creation and Crisis: Soviet Masculinities, Consumption, and Bodies after Stalin" (PhD diss., Michigan State University, 2013). Compare with a pan-European perspective on domesticity, labor, and leisure in Mary Nolan, "Consuming America, Producing Gender," in *The American Century in Europe*, ed. R. Laurence Moore and Maurizio Vaudagna (Ithaca, NY: Cornell University Press, 2003), 243–61.

[11] Michael Mahoney and Thomas Haigh, *Histories of Computing* (Cambridge, MA: Harvard University Press, 2011).

[12] Michael Mahoney, "Boy's Toys and Women's Work: Feminism Engages Software," in *Feminism in Twentieth-Century Science, Technology, and Medicine*, ed. Angela N. H. Creager, Elizabeth Lunbeck, and Londa L. Schiebinger (Chicago: University of Chicago Press, 2001), 169–85, here 171.

[13] Nathan Ensmenger, *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise* (Cambridge, MA: MIT Press, 2010); Ensmenger, "'Beards, Sandals, and Other Signs of Rugged Individualism': Masculine Culture within the Computing Professions," *Osiris* 30 (2015): 38–65. The classical work on gender and computing is Jennifer Light, "When Computers Were Women," *Technology and Culture* 40, 3 (1999): 455–83. Also see Thomas J. Misa, ed., *Gender Codes: Why Women Are Leaving Computing* (Hoboken, NJ: Wiley, 2010); Janet Abbate, *Recoding Gender: Women's Changing Participation in Computing* (Cambridge, MA: MIT Press, 2012); Marie Hicks, "De-Brogramming the History of Computing," *IEEE Annals of the History of Computing* 35, 1 (2013): 88; and Irina Nikivincze, "Solving a Career Equation: The First Doctoral Women in Computer Science," in *Communities of Computing*, 71–90. Marie Hicks connects the gendered history of computerization with the

familiar with the American masculine tokens of professionalism, they adopted and manipulated these symbols and Russian and Soviet rhetorical elements when generating the image of an ideal practitioner for domestic and foreign audiences. Methodologically, I draw on works analyzing the discursive strategies and cohesion mechanisms of Russian intelligentsia circles and late Soviet dissident groups for a close reading of ego documents originating within one particular programming community. I focus on professional lives and day-to-day experiences, contrasted with public discourse and representations.[14]

Approaching the question of gender and labor not in terms of female presence but rather as a search for professional identity by both male and female practitioners, I trace the evolution of Soviet programming cultures from their emergence in the 1950s to their shaping of a new mass profession in the 1970s. First, I study the gendered implications of the early association between programming and cybernetics. Next, I focus on the stakes of professionalization by introducing the biographies and early career choices of two prominent specialists, one female and the other male. Finally, I demonstrate how the coordination of an intellectual agenda and social networks among Western and Soviet programming experts enforced the association of masculinity, scientific authority, and programming. The conclusions connect the 1970s discourse about the professional virtues of programming to the 1980s vision of the socialist Information Society, a vision that transcended the masculine connotations of professionalism and emphasized *equality of access to, and control over, information.*

Fathering Soviet Programming

The dual nature of Soviet programming as both a field of mathematical knowledge and a type of service is recoded in the Russian official term *matematicheskoe obespechenie*—literally, "mathematical support"—which gained currency in the early 1960s. Unlike the American term "software," which establishes a binary opposition between hardware and computer programs, the Russian term explicitly characterizes the activity as mathematical and as a

histories of industrialization and argues that a technocratic heteronormativity was central to Britain's information-based economy (*Programmed Inequality: How Britain Discarded Women Technologists and Lost Its Edge in Computing* [Cambridge, MA: MIT Press, 2017]).

[14] I found especially useful the distinction between the "writing" and "experiencing" self and the attention to both Western and Soviet reception contexts in Benjamin Nathans, "Talking Fish: On Soviet Dissident Memoirs," *Journal of Modern History* 87, 3 (2015): 579–614. On Soviet memoirs and intelligentsia social mechanisms, see Barbara Walker, "On Reading Soviet Memoirs: A History of the 'Contemporaries' Genre as an Institution of Russian Intelligentsia Culture from the 1790s to the 1970s," *Russian Review* 59, 3 (2000): 327–52.

process of assistance: the etymology of *obespechenie* points to taking care of one's sorrows.[15] An apparent oxymoron, the term and its hybrid character reflect the specifically national context and chronology of its origin. The early Soviet developments in programming took place during the first postwar decade and became intertwined with that of cybernetics, and the collective memory of the field traces the genealogy of Soviet programming and Soviet cybernetics to the "father" figure of A. A. Liapunov.

The birth of Soviet digital computing was an achievement against many odds: the Soviet victory over Germany came at the price of the massive destruction of the country's industrial sector and a lasting demographic fracture caused by the loss of 27 million lives. In the late 1940s and early 1950s, the work on the first Soviet digital machines—MESM, M-1, Strela, and BESM—was a scrounger's triumph over scarcity during a difficult economic recovery. As the geopolitical tensions between the former allies rose, the domestic campaign against cosmopolitanism and imperialism raged.[16] In this context, the reception of Western cybernetics took two routes: while the press decried what they saw as a new bourgeois pseudoscience for its analogies between humans and machines, military specialists explored its notions of control, feedback, and information via publications accessible in the special closed libraries. Invisible to the public eye, Soviet computing and cybernetics did not grow in parallel with, but instead belonged to, a single set of Cold War military applications, such as the nuclear bomb, radar, and antiballistic defense systems hungry for computational power.[17]

By the fall of 1955, when the existence of the Soviet computers was first officially announced in conjunction with the international conference in Darmstadt, Germany, the scientific reputation of cybernetics had already been publicly redeemed with the appearance of a seminal publication titled "The Main Features of Cybernetics" in the key Soviet ideological

[15] The term "software" was introduced in John Tukey, "The Teaching of Concrete Mathematics," *American Mathematical Monthly* 65, 1 (1958): 1–9. On the Soviet usage of the term of "mathematical support," see Andrei Ershov and Mikhail Shura-Bura, "The Early Development of Programming in the USSR," in *A History of Computing in the Twentieth Century*, ed. Nicholas Metropolis, J. Howlett, and Gian-Carlo Rota (Orlando, FL: Academic Press, 1980), 137–96, here 187.

[16] For a case study in the history of medicine, see Nikolai Krementsov, *The Cure: A Story of Cancer and Politics from the Annals of the Cold War* (Chicago: University of Chicago Press, 2002).

[17] Slava Gerovitch, " 'Mathematical Machines' of the Cold War: Soviet Computing, American Cybernetics and Ideological Disputes in the Early 1950s," *Social Studies of Science* 31, 2 (2001): 253–87; Adam E. Leeds, "Dreams in Cybernetic Fugue: Cold War Technoscience, the Intelligentsia, and the Birth of Soviet Mathematical Economics," *HSNS* 46, 5 (2016): 633–68.

journal *Voprosy filosofii*.[18] The text of the article was drafted by the young colonel A. I. Kitov and edited and co-signed by his former teacher from the Artillery Academy, the mathematician A. A. Liapunov, and S. L. Sobolev, an academician and mathematical prodigy who contributed to the Soviet bomb project. As indicated by its title, "The Main Features of Cybernetics" focused on explaining the subject and methods of cybernetics. The article stressed the legitimate scientific nature of cybernetics and formulated its intellectual task as the creation of a general theory of control. According to Slava Gerovitch, this almost decade-long delay in the introduction of cybernetics to the Soviet public had an impact on its very content: unlike the servomechanisms that inspired the American mathematician Norbert Weiner, computers became the main technology of reference in the Soviet version of cybernetics that began to gain popularity in the late 1950s.[19]

This crucial observation, however, entails an additional question: what was the impact of the cybernetic agenda on the conceptualization and public representation of programming and its practitioners? In addition to the highly visible and celebrated role of Kitov, Liapunov, and Sobolev in changing the status of Soviet cybernetics, the three authors also played a key role in early Soviet programming, as pioneer practitioner, mentor, and patron, respectively. By 1955, Kitov, Liapunov, and Sobolev not only presented computers as the machines of reference for cybernetics but believed that programming itself was mathematical and part of a machine's self-regulation process, making it amenable to automatization.[20]

This understanding of programming was not only diffused in print; even more consequential was the direct influence of Liapunov's intellectual agenda on the first cohort of the Soviet mathematicians trained as programmers at Moscow State University (MGU). In 1952, Sobolev became director of a new specialty in computational mathematics at MGU and invited Liapunov to teach a class on programming there. During the winter of 1952–53, Liapunov came up with an original, formal description of programming algorithms that he would later call "the logical schemes of programming."[21] Unlike the existing formalizations of algorithms, such as Turing machines

[18] S. L. Sobolev, A. I. Kitov, and A. A. Liapunov, "Osnovnye cherty kibernetiki," *Voprosy filosofii*, no. 4 (1955): 136–48 (http://lyapunov.vixpo.nsu.ru/?int=VIEW&el=682&templ=VIEW).

[19] Gerovitch, *From Newspeak to Cyberspeak*, 178–79.

[20] Sobolev, Kitov, and Liapunov, "Osnovnye cherty kibernetiki," electronic version.

[21] The publication detailing the method, "On Logical Schemes of Programming," did not appear until the first issue of the cybernetics journal: A. A. Liapunov, "O logicheskikh skhemakh programm," *Problemy kibernetiki*, no. 1 (1958): 46–74 (http://odasib.ru/OpenArchive/Portrait.cshtml?id=Xu1_pavl_635212335135781250_13607).

or Markov's normal algorithms, which were oriented toward understanding the nature of computation, Liapunov's approach was directed toward the mathematical problems of optimization and equivalence, problems that fostered a technical agenda of devising "programming programs": that is, making the computer perform the programmers' work.[22] Liapunov's students would continue to study these questions, transforming Liapunov's ideas and agenda into a significant part of Soviet efforts in programming. Many were employed by the Computer Center of the Soviet Academy of Sciences, which opened in Moscow in 1955; many moved to other locations, diffusing ideas and practices across the Soviet Union.

Liapunov's understanding of programming as an applied theory of algorithms and his status as the father figure were accompanied by a set of gendered social relations. Student recollections indicate that intellectual lineage was not the only product of the pedagogical encounter: student-teacher interactions were not limited to the academic content of the class but involved the transmission of scientific views, cultural values, and social norms. Liapunov's status as a "father of programming," assigned by his intellectual descendants, was simultaneously predicated on their perception of him as a charismatic personality and role model. From his remarkable looks—tall and of slim build with sparkling dark eyes—to rumors of his military connections, Liapunov's appearance at the Mathematics Department is remembered as an event. A polyglot of encyclopedic erudition with a wide range of scientific interests, he magnetized the students within the classroom and opened the doors to new intellectual and social worlds: the conversations that began at MGU were continued during walks and transformed into tea parties at his household that day and night welcomed visitors from among the scientific, military, and artistic elite. Liapunov's status as a father figure was thus the result of a double process. One was the operation of the Cold War military academic complex, where Liapunov acquired a distinct professional charisma by successfully mediating between academics and the military and between pure mathematics and applied science communities. The other was the established tradition of intelligentsia circles and cult figures, centered on the household and on personal ties cultivated around shared meals, walks, and conversations. Commanding patriarchal authority, Liapunov transmitted

[22] R. I. Podlovchenko, "A. A. Lyapunov and A. P. Ershov in the Theory of Program Schemes and the Development of Its Logic Concepts," *Perspectives of System Informatics: 4th International Andrei Ershov Memorial Conference, PSI 2001 Akademgorodok, Novosibirsk, Russia, July 2–6, 2001 Revised Papers, Lecture Notes in Computer Science* (New York: Springer, 2001), 2244:8–23.

a gendered conceptualization of programming and cybernetics imbricating the private and professional spheres.[23]

Liapunov had not always been the enigmatic man who appeared in front of MGU youths in 1952. A descendent of a prominent prerevolutionary intelligentsia clan, Liapunov learned to navigate a dense network of Moscow's circles during his early career as a mathematician trained by Nikolai Luzin.[24] But his professional identity, self-perception, and even body were marked by World War II. Liapunov's wartime correspondence records his experiences, from the patriotic ardor that led to his volunteering, through the physical challenges he faced as well as his psychological struggles to fit in and his realizing the importance of his expertise for artillery, to joining the Party.[25] In letters to his wife, he repeatedly insisted on the transformative effect that his time in the army had had on his character. Referring to Aleksandr Pushkin's famous line, "a heavy hammer, shattering glass, forges damask," he thought of himself as a "chick" who grew into "iron."[26] This theme of a personal metamorphosis was most conspicuously articulated in his wartime poetry:

> Now I am not afraid of life.
> Of my own volition I am striving forward
> With no regards for the tempest of life.
> I am a Bolshevik and an officer.
> I march in the row of military glory.
> In the art of war—I am a pioneer.
> In battle—I am a competent scientist.
> During our ten years of marriage
> I grew in strength and in spirits.
> But the road of war
> Led me to a full-blooded life![27]

[23] Student recollections are available at http://lyapunov.vixpo.nsu.ru. On the construction of charismatic authority in modern scientific leadership, see Charles Thorpe and Steven Shapin, "Who Was J. Robert Oppenheimer? Charisma and Complex Organization," *Social Studies of Science* 30, 4 (2000): 545–90. On the operation of Russian circles as key institutions of intelligentsia culture and identity, see Barbara Walker, *Maximilian Voloshin and the Russian Literary Circle: Culture and Survival in Revolutionary Times* (Bloomington: Indiana University Press, 2004).

[24] On the Moscow mathematical community, see Loren Graham and Jean-Michel Kantor, *Naming Infinity: A True Story of Religious Mysticism and Mathematical Creativity* (Cambridge, MA: Belknap, 2009).

[25] I. A. Kraineva, "Perepiska matematika A. A. Liapunova 1941–1945 gg. kak istochnik po istorii nauki i povsednevnosti v period Velikoi otechestvennoi voiny," *Vestnik Tomskogo gosudarstvennogo universiteta*, no. 399 (2015): 97–105.

[26] A. A. Liapunov to A. S. Liapunova, 11 March 1944 (http://odasib.ru/OpenArchive/Portrait.cshtml?id=Xu1_pavl_635513015734375000_2707).

[27] A. A. Liapunov to A. S. Liapunova, 5 May 1944 (http://odasib.ru/OpenArchive/Portrait.cshtml?id=Xu1_pavl_635513015734375000_3267).

It is this wartime self-transformation and his newfound confidence in the power of mathematics that hold the key to Liapunov's embrace of cybernetics.[28] His self-representation as a modern knight found an echo in his struggles for the recognition of cybernetics as a synthetic mathematical science. Moreover, this conceptualization implied an ideal, that of a male cybernetician-mathematician fearlessly carrying the torch of reason. This image was not an abstraction but was embodied in the cohort of young officers trained by Liapunov at the Dzerzhinskii Artillery Academy during the postwar years. A quarter-century later, in 1970, Liapunov addressed one of his former students, Colonel Kitov, with the following telegram: "Dear Anatolii Ivanovich, cordial congratulations to you, the first knight of Soviet cybernetics, on your 50th birthday. Good wishes for eternal youth and thrilling work."[29] Liapunov's choice of the epithet reflected the nature of the bonds connecting the two men—as cyberneticians and warriors.

Neither the mathematical ideas nor the gendered ideals that Liapunov transmitted to his MGU students necessarily precluded female participation per se. After all, since the revolution, the Mathematics Department had both female faculty and students, and Liapunov himself trained a number of women.[30] The commemorative materials devoted to the nine female students who left the department to join the Soviet military aviation efforts at the onset of the Great Patriotic War (1941–45), attested that the choices of female mathematicians were not bound by a single predefined gendered scenario, an argument forcefully developed in Anna Krylova's work on Soviet female soldiers.[31] The issue, therefore, is not to observe the female presence in Soviet machine halls and mathematics departments but to question how the gendered element played out in the individual career choices of early practitioners, both male and female, to gain a better grasp of the social

[28] Compare with Peter Galison's arguments about the notion of "enemy" in Wiener's cybernetics, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21, 1 (1994): 228–66.

[29] Reprinted in V. A. Dolgov, *Kitov Anatolii Ivanovich—pioner kibernetiki, informatiki i avtomatizirovannykh sistem upravleniia: Nauchno-biograficheskii ocherk* (Moscow: KOS-INF, 2010), 80.

[30] According to recollections, of 13 initial students specializing in computational mathematics, 4 were female. Female mathematicians in the early 1950s included N. K. Bari, who studied under N. N. Luzin; the revolutionary logician S. A. Ianovskaia; and two younger but already prominent graduates of the department, O. A. Ladyzhenskaia and O. A. Oleinik. Compare with Margaret Murray, *Women Becoming Mathematicians: Creating a Professional Identity in Post-War World War II America* (Cambridge, MA: MIT Press, 2000).

[31] See the history page of the Mathematics Department (http://www.math.msu.su/node/283). On shifting gender roles among Soviet women soldiers, see Anna Krylova, *Soviet Women in Combat: A History of Violence on the Eastern Front* (Cambridge: Cambridge University Press, 2011).

tissue of the emerging field of programming within the existing hierarchy of expertise.

The Matrix of Identity

Liapunov's cybernetic agenda and the gendered mathematical ideals he transmitted to his MGU students emerged in parallel with the practice of coding and its corresponding occupation.[32] The tension between the two became a key site for negotiating a professional identity for those engaged in a new kind of labor, as demonstrated in the early careers of individual practitioners. Comparing the challenges facing Liapunov's male and female students demonstrates that manliness per se was not a sufficient variable and had to be reshaped into a specific set of professional qualities. This comparison also reveals that the process of turning a new technological practice into a profession was not limited to obtaining recognition by the mathematical establishment; a demarcation between cybernetics and programming became the order of the day.

R. I. Podlovchenko, a female student in computation mathematics, was already in her final year of study when Sobolev invited Liapunov and did not attend his class because she was already assigned to an internship at the Institute of Precise Mathematics and Computing Machinery (ITMiVT), the institute where Sergei Lebedev had moved from Ukraine to work on his BESM computer. Stepping for the first time into the machine hall that housed the digital computer hardware, the MGU interns found out that many engineers working on the machine were "boys" about their age—not a hiring policy but a demographic consequence of the war. The atmosphere at the institute was friendly and exciting. Podlovchenko's mentor in programming was a young female coder and recent MGU graduate, A. I. Sragovich—known by the affectionate diminutive of "Shurochka" among the interns. Later she would become one of the women responsible for calculating Sputnik's trajectory.[33] On completing the internship, the most skilled interns were immediately invited to join the institute's staff; neither their work on the diploma nor the official proscription on hiring students was an obstacle.

Podlovchenko's recollections of her time at MGU and ITMiVT expose a complex dynamic between individual choices and competing collective

[32] The most influential early publication was a manual written by a group of mathematicians working at ITMiVT: L. A. Liusternik, A. A. Abramov, V. I. Shestakov, and M. R. Shura-Bura, *Reshenie matematicheskikh zadach na avtomaticheskikh tsifrovykh mashinakh* (Moscow: Izdatel´stvo Akademii nauk SSSR, 1952) (http://books.mathtree.ru/book/lyusternik).

[33] V. A. Serebriakov, S. A. Abramov, A. I. Sragovich, and V. I. Filippov, "Otdel sistem matematicheskogo obespecheniia," *50 let VTs RAN* (Moscow: Vychislitel´nyi tsentr Rossiiskoi akademii nauk, 2005), 115–28.

identities. On the one hand, the whole experience at ITMiVT and the close interaction with other programmers influenced one's own sense of self: "Programmers were counted on fingers, and joining this tribe filled one with a feeling of exclusivity," recalls Podlovchenko. Yet her memoirs are structured around her encounter with Liapunov, an event of great consequence, narrated as a twist of fate. She first met Liapunov, not in broad daylight in front of the blackboard but in the machine hall during her nightshift, and their roles were reversed: She was a coder with experience who guided him through the installation. Podlovchenko's relationship with Sragovich is that of a barely mentioned apprenticeship and camaraderie, secondary to the experience of interaction with the machine. The encounter with Liapunov would influence Podlovchenko's understanding of this interaction and affect her entire career trajectory.[34]

When Liapunov accepted Podlovchenko as his second (nonmilitary) graduate student, this was conditional not so much on her coding skills as on her hard-won status as a model student in mathematics—she was a recipient of the Stalin Fellowship, a significant monetary award paid to students who both excelled in schoolwork and actively engaged in the social life of their institution. A portrait of Podlovchenko during her student days features the newly completed building of MGU as a background, capturing the tension between the inherited structures and the aspirations of the new generation. To correspond to Liapunov's expectations, she had to manifest a willpower and intellectual capacity to master a significant mathematics corpus ranging from functional analysis to mathematical logic to probability theory. The MGU seminars and Liapunov's household, not the machine hall, became the primary locations for Podlovchenko's initiation into Moscow's scientific milieu. The very pace of programming and the diversity of tasks presented to the BESM computer were soon considered a hindrance to her intellectual ambitions by teacher and pupil alike.[35]

Formally (if not quite practically) abandoning her first "tribe" in 1954, Podlovchenko accepted a position as a junior scientific worker at the Lebedev Institute, the powerhouse of Soviet physics. There she focused on programming methods for a specific type of calculation, vibrational spectra of simple hydrocarbon molecules—a topic considered significant enough by the establishment to grant her the degree of candidate of sciences in

[34] R. I. Podlovchenko, "Vospominaniia o pore uchenichestva u Alekseia Andreevicha Liapunova," *Istoriia informatiki v Rossii: Uchenye i ikh shkoly*, ed. V. N. Zakharov, Podlovchenko, and Ia. I. Fet (Moscow: Nauka, 2003), 370–75. Citations according to the electronic text (http://lyapunov.vixpo.nsu.ru/?el=679&mmedia=PDF), 3.

[35] Podlovchenko, "Vospominaniia."

R. I. Podlovchenko, the Model Student, in Front of the
New Building of Moscow State University, 1952

mathematics.[36] The calculations were performed, and the dissertation drafted, but no defense followed. Instead, to the great surprise of her young colleagues, in 1957 Podlovchenko got married to an older Armenian mathematician whom she met at the computer center and left the capital.[37] She moved to Erevan to head a new, tiny chair in computational mathematics at Erevan University. In Armenia, Podlovchenko not only had a family and taught programming—supplying staff to Armenian computer centers—she also kept in close personal and scientific contact with Liapunov: under his influence she began systematic research on program schemata and equivalence problem solvability, the topics she explored in her 1969 dissertation and on which she published prolifically until her death in 2016.[38]

[36] For a discussion of the early dissertations in programming, see I. A. Kraineva and N. A. Cheremnykh, *Put´ programmista* (Novosibirsk: Nonparel´, 2011), 31–32.

[37] Ershov Archive (EA) f. 197, l. 74, Ershov's comments to his mother on the telegram received from Podlovchenko on the occasion of his 50th birthday, 23 April 1981.

[38] S. A. Nigiian, "Ob erevanskoi shkole programmirovaniia," in *Istoriia informatiki v Rossii: Uchenye i ikh shkoly*, 364–69. Podlovchenko's list of publications contains over 160 articles; for a recent English-language work, see her "Primitive Program Schemata with Procedures," *Automatic Control and Computer Sciences* 48, 7 (2014): 615–22.

The opportunities, choices, and setbacks that Podlovchenko faced in her career were not entirely gender-specific or unique. For instance, Liapunov was equally exigent in the mathematical training of his male students. However, her accounts do reveal the gendered aspect of the tensions between early programming practice and Liapunov's agenda. Coding skills that Podlovchenko learned when first joining ITMiVT depended on individuals' diligence (a quality associated with feminized jobs such as telephone and punch-card machine operators) and a person's ability to exploit the characteristics of one particular machine, the kind of localized knowledge attained by recurrent practice and onsite interaction with engineers and other programmers.[39] In contrast, Liapunov's vision of programs as mathematical objects allowed for the portability of programming expertise on the basis of the authority and universality of scientific knowledge. It also entailed a hierarchy of expertise ranging from the "primitive" and "handicraft" skills associated with programming in machine codes, to the "rational" and "theory-based" approaches associated with Liapunov's own method of logical schemata. Programming as an applied theory of algorithms implied the virtues of rigor and abstraction; programming as mathematical cybernetics suggested a connection with the military and its behavioral codes of loyalty and honor, reinforcing the equation between a disciplined mind and the male body.[40] Beyond the realm of ideals and as a matter of validation, such a mathematics-based intellectual vision imposed the task of finding a niche within a mathematical establishment controlled by patriarchs.[41]

---

[39] Compare with the case of the ENIAC female programmers studied in Light, "When Computers Were Women." The most recent overview of the representations of these "famous 'forgotten women' " in scholarly and popular accounts is Thomas Haigh, Mark Priestley, and Crispin Rope, *ENIAC in Action: Making and Remaking the Modern Computer* (Cambridge, MA: MIT Press, 2016), esp. 272–74.

[40] See Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago: University of Chicago Press, 2003); and Amir Alexander, *Duel at Dawn: Heroes, Martyrs, and the Rise of Modern Mathematics* (Cambridge, MA: Harvard University Press, 2010).

[41] For instance, A. N. Kolmogorov headed the Mathematics Department during Podlovchenko's studies (all chairs before and after were male). The informal networks among the Moscow mathematical community, centered on Kolmogorov and P. S. Aleksandrov, were even more gender specific. The theme of physical exercise is recurrent in the recollections of Kolmogorov's students, as shown by "A. N. Kolmogorov v vospominaniiakh uchenikov," *Kvant*, no. 11 (1988) (http://www.kolmogorov.info/kvant-kolmogorov_v_vospominaniyah_uchenikov.html). A variation on a famous *chastushka* (a short humorous song typically performed by females) cited in student recollections of the department captures and satirizes both the epistemic hierarchies and the norms of heterosexuality: "Menia milyi ne tseluet, / Ne saditsia blizko …/ Ia, mol, chistyi matematik,/ A ty programmistka. (My sweetheart does not kiss me, / He won't sit close to me …/ He says: "I'm a pure mathematician, / And you are a

Despite the strength of the academic hierarchies permeated by gender scripts, the early generations of male and female programmers were empowered by the demand on their skills, so the question was not so much about finding a place to work but rather about striving for a certain kind of future. The careers of young male programmers reveal that masculinity alone was not enough to determine the status of their expertise: one particularly well-documented professional trajectory shows how a conflict with mathematical and cybernetic authorities turned into a drive to forge a distinct professional identity for programming.

A. P. Ershov was one of the students whose choice of career was influenced by Liapunov's course on "The Principles of Programming" and its visionary approach to man-machine interaction. Working under Liapunov, Ershov devoted his diploma thesis and first publication to a new method of matrix conversion, realized at ITMiVT. Much the same as Podlovchenko, the novice programmer joined the institute staff before graduation in 1954. Offered a place at the MGU graduate school with Liapunov, he studied both theoretical and practical questions of automatic programming, the effort culminating in a working language and compiler system for the BESM computer; his 1956 report on the topic was published almost simultaneously as a monograph in Russian (1958) and English (1959).[42]

The high demand for programmers and the young specialist's early success led to an offer by Sergei Sobolev to head the programming unit at the Mathematical Institute that Sobolev was creating in the new Novosibirsk Scientific Center, or Akademgorodok. A graduate student in his mid-20s, Ershov found himself in a position of intellectual and managerial leadership. Yet neither his post nor his gender automatically translated into acceptance by the mathematical establishment. Like Podlovchenko, Ershov faced numerous trials on the road to obtaining his scientific degree. Unlike Podlovchenko, he would push programming beyond the confines of cybernetics and eventually become the spokesperson for Soviet programmers and the discipline of theoretical programming.

Faithful to Liapunov's views, Ershov saw his own work as belonging to the hierarchy of knowledge prioritizing mathematical theory over programming skills. This perception made him reluctant to present his work

programmer"). Quoted in Mikhail Donskoi, "Zhiznennyi tsikl programmista" (http://www.computer-museum.ru/histsoft/progr_cikl.htm).

[42] A. P. Ershov, "Ob odnom metode obrashcheniia matrits," *Doklady AN SSSR* 100, 2 (1955): 209–11; Ershov, *Programmiruiushchaia programma dlia bystrodeistvuiushchei elektronnoi schetnoi mashiny* (Moscow: Akademiia nauk SSSR, 1958), published in English as *Programming Program for the BESM Computer* (London: Pergamon, 1959).

on an automatic programming system as a scientific contribution justifying a degree in mathematics. Ever ambitious, he set out to develop the theory of operator algorithms, drawing on the first formalization by another of Liapunov's students, Iu. I. Ianov.[43] But again there was no defense. Ershov's diary records a tension brewing as he was caught between the standards of mathematical writing and the uncertainties of cybernetic aspirations.

The comments penned in 1958, during his interactions with a prominent expert in mathematical logic, A. A. Markov Jr., reveal that Ershov's own espousal of the mathematical notion of rigor did not amount to the mathematician's affinity with the specificity of programming practices: "There is no doubt that he is right on some points, especially regarding the imprecision of terminology in programming, but, apparently, he does not grasp certain things."[44] In the end, the disagreements over requested changes accumulated, and Markov withdrew from Ershov's dissertation committee.[45] However, the very fact that Ershov turned to Markov was itself a function of a growing distance between his and Liapunov's interests. Ershov disregarded Liapunov's recommendation to defend on the basis of his work on the BESM programming and recorded his doubts over the sincerity of Liapunov's evaluation of his work on the theory of programing: "Interesting, what does he really think about me and all this[?]"[46] Upon Markov's withdrawal from the committee, the printed copies of Ershov's dissertation abstract accumulated dust, as he renounced searching for a replacement and indefinitely postponed the defense.

Official recognition by the national academic establishment came after Ershov's integration into international scientific networks. Unlike Podlovchenko, Ershov remained in Moscow until 1959 and benefited from a revival of international scientific life in the aftermath of "Atoms for Peace" and the International Geophysical Year.[47] A diligent student of English, Ershov was at ease during the first US-Soviet encounters of computer experts. As a result, Ershov integrated the networks of the international Algol group,

[43] Iu. I. Ianov, "O logicheskikh skhemakh algoritmov," *Problemy kibernetiki*, no. 1 (1958): 75–127; Ianov, "On the Equivalence and Transformation of Program Schemes," *Communications of the ACM* 1, 10 (1958): 8–12; Ianov, "On Matrix Program Schemes," *Communications of the ACM* 1, 12 (1958): 3–6.

[44] Ershov cited in Kraineva and Cheremnykh, *Put´ programmista*, 29.

[45] On Markov's vision for mathematics, see his student's account: Boris Kushner, "The Constructive Mathematics of A. A. Markov," *American Mathematical Monthly* 113, 6 (2006): 559–66.

[46] EA f. 35, l. 100/1, diary, August 1958.

[47] For a collective work encompassing a broad range of Cold War interactions in science and technology, see Naomi Oreskes and John Krige, eds., *Science and Technology in the Global Cold War* (Cambridge, MA: MIT Press, 2014).

which aspired to develop a universal computer language.[48] By 1962, when Ershov finally defended his dissertation, his group was actively working on a subset of the Algol language. However, this engagement with Algol would create a rift between the teacher and his student and expose their differences regarding the qualities of "good" programmers.

A conjuncture of personal and professional circumstances—namely, the growing household and disciplinary conflicts within cybernetics—prompted Liapunov to move to Siberia. Ershov's initial enthusiasm on hearing the news of Liapunov's decision to join Sobolev's team—two exclamation points followed a late September 1961 entry in Ershov's diary—did not lead to easy arrangements.[49] First, Liapunov did not approve of Ershov's Algol project. Next, there was a crisis that almost saw the dismantling of Ershov's programming group. It turned out that the group's intellectual agenda and the individual qualities of its members were interdependent.

The crisis followed the cybernetician's interviews with Ershov's subordinates. This time there was no ambiguity in Liapunov's words. As witnessed by Ershov's records, the results were nothing short of catastrophic:

> After talking with everybody he said that he will take me, Baehrs, and Voloshin. Pottosin, according to him, is a person without initiative, and he is horrified by Kozhukhin. There is no point in even mentioning everybody else. He even demoralized me to the point that I wanted to give up the laboratory and simply join him. Fortunately, such [a step] was impossible without big material losses. This sobered me down, and by the next morning I remembered myself. I was not thinking anymore of transfer and immediately said so to all mine [coworkers] with maximum clarity…. Ours [all our members] perked up on learning of my decision, but I clearly realized the additional burden on my shoulders: Liapunov took offense, and Kosarev [the chief engineer] won't make things easy.[50]

A story of one individual's "coming of age," the conflict and its resolution had a larger disciplinary dimension. Liapunov evaluated Ershov's programmers individually based on his ideals about mathematical cybernetics. The patriarch of Soviet cybernetics judged the majority of Ershov's group, including numerous female programmers, as unpromising, "gray" personalities. The choice of words in Ershov's diary, such as "mine"

[48] For examples and further citations on Algol history, see David Nofre, "Unraveling Algol: US, Europe, and the Creation of a Programming Language," *IEEE Annals of the History of Computing* 32, 2 (2010): 58–68.

[49] EA f. 35, ll. 123/1, diary, September 1961.

[50] EA f. 35, ll. 123/2, diary, October 1961. Note the multiple omissions and the informal, broken sentence structure reposing on the *synthetic* nature of Russian grammar.

[*svoi*] and "ours" [*nashi*], indicates that he perceived these people as a team.[51] When, in 1964, the Akademgorodok Computer Center separated from the Institute of Mathematics and became an independent organization, Ershov's laboratory moved out, thus solidifying the rupture between mathematical cybernetics and programming.

Liapunov's eventual recognition of Ershov's vision became manifest in their joint authorship of a 1967 article devoted to the notion of the program. The text's contents, including long sections drawing on Ershov's own publications and his students' research on parallel programming, leave little doubt that Ershov wrote the text.[52] Liapunov's signature, then, had the function of approval, adding the authority of the "father of cybernetics" to a distinct disciplinary vision articulated by his rebellious former pupil. It is not an accident that until recently, Podlovchenko still designated her research as belonging to an intersection of theoretical programming and mathematical cybernetics, the first a sign of Ershov's demarcation and the latter representing a legacy of Liapunov's agenda.[53]

The 1961 conflict over Ershov's group and its 1967 resolution with the articulation of a separate research agenda for theoretical programming demonstrated the direct connection between the changing technical nature of programming projects and the social structures required for their realization. As with the discipline of computer science, which emerged in US universities in the 1960s, theoretical programming became a new banner demarcating the disciplinary border vis-à-vis cybernetics and mathematics in the Soviet Union.[54] But the consolidation of the intellectual agenda did not automatically solve an all-too-familiar issue, the professional status of the growing numbers of Soviet programmers. Aware of this problem, Ershov argued for society's recognition of programming expertise and a higher awareness of their social responsibility among his peers. To convey his arguments, he formulated a distinctively masculine image of an ideal programmer for an audience comprising both the domestic and the international public.

---

[51] For the analysis of *svoi* in a late Soviet context, see Alexei Yurchak, *Everything Was Forever, Until It Was No More: The Last Soviet Generation* (Princeton, NJ: Princeton University Press, 2005), esp. 102–26.

[52] A. P. Ershov and A. A. Liapunov, "O poniatii programma," *Kibernetika*, no. 5 (1967): 40–57.

[53] See, e.g., Podlovchenko's biographical entry for the employees of the MGU Computer Center (http://www.srcc.msu.su/nivc/about/inf/pri.html). It is worth noting that Podlovchenko trained hundreds of programmers of both genders, but only three male students obtained scientific degrees.

[54] Tatarchenko, "'Anatomy of an Encounter.'"

The Human Factor at Home and Abroad

The key project that brought Ershov's group to the forefront of computer expertise, the Alpha translator completed in 1964, was a product of intellectual coordination with the Western community of computer experts and their aspirations to create a universal programming language. At the same time, it is the success of local knowhow and social arrangements that enabled the creation of so complex a software system. The international community was a loose network of specialists sharing a common set of interests via correspondence, a body of scholarship, and professional meetings. The Siberian programmers were brought together on a single spot at the Akademgorodok Computer Center, their lives paced by the machine schedule. The relations within both groups had a gendered element to them.

In integrating with the international community, Ershov joined a "boys' club." Journals' editorial boards, conference program committee members, and professorships at the newly created computer science departments were predominantly male. For example, Ershov had many contacts with the members of the Stanford Computer Science Department, known for its particularly successful educational model, replicated by many US institutions, as well as for its marginalization of women: no woman was tenured there until the 1990s.[55] The informal activities within this international community ranged from ubiquitous drinking to cigar smoking, more exotic tandem bike riding, and even private jet piloting.[56] In contrast, at home Ershov became proficient at managing a group that had almost as many women as men. The programmatic vision for a professional identity for programmers as articulated by Ershov in the early 1970s represented his position as a member of both social groups and the efforts to integrate them more closely.

In "Alpha-Birth," an account of the creation of the software system published in the local Akademgorodok newspaper in January 1965, Ershov summarized the principal steps and difficulties in the realization of a complex and ambitious project: to create an automatic programming system

[55] On Stanford computer science, see Joseph November, "George Forsythe, the ACM, and the Creation of Computer Science As We Know It," in *Communities of Computing*, 47–70. Also see Diana E. Forsythe, "Disappearing Women in the Social World of Computing," in *Studying Those Who Study Us: An Anthropologist in the World of Artificial Intelligence*, ed. David J. Hess (Stanford, CA: Stanford University Press, 2001), 163–82.

[56] There are numerous traces of these activities, especially in Ershov's 30-year correspondence with the American computer scientist John McCarthy. See Ksenia Tatarchenko, "Informatika ot Silikonovoi Doliny do Zolotoi Doliny: Andrei Ershov i John McCarthy," *SoRuCom-2011 Proceeding, Second International Conference on the History of Computers and Informatics in the Soviet Union and Russian Federation* (Velikii Novgorod: Novgorodskii tekhnopark, 2011), 278–82.

that could compete in terms of quality with manual programming. The accomplishment of fitting 40,000 lines of commands on the barely functional magnetic tape fed into a lamp-based M-20 computer was no small matter. The concluding lines of this popular, laudatory story revealed the collective author of the system, the group, as the main creative unit: "We will keep the experience we gained, the deep satisfaction with the completed work, and the priceless camaraderie that was born and matured during the years of work on the Alpha system." The creation of programming products on a large scale, such as system software, was predicated on coordination among humans.[57] The entries in the journal kept by the group confirm Ershov's account. These entries record the joy and despair of programming work and social interactions—from code checking to singing.[58]

The metaphor of "birth" chosen by Ershov highlights the family-like connections among programmers in which the productive coordination of efforts was embedded. "Family" was not just a figure of speech. The account, in acknowledging individual contributions by male and female specialists, also made it obvious that the pace of day and night shifts shared by young men and women produced married couples. In "Alpha-Birth" Ershov credits G. I. Kozhukhin, the star programmer of his group with contributions to Alpha's input language, an elegant method of dynamic memory allocation, and the main working block of the translator, but he also mentions the impressive achievement of S. K. Kozhukhina. She wrote every fourth line of code for the system. However, the delicate social and gender balance of the group described in Ershov's text disappeared altogether when integrated into a representation of Soviet programmer drawn by professional journalists.

The journalists from the popular science magazine *Znanie-sila* were unable to meet with Ershov due to his frequent travels. Ironically, they chose Kozhukhin—Ershov's closest collaborator, who had previously been rejected by Liapunov—as their model for representing masculinity of a cybernetic kind. They paint the Siberian star programmer as an easygoing person wearing checkered shirts and a devoted family man charged with picking up milk for his kids. Unlike Ershov's text, which situated the group's work in terms of collective programming practice, the journalists turned Kozhukhnin into an expert in a cybernetic dialogue between human and machine alongside

[57] A. Ershov, "Alpha-Rozhdenie," *Za nauku v Sibiri*, January 1965 (http://ershov-arc.iis.nsk.su/archive/eaimage.asp?did=41199&fileid=219971). The most famous American account addressing the challenges of programming labor management is Fred Brooks, *The Mythical Man-Month: Essays on Software Engineering* (Reading, MA: Addison-Wesley, 1975).

[58] There are five journals documenting the work of the group in the Ershov Archive: EA Books 1 to 5, f. 19, ll. 51–257.

The Kozhukhins at Work in the Early 1970s

the famous American information theory specialist Claude Shannon. The journalists' representation of such expertise as masculine and their omission of female contributions from their account were a case of gender bias: they noted "girly" handwriting in the software documents of Ershov's group, only to depict programming as a cybernetic field brought about by the scientific genius of a few Western men and propelled forward by the male prophets of a socialist techno-future.[59]

By the end of the 1960s, Ershov was reaping the fruits of the Alpha system's success and was ready to assume his role as one such pundit. In 1967, he was appointed the head of a state commission tasked with investigating the state of software production in the Soviet Union. In this capacity he was the chief author of the 1968 report that argued for an orientation on the IBM-360 series architecture, creating a mass profession of software engineers and fostering the scientific discipline of theoretical programming.[60] These arguments reflected Ershov's close integration with the international community, as he was able to forecast the discussions at the Conference on Software Engineering sponsored by NATO and held in Garmisch, Germany on 7–11 October 1968. As hardware became cheaper and more reliable, a widespread American and European preoccupation with the ever-growing

[59] K. E. Levitin, "Dialog s mashinoi," *Znanie-sila*, no. 9 (1966): 2–6.

[60] EA f. 347, ll. 344–87, Doklad "Ob urovne matematicheskogo obespecheniia elektronnykh vychislitel´nykh mashin," July 1968.

costs and risks associated with software gave rise to a discourse about a "software crisis" and a particularly appealing solution known as "software engineering." A historian of computing, Janet Abbate, argues that the contested concept of "software engineering" encompassed the struggle to define the programmer's professional identity according to a gendered role model of engineer.[61]

Inscribing Ershov's policy-oriented report within the context of international debates about the identity and virtues of programmers also elucidates the major domestic initiatives. The most prominent attempt at forging a corporate professional identity in coordination with the international community was the Second All-Union Conference for Programmers, held in Akademgorodok in 1970. The conference concluded with an international symposium featuring leading Western specialists who debated with the audience about the nature of programming work in the 1970s.[62] Preoccupied with domestic professionalization, the conference organizers included several contributions addressing the training of Soviet programmers and conducted a survey of the conference participants. Requesting information about education, position, and programming experience, the questionnaire presented the key question: "Do you consider yourself a professional programmer?" The majority of answers were positive.[63]

The collective profile of the conference participants showed a high proportion of women involved in the field across the country: Of the 804 questionnaires filled out, women submitted 239.[64] Like their male peers, most of the female participants were born in the 1930s and 1940s and had accumulated significant programming experience, 25,000 lines of code on average. Even so, while women appeared as authors on the 56 papers presented at the conference, none of them took the podium to give one of the prestigious invited talks or led plenary discussion sessions.[65] In addition to the patriarchal organization of Soviet institutions, this was a result of specific choices and

[61] For the original report that contributed to the diffusion of the notion of a "software crisis," see Peter Naur and Brian Randell, eds., *Software Engineering: Report on a Conference Sponsored by the NATO Science Committee, Garmisch, Germany, 7th to 11th October 1968* (Brussels: Scientific Affairs Division, NATO, 1969). The NATO conference is arguably one of the most discussed episodes of software historiography. Compare with Michael S. Mahoney, "Finding a History for Software Engineering," *IEEE Annals of the History of Computing* 25, 1 (2004): 8–19; and Abbate, *Recoding Gender.*

[62] A. P. Ershov, "Problemy programmirovaniia: Vsesoiuznaia konferentsiia v Novosibirske," *Vestnik Akademii nauk SSSR*, no. 6 (1970): 113–15.

[63] EA f. 317, l. 1/1276, ankety.

[64] Numbers from Kraineva and Cheremnykh, *Put´ programmista*, 93. This distribution is comparable to the gender ratio of the US white-collar computer workforce of the time.

[65] The conference proceedings are at http://ershov-arc.iis.nsk.su/archive/eaindex.asp?lang=1&gid=44.

the hierarchy of knowledge inherited from Liapunov's mathematical vision for programming and built into the conference program. Ershov's orientation toward "higher quality"—read: more abstract—papers, potentially presentable as the Soviet contribution to the intentional field of computer science, came at the price of deemphasizing the more practical or technical ones. This orientation could only mean fewer, not more, women authors as, based on the distribution of tasks in Ershov's own group, women were more likely to write code than to define new programming languages. The hierarchies of practice revealed by the 1970 national conference explain how Ershov came to articulate a distinctly masculine image of an ideal practitioner despite his awareness that high numbers of women were working in the field.

In 1972, Ershov was invited to give a prestigious keynote speech at the American Joint Computer Conference held by AFIPS (American Federation for Information Processing) in Atlantic City. The resulting text became his best-known publication. "Aesthetic and Human Factors in Programming" was a reflection on the social challenges facing the new profession. In the wake of the so-called "software crisis," Ershov stressed the need for a professional mythology. As part of such mythmaking, he began to paint the image of the ideal programmer:

> In his work, the programmer is challenged to combine, with the ability of a first class mathematician to deal in logical abstraction, a more practical, a more Edisonian talent, enabling him to build useful engines out of zeros and ones, alone. He must join the accuracy of a bank clerk with the acumen of a scout, and to these add the powers of fantasy of an author of detective stories and the sober practicality of a businessman. To top all this off, he must have a taste for collective work and a feeling for the corporate interests of his employer.[66]

Poetic juxtapositions of high and low, ideal and material, individual and social, enhanced the author's argument about the need for a special status for programming. In another passage Ershov even drew on biblical language and imagery to express a transcendent aspect of human-machine interaction: "The programmer plays a full trinity of roles in this familiar miracle. He feels himself to be the father-creator of the program, the son-brother of the machine on which it runs, and the carrier of the spirit which infuses life into the program/machine combination."[67]

---

[66] A. Ershov, "Aesthetic and Human Factors in Programming," *Communications of the ACM* 15 (1972): 501–5, here 502.
[67] Ibid., 504.

While the formulation of requirements itself demonstrated the author's playful mind fusing American cultural references with distinctly Soviet rhetorical structures, this supposedly universal professional ideal shared across the Atlantic Ocean and the Iron Curtain implied a male practitioner. Ershov's choice of words and images revealed and enacted mechanisms of the masculinization of authority that were operating within the new professional community. At home, such a masculine ideal corresponded to what Mark Lipovetsky labeled the "cult of the educated 'macho' " in the Soviet milieu of the technical intelligentsia.[68]

Despite its masculine ideal, the practice of programming did not preclude female choices. The anecdotal evidence indicates that young women perceived programming skills as multiplying career opportunities and enabling a balance of work and family. In fact, due to the subordinate status of applied mathematics in mathematical departments, programming was often the second choice for male students and the first choice of their female peers, who were opting for an oddly paced job in an urban location over teaching mathematics in rural schools. For instance, the first cohort of students taking programming at Far East State University consisted of 18 female students and a single male.[69] The varied arrangements and relations within Soviet computer centers also exhibited a sense of communality: good service depended on a well-functioning collective that could accommodate the challenges of work and family life for its male and female employees. Paradoxically, Ershov's calls for labor security, promoted by the image of a masculine ideal programmer, were of a greater relevance for female practitioners, who were facing the choice between professional growth and a career interruption because of child-rearing.

Ershov's managerial and personal documents show that he was dealing with issues of production and reproduction on a daily basis. He was an expert in a position of authority. He was also a son, father, and husband. Ershov often reproduced gendered stereotypes but also systematically showed consideration that his female coworkers appreciated and remembered for many years. In 1981, Ershov annotated a telegram received from two female programmers, L. K. Trokhan and R. N. Kliushkova, on the occasion of his 50th birthday with the following explanations to his own mother:

---

[68] Mark Lipovetsky, "The Poetics of ITR Discourse, in the 1960s and Today," *Ab Imperio*, no. 1 (2013): 109–39, here 118.

[69] See "Istoriia kafedry programmnogo obespecheniia EVM DVGU" (http://wwwold.dvfu.ru/en/web/kafedra-prikladnoj-matematiki-mehaniki-upravlenia-i-programmnogo-obespecenia/istoria-kafedry-programmnogo-obespecenia-evm-dvgu).

A Commemorative Group Picture from the 20th Anniversary Celebration of Ershov's Programming Department, 1978

> They are women with whom we started our work on the Alpha project upon arriving in Novosibirsk. Later they left. Trokhan followed her husband. Kliushkova, with a small daughter and problems in [her] private life, returned to her mother. During the last few months [with the group], she was so consumed with her worries that she could barely work. She borrowed a certain amount of money and disappeared for long time. A few years ago, she, by now a respectable lady, visited for the celebration of the 20th anniversary of the department. She returned the money and thanked [me] for the support and trust during those old days with tears in her eyes but happy from her feelings of relief.[70]

In a few sentences, Ershov depicted a world where professional and personal trust were tightly interwoven, love affairs set back software development, and work mixed with leisure. Neither Ershov nor his coworkers drew a radical separation between their private and their professional lives but rather relied on their synergy. The physical proximity captured in collective portraits of the group embodied the close personal ties among its members. According to Ershov's poetic description, his family, his laboratory, and the Akademgorodok community shared bonds of equal strength: "To live with

[70] EA f. 197, l. 10, L. K. Trokhan and R. N. Kliushkova to Ershov, 18 April 1981.

people is a shield against every crisis. / Three families reign in my destiny: / At home is first, the second at work. / The third is on this sunny path."[71]

In reality, the workspaces of the late Soviet computer centers were territories of encounter and negotiation where decisions were to be made. For about four decades, men and women shared a working environment that encompassed the personal and professional lives of programmers, in daytime and nighttime, seven days a week. There authority and responsibility, masculinity and femininity, were not so much in conflict as in a process of constant redefinition. Both male and female practitioners had to cope with numerous contradictions—the portability of software and the locality of coding practices, production and reproduction, national and international allegiances. Because their life choices left conspicuous evidence, the history of Soviet programmers provides insight into the very tissue of life and work in a postwar socialist society.

Decoding the Foretold Future of a Socialist Information Society

The Soviet programmers' search for professional identity belonged to a long tradition of mathematical training, equating masculinity and mathematical genius. It was shaped by the context of the Cold War, with its cybernetic battlefield technologies and its military code of honor. Even after breaking out of their early association with cybernetics, national leaders such as Ershov promoted the idea of a masculine ideal practitioner, an ideal rooted in the formal and informal male-dominated networks among the leaders of the international community. Moreover, prominent women such as Podlovchenko did not only productively perform their share of work but also contributed to the transmission of representations that enhanced the authority of male figures acting as role models for the new field. This point summarizes how and why the authority fell to men. But what do the gendered scenarios of interaction between human and the computer I have described say about technological expertise and socialist modernity?

The programmers' self-presentation as mediators between humans and machines is a reminder that technology matters. Although scholars acknowledge the dramatic increase of jobs in science and technology in the postwar period, the nature of these jobs and the identity of the workers often slip through the cracks, and with them the analytical problems regarding constituency, interests, and the political power of the technical intelligentsia.[72] The history of Soviet programming shows that pairing discourses and

[71] A. P. Ershov, "Tropa v Akademgorodke," *Stikhi* (Novosibirsk: n.p., 1991), 28.

[72] See the debates in the forum following Lipovetsky's "Poetics of the ITR Discourse," *Ab Imperio*, no. 1 (2013): 133–219.

communities of practice elucidates connections between technocratic imaginations and precollapse reforms, connections that are not tied into the inescapable logic of political disintegration. In particular, the 1970s discourse about the professional virtues of programming took on a new dimension as an agenda for the making of exemplary citizens for the socialist Information Society in the 1980s.

Famously, in January 1983, *Time Magazine* selected the personal computer as its Man of the Year, reflecting on the projected growth of the personal computer industry and the so-called Personal Computer Revolution sweeping the West.[73] The corresponding Soviet vision emphasized the person as the main site of transformation. Fusing the ideas of the MIT computer scientist and educator Seymour Papert, the decade-long experiments of his group in computer education, and the early Soviet tradition of campaigns against illiteracy, Ershov articulated the slogan of "programming, the second literacy."[74] A means to his ultimate goal, to bring about a socialist Information Society based not on the diffusion of computers as black-boxed commodities but on universal programming skills, "programming, the second literacy" simultaneously stripped programming from its professional and masculine connotations. Representing programming as a practice akin to the gender-blind skills of reading and writing was a powerful strategy for breaking with gender bias.[75]

Ershov navigated the late Soviet patronage networks and became the leader of a national educational campaign guiding the introduction of compulsory classes in programming in 1985. This computer education reform faced many challenges and became a major site for debating the Soviet future right before the official advent of perestroika. As the Western press and domestic critics ridiculed the last Soviet attempts at computerization by top-down reforms and the absence of personal computers, Ershov emphasized the notion of "algorithmic thinking"—that is, the human capacity for problem

[73] *Time*, 3 January 1983. Cover credit to Roberto Brosan and George Segal.

[74] A. Ershov, "Programming, the Second Literacy," *Computer and Education: Proceedings of the IFIP TC-3 3rd World Conference on Computer Education, WCCE 81* (Amsterdam: North Holland, 1981), 1–17. For Russian versions, see *Programmirovanie—vtoraia gramotnost´* (Novosibirsk: n.p., 1981), repr. in *Kvant*, no. 2 (1983): 2–7; *Ekonomika i organizatsiia promyshlennogo proizvodstva*, no. 2 (1982): 143–46; and *Chelovek i mashina* (Moscow: Znanie, 1985), 16–24. There were also Bulgarian, Czech, and Estonian versions.

[75] A recent version of a traditional "failure" interpretation of the reform based on the "backwardness" argument is Gregory Afinogenov, "Andrei Ershov and the Soviet Information Age," *Kritika* 14,3 (2013): 561–85. For a comparative work "normalizing" the Soviet education reforms, see Margo Boenig-Liptsin, "Making Citizens of the Information Age: A Comparative Study of the First Computer Literacy Programs for Children in the United States, France, and the Soviet Union, 1970–1990" (PhD diss., Harvard University, 2015).

Young Programmers in Akademgorodok's Experimental Classroom, 1982
© Photo archives of the Siberian Branch of the Russian Academy of Sciences. Photograph by V. T. Novikov.

solving (the term was borrowed from international discourses shared among computer scientists)—and the particular potential of the Soviet educational infrastructure. Under the framework of the computer literacy campaign, programmable calculators became key devices and the extensive networks of Soviet popular scientific publications major venues for imagining and engaging with both the technical and the social dimensions of transgression and responsibility.[76]

Ershov's correspondence attests to the scale of bottom-up engagement in debates about the Soviet digital future. When confronted with criticism of the informatics classes from Dina Vokhonina, writing on behalf of her classmates in the spring of 1986 to complain about the difficulty of the curriculum and the absence of computers in their classroom, Ershov emphasized the human factor. Access to the machine itself was secondary to the discipline of mind: "Although the teacher may take pity on you and give you a satisfactory grade, the computer will not forgive you any errors. It will stay there, an impenetrable piece of metal, up to the end of the school year. Without an algorithm, without a program, without a plan, there is no point in sitting in front of the computer."

Ershov, who himself was struggling with cancer, commended the youths for taking the initiative to resolve their problems and pointed out that they still had the chance to "catch up to the train to the future."[77] If the computer

[76] Tatarchenko, "Thinking Algorithmically: From Cold War Computer Science to the Quest for the Socialist Information Age," paper presented at a conference on "Algorithms in Culture," University of California at Berkley, December 2016; Tatarchenko, " 'Right to Be Wrong': Transgression, Gaming, and Programming in *Kon-tiki: A Path to the Earth* (1985–1986)," paper presented at a conference on "Scientific Utopias in the Soviet Union: Science, Fiction, and Power (1917–1991)," Paris, September 2016; and Tatarchenko, " 'The Man with a Micro-Calculator': Digital Modernity and Late Soviet Calculating Practices," paper presented at a workshop on "Exploring the Early Digital," Siegen, January 2017.

[77] EA f. 274, ll. 129–30, Ershov to D. Vokhonina, 15 May 1986.

was unforgiving of human errors, it was also empowering, opening up a whole realm of possibilities for a new social order.[78]

Part of perestroika's political agenda of instigating "new thinking," the philosophy of computing underpinning the 1985 education reforms had nontrivial consequences for envisioning gender, technology, and socialist society as a distinctly modern project. Not as radical as Donna Haraway's contemporaneous "A Cyborg Manifesto," which issued a call to break away from the gendered power relations of patriarchal capitalism or state socialism, Ershov's notion of programming as a second literacy shared the key characteristic of Haraway's "cyborg," its hybrid nature.[79] A fiction as much as a reality, the notion made it possible to project a socialist future predicated not on the abstract notion of gender equality but on equality of access to, and control over, information. Male or female, the citizens of this second world version, the Information Age 2.0, would be creators, not consumers. They would transcend dichotomies and possess the virtues of the ideal programmer—prudent and resolute at the same time.

In the end, it is the philosophical aspect of Ershov's vision that maintains its relevance for post-Soviet conversations about the digital divide and big data, conversations framed by issues of access and control, power and inequality. Throughout the late Soviet period, the universal computer was a malleable category encompassing many more facets than suggested by traditional narratives about early Soviet hardware triumphs and the perestroika-era absence of personal computers. Users' and programmers' communities imbued the computer with protean qualities and "revolutionary" potential. These communities were localized and embodied. The assumptions of heteronormativity channeled via national and transnational social mechanisms influenced everyday interactions between humans and machines. They compromised more radical imaginations of digital futures. Unlike his vision of universal programming literacy, Ershov's depiction of a masculine professional ideal provoked no contestation. The collapse of the Soviet Union marked the end of the national literacy campaign but did not solve technical and social issues that generated the reforms in the first place. The prominence of the gender question and of the diffusion of programming skills in the current global economy overrides

[78] A. P. Ershov, "Informatizatsiia: Ot komp´iuternoi gramotnosti uchashchikhsia k informatsionnoi kul´ture obshchestva," *Kommunist*, no. 2 (1988): 82–92.

[79] The manifesto was first drafted in 1983 and published in 1985. On the historical context of the "Cyborg Manifesto," see Donna Jeanne Haraway, *The Haraway Reader* (New York: Routledge, 2004), chap. 10: "Cyborgs, Coyotes, and Dogs: A Kinship of Feminist Figurations and There Are Always More Things Going on Than You Thought! Methodologies as Thinking Technologies."

the limits of the established chronologies of political ruptures and binary accounts of late Soviet history.[80] A Cold War phenomenon at the root of contemporary concerns about cybersecurity, the continuities between Soviet and post-Soviet programming expertise reveal that scholarly debates about the nature of Soviet modernity are of direct relevance for recapturing the materiality, ideologies, and politics of the digital in the twenty-first century.[81]

Global Studies Institute
Geneva University
Rue des Vieux-Grenadiers 10
1205 Geneva, Switzerland
ksenia.tatarchenko@unige.ch

[80] Yurchak, *Everything Was Forever*. The Internet and social media become repositories of individual voices and new historical sources calling for specific methodologies and interpretive strategies. A particularly revealing account of the 1996 move to the United States by a programmer and single mother of three is at http://hettie-lz.livejournal.com/122293.html. On the late Soviet and post-Soviet migration patterns of IT specialists, see Mario Biagioli and Vincent Lepinay, eds., *From Russia with Codes: Programming Migrations in Post-Soviet Times* (forthcoming).

[81] See the special forum "Sporia o modernosti," *Novoe literaturnoe obozrenie* 140, 4 (2016), esp. Michael David-Fox, "Russian-Soviet Modernity: None, Shared, Alternative, or Entangled?," 19–44. For arguments about the materiality of the digital and the politics of algorithmization, see Jean François Blanchette, "A Material History of Bits," *Journal of the American Society for Information Science and Technology* 62, 6 (2011): 1042–57; and Solon Barocas, Sophie Hood, and Malte Ziewitz, "Governing Algorithms: A Provocation Piece" (29 March 2013) (http://dx.doi.org/10.2139/ssrn.2245322).